

kVp and 15% Rule Practice Test

Multiple Choice

Identify the choice that best completes the statement or answers the question.

1. A ____% increase in kV will increase radiation exposure the same as doubling the mAs.
 - a. 15
 - b. 10
 - c. 100
 - d. 25
2. What type of radiographic contrast is produced with a high (120) kV technique?
 - a. Low contrast, short scale
 - b. High contrast, short scale
 - c. Low contrast, long scale
 - d. High contrast, long scale
3. The portion of useful image-forming x-rays is referred to as the _____.
 - a. frequency
 - b. MTF
 - c. signal
 - d. noise
4. As mAs is increased the signal to noise ratio is _____.
 - a. decreased
 - b. increased
 - c. not affected
 - d. doubled
5. With digital imaging, patient dose can be reduced by using higher _____ techniques.
 - a. mAs
 - b. kVp
 - c. optical density
 - d. contrast
6. DQE is _____.
 - a. density quantum effect
 - b. direct quantum efficiency
 - c. detective quantum efficiency
 - d. detective quantum energy
7. In order to reduce patient exposure, _____ kVp and _____ mAs should be used when possible.
 - a. Lower, higher
 - b. Higher, higher
 - c. Higher, lower
 - d. It makes no difference.
8. With DR imaging, what would be the appropriate change in mAs if the kVp were decreased by 15% and the SNR needs to be maintained?
 - a. Double the mAs
 - b. Halve the mAs
 - c. Use one fourth of the mAs
 - d. No change would be necessary.
9. Increasing the kVp
 - a. increases the energy of the x-ray photons
 - b. increases the quantity of x-ray photons
 - c. increases the penetrating power of x-ray photons
 - d. all of the above
10. Too little remnant radiation caused by low kVp results in a digital image in which
 - a. the image brightness appears high (light)
 - b. the image brightness appears appropriate
 - c. quantum noise is visible
 - d. B and C
11. The relationship between kVp and the quantity of remnant radiation is known as the
 - a. kVp-density rule
 - b. 15% rule
 - c. 115% rule
 - d. kVp-quantity rule
 - e. reciprocity law
12. Increasing the kVp by 15% has the same effect as
 - a. increasing the mAs by 15%
 - b. doubling the mAs
 - c. decreasing the mAs by 15%
 - d. halving the mAs
13. Which of the following exposure factors produces the same SNR (EI) as does 20 mAs at 70 kVp?
 - a. 10 mAs @ 70 kVp.
 - b. 10 mAs @ 80 kVp.
 - c. 40 mAs @ 60 kVp.
 - d. B and C.
14. 100 kVp should be changed to _____ kVp to decrease the exposure to the IR by a factor of 2.
 - a. 50
 - b. 85

- c. 115
 - d. none of the above
15. To maintain the same amount of radiation reaching the IR, if the kVp is increased by 15% the mAs needs to
 - a. remain the same
 - b. be doubled
 - c. be halved
 - d. be decreased by a minimum of 30%
16. When the intensities of radiation exiting the patient are very similar, the resulting image has
 - a. low contrast
 - b. high contrast
 - c. short-scale contrast
 - d. A and C
 - e. B and C
17. When the intensities of radiation exiting the patient are very different from each other, the film image has
 - a. low contrast
 - b. high contrast
 - c. short-scale contrast
 - d. A and C
 - e. B and C
18. _____ kVp results in the intensities of radiation exiting the patient being very _____.
 - a. Low; similar
 - b. Low; different
 - c. High; different
 - d. A and C
19. Low kVp produces _____ radiographic contrast and high kVp produces _____ radiographic contrast.
 - a. higher; higher
 - b. lower; lower
 - c. lower; higher
 - d. higher; lower
20. Low kVp produces _____ radiographic contrast and high kVp produces _____ radiographic contrast.
 - a. long-scale; long-scale
 - b. long-scale; short-scale
 - c. short-scale; long-scale
 - d. short-scale; short-scale
21. To adjust the kVp to produce the desired contrast level, the kVp must first be
 - a. as low as possible for radiation safety
 - b. as high as possible
 - c. high enough to penetrate the part
 - d. none of the above
22. Using excessive kVp with a digital IR results in
 - a. increased scatter reaching the IR
 - b. decreased image contrast
 - c. increased patient exposure
 - d. A and C
 - e. all of the above
23. Which technical factor is used to alter radiographic contrast?
 - a. mA
 - b. Exposure time
 - c. kVp
 - d. SID
24. If the kVp is increased using the "15% rule," an 80-kVp exposure would change to which of the following?
 - a. 68 kVp
 - b. 92 kVp
 - c. 105 kVp
 - d. 160 kVp
25. What is the major limitation in obtaining images of obese patients?
 - a. A strong enough table to hold the patient
 - b. Reduced resolution due to motion
 - c. Inadequate penetration of the body part
 - d. Inability to adjust the mAs high enough
26. What is the single most important technical exposure adjustment that should be made when imaging an obese patient?
 - a. Decreasing the kVp
 - b. Increasing the kVp
 - c. Decreasing the mAs
 - d. Increasing the mAs
27. Scatter radiation affects radiographic appearance by causing:
 - a. increased distortion.
 - b. increased recorded detail.
 - c. decreased contrast.
 - d. decreased density.

28. Once the part has been penetrated, a doubling of the mAs results in _____ the exposure to the IR.
 - a. One fourth
 - b. One half
 - c. Two times
 - d. Four times
29. What is the major limitation in obtaining images of obese patients?
 - a. A strong enough table to hold the patient
 - b. Reduced resolution due to motion
 - c. Inadequate penetration of the body part
 - d. Inability to adjust the mAs high enough
30. What is the single most important technical exposure adjustment that should be made when imaging an obese patient?
 - a. Decreasing the kVp
 - b. Increasing the kVp
 - c. Decreasing the mAs
 - d. Increasing the mAs
31. As kVp is increased the signal to noise ratio is _____.
 - a. decreased
 - b. increased
 - c. not affected
 - d. doubled
32. The interactions that produce scatter radiation occur primarily in the:
 - a. tabletop.
 - b. image receptor.
 - c. patient.
 - d. tube housing.
33. Compton scatter occurs when an x-ray photon interacts with which part of the atom in the patient's body?
 - a. Inner shell electron
 - b. Outer orbital electron
 - c. Nucleus-protons
 - d. Nucleus-neutrons
34. A scattered photon has _____ energy than the incoming primary beam photon.
 - a. less
 - b. more
 - c. less, if the kVp is over 80
 - d. more, if the kVp is over 80
35. Which of the following factors affects the quantity of scatter radiation fog on a radiograph?
 1. Field size
 2. Focal spot size
 3. kVp
 - a. 1 and 2 only
 - b. 1 and 3 only
 - c. 2 and 3 only
 - d. 1, 2, and 3
36. As kVp is increased, photoelectric effect interactions will:
 - a. increase.
 - b. decrease.
 - c. remain the same.
 - d. increase only above 60 kVp.
37. Of all of the energy traveling through the x-ray tube during a radiographic exposure, the largest percentage of this electrical energy is converted to
 - a. x-radiation.
 - b. infrared energy.
 - c. thermal energy (heat).
 - d. mechanical energy.
38. The total quantity of x-ray photons produced during an exposure is determined by the
 - a. kVp.
 - b. SID.
 - c. milliamperage (mA).
 - d. mAs.
39. Given the three sets of mAs calculations that follow, all three should yield the same degree of SNR. This phenomenon is referred to as:
Exposure 1: 100 kVp @ 10 mAs
Exposure 2: 115 kVp @ 5 mAs
Exposure 3: 133 kVp @ 2.5mAs
This is known as
 - a. the inverse square law.
 - b. the kVp/mAs ratio.
 - c. mA/mAs proportionality.
 - d. mAs reciprocity.
 - e. 15% rule
40. What type of radiographic contrast is produced with a low (50) kV technique?
 - a. Low contrast, short scale
 - b. High contrast, short scale
 - c. Low contrast, long scale
 - d. High contrast, long scale

41. X-ray quantity increases in direct proportion to increases in _____.
a. mAs
b. kVp
c. distance
d. filtration
42. The penetrability of an x-ray beam is called x-ray _____.
a. quantity
b. quality
c. intensity
d. all of the above

Numeric Response

% x-ray production efficiency = $0.0001 \times \text{Target Atomic Number (Z)} \times \text{kVp}$

43. What is the percentage of X-rays produced with a tungsten target (Z#74) when operating an X-ray tube at 50 kVp?
44. What is the percentage of X-rays produced with a tungsten target (Z#74) when operating an X-ray tube at 80 kVp?
45. What is the percentage of X-rays produced with a tungsten target (Z#74) when operating an X-ray tube at 137 kVp?

kVp and 15% Rule
Answer Section

MULTIPLE CHOICE

1. ANS: A PTS: 1 REF: 40

2. ANS: C PTS: 1 REF: 40

3. ANS: C

The portion of useful image-forming x-rays is referred to as the signal.

PTS: 1 DIF: Moderate REF: page 312 OBJ: Describe signal-to-noise ratio.

4. ANS: B

As mAs is increased the signal to noise ratio is increased.

PTS: 1 DIF: Moderate REF: page 312 OBJ: Understand the factors that affect SNR.

5. ANS: B

With digital imaging, patient dose can be reduced by using higher kVp techniques.

PTS: 1 DIF: Easy REF: page 315

OBJ: Understand how digital techniques can reduce patient dose.

6. ANS: C

DQE is detector quantum efficiency.

PTS: 1 DIF: Easy REF: page 316 OBJ: Define DQE.

7. ANS: C

Using a higher kVp and lower mAs is best, because the higher kVp provides more penetration, requiring less patient exposure.

PTS: 1 OBJ: 14

8. ANS: A

Decreasing the kVp by 15% would require two times the mAs in order to maintain film-screen image density.

PTS: 1 OBJ: 6

9. ANS: D

Increasing kVp produces more photons with greater energy (more penetrating).

PTS: 1 REF: 119-120 OBJ: 7

10. ANS: D

Insufficient remnant radiation (caused by low mAs or kVp) results in a digital image that has appropriate brightness (because of computer adjustment) but has quantum noise.

PTS: 1 REF: 121 OBJ: 7

11. ANS: B

The 15% rule represents the relationship between kVp and the quantity of radiation reaching the image receptor.

PTS: 1 REF: 122 OBJ: 8

12. ANS: B

Increasing the kVp by 15% has the same effect on the amount of radiation reaching the IR as does doubling the mAs.

PTS: 1 REF: 122 OBJ: 8

13. ANS: D

Fifteen percent of 70 kVp is approximately 10 kVp. Therefore using 10 mAs (one half of the mAs) at 80 kVp and using 40 mAs (two times the mAs) at 60 kVp produces the same amount of remnant radiation.

PTS: 1 REF: 122 OBJ: 8

14. ANS: B

To decrease the exposure to the IR by a factor of 2, the kVp must be reduced by 15%; 15% of 100 is 15, so 100 minus 15 is 85 kVp.

PTS: 1 REF: 122 OBJ: 8

15. ANS: C

Increasing the kVp by 15% doubles the radiation reaching the IR, so to maintain the original amount of exit radiation, the mAs needs to be halved.

PTS: 1 REF: 122 OBJ: 8

16. ANS: A

When the intensities of radiation exiting the patient are very similar, the resulting film image has low contrast (many shades of gray).

PTS: 1 REF: 123 OBJ: 7

17. ANS: E

Using a low kVp results in a greater variation of x-ray intensities exiting the patient, producing a high or short-scale contrast image.

PTS: 1 REF: 123 OBJ: 7

18. ANS: B

Low kVp results in the intensities of radiation exiting the patient being very different from each other.

PTS: 1 REF: 123 OBJ: 7

19. ANS: D

Low kVp produces higher radiographic contrast and high kVp produces lower radiographic contrast.

PTS: 1 REF: 123 OBJ: 7

20. ANS: C

Low kVp produces short-scale (high) radiographic contrast and high kVp produces long-scale (low) radiographic contrast.

PTS: 1 REF: 123 OBJ: 7

21. ANS: C

To manipulate the kVp to change radiographic contrast, it first must be at a level high enough to penetrate the anatomy.

PTS: 1 REF: 124 OBJ: 7

22. ANS: E

Using kVp that is too high results in more scatter reaching the IR as well as increased and unnecessary patient exposure. The image contrast will be adjusted by the computer to an appropriate level.

- PTS: 1 REF: 123 OBJ: 7
23. ANS: C PTS: 1 REF: Page 129
24. ANS: B PTS: 1 REF: Page 129
25. ANS: C PTS: 1 REF: Page 128
26. ANS: B PTS: 1 REF: Page 128
27. ANS: C PTS: 1 REF: Page 111
28. ANS: C

Only after the part has been adequately penetrated, doubling mAs results in twice the exposure to the IR.

- PTS: 1 OBJ: 3
29. ANS: C PTS: 1
30. ANS: B PTS: 1
31. ANS: B

As mAs is increased the signal to noise ratio is increased.

- PTS: 1 DIF: Moderate REF: page 312 OBJ: Understand the factors that affect SNR.
32. ANS: C PTS: 1 REF: Page 109
33. ANS: B PTS: 1 REF: Page 109
34. ANS: A PTS: 1 REF: Page 109
35. ANS: B PTS: 1 REF: Page 111
36. ANS: B PTS: 1 REF: Page 110
37. ANS: C

During x-ray production, 99%+ of the electrical energy passing through the x-ray tube is converted to heat in the form of thermal energy. The remaining 1% actually is converted to x-ray energy. X-ray production is a very inefficient process.

- PTS: 1 REF: p. 67
38. ANS: D

Milliamperere-seconds (mAs) is the parameter that controls the amount of x-radiation produced by the x-ray tube; it is the product of milliamperage (mA) multiplied by seconds. It directly controls the quantity of x-ray photons produced.

- PTS: 1 REF: p. 68
39. ANS: D

Milliamperere-seconds is the product of mA and time. Any combination of mA and time producing equivalent mAs values should produce equivalent exposures and therefore densities. This process is known as mAs reciprocity.

- PTS: 1 REF: p. 72
40. ANS: B PTS: 1 REF: 40
41. ANS: A

X-ray quantity increases in direct proportion to increases in mAs.

- PTS: 1 DIF: Moderate REF: page 137
- OBJ: List and discuss the factors affecting the intensity of the x-ray beam.
42. ANS: B

The penetrability of an x-ray beam is called x-ray quality.

- PTS: 1 DIF: Moderate REF: page 140 OBJ: Explain x-ray quality and penetrability.

NUMERIC RESPONSE

43. ANS: 0.37

PTS: 1

44. ANS: 0.6

PTS: 1

45. ANS: 1.01

PTS: 1