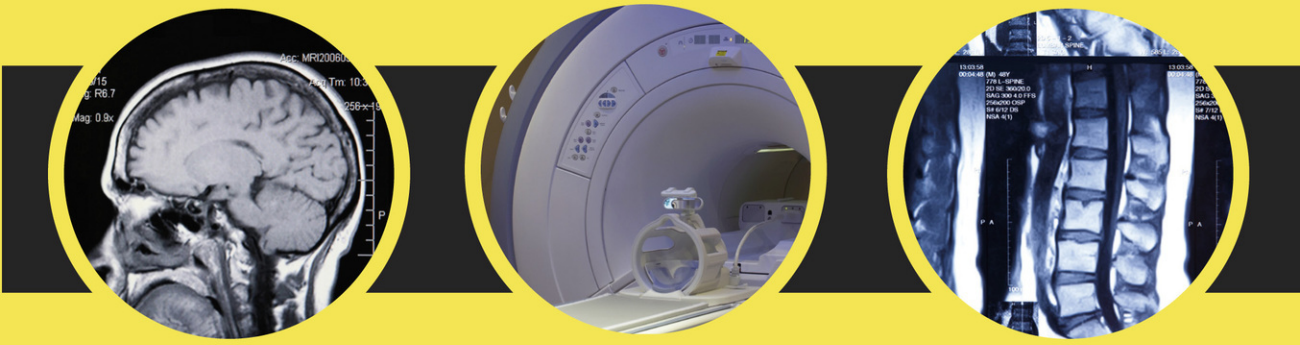
Second Edition

Review Questions for MRI



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WILEY Blackwell

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Second Edition

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Contents

The contents specified within this publication are based upon:

- Content Specifications for the ARRT (American Registry of Radiologic Technologists) registry examination in MRI and as such remain ARRT's copyright
- Technologist Examination Overview for the ARMRIT (American Registry for MRI Technologists) registry examination in MRI and as such remain ARMRIT's copyright
- Radiographer Advanced Examination in MRI for the CAMRT (Canadian Medical Radiographer Technologist) registry examination in MRI and as such remain CAMRT's copyright

Preface

Beginning with the acquisition of the first clinical MR image and continuing into the present, the principles of magnetic resonance technology have continued to confound even the academics. In response to complex imaging principles, many MR system users, mostly technologists, had given up any hope of ever learning the fundamentals of MRI. For this reason, the level of expertise of MRI technologists varies greatly between imaging centers. In response to the remarkable difference in proficiency and level of understanding, a need emerged for the standardization of MRI practitioner skills. That need was met by several accrediting agencies with the implementation of advanced-level examinations in MRI, known as the "MRI Boards". Also, in an attempt to maintain "high-quality diagnostic imaging centers" in MRI, The American College of Radiology (ACR) has implemented "site accreditation" for MRI facilities. These ACR standards include "site standards" for the facility as well as "minimum requirements" for MRI technologists. Recommendations include technologist/radiographer certification. To date, the ACR recognizes several accrediting agencies (advanced-level examinations in MRI) for technologists, including those exams offered by:

- The American Registry for Radiologic Technologists (ARRT)
- The ARMRIT (American Registry for MRI Technologists)
- The CAMRT (Canadian Medical Radiographer Technologist)

With the introduction of advanced-level examinations for MRI, technologists actively involved in MRI are looking for resource materials that will prepare them for these examinations. After facing numerous requests for registry review materials, we decided to combine and expand on the examination questions and answers that we have used effectively for the past 20+ years in each of our teaching programs. The result of this compilation was presented here as *Review Questions for MRI*, first edition. As MRI continues to evolve, we take the liberty to "update" the material within this study guide to provide the technologist or radiographer with up-to-date study materials. This second edition will provide the user with a comprehensive review of the principles and applications of MRI to prepare practicing MRI technologists for the advanced-level examination.

This book is intended for those technologists who are actively involved in MRI and/or those who have completed a training program in MRI and intend to sit for an advanced-level registry examination. This Q & A book is filled with multiple choice and True/False questions and answers that follow the topics listed in the content specifications

offered by the ARRT, the examination overview by the ARMRIT, and the CAMRT guidelines.

Who will benefit from this book?

This book will serve the needs for any technologist who is preparing for the boards, including:

- The technologist who is working in MRI and who has never had the opportunity to attend formal didactic (classroom) training, but whose employment requires that they must take and pass the Boards.
- The technologist who has recently completed a formal training program in MRI and is preparing for the Boards.

For those technologists who are preparing for their examinations, this resource will be helpful for:

- The technologist who has completed their studies and wants to "reinforce" what they have already studied, prior to taking the examination. . . .
  "The icing on the cake" so to speak!
- The technologist who has begun their studies and would like to "identify" their strengths and weaknesses in MRI theory during the study process and prior to taking the examination . . .
  "The cake"
- The technologist who has not yet begun their studies, but who is overwhelmed by the principles of MRI and would like to know "where to begin" . . .
  "The recipe for the cake"

For the record, we (Bill and Candi) are not on any of the ARRT, CAMRT, or ARMRIT committees for the registry examinations, nor are we privy to any inside information regarding the examination. Therefore, these questions are ones that have been used for previous educational programs, classroom tests, quizzes, and final examinations, as well as questions written explicitly for this publication. Any similarities between this book and the registry examination are, therefore, purely coincidental. However, having taught MRI principles and applications for the past several years, and since the content specifications themselves closely resemble our program outlines, the material covered within this review book should serve as an adequate study guide for the advanced-level examinations in MRI, also known as the MRI Boards.

Acknowledgements

First, I must thank God for the knowledge to complete this educational offering. Second, and always, I need to thank my family, friends, and my loving husband, Scott, for their support. Next, I would like to include within my "thank you list" all of hard working personnel, colleagues, and friends from Imaging Education Associates (IEA) including: my associates PJ, Pat R, Amy; my faculty and professional colleagues Joy, Wil, Barb, and the IEA faculty. Finally, I must thank all of the technologists, radiologists, nurses, and corporate personnel that I have had the opportunity to "teach". In fact, teaching these healthcare professionals has had a boomerang effect whereby they have actually "taught" me! It also goes without saying that it has been my privilege to have worked with Bill Faulkner on this and many other projects for over 25 years. I am honored to have been a part of your professional lives. May God bless you as you study for your boards!

Candi

I suppose that with a name like William Faulkner, it was inevitable that it should wind up on the front of a book. That said, since I am William Faulkner, Jr, I want to thank my parents not only for the name, but also for the support, encouragement, and love I still receive. I also want to thank and acknowledge my wife, Tricia, our daughter, Amber, her husband Ricky, and now our beautiful and wonderful granddaughter Zooey Ann for their love and support. (You can only imagine what I'm like to live with.) It would be remiss if I did not thank the unequaled group of radiologists and technologists with whom I have the pleasure of working with over the years. (You can only imagine what I'm like to work with.) In particular, I want to thank the late Dr James Crawley, who offered me my first job in MRI, and Dr Don Mills who then had to work with me while I began learning MRI. Dr Mills gave his time and energy to offer me an education that could not be given a price; I am eternally grateful. I have truly been blessed to meet and work with many wonderful professionals over the course of my career. It should be obvious that my participation in this book would not have been possible without having the great fortune to meet and work with Candi Roth. Every job has its ups and downs and we are not always happy. However, because of these great people and many others, I can say that l have always enjoyed my career. Finally, I want to thank God, for without Him, nothing would be possible.

Bill

Introduction

Magnetic resonance imaging (MRI) is a diagnostic imaging modality that is used to evaluate anatomic structures and pathologic conditions within the body. MRI is known for its exquisite demonstration of soft tissues within the body. For this reason, the majority of MR imaging is performed for the evaluation of hydrogen. Hydrogen atoms behave like a microscopic magnet when exposed to the strong magnetic field associated with MR imaging. For this reason, hydrogen is said to be "MR active". In addition, the human body is approximately 75% water. The combination of the *relative* abundance of hydrogen within the body and the magnetic characteristics of the hydrogen atom explains the utilization of hydrogen for MR imaging. Although other substances can be evaluated with magnetic resonance, hydrogen is typically preferred. It is the hydrogen in water (H_2O or two hydrogens bound to one oxygen) and the hydrogen in fat (CH_3 or three hydrogens bound to one carbon) that represent the substances typically evaluated by magnetic resonance. This evaluation can be provided by imaging (known as magnetic resonance imaging – MRI) and/or magnetic resonance spectroscopy (MRS). MRI and/or MRS can be performed on a specimen *in vivo* (within the body) or *in vitro* (outside the body, e.g. within a test tube).

To acquire MR or MRS images, a complex combination of hardware and software components are required. As the name implies, the MR imager consists of several different types of magnets. Magnets used in MRI include permanent magnets and electromagnets. Electromagnets include resistive and superconducting magnets. Resistive magnets can be used to create the main magnetic field and/or other magnetic system components. Permanent, resistive, and superconducting magnets can create various types of magnetic fields: "static" magnetic fields and "time-varying" magnetic fields. Magnets that produce static magnetic fields create magnetic fields that are "unchanging". The static magnetic field associated with the main magnet is known as the B_0 field. Magnets that produce time-varying magnetic fields (TVMF) create magnetic fields that that "vary" or "change" over time. TVMF are associated with RF fields and/or gradient fields. Oscillating magnetic fields, such as the radiofrequency (RF) field, are employed during imaging acquisition, known as excitation. This secondary (oscillating) magnetic field is known as the B_1 field. TVMF are also associated with magnetic fields that are switched on and off over time. Gradient magnetic fields produce a linear "gradation" or slope in the magnetic field that is switched on and off during image acquisition. The primary function of gradient magnetic fields is spatial encoding, allowing for various imaging planes (or views) to be acquired without moving the patient.

Various magnetic components such as RF and gradients are "pulsed" on and off during MR image acquisition. The sequence of these "pulses" determines the type of image that is acquired during MR imaging. This is known as a "pulse sequence". Computers are programmed to "direct" the various magnets within the MR imager to coordinate their usage during MR image acquisition. MR images can be acquired with various types of imaging planes (views) and/or with different types of image contrast (known as T1-, T2-, or proton density-weighted images). For example, images can be acquired whereby the fat is bright and water dark (T1-weighted image), or by changing imaging parameters (technique factors), images can be acquired whereby the water is bright and fat darker (T2-weighted image). Each patient is evaluated with several different types of images (various imaging planes or views), and/or acquisitions with different image contrast (different image weighting). The combination of images acquired for a patient is known as a protocol. The protocol consists of images acquired with various views or planes (sagittal, axial, coronal, and/or oblique) with various contrast or weighting (T1-, T2-, proton density-weighting), depending upon the anatomy and pathology to be imaged.

Each type of magnet within the MR imager functions differently. For this reason, each MR system component has unique safety considerations. To date there are no known, long-term biologic effects associated with exposure to the magnetic field. The safety consideration associated with the static magnetic field (specifically the stray field or fringe field located outside the MR imager) is generally associated with forces (translational force and rotational force) resulting in "projectiles" and "torque". Even though MR imaging does not use "ionizing" radiation, imaging does require radiofrequency (RF) energy that is considered to be low energy or "nonionizing" radiation. The Food and Drug Administration (FDA) imposes limits on exposure to various components of the MR imager, including the static field, RF field, and gradient magnetic field. Because of these various and unique magnetic field effects, patient care and safety in the MR environment is critical.

The technologist who operates the MR imager should understand all of the aspects of MR imaging. These aspects include: the MR system components (hardware or instrumentation); safety associated with these system components; the substances that can be imaged by MR (hydrogen and other elements); the method by which MR images are acquired (imaging planes and image weighting); and the anatomy (and pathology) to be imaged. In order to evaluate the knowledge of the MRI technologist, the American Registry for Radiologic technologists (ARRT) has developed an advanced-level examination in MRI. This has been divided into four categories:

- Patient care in MRI (general patient care and MRI safety)
- Imaging procedures (cross-sectional anatomy and clinical applications for MRI and contrast-enhanced MR)
- Data acquisition and processing (pulse sequences, parameters, and options for MR image formation)
- Physical principles of image formation (MR instrumentation and fundamentals for image acquisition).

To provide the technologist with information about the advanced-level examination in MRI, the ARRT has provided a document known as the "content specifications" (or

content specs). This outlines the topics and subtopics that will be tested in the examination. Essentially, the content specifications "hint" as to the categories of questions (topics), the information for the questions (subtopics), and the number of questions (per category) that will be included in the advanced-level examination for MRI. The table of contents (and the outline below it) reflects the "topics and subtopics" associated with the content specs. These documents are updated periodically; therefore, it is always recommended to visit the ARRT website for the most current version of the content specifications (www.arrt.org).

This book is designed to provide the technologist with questions associated with the content specifications provided by the ARRT. This book contains four parts that match the four main "topics" associated with the content specs. Within each part are subtopics to help technologist prepare for the MRI Boards.

Part A

Patient Care in MRI

Bioeffects, Safety, and Patient Care

Introduction

To date, there are no known long-term biological effects associated with magnetic resonance imaging (MRI). However, there are some aspects of MRI that could potentially result in irreversible and devastating outcomes for the patients and operators. These aspects include the static magnetic fields (potential projectiles and torque), the time-varying magnetic fields associated with the magnetic field gradients (peripheral nerve stimulation and acoustic noise), and the radiofrequency field (thermal injuries, heating, and burns). Part A will provide "practice" questions to prepare for the safety component of the MRI Boards.

MR image acquisition is very different from radiographic imaging, nuclear medicine, and sonography. The instrumentation used and the physical principles of image formation are "unique" for MR imaging. For these reasons, safety considerations for patients and personnel in MRI are also "unique" to the modality. For example, the strength of the magnetic field in the majority of MR imagers is so high (1.5 Tesla or 10 000 Gauss) that terminal velocity of a "paperclip" is up to 40 miles per hour. A simple paperclip would hit the side of the MR scanner at 40 mph! Furthermore, the velocity with which a metallic object (such as the paperclip) flies toward the scanner is determined by the mass of the object and the distance from the scanner (in addition to the type of metal and strength of the magnetic field). One can only imagine the damage that could be done if an oxygen

Review Questions for MRI, Second Edition. Carolyn Kaut Roth and William H. Faulkner.

tank was inadvertently brought into the MR scan room. MR safety can be a "life-or-death" scenario. Part A will provide practice questions about projectiles (flying metallic objects) as well as other "life-threatening" safety considerations in MRI.

The safety component of the MRI Boards (post primary examination and/or primary examination)

Beginning in 1995, the advanced-level examination in MRI was available as a "post primary examination". At that time, the post primary examination was only available for the registered technologist in radiography (RT (R)). To qualify for the MRI (post primary) examination, the technologist had to have a "primary certification". The primary examination could include: the radiography examination (RT (R)), the nuclear medicine examination (RT (N)), and the radiation therapy examination (RT (T)) or the sonography examination RT (S)). The assumption was that the technologist had already learned (and had been tested on) subjects such as "general patient care" during their primary examination. Therefore, when the MRI Boards were only available as a post primary examination, the safety category of the MRI boards included *only* MRI safety considerations.

Toward the fall of 2005 the ARRT announced that "the technologist need not be an *RT* to qualify for the advanced level examination in MRI". In January 2006, the ARRT defined the statement whereby one could qualify for the exam as a primary examination or a post primary examination. To qualify for the post primary examination, the technologist must have a primary certification (explained above). To qualify for the "primary examination", the "student" must attend an accredited MRI educational program. This program "can" resemble a radiography program, whereby the radiation physics is replaced by MR physics; radiation technique is replaced by MRI scan parameters; and patient care and radiation safety is replaced by patient care and MR safety. Today the MRI Boards are available as a "post primary examination" (for the RT) and also as a "primary examination" (for the non-RT). For this reason, the safety category within the advanced-level examination in MRI includes not only MRI safety but also general patient care.

There are several types of examination for the MRI technologist in North America, including the ARRT examination, the ARMRIT examination, and the CAMRT examination. Each examination has safety questions and these make up roughly 15–20% of the examination.

Part A offers review questions and answers that relate to general patient care and MRI safety considerations. Even though the questions are set with the guidelines from the content specifications from North American Boards in mind, MRI safety is critical for healthcare workers in the MR environment worldwide!

General patient care

1. Legal and ethical principles
   a. Confirmation of exam requisition
   b. Legal issues

c. Patient's rights
d. ARRT standard of ethics

2. Patient assessment, monitoring, and management
a. Routine monitoring
b. Emergency response
c. Patient transfer and body mechanics
d. Assisting patients with medical equipment

3. Interpersonal communications
a. Modes of communication
b. Challenges in communication
c. Patient education
d. Medical terminology

4. Infection control
a. Terminology and basic concepts
b. Cycle of infection
c. Standard precautions (general patient contact)
d. Additional or transmission-based precautions (e.g. hepatitis B, HIV, tuberculosis)
e. Disposal of contaminated materials

Legal and ethical principles

It is important for the MRI technologist to understand legal and ethical issues associated with MR imaging. This information is critical as deviation from these standards can lead to unsafe patient practices, lawsuits, and/or termination of employment. Questions on legal and ethical principles are drawn from the following subject areas:

a. Confirmation of exam requisition
i. Verification of patient identification
ii. Comparison of request to clinical indications

b. Legal issues
i. Common terminology (e.g. negligence, malpractice)
ii. Legal doctrines (e.g. *respondeat superior*, *res ipsa loquitur*)

c. Patient's rights
i. Informed consent (written, oral, implied)
ii. Confidentiality (HIPAA)
iii. Patient's Bill of Rights (e.g. privacy, access to information, healthcare proxy, research participation)

d. Standard of ethics
i. ARRT
ii. CAMRT
iii. ARMRIT

Questions 1–29 concern legal and ethical principles.

Patient assessment, monitoring, and management

This category has been modified from the original content specifications and includes patient management information. Questions on patient assessment, monitoring, and assessment are drawn from the following subject areas:

a. Routine monitoring
- **i.** Vital signs
- **ii.** Physical signs and symptoms
- **iii.** Sedated patients
- **iv.** Claustrophobic patients

b. Emergency response
- **i.** Reactions to contrast
- **ii.** Other allergic reactions (e.g. latex)
- **iii.** Cardiac/respiratory arrest (CPR)
- **iv.** Physical injury, trauma, or RF burn
- **v.** Other medical disorders (e.g. seizures, diabetic reactions)
- **vi.** Life-threatening situations (e.g. quench, projectiles)

c. Patient transfer and body mechanics

d. Assisting patients with medical equipment
- **i.** Implantable devices (e.g. infusion catheters, pumps, pacemakers, others)
- **ii.** Oxygen delivery systems
- **iii.** Other (e.g. nasogastric tubes, urinary catheters)

Questions 30–104 concern patient assessment, monitoring, and management.

Interpersonal communications

Since the advanced-level examination offered by the ARRT is now available as a primary examination (for the person who attended an accredited MRI school) or a post primary examination [for the technologist who first studied a primary modality such as radiography RT (R), or nuclear medicine RT (N), or radiation therapy RT (T)], new patient care information has been added to the content specifications. Questions on communication are drawn from the following subject areas:

a. Modes of communication
- **i.** Verbal, written
- **ii.** Nonverbal (e.g. eye contact, touching)

b. Challenges in communication
- **i.** Patient characteristics (e.g. cultural factors, physical or emotional status)
- **ii.** Strategies to improve understanding

c. Patient education
- **i.** Explanation of procedure (e.g. risks, benefits)
- **ii.** Follow-up instructions
- **iii.** Referral to other services

d. Medical terminology

Questions 105–114 concern interpersonal communications.

Infection control

Since the advanced-level examination offered by the ARRT is now available as a primary examination (for the person who attended an accredited MRI school) or a post primary examination [for the technologist who first studied a primary modality such as radiography RT (R), or nuclear medicine RT (N), or radiation therapy RT (T)], new patient care information has been added to the content specifications. Questions on infection control are drawn from the following subject areas:

a. Terminology and basic concepts
- **i.** Types of asepsis
- **ii.** Sterile technique
- **iii.** Pathogens (e.g. fomites, vehicles, vectors)
- **iv.** Nosocomial infections

b. Cycle of infection
- **i.** Pathogen
- **ii.** Source or reservoir of infection
- **iii.** Susceptible host
- **iv.** Method of transmission (contact, droplet, airborne, common vehicle, vector borne)

c. Standard precautions (general patient contact)
- **i.** Handwashing
- **ii.** Gloves, gowns
- **iii.** Masks
- **iv.** Medical asepsis/disinfection

d. Additional or transmission-based precautions (e.g. hepatitis B, HIV, tuberculosis)
- **i.** Airborne (e.g. negative ventilation)
- **ii.** Droplet (e.g. particulate mask)
- **iii.** Contact (e.g. gloves, gown)

e. Disposal of contaminated materials
- **i.** Linens
- **ii.** Needles
- **iii.** Patient supplies

Questions 115–138 concern infection control.

MRI screening and safety

This category is from the original (ARRT post primary) examination. Questions on MRI screening and safety are drawn from the following subject areas. (The ARMRIT and the CAMRT also have MRI screening and safety categories within their examinations.)

1. Biological effects and MRI safety considerations
- **a.** RF field
  - **i.** Specific absorption rate (SAR)
  - **ii.** Biological effects
  - **iii.** FDA guidelines
- **b.** Static and gradient magnetic fields
  - **i.** Biological effects
  - **ii.** FDA guidelines
- **c.** Acoustic noise

2. MRI screening, monitoring, and assessment
- **a.** Screening
  - **i.** Biomedical implants (e.g. pacemakers, clips)
  - **ii.** Ferrous foreign bodies
  - **iii.** Medical conditions
  - **iv.** Prior diagnostic or surgical procedures
- **b.** Equipment safety
  - **i.** Placement of conductors (e.g. ECG leads, coils, cables)
  - **ii.** Cryogen safety
  - **iii.** Ancillary equipment in proximity
  - **iv.** Emergency procedures (e.g. quench, fire)
- **c.** Environment
  - **i.** Climate control (temperature, humidity)
  - **ii.** Gauss lines
  - **iii.** Magnetic shielding
  - **iv.** RF shielding
  - **v.** American Registry for Radiologic technologists Warning signs

Questions 139–202 concern MRI screening and safety.

Part A: Questions

Legal and ethical principles

1. What is the first duty the technologist should perform when beginning an MR examination?

- **a.** Check the physician's orders in the chart ☐
- **b.** Verify the patient's identity ☐
- **c.** Place the film in the Bucky tray ☐
- **d.** Obtain an accurate medical history on the patient ☐

2. In a medical malpractice suit, the _____ must prove medical malpractice.

- **a.** Physician charged ☐
- **b.** Risk manager ☐
- **c.** Patient plaintiff ☐
- **d.** Technologist performing the scan ☐

3. Healthcare workers generally practice _____, which states the "goal is to do no harm".

- **a.** Beneficence ☐
- **b.** Confidentiality ☐
- **c.** Nonmaleficence ☐
- **d.** The prudent professional standard ☐

4. A patient on the MRI table is left unattended and rolls off onto the floor, causing an injury to the head. The technologist in attendance can be sued for:

- **a.** Slander ☐
- **b.** Negligence ☐
- **c.** Battery ☐
- **d.** False imprisonment ☐

5. A patient, deemed competent, becomes claustrophobic during an MRI procedure and refuses to continue with the study. The technologist should first:

- **a.** Call for security and force the patient to continue ☐
- **b.** Stop the study and inform the supervisor ☐
- **c.** Coerce the patient to be more cooperative ☐
- **d.** Reassure the patient and attempt to talk him or her through the procedure ☐

6. A malpractice case based on an obvious negligent act, e.g. a radiograph (or MR image) of the abdomen demonstrates that a surgical sponge was inadvertently left in the surgical site (within the peritoneum) after surgery, will likely be considered under the doctrine of:

- **a.** *Respondeat superior* ☐
- **b.** *Res ipsa loquitor* ☐
- **c.** *Stare decisis* ☐
- **d.** Breach of confidentiality ☐

7. When entering data on a patient's chart, the technologist must be sure to:

- **a.** Sign and date the entry ☐
- **b.** Date the entry, record the time, and sign using name and credentials ☐
- **c.** Date the entry, record the time, and indicate your department ☐
- **d.** Date the entry and sign using name and credentials ☐

8. Unintentional misconduct is also known as:

- **a.** Libel ☐
- **b.** Battery ☐
- **c.** False imprisonment ☐
- **d.** Negligence ☐

9. Which of the following describes assault of the patient?

- **a.** Hitting the patient ☐
- **b.** Restraining the patient ☐
- **c.** Causing the patient to feel threatened ☐
- **d.** Performing an MRI study against the patient's will ☐

10. Which of the following statements is incorrect regarding the principle of the double effect?

- **a.** The action must be morally neutral or good ☐
- **b.** The good effect is not the only intention ☐
- **c.** The good effect must be equal to or greater in importance than the bad effect ☐
- **d.** The bad effect must not be the means by which the good effect is accomplished ☐

11. An ambulatory, outpatient lying down on the MRI table as requested by the technologist has given:

- **a.** Implied consent ☐
- **b.** Informed consent ☐
- **c.** Emergency consent ☐
- **d.** Vicarious liability ☐

12. Which of the following is an example of battery?

- **a.** Threatening the patient ☐
- **b.** Sharing patient information with another technologist in the work area ☐
- **c.** Imaging the incorrect body part ☐
- **d.** Using an immobilization device ☐

13. Which is the most likely type of law under which a suit is brought against a technologist for performing unintentional acts that fall below the standard of care and result in patient injury?

- **a.** Felonious ☐
- **b.** Tort ☐
- **c.** Criminal ☐
- **d.** Administrative ☐

14. *Respondeat superior* is a Latin term meaning:

- **a.** The thing speaks for itself ☐
- **b.** The reasonable technologist should make the decision ☐
- **c.** There is no need for the MRI technologist to carry their own liability insurance ☐
- **d.** Let the master answer ☐

15. Which of the following is NOT a true statement regarding informed consent?

- **a.** Consent must be given under no duress ☐
- **b.** The patient must understand all aspects of the procedure being performed ☐
- **c.** The patient must be of legal age ☐
- **d.** The procedure must be explained in terms that the patient can understand, to include risks and benefits ☐

16. Destroying or altering medical records without legitimate authorization or reason is called:

- **a.** Medical negligence ☐
- **b.** Failure to follow standard of care ☐
- **c.** Spoliation ☐
- **d.** Vicarious liability ☐

17. Which of the following means "to stand by things decided"?

- **a.** Consequentialism ☐
- **b.** *Res ipsa loquitor* ☐
- **c.** *Respondeat superior* ☐
- **d.** *Stare decisis* ☐

18. A technologist who touches a patient without permission (with the exception of emergency consent) could be found guilty of:

- **a.** Negligence ☐
- **b.** Breach of confidentiality ☐
- **c.** Battery ☐
- **d.** Assault ☐

19. Discussing a patient's confidential medical information with a person who does not have a need to know is called:

- **a.** Vicarious liability ☐
- **b.** Invasion of privacy ☐
- **c.** Libel ☐
- **d.** *Stare decisis* ☐

20. If the supervising radiologist instructs you to scan a patient with a known cardiac pacemaker and the patient goes into cardiac arrest due to pacemaker failure, you MAY be protected from a lawsuit under the doctrine of *respondeat superior*, which means:

- **a.** Let the master answer ☐
- **b.** The thing speaks for itself ☐
- **c.** Radiologists (like all supervising physicians) are always liable ☐
- **d.** Hospital administration decides who is liable in each situation ☐

21. Patient rights would include all of the following EXCEPT:

- **a.** Right to privacy ☐
- **b.** Right to a diagnosis by the MRI technologist ☐
- **c.** Right to refuse the MRI study ☐
- **d.** Right to know potential risks of the MRI study ☐

22. Which of the following is the term used to describe written malicious spreading of information?

- **a.** Breach of confidentiality ☐
- **b.** Libel ☐
- **c.** Slander ☐
- **d.** Qualified privilege ☐

23. The burden of proof for medical negligence rests with the:

- **a.** Physician ☐
- **b.** Patient ☐
- **c.** Radiographer ☐
- **d.** Risk manager ☐

24. All of the following may be considered an example of battery EXCEPT:

- **a.** Touching the patient without consent ☐
- **b.** Sharing patient information with another technologist in the work area ☐
- **c.** Imaging the wrong body part ☐
- **d.** Restraining the patient ☐

25. Which of the following describes assault of the patient?

- **a.** Striking the patient ☐
- **b.** Touching the patient without consent ☐
- **c.** Threatening the patient or causing the patient to feel threatened ☐
- **d.** Performing a radiographic procedure against the patient's will ☐

26. The concept of the reasonable prudent person is interpreted as:

- **a.** How a reasonable jury member would perform the act ☐
- **b.** How a professional with similar education, training, and experience would perform the act ☐
- **c.** How a prudent attorney would interpret the act ☐
- **d.** How a reasonable and prudent judge will rule on the act ☐

27. According to the ARRT standard of ethics, the radiologic technologist acts to advance the principal objective of the profession to provide services to humanity _____.

- **a.** With full respect for the dignity of mankind ☐
- **b.** With discrimination on the basis of sex, race, creed, religion, or socio-economic status ☐
- **c.** Understanding interpretation and diagnosis are within the scope of practice for the profession ☐
- **d.** Providing full disclosure for all patient information among colleagues and other patients ☐

28. According to the ARRT standard of ethics (specifically within the Code of Ethics), the radiologic technologist acts to advance the principal objective of the profession to provide services to humanity and includes all of the following EXCEPT:

- **a.** The radiologic technologist conducts herself or himself in a professional manner, responds to patient needs, and supports colleagues and associates in providing quality patient care ☐
- **b.** The radiologic technologist acts to advance the principal objective of the profession to provide services to humanity with full respect for the dignity of mankind ☐
- **c.** Delivers patient care and service unrestricted by the concerns of personal attributes or the nature of the disease or illness, and without discrimination on the basis of sex, race, creed, religion, or socio-economic status ☐
- **d.** Practices technology founded upon theoretical knowledge and concepts, uses equipment and accessories inconsistent with the purposes for which they were designed, and employs procedures and techniques inappropriately ☐

29. Which of the following circumstances would NOT be an ARRT ethical violation?

- **a.** Contacting a referring doctor when he or she has ordered the wrong procedure on a patient ☐
- **b.** Discussing with your colleagues whether or not you should do the procedure if the order is incorrect ☐
- **c.** Performing the procedure on the patient if the order is not correct ☐
- **d.** Performing a procedure on a patient without any order ☐

Patient assessment, monitoring, and management

30. Which of the following may cause a patient to experience a syncopal episode?

1. Anxiety
2. Hunger
3. Hypertension

a. 1 only ☐
b. 3 only ☐
c. 1 and 2 only ☐
d. 2 and 3 only ☐

31. All claustrophobic patients who are scheduled for MRI examinations should be:

a. Sedated ☐
b. Forced to overcome their fear to complete the examination ☐
c. Rescheduled for another day ☐
d. Handled delicately so as not to compound their anxiety ☐

32. Patients who should be monitored (with pulse oximetry) during MRI procedures are:

1. Unresponsive and uncommunicative patients
2. Sedated, psychiatric and pediatric patients
3. Patients who have weak voices and/or impaired hearing

a. 1 only ☐
b. 1 and 2 only ☐
c. 1 and 3 only ☐
d. 1, 2, and 3 ☐

33. Patients who have been sedated with diazepam should be monitored with:

a. Pulse oximetry ☐
b. ECG gating ☐
c. Peripheral gating ☐
d. Verbal communication ☐

34. It is good practice for all patients who undergo MRI to be monitored:

a. Visually and/or verbally ☐
b. By ECG ☐
c. By respiratory monitors ☐
d. Not at all ☐

35. BEFORE the publication of the "Contrast Media Update" by the ACR in 2010, contraindications for using gadolinium included:
1. Sickle cell crisis and hypertension
2. Pregnancy and breast-feeding mothers
3. High BUN and creatinine
4. Low GFR
5. Renal insufficiency and/or acute renal injury
6. None known

a. 6 only ☐
b. 1, 2, and 3 only ☐
c. 4 and 5 only ☐
d. 1, 2, 3, 4, and 5 only ☐

36. AFTER the publication of the first edition of the "Contrast Media Update" by the ACR in 2010, contraindications for using gadolinium included:
1. Sickle cell crisis and hypertension
2. Pregnancy and breast-feeding mothers
3. High BUN and creatinine
4. Low GFR
5. Renal insufficiency and/or acute renal injury
6. None known

a. 6 only ☐
b. 1, 2, and 3 only ☐
c. 4 and 5 only ☐
d. 1, 2, 3, 4, and 5 only ☐

37. Precautions for the use of gadolinium include:
1. Sickle cell crisis and hypertension
2. Pregnancy
3. Low GFR
4. Hemolytic anomalies and lactating mothers
5. Prior contrast reactions and patients with a history of asthma or allergies

a. 3 only ☐
b. 1, 2, and 3 only ☐
c. 2, 3, 4, and 5 only ☐
d. 1, 2, 3, 4, and 5 ☐

38. The approved gadolinium contrast agents are currently indicated for:
1. Intravenous injection for pediatric imaging
2. Intravenous injection for abdominal imaging
3. Intravenous injection for central nervous system (CNS) imaging
4. Intra-articular injection for musculoskeletal imaging