This handbook provides important information for persons planning to take a California licensing/permit exam listed below. Policies, procedures and information in this handbook supersede previous editions. Please review this information carefully; you are responsible for understanding the contents of this handbook.

This handbook will no longer be mailed as of January 1, 2023.
Handbooks can be accessed at www.state.arrt.org.

JANUARY THROUGH JUNE

EXAMINATION HANDBOOK

for California Licensing/Permit Exams
Administered by ARRT in

2022

- Radiography
- Radiation Therapy
- Mammography
- Limited Scope of Practice in Radiography
  (Core, Chest, Extremities, Skull/Sinus, Spine, Podiatric)
- Dual Energy X-Ray Absorptiometry (DEXA) Permit
- Radiography Supervisor and Operator Permit
- Fluoroscopy Supervisor and Operator Permit
- Radiography and Fluoroscopy Supervisor and Operator Permit
- Physician Assistant Fluoroscopy Permit
- Dermatology Supervisor and Operator Permit
- Dental Laboratory Radiography Permit

Important Notice:
State Licensing is Not ARRT Credentialing

A passing score on a state licensing examination does not make a candidate eligible for ARRT certification and registration. Candidates seeking ARRT certification and registration must have submitted an application directly to ARRT and must have met all other criteria for ARRT certification and registration. Those seeking only state licensing must meet criteria established by the state. Test scores earned as a state candidate may not be used for ARRT certification and registration.

How to Use This Handbook

Licensing vs. Certification and Registration

The information contained in this handbook pertains to California licensing/permit examinations and processing.

*These California licensing/permit exams, their eligibility, or application process bear **no relation** in any way to national credentialing in radiologic technology offered by ARRT.*

This Examination Handbook is designed to help California Department of Public Health — Radiologic Health Branch (CDPH-RHB) licensing/permit candidates understand and prepare for their examination. It is published twice a year, but changes to content specifications and policies and procedures may occur during the year so be sure to check **www.state.arrt.org** for updates. To ensure that your exam experience is as successful as possible, you will want to read the following information very carefully and keep the handbook for future reference.

The information in this handbook supersedes that in any prior publications of ARRT. Earlier versions may contain outdated information. It is your responsibility to obtain a handbook corresponding to the year in which your examination is to be taken, as noted on the front cover of the handbook; and to familiarize yourself with the contents.

ARRT does not discriminate against candidates on the basis of their race, color, creed, religion, national origin, sex, marital status, status with regard to public assistance, familial status, disability, sexual orientation, gender identity, veteran status, age, or any other legally protected basis.

NOTE: 2022 will be the last year the handbook will be printed. Beginning 2023, the handbook will be online only at www.state.arrt.org.

Watch for These Symbols

This exclamation point is your pointer to key pieces of information you need to know.

This icon tips you to ways you can streamline your journey through the examination process.

NCCA Accreditation

ARRT's Radiography, Nuclear Medicine Technology, Radiation Therapy, Sonography, Computed Tomography, and Registered Radiologist Assistant certification and registration programs have earned accreditation by the National Commission for Certifying Agencies (NCCA), the accrediting body of the Institute for Credentialing Excellence (ICE).
To receive NCCA accreditation, ARRT demonstrated that this certification and registration program met strict standards in accordance with ICE's mission to promote excellence in competency assurance for practitioners in all occupations and professions.
For more information on ICE/NCCA and their accreditation programs, visit **www.credentialingexcellence.org**.

ARRT is unable to respond to questions regarding licensing requirements for the state of California.

- Direct questions regarding your state license/permit application, the CDPH-RHB one-year eligibility period, or changes to your name, address, social security number, or date of birth to:

  California Department of Public Health
  Radiologic Health Branch
  PO Box 997414 MS#7610
  Sacramento, CA 95899-7414
  Phone: (916) 327-5106
  Fax: (916) 440-7999
  E-mail: rhblistc@cdph.ca.gov
  Website: www.cdph.ca.gov/rhb

- After carefully reading this handbook, direct questions regarding examination procedures to:

  ARRT
  1255 Northland Drive
  St. Paul, MN 55120-1155
  Phone: 651.687.0048 *Select the option to earn an ARRT credential*

*For information about **national credentialing in radiologic technology**, contact:*

The American Registry of Radiologic Technologists®
1255 Northland Drive, St. Paul, Minnesota 55120-1155
Phone: (651) 687-0048
www.arrt.org

2022 January through June Examination Handbook for California Licensing/Permit Examinations

Table of Contents

California Licensing/Permit Examinations

California licensing/permit exams are administered by The American Registry of Radiologic Technologists®, but state licensing is *not* ARRT credentialing.

Certification and Registration vs. State-Related Licensing

More than 75 percent of the states have licensing laws covering the practice of radiologic technology. In these states, you must obtain a state license before you can work as a radiologic technologist. In addition, many states use ARRT exam scores and/or credentials when making licensing decisions.

Terminology used in establishing the authority of a technologist is often confusing.

ARRT uses the term “certification and registration” when an individual satisfies all eligibility requirements — which include ethics, education and examination. If you wish to become certified and registered with ARRT, you will need to submit an application directly to ARRT. Submitting an application to an individual state licensing agency does not make you eligible for ARRT certification and registration.

Although you may have earned your ARRT credential, this does not automatically mean that you are eligible to work in your state. Most states have their own licensing policies and procedures that you must meet in order to work in the state. Verify with the state licensing agency in the state where you plan to work to make sure you meet their eligibility requirements.

Exam scores earned as a state candidate may not be used for later application to ARRT for certification and registration; however, if you attempt to pass an exam as a state licensing candidate it will be counted as an attempt for purposes of ARRT’s three-attempt, three-year limit for certification and registration (see page 18 for details).

ARRT is unable to respond to questions regarding licensing requirements for the state of California. Direct questions regarding your state license/permit application, the CDPH-RHB one-year eligibility period, or changes to your name, address, social security number or date of birth to the CDPH-RHB at (916) 327-5106. Full contact information can be found on the inside front cover of this handbook.

California Licensing/Permit Exams

The ARRT is a national, voluntary certification and registration organization that administers examinations both for its own credentialing programs and on behalf of states for their use in issuing state licenses. ARRT-developed exams are produced in collaboration with content experts from various specialties. The examinations consist of questions designed to measure the knowledge and cognitive skills underlying the intelligent performance of the major tasks typically required of a radiologic technologist.

In addition to developing and administering its own examinations, ARRT administers examinations developed by the state of California to individuals designated by the state. This handbook addresses California-developed state examinations as well as exams developed by ARRT for state-approved licensing/permit candidates.

It is your responsibility to know which exam discipline you should apply for when submitting your application to CDPH-RHB. ARRT cannot respond to questions regarding eligibility requirements and procedures for state licensing permit exams. Contact the CDPH-RHB directly for answers regarding state licensing.

The following California-specific licensing/permit examinations have been developed and are owned by the state of California:

- Dermatology Supervisor and Operator Permit
- Dental Laboratory Radiography Permit

The exams listed below have been developed by and are owned and copyrighted by the ARRT:

- Radiography*
- Radiation Therapy*
- Mammography*
- Limited Scope of Practice in Radiography*
  (Core, Chest, Extremities, Skull/Sinus, Spine, Podiatric)
- Bone Densitometry Equipment Operator*##
- Fluoroscopy*++
- Radiography Supervisor and Operator Permit

**Unscored pilot questions are embedded in the exam. The following section provides additional information on pilot questions.*

##The Bone Densitometry Equipment Operator exam is administered to candidates required to take the CDPH-RHB Dual Energy X-Ray Absorptiometry (DEXA) Permit exam.

++The Fluoroscopy examination is administered to candidates required to take a CDPH-RHB-approved exam to obtain either: (1) a Radiologic Technologist Fluoroscopy Permit; (2) a Fluoroscopy Supervisor and Operator Permit; or (3) a Physician Assistant Fluoroscopy Permit.

Pilot Questions
Pilot questions are unscored questions embedded in the test. ARRT uses data from these pilot questions to evaluate new questions. This is a cost-effective way to develop test materials for future candidates, just as past candidates assisted in piloting questions for today.

These questions are not identified as pilot questions, and they appear just like any other question on the test. Up to 20 percent of your exam may be unscored pilot questions. Your answers to these questions will not affect test scores.

Copyrighted Exam Material
Law prohibits any attempt to reproduce all or part of the examinations. Anyone caught removing exam content from the test center, whether by physical removal or by reproducing materials from memory, will be prosecuted to the full extent of the law and will be permanently barred from future examinations.

Upholding Exam Security

ARRT has strict security regulations and takes exam security seriously. ARRT prohibits you from cheating on your exam or taking action that would help another candidate cheat. If you violate the regulations, you can face legal action and/or risk being banned from future testing.

Why Does Security Matter So Much?

It's a matter of public health.

Security is critical to ensuring that the examination is an accurate and reliable measure of the critical knowledge and cognitive skills underlying the tasks typically required for the practice of medical imaging, interventional procedures, and radiation therapy. In fact, subverting the integrity of ARRT's exams is illegal, based on a Minnesota law that went into effect on August 1, 2010. More information can be found by visiting **www.state.arrt.org**.

Ask yourself: Would you want a loved one to receive care from an individual who passed the ARRT-administered exam because they got a sneak peek at questions and memorized the answers rather than having learned all the critical content that the questions scientifically sample?

Candidate Agreement On Exam Disclosure

Disclosing exam information using language that is substantially similar to that used in questions and/or answers on the ARRT exams is considered an attempt to subvert the integrity of the exam when such information is gained as a direct result of having been a candidate. This includes (but is not limited to) disclosures to: students in educational programs, graduates of educational programs, educators, or anyone else involved in the preparation of candidates to sit for the exam. It is also considered an attempt to subvert the integrity of the exam to receive, from a candidate, exam information that uses language that is substantially similar to that used in questions and/or answers on the ARRT exam, whether requested or not, or to relay such information.

Help Us Protect Exam Security

*If you know of any situations in which the security of ARRT exam materials might be compromised, we invite you to visit **www.state.arrt.org**.*

Disclosing Exam Information: The Bright Line Between What's OK and What's Not

Candidates for state licensing and/or permit examinations see language in the ARRT state licensing examination handbooks, as well as the non-disclosure screens at the test center that clarify what they are agreeing to comply with regarding exam security. This language is reproduced in the box on page 16.

Failure to comply with these agreements can result in an ARRT investigation which may lead up to the invalidation of the results of the current and any prior examinations. This could also permanently bar the candidate from all future exams as well as the appropriate state licensing agency being notified. Violating these agreements could also lead to legal action. Appendix D has a list of potential exam disclosure scenarios.

If you have any questions about your responsibilities under ARRT's exam disclosure policy, visit **www.state.arrt.org**. A video depicting the consequences of violating this policy is available at **www.arrt.org/video-library**.

NOTE: ARRT reserves the right to bar state candidates from examination who are currently sanctioned by the ARRT.

Application Procedures

Exam Fees

Fees paid to ARRT are non-refundable under any circumstances, nor can they be transferred to another discipline of examination.

Process for Examination

Application to State
Before paying ARRT for your examination, you must submit your license and/or permit application and any appropriate application fees directly to your state licensing agency. If your state licensing agency determines you're eligible for examination, they will notify you. The notification you receive from your state licensing agency should provide you with instructions for paying your examination fee to ARRT. ARRT will accept payment by credit card only. It is important to note that the examination fee paid to ARRT is different than the application fee you submit to your state licensing agency.

Create an Account at www.state.arrt.org:
After receiving notification from your state licensing agency that you are eligible to sit for an examination, ARRT requires that you create an online account at **www.state.arrt.org**. Third-party individuals, schools, or businesses will not be allowed to create the online account for you. Before paying your examination fee, you will be required to read and respond to:

- An Agreement of State Candidates which is your attestation to not divulge or receive examination information that uses language that is substantially similar to that used in questions and/or answers on ARRT examinations; and
- Electronically indicate yes or no regarding your potential need and consideration for testing accommodations based on the Americans with Disabilities Act (ADA) guidelines. (See page 7 for further details)

After responding to these questions, you will be directed to pay your examination fee. You are responsible for making sure your state licensing agency submitted your correct name and address, as well as correct examination discipline. This information will appear after you create your online account as well as appearing on the payment page for you to verify before submitting your fee. If any of the information appearing on your online account is incorrect, please notify your state licensing agency immediately and **before** paying your examination fee. Do not make your examination payment until your information has been corrected by your state licensing agency.

All updates by your state licensing agency will automatically appear on your online account. Once you confirm any necessary updates have been completed, you can go online to pay for your examination. After making your online credit card payment, you will not be able to change the state-assigned examination. Examination fees are nonrefundable and non-transferrable.

After ARRT processes your examination fee, your information will be sent to Pearson VUE. You will also receive an examination handbook and a Candidate Status Report (CSR) via USPS mail, which has your personal ARRT ID#. Your CSR will also be available on your online account. Once you review your CSR and determine everything is correct, you can contact Pearson VUE to schedule your examination appointment. (See page 10 for more details.)

One Exam at a Time

You may apply for one exam at a time. That means if you're planning to take a state exam (administered by ARRT) and an ARRT certification exam, you must choose which one to take first. If you choose to take your state exam first, your application and fee for an ARRT certification exam will be held and not processed until you complete your state exam. Similarly, if you have been assigned an exam window for an ARRT certification exam, your fee for your state exam will be returned to you. Once you complete your ARRT exam, you can re-submit your fee for your state licensing exam.

If You Do Sign Up for Both Radiography and Fluoroscopy Supervisor and Operator Exams...

Be aware that if you sign up for both the Radiography and Fluoroscopy Supervisor and Operator exams at the same time, you will not be able to change the exam at a later time. If you do not complete both sections of the exam, your exam will not be scored and your fee will be forfeited. Verify with CDPH-RHB ***before*** *submitting your exam fee to the ARRT whether you need to take both exams.*

Testing Accommodations

To comply with the Americans with Disabilities Act (ADA), we'll provide testing accommodations if our partner organization, Paradigm Testing, determines that you meet ADA requirements. Testing accommodations include any changes to standard testing procedures, including requests for additional time, a reader, as well as medical aids such as insulin pumps, Pico magnifiers, lumbar pillows, asthma inhalers, etc.

After logging into your online account at **www.state.arrt.org**, and before paying your examination fee, you will see a question asking if you wish to be considered for testing accommodations. If you respond with "yes," you will be provided with instructions for submitting an online application and supporting documents to Paradigm via its secure website. You must indicate "yes" each time you apply – including re-examination attempts. If you indicate "no," you cannot request accommodations at a later time.

We'll place your examination authorization on hold until you submit your accommodation request and Paradigm processes it. In addition, you won't be able to schedule your exam until we send you a decision letter based on Paradigm's review of your documentation. If you're denied an accommodation based on your documentation, you'll be able to appeal the decision by providing additional documentation. It is in your best interest to submit as much supporting documentation as possible with your original request to avoid delays in having your examination authorization released to allow scheduling your exam appointment. Details on supporting documentation requirements can be found at **www.arrt.org/accommodations**. Most accommodations decisions are made within 10 business days.

If you don't submit a request to Paradigm within a year of submitting your application, we'll process your exam authorization without accommodations and assign you an exam window. You will be notified your application has been processed and an exam window has been assigned. At that point, we can't grant any accommodations.

Before the Examination

Familiarize yourself with exam procedures explained in this handbook before scheduling your exam at any of hundreds of test centers across the U.S. and internationally.

Status Report Info Incorrect?

If the information on your CSR is incorrect, contact CDPH-RHB (not ARRT) right away — and before scheduling an exam appointment.

Name/Address Change? Notify the State

You should notify CDPH-RHB (not ARRT) immediately of any name and/or address changes before scheduling an exam appointment.

State Exam Eligibility vs. ARRT Exam Window

Your one-year license eligibility period, determined by the CDPH-RHB, is different than the 90-day examination window assigned by ARRT.

Address or Name Changes

You must notify CDPH-RHB (not ARRT) immediately of any changes to your name or address as submitted on your license/permit application form using the form found at **www.cdph.ca.gov**. Changes cannot be processed by ARRT, the Pearson VUE Call Center or at the test center.

At the test center, the name on your IDs must match your name as it appears on your CSR (the only permissible exception is middle initial versus middle name, as long as the first letters match). Name change requests must be directed to CDPH-RHB at least 10 business days before a scheduled appointment to allow enough time for your information to be submitted to Pearson VUE for processing. Requests received less than 10 business days before your exam appointment may not be processed in time, which may result in your being turned away from the test center and forfeiting your fee. If the name on your IDs doesn't match your CSR, cancel your appointment (see page 11) and correct the discrepancy with CDPH-RHB. Don't schedule a new appointment until you receive a new CSR and verify the changes are correct. Updates will also appear on your online CSR at www.state.arrt.org.

CDPH-RHB One-Year Eligibility Period

California Code of Regulations, title 17, section 30405, requires that an applicant pass Department-approved examinations within one year from the postmark date of written notification that the application was accepted for filing, which is the initial Notice of Application Status letter. No extensions to the one-year eligibility period can be granted. Please note that the CDPH-RHB assigned one-year eligibility period is different than the ARRT 90-day examination window. Questions regarding CDPH-RHB eligibility should be directed to CDPH-RHB — not ARRT. If you find you are unable to complete your exam within the ARRT-assigned 90-day examination window, you may request a window extension (see "Extending an Exam Window" on page 9).

ARRT 90-Day Examination Window

ARRT will assign you a 90-day exam window. You should schedule your exam appointment for a date within the 90-day exam window appearing on your CSR. Please be aware that the ARRT-assigned 90-day exam window is different than the one-year CDPH-RHB eligibility period. Generally, examination windows begin on the Wednesday after payment is processed (not received) by ARRT, and extend for 90 calendar days. For example, if an exam payment is processed on Thursday, April 14, 2022, the examination window will begin on Wednesday, April 20, 2022, and end on Monday, July 18, 2022.

NOTE: Exam windows cannot go beyond your CDPH-RHB one year eligibility period. If you wait until the end of your state eligibility period to pay ARRT your exam window may be less than 90 days in length.

Your exam window will close automatically after 90 days, or if you miss an appointment, if an appointment is not canceled in time, you fail to comply with the non-disclosure agreement at the test center (see page 16), the name on your IDs do not match the name on your CSR, or if you have an invalid ID. In addition, your exam fee is forfeited. To open a new exam window, you would have to contact CDPH-RHB for information on re-examination requirements and submit a new exam fee to ARRT.

Extending an Exam Window

If circumstances make it impossible for you to schedule your examination during your ARRT-assigned 90-day exam window, you may request a window extension. You will be allowed up to three extensions per exam fee.

If you have an existing appointment, you must cancel it before requesting a window extension, scheduling a new exam date, or changing the test center location. (See "Canceling or Rescheduling Your Appointment" on page 11.)

ARRT requires you complete the Window Extension Request Form and fax it to ARRT. ARRT must receive the request on or before the last day of your current ARRT 90-day examination window. If your window expires on a weekend or holiday, your request must be received on or before the last business day prior to the expiration date. (Saturday and Sunday are not considered ARRT business days.) The Examination Window Extension Request form is located at the bottom of the California home page at **www.state.arrt.org**. If you provide an email address, a confirmation of receipt of your request will be sent. If you do not provide an email address, you should follow-up with a phone call to (651) 687-0048, select the option to earn an ARRT credential, to confirm that your fax has been received. Your new ARRT exam window will begin on the day ARRT processes the extension request. ARRT will not accept requests for specific window dates.

NOTE: ARRT cannot process requests it receives after the last day of your current window. Window extensions will be processed only if sufficient time remains in your CDPH-RHB one-year license/permit eligibility period. ARRT cannot extend your 90-day exam window beyond your CDPH-RHB one-year license/permit eligibility period under any circumstances. It is your responsibility to know when your CDPH-RHB one-year eligibility period expires. This information appears on your CSR. You can also check your online CSR for updates at **www.state.arrt.org**.

TIP

Window Extension... Notify ARRT

If you need to request a window extension, you must make sure you have time remaining in your state-assigned one-year eligibility period. Window extension requests must be faxed to the ARRT before the last day of your current ARRT 90-day exam window. You must cancel any scheduled exam appointments before requesting a window extension.

TIP

Maximum of Three Changes

You will be allowed a maximum of three window extensions per exam fee; however, an extension cannot go beyond your 1-year state eligibility period. If a third window extension is allowed to expire, you forfeit your exam fee. To be considered for a new exam window, you will need to contact CDPH-RHB.

Test Centers

ARRT examinations are administered by Pearson VUE, the electronic testing business of Pearson Education. Their network of more than 200 high-security test centers is specifically designed and built for professional licensure and certification markets in the U.S. and its territories. Their international test centers are equipped to deliver ARRT exams in selected cities in Canada, Europe, Asia, and Australia. Current test center locations and driving directions may be viewed at **www.pearsonvue.com/arrt**.

Study Materials

Use the content outlines in Appendix A of this handbook to prepare for your examination.

ARRT does NOT provide specific lists of study materials or textbooks for any ARRT-developed CDPH-RHB licensing/permit exams nor do we recommend or endorse any review programs, mock registries or study guides. It is recommended that you use a variety of references when preparing for your exam.

The Examination Appointment

Scheduling Your Appointment

Pearson VUE schedules appointments on a first-come, first-served basis. Once you receive your CSR, you may schedule your appointment one of two ways:

- call the Pearson VUE Call Center at the toll-free phone number shown on your CSR (Monday–Friday, 7 a.m.–7 p.m. Central Time); or
- online at www.pearsonvue.com/arrt (see "tip" box at left for details on scheduling an appointment through the Internet).

Even if you don't want to take your exam immediately, it's better to schedule early to obtain your choice of exam date.

If you delay too long in scheduling your examination, you may not find an available appointment prior to the expiration date. If your window is allowed to expire, your file is closed, and you must contact CDPH-RHB for instructions on re-application (see "Extending an Exam Window" on page 9).

You will be providing and receiving a great deal of important information when scheduling your appointment with Pearson VUE. It is your responsibility to manage that information each step along the way.

Have Your Info Available
You cannot schedule a testing appointment until you receive your CSR. You will be able to select a test center from those listed on the Pearson VUE website.

When calling to schedule your appointment, you will be asked to verify your name as listed on your current CSR and provide your ARRT-assigned ID number appearing on your CSR. Calls may be recorded for quality assurance purposes.

Pearson VUE Call Center staff will help you schedule a date and time for your exam. Test centers are generally open Monday through Friday between the hours of 8 a.m. and 6 p.m. Some test centers offer extended evening or weekend hours.

NOTE: Call Center staff cannot make changes (except adding email and phone info) to the application information you provided to CDPH-RHB. (See "Address or Name Changes" on page 8.)

Confirm Your Scheduling Information
After scheduling your appointment, Pearson VUE will email a letter confirming your appointment. The letter will include the address, phone number, and directions to the test center, as well as the name, date, and time of your exam and other important information. Driving directions are also available at **www.pearsonvue.com/arrt**.

NOTE: Occasionally the email confirmation may be filtered into a SPAM folder based on the security settings of your email account. Be aware that the email confirmation comes from PearsonVUEconfirmation@pearson.com. If you do not receive an email confirmation from VUE immediately after scheduling, check your filter settings and/or contact the VUE Call Center to confirm your email address on file and your appointment date and time, and request that a new confirmation email be sent.

ARRT and CDPH-RHB are not able to confirm exam dates, times, or locations for your examination, nor can we provide driving directions to test centers.

TIP

Internet Scheduling

After you have been notified of your eligibility to sit for the exam, you may schedule online at www.pearsonvue.com/arrt. When you arrive at the web page, the process will differ depending on if you're a first-time or returning user.

First-time users should click on the "Create an Account" link, where you will be asked for your ID number and personal information listed on your Candidate Status Report. Make sure the information you enter on the screen matches the information listed on the front of your CSR. When creating your profile, follow the prompts until you have completed the process and can select the "Finish" link. You will be provided a link to follow the prompts for scheduling your exam.

Returning users should click on the "Sign In" link. If you have forgotten your password, click on the "Forgot my Password" link and follow the prompts.

NOTE: If you have created an online account when scheduling an ARRT certification exam, you will need to create a new account using the ID number appearing on your current CSR.

To schedule online, candidates must provide an email address. Otherwise, phone the Pearson VUE Call Center directly to schedule an appointment.

Missing Your Appointment

If you fail to keep your appointment or fail to reschedule it as detailed in the next section, your file will close, and you will forfeit your examination fee. Neither ARRT nor CDPH-RHB are responsible for appointment time discrepancies between you and the test center.

Canceling or Rescheduling Your Appointment

You may cancel or reschedule an appointment up to 24 hours (one business day) prior to the scheduled appointment — either by phoning (800) 632-9055 (leaving a voicemail on an answering machine is not acceptable) or at **www.pearsonvue.com/arrt** (be sure to follow the prompts to complete the process). If you make a new appointment, follow up by phoning the Call Center to confirm it. See the "Follow-Up and Confirm your Exam Appointment" at right. Pearson VUE will immediately send you an email confirmation each time an appointment is made, changed, or canceled. If you do not receive a confirmation, contact Pearson VUE to confirm the transaction. Pearson VUE charges a $10 fee for exam appointments that are canceled or rescheduled. Pearson VUE will collect fees by credit card payment (American Express, MasterCard, Visa, or Discover) at the time the appointment is canceled or rescheduled. This includes all changes made online or via the Pearson VUE Call Center.

The table below shows that appointments for a given time on the scheduled exam day must be canceled by the same time on the preceding business day:

Scheduled Exam Day	Cancel/Change Deadline (same time as appointment)
Monday	Friday of the preceding week
Tuesday	Monday of the same week
Wednesday	Tuesday of the same week
Thursday	Wednesday of the same week
Friday	Thursday of the same week
Saturday	Friday of the same week

Exception

Due to center hours, if your appointment is in a time zone ahead of Central (i.e., Eastern or further east), you must cancel any 8 a.m. appointment by 7 p.m. CT two days in advance.

For example, if your exam is scheduled for 9 a.m. on Monday, you must call by 9 a.m. on Friday to cancel your appointment. VUE will follow-up with a confirmation email detailing your cancellation or appointment change information.

NOTE: National holidays and weekends are not considered business days.

If you fail to appear for your scheduled appointment and do not reschedule through the procedure above, you will forfeit your examination fee. To receive a new eligibility letter, you must contact CDPH-RHB. Neither ARRT nor CDPH-RHB are responsible for appointment errors.

ARRT does not grant exceptions for missed appointments under any circumstance.

Follow-Up and Confirm Your Exam Appointment

You are responsible for confirming the date, time, and location of your exam with Pearson VUE. If you don't receive an email confirmation immediately after scheduling, contact the Pearson VUE Call Center to confirm over the phone and request that a duplicate confirmation letter be sent.

This applies to appointments scheduled via the Call Center as well as those scheduled through the Pearson VUE website.

Calling to Reschedule? — Remember to Cancel

TIP

Just because you call to reschedule a testing appointment doesn't necessarily mean that the initial appointment is automatically canceled. And an uncanceled appointment is your responsibility, potentially resulting in forfeiting the application fee.

If you call Pearson VUE intending to reschedule a testing appointment, your initial appointment will remain in effect until you formally approve a new appointment date/time. If you can't find an appropriate alternative appointment and plan to call back later, your initial appointment will still be on the books.

Play it safe when changing your appointment. Be sure to specifically request that the initial appointment is canceled. You will receive an email confirmation immediately after your cancellation request is processed.

Exam Administration Day

Here's a preview of what you'll encounter when you open the test center's front door on the day of your state licensing exam appointment.

TIP

What to Expect On Exam Day

ARRT encourages you to watch the "What to Expect on Exam Day" video at ***www.arrt.org/video-library*** *to familiarize yourself with the process. NOTE: You will not see a preliminary score after your exam as depicted in the video.* *(See page 18 for score information.)*

TIP

Invalid ID? Cancel Appointment

If you arrive at the test center with invalid forms of ID, you will not be admitted to take the test, and you will forfeit your fee.

Your ID is invalid if:
- *it is not current (expired), or*
- *the name on ID varies from that on your ARRT file, or*
- *there is no signature, or*
- *it is not an accepted form of ID* *(see box on page 13).*

Cancel your appointment in time and re-schedule when you have acquired two forms of valid ID.

Test Center Environment

Pearson VUE test centers provide computerized testing for many organizations. Be aware that other exams may be administered in the test center at the same time as ARRT examinations.

Most test centers are located in buildings comprised of several other offices. Waiting areas at the test centers are small. Friends, relatives, or children will not be permitted to wait in the test center or to contact you during your examination.

Test center personnel try to maintain a comfortable temperature in the testing rooms. In spite of these efforts, the room may be too cool or too warm for an individual's preference, so dress accordingly. Be aware that outerwear (overcoat, windbreaker, hats, jacket, etc.) is not allowed in the testing room; however, clothing typically worn indoors (sweater, sweatshirt without a hood, blazer, etc.) is allowed.

Keep in mind that there will be other people at the test center taking exams, so typing, coughing and/or people entering and leaving the testing room may be heard. It is impossible to provide a completely noise-free exam environment. If you feel these distractions may be disruptive to your testing, be sure to request earplugs before beginning your exam. Noise reduction headphones can also be provided.

Follow Procedures

Test center personnel adhere to designated procedures to ensure that their operations meet ARRT criteria for standardized testing. Review the following information before the examination to become familiar with the procedures.

Arrive Early

Having already confirmed the location of the test center, plan your schedule and route to ensure that you arrive at least 30 minutes before your scheduled appointment, to allow time for check-in procedures. Be sure to allow ample time for your commute, especially if inclement weather is a factor.

If you arrive at the test center 15 minutes after your scheduled appointment, you may be required to forfeit the appointment. If an appointment is forfeited, the test center will report to ARRT your failure to take the examination and your file will close. ARRT does not refund exam fees on forfeited appointments. If you wish to be assigned a new exam window, you must contact CDPH-RHB for new exam eligibility information.

ID, Photo, Signature, Palm Vein Recognition (PVR)

When you arrive at the test center, you will be required to show two forms of identification, both of which show your signature and your pre-printed name as it appears on your CSR. One of the IDs must be a current official government-issued photo ID. See next page for examples of the two types of IDs required.

Your name on your government-issued ID must be the same as that on record with ARRT, as reflected on your most recent CSR. Your ID may contain your full middle name as long as the middle initial on your CSR matches the first letter of your middle name. If your name has a cultural variation, ensure that the same variation appears on the CSR and both IDs.

If you arrive without proper ID or with discrepancies in your name listed on the IDs, you will not be admitted to the test center. You will not be allowed to re-schedule your exam appointment and will forfeit your examination fee. If you are admitted with questionable ID, you may have your score canceled following investigation by ARRT.

Upon checking in, you will be asked to provide a digital signature, which constitutes a) your consent for ARRT and/or Pearson VUE to retain and transmit personal data and exam responses; and b) your agreement to abide by the ARRT Rules Agreement, which will be presented to you prior to your exam.

You will also have your palm vein scanned and be photographed. If you leave the testing area for any reason, your palm will be scanned upon leaving and again before re-entering.

The palm-vein information and photo are for authentication purposes only. The information is kept confidential and not shared with any organization.

Palm Vein Recognition Replaces Fingerprint

As of January 1, 2011, a new biometric procedure was added to the admissions process, replacing the fingerprint process. Called palm vein technology, it scans the veins inside the hand to create a digital template that represents your vein pattern. The pattern reader uses a safe, near-infrared light source, similar to a television remote.

Assignment to Testing Station

Test center personnel will give you a short orientation, provide you with a copy of the ARRT Rules Agreement (see Appendix E) to read, and then escort you to an assigned workstation. You must remain in your assigned seat during your examination, except when authorized to leave by a test center staff member.

You will be required to keep all personal items in a secure locker. Don't wear jewelry that may be noisy or disruptive in the testing room. You will be asked to remove jewelry that is wider that ¼" as such items can pose a threat to exam security. If you bring a phone or other electronic device, turn off the device and store it in your locker. You may not access any electronic device until you have completed your exam and are ready to leave the test center. You cannot access items placed in a secure locker or anywhere else in the test center building for the duration of your exam unless you receive written pre-approval from ARRT. This includes breaks. Test centers assume no responsibility for candidates' personal belongings.

If you need to leave the testing room for personal reasons, you must first raise your hand to get test center staff's permission. No additional time is allowed to make up for lost time due to this reason. Test center staff is required to file an incident report with ARRT on any candidate that leaves the testing room for more than 10 minutes.

Test center personnel are not trained to answer specific questions related to ARRT examination content.

Calculators and Notes

Personal calculators are not permitted. Both scientific and basic four-function calculators are provided on the computer, or you may request a basic four-function calculator from test center personnel. Appendix B presents facsimiles of the computer calculator, and examples are also included in the tutorial at the beginning of the exam.

Test center personnel will provide a booklet and pen to make notations, which may be replaced as needed during testing but may not be removed from the testing room at any time. Do not start writing in the booklet until after responding to the non-disclosure agreement, and you may not hold your booklet up to the screen when responding to questions. Non-approved scratch paper, pens, or pencils are not allowed in the testing room.

TIP

Don't Bring Yours... Calculators Provided

Personal calculators are not permitted, so don't even bring one to the test center. You can use theirs.

Acceptable Forms of Identification

***PRIMARY**: Must be government-issued, have **pre-printed name, photo, and signature,** and not be expired.*

- *Government-issued driver's license*
- *State ID card*
- *Passport*
- *Military ID**

**Barcode for signature acceptable with Military IDs only.*

***Very Important!** Please note that Permanent-Residence Cards ("Green Cards") or any other IDs that do not have your signature **will not be accepted** at the test center as valid primary or secondary identification.*

***SECONDARY:** Must have **pre-printed name and signature** and not be expired.*

- *Government-issued IDs (e.g., U.S. social security card)*
- *Employee ID or work badge*
- *Bank automated teller machine (ATM) card*
- *School ID*
- *Credit card*
- *Any form of ID on the primary list*

Requesting Assistance

Raise your hand to notify test center personnel if:

- you need assistance adjusting the computer screen's brightness or contrast;
- you would like a hand-held calculator;
- you need earplugs;
- an image appears too large to be fully viewed;
- you suspect a problem with the computer;
- you need another booklet;
- you need a break;
- you have completed your exam; or
- you need a staff member for any other reason.

Pace Yourself

It's important to use your time economically. Time remaining is displayed in the upper right corner of the computer screen. See "Taking the Exam" on page 16 and Appendix B for more information.

Exam Timing

Time allowed for completing an examination is based on the number of questions on the exam. The following table indicates how much time has been allocated for each of the different examinations. The column labeled "exam time" below indicates how much time has been allocated to answer the questions on the examination. The column labeled "total time" adds 20 minutes to exam time to allow the candidate 8 minutes designated for the tutorial, followed by two minutes to respond to the non-disclosure agreement and 10 minutes designated for the survey after the examination has been completed. This extra 20 minutes is for completion of the tutorial and survey and cannot be used to answer examination questions. Voluntary breaks are subtracted from the allowed testing time; that is, the clock is not stopped during voluntary breaks.

ARRT recommends that you complete the tutorial to familiarize yourself with the testing program and the online calculators. You must also click "A" for the non-disclosure agreement (see box on page 16), which appears after the tutorial and before starting your exam.

Discipline	Exam Time	Total Time
Radiography	3 hrs, 50 min	4 hrs, 10 min
Radiation Therapy	3 hrs, 50 min	4 hrs, 10 min
Mammography	2 hrs, 30 min	3 hours
Bone Densitometry Equip Operator	1 hr, 30 min	1 hr, 50 min
Fluoroscopy	2 hours	2 hrs, 20 min
CA Radiography S&O Permit	1 hr, 45 min	2 hrs, 5 min
CA Rad & Fluoro S&O Permit	3 hrs, 45 min	4 hrs, 5 min
CA Dermatology S&O Permit	1 hour	1 hr, 20 min
CA Dental Lab Radiography Permit	1 hr, 30 min	1 hr, 50 min

Exam Timing for Limited Scope of Practice in Radiography: Each module is separately timed. The amount of time is determined by the number of questions in a module, at a rate of about one minute per question. It is important to pace yourself so that you complete each module within the allotted time.

NOTE: Breaks are not scheduled between modules. That is, the clock will continue ticking after completing one module and moving to the next module.

- **Which Modules.** The computer will present only those modules that were assigned to you by your state licensing agency. Those same modules are listed on your CSR. If you feel you have not been assigned the correct modules, contact CDPH-RHB — not ARRT — immediately and before scheduling your appointment.

- **Review Session.** The computer requires that you answer every question. If you are unsure of an answer to a question, you can "mark" the question and come back to it later. After you have answered all questions in a module, a review screen allows you to go back to any question you marked. You can change

answers during the review. When done reviewing questions, you can end the module. Extra time is not given for the review session; it must be completed during the time allowed for that specific module. A sample review screen is printed in Appendix C.

- **End Module/End Exam.** Once you end the review session, the module ends. You will not be able to go back and review questions in that module. At this point, one of two things happen: 1) if you have additional modules to complete, the next module will appear; 2) if you do not have additional modules to complete, the exam ends.

Test Center Misconduct and Score Cancellation

Numerous security measures are enforced during the exam administration to ensure the integrity of ARRT exams. Be aware that you will be observed at all times while completing the exam. This includes direct observation by test center staff, as well as video and audio recording of the testing session.

Zero Tolerance Policy
ARRT has a zero-tolerance policy regarding possession of cell phones and other electronic devices in the test center, as well as candidates leaving the test center building prior to completing the examination and attempting to re-enter the test center. Automatic score cancellation will result for any candidate violating this policy.

1. Under no circumstances are candidates permitted to access cell phones or any other type of electronic device after check-in at the test center. Test center personnel are instructed to dismiss any candidate found in possession of an electronic device after the candidate has completed the check-in procedures. This includes candidates on breaks.

   Such electronic devices include, but are not limited to:

   - cellular phones;
   - media players;
   - compact disc players or any other electronic communication/recording/ listening device;
   - removable storage devices;
   - personal digital assistants (PDAs);
   - calculator or computing watches;
   - scan pens;
   - laptop computers, tablets, or any computer device; and
   - photographic devices.

   If a candidate is found possessing, or otherwise having access to, a cell phone or any other type of electronic device during the administration of their exam, the candidate will not be allowed to continue testing and the test center administrator will file an incident report. Possession of a cell phone or any other type of electronic listening device after check-in will result in automatic score cancellation.

2. If test center staff observes a candidate leaving the test center building and re-entering the test center prior to completing the exam, the candidate will not be allowed to continue testing and the test center administrator will file an incident report. Leaving the test center building and attempting to re-enter the test center will result in automatic score cancellation.

3. Candidates should not bring papers, pamphlets, books, notebooks, or study guides into the test center. If you bring these items they must remain in your locker for the duration of your exam. If you are found in possession of, or otherwise having access to, any prohibited item during the administration of your exam, you will not be allowed to continue testing and the test center administrator will file an incident report. This will also result in automatic score cancellation.

4. For any candidate demonstrating misconduct or irregular behavior during or in connection with the examination — as evidenced by observation, statistical

Severe Weather Looming?

If you anticipate severe weather and your appointment is more than 24 hours out, consider rescheduling to avoid transportation hassles.

If you miss your appointment due to weather and the test center was open, you will forfeit your exam fee and will need to contact CDPH-RHB for a new eligibility window.

Non-Disclosure Agreement

After the tutorial, a non-disclosure agreement will appear on the computer screen. You must accept the terms of the agreement in order to proceed with the exam. By accepting these terms, you agree not to disclose exam questions in any form or remove them from the test center. You have two minutes to indicate your acceptance of the agreement. If you do not respond within two minutes, the exam will end and you will have to submit a re-application form and fee to obtain a new exam window.

The agreement states: "This exam is confidential and is protected by copyright law. You are expressly prohibited from disclosing, publishing, reproducing, or transmitting this exam, in whole or in part, in any form or by any means, oral or written, electronic or mechanical, for any purpose."

The screen will instruct you to click the "A" (for Accept) button to symbolize your signature and to accept the terms. Selecting "A" will allow you to continue with the exam. If you do not accept these terms, click "N" (for Not Accept) to let test center staff know that you are through with the exam. If you click "N" but later decide to examine at a future date, you will need to submit a re-application form and fee.

Learn more about the non-disclosure agreement in the "What to Expect on Exam Day" video at **www.arrt.org/video-library**.

analysis of exam responses or otherwise — the ARRT will withhold examination scores and may revoke or suspend a certificate, deny, or reject an application for renewal of certification and registration, censure or take any other appropriate action. This includes permanently barring the candidate from all future examinations, terminating candidate participation in the exam, and invalidating the results of that exam and any prior exam.

Examples of misconduct or irregular behavior include, but are not limited to:

- Removing items from a secured locker without prior authorization
- Giving or receiving unauthorized help
- Attempting to take the examination for someone else; or having someone else take an exam for you
- Failing to follow test center staff instructions
- Tampering with the operation of the computer or attempting to use it for any function other than completing the examination
- Attempting to remove exam content (in any format) from the test center
- Creating a disturbance of any kind
- Accessing notes, books, study guides or unauthorized electronic devices

If found to be in violation of this policy, you may find yourself part of an ARRT ethics investigation, or even a federal court lawsuit for copyright infringement and/or breach of contract.

What if the Test Center is Closed?

If you are unsure whether a test center is closed because of inclement weather or some other factor, phone Pearson VUE's Call Center at (800) 632-9055. If the test center is open, it is your responsibility to keep your appointment. If it is closed, you will be given the opportunity to reschedule your appointment.

In the event of a test center closing, Pearson VUE will contact you via the email address you provided during scheduling to reschedule your exam appointment. You may also call Pearson VUE to reschedule your exam.

Taking the Exam

Order of Questions
ARRT examinations present questions in random order, which is consistent with the purposes of education and evaluation. When an individual learns an important concept, the intent is that he or she will take that knowledge beyond a specific context or environment and generalize that knowledge to the practice setting.

Item Format
Most exam items are standard multiple-choice with one best answer. ARRT is also introducing new formats on a limited basis. Some items may require that you select multiple answers from a list or use the mouse to sort a list of options into a particular order. A few items may require that you identify anatomic structures on an image by placing the mouse arrow (cursor) over the correct location on the screen and clicking. Others may require you to answer a multiple-choice question after viewing a short video clip. Appendix B provides additional information on exam item formats.

Selecting Answers
An answer must be recorded for a question before the computer allows display of the next question. You may flag questions for later review if you are unsure of the answer. For further information, refer to Appendix B.

Pacing
It's important to use your time economically. Time remaining is displayed in the upper right corner of the computer screen. If a question is difficult, guess at the answer, flag the question for review, and go on to the next question. When you

have finished the examination and there is still time left, go back to the questions that you flagged and review them by clicking on the “Review Flagged” button. See details in Appendix B.

Guessing
Exam scores are based upon the total number of correct answers. Therefore, it is to your advantage to answer every question, even if that means selecting an answer of which you are not sure. You must indicate some response to each question before the computer will proceed to the next question.

Candidate Comments

You may comment on a specific question at the time you answer the question by clicking on the “Comment” button at the top of that page. No additional testing time is allowed during the exam for making comments on questions.

You may comment on your test center experience in the evaluation survey at the end of your exam.

Leaving the Test Center

When you are finished with the examination and evaluation survey, raise your hand and test center staff will collect the erasable note board before dismissing you. Do not leave your seat until you have been dismissed. You may not remove your booklet from the testing room. Your palm will be scanned again before leaving the test center.

Appeals of Exam Administration

ARRT makes every effort to assure that examinations are fairly administered in a comfortable and safe environment.

On rare occasions, candidates may encounter technical difficulties at the test center. If you experience a technical difficulty, notify the test center administrator immediately. Test center personnel will make every effort to correct any difficulties as quickly as possible.

Should the test center experience a loss of power, back-up systems are in place, so every reasonable effort will be made to retrieve testing data. Once power is restored, you will be able to continue your testing session from the point where you were interrupted. If you are unable to continue the testing session due to severe technical difficulties, reasonable accommodations will be made, including re-scheduling of an exam appointment. ARRT will evaluate individual requests for re-scheduling at no cost.

If you believe that your examination was administered in a manner that substantially deviated from normal testing procedures, you may request a review of the procedures. If you experience a problem, verify with the test center administrator before you leave the test center that they will file a report regarding your issue.

If you wish to request a review, submit a completed Eligibility Appeal Request form (at **www.state.arrt.org**) detailing the specific nature of the alleged deviation from normal testing procedures.

Because ARRT will investigate complaints only if they are received before your results have been released, you have only two days to submit the request. You may fax the appeal form to (651) 681-3295.

If ARRT finds that any such deviation unfairly interfered with your ability to complete the exam to the best of your ability in the allotted time, your original score will be canceled, and you will be allowed to retake the examination at no cost. Under no circumstances will your score be adjusted based upon the findings of the review.

After the Examination

After the examination, all exam data is returned to ARRT, where scoring and analysis is completed. ARRT follows strict procedures to ensure accuracy of scoring.

TIP

How/When Will I Get Exam Results?

Examination results are sent to CDPH-RHB for final pass/fail determination. Please allow up to forty-five days for processing, then contact CDPH-RHB — not ARRT — for information on your exam results. (See inside cover of handbook for contact information.)

State Attempts Count Against Three-Attempt Limit

As of January 1, 2010, if you attempt the exam as a state candidate instead of taking the exam for ARRT certification and registration, you will have the state attempt count as an attempt toward future ARRT certification and registration attempts.

Cancellation of Scores

ARRT may withhold or cancel scores if there is evidence that the security of the examination has been compromised. Such action may be necessary even in the absence of evidence indicating that a candidate was knowingly involved in the compromising activities. ARRT expects candidates to cooperate in any investigation. Once scores are canceled, they are not available for reporting at a later date.

Some scores may be rendered invalid because of circumstances beyond a candidate's control, such as technical difficulties. ARRT investigates each of these situations. When this results in a cancellation of scores, ARRT arranges for a makeup administration of the exam at no additional cost.

Score Reporting

You will not see a preliminary score at the end of your exam at the test center. ARRT does not release examination scores to state candidates. Your score information is forwarded to CDPH-RHB which, in turn, determines your pass/fail status. Within 45 days of completing your exam, you will be informed of your results by U.S. Postal Service from CDPH-RHB. Contact CDPH-RHB (not ARRT) if you have not received your scores within six weeks.

Interpreting Scores

ARRT uses "scaled scores" to report examination results for the Radiography, Radiation Therapy, Mammography and Fluoroscopy exams. Scaled scores are more meaningful than raw scores (i.e., number or percentage correct) because they take into account the difficulty of a particular exam compared to other forms of the same exam. Therefore, a scaled score of 75 represents the same level of exam performance, regardless of what examination form was administered.

Total scores are reported on a scale that ranges from 1 to 99. The total scaled score does not equal the number or percentage of questions answered correctly. A total scaled score of 75 is required to pass the exam. The number of correct answers required to achieve a score of 75 was determined through a standard-setting (or passing score) study. ARRT and panels of consultants periodically review the passing score to assure its validity.

Performance on each section of the exam is also reported using scaled scores. These section scores provide information to candidates regarding their strengths and weaknesses in particular content categories. Pass/fail decisions are not based on individual sections of the exam. Section scores can range from 1 to 10 and are reported in one-tenth point intervals (e.g., 8.1, 8.6). Section scores are intentionally placed on a narrower scale because they are based on fewer exam questions. Therefore, section scores are not as reliable as the total scaled score and should be interpreted with some discretion.

Results for the Limited Scope of Practice in Radiography, the Bone Densitometry Equipment Operator exam, and the California-specific licensing/permit exams are reported to CDPH-RHB as number correct for each section of the exam. CDPH-RHB determines pass/fail scores based on the number correct.

Appeals of Exam Scoring

ARRT employs several quality control procedures to ensure that all examinations are scored with complete accuracy. However, you may request a review of the accuracy of the scoring process if you feel an error has occurred.

If you wish a review of scoring, you must complete the Eligibility Appeal Request form located at **www.state.arrt.org** within 30 days of your exam date — detailing the specific reason a scoring error is suspected. Requests must be accompanied by a $25 fee, payable to ARRT.

ARRT will review your responses to each question, compare those responses to the answer key, and recalculate raw scores. Final passing scores are determined by CDPH-RHB.

ARRT will report its findings to you within 30 days of receiving the written request. If ARRT finds evidence of any scoring error, it will cancel your original score and notify CDPH-RHB of the corrected score.

Re-examination

If you fail the examination, do not appear as scheduled, answer "no" or do not respond to the non-disclosure agreement, allow your 90-day exam window to expire, or you were turned away due to invalid IDs, you should contact CDPH-RHB for information on your examination eligibility. Once it has been determined you are eligible for re-examination, the CDPH-RHB will send you an eligibility letter with instructions on how to pay ARRT your new exam fee. Once ARRT processes your new exam fee, a new handbook and CSR indicating your new 90-day exam window will be mailed to you.

Appendices

Dermatology Supervisor and Operator Permit Examination

Exam Content	Number of Questions
Dermatology Radiation Protection	50

Dental Laboratory Radiography Permit Examination

Exam Content	Number of Questions
Dental Anatomy and Physiology	15
Dental Landmarks and Radiographic Positioning	15
Technical Factors and Radiographic Exposure	10
Darkroom and Film Processing	10
Radiographic Physics, Equipment, and Accessories	10
Professional Ethics and Nursing Procedures	10
Dental Bone Age	10
	Total: 80 questions

*A new California Radiography Supervisor and Operator Permit Exam launched July 1, 2018. Please see full announcement posted at www.cdph.ca.gov/RHB.

See pages 21-95 for content specifications for the exams in Radiography, Radiation Therapy, Mammography, Limited Scope, Bone Densitometry Equipment Operator, Fluoroscopy, and Radiography Supervisor and Operator Permit.

EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2021**
IMPLEMENTATION DATE: **JANUARY 1, 2022**

Radiography

The purpose of the exam is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of the staff technologist at entry into the profession. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of radiographers.[1] An advisory committee then determined the knowledge and cognitive skills needed to perform the tasks on the task inventory and these are organized into the content categories within this document. Every content category can be linked to one or more tasks on the task inventory. The document is used to develop the examination. The *Task Inventory for Radiography* may be found on the ARRT's website (www.arrt.org).

The ARRT avoids content when there are multiple resources with conflicting perspectives. Educational programs accredited by a mechanism acceptable to ARRT offer education and experience beyond the minimum requirements specified in the content specifications and clinical competency requirements documents.

This document is not intended to serve as a curriculum guide. Although ARRT programs for certification and registration and educational programs may have related purposes, their functions are clearly different. Educational programs are generally broader in scope and address the subject matter that is included in these content specifications, but do not limit themselves to only this content.

The table below presents the major content categories and subcategories covered on the examination. The number of test questions in each category are listed in bold and the number of test questions in each subcategory in parentheses. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	**Number of Scored Questions[2]**
Patient Care	**33**
Patient Interactions and Management (33)	
Safety	**50**
Radiation Physics and Radiobiology[3] (21)	
Radiation Protection (29)	
Image Production	**51**
Image Acquisition and Evaluation (26)	
Equipment Operation and Quality Assurance (25)	
Procedures	**66**
Head, Spine and Pelvis Procedures (18)	
Thorax and Abdomen Procedures (20)	
Extremity Procedures (28)	
Total	**200**

[1] A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.
[2] Each exam includes an additional 30 unscored (pilot) questions.
[3] SI units are the primary (principle) units of radiation measurement used on the radiography examination.

RADIOGRAPHY
CONTENT OUTLINE

ARRT BOARD APPROVED: **JANUARY 2021**
IMPLEMENTATION DATE: **JANUARY 2022**

Patient Care

1. Patient Interactions and Management

A. Ethical and Legal Aspects
   1. patients' rights
      a. consent (*e.g., informed, oral, implied)
      b. confidentiality (HIPAA)
      c. American Hospital Association (AHA) Patient Care Partnership (Patients' Bill of Rights)
         1. privacy
         2. extent of care (e.g., DNR)
         3. access to information
         4. living will, health care proxy, advanced directives
         5. research participation
   2. legal issues
      a. verification (e.g., patient identification, compare order to clinical indication)
      b. common terminology (e.g., battery, negligence, malpractice, beneficence)
      c. legal doctrines (e.g., respondeat superior, res ipsa loquitur)
      d. restraints versus positioning aids used to eliminate motion artifact
      e. manipulation of electronic data (e.g., exposure indicator, processing algorithm, brightness and contrast, cropping or masking off anatomy)
      f. documentation (e.g., changes to order, medical event)
   3. ARRT Standards of Ethics

B. Interpersonal Communication
   1. modes of communication
      a. verbal/written
      b. nonverbal (e.g., eye contact, touching)
   2. challenges in communication
      a. interactions with others
         1. language barriers
         2. cultural and social factors
         3. physical, sensory, or cognitive impairments
         4. age
         5. emotional status, acceptance of condition (e.g., stage of grief)
      b. explanation of medical terms
      c. strategies to improve understanding
   3. patient education
      a. explanation of current procedure (e.g., purpose, length of time, radiation dose)
      b. pre- and post-examination instructions (e.g., preparation, diet, medications and discharge instructions)
      c. respond to inquiries about other imaging modalities (e.g., dose differences, types of radiation, patient preps)

C. Ergonomics and Monitoring
   1. body mechanics (e.g., balance, alignment, movement)
      a. patient transfer techniques
      b. safe patient handling devices (e.g., transfer board, Hoyer lift, gait belt)
   2. assisting patients with medical equipment
      a. infusion catheters and pumps
      b. oxygen delivery systems
      c. other (e.g., nasogastric tubes, urinary catheters, tracheostomy tubes)
   3. patient monitoring and documentation
      a. vital signs
      b. physical signs and symptoms (e.g., motor control, severity of injury)
      c. fall prevention

D. Medical Emergencies
   1. non-contrast allergic reactions (e.g., latex)
   2. cardiac/respiratory arrest (e.g., CPR, AED)
   3. physical injury or trauma
   4. other medical disorders (e.g., seizures, diabetic reactions)

*The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)

RADIOGRAPHY
CONTENT OUTLINE

ARRT BOARD APPROVED: **JANUARY 2021**
IMPLEMENTATION DATE: **JANUARY 2022**

Patient Care (continued)

E. Infection Control
   1. chain of infection (cycle of infection)
      a. pathogen
      b. reservoir
      c. portal of exit
      d. mode of transmission
         1. direct
            a. droplet
            b. direct contact
         2. indirect
            a. airborne
            b. vehicle borne (fomite)
            c. vector borne (mechanical or biological)
      e. portal of entry
      f. susceptible host
   2. asepsis
      a. equipment disinfection
      b. equipment sterilization
      c. medical aseptic technique
      d. sterile technique
   3. CDC Standard Precautions
      a. hand hygiene
      b. use of personal protective equipment (e.g., gloves, gowns, masks)
      c. safe handling of contaminated equipment/surfaces
      d. disposal of contaminated materials
         1. linens
         2. needles
         3. patient supplies
         4. blood and body fluids
      e. safe injection practices
   4. transmission-based precautions
      a. contact
      b. droplet
      c. airborne
   5. additional precautions
      a. neutropenic precautions (reverse isolation)
      b. healthcare-associated (nosocomial) infections

F. Handling and Disposal of Toxic or Hazardous Material
   1. types of materials
      a. chemicals
      b. chemotherapy
   2. safety data sheet (material safety data sheet)

G. Pharmacology
   1. patient history
      a. medication reconciliation (current medications)
      b. premedications
      c. contraindications
      d. scheduling and sequencing examinations
   2. administration
      a. routes (e.g., IV, oral)
      b. supplies (e.g., enema kits, needles)
      c. procedural technique (e.g., venipuncture)
      d. contrast media dose calculation
   3. contrast media types and properties (e.g., iodinated, water soluble, barium, ionic versus non-ionic)
   4. appropriateness of contrast media to examination
      a. patient condition (e.g., perforated bowel)
      b. patient age and weight
      c. laboratory values (e.g., BUN, creatinine, eGFR)
   5. complications/reactions
      a. local effects (e.g., extravasation/infiltration, phlebitis)
      b. systemic effects
         1. mild
         2. moderate
         3. severe
      c. emergency medications
      d. radiographer's response and documentation

RADIOGRAPHY
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Safety

1. Radiation Physics and Radiobiology

A. Principles of Radiation Physics
   1. x-ray production
      a. source of free electrons (e.g., thermionic emission)
      b. acceleration of electrons
      c. focusing of electrons
      d. deceleration of electrons
   2. target interactions
      a. bremsstrahlung
      b. characteristic
   3. x-ray beam
      a. frequency and wavelength
      b. beam characteristics
         1. quality
         2. quantity
         3. primary versus remnant (exit)
      c. inverse square law
      d. fundamental properties (e.g., travel in straight lines, ionize matter)
   4. photon interactions with matter
      a. photoelectric
      b. Compton
      c. coherent (classical)
      d. attenuation by various tissues
         1. thickness of body part
         2. type of tissue (atomic number)

B. Biological Effects of Radiation
   1. SI units of measurement (NCRP #160)
      a. absorbed dose (Gy)
      b. dose equivalent (Sv)
      c. exposure (C/kg)
      d. effective dose (Sv)
      e. air kerma (Gy)
   2. radiosensitivity
      a. dose-response relationships
      b. relative tissue radiosensitivities (e.g., LET, RBE)
      c. cell survival and recovery (LD_{50})
      d. oxygen effect
   3. somatic effects
      a. cells
      b. tissue (e.g., eye, thyroid, breast, skin, marrow, gonad)
      c. embryo and fetus
      d. carcinogenesis
      e. early versus late or acute versus chronic
      f. deterministic (tissue reactions) versus stochastic
      g. short-term versus long-term exposure
      h. acute radiation syndromes
         1. hemopoietic
         2. gastrointestinal (GI)
         3. central nervous system (CNS)

(Safety continues on the following page.)

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Safety (continued)

2. Radiation Protection

A. Minimizing Patient Exposure
   1. exposure factors
      a. kVp
      b. mAs
      c. automatic exposure control (AEC)
   2. beam restriction
      a. purpose of primary beam restriction
      b. types (e.g., collimators)
   3. patient considerations
      a. positioning
      b. communication
      c. pediatric
      d. morbid obesity
   4. filtration
      a. effect on skin and organ exposure
      b. effect on average beam energy
      c. NCRP recommendations (NCRP #102, minimum filtration in useful beam)
   5. radiographic dose documentation
   6. image receptors
   7. grids
   8. fluoroscopy
      a. pulsed
      b. exposure factors
      c. grids
      d. positioning
      e. fluoroscopy time
      f. automatic brightness control (ABC) or automatic exposure rate control (AERC)
      g. receptor positioning
      h. magnification mode
      i. air kerma display
      j. last image hold
      k. dose or time documentation
      l. minimum source-to-skin distance (21 CFR)
   9. dose area product (DAP) meter

B. Personnel Protection (ALARA)*
   1. sources of radiation exposure
      a. primary x-ray beam
      b. secondary radiation
         1. scatter
         2. leakage
      c. patient as source
   2. basic methods of protection
      a. time
      b. distance
      c. shielding
   3. protective devices
      a. types (e.g., aprons, barriers)
      b. attenuation properties
      c. minimum lead equivalent (NCRP #102)
   4. special considerations
      a. mobile units
      b. fluoroscopy
         1. protective drapes
         2. protective Bucky slot cover
         3. cumulative timer
         4. remote-controlled fluoroscopy
      c. guidelines for fluoroscopy and mobile units (NCRP #102, 21 CFR)
         1. fluoroscopy exposure rates (normal and high-level control)
         2. exposure switch guidelines
   5. radiation exposure and monitoring
      a. dosimeters
         1. types
         2. proper use
      b. NCRP recommendations for personnel monitoring (NCRP #116)
         1. occupational exposure
         2. public exposure
         3. embryo/fetus exposure
         4. dose equivalent limits
         5. evaluation and maintenance of personnel dosimetry records
   6. handling and disposal of radioactive material

* (August 24, 2016) Note: Although it is the radiographer's responsibility to apply radiation protection principles to minimize bioeffects for both patients and personnel, the ALARA concept is specific to personnel protection and is listed only for that section.

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Image Production

1. Image Acquisition and Evaluation

A. Factors Affecting Radiographic Quality
(X indicates topics covered on the examination.)

	1. Receptor Exposure	2. Spatial Resolution	3. Distortion
a. mAs	X		
b. kVp	X		
c. OID		X	X
d. SID	X	X	X
e. focal spot size		X	
f. grids*	X		
g. tube filtration	X		
h. beam restriction	X		
i. motion		X	
j. anode heel effect	X		
k. patient factors (size, pathology)	X	X	X
l. angle (tube, part, or receptor)		X	X

* Includes conversion factors for grids

B. Technique Charts
   1. anatomically programmed technique
   2. fixed versus variable kVp
   3. special considerations
      a. casts
      b. pathologic factors
      c. age (e.g., pediatric, geriatric)
      d. body mass index (BMI)
      e. contrast media
      f. grids
      g. OID

C. Automatic Exposure Control (AEC)
   1. effects of changing exposure factors on radiographic quality
   2. detector selection
   3. anatomic alignment
   4. exposure adjustment (e.g., density, +1 or –1)

D. Digital Imaging Characteristics
   1. spatial resolution
      a. pixel characteristics (e.g., size, pitch)
      b. detector element (DEL) (e.g., size, pitch, fill factor) CCD, CMOS (e.g., size, pitch)
      c. sampling frequency (CR)
      d. matrix size
      e. modulation transfer function (MTF)
   2. contrast resolution
      a. bit depth
      b. detective quantum efficiency (DQE)
      c. grids
   3. image signal
      a. dynamic range
      b. quantum noise (quantum mottle)
      c. signal to noise ratio (SNR)

E. Image Identification
   1. methods (e.g., radiographic, electronic)
   2. legal considerations (e.g., patient data, examination data)

F. Criteria for Image Evaluation
   1. exposure indicator
   2. quantum noise (quantum mottle)
   3. gross exposure error (e.g., loss of contrast, saturation)
   4. contrast
   5. spatial resolution
   6. distortion (e.g., size, shape)
   7. identification markers (e.g., anatomical side, patient, date)
   8. image artifacts
   9. radiation fog (CR)

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Image Production (continued)

2. Equipment Operation and Quality Assurance

A. Imaging Equipment
1. x-ray generator, transformers and rectification system
   a. basic principles
   b. phase, pulse and frequency
   c. tube loading
2. components of radiographic unit (fixed or mobile)
   a. operating console
   b. x-ray tube construction
      1. electron source
      2. target materials
      3. induction motor
      4. filtration
   c. automatic exposure control (AEC)
      1. radiation detectors
      2. back-up timer
      3. exposure adjustment (e.g., density, +1 or -1)
      4. minimum response time
   d. manual exposure controls
   e. image receptors
      1. computed radiography (CR)
         a. plate (e.g., photo-stimulable phosphor (PSP))
         b. plate reader
      2. digital radiography (DR)
         a. direct conversion
         b. indirect conversion
            1. amorphous silicon (a-Si)
            2. charge coupled device (CCD)
            3. complementary metal oxide semiconductor (CMOS)
   f. beam restriction
3. components of fluoroscopic unit (fixed or mobile)
   a. image receptors
      1. image intensifier
      2. flat panel
   b. viewing systems
   c. recording systems
   d. automatic brightness control (ABC) or automatic exposure rate control (AERC)
   e. magnification mode
   f. table
4. accessories
   a. stationary grids
   b. Bucky assembly
   c. compensating filters

B. Image Processing and Display
1. raw data (pre-processing)
   a. analog-to-digital converter (ADC)
   b. quantization
   c. corrections (e.g., rescaling, flat fielding, dead pixel correction)
   d. histogram
2. corrected data for processing
   a. grayscale
   b. edge enhancement
   c. equalization
   d. smoothing
3. data for display
   a. values of interest (VOI)
   b. look-up table (LUT)
4. post-processing
   a. brightness
   b. contrast
   c. region of interest (ROI)
   d. electronic cropping or masking
   e. stitching
5. display monitors
   a. viewing conditions (e.g., viewing angle, ambient lighting)
   b. spatial resolution (e.g., pixel size, pixel pitch)
   c. brightness and contrast
6. imaging informatics
   a. information systems, (e.g., HIS, RIS, EMR, EHR)
   b. networking
      1. PACS
      2. DICOM
   c. downtime procedures

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Image Production (continued)

C. Quality Control of Imaging Equipment and Accessories
   1. beam restriction
      a. light field to radiation field alignment
      b. central ray alignment
   2. recognition and reporting of malfunctions
   3. digital imaging receptor systems
      a. maintenance (e.g., detector calibration, plate reader calibration)
      b. QC tests (e.g., erasure thoroughness, plate uniformity, spatial resolution)
      c. display monitor quality assurance (e.g., grayscale standard display function, luminance)
   4. shielding accessories (e.g., testing lead apron, gloves)

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Procedures

This section addresses imaging procedures for the anatomic regions listed below. Questions will cover the following topics:

1. Positioning (e.g., topographic landmarks, body positions, path of central ray, positioning aids, respiration).
2. Anatomy (e.g., including physiology, basic pathology, related medical terminology).
3. Procedure adaptation (e.g., body habitus, body mass index, trauma, pathology, age, limited mobility).
4. Evaluation of displayed anatomical structures (e.g., patient positioning, tube-part-image receptor alignment).

The specific radiographic positions and projections within each anatomic region that may be covered on the examination are listed in *Attachment A*. A guide to positioning terminology appears in *Attachment B*.

1. Head, Spine and Pelvis Procedures

A. Head
1. skull
2. facial bones
3. mandible
4. temporomandibular joints
5. nasal bones
6. orbits
7. paranasal sinuses

B. Spine and Pelvis
1. cervical spine
2. thoracic spine
3. scoliosis series
4. lumbar spine
5. sacrum and coccyx
6. myelography
7. sacroiliac joints
8. pelvis and hip

2. Thorax and Abdomen Procedures

A. Thorax
1. chest
2. ribs
3. sternum
4. soft tissue neck
5. sternoclavicular joints

B. Abdomen and GI Studies
1. abdomen
2. esophagus
3. swallowing dysfunction study
4. upper GI series, single or double contrast
5. small bowel series
6. contrast enema, single or double contrast
7. surgical cholangiography
8. ERCP

C. GU Studies
1. cystography
2. cystourethrography
3. intravenous urography
4. retrograde urography
5. hysterosalpingography

3. Extremity Procedures

A. Upper Extremities
1. fingers
2. hand
3. wrist
4. forearm
5. elbow
6. humerus
7. shoulder
8. scapula
9. clavicle
10. acromioclavicular joints

B. Lower Extremities
1. toes
2. foot
3. calcaneus
4. ankle
5. tibia/fibula
6. knee/patella
7. femur
8. long bone measurement

C. Other
1. bone age
2. bone survey (e.g., metastatic, non-accidental trauma)
3. arthrography

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Attachment A

Radiographic Positions and Projections

1. Head, Spine and Pelvis

A. Head

1. Skull
   a. AP axial (Towne)
   b. lateral
   c. PA axial (Caldwell)
   d. PA
   e. submentovertex (full basal)
   f. trauma cross-table (horizontal beam) lateral
   g. trauma AP axial (reverse Caldwell)
   h. trauma AP
   i. trauma AP axial (Towne)
2. Facial Bones
   a. lateral
   b. parietoacanthial (Waters)
   c. PA axial (Caldwell)
   d. modified parietoacanthial (modified Waters)
3. Mandible
   a. axiolateral oblique
   b. PA
   c. AP axial (Towne)
   d. PA axial
   e. PA (modified Waters)
   f. submentovertex (full basal)
4. Temporomandibular Joints
   a. axiolateral oblique (modified Law)
   b. axiolateral (modified Schuller)
   c. AP axial (modified Towne)
5. Nasal Bones
   a. parietoacanthial (Waters)
   b. lateral
   c. PA axial (Caldwell)
6. Orbits
   a. parietoacanthial (Waters)
   b. lateral
   c. PA axial (Caldwell)
   d. modified parietoacanthial (modified Waters)
7. Paranasal Sinuses
   a. lateral, horizontal beam
   b. PA axial (Caldwell), horizontal beam
   c. parietoacanthial (Waters), horizontal beam
   d. submentovertex (full basal), horizontal beam

B. Spine and Pelvis

1. Cervical Spine
   a. AP axial
   b. AP open mouth
   c. lateral
   d. cross-table (horizontal beam) lateral
   e. PA axial obliques
   f. AP axial obliques
   g. lateral swimmers
   h. lateral flexion and extension
   i. AP dens (Fuchs)
2. Thoracic Spine
   a. AP
   b. lateral, breathing
   c. lateral, expiration
3. Scoliosis Series
   a. AP or PA
   b. lateral
4. Lumbar Spine
   a. AP
   b. PA
   c. lateral
   d. L5-S1 lateral spot
   e. posterior oblique
   f. anterior oblique
   g. AP axial L5-S1
   h. AP right and left bending
   i. lateral flexion and extension
5. Sacrum and Coccyx
   a. AP axial sacrum
   b. AP axial coccyx
   c. lateral sacrum and coccyx, combined
   d. lateral sacrum or coccyx, separate
6. Myelography
7. Sacroiliac Joints
   a. AP axial
   b. posterior oblique
   c. anterior oblique
8. Pelvis and Hip
   a. AP hip only
   b. cross-table (horizontal beam) lateral hip
   c. unilateral frog-leg, non-trauma
   d. axiolateral inferosuperior, trauma (Clements-Nakayama)
   e. AP pelvis
   f. AP pelvis, bilateral frog-leg
   g. AP pelvis, axial anterior pelvic bones (inlet, outlet)
   h. posterior oblique pelvis, acetabulum (Judet)

2. Thorax and Abdomen

A. Thorax

1. Chest
   a. PA or AP upright
   b. lateral upright
   c. AP lordotic
   d. AP supine
   e. lateral decubitus
2. Ribs
   a. AP and PA, above and below diaphragm
   b. anterior and posterior obliques
3. Sternum
   a. lateral
   b. RAO
4. Soft Tissue Neck
   a. AP upper airway
   b. lateral upper airway
5. Sternoclavicular joints
   a. PA
   b. LAO and RAO

B. Abdomen and GI Studies

1. Abdomen
   a. AP supine
   b. AP upright
   c. lateral decubitus
   d. dorsal decubitus
2. Esophagus
   a. RAO
   b. left lateral
   c. AP
   d. PA
   e. LAO
3. Swallowing Dysfunction Study
4. Upper GI series*
   a. AP or PA scout
   b. RAO
   c. PA
   d. right lateral
   e. LPO
   f. AP
5. Small Bowel Series
   a. PA scout
   b. PA (follow through)
   c. ileocecal spots
6. Contrast Enema*
   a. left lateral rectum
   b. left lateral decubitus
   c. right lateral decubitus
   d. LPO and RPO
   e. PA
   f. RAO and LAO
   g. AP axial (sigmoid)
   h. PA axial (sigmoid)
   i. PA or AP post-evacuation
7. Surgical Cholangiography
8. ERCP

*single or double contrast

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C. GU Studies
1. Cystography
   a. AP
   b. LPO and RPO
   c. lateral
   d. AP axial
2. Cystourethrography
   a. AP voiding cystourethrogram female
   b. RPO voiding cystourethrogram male
3. Intravenous Urography
   a. AP, scout, and series
   b. RPO and LPO
   c. post-void
4. Retrograde Urography
   a. AP scout
   b. AP pyelogram
   c. AP ureterogram
5. Hysterosalpingography

3. Extremities

A. Upper Extremities
I. Fingers
   a. PA entire hand
   b. PA finger only
   c. lateral
   d. medial and/or lateral oblique
   e. AP thumb
   f. medial oblique thumb
   g. lateral thumb
2. Hand
   a. PA
   b. lateral
   c. lateral oblique
3. Wrist
   a. PA
   b. lateral oblique
   c. lateral
   d. PA–ulnar deviation
   e. PA axial (Stecher)
   f. tangential carpal canal (Gaynor-Hart)
4. Forearm
   a. AP
   b. lateral
5. Elbow
   a. AP
   b. lateral
   c. lateral oblique
   d. medial oblique
   e. AP partial flexion
   f. trauma axial laterals (Coyle)
6. Humerus
   a. AP
   b. lateral
   c. neutral
   d. transthoracic lateral
7. Shoulder
   a. AP internal and external rotation
   b. inferosuperior axial (Lawrence)
   c. posterior oblique (Grashey)
   d. AP neutral
   e. PA oblique (scapular Y)
   f. supraspinatus outlet (Neer)
8. Scapula
   a. AP
   b. lateral
9. Clavicle
   a. AP or PA
   b. AP axial
   c. PA axial
10. Acromioclavicular Joints – AP bilateral with and without weights

B. Lower Extremities
1. Toes
   a. AP, entire forefoot
   b. AP or AP axial toe
   c. oblique toe
   d. lateral toe
   e. sesamoids, tangential
2. Foot
   a. AP axial
   b. medial oblique
   c. lateral oblique
   d. lateral
   e. AP axial weight bearing
   f. lateral weight bearing
3. Calcaneus
   a. lateral
   b. plantodorsal, axial
   c. dorsoplantar, axial
4. Ankle
   a. AP
   b. mortise
   c. lateral
   d. medial oblique
   e. AP stress
   f. AP weight bearing
   g. lateral weight bearing
5. Tibia/Fibula
   a. AP
   b. lateral
6. Knee/patella
   a. AP
   b. lateral
   c. AP weight bearing
   d. lateral oblique
   e. medial oblique
   f. PA axial–intercondylar fossa (Holmblad)
   g. PA axial–intercondylar fossa (Camp Coventry)
   h. AP axial–intercondylar fossa (Béclère)
   i. PA patella
   j. tangential (Merchant)
   k. tangential (Settegast)
7. Femur
   a. AP
   b. lateral
8. Long Bone Measurement

C. Other
1. Bone Age
2. Bone Survey
3. Arthrography

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Attachment B

Standard Terminology for Positioning and Projection

Radiographic View: Describes the body part as seen by the image receptor. Restricted to the discussion of a *radiograph* or *image*.

Radiographic Position: Refers to a specific body position, such as supine, prone, recumbent, erect or Trendelenburg. Restricted to the discussion of the *patient's physical position*.

Radiographic Projection: Restricted to the discussion of the *path of the central ray*.

POSITIONING TERMINOLOGY

A. Lying Down

1. *supine* – lying on the back
2. *prone* – lying face downward
3. *decubitus* – lying down with a horizontal x-ray beam
4. *recumbent* – lying down in any position

B. Erect or Upright

1. *anterior position* – facing the image receptor
2. *posterior position* – facing the radiographic tube

C. Either Upright or Recumbent

1. oblique torso positions
   a. anterior oblique (facing the image receptor)
      i. *left anterior oblique (LAO)* — body rotated with the left anterior portion closest to the image receptor
      ii. *right anterior oblique (RAO)* — body rotated with the right anterior portion closest to the image receptor
   b. posterior oblique (facing the radiographic tube)
      i. *left posterior oblique (LPO)* — body rotated with the left posterior portion closest to the image receptor
      ii. *right posterior oblique (RPO)* — body rotated with the right posterior portion closest to the image receptor
2. oblique extremity positions
   a. lateral (external) rotation — from either prone or supine, outward rotation of the extremity
   b. medial (internal) rotation — from either prone or supine, inward rotation of the extremity

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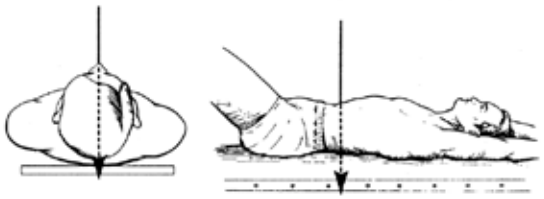
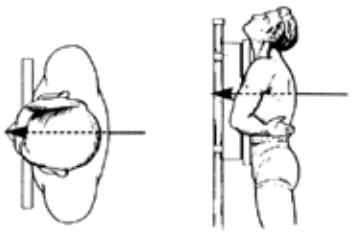
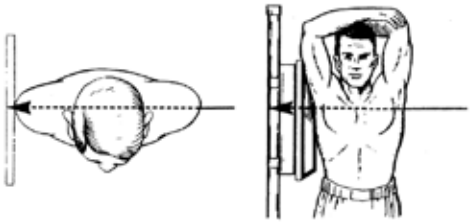
Anteroposterior Projection



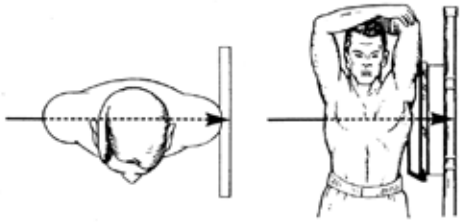
Posteroanterior Projection



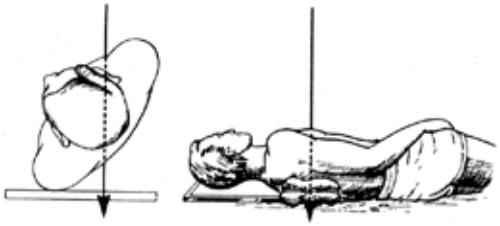
Right Lateral Position



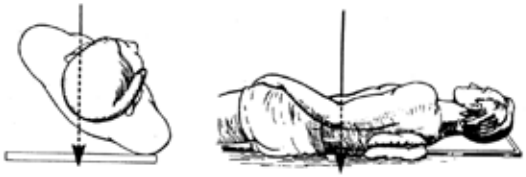
Left Lateral Position



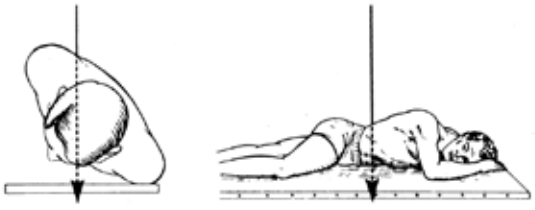
Left Posterior Oblique Position



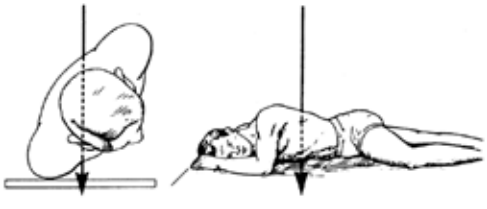
Right Posterior Oblique Position



Left Anterior Oblique Position



Right Anterior Oblique Position



EXAMINATION CONTENT SPECIFICATIONS

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Radiation Therapy

The purpose of the *radiation therapy exam* is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of the staff technologist at entry into the profession. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of radiation therapists.[1] An advisory committee then determined the knowledge and cognitive skills needed to perform the tasks on the task inventory and these are organized into the content categories within this document. Every content category can be linked to one or more tasks on the task inventory. The document is used to develop the examination. The *Task Inventory for Radiation Therapy* may be found on the ARRT's website (www.arrt.org**)**.

The ARRT avoids content when there are multiple resources with conflicting perspectives. Educational programs accredited by a mechanism acceptable to ARRT offer education and experience beyond the minimum requirements specified in the content specifications and clinical competency documents.

This document is not intended to serve as a curriculum guide. Although ARRT programs for certification and registration and educational programs may have related purposes, their functions are clearly different. Educational programs are generally broader in scope and address the subject matter that is included in these content specifications, but do not limit themselves to only this content.

The table below presents the major content categories and subcategories covered on the examination. The number of test questions in each category are listed in bold and number of test questions in each subcategory in parentheses. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	**Number of Scored Questions[2]**
Patient Care	**46**
Patient Interactions and Management (29)	
Patient and Medical Record Management (17)	
Safety	**51**
Radiation Physics and Radiobiology (21)	
Radiation Protection[3], Equipment Operation, and Quality Assurance (30)	
Procedures	**103**
Treatment Sites and Tumors (26)	
Treatment Volume Localization (18)	
Prescription and Dose Calculation (24)	
Treatments (35)	
Total	**200**

[1] A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.
[2] The exam includes an additional 30 unscored (pilot) questions.
[3] SI units are the primary (principal) units of radiation measurement used on the radiation therapy examination.

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

ARRT BOARD APPROVED: **JANUARY 2021**
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Patient Care

1. Patient Interactions and Management

A. Ethical and Legal Aspects
   1. patients' rights
      a. consent (*e.g., informed, oral, implied)
      b. confidentiality (HIPAA)
      c. American Hospital Association (AHA) Patient Care Partnership (Patients' Bill of Rights)
         1. privacy
         2. extent of care (e.g., DNR)
         3. access to information
         4. living will, health care proxy, advanced directives
         5. research participation
         6. goal of care (e.g., definitive, palliative)
   2. legal issues
      a. verification (e.g., patient identification, treatment site, prescription)
      b. common terminology (e.g., battery, negligence, malpractice, beneficence)
      c. legal doctrines (e.g., respondeat superior, res ipsa loquitur)
      d. restraints versus immobilization (e.g., positioning aids used to prevent motion)
   3. ARRT Standards of Ethics

B. Interpersonal Communication
   1. modes of communication
      a. verbal/written
      b. nonverbal (e.g., eye contact, touching)
   2. challenges in communication
      a. interactions with others
         1. language barriers
         2. cultural and social factors
         3. physical, sensory, or cognitive impairments
         4. age
         5. emotional status, acceptance of condition (e.g., stage of grief)
      b. explanation of medical terms
      c. strategies to improve understanding
   3. patient education
      a. explanation of treatment or procedure (e.g., purpose, length of time, radiation dose)
      b. pre- and post-treatment or procedure instructions (e.g., preparation, diet, and medications)
      c. respond to inquiries about other imaging modalities (e.g., dose differences, types of radiation, patient preparation)
      d. treatment compliance (e.g., positioning, skin marks)
   4. support services
      a. hospice
      b. other professionals (e.g., dietitian, clergy, social services)

C. Ergonomics and Monitoring
   1. body mechanics (e.g., balance, alignment, movement)
      a. patient transfer techniques
      b. ergonomic devices (e.g., transfer board, Hoyer lift, gait belt)
   2. assisting patients with medical equipment
      a. infusion catheters and pumps
      b. oxygen delivery systems
      c. other (e.g., nasogastric tubes, urinary catheters, tracheostomy tubes)
   3. patient monitoring and documentation
      a. vital signs
      b. signs and symptoms (e.g., motor control, cognitive changes)
      c. fall prevention
      d. weight

D. Medical Emergencies
   1. non-contrast allergic reactions (e.g., latex)
   2. cardiac/respiratory arrest (e.g., CPR, AED)
   3. physical injury or trauma
   4. other medical disorders (e.g., seizures, diabetic reactions)

*The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

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Patient Care (continued)

E. Infection Control
   1. chain of infection (cycle of infection)
      a. pathogen
      b. reservoir
      c. portal of exit
      d. mode of transmission
         1. direct
            a. droplet
            b. direct contact
         2. indirect
            a. airborne
            b. vehicle borne (fomite)
            c. vector borne (mechanical or biological)
      e. portal of entry
      f. susceptible host
   2. asepsis
      a. equipment disinfection
      b. equipment sterilization
      c. medical aseptic technique
      d. sterile technique
   3. CDC Standard Precautions
      a. hand hygiene
      b. use of personal protective equipment (e.g., gloves, gowns, masks)
      c. safe handling of contaminated equipment/surfaces
      d. disposal of contaminated materials
         1. linens
         2. needles
         3. patient supplies
         4. blood and body fluids
      e. safe needle practices
   4. transmission-based precautions
      a. contact
      b. droplet
      c. airborne
   5. additional precautions
      a. neutropenic precautions (reverse isolation)
      b. healthcare-associated (nosocomial) infections

F. Handling and Disposal of Toxic or Hazardous Material
   1. types of materials
      a. chemicals
      b. chemotherapy
      c. metals (e.g., block alloy)
   2. safety data sheet (e.g., material safety data sheet)

G. Pharmacology
   1. contrast media types and properties (e.g., iodinated, water soluble, barium, ionic versus non-ionic)
   2. appropriateness of contrast media to procedure
      a. patient condition
      b. patient age and weight
      c. laboratory values (e.g., BUN, creatinine, eGFR)
   3. complications/reactions
      a. local effects (e.g., extravasation/infiltration, phlebitis)
      b. systemic effects
         1. mild
         2. moderate
         3. severe
      c. emergency medications
      d. radiation therapist's response and documentation

(Patient Care continues on the following page.)

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

ARRT BOARD APPROVED: **JANUARY 2021**
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Patient Care (continued)

2. Patient and Medical Record Management

A. Evaluation
   1. epidemiology and etiology
      a. cancer risk factors
      b. prevalence and incidence
   2. cancer screening
   3. signs and symptoms
   4. history and physical examination
   5. imaging studies (e.g., CT, MRI, PET/CT)
   6. other diagnostic studies
      a. lab results
      b. surgical reports
      c. pathology reports

B. Assessment
   1. treatment side effects
      a. signs and symptoms
      b. causes
      c. management
   2. blood studies
      a. types of studies (e.g., CBC, BUN, PSA)
      b. factors affecting blood values
   3. dietary counseling
      a. common problems
      b. causes
      c. dietary management

C. Documentation
   1. information included in treatment record
      a. prescription
      b. monitor units
      c. target dose (daily and accumulated)
      d. energy and type of radiation
      e. date
      f. time of day for b.i.d. treatment
      g. fraction
      h. elapsed days
      i. field number and description
      j. doses to other regions of interest
      k. set-up instructions
      l. imaging orders
   2. elements of record keeping
      a. patient identification
      b. accountability (e.g., signatures)
      c. accuracy and legibility
      d. variance from prescription (errors, prescription changes)
      e. medical events (definition and required documentation)
   3. basic charge capture terminology [1]
      a. professional and technical components
      b. general principles and purpose (e.g., billable services, procedures, and devices)

[1] Specific CPT® codes are not covered.

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

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Safety

1. Radiation Physics and Radiobiology

A. Sources of Radiation
   1. radioactive material
   2. machine-produced radiation
      a. target interactions (i.e., bremsstrahlung, characteristic)
      b. particles (e.g., protons)

B. Principles of Radiation Physics
   1. wave characteristics
   2. attenuation
   3. inverse-square law
   4. x-ray beam quality
   5. interactions with matter
      a. photon interactions (e.g., Compton, photoelectric effect, pair production)
      b. electron interactions
      c. particle interactions (e.g., proton, neutron)
      d. attenuation by various tissues

C. Biological Effects of Radiation
   1. Units of measurement (NCRP #160)
      a. absorbed dose (Gy)
      b. dose equivalent (Sv, rem)
      c. exposure (C/kg)
      d. effective dose (Sv, rem)
      e. air kerma (Gy)
   2. radiosensitivity
      a. dose-response relationships
      b. relative tissue radiosensitivities (e.g., LET, RBE)
      c. oxygen effect
   3. somatic effects
      a. cells
      b. tissue (e.g., hemopoietic, skin, reproductive organs)
      c. embryo and fetus
      d. carcinogenesis
      e. early versus late or acute versus chronic
      f. deterministic versus stochastic
      g. short-term versus long-term exposure
      h. acute radiation syndromes
         1. hemopoietic
         2. gastrointestinal (GI)
         3. central nervous system (CNS)
   4. genetic effects (e.g., genetically significant dose)

D. Radiation Tissue Tolerance
   1. tolerance levels (i.e., whole organ $TD_{5/5}$)
   2. adverse effects
   3. dose to critical structures
   4. radiobiological factors (e.g., dose, fractionation schemes, volume)
   5. biological factors (e.g., age, anatomic variation, medical conditions)
   6. medical factors (e.g., prior surgery, pacemakers)
   7. other factors (e.g., radiosensitizers, radioprotectors)
   8. contribution from other sources
      a. chemotherapy
      b. brachytherapy [2]
      c. other fields (e.g., prior or abutting)
      d. radiation effect modifiers
      e. daily imaging
      f. CT simulation

[2] Only basic concepts related to common uses of brachytherapy are covered, including dose to surrounding tissue and radiation protection issues. Specific procedures and isotope characteristics are not covered.

(Safety continues on the following page.)

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RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

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Safety (continued)

2. Radiation Protection, Equipment Operation, and Quality Assurance

A. Minimizing Patient Exposure
   1. exposure factors
      a. kVp
      b. mAs
   2. shielding
      a. rationale for use
      b. types
      c. placement
   3. collimation/beam width
   4. patient considerations
      a. positioning
      b. communication
      c. pediatric
      d. morbid obesity

B. Personnel Protection (ALARA)
   1. sources of radiation exposure
   2. basic methods of protection (i.e., time, distance, shielding)
   3. personnel monitoring (NCRP recommendations for personnel monitoring, Report #116)
      a. occupational exposure
      b. public exposure
      c. embryo/fetus exposure
      d. dose equivalent limits
      e. evaluation and maintenance of personnel dosimetry records

C. Facilities and Area Monitoring
   1. NRC regulations (10 CFR, parts 20 and 35)
      a. classification of areas (restricted, controlled, unrestricted)
      b. required postings (signs)
      c. area monitoring devices
   2. barrier requirements
      a. primary
      b. secondary

D. MRI Magnetic Field Screening
   1. biomedical implants
   2. ferrous foreign bodies
   3. medical conditions (e.g., pregnancy)
   4. prior diagnostic or surgical procedures
   5. topical or externally applied items (e.g., tattoos, medication patches, body piercing jewelry, monitoring devices, clothing)
   6. ancillary equipment (e.g., oxygen tank, IV pole)

E. Handling and Disposal of Radioactive Materials

F. Components and Operation
   1. linear accelerator
   2. CT simulator

G. Instrumentation
   1. ionization chamber
   2. Geiger-Müller detector
   3. TLD/OSL (optically stimulated luminescence)
   4. diodes
   5. neutron detectors

(Safety continues on the following page.)

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

ARRT BOARD APPROVED: **JANUARY 2021**
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Safety (continued)

H. Quality Control Procedures
   1. warm-up and inspection of linear accelerators
      a. interlock systems
      b. safety lights
      c. emergency switches
      d. laser alignment
      e. critical machine parameters (e.g., pressure, temperature)
      f. electrical and mechanical hazards
      g. imaging systems
      h. audio/visual systems
   2. warm-up and inspection of CT simulators
      a. safety lights
      b. emergency switches
      c. laser alignment
      d. QC water phantom (e.g., CT number, noise)
      e. tube warm-up
   3. radiation output verification
      a. methods
      b. frequency
      c. effect of environment (e.g., humidity) on measurements
   4. light and treatment field checks
      a. light and radiation field agreement
      b. collimator indicator agreement
      c. multileaf collimator performance
      d. sidelight/laser accuracy check (isocenter)
   5. rotation check
      a. safety procedures
      b. operation of gantry/console
   6. evaluation of quality assurance results
      a. interpretation
      b. course of action
      c. documentation

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

ARRT BOARD APPROVED: **JANUARY 2021**
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Procedures

1. Treatment Sites and Tumors

A. Anatomy, Pathophysiology, Lymphatic Drainage, and Metastatic Patterns
   1. brain and spinal cord
   2. head and neck (including thyroid and salivary glands)
   3. breast
   4. lung
   5. abdomen, pelvis, GI, and GU
      a. esophagus, stomach, small bowel, large bowel, rectum, and anus
      b. pancreas, adrenals, liver, and gallbladder
      c. ureters, kidneys, bladder, and urethra
   6. reproductive
      a. prostate, testes, penis
      b. endometrium, cervix, ovaries, uterus, vagina, and vulva
   7. skeletal
   8. miscellaneous
      a. lymphoma (Hodgkin and non-Hodgkin)
      b. sarcomas (bone and soft tissue)
      c. multiple myeloma
      d. skin
      e. leukemia
      f. mycosis fungoides
      g. bone marrow transplant
      h. benign (e.g., heterotopic bone, keloid, AVM, meningioma)
      i. oncologic emergencies (e.g., whole brain, SVC, cord compression)

B. Tumor Classification
   1. histopathologic types (e.g., benign, sarcomas, carcinomas)
   2. histopathologic grade
      a. purpose (differentiation and growth rate)
      b. grading system (e.g., GX, G1-G4)
   3. staging (basic concepts; not specific sites)
      a. purpose
      b. systems (e.g., TNM, Ann Arbor)

2. Treatment Volume Localization

A. Treatment Techniques and Anatomic Relationships
   1. radiation therapy techniques
   2. sectional and topographic anatomy
   3. critical organs
   4. patient positioning and immobilization
   5. types and uses of contrast media

B. CT Simulation
   1. CT image acquisition (e.g., mA, slice thickness)
   2. CT image processing and display (e.g., reconstruction, window level, field of view, CT number)
   3. contour volume and isocenter determination
   4. image transmission, storage, and retrieval
   5. programmable lasers

C. Documentation and Verification of Simulation Procedure
   1. implement according to physician order
   2. anatomic position
   3. equipment orientation
   4. accessory equipment
   5. field parameters
   6. set-up instructions
   7. set-up photographs
   8. temporary and/or permanent reference marks

(Procedures continues on the following page.)

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

ARRT BOARD APPROVED: **JANUARY 2021**
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Procedures (continued)

3. Prescription and Dose Calculation

A. Treatment Prescription
   1. total target dose
   2. fractionation schedules
   3. beam energy
   4. types of radiation
   5. treatment volume (e.g., GTV, CTV, PTV)
   6. number of fields
   7. fixed/rotational fields
   8. field weighting
   9. field orientation
   10. treatment unit capabilities and limitations
   11. plan modifications
   12. beam modifiers

B. Geometric Parameters and Patient Measurements
   1. field size and shape
   2. target depth
   3. patient thickness
   4. SSD (TSD) and SAD (TAD)
   5. collimator setting
   6. abutting fields (e.g., gap calculations)
   7. fusion with outside diagnostic studies

C. Dose Calculation and Verification
   1. selection of energy
   2. equivalent square (open and blocked field)
   3. scatter factors (e.g., collimator, phantom)
   4. depth of maximum equilibrium (d_{max})
   5. percentage depth dose
   6. TAR, TMR
   7. SSD (TSD), SAD (TAD)
   8. inverse square
   9. extended distance factors
   10. wedges (e.g., wedge angle or factor)
   11. off-axis calculation
   12. isodose curve characteristics (e.g., penumbra, DVH)
   13. factors for beam modifiers (e.g., tray factor, bolus, compensator)
   14. inhomogeneity correction factors
   15. machine output data
   16. verification and documentation

4. Treatments

A. Treatment Options (indications, benefits, risks)
   1. chemotherapy
   2. surgery
   3. radiation therapy
      a. external beam (e.g., photon, electron)
      b. brachytherapy [2]
   4. multimodality treatment

B. Verification and Application of the Treatment Plan
   1. patient position
   2. isocenter location and shifts
   3. treatment parameters (e.g., beam orientation, energy)
   4. prescription
   5. techniques
      a. 2D
      b. 3D
      c. non-volumetric arc therapy
      d. 4D (e.g., respiratory gating)
      e. IMRT
      f. volumetric arc therapy
      g. stereotactic
   6. imaging procedures
      a. kV imaging
      b. cone beam CT (CBCT)
      c. MV imaging

[2] Only basic concepts related to common uses of brachytherapy are covered, including dose to surrounding tissue and radiation protection issues. Specific procedures and isotope characteristics are not covered.

(Procedures continues on the following page.)

RADIATION THERAPY EXAMINATION
CONTENT OUTLINE

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Procedures (continued)

C. Treatment Machine Set-Up
   1. auxiliary set-up devices
      a. couch indexing
      b. positioning aids
      c. alignment lasers
      d. motion management
         1. surface guided radiation therapy (SGRT)
         2. gating systems
         3. abdominal compression
   2. machine operations
      a. collimator or cone settings
      b. optical or mechanical distance indicator
      c. gantry angle
      d. collimator angle
      e. field light
      f. treatment couch
      g. six degrees of freedom couch
      h. console controls
      i. pendant controls
   3. parameters
      a. SSD (TSD), SAD (TAD), depth
      b. gantry, collimator, and field size settings
      c. beam energy and type

D. Treatment Accessories
   1. beam modifiers
      a. compensating filters
      b. shielding
      c. blocks (e.g., thickness, half value layer (HVL), half-value thickness (HVT))
      d. multileaf collimation
      e. bolus
      f. wedges (enhanced dynamic wedge, physical wedge)
   2. immobilization devices
      a. custom
      b. standard

E. Treatment Administration
   1. patient monitoring
      a. visual
      b. audio
      c. back-up systems
      d. monitoring regulations
      e. emergency situations
   2. record and verify systems
   3. image acquisition and registration
   4. site verification
   5. dose verification (e.g., diodes)
   6. equipment malfunctions
      a. types (e.g., radiation, electrical, mechanical, software)
      b. troubleshooting and correction
      c. documentation and reporting

EXAMINATION CONTENT SPECIFICATIONS

ARRT® BOARD APPROVED: **JULY 2019**
IMPLEMENTATION DATE: **JULY 1, 2020**

Mammography

The purpose of the mammography examination is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of mammographers at entry into the profession. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of mammographers.[1] The *Task Inventory for Mammography* may be found on the ARRT's website (www.arrt.org).

The *Examination Content Specifications for Mammography* identifies the knowledge areas underlying performance of the tasks on the *Task Inventory for Mammography.* Every content category can be linked to one or more tasks on the task inventory.

The table below presents the major content categories and subcategories covered on the examination. The number of test questions in each category are listed in bold and number of test questions in each subcategory in parentheses. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	**Number of Scored Questions[2]**
Patient Care	**14**
Patient Interactions and Management (14)	
Image Production	**33**
Image Acquisition and Quality Assurance (33)	
Procedures	**68**
Anatomy, Physiology, and Pathology (26)	
Mammographic Positioning, Special Needs, and Imaging Procedures (42)	
Total	**115**

1. A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.

2. The exam includes an additional 25 unscored (pilot) questions.

MAMMOGRAPHY
CONTENT OUTLINE

ARRT® BOARD APPROVED: **JULY 2019**
IMPLEMENTATION DATE: **JULY 1, 2020**

Patient Care

1. Patient Interactions and Management

A. Patient Communication
   1. pre-exam instructions (*e.g., removal of deodorant, clothing)
   2. explanation of mammographic procedure
      a. establish patient rapport
      b. psychological and emotional support
      c. address physical and mental limitations
   3. patient education
      a. guidelines for mammography screening (ACS, ACR)
      b. breast self-examination (BSE)
      c. clinical breast examination (CBE)
      d. typical patient dose

B. Patient Assessment (risks for breast cancer; implication for imaging)
   1. epidemiology of breast cancer
      a. incidence
      b. risk factors
         1. female gender
         2. advancing age
         3. personal history of breast cancer
         4. personal history of other cancers
         5. family history of breast cancer
         6. genetic predisposition
         7. race
         8. abnormal breast biopsy
         9. early menarche
         10. late menopause
         11. nulliparity
         12. late age at primiparity
         13. previous breast radiation
         14. obesity
         15. hormone replacement therapy (HRT)
         16. breast tissue density (tissue composition)
   2. signs and symptoms
      a. pain
      b. lump
      c. thickening
      d. nipple discharge
      e. skin changes
      f. nipple and areolar changes
      g. edema
      h. erythema
      i. dimpling
   3. documentation of medical history and clinical findings
   4. previous mammograms
      a. review prior to exam
      b. importance of having prior images available

C. Breast Cancer Treatment Options[1]
   1. surgical options
      a. lumpectomy/breast-conserving surgery
      b. sentinel/axillary node dissection
      c. simple (total) mastectomy
      d. modified radical mastectomy
      e. prophylactic mastectomy
   2. nonsurgical options
      a. radiation therapy
      b. chemotherapy
      c. hormone therapy (antiestrogen therapy)
         1. hormone receptor status (ER+/-)
         2. hormone receptor status (PR+/-)
         3. anti-HER2/neu therapy
   3. reconstruction
      a. implant
      b. TRAM flap
      c. latissimus dorsi flap

* The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

[1] The mammographer is expected to understand the definitions and basic descriptions of these terms.

MAMMOGRAPHY
CONTENT OUTLINE

ARRT® BOARD APPROVED: **JULY 2019**
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Image Production

1. Image Acquisition and Quality Assurance

A. Design Characteristics of Mammography Units
   1. kVp range
   2. mammography tube (e.g., anode, filtration, window, focal spot)
   3. compression paddles
   4. grids
   5. system geometry (e.g., SID, OID, magnification)

B. Digital Acquisition, Display and Informatics
   1. acquisition type
      a. full field digital mammography-direct radiography (FFDM-DR/2D)
      b. digital breast tomosynthesis (DBT/3D)
   2. image receptors
   3. monitors
      a. acquisition workstation
      b. radiologist interpretation workstation
   4. digital image display and informatics
      a. workflow (e.g., appropriate documentation, matching images, merging patient data)
      b. PACS
         1. storage and retrieval of data
         2. backup and archive
   5. computer-aided detection (CAD)

C. Quality Assurance and Evaluation
   1. accreditation and certification
      a. agencies (ACR, FDA)
      b. purpose
      c. process
      d. frequency
   2. MQSA regulations
      a. personnel requirements
      b. record keeping (e.g., assessment categories, image ID and labeling, maintenance of images and reports, communication of results to providers and patient)
      c. medical outcomes audit
      d. required policies (e.g., infection control, consumer complaint)
      e. Enhancing Quality Using the Inspection Program (EQUIP)
         1. quality assurance (clinical image corrective action)
         2. clinical image quality
         3. quality control oversight

(Image Production continues on the following page.)

MAMMOGRAPHY
CONTENT OUTLINE

ARRT® BOARD APPROVED: **JULY 2019**
IMPLEMENTATION DATE: **JULY 1, 2020**

Image Production (continued)

D. Quality Control[2]
   1. mammographer tests
      a. phantom image
         1. quality
         2. artifact
      b. compression thickness
      c. visual checklist
      d. acquisition and radiologist workstation monitors
         1. monitor cleanliness
         2. monitor calibration and test pattern (e.g., SMPTE, TG18)
      e. repeat analysis
      f. viewing conditions
      g. compression force
      h. manufacturer detector calibration

FOCUS OF QUESTIONS

- Purpose
- Frequency
- Equipment and Procedure
- Performance Criteria
- Corrective Action

   2. medical physicist tests
      a. mammographic equipment evaluation
      b. collimation assessment
      c. system resolution tests
         1. spatial resolution
         2. modulation transfer function (MTF)
      d. low contrast performance tests
         1. signal-to-noise (SNR)
         2. contrast-to-noise (CNR)
      e. automatic exposure control system performance
      f. artifact evaluation
      g. phantom image quality evaluation
      h. kVp accuracy and reproducibility
      i. beam quality assessment (half-value layer)
      j. average glandular dose
      k. room illuminance
      l. evaluation of technologist's quality control program
      m. application of compression
      n. compression paddle alignment
      o. acquisition and radiologist interpretation workstation QC

FOCUS OF QUESTIONS

- Purpose
- Frequency

[2] The Quality Control (QC) tests for the mammographer and the medical physicist tests listed are referenced in the 2018 ACR Digital Mammography Quality Control Manual. The mammographer is expected to have a detailed understanding of all the mammographer QC tests and a basic understanding of the medical physicist QC tests.

(Image Production continues on the following page.)

MAMMOGRAPHY
CONTENT OUTLINE

ARRT® BOARD APPROVED: **JULY 2019**
IMPLEMENTATION DATE: **JULY 1, 2020**

Image Production (continued)

E. Mammographic Technique and Image Evaluation

1. technical factors
   a. kVp
   b mAs
   c. automatic exposure
   d. manual exposure
   e. compression thickness
   f. target/filter
   g. focal spot
   h. grids
   i. magnification
   j. labeling

2. evaluation of image quality
   a. positioning
   b. compression
   c. exposure
   d. contrast
   e. sharpness
   f. noise
   g. artifacts
   h. collimation
   i. motion

5

MAMMOGRAPHY
CONTENT OUTLINE

ARRT® BOARD APPROVED: **JULY 2019**
IMPLEMENTATION DATE: **JULY 1, 2020**

Procedures

1. Anatomy, Physiology, and Pathology

A. Localization Terminology
   1. clock position
   2. quadrants
   3. triangulation

B. External Anatomy
   1. breast margins
   2. nipple
   3. areola
      a. Morgagni tubercles
      b. Montgomery glands
   4. angle of pectoral muscle
   5. skin
      a. sebaceous glands
      b. sweat glands
      c. hair follicles
   6. axillary tail
   7. inframammary fold

C. Internal Anatomy
   1. fascial layers
   2. retromammary space
   3. fibrous tissues
   4. glandular tissues
      a. lobules
      b. terminal ductal lobular unit (TDLU)
         1. extralobular terminal duct
         2. intralobular terminal duct
         3. acinus (ductal sinus)
   5. adipose tissues
   6. Cooper ligaments
   7. pectoral muscle
   8. vascular system
   9. lymphatic system

D. Cytology
   1. epithelial cells
   2. myoepithelial cells
   3. basement membrane

E. Pathology
   1. mammographic appearance and reporting terminology (BI-RADS®)
      a. architectural distortion (e.g., asymmetry, focal asymmetry)
      b. characteristics of masses
         1. shape (e.g., round, irregular)
         2. margin (e.g., circumscribed, indistinct, spiculated)
         3. density
      c. characteristics of calcifications
         1. typically benign (e.g., skin, vascular, coarse, milk of calcium, dystrophic)
         2. suspicious morphology (e.g., amorphous, heterogenous, fine pleomorphic)
         3. distribution (e.g., diffuse, grouped, linear)
      d. BI-RADS® categories
         1. mammographic assessment
         2. breast composition (e.g., entirely fatty, heterogenously dense)
      e. recommendations
   2. benign pathology and mammographic appearance
      a. cyst
      b. galactocele
      c. fibroadenoma
      d. lipoma
      e. hamartoma
      f. papilloma
      g. ductal ectasia
      h. hematoma
      i. abscess and inflammation
      j. fat necrosis
      k. lymph nodes
      l. gynecomastia
      m. radial scar
   3. high risk pathology and mammographic appearance
      a. lobular carcinoma in situ (LCIS)
      b. atypical ductal hyperplasia (ADH)
      c. atypical lobular hyperplasia (ALH)
      d. papilloma with atypia
   4. malignant pathology and mammographic appearance
      a. ductal carcinoma in situ (DCIS)
      b. invasive/infiltrating ductal carcinoma (IDC)
      c. invasive lobular carcinoma
      d. inflammatory carcinoma
      e. Paget disease of the breast
      f. sarcoma
      g. lymphoma

(Procedures continues on the following page.)

MAMMOGRAPHY
CONTENT OUTLINE

ARRT® BOARD APPROVED: **JULY 2019**
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Procedures (continued)

2. Mammographic Positioning[3], Special Needs, and Imaging Procedures

A. Views
1. craniocaudal (CC)
2. mediolateral oblique (MLO)
3. mediolateral (ML)
4. lateromedial (LM)
5. exaggerated craniocaudal (XCCL, XCCM)
6. cleavage (CV)
7. axillary tail (AT)
8. tangential (TAN)
9. rolled (RL, RM, RS, RI)
10. implant displaced (ID)
11. nipple in profile
12. anterior compression
13. spot compression
14. magnification

B. Special Patient Situations
1. chest wall variations (e.g., pectus excavatum, pectus carinatum)
2. irradiated breast
3. reduction mammoplasty
4. postsurgical breast
5. male patients
6. kyphotic/lordotic patients
7. protruding abdomen
8. implanted devices (e.g., pacemaker, port)
9. breast augmentation
10. lactating breast
11. extremely large/small breast

C. Imaging Examinations
1. mammography
   a. screening
      1. 2D
      2. digital breast tomosynthesis (DBT/3D)
   b. diagnostic
2. breast ultrasound
3. breast MRI[4]
4. sentinel node mapping [4]

D. Interventional Procedures[4]
1. informed consent
2. procedures and associated imaging
   a. biopsy with clip placement
      1. ultrasound core biopsy
      2. stereotactic core biopsy
   b. cyst aspiration
   c. fine needle aspiration biopsy
   d. needle localization
   e. interventional imaging
      1. specimen (e.g., stereotactic, surgical)
      2. localization
      3. clip
3. handling and disposing of biohazardous materials
   a. biopsy specimens
   b. cyst aspirate

[3] The mammographer is expected to know positioning as presented in the ACR *Mammography Quality Control Manual-Clinical Image Quality* (1999). Approximately six items in this section will cover the standard views (CC and MLO).

[4] The mammographer is expected to have the basic knowledge of these examinations and procedures.

EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Limited Scope of Practice in Radiography

The purpose of the *Limited Scope of Practice in Radiography Examination*, which is developed and administered by *The American Registry of Radiologic Technologists (ARRT)* on behalf of state licensing agencies, is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of operators of radiographic equipment used to radiograph selected anatomic regions (chest, extremities, etc.). ARRT administers the examination to state approved candidates under contractual arrangement with the state and provides the results directly to the state. This examination is not associated with any type of certification and registration by the ARRT.

The knowledge and skills covered by the examination were determined by administering a comprehensive practice analysis survey to a nationwide sample of radiographers and adopting a subset of the tasks developed for the radiography task inventory as the limited scope task inventory. The task inventory appears in *Attachment D* of this document. The content specifications for the limited scope examination identify the knowledge areas underlying performance of the tasks on the limited scope task inventory. Every content category can be linked to one or more activities on the task inventory.

It is the philosophy of the ARRT that an individual licensed in limited scope radiography possess the same knowledge and cognitive skill, in his or her specific area of radiography, as radiographers. The modules covered by the examination are outlined below. Subsequent pages describe in detail the topics covered within each module. All candidates take the CORE module of the examination and one or more PROCEDURE modules, depending on the type of license for which they have applied.

Core Module	**Number of Scored Questions[1]**	**Testing Time**
Patient Care	18	
Patient Interactions and Management (18)		
Safety[2]	40	
Radiation Physics and Radiobiology (12)		
Radiation Protection (28)		
Image Production	42	
Image Acquisition and Technical Evaluation (20)		
Equipment Operation and Quality Assurance (22)		
Total for Core Module	100	1 hr, 55 min
Procedure Modules		
1. Chest	20	25 min
2. Extremities	25	30 min
3. Skull/Sinuses	20	25 min
4. Spine	25	30 min
5. Podiatric	20	25 min

1. The core module includes an additional 15 unscored (pilot) questions. Each of the procedure modules has five additional unscored questions.
2. SI units will become the primary (principle) units of radiation measurement used on the limited scope of practice in radiography examination in 2018.

LIMITED SCOPE OF PRACTICE
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Patient Care

1. Patient Interactions and Management

A. Ethical and Legal Aspects
   1. patient's rights
      a. informed consent (*e.g., written, oral, implied)
      b. confidentiality (HIPAA)
      c. American Hospital Association (AHA) Patient Care Partnership (Patient's Bill of Rights)
         1. privacy
         2. extent of care (e.g., DNR)
         3. access to information
         4. living will, health care proxy, advanced directives
         5. research participation
   2. legal issues
      a. verification (e.g., patient identification, compare order to clinical indication)
      b. common terminology (e.g., battery, negligence, malpractice, beneficence)
      c. legal doctrines (e.g., respondeat superior, res ipsa loquitur)
      d. restraints versus immobilization
      e. manipulation of electronic data (e.g., exposure indicator, processing algorithm, brightness and contrast, cropping or masking off anatomy)
   3. Professional Ethics

B. Interpersonal Communication
   1. modes of communication
      a. verbal/written
      b. nonverbal (e.g., eye contact, touching)
   2. challenges in communication
      a. interactions with others
         1. language barriers
         2. cultural and social factors
         3. physical or sensory impairments
         4. age
         5. emotional status, acceptance of condition
      b. explanation of medical terms
      c. strategies to improve understanding
   3. patient education (e.g., explanation of current procedure purpose, exam length)

C. Physical Assistance and Monitoring
   1. patient transfer and movement
      a. body mechanics (e.g., balance, alignment, movement)
      b. patient transfer techniques
   2. assisting patients with medical equipment (e.g., oxygen delivery systems, urinary catheters)
   3. routine monitoring
      a. vital signs
      b. physical signs and symptoms (e.g., motor control, severity of injury)
      c. fall prevention
      d. documentation

D. Medical Emergencies
   1. allergic reactions (e.g., contrast media, latex)
   2. cardiac or respiratory arrest (e.g., CPR)
   3. physical injury or trauma
   4. other medical disorders (e.g., seizures, diabetic reactions)

* The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)

Patient Care (continued)

E. Infection Control
   1. cycle of infection
      a. pathogen
      b. reservoir
      c. portal of exit
      d. mode of transmission
         1. direct
            a. droplet
            b. direct contact
         2. indirect
            a. airborne
            b. vehicle borne–fomite
            c. vector borne–mechanical or biological
      e. portal of entry
      f. susceptible host
   2. asepsis
      a. equipment disinfection
      b. equipment sterilization
      c. medical aseptic technique
      d. sterile technique
   3. CDC Standard Precautions
      a. hand hygiene
      b. use of personal protective equipment (e.g., gloves, gowns, masks)
      c. safe injection practices
      d. safe handling of contaminated equipment/surfaces
      e. disposal of contaminated materials
         1. linens
         2. needles
         3. patient supplies
         4. blood and body fluids
   4. transmission-based precautions
      a. contact
      b. droplet
      c. airborne
   5. additional precautions
      a. neutropenic precautions (reverse isolation)
      b. healthcare associated (nosocomial) infections

F. Handling and Disposal of Toxic or Hazardous Material
   1. chemicals
   2. safety data sheet (e.g., material safety data sheets)

LIMITED SCOPE OF PRACTICE
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
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Safety

1. Radiation Physics and Radiobiology

A. Principles of Radiation Physics
   1. x-ray production
      a. source of free electrons (e.g., thermionic emission)
      b. acceleration of electrons
      c. focusing of electrons
      d. deceleration of electrons
   2. target interactions
      a. bremsstrahlung
      b. characteristic
   3. x-ray beam
      a. frequency and wavelength
      b. beam characteristics
         1. quality
         2. quantity
         3. primary versus remnant (exit)
      c. inverse square law
      d. fundamental properties (e.g., travel in straight lines, ionize matter)
   4. photon interactions with matter
      a. Compton effect
      b. photoelectric absorption
      c. coherent (classical) scatter
      d. attenuation by various tissues
         1. thickness of body part
         2. type of tissue (atomic number)

B. Biological Aspects of Radiation
   1. SI units of measurement (NCRP Report #160)
      a. absorbed dose (Gy)
      b. dose equivalent (Sv)
      c. exposure (C/kg)
      d. effective dose (Sv)
   2. radiosensitivity
      a. dose-response relationships
      b. relative tissue radiosensitivities (e.g., LET, RBE)
      c. cell survival and recovery (LD50)
      d. oxygen effect
   3. somatic effects
      a. short-term versus long-term effects
      b. acute versus chronic effects
      c. carcinogenesis
      d. organ and tissue response (e.g., eye, thyroid, breast, bone marrow, skin, gonadal)
   4. acute radiation syndromes
      a. hemopoietic
      b. gastrointestinal (GI)
      c. central nervous system (CNS)
   5. embryonic and fetal risks
   6. genetic impact
      a. genetically significant dose
      b. goals of gonadal shielding

(Safety continues on the following page.)

4

Safety (continued)

2. Radiation Protection

A. Minimizing Patient Exposure
   1. exposure factors
      a. kVp
      b. mAs
   2. shielding
      a. rationale for use
      b. types
      c. placement
   3. beam restriction
      a. purpose of primary beam restriction
      b. types (e.g., collimators)
   4. filtration
      a. effect on skin and organ exposure
      b. effect on average beam energy
      c. NCRP recommendations (NCRP #102, minimum filtration in useful beam)
   5. patient considerations
      a. positioning
      b. communication
      c. pediatric
      d. morbid obesity
   6. radiographic dose documentation
   7. image receptors
   8. dose area product (DAP) meter

B. Personnel Protection (ALARA)*
   1. sources of radiation exposure
      a. primary x-ray beam
      b. secondary radiation
         1. scatter
         2. leakage
      c. patient as source
   2. basic methods of protection
      a. time
      b. distance
      c. shielding
   3. protective devices
      a. types
      b. attenuation properties
      c. minimum lead equivalent (NCRP #102)
   4. radiation exposure and monitoring
      a. dosimeters
         1. types
         2. proper use
      b. NCRP recommendations for personnel monitoring (NCRP #116)
         1. occupational exposure
         2. public exposure
         3. embryo/fetus exposure
         4. dose equivalent limits
         5. evaluation and maintenance of personnel dosimetry records

* Note: Although it is the responsibility of the individual licensed in limited scope radiography to apply radiation protection principles to minimize bioeffects for both patients and personnel, the ALARA concept is specific to personnel protection and is listed only for that section.

Image Production

1. Image Acquisition and Technical Evaluation

A. Selection of Technical Factors Affecting Radiographic Quality
Refer to *Attachment C* to clarify terms that may occur on the exam. (X indicates topics covered on the examination.)

	1. Receptor Exposure	2. Contrast	3. Spatial Resolution	4. Distortion
a. mAs	X			
b. kVp	X	X		
c. OID		X (air gap)	X	X
d. SID	X		X	X
e. focal spot size			X	
f. tube filtration	X	X		
g. beam restriction	X	X		
h. motion			X	
i. anode heel effect	X			
j. patient factors (size, pathology)	X	X	X	X
k. angle (tube, part, or receptor)			X	X

B. Technique Charts
   1. anatomically programmed technique
   2. caliper measurement
   3. fixed versus variable kVp
   4. special considerations
      a. pathologic factors
      b. age (e.g., pediatric, geriatric)
      c. body mass index (BMI)

C. Digital Imaging Characteristics
   1. spatial resolution (equipment related)
      a. pixel characteristics (e.g., size, pitch)
      b. detector element (DEL) (e.g., size, pitch, fill factor)
      c. matrix size
      d. sampling frequency
   2. contrast resolution (equipment related)
      a. bit depth
      b. modulation transfer function (MTF)
      c. detective quantum efficiency (DQE)
   3. image signal (exposure related)
      a. dynamic range
      b. quantum noise (quantum mottle)
      c. signal to noise ratio (SNR)
      d. contrast to noise ratio (CNR)

D. Image Identification
   1. methods (e.g., radiographic, electronic)
   2. legal considerations (e.g., patient data, examination data)

(Image Production continues on the following page.)

Image Production (continued)

2. Equipment Operation and Quality Assurance

A. Imaging Equipment
1. components of radiographic unit (fixed or mobile)
   a. operating console
   b. x-ray tube construction
      1. electron source
      2. target materials
      3. induction motor
   c. manual exposure controls
   d. beam restriction
2. x-ray generator, transformers and rectification system
   a. basic principles
   b. tube loading
3. components of digital imaging
   a. CR components
      1. plate (e.g., photo-stimulable phosphor [PSP])
      2. plate reader
   b. DR image receptors
      1. flat panel
      2. charge coupled device (CCD)
      3. complementary metal oxide semiconductor (CMOS)

B. Image Processing and Display
1. raw data (pre-processing)
   a. analog-to-digital converter (ADC)
   b. quantization
   c. corrections (e.g., rescaling, flat fielding, dead pixel correction)
   d. histogram
2. corrected data for processing
   a. grayscale
   b. edge enhancement
   c. equalization
   d. smoothing
3. data for display
   a. values of interest (VOI)
   b. look-up table (LUT)
4. post-processing
   a. brightness
   b. contrast
   c. region of interest (ROI)
   d. electronic cropping or masking
   e. stitching
5. display monitors
   a. viewing conditions (e.g., viewing angle, ambient lighting)
   b. spatial resolution (e.g., pixel size, pixel pitch)
   c. brightness and contrast
6. imaging informatics
   a. DICOM
   b. PACS
   c. RIS (modality work list)
   d. HIS
   e. EMR or EHR

(Image Production continues on the following page.)

Image Production (continued)

C. Criteria for Image Evaluation of Technical Factors
   1. exposure indicator
   2. quantum noise (quantum mottle)
   3. gross exposure error (e.g., loss of contrast, saturation)
   4. contrast
   5. spatial resolution
   6. distortion (e.g., size, shape)
   7. identification markers (e.g., anatomical side, patient, date)
   8. image artifacts
   9. radiation fog

D. Quality Control of Imaging Equipment and Accessories
   1. beam restriction
      a. light field to radiation field alignment
      b. central ray alignment
   2. recognition and reporting of malfunctions
   3. digital imaging receptor systems
      a. maintenance (e.g., detector calibration, plate reader calibration)
      b. QC tests (e.g., erasure thoroughness, plate uniformity, spatial resolution)
      c. display monitor quality assurance (e.g., grayscale standard display function, luminance)
   4. shielding accessories (e.g., lead apron, glove testing)

LIMITED SCOPE OF PRACTICE
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
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Procedures

The specific positions and projections within each anatomic region that may be covered on the examination are listed in *Attachment A*. A guide to positioning terminology appears in *Attachment B*.

PROCEDURE MODULE [1]		**# QUESTIONS PER MODULE** [2]
1. Chest		
A. Routine		16
B. Other		4
	TOTAL	**20**
2. Extremities		
A. Lower (toes, foot, calcaneus, ankle, tibia/ fibula, knee/ patella, and distal femur)		11
B. Upper (fingers, hand, wrist, forearm, elbow, and humerus)		11
C. Pectoral Girdle (shoulder, scapula, clavicle, and acromioclavicular joints)		3
	TOTAL	**25**
3. Skull/Sinuses		
A. Skull		8
B. Paranasal Sinuses		8
C. Facial Bones (orbits, nasal bones)		4
	TOTAL	**20**
4. Spine		
A. Cervical Spine		8
B. Thoracic Spine		6
C. Lumbar Spine		8
D. Sacrum, Coccyx, and Sacroiliac Joints		2
E. Scoliosis Series		1
	TOTAL	**25**
5. Podiatric		
A. Foot and Toes		14
B. Ankle		5
C. Calcaneus (os calcis)		1
	TOTAL	**20**

FOCUS OF QUESTIONS [3]

1. **Positioning** (e.g., topographic landmarks, body positions, path of central ray, immobilization devices, respiration)

   emphasis: high

2. **Anatomy** (including physiology, basic pathology, and related medical terminology)

   emphasis: medium

3. **Evaluation of displayed anatomical structures** (e.g., patient positioning, tube-part-image receptor alignment)

   emphasis: medium

4. **Procedure adaptation** (e.g., body habitus, body mass index, trauma, pathology, age, limited mobility, casts, splints, soft tissue for foreign body, etc.)

   emphasis: low

5. **Equipment and Accessories** (grids or Bucky, compensating filter, automatic exposure control [AEC], automatic collimation)

   emphasis: low

Notes:

1. Examinees take one or more procedure modules, depending on the type of license they have applied for. Each procedure module has 20 or 25 scored test questions, depending on the module (see chart above). The number of questions within a module should be regarded as approximate values.
2. Each of the procedure modules has five additional unscored questions.
3. The procedure modules may include questions about the five areas listed under *FOCUS OF QUESTIONS* on the right side of the chart. The podiatric module does not include questions from the equipment and accessories section.

LIMITED SCOPE OF PRACTICE
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
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Attachment A
Radiographic Positions and Projections

I. Chest
- A. Chest
  1. PA or AP upright
  2. lateral upright
  3. AP Lordotic
  4. AP supine
  5. lateral decubitus
  6. anterior and posterior obliques

II. Extremities
- A. Toes
  1. AP, entire forefoot
  2. AP or AP axial toe
  3. oblique toe
  4. lateral toe
  5. sesamoids, tangential
- B. Foot
  1. AP axial
  2. medial oblique
  3. lateral oblique
  4. lateral
  5. AP axial weight bearing
  6. lateral weight bearing
- C. Calcaneus
  1. lateral
  2. plantodorsal, axial
  3. dorsoplantar, axial
- D. Ankle
  1. AP
  2. mortise
  3. lateral
  4. medial oblique
  5. AP stress views
  6. AP weight bearing
  7. lateral weight bearing
- E. Tibia/Fibula
  1. AP
  2. lateral
- F. Knee/patella
  1. AP
  2. Lateral
  3. AP weight bearing
  4. lateral oblique
  5. medial oblique
  6. PA axial–intercondylar fossa (Holmblad)
  7. PA axial–intercondylar fossa (Camp Coventry)
  8. AP axial–intercondylar fossa (Béclère)
  9. PA patella
  10. Tangential (Merchant)
  11. tangential (Settegast)
  12. tangential (Hughston)
- G. Femur (Distal)
  1. AP
  2. lateral
- H. Fingers
  1. PA entire hand
  2. PA finger only
  3. lateral
  4. medial and/or lateral oblique
  5. AP thumb
  6. medial oblique thumb
  7. lateral thumb
- I. Hand
  1. PA
  2. lateral
  3. lateral oblique
- J. Wrist
  1. PA
  2. lateral oblique
  3. lateral
  4. PA–ulnar deviation
  5. PA axial (Stecher)
  6. tangential carpal canal (Gaynor-Hart)
- K. Forearm
  1. AP
  2. lateral
- L. Elbow
  1. AP
  2. lateral
  3. lateral oblique
  4. medial oblique
  5. AP partial flexion
  6. trauma axial laterals (Coyle)
- M. Humerus
  1. AP
  2. lateral
  3. neutral
  4. transthoracic lateral
- N. Shoulder
  1. AP internal and external rotation
  2. inferosuperior axial (Lawrence)
  3. posterior oblique (Grashey)
  4. AP neutral
  5. scapular Y
- O. Scapula
  1. AP
  2. lateral
- P. Clavicle
  1. AP
  2. AP axial
  3. PA axial
- Q. Acromioclavicular Joints – AP Bilateral With and Without Weights

III. Skull/Sinuses
- A. Skull
  1. AP axial (Towne)
  2. lateral
  3. PA axial (Caldwell)
  4. PA
  5. submentovertex (full basal)
- B. Facial Bones
  1. lateral
  2. parietoacanthial (Waters)
  3. PA axial (Caldwell)
  4. modified parietoacanthial (modified Waters)
- C. Nasal Bones
  1. parietoacanthial (Waters)
  2. lateral
  3. PA axial (Caldwell)
- D. Orbits
  1. parietoacanthial (Waters)
  2. lateral
  3. PA axial (Caldwell)
  4. modified parietoacanthial (modified Waters)
- E. Paranasal Sinuses
  1. lateral, horizontal beam
  2. PA axial (Caldwell), horizontal beam
  3. parietoacanthial (Waters), horizontal beam
  4. submentovertex (full basal), horizontal beam
  5. open mouth parietoacanthial (Waters), horizontal beam

IV. Spine
- A. Cervical Spine
  1. AP axial
  2. AP open mouth
  3. lateral
  4. PA axial obliques
  5. AP axial obliques
  6. lateral swimmers
  7. lateral flexion and extension
- B. Thoracic Spine
  1. AP
  2. lateral, breathing
  3. lateral, expiration
- C. Lumbar Spine
  1. AP
  2. PA
  3. lateral
  4. L5-S1 lateral spot
  5. posterior oblique
  6. anterior oblique
  7. AP axial L5-S1
  8. AP right and left bending
  9. lateral flexion and extension
- D. Sacrum and Coccyx
  1. AP axial sacrum
  2. AP axial coccyx
  3. lateral sacrum and coccyx, combined
  4. lateral sacrum or coccyx, separate
- E. Sacroiliac Joints
  1. AP
  2. posterior oblique
  3. anterior oblique
- F. Scoliosis Series
  1. AP or PA
  2. lateral

V. Podiatric
- A. Foot and Toes
  1. dorsal plantar (DP)*
  2. medial oblique
  3. lateral oblique
  4. lateral*
  5. sesamoidal axial*
- B. Ankle*
  1. AP*
  2. mortise*
  3. AP medial oblique*
  4. AP lateral oblique*
  5. lateral*
- C. Calcaneus
  1. axial calcaneal*
  2. Harris and Beath (ski-jump)*

*weightbearing

Attachment B
Standard Terminology
for Positioning and Projection

Radiographic View: Describes the body part as seen by the image receptor or other recording medium, such as a fluoroscopic screen. Restricted to the discussion of a *radiograph* or *image*.

Radiographic Position: Refers to a specific body position, such as supine, prone, recumbent, erect or Trendelenburg. Restricted to the discussion of the *patient's physical position*.

Radiographic Projection: Restricted to the discussion of the *path of the central ray*.

POSITIONING TERMINOLOGY

A. Lying Down

1. *supine* – lying on the back
2. *prone* – lying face downward
3. *decubitus* – lying down with a horizontal x-ray beam
4. *recumbent* – lying down in any position

B. Erect or Upright

1. *anterior position* – facing the image receptor
2. *posterior position* – facing the radiographic tube

C. Either Upright or Recumbent

1. oblique torso positions

   a. anterior oblique (facing the image receptor)

      i. *left anterior oblique (LAO)* — body rotated with the left anterior portion closest to the image receptor

      ii. *right anterior oblique (RAO)* — body rotated with the right anterior portion closest to the image receptor

   b. posterior oblique (facing the radiographic tube)

      i. *left posterior oblique (LPO)* — body rotated with the left posterior portion closest to the image receptor

      ii. *right posterior oblique (RPO)* — body rotated with the right posterior portion closest to the image receptor

2. oblique extremity positions

   a. lateral (external) rotation — from either prone or supine, outward rotation of the extremity

   b. medial (internal) rotation — from either prone or supine, inward rotation of the extremity

LIMITED SCOPE OF PRACTICE
EXAMINATION CONTENT SPECIFICATIONS

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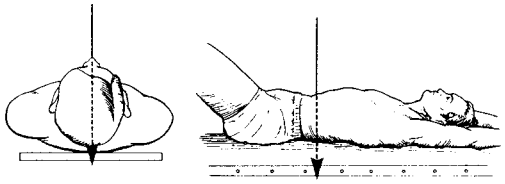
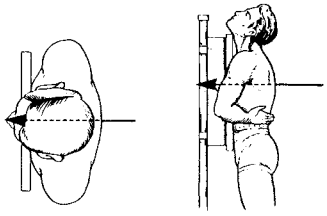
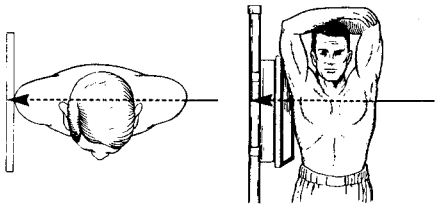
Anteroposterior Projection



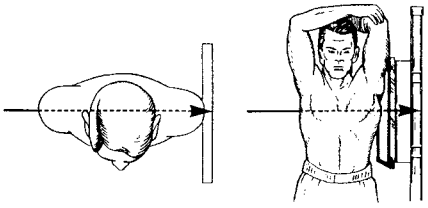
Posteroanterior Projection



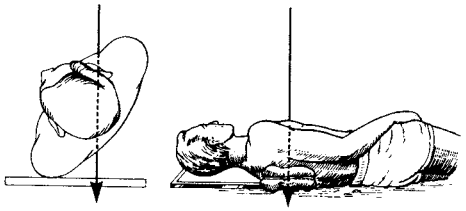
Right Lateral Position



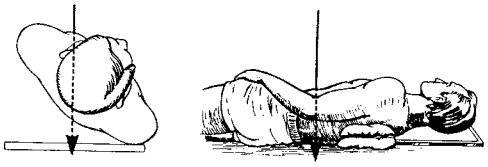
Left Lateral Position



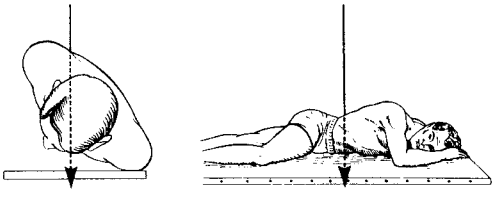
Left Posterior Oblique Position



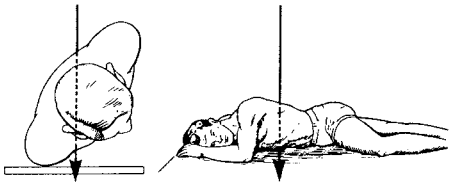
Right Posterior Oblique Position



Left Anterior Oblique Position



Right Anterior Oblique Position



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Attachment C
ARRT Standard Definitions

Digital Radiography	Digital Radiography includes both computed radiography and direct radiography. *Computed Radiography (CR)* systems use storage phosphors to temporarily store energy representing the image signal. The phosphor then undergoes a process to extract the latent image. *Direct Radiography (DR)* systems have detectors that directly capture and readout an electronic image signal.
Spatial Resolution	The sharpness of the structural edges recorded in the image.
Receptor Exposure	The amount of radiation striking the image receptor.
Brightness	Brightness is the measurement of the luminance of an area in a radiographic image displayed on a monitor. It is calibrated in units of candela (cd) per square meter.
Contrast	Contrast is the visible difference between any two selected areas of brightness levels within the displayed radiographic image. It is determined primarily by the processing algorithm (mathematical codes used by the software to provide the desired image appearance). The default algorithm determines the initial processing codes applied to the image data. *Grayscale* refers to the number of brightness levels (or gray shades) visible on an image and is linked to the bit depth of the system. *Long Scale* is the term used when slight differences between gray shades are present (low contrast) but the total number of gray shades is great. *Short Scale* is the term used when considerable or major differences between gray shades are present (high contrast) but the total number of gray shades is small.
Dynamic Range	The range of exposures that may be captured by a detector.
Receptor Contrast	The fixed characteristic of the receptor. Most digital receptors have an essentially linear response to exposure. This is impacted by **contrast resolution** (the smallest exposure change or signal difference that can be detected). Ultimately, contrast resolution is limited by the **quantization** (number of bits per pixel) of the analog-to-digital convertor.
Exposure Latitude	The range of exposures which produces quality images at appropriate patient dose.
Subject Contrast	The magnitude of the signal difference in the remnant beam as a result of the different absorption characteristics of the tissues and structures making up that part.

LIMITED SCOPE OF PRACTICE
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
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Attachment D

Task Inventory for Limited Scope of Practice in Radiography Examination

	Activity	Content Categories Legend: PC = Patient Care, S = Safety, IP = Image Production, P = Procedures
1.	Confirm patient's identity.	PC.1.A.2.A., PC.1.B., IP.1.D.
2.	Evaluate patient's ability to understand and comply with requirements for the requested examination.	PC.1.B.
3.	Obtain pertinent medical history.	PC.1.A.2.A., PC.1.B.
4.	Manage complex interpersonal interactions within the workplace in an effective manner.	PC.1.B.2.
5.	Review imaging examination request to verify accuracy and completeness of information (e.g., patient history, clinical diagnosis, physician's orders).	PC.1.A.2.A.
6.	Respond as appropriate to imaging study inquiries from patients.	PC.1.B.
7.	Assume responsibility for medical equipment attached to patients (e.g., IVs, oxygen) during the imaging procedures.	PC.1.C.2.
8.	Follow environmental protection standards for handling and disposing of bio-hazardous materials (e.g., sharps, blood, and body fluids).	PC.1.E.3.E.
9.	Provide for patient safety, comfort, and modesty.	PC.1.A., PC.1.C.
10.	Notify appropriate personnel of adverse events or incidents (e.g., patient fall, wrong patient imaged).	PC.1.A.2.A., PC.1.C.3., IP.1.D.
11.	Communicate scheduling delays to waiting patients.	PC.1.B.
12.	Demonstrate and promote professional and ethical behavior.	PC.1.A., PC.1.B.
13.	Verify informed consent as necessary.	PC.1.A.1.A., PC.1.B.
14.	Communicate relevant information to others (e.g., M.D.s, RNs, other radiology personnel).	PC.1.A., PC.1.B., PC.1.C.3.D.
15.	Explain procedure instructions to patient or patient's family.	PC.1.B.3.
16.	Practice Standard Precautions.	PC.1.E.3.
17.	Follow appropriate procedures when caring for patients with communicable diseases.	PC.1.E.3., PC.1.E.4., PC.1.E.5.
18.	Use immobilization devices, as needed, to prevent patient movement and/or ensure patient safety.	PC.1.A.2.D., P.
19.	Use proper body mechanics when assisting a patient.	PC.1.C.1.A.
20.	Use patient transfer devices when needed.	PC.1.C.1.B.
21.	Use sterile or aseptic technique when indicated.	PC.1.E.2.
22.	Follow environmental protection standards for handling hazardous materials.	PC.1.F.
23.	Obtain vital signs.	PC.1.C.3.A.

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(continued on next page)

LIMITED SCOPE OF PRACTICE
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
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Activity		Content Categories Legend: PC = Patient Care, S = Safety, IP = Image Production, P = Procedures
24.	Recognize and communicate the need for prompt medical attention.	PC.1.C.3., PC.1.D.
25.	Administer emergency care.	PC.1.C.2., PC.1.C.3., PC.1.D.
26.	Explain post-procedural instructions to patient or patient's family.	PC.1.B.3.
27.	Maintain confidentiality of patient information.	PC.1.A.1.B., PC.1.A.3.
28.	Clean, disinfect, or sterilize facilities and equipment, and dispose of contaminated items in preparation for next examination.	PC.1.E.2., PC.1.E.3.
29.	Document required information on patient's medical record (e.g., imaging procedure documentation, images). a. On paper b. Electronically	PC.1.B.1.A., PC.1.C.3.D., IP.1.D., IP.2.B.6.
30.	Evaluate the need for and use of protective shielding.	S.2.A.2., S.2.B.3.
31.	Take appropriate precautions to minimize radiation exposure to the patient.	S.2.A.
32.	Question female patient of child-bearing age about date of last menstrual period or possible pregnancy and take appropriate action (e.g., document response, contact physician).	PC.1.B., S.1.B.5., S.1.B.6.
33.	Restrict beam to the anatomical area of interest.	S.2.A.3., IP.1.A.1.G., IP.1.A.2.G.
34.	Set technical factors to produce diagnostic images and adhere to ALARA.	S.2.A., IP.1.A., IP.1.B.
35.	Document radiographic procedure dose.	S.2.A.6., IP.2.B.6.E.
36.	Prevent all unnecessary persons from remaining in area during x-ray exposure.	S.2.B.4.B.
37.	Take appropriate precautions to minimize occupational radiation exposure.	S.2.B.
38.	Advocate radiation safety and protection.	S.1.B., S.2.A., S.2.B.4.B.
39.	Describe the potential risk of radiation exposure when asked.	PC.1.B.3., S.1.B.
40.	Wear a personnel monitoring device while on duty.	S.2.B.4.A.
41.	Evaluate individual occupational exposure reports to determine if values for the reporting period are within established limits.	S.2.B.4.B.
42.	Determine appropriate exposure factors using the following: a. Fixed kVp technique chart b. Variable kVp technique chart c. Calipers (to determine patient thickness for exposure) d. Anatomically programmed technique*	IP.1.A., IP.1.B.

* Applies to specific modules

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LIMITED SCOPE OF PRACTICE
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ARRT BOARD APPROVED: **JANUARY 2017**
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Activity	Content Categories Legend: PC = Patient Care, S = Safety, IP = Image Production, P = Procedures
43. Select radiographic exposure factors. a. Automatic Exposure Control (AEC)* b. kVp and mAs (manual)	IP.1.A., IP.1.B., IP.1.C.
44. Operate radiographic unit and accessories including: a. Fixed unit b. Mobile unit (portable)	IP.2.A.1., IP.2.A.2., IP.2.A.3.
45. Operate electronic imaging and record keeping devices including: a. Computed radiography (CR) with photostimulable storage phosphor (PSP) plates b. Direct radiography (DR) c. Picture archiving and communication system (PACS) d. Hospital information system (HIS) e. Radiology information system (RIS) f. Electronic medical record (EMR) system	IP.2.A.3., IP.2.B.
46. Modify technical factors to correct for noise in a digital image.	IP.1.D.3.B., IP.2.C.
47. Remove all radiopaque materials from patient or table that could interfere with the image (e.g., clothing removal, jewelry removal).	PC.1.B.3.A., IP.2.C.8.
48. Perform post-processing on digital images in preparation for interpretation.	IP.2.B.4.
49. Use radiopaque anatomical side markers at the time of image acquisition.	IP.1.E., IP.2.C.7.
50. Add electronic annotations on digital images to indicate position or other relevant information (e.g., time, upright, decubitus, post-void).	PC.1.A.2.E., IP.1.E., IP.2.C.7.
51. Select equipment and accessories (e.g., grid*, compensating filter*, shielding) for the examination requested.	S.2.A.2., P.
52. Explain breathing instructions prior to making the exposure.*	PC.1.B.3.A., IP.1.A.3.H., P.
53. Position patient to demonstrate the desired anatomy using anatomical landmarks.	P.
54. Modify exposure factors for circumstances such as involuntary motion, casts and splints*, pathological conditions, or patient's inability to cooperate.	IP.1.A.3.H., IP.1.A.3.J., IP.1.B., P.
55. Verify accuracy of patient identification on image.	IP.1.E., IP.2.C.7.
56. Evaluate images for diagnostic quality.	IP.2.C., IP.2.D., P.
57. Respond appropriately to digital exposure indicator values.	IP.2.C.1.
58. Determine corrective measures if image is not of diagnostic quality and take appropriate action.	IP.2.C., P.
59. Identify image artifacts and make appropriate corrections as needed.	IP.2.C.8.
60. Store and handle image receptor in a manner which will reduce the possibility of artifact production.	IP.2.C.8., IP.2.C.9., IP.2.D.3.

* Applies to specific module

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LIMITED SCOPE OF PRACTICE
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Activity	Content Categories Legend: PC = Patient Care, S = Safety, IP = Image Production, P = Procedures
61. Visually inspect, recognize, and report malfunctions in the imaging unit and accessories.	IP.2.C.8., IP.2.D.2.
62. Recognize the need for periodic maintenance and evaluation of radiographic equipment affecting image quality and radiation safety (e.g., shielding, image display monitor, light field, central ray detector calibration).	IP.2.D.
63. Perform routine maintenance on digital equipment including: a. Detector calibration b. CR plate erasure c. Equipment cleanliness d. Test images	IP.2.D.3.
64. Adapt radiographic procedures for patient condition (e.g., age, size, trauma, pathology) and location (e.g., mobile, surgical, isolation).	PC.1.C., PC.1.E., S.2.A.5., IP.1., P.
65. Select appropriate geometric factors (e.g., SID, OID, focal spot size, tube angle).	IP.1.A.
Position patient, x-ray tube, and image receptor to perform the following diagnostic examinations:	
66. Chest	P.1.A.
67. Cervical spine	P.4.A.
68. Thoracic spine	P.4.B.
69. Scoliosis series	P.4.E.
70. Lumbar spine	P.4.C.
71. Sacrum/coccyx	P.4.D.
72. Sacroiliac joints	P.4.D.
73. Skull	P.3.A.
74. Facial bones	P.3.C.
75. Nasal bones	P.3.C.
76. Orbits	P.3.C.
77. Paranasal sinuses	P.3.B.
78. Toes	P.2.A., P.5.A.
79. Foot	P.2.A., P.5.A.
80. Calcaneus	P.2.A., P.5.C.
81. Ankle	P.2.A., P.5.B.
82. Tibia/fibula	P.2.A.

* Applies to specific modules

LIMITED SCOPE OF PRACTICE
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Activity		Content Categories Legend: PC = Patient Care, S = Safety, IP = Image Production, P = Procedures
83.	Knee/patella	P.2.A.
84.	Distal femur	P.2.A.
85.	Fingers	P.2.B.
86.	Hand	P.2.B.
87.	Wrist	P.2.B.
88.	Forearm	P.2.B.
89.	Elbow	P.2.B.
90.	Humerus	P.2.B.
91.	Shoulder	P.2.C.
92.	Scapula	P.2.C.
93.	Clavicle	P.2.C.
94.	Acromioclavicular joints	P.2.C.

EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
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Bone Densitometry Equipment Operator

The purpose of the *Bone Densitometry Equipment Operator Examination*, which is made available to state licensing agencies, is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of operators of bone densitometry equipment at entry into the profession. The ARRT administers the examination to state approved candidates under contractual arrangement with the state and provides the results directly to the state. This examination is not associated with any type of certification and registration by the ARRT.

The knowledge and skills covered by the examination were determined by administering a comprehensive practice analysis survey to a nationwide sample of bone density equipment operators. The results of the practice analysis are reflected in this document.[1]

The *Task Inventory for Bone Densitometry Equipment Operator* appears in *Attachment A* of this document. The content specifications identify the knowledge areas underlying performance of the tasks on the *Task Inventory for Bone Densitometry Equipment Operator*. Every content category can be linked to one or more activities on the task inventory.

The table below presents the major categories covered on the examination, along with the number of test questions in each category. The remaining pages of this document list the specific topics addressed within each category.

Section	Number of Scored Questions[2]
Patient Care	12
Safety	8
Image Production	15
Procedures	25
Total	**60**

1. A special debt of gratitude is due to the hundreds of professionals participating in the project as committee members, survey respondents, and reviewers.
2. The exam includes an additional 15 unscored (pilot) questions.

BONE DENSITOMETRY EQUIPMENT OPERATOR
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
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Patient Care

1. Osteoporosis

A. World Health Organization (WHO) Definition and Diagnostic Criteria
B. Primary
C. Secondary

2. Bone Physiology

A. Functions of Bone
   1. structural support and protection
   2. storage of essential minerals
B. Types of Bone
   1. cortical bone
   2. trabecular bone
C. Bone Remodeling Cycle
   1. resorption/formation
   2. osteoblasts/osteoclasts

3. Bone Health and Patient Education

A. Nutrition
B. Exercise
C. Risk Factors
   1. controllable (*e.g., smoking, alcohol, calcium, vitamin D, hormone therapy, medications)
   2. uncontrollable (heredity, race, gender, age, medical conditions)

4. Patient Preparation

A. Patient Instructions and Explanation of Procedure
B. Patient History
   1. medical history (e.g., bone disorder, prosthesis, peak height)
   2. contraindications (e.g., contrast agents, calcium supplements, pregnancy)
   3. clinical indications and guidelines (Bone Mass Measurement Act)
C. Patient Factors
   1. limited mobility or mental impairment
   2. unusual anatomy, pathology, or body habitus
   3. removable artifacts
   4. pediatric patients

* The abbreviation "e.g.," is used to indicate that examples are listed in parenthesis, but that it is not a complete list of all possibilities.

Safety

1. Fundamental Principles

A. ALARA
B. Basic Methods of Protection
   1. time
   2. distance
   3. shielding

2. Biological Effects of Radiation

A. Long-Term Effects
B. Radiosensitive Tissues/Organs

3. Units of Measurement

A. Absorbed Dose (e.g., Rad/Gray)
B. Exposure (e.g., Rem/Sievert)

4. Radiation Protection in BD

A. General Protection Issues
   1. radiation signs posted
   2. door closed
   3. only patient and operator in room
B. Occupational Protection
   1. scanner-operator distance
   2. personnel monitoring
   3. exposure records
C. Patient Protection
   1. comparison levels of radiation
      a. peripheral DXA
      b. axial DXA
      c. natural background radiation
   2. strategies to minimize patient exposure
      a. patient instructions
      b. correct exam performance

BONE DENSITOMETRY EQUIPMENT OPERATOR
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Image Production

1. Fundamentals of X-ray Production

A. Properties of X-ray Beam
   1. quality (kVp)
   2. quantity (mA)
   3. duration/time (S)

B. Filters and Collimators

C. X-ray Energy Production

D. Fan Beam DXA Systems

2. Quality Control

A. Equipment Safety (electrical, pinch points, emergency stop)

B. Use of Phantoms and/or Calibration

C. DXA Calibration
   1. in vivo precision study
   2. cross-calibration

D. Troubleshooting
   1. shift or drift
   2. pass/fail
   3. need for service

E. Record Maintenance

3. Measuring BMD

A. Basic Statistical Concepts
   1. mean
   2. standard deviation
   3. coefficient of variation

B. Reporting Patient Results
   1. BMD formula
   2. Z-score
   3. T-score

C. FRAX® (WHO Fracture Risk Assessment Tool)

D. Vertebral Fracture Assessment (VFA)

E. Pediatric/Adolescent Scanning (ages 5-19)

4. Determining Quality in BMD

A. Precision

B. Accuracy

C. Factors Affecting Accuracy and Precision
   1. scanner
   2. operator
   3. patient variables

5. File and Database Management

A. Storage and Retrieval of Data

B. Back-up and Archiving

Procedures

1. DXA Scanning of Lumbar Spine

A. Anatomy
   1. regions of interest
   2. bony landmarks
   3. radiographic appearance
   4. adjacent structures

B. Scan Acquisition
   1. patient instructions
   2. patient positioning
   3. evaluating pre-set scan parameters

C. Scan Analysis
   1. accurate ROI placement
   2. BMC, area, and BMD
   3. T-score, Z-score

D. Common Problems
   1. poor bone edge detection
   2. nonremovable artifacts
   3. variant anatomy
   4. fractures or pathology

E. Follow-Up Scans
   1. unit of comparison
      a. BMD
      b. T-score
   2. reproduce baseline study

2. DXA Scanning of Proximal Femur

A. Anatomy
   1. regions of interest
   2. bony landmarks
   3. radiographic appearance
   4. adjacent structures

B. Scan Acquisition
   1. patient instructions
   2. patient positioning
   3. evaluating pre-set scan parameters

C. Scan Analysis
   1. accurate ROI placement
   2. BMC, area, and BMD
   3. T-score, Z-score

D. Common Problems
   1. poor bone edge detection
   2. nonremovable artifacts
   3. variant anatomy
   4. fractures or pathology

E. Follow-Up Scans
   1. unit of comparison
      a. BMD
      b. T-score
   2. reproduce baseline study

3. DXA Scanning of Forearm

A. Anatomy
   1. regions of interest
   2. bony landmarks
   3. radiographic appearance
   4. adjacent structures

B. Scan Acquisition
   1. patient instructions
   2. patient positioning
   3. evaluating pre-set scan parameters
   4. selection (right versus left)

C. Scan Analysis
   1. accurate ROI placement
   2. BMC, area, and BMD
   3. T-score, Z-score

D. Common Problems
   1. poor bone edge detection
   2. nonremovable artifacts
   3. variant anatomy
   4. fractures or pathology

E. Follow-Up Scans
   1. unit of comparison
      a. BMD
      b. T-score
   2. reproduce baseline study

BONE DENSITOMETRY EQUIPMENT OPERATOR
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Attachment A

Task Inventory for Bone Densitometry Equipment Operator

	Activity	Content Categories Legend: PC = Patient Care S = Safety, IP = Image Production, P = Procedures
1.	Perform routine QC tests on scanning equipment according to manufacturer guidelines.	IP.2.
2.	Inspect and interpret results of routine QC tests and determine need for corrective action.	IP.2.D.
3.	Arrange for corrective action or repairs based on the results of the QC tests.	IP.2.D.3.
4.	Record results of QC tests in binder, chart, or database.	IP.2.E.
5.	Inspect equipment to make sure it is safe and operable (*e.g., cables, cords, table pads).	IP.2.A.
6.	Troubleshoot mechanical problems of scanning equipment.	IP.2.D.
7.	Perform an in vivo precision study.	IP.2.C.1.
8.	Ensure that cross-calibration between new/existing machines is performed as needed.	IP.2.C.2.
9.	Clean and disinfect work area.	PC.4.
10.	Direct patients to where they can find more information about low bone density.	PC.1., PC.2., PC.3.
11.	Answer basic questions put forth by the patient or family members (or refer them to the appropriate resources) concerning bone health, fall prevention, exercise, and nutrition.	PC.1., PC.2., PC.3.
12.	Explain procedure of DXA exam including positioning, duration, and notification policy of results.	PC.4.A.
13.	Record patient history relevant to bone densitometry.	PC.4.B.
14.	Verify current clinical indications meet specifications of CMS billing and coding guidelines if appropriate.	PC.4.B.3.
15.	Determine if patient has recently received a radiopaque contrast agent or radionuclide.	PC.4.B.2.
16.	Determine if patient has recently ingested contraindicated medications or supplements (e.g., calcium).	PC.4.B.2.
17.	Question female patients of childbearing age about possibility of pregnancy.	PC.4.B.2.
18.	Measure and record patient's current height and weight.	PC.4.B.1.
19.	Ask patients about their peak height.	PC.4.B.1.

* The abbreviation "e.g.," is used to indicate that examples are listed in parenthesis, but that it is not a complete list of all possibilities.

5

BONE DENSITOMETRY EQUIPMENT OPERATOR
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Activity		Content Categories Legend: PC = Patient Care S = Safety, IP = Image Production, P = Procedures
20.	Determine if patient anatomy, pathology, or other limitations require special consideration in patient positioning.	PC.4.C.2.
21.	Ensure that artifact-producing objects (e.g., zippers, buttons, jewelry) within scan area have been removed from the patient.	PC.4.C.3.
22.	Prevent unnecessary persons from remaining in the area during x-ray exposure.	S.4.
23.	Take appropriate precautions to minimize occupational x-ray exposure.	S.
24.	Take appropriate precautions to minimize x-ray exposure to patient.	S.
25.	Provide mobility assistance to patients with disabilities or limited mobility.	PC.4.C.
26.	Assist patient onto and off the scanning table.	PC.4.C.
27.	Review patient records and provider's request to determine appropriate anatomical sites to scan.	PC.4.B.
28.	Review prior scans and reproduce patient positioning during follow-up scan appointments.	IP.4., P.1.E., P.2.E., P.3.E.
29.	Select appropriate immobilization devices or positioning aids.	P.1.B., P.2.B., P.3.B.
30.	Record positioning details in patient records to ensure consistency.	P.1.B., P.2.B., P.3.B.
31.	Enter accurate patient data necessary to initiate scan to utilize correct reference data.	IP.3.
32.	Select appropriate exam modes and perform necessary scans.	IP.
33.	Position patient to scan desired region of interest (ROI) using bony landmarks and surface anatomical features.	P.1.A., P.2.A., P.3.A.
34.	Evaluate accuracy of vertebral labels and intervertebral markers for scan of lumbar spine and modify if necessary.	P.1.C.
35.	Evaluate automatic placement of region of interest (ROI) and modify if necessary.	P.1.C, P.2.C., P.3.C.
36.	Enhance or modify image appearance.	P.1.D., P.2.D., P.3.D.
37.	Compare bone density measurements from two different occasions (for same patient) to assess changes over time.	P.1.E., P.2.E., P.3.E.
38.	Evaluate scan results for technical problems (e.g., incorrect scan mode or site) and take corrective action.	IP.4.

Activity		Content Categories Legend: PC = Patient Care S = Safety, IP = Image Production, P = Procedures
39.	Review scan results to identify bone density measurements that may be inaccurate due to artifacts, unusual anatomy, pathology, or positioning problems and rescan if necessary.	P.1.D., P.2.D., P.3.D.
40.	Review scan results to determine if scanning an additional site is required in order to obtain more precise bone density measurements.	IP.4.
41.	Identify bone density measurements that require interpreting provider's attention (e.g., low T-score, unreliable results).	IP.3.A., IP.3.B.
42.	Utilize FRAX® tool to assess 10-year fracture risk.	IP.3.C.
43.	Maintain patient records to include the archiving, copying, deleting, and retrieving functions.	IP.5.
44.	Perform bone densitometry scans using a fan beam system.	IP.1.
45.	Perform and analyze bone densitometry scans of the forearm utilizing DXA equipment.	P.3.
46.	Perform and analyze bone densitometry scans of the proximal femur utilizing DXA equipment.	P.2.
47.	Perform and analyze bone densitometry scans of the lumbar spine PA utilizing DXA equipment.	P.1.
48.	Perform bone densitometry scans of the spine – VFA (vertebral fracture assessment).	IP.3.D.
49.	Perform and analyze bone densitometry scans on pediatric patients (ages 5-19) utilizing DXA equipment.	IP.3.E.

EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Fluoroscopy

The purpose of the fluoroscopy examination, which is developed and administered by The American Registry of Radiologic Technologists (ARRT) on behalf of state licensing agencies, is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required to safely operate a fluoroscopy unit. ARRT administers the examination to state approved candidates under contractual arrangement with the state and provides the results directly to the state. This examination is not associated with any type of certification and registration by the ARRT.

To identify the knowledge and cognitive skills covered by the examination, the ARRT conducted a practice analysis study using input from subject matter experts and related published documents such as the *ASRT Fluoroscopy Educational Framework for Physician Assistants (2009)*.[1] The practice analysis resulted in a task inventory which serves as the basis for these content specifications and appears in *Appendix A* of this document.

The table below presents the major content categories and subcategories covered on the examination. The number of test questions in each category are listed in bold and number of test questions in each subcategory in parentheses. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

This document is not intended to serve as a curriculum guide. Although testing programs and educational programs may have related purposes, their functions are clearly different. Educational programs are generally broader in scope and address subject matter not included in these content specifications.

Content Category	**Number of Questions[2]**
Patient Care	**9**
Patient Interactions and Management (9)	
Safety	**46**
Radiation Physics and Radiobiology[3] (22)	
Radiation Protection (24)	
Image Production	**35**
Equipment Operation (22)	
Image Evaluation and Quality Control (13)	
Total	**90**

1. A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.
2. The exam includes up to an additional 30 unscored (pilot) questions.
3. SI units will become the primary (principle) units of radiation measurement used on the fluoroscopy examination in 2018.

FLUOROSCOPY
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Patient Care

1. Patient Interactions and Management

A. Patient Identification and Procedure Verification

B. Components of Informed Consent

C. Risk versus Benefit

D. Patient Education
   1. explanation
   2. respond to inquiries (*e.g., radiation dose, types of radiation)

E. Procedural Understanding to Reduce Exposure

F. Procedure Radiation Exposure (NCRP #160)

G. Cumulative Dose Education

H. Pregnancy Status (e.g., tests and limitations)

I. Contrast Reactions
   1. allergy history (e.g., appropriate pre-medication)
   2. types of reactions (mild to severe)

J. Patient Record Information
   1. patient dose/technical factors
   2. adverse reactions
   3. picture archiving and communication system (PACS)
   4. hospital information system (HIS)
   5. radiology information system (RIS)
   6. electronic medical record (EMR) or electronic health record (EHR) systems

K. Standards of Care

L. HIPAA

* The abbreviation “e.g.,” is used to indicate that examples are listed in parenthesis, but that it is not a complete list of all possibilities.

FLUOROSCOPY
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Safety

1. Radiation Physics and Radiobiology

A. Radiation Physics
   1. photon interactions with matter
      a. Compton effect
      b. photoelectric absorption
      c. coherent (classical) scatter
      d. attenuation by various tissues
         1. thickness of body part
         2. type of tissue (e.g., atomic number, density)
   2. x-ray production
      a. source of free electrons (e.g., thermionic emission)
      b. acceleration of electrons
      c. focusing of electrons
      d. deceleration of electrons
      e. target interaction (e.g., x-ray spectrum)
         1. bremsstrahlung
         2. characteristic
   3. x-ray beam
      a. frequency and wavelength
      b. beam characteristics
         1. quality
         2. quantity
         3. primary versus remnant (exit)
      c. scatter
      d. inverse square law
      e. fundamental properties (e.g., travel in straight lines, ionize matter)

B. Radiation Biology
   1. radiosensitivity
      a. dose-response relationships
      b. relative tissue radiosensitivity (e.g., LET, RBE)
      c. cell survival and recovery
      d. oxygen effect
   2. somatic effects
      a. short-term versus long-term effects
      b. acute versus chronic effects
      c. carcinogenesis
      d. organ and tissue response (e.g., eye, thyroid, breast, bone marrow, skin, gonadal)
   3. embryonic and fetal risks
   4. genetic effects

(Safety section continues on the following page.)

FLUOROSCOPY
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Safety (continued)

2. Radiation Protection

A. Minimizing Patient Exposure
1. exposure factors
   a. kVp
   b. mA
   c. fluoroscopy time
   d. automatic brightness control (ABC)
   e. automatic exposure rate control (AERC)
2. shielding
   a. rationale for use
   b. types
   c. placement
3. beam restriction
   a. purpose of primary beam restriction
   b. collimators
4. filtration
   a. effect on skin and organ exposure
   b. effect on average beam energy
   c. NCRP recommendations (NCRP #102, minimum filtration in useful beam)
5. equipment features
   a. last image hold
   b. cumulative timer
   c. magnification mode
   d. dose mode
      1. low dose
      2. cine
      3. high-level control
      4. pulsed
6. pediatric dose reduction
7. grids
8. receptor positioning
9. patient positioning
   a. impact on dose
   b. patient immobilization devices
10. dose or time documentation
11. dose area product (DAP) meter
12. air kerma display
13. minimum source-to-skin distance (21 CFR)

B. Personnel Protection
1. sources of radiation exposure
   a. primary x-ray beam
   b. secondary radiation
      1. scatter
      2. leakage
   c. patient as source
2. basic methods of protection
   a. time
   b. distance
   c. shielding
3. protective devices
   a. protective drapes
   b. Bucky slot cover
   c. shields (e.g., aprons, gloves, eye, face, floating, thyroid)
   d. attenuation properties
   e. cumulative timer
   f. remote-controlled fluoroscopy
4. minimum lead equivalent (NCRP #102)
5. guidelines for fluoroscopy and mobile units (NCRP #102, 21 CFR)
   a. fluoroscopy exposure rates (e.g., normal, high-level control)
   b. exposure switch guidelines
6. recommendations for personnel monitoring (NCRP #116)
   a. occupational exposure
   b. public exposure
   c. embryo/fetus exposure
   d. ALARA and dose equivalent limits
   e. evaluation and maintenance of personnel dosimetry records
7. units of measurement
   a. absorbed dose
   b. dose equivalent
   c. exposure
   d. effective dose
   e. air kerma
8. dosimeters
   a. types
   b. proper use

FLUOROSCOPY
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Image Production

1. Equipment Operation

A. Technical Factors
1. kVp
2. mA
3. object-to-image distance (OID)
4. source-to-image distance (SID)
5. focal spot size
6. grids
7. filtration
8. beam restriction
9. automatic brightness control (ABC)
10. automatic exposure rate control (AERC)
11. anatomic alignment
12. exposure compensation
13. magnification mode
14. spot imaging (digital spot)
15. high level control (e.g., boost, high dose rate)
16. pulse rate

B. Image Receptors
1. image intensifier
2. flat panel detector

C. Image Display
1. viewing conditions (e.g., luminance, ambient lighting, eye physiology, ergonomics)
2. spatial resolution (e.g., pixel size, pixel pitch)
3. contrast resolution/dynamic range
4. DICOM gray scale function
5. brightness and contrast

D. Recording Systems
1. digital subtraction angiography (DSA)
2. image capture
3. spot imaging (digital spot)

E. Imaging Informatics
1. digital imaging and communications in medicine (DICOM)
2. picture archiving and communication systems (PACS)
3. radiology information system (RIS) (e.g., modality worklist)
4. hospital information system (HIS)
5. electronic medical records (EMR) or electronic health records (EHR)

2. Image Evaluation and Quality Control

A. Digital Image Characteristics
1. spatial resolution (equipment related)
   a. sampling frequency
   b. detector element size (DEL) (e.g., size, pitch, fill factor)
   c. receptor size and matrix size
   d. pixel characteristics (e.g., size, pitch)
2. image signal (exposure related)
   a. quantum mottle (quantum noise)
   b. dynamic range
   c. signal to noise ratio (SNR)
   d. contrast to noise ratio (CNR)
3. contrast resolution (equipment related)
   a. bit depth
   b. modulation transfer function (MTF)
   c. detective quantum efficiency (DQE)

B. Criteria for Image Evaluation
1. demonstration of anatomical structures (e.g., positioning, motion)
2. identification markers (radiographic or electronic) (e.g., anatomical, patient, date)
3. patient considerations (e.g., pathologic conditions)
4. quantum mottle (quantum noise)
5. gross exposure error (e.g., loss of contrast, saturation)
6. contrast
7. spatial resolution
8. distortion (e.g., size, shape)
9. image artifacts (e.g., grid lines, dead pixels, distortion)

C. Recognition and Reporting of Malfunctions
1. quality control
   a. display monitor (e.g., grayscale standard display function, luminance)
   b. shielding accessory testing (e.g., lead apron and glove testing)
   c. exposure rate output
   d. spot imager
   e. image quality (e.g., resolution)
2. recording and reporting of overexposure

5

FLUOROSCOPY
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Attachment A
Task Inventory for Fluoroscopy Examination

	Activity	Content Categories Legend: PC = Patient Care, S = Safety, IP = Image Production
1.	Confirm patient's identity.	PC.1.A.
2.	Advocate radiation safety and protection.	PC., S., S.1.B., S.2., IP.1.
3.	Assess the patient's radiation dose and history.	PC., PC.1.F., PC.1.G., PC.1.J.
4.	Assess alternative procedures based on patient dose.	PC.1.C.
5.	Assess risk factors that may contraindicate the procedure (e.g., health history, medications, pregnancy, psychological indicators, alternative medicines).	PC.1.A., PC.1.G., PC.1.I., S.1.B.3.
6.	Evaluate patient's ability to understand and comply with requirements for the requested examination.	PC.1.D.
7.	Obtain pertinent medical history.	PC.1.J.
8.	Question female patient of child-bearing age about date of last menstrual period or possible pregnancy and take appropriate action (e.g., document response, contact physician).	PC.1.H.
9.	Examine imaging examination requisition to verify accuracy, completeness of information, and exam appropriateness (e.g., patient history, clinical diagnosis, physician's orders).	PC.1.A., PC.1.I., PC.1.L.
10.	Verify or obtain patient consent as necessary (e.g., contrast studies).	PC.1.B.
11.	Respond as appropriate to imaging study inquiries from patients.	PC.1.D.2.
12.	Explain effects and potential side effects to the patient regarding the radiation required for the examination.	PC.1.G., S.1.B.2.D.
13.	Select immobilization devices, when indicated, to prevent patient's movement and/or ensure patient's safety.	S.2.A.9.B.
14.	Remove all radiopaque materials from patient or table that could interfere with the image (e.g., clothing, jewelry, prosthesis).	PC.1.E., IP.2.B.
15.	Select equipment and accessories (e.g., grid, shielding) for the examination requested.	S.2.A.2., S.2.A.4., IP.1.A.6., IP.1.A.7.
16.	Prior to administration of a contrast agent, determine if patient is at increased risk for an adverse reaction.	PC.1.I., PC.1.J.2.
17.	Observe patient after administration of contrast media to detect adverse reactions.	PC.1.I.2.
18.	Recognize and communicate the need for prompt medical attention.	PC.1.I.2.
19.	Take appropriate precautions to minimize occupational radiation exposure.	S.1., S.2.B., S.2.B.8., IP.2.C.
20.	Prevent all unnecessary persons from remaining in area during radiation exposure.	S.1., S.2.B.

FLUOROSCOPY
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Activity		**Content Categories** Legend: PC = Patient Care, S = Safety, IP = Image Production
21.	Take appropriate precautions to minimize radiation exposure to patient.	S.1., S.2.A.
22.	Set kVp, mA, and time or automatic exposure system to achieve optimum image quality, safe operating conditions, and minimum radiation dose.	PC.1.J.1., S.2.A., S.2.A.5., IP.1.A.
23.	Select appropriate geometric factors (e.g., SID, OID, focal spot size, magnification).	IP.1.A.3.-A.5., IP.1.A.13.
24.	Position patient to demonstrate the desired anatomy using anatomical landmarks.	S.2.A.9., IP.2.B.2.
25.	Explain breathing instructions prior to making the exposure.	PC.1.D.1., PC.1.E., IP.2.B.2.
26.	Operate a fluoroscopic unit and accessories including: a. fixed unit b. mobile fluoroscopic unit (C-arm)	S.1., S.2.A., S.2.B., IP.1.
27.	Operate fluoroscopic equipment in compliance with Standards of Care, regulatory requirements, and medical ethics.	PC.1.K., S.2.A.4., S.2.B.4., S.2.B.5.
28.	Modify technical factors for circumstances, such as involuntary motion, contrast media, pathological conditions, or patient's inability to cooperate.	IP.1.A., IP.2.B.1.-B.3.
29.	Adapt fluoroscopic procedures for patient condition (e.g., age, size, trauma, pathology) and location (e.g., mobile, surgical, isolation).	IP.1.A.-C.
30.	Modify technical factors for pediatric patients.	S.2.A., S.2.A.6., IP.1.A.
31.	Modify technical factors to correct for noise in a digital image.	IP.1.A., IP.2.A.2., IP.2.B.4.
32.	Select continuous or pulsed fluoroscopy.	IP.1.A.16.
33.	Restrict beam to limit exposure area, improve image quality, and reduce radiation dose.	S.2.A.3., IP.1.A.8.
34.	Verify accuracy of patient identification on image.	IP.2.B.2.
35.	Evaluate images for diagnostic quality.	IP.1.C., IP.2.B.
36.	Determine corrective measures if image is not of diagnostic quality and take appropriate action.	IP.1.A., IP.2.A.
37.	Identify image artifacts and make appropriate corrections as needed.	IP.1.B., IP.1.D., IP.2.C.1.
38.	Add electronic annotations/radiopaque markers on images to indicate anatomical side, position, and other relevant information.	IP.2.B.2.
39.	Perform post-processing on digital images in preparation for interpretation.	IP.1.D.1.
40.	Operate electronic imaging and record keeping systems. a. picture archival and communication system (PACS) b. hospital information system (HIS) c. radiology information system (RIS) (e.g., modality worklist) d. electronic medical record (EMR) system e. electronic health record (EHR) system	PC.1.J.3.-J.6.
41.	Document required information on patient's medical record (e.g., imaging procedure documentation, images, adverse reactions).	PC.1.J.

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FLUOROSCOPY
EXAMINATION CONTENT SPECIFICATIONS

ARRT BOARD APPROVED: **JANUARY 2017**
IMPLEMENTATION DATE: **JANUARY 1, 2018**

Activity		**Content Categories** Legend: PC = Patient Care, S = Safety, IP = Image Production
42.	Document fluoroscopy time and/or technical factors.	PC.1.J., IP.2.C.2.
43.	Document fluoroscopy dose when available.	PC.1.J., S.2.A.10.
44.	Maintain confidentiality of patient information.	PC.1.L.
45.	Store and handle imaging equipment in a manner which will reduce the possibility of artifact production.	C.1.B., C.1.D., IP.2.C.1.
46.	Visually inspect, recognize, and report malfunctions in the imaging unit and accessories.	IP.2.C.
47.	Recognize the need for periodic maintenance and evaluation of radiographic equipment affecting image quality and radiation safety (e.g., shielding accessories, image display monitor, exposure rate).	IP.2.C.
48.	Appropriately report overexposure.	IP.2.C.2.
49.	Wear a personnel monitoring device as required.	S.2.B.8.
50.	Evaluate individual occupational exposure reports to determine if values for the reporting period are within established limits.	S.2.B.6-B.8.

EXAMINATION CONTENT SPECIFICATIONS

APPROVED BY CALIFORNIA: **SEPTEMBER 19, 2017**
IMPLEMENTATION DATE: **JULY 1, 2018**

California Radiography Supervisor and Operator Examination

The American Registry of Radiologic Technologists (ARRT) develops and administers the *Radiography Supervisor and Operator Examination* on behalf of the State of California. The purpose of the examination as established by the State is to assess the knowledge and cognitive skills expected of licentiates who supervise operators of radiographic equipment or who operate radiographic equipment themselves.

A practice analysis was conducted on a nationwide sample of radiographers to identify the tasks typically associated with the performance of imaging procedures using radiographic equipment. The State of California Radiologic Health Branch selected a subset of these tasks as relevant to radiography supervisors and operators. The content of the examination reflects the knowledge and cognitive skills required to safely and effectively perform the selected tasks. The *Task Inventory* for the *Radiography Supervisor and Operator Examination* appears in *Attachment B* of this document. The *Content Specifications for the Radiography Supervisor and Operator Examination* identify the content areas covered on the examination and the number of questions for each area. Every content category can be linked to one or more activities on the task inventory.

The table below presents the major content categories and the number of test questions appearing in each category. The remaining pages provide a detailed listing of topics addressed within each major content category.

	Number of Scored Questions	Testing Time
Patient Care	18	
Safety[1]	40	
Image Production	42	
Total	**100**	**1 hr, 45 min**

1. SI units are the primary (principal) units of radiation measurement used on this examination.

CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

APPROVED BY CALIFORNIA: **SEPT 19, 2017**
IMPLEMENTATION DATE: **JULY 1, 2018**

Patient Care

1. Patient Interactions and Management

A. Ethical and Legal Aspects
   1. patient's rights
      a. informed consent (*e.g., written, oral, implied)
      b. confidentiality (HIPAA)
      c. American Hospital Association (AHA) Patient Care Partnership (Patient's Bill of Rights)
         1. privacy
         2. extent of care (e.g., DNR)
         3. access to information
         4. living will, health care proxy, advanced directives
         5. research participation
   2. legal issues
      a. verification (e.g., patient identification, compare order to clinical indication)
      b. common terminology (e.g., battery, negligence, malpractice, beneficence)
      c. legal doctrines (e.g., respondeat superior, res ipsa loquitur)
      d. restraints versus immobilization
      e. manipulation of electronic data (e.g., exposure indicator, processing algorithm, brightness and contrast, cropping or masking off anatomy)
   3. Professional Ethics

B. Interpersonal Communication
   1. modes of communication
      a. verbal/written
      b. nonverbal (e.g., eye contact, touching)
   2. challenges in communication
      a. interactions with others
         1. language barriers
         2. cultural and social factors
         3. physical or sensory impairments
         4. age
         5. emotional status, acceptance of condition
      b. explanation of medical terms
      c. strategies to improve understanding
   3. patient education (e.g., explanation of current procedure purpose, exam length)

C. Physical Assistance and Monitoring
   1. patient transfer and movement
      a. body mechanics (e.g., balance, alignment, movement)
      b. patient transfer techniques
   2. assisting patients with medical equipment (e.g., oxygen delivery systems, urinary catheters)
   3. routine monitoring
      a. vital signs
      b. physical signs and symptoms (e.g., motor control, severity of injury)
      c. fall prevention
      d. documentation

D. Medical Emergencies
   1. allergic reactions (e.g., contrast media, latex)
   2. cardiac or respiratory arrest (e.g., CPR)
   3. physical injury or trauma
   4. other medical disorders (e.g., seizures, diabetic reactions)

* The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)

CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

APPROVED BY CALIFORNIA: **SEPT 19, 2017**
IMPLEMENTATION DATE: **JULY 1, 2018**

Patient Care (continued)

E. Infection Control
   1. cycle of infection
      a. pathogen
      b. reservoir
      c. portal of exit
      d. mode of transmission
         1. direct
            a. droplet
            b. direct contact
         2. indirect
            a. airborne
            b. vehicle borne–fomite
            c. vector borne–mechanical or biological
      e. portal of entry
      f. susceptible host
   2. asepsis
      a. equipment disinfection
      b. equipment sterilization
      c. medical aseptic technique
      d. sterile technique
   3. CDC Standard Precautions
      a. hand hygiene
      b. use of personal protective equipment (e.g., gloves, gowns, masks)
      c. safe injection practices
      d. safe handling of contaminated equipment/surfaces
      e. disposal of contaminated materials
         1. linens
         2. needles
         3. patient supplies
         4. blood and body fluids
   4. transmission-based precautions
      a. contact
      b. droplet
      c. airborne
   5. additional precautions
      a. neutropenic precautions (reverse isolation)
      b. healthcare associated (nosocomial) infections

F. Handling and Disposal of Toxic or Hazardous Material
   1. chemicals
   2. safety data sheet (e.g., material safety data sheets)

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CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

APPROVED BY CALIFORNIA: **SEPT 19, 2017**
IMPLEMENTATION DATE: **JULY 1, 2018**

Safety

1. Radiation Physics and Radiobiology

A. Principles of Radiation Physics
   1. x-ray production
      a. source of free electrons (e.g., thermionic emission)
      b. acceleration of electrons
      c. focusing of electrons
      d. deceleration of electrons
   2. target interactions
      a. bremsstrahlung
      b. characteristic
   3. x-ray beam
      a. frequency and wavelength
      b. beam characteristics
         1. quality
         2. quantity
         3. primary versus remnant (exit)
      c. inverse square law
      d. fundamental properties (e.g., travel in straight lines, ionize matter)
   4. photon interactions with matter
      a. Compton effect
      b. photoelectric absorption
      c. coherent (classical) scatter
      d. attenuation by various tissues
         1. thickness of body part
         2. type of tissue (atomic number)

B. Biological Aspects of Radiation
   1. SI units of measurement
      a. absorbed dose
      b. dose equivalent
      c. exposure
      d. effective dose
   2. radiosensitivity
      a. dose-response relationships
      b. relative tissue radiosensitivities (e.g., LET, RBE)
      c. cell survival and recovery (LD50)
      d. oxygen effect
   3. somatic effects
      a. short-term versus long-term effects
      b. acute versus chronic effects
      c. carcinogenesis
      d. organ and tissue response (e.g., eye, thyroid, breast, bone marrow, skin, gonadal)
   4. acute radiation syndromes
      a. hemopoietic
      b. gastrointestinal (GI)
      c. central nervous system (CNS)
   5. embryonic and fetal risks
   6. genetic impact
      a. genetically significant dose
      b. goals of gonadal shielding

(Safety continues on the following page.)

4

CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

APPROVED BY CALIFORNIA: **SEPT 19, 2017**
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Safety (continued)

2. Radiation Protection

A. Minimizing Patient Exposure
   1. exposure factors
      a. kVp
      b. mAs
   2. shielding
      a. rationale for use
      b. types
      c. placement
   3. beam restriction
      a. purpose of primary beam restriction
      b. types (e.g., collimators)
   4. filtration
      a. effect on skin and organ exposure
      b. effect on average beam energy
      c. NCRP recommendations (NCRP #102, minimum filtration in useful beam)
   5. patient considerations
      a. positioning
      b. communication
      c. pediatric
      d. morbid obesity
   6. radiographic dose documentation
   7. image receptors
   8. dose area product (DAP) meter

B. Personnel Protection (ALARA)*
   1. sources of radiation exposure
      a. primary x-ray beam
      b. secondary radiation
         1. scatter
         2. leakage
      c. patient as source
   2. basic methods of protection
      a. time
      b. distance
      c. shielding
   3. protective devices
      a. types
      b. attenuation properties
      c. minimum lead equivalent (NCRP #102)
   4. radiation exposure and monitoring
      a. dosimeters
         1. types
         2. proper use
      b. NCRP recommendations for personnel monitoring (NCRP #116)
         1. occupational exposure
         2. public exposure
         3. embryo/fetus exposure
         4. dose equivalent limits
         5. evaluation and maintenance of personnel dosimetry records

* Note: Although it is the responsibility of the individual with this permit to apply radiation protection principles to minimize bioeffects for both patients and personnel, the ALARA concept is specific to personnel protection and is listed only for that section.

Image Production

1. Image Acquisition and Technical Evaluation

A. Selection of Technical Factors Affecting Radiographic Quality
Refer to *Attachment A* to clarify terms that may occur on the exam. (X indicates topics covered on the examination.)

	1. Receptor Exposure	2. Contrast	3. Spatial Resolution	4. Distortion
a. mAs	X			
b. kVp	X	X		
c. OID		X (air gap)	X	X
d. SID	X		X	X
e. focal spot size			X	
f. tube filtration	X	X		
g. beam restriction	X	X		
h. motion			X	
i. anode heel effect	X			
j. patient factors (size, pathology)	X	X	X	X
k. angle (tube, part, or receptor)			X	X

B. Technique Charts
   1. anatomically programmed technique
   2. caliper measurement
   3. fixed versus variable kVp
   4. special considerations
      a. pathologic factors
      b. age (e.g., pediatric, geriatric)
      c. body mass index (BMI)

C. Digital Imaging Characteristics
   1. spatial resolution (equipment related)
      a. pixel characteristics (e.g., size, pitch)
      b. detector element (DEL) (e.g., size, pitch, fill factor)
      c. matrix size
      d. sampling frequency
   2. contrast resolution (equipment related)
      a. bit depth
      b. modulation transfer function (MTF)
      c. detective quantum efficiency (DQE)
   3. image signal (exposure related)
      a. dynamic range
      b. quantum noise (quantum mottle)
      c. signal to noise ratio (SNR)
      d. contrast to noise ratio (CNR)

D. Image Identification
   1. methods (e.g., radiographic, electronic)
   2. legal considerations (e.g., patient data, examination data)

(Image Production continues on the following page.)

Image Production (continued)

2. Equipment Operation and Quality Assurance

A. Imaging Equipment
1. components of radiographic unit (fixed or mobile)
   a. operating console
   b. x-ray tube construction
      1. electron source
      2. target materials
      3. induction motor
   c. manual exposure controls
   d. beam restriction
2. x-ray generator, transformers and rectification system
   a. basic principles
   b. tube loading
3. components of digital imaging
   a. CR components
      1. plate (e.g., photo-stimulable phosphor [PSP])
      2. plate reader
   b. DR image receptors
      1. flat panel
      2. charge coupled device (CCD)
      3. complementary metal oxide semiconductor (CMOS)

B. Image Processing and Display
1. raw data (pre-processing)
   a. analog-to-digital converter (ADC)
   b. quantization
   c. corrections (e.g., rescaling, flat fielding, dead pixel correction)
   d. histogram
2. corrected data for processing
   a. grayscale
   b. edge enhancement
   c. equalization
   d. smoothing
3. data for display
   a. values of interest (VOI)
   b. look-up table (LUT)
4. post-processing
   a. brightness
   b. contrast
   c. region of interest (ROI)
   d. electronic cropping or masking
   e. stitching
5. display monitors
   a. viewing conditions (e.g., viewing angle, ambient lighting)
   b. spatial resolution (e.g., pixel size, pixel pitch)
   c. brightness and contrast
6. imaging informatics
   a. DICOM
   b. PACS
   c. RIS (modality work list)
   d. HIS
   e. EMR or EHR

(Image Production continues on the following page.)

CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

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Image Production (continued)

C. Criteria for Image Evaluation of Technical Factors
   1. exposure indicator
   2. quantum noise (quantum mottle)
   3. gross exposure error (e.g., loss of contrast, saturation)
   4. contrast
   5. spatial resolution
   6. distortion (e.g., size, shape)
   7. identification markers (e.g., anatomical side, patient, date)
   8. image artifacts
   9. radiation fog

D. Quality Control of Imaging Equipment and Accessories
   1. beam restriction
      a. light field to radiation field alignment
      b. central ray alignment
   2. recognition and reporting of malfunctions
   3. digital imaging receptor systems
      a. maintenance (e.g., detector calibration, plate reader calibration)
      b. QC tests (e.g., erasure thoroughness, plate uniformity, spatial resolution)
      c. display monitor quality assurance (e.g., grayscale standard display function, luminance)
   4. shielding accessories (e.g., lead apron, glove testing)

8

Attachment A
ARRT Standard Definitions

Digital Radiography	Digital Radiography includes both computed radiography and direct radiography. *Computed Radiography (CR)* systems use storage phosphors to temporarily store energy representing the image signal. The phosphor then undergoes a process to extract the latent image. *Direct Radiography (DR)* systems have detectors that directly capture and readout an electronic image signal.
Spatial Resolution	The sharpness of the structural edges recorded in the image.
Receptor Exposure	The amount of radiation striking the image receptor.
Brightness	Brightness is the measurement of the luminance of an area in a radiographic image displayed on a monitor. It is calibrated in units of candela (cd) per square meter.
Contrast	Contrast is the visible difference between any two selected areas of brightness levels within the displayed radiographic image. It is determined primarily by the processing algorithm (mathematical codes used by the software to provide the desired image appearance). The default algorithm determines the initial processing codes applied to the image data. *Grayscale* refers to the number of brightness levels (or gray shades) visible on an image and is linked to the bit depth of the system. *Long Scale* is the term used when slight differences between gray shades are present (low contrast) but the total number of gray shades is great. *Short Scale* is the term used when considerable or major differences between gray shades are present (high contrast) but the total number of gray shades is small.
Dynamic Range	The range of exposures that may be captured by a detector.
Receptor Contrast	The fixed characteristic of the receptor. Most digital receptors have an essentially linear response to exposure. This is impacted by **contrast resolution** (the smallest exposure change or signal difference that can be detected). Ultimately, contrast resolution is limited by the **quantization** (number of bits per pixel) of the analog-to-digital convertor.
Exposure Latitude	The range of exposures which produces quality images at appropriate patient dose.
Subject Contrast	The magnitude of the signal difference in the remnant beam as a result of the different absorption characteristics of the tissues and structures making up that part.

CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

APPROVED BY CALIFORNIA: **SEPT 19, 2017**
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Attachment B

Task Inventory for the California Radiography Supervisor and Operator Examination

	Activity	**Content Categories** Legend: PC = Patient Care, S = Safety, IP = Image Production
1.	Confirm patient's identity.	PC.1.A.2.A., PC.1.B., IP.1.D.
2.	Evaluate patient's ability to understand and comply with requirements for the requested examination.	PC.1.B.
3.	Obtain pertinent medical history.	PC.1.A.2.A., PC.1.B.
4.	Manage complex interpersonal interactions within the workplace in an effective manner.	PC.1.B.2.
5.	Review imaging examination request to verify accuracy and completeness of information (e.g., patient history, clinical diagnosis, physician's orders).	PC.1.A.2.A.
6.	Respond as appropriate to imaging study inquiries from patients.	PC.1.B.
7.	Assume responsibility for medical equipment attached to patients (e.g., IVs, oxygen) during the imaging procedures.	PC.1.C.2.
8.	Follow environmental protection standards for handling and disposing of bio-hazardous materials (e.g., sharps, blood, and body fluids).	PC.1.E.3.E.
9.	Provide for patient safety, comfort, and modesty.	PC.1.A., PC.1.C.
10.	Notify appropriate personnel of adverse events or incidents (e.g., patient fall, wrong patient imaged).	PC.1.A.2.A., PC.1.C.3., IP.1.D.
11.	Communicate scheduling delays to waiting patients.	PC.1.B.
12.	Demonstrate and promote professional and ethical behavior.	PC.1.A., PC.1.B.
13.	Verify informed consent as necessary.	PC.1.A.1.A., PC.1.B.
14.	Communicate relevant information to others (e.g., M.D.s, RNs, other radiology personnel).	PC.1.A., PC.1.B., PC.1.C.3.D.
15.	Explain procedure instructions to patient or patient's family.	PC.1.B.3.
16.	Practice Standard Precautions.	PC.1.E.3.
17.	Follow appropriate procedures when caring for patients with communicable diseases.	PC.1.E.3., PC.1.E.4., PC.1.E.5.
18.	Use immobilization devices, as needed, to prevent patient movement and/or ensure patient safety.	PC.1.A.2.D.
19.	Use proper body mechanics when assisting a patient.	PC.1.C.1.A.
20.	Use patient transfer devices when needed.	PC.1.C.1.B.
21.	Use sterile or aseptic technique when indicated.	PC.1.E.2.
22.	Follow environmental protection standards for handling hazardous materials.	PC.1.F.
23.	Obtain vital signs.	PC.1.C.3.A.
24.	Recognize and communicate the need for prompt medical attention.	PC.1.C.3., PC.1.D.
25.	Administer emergency care.	PC.1.C.2., PC.1.C.3., PC.1.D.
26.	Explain post-procedural instructions to patient or patient's family.	PC.1.B.3.
27.	Maintain confidentiality of patient information.	PC.1.A.1.B., PC.1.A.3.

CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

APPROVED BY CALIFORNIA: **SEPT 19, 2017**
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Activity		**Content Categories** Legend: PC = Patient Care, S = Safety, IP = Image Production
28.	Clean, disinfect, or sterilize facilities and equipment, and dispose of contaminated items in preparation for next examination.	PC.1.E.2., PC.1.E.3.
29.	Document required information on patient's medical record (e.g., imaging procedure documentation, images). a. On paper b. Electronically	PC.1.B.1.A., PC.1.C.3.D., IP.1.D., IP.2.B.6.
30.	Evaluate the need for and use of protective shielding.	S.2.A.2., S.2.B.3.
31.	Take appropriate precautions to minimize radiation exposure to the patient.	S.2.A.
32.	Question female patient of child-bearing age about date of last menstrual period or possible pregnancy and take appropriate action (e.g., document response, contact physician).	PC.1.B., S.1.B.5., S.1.B.6.
33.	Restrict beam to the anatomical area of interest.	S.2.A.3., IP.1.A.1.G., IP.1.A.2.G.
34.	Set technical factors to produce diagnostic images and adhere to ALARA.	S.2.A., IP.1.A., IP.1.B.
35.	Document radiographic procedure dose.	S.2.A.6., IP.2.B.6.E.
36.	Prevent all unnecessary persons from remaining in area during x-ray exposure.	S.2.B.4.B.
37.	Take appropriate precautions to minimize occupational radiation exposure.	S.2.B.
38.	Advocate radiation safety and protection.	S.1.B., S.2.A., S.2.B.4.B.
39.	Describe the potential risk of radiation exposure when asked.	PC.1.B.3., S.1.B.
40.	Wear a personnel monitoring device while on duty.	S.2.B.4.A.
41.	Evaluate individual occupational exposure reports to determine if values for the reporting period are within established limits.	S.2.B.4.B.
42.	Determine appropriate exposure factors using the following: a. Fixed kVp technique chart b. Variable kVp technique chart c. Calipers (to determine patient thickness for exposure) d. Anatomically programmed technique*	IP.1.A., IP.1.B.
43.	Select radiographic exposure factors. a. Automatic Exposure Control (AEC)* b. kVp and mAs (manual)	IP.1.A., IP.1.B., IP.1.C.
44.	Operate radiographic unit and accessories including: a. Fixed unit b. Mobile unit (portable)	IP.2.A.1., IP.2.A.2., IP.2.A.3.
45.	Operate electronic imaging and record keeping devices including: a. Computed radiography (CR) with photostimulable storage phosphor (PSP) plates b. Direct radiography (DR) c. Picture archiving and communication system (PACS) d. Hospital information system (HIS) e. Radiology information system (RIS) f. Electronic medical record (EMR) system	IP.2.A.3., IP.2.B.

* Applies to specific modules

11

CALIFORNIA RADIOGRAPHY SUPERVISOR AND OPERATOR EXAMINATION CONTENT SPECIFICATIONS

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Activity		Content Categories Legend: PC = Patient Care, S = Safety, IP = Image Production
46.	Modify technical factors to correct for noise in a digital image.	IP.1.D.3.B., IP.2.C.
47.	Remove all radiopaque materials from patient or table that could interfere with the image (e.g., clothing removal, jewelry removal).	PC.1.B.3.A., IP.2.C.8.
48.	Perform post-processing on digital images in preparation for interpretation.	IP.2.B.4.
49.	Use radiopaque anatomical side markers at the time of image acquisition.	IP.1.E., IP.2.C.7.
50.	Add electronic annotations on digital images to indicate position or other relevant information (e.g., time, upright, decubitus, post-void).	PC.1.A.2.E., IP.1.E., IP.2.C.7.
51.	Select equipment and accessories (e.g., grid*, compensating filter*, shielding) for the examination requested.	S.2.A.2.
52.	Explain breathing instructions prior to making the exposure.*	PC.1.B.3.A., IP.1.A.3.H.
53.	Modify exposure factors for circumstances such as involuntary motion, casts and splints*, pathological conditions, or patient's inability to cooperate.	IP.1.A.3.H., IP.1.A.3.J., IP.1.B.
54.	Verify accuracy of patient identification on image.	IP.1.E., IP.2.C.7.
55.	Evaluate images for diagnostic quality.	IP.2.C., IP.2.D.
56.	Respond appropriately to digital exposure indicator values.	IP.2.C.1.
57.	Determine corrective measures if image is not of diagnostic quality and take appropriate action.	IP.2.C.
58.	Identify image artifacts and make appropriate corrections as needed.	IP.2.C.8.
59.	Store and handle image receptor in a manner which will reduce the possibility of artifact production.	IP.2.C.8., IP.2.C.9., IP.2.D.3.
60.	Visually inspect, recognize, and report malfunctions in the imaging unit and accessories.	IP.2.C.8., IP.2.D.2.
61.	Recognize the need for periodic maintenance and evaluation of radiographic equipment affecting image quality and radiation safety (e.g., shielding, image display monitor, light field, central ray detector calibration).	IP.2.D.
62.	Perform routine maintenance on digital equipment including: a. Detector calibration b. CR plate erasure c. Equipment cleanliness d. Test images	IP.2.D.3.
63.	Adapt radiographic procedures for patient condition (e.g., age, size, trauma, pathology) and location (e.g., mobile, surgical, isolation).	PC.1.C., PC.1.E., S.2.A.5., IP.1.
64.	Select appropriate geometric factors (e.g., SID, OID, focal spot size, tube angle).	IP.1.A.

* Applies to specific modules

Computer-Based Testing Overview

After you have completed check-in procedures, test-center staff will show you to a workstation and will make sure the computer is ready to deliver your exam. The testing session consists of four segments:

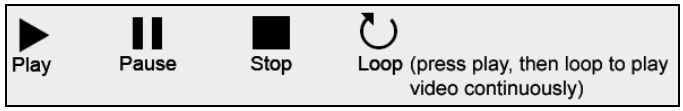
1. **Introduction, Tutorial, and Non-Disclosure Agreement:** During this segment, the computer will verify your name and allow you to complete a tutorial if you choose. We strongly urge candidates to spend the few minutes to take the tutorial. You will also be asked to read and accept a non-disclosure agreement – it requires that all candidates agree to ***not*** copy any test questions or otherwise disclose the content of the exam. You must accept the terms of the non-disclosure agreement; if you do not respond within 2 minutes your exam session will end. The entire introductory segment will take anywhere from a few minutes up to 10 minutes, depending on how much time you spend reviewing the tutorial. You will have up to eight minutes to review the tutorial.

2. **Examination Session:** You will be given the exam during this period. In addition to answering questions, you can mark questions for later review or even comment on questions. The clock will be running, so pace yourself. Most questions are in the standard multiple-choice format and require you to select one best answer. In addition, a small portion of the exam may consist of the question formats noted below:

    a. *Select Multiple*: This format consists of a question or statement followed by a list of 4 to 10 response options. You are required to select all options that are correct.

    b. *Sorted List*: This format presents a list of 4 to 8 options and requires you to place them in correct sequence. You accomplish this by using the mouse to "click-and-drag" the options into a box so that they end up in a specified order, such as numerical, alphabetical or chronological.

    c. *Items with Hot Areas or Videos*: This format consists of a question accompanied by a medical image, drawing, graphic, or video.
    To answer a 'hot area' question, place the cursor over the selected area and click the mouse; the highlighted areas are possible answers to the question. When selected, the area will become outlined and change color. To change your answer, move the mouse to another shaded area and click the mouse. The final selected shaded area will be recorded as your final answer.
    For video items, you will need to read the question, open the exhibit, press the play arrow on the video, watch the video in its entirety, and then answer the question. You will not be able to move forward on the exam until you have opened and watched the entire video. The video controls are shown and described below. **Note: The videos are silent (no sound).**



Sample questions illustrating these formats can be obtained from the ARRT website (Examinations>Exam Format and Length), or by contacting the ARRT. In addition, the tutorial at the test center presents an example of each format.

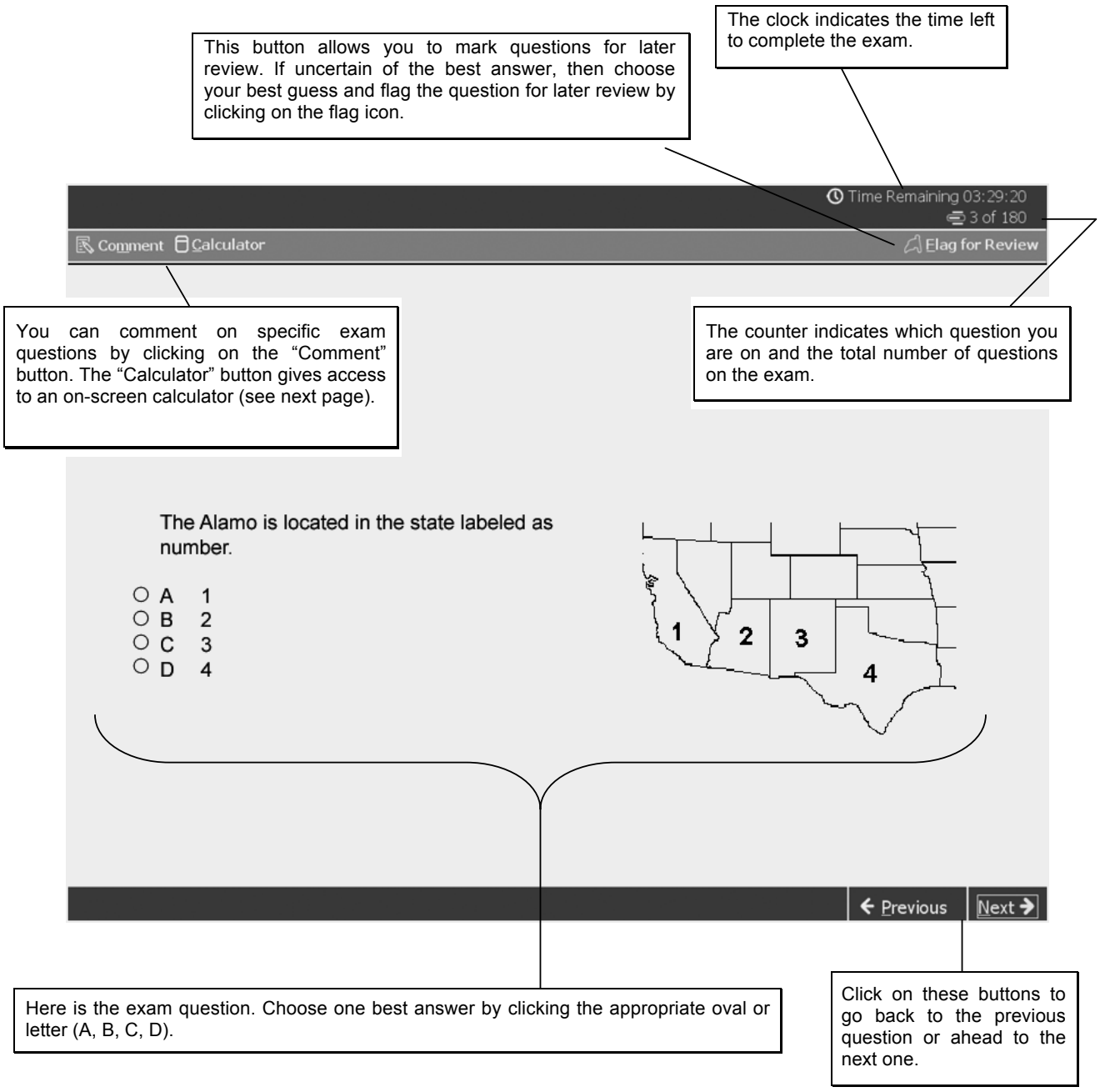
3. **Item Review and End Review:** After responding to all questions, you will have the opportunity to go back and review questions in the time remaining. You can change answers during the review. Once you select the "End Review" button you will no longer be able to go back to the exam. A sample review screen appears later in this Appendix.

4. **Survey:** After the exam a short survey will appear. Most people complete it in just a few minutes. The survey is important because it gives you the opportunity to let ARRT know about the quality of your testing experience. If something went wrong – or exceptionally right – this is the place to tell us.

The following pages illustrate the approximate appearance of a few of the more important computer screens. Taking a few minutes now to review these pages will help prepare you for exam day.

Appearance of Test Questions

When the examination starts, the clock will be reset to the time allowed for the exam you are taking (see Exam Timing under the Exam Administration Day Section of the handbook to find the time allotted for your exam). Exam questions are presented in random order. The exam consists of a set number of scored questions plus several unscored pilot questions. The content specifications provide additional information about the number of questions and topics covered. This information is also provided in the tutorial at the test center.



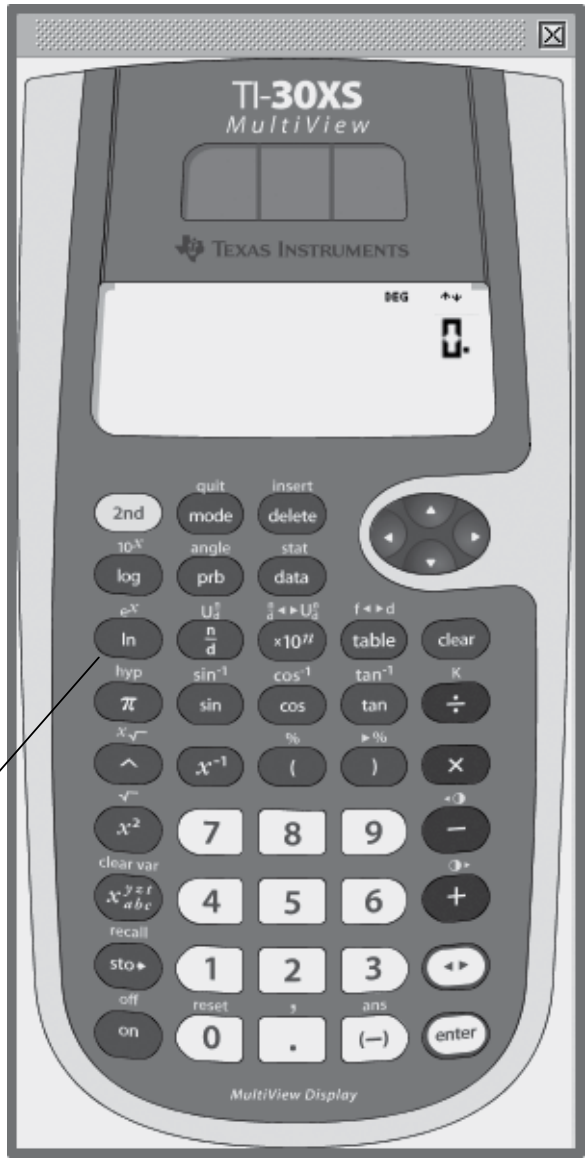
Online Calculator

To use the calculator, click on the "Calculator" button at the upper left side of the exam screen. You can operate the calculator by using the mouse to click on numbers or arithmetic operations. Alternatively, the keyboard can be used. **Note: Please make sure to check the display screen on the calculator to verify the correct entry of numbers.**

The "Modes" button on the calculator allows you to toggle between the Standard and Scientific calculators. Note that most calculations on the exam can be done with the Standard calculator. However, some candidates may wish to use the Scientific calculator for certain calculations.

Standard

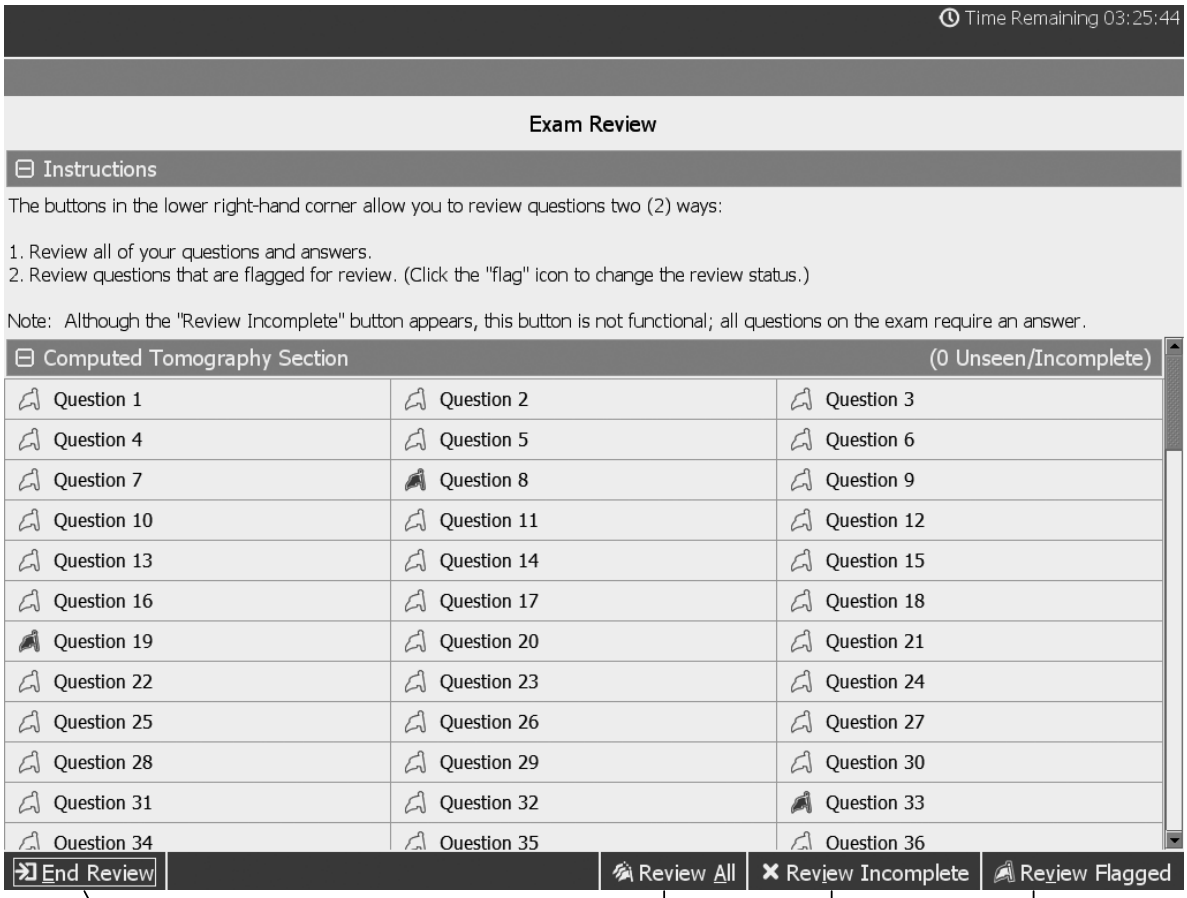
Scientific



Some calculations may require the use of the natural logarithm function ("ln" key) or the e^x function ("2nd" key, then "ln" key). First press the key for the function that you would like, then enter the relevant number for the calculation.

Exam Review

After you have completed all questions on the exam, a screen appears that allows you to go back to review questions. A filled-in flag icon appears next to any questions that you selected for review.



This button ends the exam. When you are done with your review, click this button to exit.

Once you click "End Review" you will no longer be able to review questions or change answers, **so be sure you are really ready to stop!**

You can return and review all questions on the exam by clicking on the "Review All" button.

You can return to the questions you selected for review by clicking on the "Review Flagged" button. To review all items on the exam, just click on "Review All."

If you click this button you will see that you have no incomplete questions, because skipping of questions is not an option on ARRT exams.

After the Examination

After you click "End Review" and confirm that you will not be able to return to the exam, a screen will appear to remind you not to discuss questions and/or answers with anyone.

A short survey appears on the screen. It asks a few important questions about the quality of the test administration and provides a place for you to type any general comments. We appreciate your feedback.

Computer-Based Testing Overview

After you have completed check-in procedures, test-center staff will show you to a workstation and will make sure the computer is ready to deliver your exam. The testing session consists of four segments:

1. **Introduction, Tutorial, and Non-Disclosure Agreement:** During this segment, the computer will verify your name and allow you to complete a tutorial if you choose. We strongly urge candidates to spend the few minutes to take the tutorial. You will also be asked to read and accept a non-disclosure agreement – it requires that all candidates agree to ***not*** copy any test questions or otherwise disclose the content of the exam. You must accept the terms of the non-disclosure agreement; if you do not respond within 2 minutes your exam session will end. The entire introductory segment will take anywhere from a few minutes up to 10 minutes, depending on how much time you spend reviewing the tutorial. You will have up to eight minutes to review the tutorial.

2. **Examination Session – Modules:** The Limited Scope of Practice in Radiography Exam is delivered in modules. The modules are Core, Chest, Extremities, Skull/Sinuses, Spine, and Podiatric (refer to the Content Specifications for details). Candidates may take some or all modules, depending on the type of license offered by your state.

   Which Modules. The computer will present ***only*** those modules that were assigned to you by your state licensing agency. Those same modules are printed on your *Candidate Status Report*.

   Time Allowed. Each module is separately timed. The amount of time is determined by the number of questions in a module, at a rate of about 1 minute per question. Each of the radiographic procedure modules include five additional unscored questions. It is important to pace yourself so that you complete each module within the allotted time.

   Review Session. The computer requires that you answer every question. If you are unsure of an answer to a question, you can "mark" the question and come back to it later. After you have answered all questions in a module, a review screen allows you to go back to any questions you marked. You can change answers during the review. When done reviewing questions, you can end the module. Extra time is not given for the review session; it must be completed during the time allowed for each module. A sample review screen is presented later in this Appendix.

3. **Item Review and End Review:** After responding to all questions within a module, you will have the opportunity to go back and review questions in the time remaining. You can change answers during the review. Once you select the "End Review" button, the module ends and you will no longer be able to go back and review questions in that module. At this point, one of two things happen: (1) If you have additional modules to complete, the next module will appear; (2) If you do not have additional modules to complete, the exam ends. A sample review screen appears later in this Appendix.

4. **Survey:** After the exam a short survey will appear. Most people complete it in just a few minutes. The survey is important because it gives you the opportunity to let ARRT know about the quality of your testing experience. If something went wrong – or exceptionally right – this is the place to tell us.

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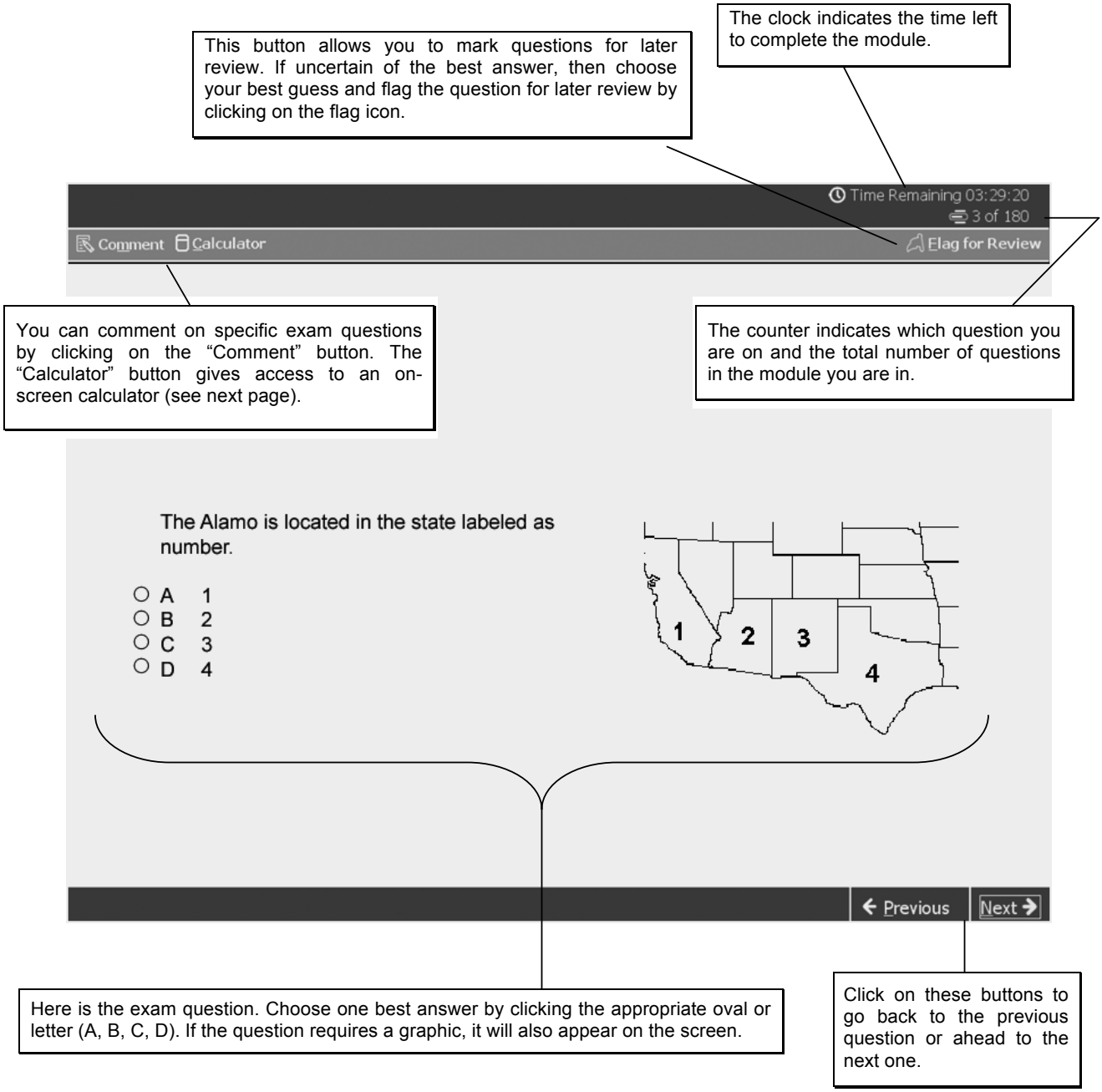
Appearance of Test Questions

When the examination starts, the clock will be reset to the time allowed for the module you are taking. Both the scored and unscored exam questions are presented in random order within each module. The content specifications provide additional information about the number of questions and topics covered.



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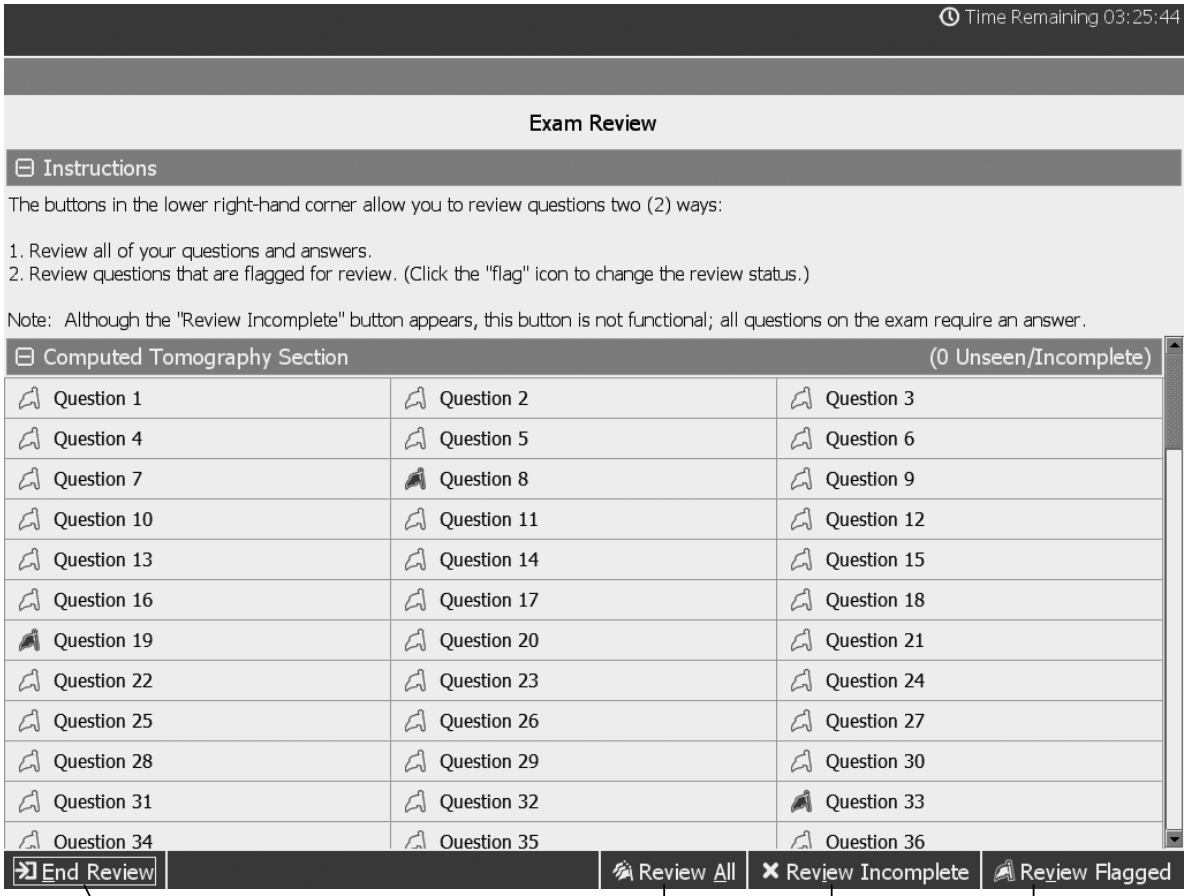
Standard

Scientific

Some calculations may require the use of the natural logarithm function ("ln" key) or the e^x function ("2nd" key, then "ln" key). First press the key for the function that you would like, then enter the relevant number for the calculation.

Exam Review

After you have completed all questions in a module, a screen appears that allows you to go back to review questions. A filled-in flag icon appears next to any questions that you selected for review.



This button ends the module. When you are done with your review, click this button to exit.

Once you click "End Review" you will no longer be able to review questions or change answers within that module, **so be sure you are really ready to stop!**

You can return and review all questions within the module by clicking on the "Review All" button.

You can return to the questions you selected for review by clicking on the "Review Flagged" button. To review all items within the module, just click on "Review All."

If you click this button you will see that you have no incomplete questions, because skipping of questions is not an option on ARRT exams.

After the Examination

After you click "End Review" (at the end of your last module) and confirm that you will not be able to return to the exam, a screen will appear to remind you not to discuss questions and/or answers with anyone.

A short survey appears on the screen. It asks a few important questions about the quality of the test administration and provides a place for you to type any general comments. We appreciate your feedback.

Potential Exam Disclosure Scenarios

Scenario	When it's OK	When it's not OK	Bottom line
Educator asks candidates to "stop by" after the exam to "let me know how it went."	If the invitation and the feedback to the educator relates to their general experience ("I thought the test was not as difficult as I expected…").	This type of invitation from an educator may be misinterpreted by the candidate — and the student may think that the educator is asking the candidate to reveal copyrighted information.	If the candidate is asked to reveal ARRT's questions or their answer options, then he or she will need to report the educator to the ARRT Ethics Committee. The educator should stop the candidate immediately from revealing any exam content, since doing so may subject both the candidate and educator to ARRT's ethics process.
Candidate tells another candidate, "The test was very difficult — I felt like I didn't have enough time."	The candidate is simply telling another candidate how they felt about the exam. This is all right because the candidate is not revealing any of ARRT's questions or the answer options.	One candidate (or potential candidate) asks another candidate about the specific questions.	If ARRT's questions or answer options are shared, these individuals may find themselves part of an ARRT ethics investigation and/or legal complaint.
Candidate to educator: "You didn't teach me about this question that asked [specific question]. I felt unprepared."	Never.	It is not all right and it will never be all right to reveal ARRT's copyrighted questions (or answer options) to anyone.	Candidates sign numerous documents stating that they will not share exam questions, and ARRT expects the candidates to abide by those contracts. Those who don't may find themselves part of an ARRT ethics investigation and/or legal complaint.
Candidate tells a potential candidate that there were multiple-choice and sorted-list questions on the test.	This is public information, noted in the certification and registration handbook.	It's not all right to reveal anything beyond what's in the handbook.	Keep the conversation limited to what's public information, such as the content specifications, and there's no problem.
Candidate asks another candidate, "I don't think that I understood this question…[relates question]… Do you know what they were asking?"	Never.	It is not all right and it will never be all right to reveal ARRT's copyrighted questions (or answer options) to anyone.	As noted two boxes up, candidates sign numerous documents stating that they will not share exam questions, and ARRT expects the candidates to abide by those contracts. Those who don't may find themselves part of an ARRT ethics investigation and/or legal complaint.
Candidate says to a potential candidate, "If I were you, I would bring a sweater — it was cold at the test site."	This candidate is simply telling another candidate about their surroundings at the test site. This is all right because the candidate is not revealing any of ARRT's questions or the answer options.	If it leads a candidate (or potential candidate) to ask another candidate about the specific questions.	If ARRT's questions or answer options are shared, these individuals may find themselves part of an ARRT ethics investigation and/or legal complaint.
Potential candidate says to a candidate, "Were there a lot of questions on [specific topic]?"	Never.	This candidate should be aware of the topics that are contained in the exam from the content specifications published in the certification and registration handbooks and should not be asking for more specific information than is contained in that publication.	If the potential candidate is asking the candidate to reveal ARRT's questions or the answer options, then this conversation violates both the *ARRT Standards of Ethics* and the legal contract that both the candidate and the potential candidate have signed. If asked this type of question, the potential candidate should be shown the content specifications and should be warned of the consequences of revealing ARRT's copyrighted questions or their answer options.

Pearson VUE

ARRT Rules Agreement

Please review the following information and ask the Test Administrator if you have questions.

1.	ARRT has a zero-tolerance policy regarding possession of cell phones and other electronic devices at the test center. If you are found to be in possession of, or otherwise have access to, one of these devices after initial check-in (including during scheduled or unscheduled breaks), you will not be allowed to resume your exam or assessment, you will forfeit your exam or assessment fee, your score will be canceled, and it will count as an attempt in your three-attempt, three-year time period. For SSA participants, you will be assigned the full prescription for your discipline. Should you bring an electronic device into the test center, you must turn off the device and store it in one of the test center's lockers before you enter the testing room. Do not access your electronic device again until you have fully completed your exam or assessment.
2.	Jewelry that is wider than 1/4 in (1 cm) is not permitted inside the testing room, and you will be asked to remove it.
3.	Do not use the booklet provided by the Test Administrator until after you have responded to the Non-Disclosure Agreement. If you need a clean booklet during the exam or assessment, you should raise your hand to get the Test Administrator's assistance. You must return all items to the Test Administrator after completing your exam or assessment.
4.	Eating, drinking, smoking, chewing gum, and making noise that creates a disturbance for other candidates is prohibited during the exam or assessment.
5.	The Test Administrator will monitor you continuously while you complete your exam or assessment. The session may be videotaped or otherwise recorded for security or other purposes.
6.	If you experience problems that affect your ability to complete your exam or assessment, notify the Test Administrator immediately by raising your hand. The Test Administrator cannot answer questions related to exam or assessment content and performance.
7.	To request an unscheduled break, you must raise your hand to get the Test Administrator's attention. The exam or assessment timer will not stop while you are on an unscheduled break. The Test Administrator will sign you out after you leave the testing room. Before returning to your seat, the Test Administrator will sign you in; after being signed in, you may resume your exam or assessment.
8.	You should not remove any items from your secure locker. If you must access a personal item, such as an item needed to take to the restroom, this is allowed after notifying the Test Administrator. However, if you access any other prohibited item from the secure locker (cell phone, books, notes, etc.), your score will be canceled, your testing fees will not be refunded, and it will count as an attempt in your three-attempt, three-year time period. **Note:** During scheduled breaks, Registered Radiology Assistant (RA) and Sonography (SON) candidates may access their locker in order to retrieve snacks. You may not access any electronic devices during your scheduled break.
9.	You may not leave the building for any reason (unless directed to leave by the Test Administrator); this includes all scheduled and unscheduled breaks. If you leave the building you will not be allowed to resume your exam or assessment, you will forfeit your exam or assessment fee, and your score will be canceled. The exam will count as an attempt in your three-attempt, three-year period. For SSA participants, you will be assigned the full prescription for your discipline.
10.	Do not remove copies of exam or assessment questions and answers from the testing room (including by writing on your person or clothing). Do not share exam or assessment questions and answers with anyone. Reproduction of exam or assessment questions and answers, in whole or part, constitutes a breach of your agreement, and you can/will be prosecuted in federal or state court. Depending upon your candidate or participant status, this will also result in score cancelation, future certification and registration ineligibility, and/or discontinuation of your certification and registration.
11.	After completing your exam or assessment, raise your hand. The Test Administrator will come to your workstation to ensure your exam or assessment has ended properly and will escort you from the testing room.
12.	If you do not follow the rules, are suspected of cheating or tampering with the computer, and/or demonstrate irregular behavior the issue will be reported to Pearson VUE, the ARRT, and your state licensing agency (if applicable). Your exam or assessment may be invalidated, the ARRT may take other action such as canceling your score, and you will not be refunded your exam or assessment fee.

Candidate/Participant Statement: *By providing a digital signature, I give Pearson VUE my explicit consent to retain and transmit my personal data and test responses to the Pearson VUE corporate office and the ARRT (either of which may be outside of the country in which I am testing). I understand the information provided above and agree to abide by the ARRT Rules Agreement. In addition, I understand that if I am found to be in violation of any rule listed above, this will constitute grounds for the ARRT to take appropriate punitive action up to and including terminating my participation in the exam or assessment, invalidating the results of this exam or assessment and any prior exam or assessment, and permanently barring me from all future exams or assessments. In addition, I understand I may be subject to an ARRT ethics investigation or even a federal court lawsuit for copyright infringement and/or breach of contract. Any information collected by an ARRT investigation may be forwarded to my state licensing agency for review of state ethics violations.*

ARRT Candidate Rules Agreement Version 3.8 / October 2020

California Licensing/Permit Examination Handbook Checklist

When you review your Candidate Status Report (CSR) from ARRT…and before scheduling your exam you will want to check…

- Does your name on your CSR match the name appearing on your two forms of required ID?
  – If your names do not match, do not schedule an appointment. Contact CDPH-RHB to make the necessary changes and have them notify ARRT so we can mail you a new CSR with your updated info. Updates will also appear on your online CSR.
  – Once you verify the changes to your CSR are correct, go ahead and schedule your exam.

- Name or address change after you review your information from ARRT?
  – All changes must be made via the CDPH-RHB office.

- Be sure to note the different dates on your CSR. Your 90-day exam window is different than your 1-year CDPH-RHB eligibility period.
  – You must schedule your exam for a time within the 90-day exam window appearing on your CSR
  – Your 1-year CDPH-RHB eligibility period allows you to complete 3 attempts within the one-year period listed on your CSR.

- If you can't take your exam within your 90-day exam window, you are allowed up to 3 extensions.
  – Cancel any existing appointment.
  – Print the window extension request form located at www.state.arrt.org.
  – Fax to ARRT at 651.681.3294 before the last day of your existing 90-day window.
  – A new CSR will be mailed to you once the request has been processed at ARRT.
  – Updates will also appear on your online CSR at www.state.arrt.org.

- Required IDs at the test center.
  – Make sure your IDs meet ARRT's requirements listed in the handbook to prevent being turned away from the test center and losing your fee.
  – If you are unsure, cancel your appointment and reschedule when you are certain your IDs will be acceptable.

- Questions on exam results?
  – ARRT processes results each week and provides your score information to CDPH-RHB.
  – CDPH-RHB determines your pass/fail status, not ARRT.
  – Please allow up to 45 days for CDPH-RHB to get your results in the mail.
  – Contact information for CDPH-RHB is on the inside cover of this handbook.

Important Notice: ***State Licensing is Not ARRT Credentialing***

A passing score on a state licensing examination does not make a candidate eligible for ARRT certification and registration. Candidates seeking ARRT certification and registration must have submitted an application directly to ARRT and must have met all other criteria for ARRT certification and registration. Those seeking only state licensing must meet criteria established by the state. Test scores earned as a state candidate may not be used for ARRT certification and registration.

Direct questions regarding your state license/permit application, the CDPH-RHB one-year eligibility period, or changes to your name, address, social security number, or date of birth to:

California Department of Public Health
Radiologic Health Branch
PO Box 997414 MS#7610
Sacramento, CA 95899-7414
Phone: (916) 327-5106
E-mail: rhblistc@cdph.ca.gov
Website: www.cdph.ca.gov [go to “Programs” and click on “R” to get to Radiologic Health Branch (RHB)]