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CORRECT ANSWERS ARE LOCATED IN THE 2ND HALF OF THIS DOC.

TRUE/FALSE - Write 'T' if the statement is true and 'F' if the statement is false.

1) Light rays are refracted (bent) when they cross the interface between materials with different refractive indices.
   - ◎ true
   - ◎ false

2) A substage condenser is used to focus light onto the specimen, which increases the resolution of a light microscope.
   - ◎ true
   - ◎ false

3) Confocal microscopes, in combination with specialized computer software, can be used to create three-dimensional images of cell structures.
   - ◎ true
   - ◎ false

4) A light microscope with an objective lens numerical aperture of 0.65 is capable of allowing two objects 400 nm apart to be distinguished when using light with a wavelength of 420 nm.
   - ◎ true
   - ◎ false

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5) Resolution improves when the wavelength of the illuminating light decreases.
   - ◎ true
   - ◎ false

6) Immersion oil is used to prevent a specimen from drying out.
   - ◎ true
   - ◎ false

7) It is possible to build a light microscope capable of 10,000× magnification, but the image would not be sharp because resolution is independent of magnification.
   - ◎ true
   - ◎ false

8) Immersion oil increases the amount of light entering the objective lens.
   - ◎ true
   - ◎ false

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9) Gram staining divides bacterial species into two groups based on differences in cell wall structure.
   - ◎ true
   - ◎ false

10) Negative staining facilitates the visualization of bacterial capsules that are intensely stained by the procedure.
   - ◎ true
   - ◎ false

11) Negative staining with India ink can be used to reveal the presence of capsules that surround bacterial cells.
   - ◎ true
   - ◎ false

12) Mordants increase the binding between a stain and specimen.
   - ◎ true
   - ◎ false

13) In order to stain flagella so that they may be readily observed by light microscopy, it is usually necessary to increase their thickness.
   - ◎ true
   - ◎ false

14) The Gram-staining procedure is widely used because it allows rapid identification of a microorganism with little additional testing.
   - ◎ true
   - ◎ false

15) Because transmission electron microscopy uses electrons rather than light, it is not necessary to stain biological specimens before observing them.
   - ◎ true
   - ◎ false

16) Scanning electron microscopes bombard specimens with a stream of electrons; however, the specimen image is produced by electrons that are derived from atoms of the specimen itself rather than by the electrons used to bombard the specimen.
   - ◎ true
   - ◎ false

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17) It was possible to view viruses only after the invention of the electron microscope because they are too small to be seen with a light microscope.
- ◎ true
- ◎ false

18) Scanning tunneling electron microscopes create a three-dimensional image of specimens at atomic-level resolution.
- ◎ true
- ◎ false

MULTIPLE CHOICE - Choose the one alternative that best completes the statement or answers the question.

19) Confocal microscopes exhibit improved contrast and resolution by_____.
- A) illumination of a large area of the specimen
- B) blocking out stray light with an aperture located above the objective lens
- C) use of light at longer wavelengths
- D) use of ultraviolet light to illuminate the specimen

20) A 30× objective and a 20× ocular produce a total magnification of_____.
- A) 230×
- B) 320×
- C) 50×
- D) 600×

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21) A 45× objective and a 10× ocular produce a total magnification of_____.
- A) 900×
- B) 55×
- C) 450×
- D) 145×

22) A microscope that exposes specimens to ultraviolet, violet, or blue light and forms an image with the light emitted at a different wavelength is called a_____ microscope.
- A) phase-contrast
- B) dark-field
- C) scanning electron
- D) fluorescence

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23) Immersion oil can be used to increase the resolution achieved with some microscope lenses because it increases the_____ between the specimen and the objective lens.
A) optical density
B) refractive index
C) optical density and refractive index
D) neither optical density nor refractive index

24) If the objective lenses of a microscope can be changed without losing focus on the specimen, they are said to be_____.
A) equifocal
B) totifocal
C) parfocal
D) optifocal

25) An instrument that magnifies slight differences in the refractive index of cell structures is called a(n)_____ microscope.
A) phase-contrast
B) electron
C) fluorescence
D) densitometric

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26) The instrument that produces a bright image of the specimen against a dark background is called a(n)_____ microscope.
A) phase-contrast
B) electron
C) bright-field
D) dark-field

27) As the magnification of a series of objective lenses increases, the working distance_____.
A) increases
B) decreases
C) stays the same
D) cannot be predicted

28) Prior to staining, smears of microorganisms must be heat-fixed in order to_____.
A) allow eventual visualization of internal structures
B) ensure removal of dust particles from the slide surface
C) attach them firmly to the slide
D) create small pores in cells that facilitates binding of stain to cell structures

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29) Acid-fast organisms such as *Mycobacterium tuberculosis* contain_____ constructed from mycolic acids in their cell walls.
A) proteins
B) carbohydrates
C) lipids
D) peptidoglycan

30) In the Gram-staining procedure, the primary stain is_____.
A) iodine
B) safranin
C) crystal violet
D) alcohol

31) In the Gram-staining procedure, the decolorizer is_____.
A) iodine
B) safranin
C) crystal violet
D) ethanol or acetone

32) In the Gram-staining procedure, the counterstain is_____.
A) iodine
B) safranin
C) crystal violet
D) alcohol

33) In the Gram-staining procedure, the mordant is_____.
A) iodine
B) safranin
C) crystal violet
D) alcohol

34) After the primary stain has been added but before the decolorizer has been used, Gram-positive organisms are stained_____ and Gram-negative organisms are stained_____.
A) purple; purple
B) purple; colorless
C) purple; pink
D) pink; pink

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35) After the decolorizer has been added, Gram-positive organisms are stained_____ and Gram-negative organisms are stained_____.
A) purple; purple
B) purple; colorless
C) purple; pink
D) pink; pink

36) After the mordant has been added, Gram-positive organisms are stained _____ and Gram-negative organisms are stained _____.
A) purple; purple
B) purple; colorless
C) purple; pink
D) pink; pink

37) If the decolorizer is left on too long in the Gram-staining procedure, Gram-positive organisms will be stained_____ and Gram-negative organisms will be stained_____.
A) purple; blue
B) purple; colorless
C) purple; pink
D) pink; pink

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38) If the decolorizer is not left on long enough in the Gram-staining procedure, Gram-positive organisms will be stained_____ and Gram-negative organisms will be stained_____.
A) purple; purple
B) purple; colorless
C) purple; pink
D) pink; pink

39) Which of the following is considered to be a differential staining procedure?
A) Gram stain
B) Acid-fast stain
C) Both Gram stain and Acid-fast stain
D) Leifson's flagella stain

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40) Basic dyes such as methylene blue bind to cellular molecules that are_____.
- A) hydrophobic
- B) negatively charged
- C) positively charged
- D) aromatic

41) The Gram-staining procedure is an example of _____.
- A) simple staining
- B) negative staining
- C) differential staining
- D) fluorescent staining

42) Regions of a specimen with higher electron density scatter_____ electrons and, therefore, appear_____ in the image projected onto the screen of a transmission electron microscope.
- A) more; lighter
- B) more; darker
- C) fewer; darker
- D) fewer; lighter

43) Scanning electron microscopy is most often used to reveal_____.
- A) surface structures
- B) internal structures
- C) both surface and internal structures simultaneously
- D) either surface or internal structures, but not simultaneously

44) Small internal cell structures are best visualized with a_____.
- A) light microscope
- B) dark-field microscope
- C) transmission electron microscope
- D) flagellar microscope

45) In transmission electron microscopy, spreading a specimen out in a thin film with uranyl acetate, which does not penetrate the specimen, is called_____.
- A) freeze-etching
- B) simple staining
- C) shadow staining
- D) negative staining

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46) Atomic force microscopes use a scanning probe that maintains a fixed distance from the surface of the specimen. It is useful for specimens that_____.
A) do not conduct electricity well
B) have extremely uneven surfaces
C) do not conduct electricity well, and have extremely uneven surfaces
D) conduct electricity well, and have smooth surfaces

47) If immersion oil was replaced with water, what would happen?
A) The refractive index would increase, improving resolution.
B) The refractive index of water would be greater than air but less than oil, improving resolution less than oil.
C) The refractive index of water would be less than that of air, decreasing resolution.
D) There would be no difference.

48) As the resolution of a microscope system improves, the size of the smallest object that can be seen clearly _____.
A) is larger
B) is smaller
C) is not affected

49) If you forgot to heat fix a smear before doing a Gram stain, which of the following might occur?
A) The stains would not adhere to the bacteria.
B) The smear may not adhere to the slide.
C) The decolorization step of the Gram stain would not work properly.
D) Gram-positive and Gram-negative bacteria would both stain purple.

50) A specimen has been prepared for viewing with a transmission electron microscope, using uranyl acetate as a negative stain. The area stained by the uranyl acetate will be _____ electron-dense compared to the specimen itself.
A) more
B) less
C) equally

51) If you forgot the decolorization step while performing a Gram stain, which outcome would you expect?
A) Gram-positive bacteria would stain pink
B) Gram-negative bacteria would stain purple
C) Gram-negative bacteria would be unstained
D) Gram-positive bacteria would be unstained

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52) If you forgot to apply the safranin counterstain while performing a Gram stain, which outcome would you expect?
A) Gram-positive bacteria would stain pink.
B) Gram-negative bacteria would stain purple.
C) Gram-negative and Gram-positive bacteria would be unstained.
D) Gram-negative bacteria would be unstained.

53) Which type of microscopy would be preferred for creating a three-dimensional view of the distribution and arrangement of flagella on a bacterial cell surface?
A) Bright-field microscopy
B) Scanning electron microscopy
C) Fluorescence microscopy
D) Transmission electron microscopy

54) Which type of microscopy would be preferred for showing fine internal detail of the eukaryotic organelles?
A) Bright-field microscopy
B) Scanning electron microscopy
C) Fluorescence microscopy
D) Transmission electron microscopy

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55) You are researching the structure of a transmembrane protein. Which type of microscopy would provide you the best view of this protein?
A) Bright field microscopy
B) Scanning electron microscopy
C) Transmission electron microscopy
D) Atomic force microscopy

56) If the strength of a lens is the reciprocal of its focal length ($^1/_f$), which of the following lenses will have the greatest strength?
A) A lens with a focal length of 1cm
B) A lens with a focal length of 100 mm
C) A lens with a focal length of 0.1 mm
D) A lens with a focal length of 1 mm

57) Glass has a greater refractive index than air. This means that_____.
A) the velocity of the light is slowed when it passes through the glass from the air
B) the velocity of the light accelerates when it passes through the glass from the air
C) the velocity of the light is slowed when it passes through the air from the glass
D) the light is bent away from the normal when passing through glass from air

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FILL IN THE BLANK. Write the word or phrase that best completes each statement or answers the question.

58) The_____ is the point at which a lens focuses parallel beams of light.

59) The_____ is the distance between the center of a lens and the point at which it focuses parallel beams of light.

60) The_____ is the distance between the specimen and the objective lens when the specimen is in focus.

61) The useful magnification of a light microscope is limited by the_____ of the light source being utilized.

62) The special dyes used in fluorescence microscopy that absorb light at one wavelength and emit light at a different wavelength are called_____.

63) In order to view a specimen with a total magnification of 400×, a_____ objective must be used if the ocular is 10×.

64) The procedure in which a single stain is used to visualize microorganisms is called_____ staining.

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65) _____ is the process by which internal and external structures of cells and organisms are preserved and maintained in position.

66) Thin films of bacteria that have been air-dried onto a glass microscope slide are called_____.

67) A procedure that divides organisms into two or more groups depending on their individual reactions to the same staining procedure is referred to as_____ staining.

68) An electron microscope uses_____ lenses to focus beams of electrons onto a specimen.

69) _____ breaks frozen specimens along lines of greatest weakness, often down the middle of lipid bilayer membranes so that they may be observed by transmission electron microscopy.

70) The_____ microscope is capable of atomic resolution of specimens, even when they are immersed in water.

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71) The designer of the first transmission electron microscope,_____, was awarded the 1986 Nobel Prize in physics.

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Answer Key

Test name: Chapter 02

1) TRUE
2) TRUE
3) TRUE
4) TRUE
5) TRUE
6) FALSE
7) TRUE
8) TRUE
9) TRUE
10) FALSE
11) TRUE
12) TRUE
13) TRUE
14) FALSE
15) FALSE
16) TRUE
17) TRUE
18) TRUE
19) B
20) D
21) C
22) D
23) B
24) C
25) A
26) D
27) B
28) C
29) C
30) C
31) D
32) B
33) A
34) A
35) B
36) A
37) D

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38) A
39) C
40) B
41) C
42) B
43) A
44) C
45) D
46) A
47) B
48) B
49) B
50) A
51) B
52) D
53) B
54) D
55) D
56) C
57) A
58) focal point
59) focal length
60) working distance
61) wavelength
62) fluorochromes
63) 40×
64) simple
65) Fixation
66) smears
67) differential
68) magnetic
69) Freeze-etching
70) scanning tunneling
71) Ernst Ruska

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