

Student name: _____

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

- 1) The _____ is the point at which a lens focuses parallel beams of light.
- 2) The _____ is the distance between the center of a lens and the point at which it focuses parallel beams of light.
- 3) The _____ is the distance between the specimen and the objective lens when the specimen is in focus.
- 4) The useful magnification of a light microscope is limited by the _____ of the light source being utilized.
- 5) The special dyes used in fluorescence microscopy that absorb light at one wavelength and emit light at a different _____ wavelength are called _____.
- 6) In order to view a specimen with a total magnification of $400\times$, a _____ objective must be used if the ocular is $10\times$.
- 7) The procedure in which a single stain is used to visualize microorganisms is called _____ staining.
- 8) _____ is the process by which internal and external structures of cells and organisms are preserved and maintained in position.

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

10) 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.

11) An electron microscope uses _____ lenses to focus beams of electrons onto a specimen.

12) _____ 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.

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

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

14) 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

15) A 30× objective and a 20× ocular produce a total magnification of _____.

- A) 230×
- B) 320×

- C) 50×
- D) 600×

16) A 45× objective and a 10× ocular produce a total magnification of _____.

- A) 900×
- B) 55×

- C) 450×
- D) 145×

17) 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

18) 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

19) 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

20) An instrument that magnifies slight differences in the refractive index of cell structures is called a/an _____ microscope.

- A) phase-contrast
- B) electron

- C) fluorescence
- D) densitometric

21) The instrument that produces a bright image of the specimen against a dark background is called a/an _____ microscope.

- A) phase-contrast
- B) electron

- C) bright-field
- D) dark-field

22) 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

23) 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

24) Acid-fast organisms such as *Mycobacterium tuberculosis* contain _____ constructed from mycolic acids in their cell walls.

- A) proteins
- B) carbohydrates

- C) lipids
- D) peptidoglycan

25) In the Gram-staining procedure, the primary stain is _____.

- A) iodine
- B) safranin

- C) crystal violet
- D) alcohol

26) In the Gram-staining procedure, the decolorizer is _____.

- A) iodine
- B) safranin

- C) crystal violet
- D) ethanol or acetone

27) In the Gram-staining procedure, the counterstain is _____.

- A) iodine
- B) safranin

- C) crystal violet
- D) alcohol

28) In the Gram-staining procedure, the mordant is _____.

- A) iodine
- B) safranin

- C) crystal violet
- D) alcohol

29) 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

30) 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

31) 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

32) 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

33) 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

34) Which of the following is considered to be a differential staining

- A) Gram stain
- B) Acid-fast stain
- C) Both Gram stain and Acid-fast stain
- D) Leifson's flagella stain

35) Basic dyes such as methylene blue bind to cellular molecules that are _____.

- A) hydrophobic
- B) negatively charged

- C) positively charged
- D) aromatic

36) The Gram-staining procedure is an example of _____.

- A) simple staining
- B) negative staining
- C) differential staining

- D) fluorescent staining

37) 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

38) 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

39) Small internal cell structures are best visualized with a _____.

- A) light microscope
- B) dark-field microscope
- C) transmission electron microscope

D) flagellar microscope

40) 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

41) 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.

42) 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

43) 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.

44) 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

A) more

_____ electron dense compared to specimen itself.

- B) less
- C) equally

45) 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

46) 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.

47) 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 1 cm
- 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

48) Glass has a greater refractive index than air. This

- 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

means that _____.

through the air from the glass

D) the light is bent away from the normal when passing through glass from air

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

49) Light rays are refracted (bent) when they cross the

- ☐ true
- ☐ false

interface between materials with different refractive indices.

50) A substage condenser is used to focus light onto the specimen, which increases the resolution of a light microscope.

- ☐ true
- ☐ false

51) Confocal microscopes, in combination with specialized computer software, can be used to create three-

- ☐ true
- ☐ false

dimensional images of cell structures.

52) 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

53) Resolution improves when the wavelength of the illuminating light decreases.

☐ true

☐ false

54) Immersion oil is used to prevent a specimen from drying out.

☐ true

☐ false

55) 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

56) Immersion oil increases the amount of light entering the objective lens.

☐ true

☐ false

57) Gram staining divides bacterial species into two groups based on differences in cell wall structure.

☐ true

☐ false

58) Negative staining facilitates the visualization of bacterial capsules that are intensely stained by the procedure.

☐ true

☐ false

59) Negative staining with India ink can be used to reveal the presence of capsules that surround bacterial cells.

☐ true

☐ false

60) Mordants increase the binding between a stain and specimen.

☐ true

☐ false

61) 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

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

☐ true

☐ false

63) Because transmission electron microscopy uses electrons rather than light, it is not necessary to stain

biological specimens before observing them.

☐ true

☐ false

64) 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

- ☐ true
- ☐ false

electrons used to bombard the specimen.

65) It was possible to view viruses only after the invention of the electron microscope because they are too small to be

- ☐ true
- ☐ false

seen with a light microscope.

Answer Key

Test name: Principles of Microbiology ch02

- 1) focal point
- 2) focal length
- 3) working distance
- 4) wavelength
- 5) fluorochromes
- 6) 40×
- 7) simple
- 8) Fixation
- 9) smears
- 10) differential
- 11) magnetic
- 12) Freeze-etching
- 13) Ernst Ruska
- 14) B
- 15) D
- 16) C
- 17) D
- 18) B
- 19) C

20) A

21) D

22) B

23) C

24) C

25) C

26) D

27) B

28) A

29) A

30) B

31) C

32) D

33) A

34) C

35) B

36) C

37) B

38) A

39) C

40) D

- 41) B
- 42) B
- 43) B
- 44) A
- 45) B
- 46) D
- 47) C
- 48) A
- 49) TRUE
- 50) TRUE
- 51) TRUE
- 52) TRUE
- 53) TRUE
- 54) FALSE
- 55) TRUE
- 56) TRUE
- 57) TRUE
- 58) FALSE
- 59) TRUE
- 60) TRUE
- 61) TRUE

62) FALSE

63) FALSE

64) TRUE

65) TRUE