

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question and place your selection ON THE ANSWER SHEET.

1. A carbon skeleton is covalently bonded to both an amine group and a carboxyl group. When placed in water,
 - A) it would function only as an acid because of the carboxyl group
 - B) it would function only as a base because of the amine group
 - C) it would function neither an acid nor a base
 - D) it would function as both an acid and a base
 - E) it is impossible to determine how it would function
2. What do cohesion, surface tension, and adhesion have in common with reference to water?
 - A) All increase when temperature increases
 - B) All are properties related to hydrogen bonding
 - C) All have to do with nonpolar covalent bonds
 - D) All are produced by ionic bonding
 - E) C and D only
3. How many structural isomers are possible for a substance having the molecular formula C_4H_{10} ?
 - A) 3
 - B) 2
 - C) 11
 - D) 4
 - E) 1
4. An organism with a cell wall would have the most difficulty doing which process?
 - A) phagocytosis
 - B) active transport
 - C) osmosis
 - D) diffusion
 - E) exocytosis
5. A patient has had a serious accident and lost a lot of blood. In an attempt to replenish body fluids, distilled water, equal to the volume of blood lost, is transferred directly into one of his veins. What will be the most probable result of this transfusion?
 - A) The patient's red blood cells will shrivel up because the blood fluid is hypertonic compared to the cells.
 - B) It will have no unfavorable effect as long as the water is free of viruses and bacteria.
 - C) The patient's red blood cells will shrivel up because the blood fluid is hypotonic compared to the cells.
 - D) The patient's red blood cells will swell because the blood fluid is hypotonic compared to the cells.
 - E) The patient's red blood cells will burst because the blood fluid is hypertonic compared to the cells.
6. Zinc, an essential trace element for most organisms, is present in the active site of the enzyme carboxypeptidase. The zinc most likely functions as a(n);
 - A) cofactor necessary for enzyme activity
 - B) competitive inhibitor of the enzyme
 - C) noncompetitive inhibitor of the enzyme
 - D) allosteric activator of the enzyme
 - E) coenzyme derived from a vitamin

7. Use the diagram of the U-tube in Figure 7.2 to answer question #7 that follows.

The solutions in the two arms of this U-tube are separated by a membrane that is permeable to water and glucose but not to sucrose. Side A is half filled with a solution of 2 M sucrose and 1 M glucose. Side B is half filled with 1 M sucrose and 2 M glucose. Initially, the liquid levels on both sides are equal.

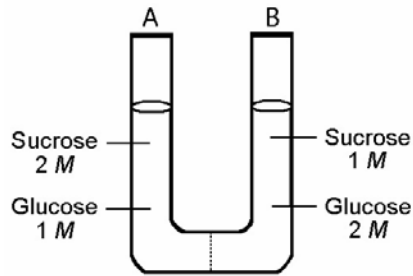


Figure 7.2

Initially, in terms of tonicity, the solution in side A with respect to that in side B is:

- A) isotonic B) hypotonic C) plasmolyzed D) hypertonic E) saturated

8. In the absence of oxygen, a yeast cell undergoes fermentation and uses 100 molecules of glucose. How much net ATP will be generated?

- A) 100 B) 400 C) 300 D) 200 E) 36

9. Eukaryotic sexual life cycles show tremendous variation. Of the following elements, which do *all* sexual life cycles have in common?

- I. alternation of generations
- II. meiosis
- III. fertilization
- IV. gametes
- V. spores

- A) II, IV, and V
 B) II, III, and IV
 C) I, IV, and V
 D) I, II, and IV
 E) I, II, III, IV, and V

10. How do the daughter cells at the end of mitosis and cytokinesis compare with their parent cell when it was in G¹ of the cell cycle?

- A) The daughter cells have the same number of chromosomes and half the amount of DNA.
 B) The daughter cells have the same number of chromosomes and the same amount of DNA.
 C) The daughter cells have half the number of chromosomes and half the amount of DNA.
 D) The daughter cells have half the amount of cytoplasm and half the amount of DNA
 E) The daughter cells have the same number of chromosomes and twice the amount of DNA.

11. Which of the following is missing from the life cycle progression shown below?

- sporophyte-*meiosis*-spore-_____ -gametophyte-*mitosis*-gametes- *fertilization*-zygote
 A) mitosis B) synapsis C) fertilization D) karyotype E) meiosis

12. In both eukaryotes and prokaryotes, gene expression is primarily regulated at the level of
- A) transcription
 - B) mRNA splicing
 - C) protein stability
 - D) translation
 - E) mRNA stability
13. Which of the following are NOT involved in the DNA replication process?
- A) DNA polymerase
 - B) DNA ligase
 - C) DNA helicase
 - D) DNA replicase
 - E) All of the above are involved
14. An increase in the permeability to water in the cells of the collecting tubule of the nephron is due to
- A) a decrease in the concentration of the blood plasma
 - B) an increase in the production of aldosterone
 - C) an increase in the production of ADH
 - D) a decrease in the production of ADH
 - E) all of the above will cause an increase in the permeability
15. All of the following statements about photosynthesis are true EXCEPT:
- A) the light reactions convert solar energy to chemical energy in the form of ATP and NADPH
 - B) the Calvin cycle uses ATP and NADPH to convert CO₂ to sugar
 - C) photosystem I contains P700 chlorophyll a molecules at the reaction center; photosystem II contains P680 molecules
 - D) in chemiosmosis, electron transport chains pump protons (H⁺) across a membrane from a region of high H⁺ concentration to a region of low H⁺ concentration
 - E) the steps of the Calvin cycle are sometimes referred to as the dark reactions, because they do not require light in order to take place
16. If you expose a photosynthesizing plant to water that contains both radioactive H and radioactive O, in which of the products of photosynthesis will the radioactive H and O show up?
- A) H and O both in glucose
 - B) H in glucose; O in water
 - C) H in water; O in glucose
 - D) H in glucose and water; O in O₂
 - E) H in glucose and water; O in water and O₂
17. A homeotic gene does which of the following?
- A) turns on the genes necessary for synthesis of proteins
 - B) serves as a master control gene that functions during embryonic development by controlling the developmental fate of groups of cells
 - C) represses gene transcription
 - D) produces a product that controls the transcription of other genes
 - E) both A and D

18. John Smith is a deaf individual born to parents with normal hearing. Deafness is a recessive trait that is associated with the abnormal allele *d*. The normal allele at this locus, associated with normal hearing, is *D*. John's parents would most likely have which of the following genotypes?
- A) *DD* and *dd*
 - B) *Dd* and *dd*
 - C) *Dd* and *Dd*
 - D) *dd* and *dd*
 - E) either B or C
19. All of the following statements are part of Darwin's theory of evolution EXCEPT
- A) the most important contribution to evolution is made by genetic mutation
 - B) natural selection is the force behind evolution
 - C) natural selection occurs as a result of the differing reproductive success of individuals in a population
 - D) the driving force of evolution is the adaptation of a population of organisms to their environment
 - E) more individuals are born in a population than will survive to reproduce
20. Which of the following characteristics is common to all bryophytes?
- A) small, independent gametophytes
 - B) large, independent sporophytes
 - C) haploid spores
 - D) seed production
 - E) vascular tissue
21. All of the following are true about CO_2 in the atmosphere surrounding Earth EXCEPT;
- A) the process of photosynthesis in plants takes in CO_2 from the atmosphere
 - B) this CO_2 absorbs and re-reflects infrared rays from the sun
 - C) the level of CO_2 in the atmosphere is increasing, which is causing the Earth's temperature to rise
 - D) the higher the level of CO_2 in the atmosphere, the faster the rate of growth of some plants
 - E) the increase in CO_2 in the atmosphere is mainly due to the decrease in the number of plants on the earth's surface due to deforestation
22. All of the following processes occur in ecosystems *except* that;
- A) energy flows through the system
 - B) carbon is cycled between biotic and abiotic forms
 - C) nitrogen is cycled between biotic and abiotic forms
 - D) producers take up elements in inorganic form from the soil
 - E) the energy source that powers the system is used by consumers to make organic compounds
23. According to most conservation biologists, the single greatest threat to global biodiversity is
- A) chemical pollution of water and air
 - B) stratospheric ozone depletion
 - C) insufficient recycling programs for nonrenewable resources
 - D) alteration or destruction of physical habitat
 - E) global climate change resulting from a variety of human activities
24. The most probable method that bacteria may become drug-resistant to our antibiotics is
- A) transformation
 - B) transduction
 - C) conjugation
 - D) binary fission
 - E) sexual reproduction

25. Many sterile worker bees give their lives to save a bee hive from an attack by bears, etc. In such cases, we now know
- these female worker bees are more related to hive offspring than they would be if they were themselves fertile and mated – it is ‘calculated selfishness’
 - this is really a case of bees consciously understanding the need to preserve the nest for their individual benefit and they might survive if all work together
 - each female worker is waiting to get her chance to reproduce
 - this is a case of sexual selection
 - this system is not yet understood
26. A sample of methane gas, CH₄, has a mass of 8.00 grams. What mass of hydrogen chloride gas, HCl, would contain the same number of molecules?
- 16.0 g
 - 18.3 g
 - 36.5 g
 - 73.0 g
 - 80.0 g
27. At a crime scene, forensic scientists obtained a sample of a pure gas. When analyzed, the gas was found to have a density of 1.964 g/L at STP. The scientists concluded the gas was:
- SO₃
 - C₄H₁₀
 - N₂O
 - NO₂
 - HCl
28. The electron configuration [Kr]4d⁵ 5s¹ represents the ground state of:
- Cr
 - Rb
 - Mo
 - Tc²⁺
 - Zr⁺
29. In the following nuclear decay sequence, determine the correct symbol for the product D. α represents an alpha particle, β represents a beta particle and γ represents a gamma ray.
- $${}_{90}^{234}\text{Th} \xrightarrow{\beta} A \xrightarrow{\beta} B \xrightarrow{\gamma} C \xrightarrow{\alpha} D$$
- ${}_{90}^{230}\text{Th}$
 - ${}_{91}^{234}\text{Pa}$
 - ${}_{92}^{234}\text{U}$
 - ${}_{88}^{226}\text{Ra}$
 - ${}_{86}^{222}\text{Rn}$
30. A container of fixed volume contains 22 grams of CO₂ gas exerting a pressure of 1.00 atm. Methane gas, CH₄, is added to the container, increasing the pressure to 1.50 atm. If the temperature remains constant and no gas escapes, what mass of methane gas was added?
- 32.0 g
 - 24.0 g
 - 16.0 g
 - 8.00 g
 - 4.00 g
31. Which of the following ions has tetrahedral molecular geometry?
- H₃O⁺
 - NH₄⁺
 - H₂F⁺
 - NO₃⁻
 - CO₃²⁻
32. When solid magnesium reacts with chlorine gas, the reaction involves a(n)
- transfer of electrons from Mg to Cl
 - transfer of electrons from Cl to Mg
 - equal sharing of electrons between Mg and Cl
 - unequal sharing of electrons between Cl and Mg
 - creation of electrons
33. The mass of Li₂O formed when 2.00 g of lithium reacts with 2.00 g of oxygen is 3.02 g. What is the percent yield?
- 78.2%
 - 80.6%
 - 81.3%
 - 82.0%
 - 83.8%

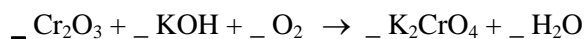
34. Which of the following solutions will have the lowest boiling point? You may assume all salts are 100% ionized.
- 0.012 m ScCl_3
 - 0.012 m $\text{Ce}(\text{NO}_3)_4$
 - 0.015 m $(\text{NH}_4)_2\text{SO}_4$
 - 0.020 m NaCl
 - 0.035 m KNO_3
35. Determine the number of moles of AgCl ($K_{\text{sp}} = 1.6 \times 10^{-10}$) that can dissolve in 250 mL of solution in which 0.10 moles of NaCl is already dissolved.
- 1.0×10^{-10}
 - 1.0×10^{-11}
 - 1.6×10^{-9}
 - 1.6×10^{-10}
 - 1.6×10^{-11}
36. Consider the following equations:
- $\text{N}_{2(\text{g})} + 3\text{H}_{2(\text{g})} \rightarrow 2\text{NH}_{3(\text{g})}$
 - $\text{I}_{2(\text{s})} \rightarrow \text{I}_{2(\text{g})}$
 - $\text{H}_2\text{O}_{(\text{l})} \rightarrow \text{H}_2\text{O}_{(\text{s})}$
 - $\text{C}_{25}\text{H}_{52(\text{s})} \rightarrow \text{C}_{25}\text{H}_{52(\text{l})}$
 - $\text{NaCl}_{(\text{s})} \rightarrow \text{Na}_{(\text{aq})} + \text{Cl}_{(\text{aq})}$
- Which of the equations represent an increase in entropy?
- I, II, III
 - I, II, IV
 - II, III, IV
 - III, V
 - II, IV, V
37. Which set of conditions describes a reaction in which the forward reaction is spontaneous at high temperatures and the reverse reaction is spontaneous at low temperatures?
- ΔH is zero and ΔS is positive
 - ΔH is negative and ΔS is positive
 - ΔH is negative and ΔS is negative
 - ΔH is positive and ΔS is negative
 - ΔH is positive and ΔS is positive
38. Aluminum chloride forms a hydrate with the formula $\text{AlCl}_3 \cdot n\text{H}_2\text{O}$. A sample of aluminum chloride was heated to constant mass and the data recorded.
- Data:
- | | |
|--|---------|
| Mass of crucible | 23.40 g |
| Mass of crucible and hydrate | 31.44 g |
| Mass of crucible and residue after heating | 27.84 g |
- The value for “ n ” is:
- 2
 - 3
 - 6
 - 10
 - 12
39. A real gas deviates from an ideal gas because of its
- rapid molecular motion.
 - catalytic effect of the container walls.

- C) small but finite mass of each molecule.
- D) elastic collisions between the molecules.
- E) attractive forces between the molecules.

40. A solution containing sodium acetate and acetic acid
When sodium acetate is added to acetic acid, the resulting solution will

- A) resist a change in pH
- B) have a pH lower than 1.0
- C) have a pH greater than 7.0
- D) show a decrease in $[H_3O^+]$
- E) have a pH lower than the acid alone

41. When this equation is correctly balanced using the lowest whole-number coefficients, what is the coefficient of O_2 ?



- A) 2 B) 3 C) 4 D) 6 E) 8

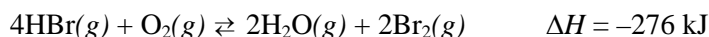
42. In the original periodic table that Mendeleev created in 1869, the noble gas family was

- A) listed on the bottom of the chart, aside from the remaining elements.
- B) partially missing, with certain gaps left for future discovery.
- C) present as it is on the modern periodic table.
- D) broken into groups VIII A and VIII B.
- E) completely missing.

43. Which property of the elements increases continually with increasing atomic number?

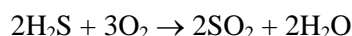
- A) atomic size
- B) nuclear charge
- C) chemical reactivity
- D) first ionization energy
- E) number of valence electrons

44. Which change to this system at equilibrium will increase the concentration of $Br_2(g)$?



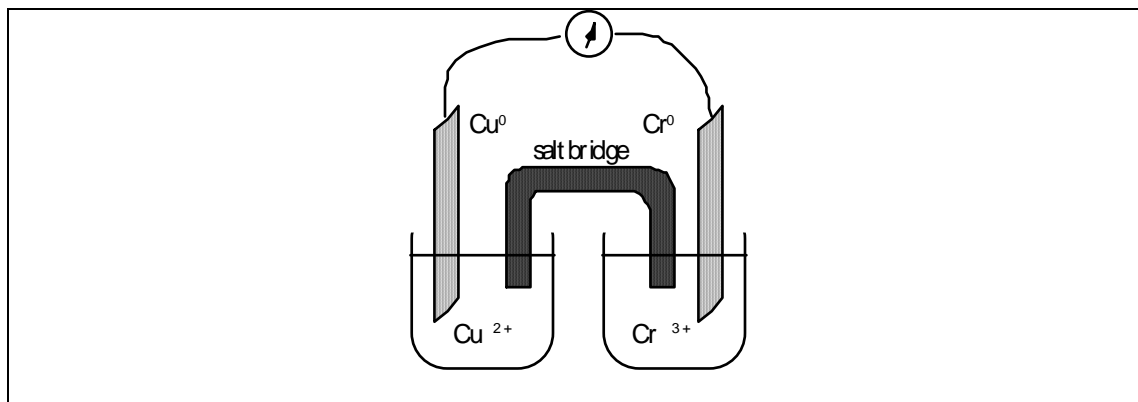
- A) the addition of water vapor, $H_2O(g)$
- B) an increase in temperature
- C) the removal of oxygen, O_2
- D) an increase in pressure
- E) the removal of HBr

45. What is the change in the oxidation number of sulfur in this equation?



- A) -2 to +4 B) +2 to +4 C) -2 to +6 D) +2 to +6 E) +4 to +6

46. The maximum voltage developed by this cell is likely to be



Half-Reaction	Reduction Potential
$\text{Cr}^{3+} + 3e^- \rightleftharpoons \text{Cr}^0$	$E^0 = -0.74 \text{ V}$
$\text{Cu}^{2+} + 2e^- \rightleftharpoons \text{Cu}^0$	$E^0 = +0.34 \text{ V}$

- A) -1.08 V B) -0.40 V C) $+0.40 \text{ V}$ D) $+1.08 \text{ V}$ E) 0.0 V

47. In a titration, 60.0 mL of 0.01M NaOH was added to 35.0 mL of 0.02M HCl. What was the pH of the remaining solution?

- A) 11.0 B) 5.41 C) 4.00 D) 2.98 E) 1.70

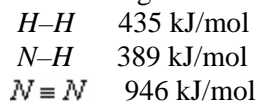
48. The reaction of an organic acid and an alcohol is called a condensation reaction. In addition to the formation of water, the main product is

- A) an ether
 B) an ester
 C) an ketone
 D) an aldehyde
 E) a carbohydrate

49. If 2.00 L of 0.600 M hydrochloric acid, HCl, and 3.00 L of 0.400 M hydrochloric acid are mixed, what is the concentration of the resulting solution?

- A) 0.100 M B) 0.200 M C) 0.480 M D) 1.02 M E) 2.40 M

50. What is the value of ΔH for the reaction $3 \text{H}_2(g) + \text{N}_2(g) \rightarrow 2 \text{NH}_3(g)$ given the following bond energies?



- A) -83 kJ B) -122 kJ C) +122 kJ D) -1084 kJ E) -1770 kJ

51. Which element is the most common by weight in the crust of the earth?

- A) silicon B) iron C) oxygen D) aluminum E) hydrogen

52. Which mineral family is the most common in the crust of the earth?

- A) silicates

- B) oxides
- C) halides
- D) carbonates
- E) native elements

53. Where is most metamorphic rock formed and modified?
- A) next to hydrothermal vents
 - B) bordering magma intrusions
 - C) on the ocean floor or continental shelf
 - D) deep in the earth during the earth's formation
 - E) deep in the earth during mountain-building processes
54. Which material would best be considered the beginning of the rock cycle?
- A) igneous rock
 - B) lava or magma
 - C) sedimentary rock
 - D) metamorphic rock
 - E) weathered material
55. Which of the following rocks will chemically weather the fastest in humid environments?
- A) basalt
 - B) granite
 - C) limestone
 - D) sandstone
 - E) conglomerate
56. Most of the fresh water on the earth can be found in:
- A) groundwater
 - B) atmosphere
 - C) glaciers
 - D) lakes
 - E) rivers
57. Which of the following properties does not belong to an old river?
- A) slow
 - B) clear
 - C) not steep
 - D) meandering
 - E) wide and shallow
58. How does the flood stage of a river change as urban development increases upstream?
- A) floods later and higher
 - B) floods later and lower
 - C) floods sooner and lower
 - D) floods sooner and higher
 - E) development upstream has no significant effect on downstream flooding
59. How do most rivers transport the highest percentage of their load?
- A) dissolved
 - B) in solution

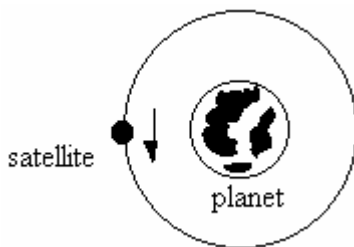
- C) as bed load
 - D) in suspension
 - E) rolling along the bottom
60. Which causes the greatest amount of damage done by an earthquake?
- A) Tsunamis
 - B) Surface wave
 - C) Primary wave
 - D) Secondary wave
 - E) The actual fault displacement at the surface
61. How many seismographs are needed to properly locate the epicenter of an earthquake?
- A) one
 - B) two
 - C) three
 - D) four
 - E) five
62. Why can't Secondary waves be recorded by seismographs on the far side of the earth from an earthquake?
- A) they are reflected at the Moho boundary
 - B) they cannot go through the outer core because it is liquid
 - C) they are local because they are weak and cannot travel that far
 - D) they cannot go through the earth's core because it is made of iron
 - E) they only travel on the earth's surface and therefore cannot travel that far
63. In which direction is the North American Plate moving?
- A) east
 - B) west
 - C) north
 - D) south
 - E) it is not moving
64. Where can most divergent plate boundaries be found?
- A) along the outer edge of the Pacific Ocean
 - B) where the ocean floor is the youngest
 - C) near large earthquake zones
 - D) near volcanic island arcs
 - E) on continental plates
65. Oceanic convergent zones are associated with all but which one of the following?
- A) earthquakes
 - B) volcanoes
 - C) hot spots
 - D) tsunamis
 - E) trenches
66. If an igneous dike crosses a sandstone layer, what can be deduced about the igneous rock?
- A) the igneous rock is basaltic
 - B) the igneous rock is extrusive
 - C) the igneous rock is weathered
 - D) the igneous rock is younger than the sandstone
 - E) the sandstone was produced from the weathered igneous rock
67. Which geologic time period(s) was known as the "Age of Fishes"?
- A) Permian
 - B) Tertiary

- C) Cambrian
- D) Jurassic and Triassic
- E) Devonian and Silurian

68. What percentage of parent material is left after four half-lives?
A) 100 % B) 50 % C) 25 % D) 12.5 % E) 6.25 %
69. Which part of the ocean floor would most likely be biologically productive?
A) abyssal plain
B) continental rise
C) continental shelf
D) continental slope
E) mid-oceanic ridges
70. Ocean water at the abyssal plain is:
A) low temperature and low salinity
B) low temperature and high salinity
C) high temperature and low salinity
D) high temperature and high salinity
E) pretty much the same as the water above it
71. **Eliminated** ~~The seasons occur because:~~
A) ~~the sun emits more energy in the summer, less in the winter~~
B) ~~the earth revolves slower in the summer, faster in the winter~~
C) ~~the earth is tilted more during the summer, less in the winter~~
D) ~~the earth is closer to the sun during summer, farther in the winter~~
E) ~~the orientation of the earth's tilt changes as it revolves around the sun~~
72. Which of the following is not a reason that land heats up faster than ocean areas?
A) ocean water mixes
B) ocean water evaporates and therefore cools
C) ocean water has a higher specific heat than land
D) ocean water tends to reflect light better than land
E) ocean water is more transparent, therefore solar energy penetrates into the water
73. Low pressure areas are associated with:
A) rising air
B) clear weather
C) low wind speed
D) surface divergence areas
E) clockwise movement of air
74. Which occurs because the earth revolves around the sun?
A) the sun rises in the east, set in the west
B) daily star motion across the sky
C) shifting constellation patterns
D) phases of the moon
E) tides
75. What property of a star cannot be determined directly by studying the spectra of that star?
A) composition
B) temperature

- C) velocity
- D) color
- E) age

76. Which one of the following measurements is the longest length?
- A) 10^0 meters
 - B) 10^2 centimeters
 - C) 10^4 millimeters
 - D) 10^5 micrometers
 - E) 10^7 nanometers
77. A projectile is fired from a gun and has initial horizontal and vertical components of velocity equal to 30 m/s and 40 m/s, respectively. What is the acceleration of the projectile when it reaches its maximum height?
- A) zero
 - B) 9.8 m/s^2 , downward
 - C) 4.9 m/s^2 , downward
 - D) smaller than 9.8 m/s^2 and non-zero.
 - E) Its magnitude is 9.8 m/s^2 and; its direction is changing.
78. The centers of two masses, m and M , are separated by a distance d . If the distance between the centers of the masses is increased to $3d$, how does the gravitational force between them change?
- A) The force will be one-third as great.
 - B) The force will be one-ninth as great.
 - C) The force will be three times as great.
 - D) The force will be nine times as great.
 - E) It is impossible to determine without knowing the numerical values of m , M , and d .
79. An astronaut in training is being whirled at high constant speed around a circular track in a capsule to measure his resistance to 'g' forces. What happens to the centripetal acceleration acting on the astronaut if the number of rotations per minute of the machine is doubled?
- A) It remains the same.
 - B) It increases by a factor of 2.
 - C) It increases by a factor of 4.
 - D) It is decreased by a factor of one-half.
 - E) It is decreased by a factor of one-fourth.
80. A 2400-kg research satellite is in a circular orbit around a planet. The satellite travels with a constant speed of $6.67 \times 10^3 \text{ m/s}$.



The radius of the circular orbit is $8.92 \times 10^6 \text{ m}$. At the instant shown in the figure, which direction indicates the direction of the net force on the satellite?

- A) To the right
 - B) To the left
 - C) Upward
 - D) Downward
 - E) Down & to the right @ 45°
81. A small helicopter of mass 1250 kg is cruising at a speed of 25.0 m/s at an altitude of 185 m. What is the total mechanical energy of the helicopter?

- A) $3.91 \times 10^5 \text{ J}$
- B) $2.66 \times 10^6 \text{ J}$
- C) $2.27 \times 10^6 \text{ J}$
- D) $6.18 \times 10^5 \text{ J}$
- E) $1.88 \times 10^6 \text{ J}$

82. Which one of the following is not a unit of energy?

- A) foot • pound
- B) kilowatt • hour
- C) newton • meter
- D) watt
- E) joule

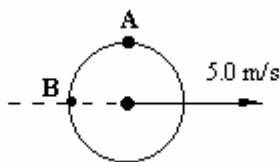
83. A child at T-Ball practice, hits a stationary baseball of mass m with a bat so that it acquires a speed v . If t represents the duration of the collision between the bat and the ball, which expression determines the magnitude of the average force exerted on the ball?

- A) $(1/2)mv^2$
- B) $mv t$
- C) $(1/2)mv^2 t$
- D) $mt^2/(2v)$
- E) mv/t

84. A collision is *elastic* if

- A) the final velocities are zero.
- B) the objects stick together.
- C) the final kinetic energy is zero.
- D) the final momentum is zero.
- E) the total kinetic energy is conserved.

85. A 2.0-kg solid disk rolls without slipping on a horizontal surface so that its center proceeds to the right with speed 5.0 m/s.

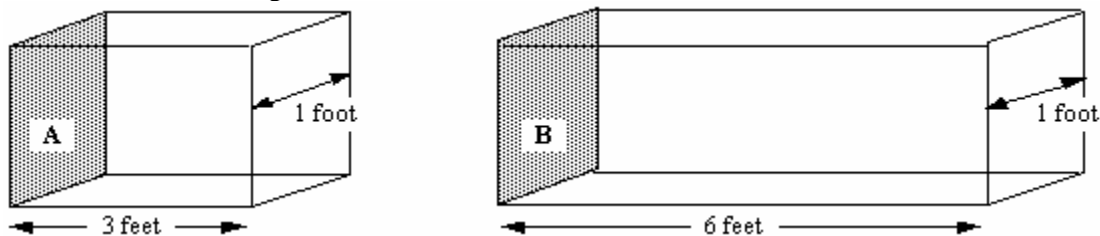


The point **A** is the uppermost point on the disk and the point **B** is along the horizontal line that connects the center of the disk to the rim. Which one of the following statements concerning the direction of the disk's *angular velocity* is true?

- A) It points to the left.
- B) It points to the right.
- C) It points into the paper.
- D) It points out of the paper.
- E) It varies from point to point on this disk.

86. The figure below shows two fish tanks, each having sides of width 1 foot. Tank A is 3 feet

long while tank **B** is 6 feet long. Both tanks are filled with 1 foot of water.



SA = the magnitude of the force of the water on the side of tank **A**

SB = the magnitude of the force of the water on the side of tank **B**

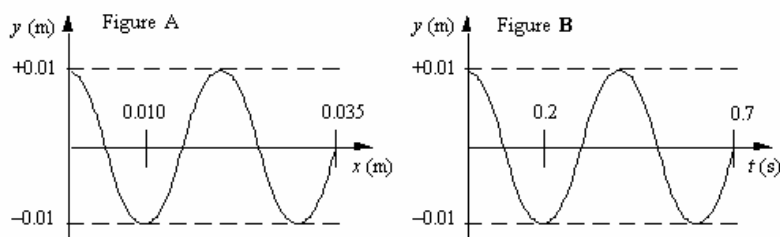
BA = the magnitude of the force of the water on the bottom of tank **A**

BB = the magnitude of the force of the water on the bottom of tank **B**

Using the notation given above, which one of the following sets of equations below is correct for this situation?

- A) $SA = SB$ and $BA = BB$
 B) $SA = 2SB$ and $BA = BB$
 C) $2SA = SB$ and $2BA = BB$
 D) $SA = SB$ and $2BA = BB$
 E) $SA = 2SB$ and $BA = 2BB$
87. The space between the inner walls of a thermos bottle is evacuated (essentially a vacuum) to minimize heat transfer by
- A) radiation
 B) conduction
 C) conduction and radiation.
 D) conduction and convection.
 E) conduction, convection, and radiation.
88. The absolute temperature of an ideal gas is directly proportional to
- A) the number of molecules in the sample.
 B) the average momentum of a molecule of the gas.
 C) the average translational kinetic energy of the gas.
 D) the amount of heat required to raise the temperature of the gas by 1 C° .
 E) the relative increase in volume of the gas for a temperature increase of 1 C° .
89. A periodic transverse wave is established on a string such that there are exactly two cycles traveling along a 3.0 m section of the string. The crests move at 20 m/s. How could the speed of the wave be increased?
- A) by increasing the period
 B) by decreasing the amplitude
 C) by decreasing the frequency
 D) by increasing the tension in the string
 E) by increasing amplitude

90. A periodic traveling wave is generated on a string of linear density 8.0×10^{-4} kg/m. Figure A shows the displacements of the particles in the string as a function of the position x along the string at $t = 0$. Figure B shows the displacement of the particle at $x = 0$ as a function of time. The particle positions are measured from the left end of the string ($x = 0$) and the wave pulses move to the right.



What is the wavelength of the wave?

- A) 0.005 m
 B) 0.010 m
 C) 0.015 m
 D) 0.020 m
 E) 0.025 m
91. Each of three objects has a net charge. Objects A and B attract one another. Objects B and C also attract one another, but objects A and C repel one another. Which one of the following table entries is a possible combination of the signs of the net charges on these three objects?
- | | A | B | C |
|----|---|---|---|
| A) | + | + | - |
| B) | - | + | + |
| C) | + | - | - |
| D) | - | + | - |
| E) | - | - | + |
- A) A B) B C) C D) D E) E
92. An isolated system consists of two conducting spheres A and B. Sphere A has five times the radius of sphere B. Initially, the spheres are given equal amounts of positive charge and are isolated from each other. The two spheres are then connected by a conducting wire. Which one of the following statements is true *after* the spheres are connected by the wire?
- Note:** The potential of a sphere of radius R that carries a charge Q is $V = kQ/R$, if the potential at infinity is zero.
- A) The electric potential of A is 1/25 as large as that of B.
 B) Both spheres are at the same electric potential.
 C) The electric potential of A is 25 times larger than that of B.
 D) The electric potential of A is 1/5 as large as that of B.
 E) The electric potential of A is five times larger than that of B.
93. Three resistors, 50- Ω , 100- Ω , 200- Ω , are connected in series in a circuit. What is the equivalent resistance of this combination of resistors?
- A) 350 Ω B) 250 Ω C) 200 Ω D) 120 Ω E) 29 Ω

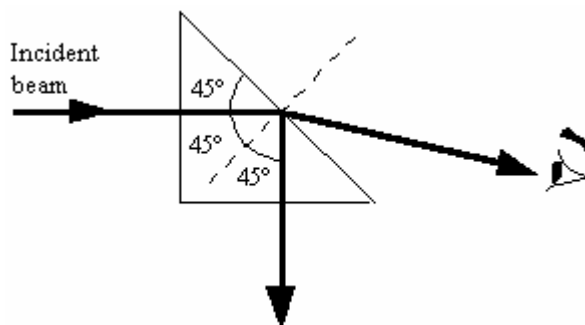
94. Which one of the following quantities can be converted to kilowatt • hours (kWh)?
 A) 2.0 A B) 8.3 V C) 5.8 J D) 9.6 W E) 6.2 C/V
95. The magnitude of the magnetic force that acts on a charged particle in a magnetic field is independent of
 A) the sign of the charge.
 B) the magnitude of the charge.
 C) the magnitude of the magnetic field.
 D) the direction of motion of the particle.
 E) the velocity components of the particle.
96. Which one of the following statements is *not* a characteristic of a plane mirror?
 A) The image is real.
 B) The magnification is +1.
 C) The image is always upright.
 D) The image is the same size as the object.
 E) The image and object distances are equal in magnitude.
97. The table lists the index of refraction for various substances at 20°C for light with a wavelength of 589 nm in a vacuum. Through which substance will light with a vacuum wavelength of 589 nm travel with the greatest speed?

<i>Substance</i>	<i>n</i>
fused quartz	1.458
ethyl alcohol	1.362
crown glass	1.520
carbon tetrachloride	1.461
crystalline quartz	1.544

- A) fused quartz
 B) crown glass
 C) ethyl alcohol
 D) carbon tetrachloride
 E) crystalline quartz
98. Which one of the following statements is true concerning the radioisotope carbon-14 that is used in carbon dating?
 A) It is produced by living cells.
 B) It is produced during β^- decay.
 C) It is produced by the decay of carbon-12.
 D) It is produced by cells after they have died.
 E) It is produced by cosmic rays striking the atmosphere.

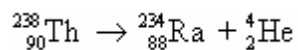
99. A beam of light that consists of a *mixture* of **red**, **green** and **violet** light strikes a prism (surrounded by air) as shown. Indices of refraction for this prism for the various colors are indicated in the table. An observer is located to the right of the prism as shown.

<i>color</i>	<i>n</i>
red	1.43
green	1.40
violet	1.37



Which physical phenomenon is illustrated by the fact that the prism has different refractive indices for different colors?

- A) Doppler effect
 - B) dispersion
 - C) diffraction
 - D) total internal reflection
 - E) interference
100. Which one of the following processes is illustrated by the reaction:



- A) beta decay
- B) alpha decay
- C) gamma decay
- D) neutrino emission
- E) positron emission

Continue on the next page

Read the following selection and answer questions 101-105 on the answer sheet.

Air Pollution

Air pollution and air quality were not considered a global concern until the second half of the twentieth century. The topic was traditionally a problem only for heavily industrialized areas. The effects of air pollution and poor air quality manifest far downwind from the sources of the pollution. The cumulative effects of air pollution are historically linked to our dependence on the combustion of fossil fuels to satisfy domestic, industrial and automotive energy demands. Developed nations have implemented costly technologies and pollution regulations to decrease the units of air pollution emitted. However, problems still exist in these nations because of their large populations. Developing nations typically do not have adequate pollution regulations and cannot afford to implement the costly technology to minimize air pollutants. Air pollution and air quality problems extend far beyond urban and industrialized areas.

101. Air pollution contributes to the following environmental problems:
- A) acid rain
 - B) ozone depletion
 - C) global warming
 - D) all of the above
 - E) none of the above
102. Sulfur emissions from coal-fired power plants are one of the sources of air pollution and poor air quality because it
- I. Contributes to the acid rain problem
 - II. Damages the lungs of living organisms
 - III. Smells like rotten eggs
- A) I & II
 - B) I & III
 - C) II & III
 - D) I, II & III
103. The human effect of poor air quality are being seen through an increase in everything but
- A) Asthma and emphysema
 - B) Birth defects and cancer
 - C) Allergies and diabetes
 - D) Bronchitis and pneumonia
104. Which of the following do air pollutants affect the least?
- A) the hydrologic cycle
 - B) the biochemical cycles
 - C) the biosphere
 - D) the atmosphere
 - E) the rock cycle
105. Particulate matter degrades air quality. Which of the following does not contribute to the release of particulates into the air?
- A) Revegetation
 - B) Deforestation
 - C) Urban sprawl
 - D) Volcanic eruptions
 - E) Automobile exhaust

Read the following selection and answer questions 106-110 on the answer sheet.

Water Pollution

The majority of the water on this planet is located in the oceans or is frozen. The amount of water on which all plants, animals and people sustain themselves, totals less than one percent. As the human population increases so does their need for water. Presently the majority of the drinking water consumed comes from surface water or groundwater. Restoring polluted surface water and/or groundwater is a time consuming and expensive process. Presently, the primary water pollution problem in the world is the lack of clean, disease-free drinking water. In the United States it is sediment pollution.

106. What tests would you perform on a water sample to help determine if the water sample is disease free?
- A) Nitrogen and phosphorus
 - B) Pesticides and fertilizers
 - C) Heavy metals and sediment
 - D) Fecal coliform and cryptosporidium
 - E) Dissolved oxygen and biological oxygen demand
107. Following a heavy rainfall, a sample of water is taken from a shallow lake. Successive pH readings over several months show the average pH of the rainfall measurements is 5.0 You should
- A) not worry, it is normal
 - B) test the water for sulfates
 - C) test the water for phosphates
 - D) look at the aquatic insects along the shore
108. If a water body has a mat of green algae growing over its surface it is termed eutrophic. Eutrophication can be caused naturally or by man. If the algae mat gets too thick the water body will
- A) Have a high dissolved oxygen and low biological oxygen demand
 - B) Have a low dissolved oxygen and a high biological oxygen demand
 - C) Have a low dissolved oxygen and a low biological oxygen demand
 - D) Have a high dissolved oxygen and a high biological oxygen demand
109. An increase in sediment in surface water can be caused by
- A) Cultivating crop land
 - B) Construction of buildings
 - C) Grazing or Feeding lots
 - D) All of the above
 - E) None of the above
110. **Eliminated** ~~Aquifers are underground zones from which groundwater can be extracted. Groundwater flows very slowly and if polluted is extremely difficult to remediate. Aquifers are not presently~~
- ~~A) being contaminated by underground storage tanks~~
 - ~~B) being stressed because of an increase in usage~~
 - ~~C) drying up because of lack of recharge~~
 - ~~D) an issue of environmental concern~~
 - ~~E) experiencing salt water intrusion~~

The End