

Exam

Name _____

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

- 1) A nanometer would be a suitable unit of measurement for which of the following? 1) _____
A) eukaryotic cells
B) molecules and atoms
C) cellular organelles and viruses
D) bacterial colonies
E) prokaryotic cells
- 2) The numerical aperture of a lens refers to its 2) _____
A) thickness.
B) ability to gather light.
C) resolution distance.
D) curvature.
E) working distance.
- 3) Empty magnification results from increasing magnification without increasing the 3) _____
A) wavelength.
B) resolution.
C) refraction.
D) curvature of the lens.
E) focal point.
- 4) The total magnification of a compound microscope is calculated using the magnification of which 4) _____
of the following?
A) the objective and the condenser lense
B) the objective and the ocular lenses
C) the objective lens and the prism
D) the condenser lens and the diaphragm
E) the condenser and the ocular lenses
- 5) If you were trying to visualize flagella without staining, which microscope would you use? 5) _____
A) fluorescent
B) phase-contrast
C) confocal
D) dark-field
E) bright-field
- 6) Why does immersion oil improve resolution? 6) _____
A) It allows light to travel at a uniform speed on its way to the lens.
B) It decreases the working distance.
C) It increases the numerical aperture.
D) Both A and C are correct.
E) A, B, and C are correct.

- 7) Cilia and flagella can be visualized using which of the following types of microscopes? 7) _____
A) darkfield microscopes
B) phase-contrast microscopes
C) Nomarski microscopes
D) All of the above are correct.
E) None of the above is correct.
- 8) Which of the following types of microscopes is capable of generating a three-dimensional image of a specimen? 8) _____
A) scanning electron
B) confocal
C) differential interference contrast
D) Both B and C are correct.
E) A, B, and C are correct.
- 9) All of the following are associated with an electron microscope EXCEPT: 9) _____
A) magnetic fields.
B) a fluorescent screen.
C) a prism.
D) an electron beam.
E) a vacuum.
- 10) All of the following are types of light microscopes EXCEPT: 10) _____
A) phase-contrast.
B) confocal.
C) bright-field.
D) fluorescent.
E) scanning tunneling.
- 11) Which of the following microscopes is capable of more than 100,000,000X magnification? 11) _____
A) scanning electron microscopes
B) scanning tunneling microscopes
C) transmission electron microscopes
D) bright-field microscopes
E) differential interference contrast microscopes
- 12) If a microbiology lab technician left the crystal violet out of the Gram stain procedure, what would be the result? 12) _____
A) Gram-positive cells would be colorless and Gram-negative cells would be pink.
B) Gram-positive cells would be purple and Gram-negative cells would be colorless.
C) All cells would be pink.
D) Gram-positive cells would be pink and Gram-negative cells would be purple.
E) All cells would be purple.
- 13) All of the following are common to both the Gram stain and the acid-fast stain EXCEPT: 13) _____
A) primary stain.
B) a decolorizing agent and a mordant.
C) a decolorizing agent.
D) a mordant.
E) counterstain.

- 14) A patient suffering from tuberculosis could be diagnosed by use of the _____ stain. 14) _____
A) Gram B) flagellar C) endospore D) acid-fast E) capsule
- 15) Which of the following staining procedures uses heat to drive the stain into the cell? 15) _____
A) endospore stain
B) acid-fast stain
C) capsule stain
D) Both A and B are correct.
E) A, B, and C are correct.
- 16) Carbofuchsin is used in which of the following staining procedures? 16) _____
A) flagellar stain
B) Gram stain
C) endospore stain
D) capsule stain
E) acid-fast stain
- 17) All of the following are components of electron microscopy stains EXCEPT: 17) _____
A) tungsten. B) uranium. C) lead. D) eosin. E) osmium.
- 18) The kingdoms included in the Linnaean system are: 18) _____
A) Animalia and Prokaryotae.
B) Fungi and Protista.
C) Protista and Plantae.
D) Animalia and Plantae.
E) Prokaryotae and Protista.
- 19) The rules of naming organisms are called 19) _____
A) nomenclature.
B) classification.
C) identification.
D) binomials.
E) taxonomy.
- 20) All of the following are kingdoms proposed by Robert Whitaker EXCEPT: 20) _____
A) Plantae. B) Protista. C) Animalia. D) Archaea. E) Fungi.
- 21) All of the following are characteristics of a genus name EXCEPT: 21) _____
A) it is either underlined or in italics.
B) it is always capitalized.
C) it is one of two names used to identify an organism.
D) it is written before the specific epithet.
E) it is usually an adjective.

- 22) Carl Woese proposed the concept of the domain based on differences among which of the following cellular molecules? 22) _____
- A) ribosomal RNA
 - B) membrane lipids
 - C) DNA
 - D) proteins
 - E) transfer RNA
- 23) Which of the following classification methods involves the use of antibodies to recognize different strains of a particular microbe? 23) _____
- A) biochemical tests
 - B) physical characteristics
 - C) phage typing
 - D) analysis of nucleic acids
 - E) serological tests
- 24) A cell's GC ratio is associated with which of the following classification methods? 24) _____
- A) physical characteristics
 - B) analysis of nucleic acids
 - C) serological tests
 - D) phage typing
 - E) biochemical tests
- 25) The size of most cells is measured in 25) _____
- A) micrometers.
 - B) meters.
 - C) centimeters.
 - D) nanometers.
 - E) millimeters.
- 26) Why is visible light relatively limited in its usefulness for microscopy? 26) _____
- A) It does not produce enough contrast in specimens.
 - B) It is not powerful enough to penetrate some specimens.
 - C) Its wavelength is too long to enable high resolution of images.
 - D) Both A and B are correct.
 - E) A, B, and C are correct.
- 27) The refraction of radiation as it passes through a lens creates which of the following? 27) _____
- A) resolution distance
 - B) magnification
 - C) immunofluorescence
 - D) resolving power
 - E) contrast
- 28) All of the following types of microscopes are limited to magnification of about 2000X EXCEPT: 28) _____
- A) a dark-field microscope.
 - B) a scanning tunneling microscope.
 - C) a phase-contrast microscope.
 - D) a fluorescent microscope.
 - E) a differential interference contrast microscope.

- 29) A structure that appears in a transmission electron micrograph but which is not actually present in the specimen is known as a(n) _____
 A) antigen. B) refraction. C) mordant. D) biofilm. E) artifact.
- 30) Which of the following is NOT true of transmission electron microscopy? _____
 A) Glass lenses are used.
 B) Stains can be applied to improve contrast.
 C) The sample is placed in a vacuum.
 D) Electrons are the source of illumination.
 E) Thin segments must be used.
- 31) Basic dyes are more commonly used than acidic dyes because _____
 A) they are positively charged.
 B) they bind specifically to the lipid membrane of the cell.
 C) they fluoresce under UV light.
 D) they are best used for electron microscopy.
 E) they work best at a low pH.
- 32) All of the following are associated with smear preparation EXCEPT: _____
 A) fixation using heat.
 B) agglutination of the specimen.
 C) killing the microbes in the specimen.
 D) spreading the specimen onto a slide.
 E) fixation using methanol or formalin.
- 33) The Gram stain works due to differences in the _____ of bacteria. _____
 A) cell walls
 B) antigens
 C) cell membranes
 D) capsules
 E) genetic characteristics
- 34) In the Linnaean system of taxonomy, an order is a subset of a larger taxonomic group called the _____
 A) genus. B) kingdom. C) class. D) family. E) phylum.
- 35) Why are modern light microscopes better than the ones Leeuwenhoek used? _____
 A) Modern microscopes are compound instead of simple.
 B) Modern microscopes have a fivefold better resolution.
 C) Modern microscopes have lenses with smaller numerical apertures.
 D) Both A and B are correct.
 E) A, B, and C are correct.

MATCHING. Choose the item in column 2 that best matches each item in column 1.

Match the names of the objective lenses on the left with the appropriate power of magnification on the right:

- 36) Low-power objective lens A) 10X 36) _____

- | | | |
|----------------------------------|---------|-----------|
| 37) Oil immersion objective lens | A) 100X | 37) _____ |
| 38) Scanning objective lens | B) 40X | 38) _____ |
| 39) High, dry objective lens | C) 4X | 39) _____ |

Match the reagent on the left with the staining procedure in which it is used on the right:

- | | | |
|----------------------|------------------------------|-----------|
| 40) Osmium tetroxide | A) Negative stain | 40) _____ |
| 41) Eosin | B) Gram stain | 41) _____ |
| 42) Crystal violet | C) Endospore stain | 42) _____ |
| 43) Carbofuchsin | D) Flagellar stain | 43) _____ |
| 44) Malachite green | E) Electron microscopy stain | 44) _____ |
| 45) Pararosaniline | F) Acid-fast stain | 45) _____ |

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

- | | |
|---|-----------|
| 46) A resolution of 1 μm would be better than a resolution of 0.5 μm . | 46) _____ |
| 47) Bacterial cells are so similar to each other that physical characteristics cannot be used in identification of organisms. | 47) _____ |
| 48) The three domains proposed by Carl Woese are the Archaea, the Eukarya, and the Bacteria. | 48) _____ |
| 49) Linnaeus proposed the system of binomial nomenclature that we use today. | 49) _____ |
| 50) A negative stain leaves cells colorless while staining the background of the smear. | 50) _____ |
| 51) Members of the genera <i>Bacillus</i> and <i>Clostridium</i> can be identified using the endospore stain. | 51) _____ |
| 52) Acid-fast cells such as <i>Mycobacterium</i> lose the color of the primary stain in the presence of hydrochloric acid. | 52) _____ |
| 53) In the presence of a decolorizing agent, Gram-negative cells lose the color of the counterstain. | 53) _____ |
| 54) Light rays that are in phase reinforce each other and produce a brighter image. | 54) _____ |
| 55) Light rays that pass through the edge of a curved lens will be refracted more than those that pass through the center. | 55) _____ |

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- | | |
|---|-----------|
| 56) A(n) _____ microscope has a single ocular lens. | 56) _____ |
|---|-----------|

- 57) A(n) _____ molecule is one that absorbs invisible radiation and emits visible light. 57) _____
- 58) The total magnification using a 10X ocular and a 40X objective would be _____. 58) _____
- 59) A(n) _____ is a substance that binds to a dye and makes it less soluble. 59) _____
- 60) In taxonomy, organisms in similar classes can be classified in larger groups called _____. 60) _____
- 61) An agglutination test is an example of a(n) _____ type of classification test. 61) _____
- 62) Robert Whittaker first proposed a taxonomic approach that is based on _____ kingdoms. 62) _____
- 63) Carl Woese and his colleagues proposed the _____, a taxon that replaces the kingdom. 63) _____
- 64) The definitive reference work for the identification of bacteria is known as _____. 64) _____
- 65) Bacterial viruses that can be used to help classify different groups of bacteria are called _____. 65) _____
- 66) A(n) _____ is a clear area on a bacterial lawn that is evidence of virus growth. 66) _____
- 67) An integral part of serological testing is the use of a solution called _____ that contains antibodies. 67) _____
- 68) In a compound microscope, the lens that directs light through the specimen is the _____ lens. 68) _____
- 69) _____ is the process of immobilizing organisms on a glass slide through the application of either heat or chemicals. 69) _____
- 70) A staining procedure that uses more than one dye is called a(n) _____ stain. 70) _____

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

- 71) Discuss the ways in which light rays can be manipulated in order to increase resolution and/or contrast.
- 72) Compare and contrast the light microscope with the electron microscope.
- 73) Discuss the role of the decolorizing agent in differential staining procedures.
- 74) Compare and contrast the three domains identified by Woese—Eukarya, Bacteria, and Archaea.
- 75) List and explain five types of techniques that can be used to identify unknown microorganisms.

Answer Key

Testname: UNTITLED4

- 1) C
- 2) B
- 3) B
- 4) B
- 5) B
- 6) D
- 7) B
- 8) E
- 9) C
- 10) E
- 11) B
- 12) C
- 13) D
- 14) D
- 15) D
- 16) E
- 17) D
- 18) D
- 19) A
- 20) D
- 21) E
- 22) A
- 23) E
- 24) B
- 25) A
- 26) C
- 27) B
- 28) B
- 29) E
- 30) A
- 31) A
- 32) B
- 33) A
- 34) D
- 35) D
- 36) A
- 37) A
- 38) C
- 39) B
- 40) E
- 41) A
- 42) B
- 43) F
- 44) C
- 45) D
- 46) FALSE
- 47) FALSE
- 48) TRUE
- 49) TRUE
- 50) TRUE

Answer Key

Testname: UNTITLED4

- 51) TRUE
- 52) FALSE
- 53) FALSE
- 54) TRUE
- 55) TRUE
- 56) monocular
- 57) fluorescent
- 58) 400X
- 59) mordant
- 60) phyla
- 61) serological
- 62) five
- 63) domain
- 64) *Bergey's Manual*
- 65) bacteriophages
- 66) plaque
- 67) antiserum
- 68) condenser
- 69) Fixation
- 70) differential
- 71) There are a variety of ways that light rays can be manipulated in order to increase the resolution and contrast of a specimen. In bright-field microscopes, immersion oil is used to capture light rays that would otherwise be refracted and lost, thereby increasing the resolution of the image. Dark-field microscopes purposely scatter light rays in such a way as to improve the contrast of the specimen. Phase microscopes alter the wavelengths of light rays by making them in and out of phase with each other, thereby increasing contrast. Finally, fluorescent microscopes use UV light, which produces increased resolution because of its shorter wavelength, and the fluorescent dyes that are used emit a variety of colors, increasing contrast.
- 72) Both the light microscope and the electron microscope depend on the wavelength of radiation in order to achieve the resolution necessary to see fine details of specimens. Light microscopes use light rays, which, because of their relatively long wavelengths, limit the magnification of these microscopes to 2000X or less. Electron beams, on the other hand, have such a short wavelength that the resolution is greatly increased, to the point that magnification of 100,000X or more is possible. Both microscopes are capable of modulating and focusing their radiation sources in such a way as to increase the quality of the magnification; however, in a light microscope, the light rays are focused using glass lenses, whereas in an electron microscope, the electron beam is focused with magnetic fields. Because of their higher levels of magnification and extreme resolving power, electron microscopes are capable of seeing the finest details of the cell's ultrastructure, even to the point of being able to visualize molecules and atoms; light microscopes are capable of seeing only the larger cellular structures such as organelles.
- 73) All differential stains involve a series of reagents applied to a smear in such a way that different cells will have a different microscopic appearance or color. For example, the Gram stain produces two outcomes: some cells stain purple and are labeled Gram-positive, while other cells stain pink (Gram-negative). In the Gram stain and in other differential stains, the role of the decolorizing agent is to wash the primary stain out of some cells, while being unable to remove it from others. The decolorizing agent in the Gram stain is ethanol-acetone, and removes the primary stain only from Gram-negative cells. The acid-fast stain uses hydrochloric acid to remove the primary stain from non-acid-fast cells. The endospore stain uses water to wash the primary stain out of the vegetative cells. In each case, the decolorizing agent leaves these cells colorless, so that a counterstain is necessary to give a color to them.

Answer Key

Testname: UNTITLED4

- 74) With respect to cell type, organisms in Eukarya have eukaryotic cells and the characteristics that go with this cell type, such as a nucleus and membrane-bound organelles. Bacteria and Archaea both have prokaryotic cells lacking nuclei and membrane-bound organelles. All three have different rRNA sequences found in the small subunit of their ribosomes that are characteristic of the domain, which is an important tool for categorizing organisms. All three have cell membranes; however, they differ in the lipids found in the cell membrane. Eukaryotes belong to one of four kingdoms: plant, animal, protista, or fungi. Archaea have only three kingdoms and Bacteria have over fifty.
- 75) There are five major types of identification techniques used in the microbiology lab. One method is simply observation and classification of the physical characteristics of an organism, which includes both cellular morphology and colony morphology. A second method is the use of biochemical tests such as fermentation of carbohydrates or production of metabolic by-products to place microbes in different groups. A third type of identification technique is serological testing, in which antibodies are used to detect particular antigens on the surfaces of different microbes, in an effort to distinguish between closely related species or strains of microbes. Phage typing is the fourth technique, which is the use of bacteriophages to infect bacterial cells; because bacteriophages are highly specific in their infection of cells, the patterns of infected and uninfected cells can be used to differentiate between bacterial strains and species. Finally, a fifth method involves the analysis of the genetic material of microbes, such as the percentage of G and C bases in a cell's DNA, as a way of demonstrating possible relationships between species.