Kaplan: Clinical Chemistry, 5th Edition

Chapter 1: Basic Laboratory Principles and Techniques

Test Bank

MULTIPLE CHOICE

1. Which of the following water purification techniques is most effective in removing dissolved ionized gases?
   a. distillation
   b. deionization
   c. reverse osmosis
   d. ultrafiltration

   ANS: B
   Deionization is excellent for removal of dissolved ionized gases.

   DIF: 1 REF: 3

2. A material that is used to absorb and remove water from the air is known as a:
   a. teratogen
   b. desiccant
   c. carcinogen
   d. reference material

   ANS: B
   A desiccant is a material used to absorb and remove water from the air.

   DIF: 1 REF: 6-7

3. Which of the following laboratory containers should be selected to store an organic hydrocarbon solvent?
   a. borosilicate glass
   b. polyethylene
   c. polycarbonate
   d. polyvinyl chloride (PVC)

   ANS: A
   Borosilicate glass is relatively inert and is resistant to attachment by organic solvents. Organic solvents are known to cause swelling and penetration of most plastics.

   DIF: 3 REF: 7-8

4. Which laboratory glassware should be selected to ensure accuracy in the preparation of a 100 mL of 0.5 N HCl solution?
   a. a beaker
   b. a graduated cylinder
   c. an Erlenmeyer flask

d. a volumetric flask

ANS: D
Volumetric flasks are essential for the accurate preparation of solutions of known concentration.

DIF: 3 REF: 10

5. Pipets that must be rinsed in order to deliver the measured volume are known as ______ pipets. Pipets that deliver the measured volume without rinsing are known as ______ pipets. ______ pipets are not to be blown out when delivering the full volume of the pipet.
a. to contain (TC), to deliver (TD), serological
b. to contain (TC), to deliver (TD), volumetric
c. to deliver (TD), to contain (TC), serological
d. to deliver (TD), to contain (TC), volumetric

ANS: B
To contain (TC) pipets must be rinsed out in order to deliver the volume measured by the pipet. To deliver (TD) pipets will deliver the measured volume without rinsing. Volumetric pipets deliver the exact volume measured with a high degree of accuracy after draining and require no "blow out."

DIF: 1 REF: 10

6. Suppose you are setting up an assay in which patient samples are run in duplicate. All duplicate patient results match except for one. Which of the following would be a reasonable explanation (or explanations) for the lack of reproducibility for the patient results?
a. The pipet tip for one of the patient analyses was not placed tightly on the micropipet.
b. The patient sample was "wicked" out when wiping the pipet tip.
c. The technologist did not depress the piston of the micropipet to the second stop when delivering patient sample in one of the analyses.
d. All of the above

ANS: D
Micropipets work on the principle of air displacement. If the disposable micropipet tip is not placed on the micropipet tightly, there will be improper air displacement, resulting in errant volume delivery. Likewise, if care is not taken when wiping extraneous droplets from the pipet tip, some patient sample will be removed (wicked) from the tip, also causing errant volume delivery. Finally, depressing the piston of the micropipet to the second stop is important in complete volume delivery.

DIF: 3 REF: 14

7. In the metric system, 1 L is equal to how many fL?
a. 10^{-12}
b. 10^{-15}

c. 10^{12}
d. 10^{15}

ANS: D
In the metric system, a femtoliter is 10^{-15} as large as a liter. Therefore, it will take 10^{15} femtoliters to equal 1 liter.

DIF: 1 REF: 17

8. Taring an electronic balance refers to:
a. verifying balance performance using Class S weights
b. leveling the balance by adjusting the foot screws
c. zeroing the weight of the weighing vessel
d. adding counterweights to determine the true weight of the material being measured

ANS: C
Electronic balances use electromagnetic force to determine the weight in the measurement pan. These balances have a built-in taring ability which allows the weight of the weighing vessel to be recorded and then zeroed out. As a result, the weight displayed will be the true weight of the material in the measurement pan.

DIF: 1 REF: 18

9. The force produced by centrifugation is relative centrifugal force (RCF). The units for RCF are expressed as:
a. rpm
b. radius
c. number of times greater than gravity
d. there are no units for RCF

ANS: C
RCF units are expressed as number of times greater than gravity. For example, RCF may be expressed as $1200 \times g$ or $1200 \bullet g$.

DIF: 1 REF: 20

10. A fire associated with actively operating electrical equipment is classified as a ______ fire. The most appropriate type of fire extinguisher for this type of fire would be ______.
a. Class A, halotron
b. Class B, carbon dioxide
c. Class C, halotron
d. Class A and B, dry chemical

ANS: C
Fires involving electrical equipment that is actively operating are Class C fires. Halotron fire extinguishers are preferred in this system because there is no damage to the equipment following use.

DIF: 1 REF: 24

11. According to the Hazards Identification System developed by NFPA, the blue diamond indicates:
   a. the reactivity-stability hazard of the chemical
   b. any special hazard information about the chemical
   c. the flammability hazard of the chemical
   d. the health hazard associated with the chemical

   ANS: D
   The blue diamond is located on the left side of the NFPA diamond and serves to identify the health hazard associated with the chemical on a scale of 0 to 4.

   DIF: 1 REF: 26

12. Sodium azide is used in small amounts as a preservative in laboratory reagents. What is the safety concern associated with sodium azide?
   a. it can become explosive
   b. it can become volatile
   c. it is an environmental hazard
   d. it acts as a strong acid

   ANS: A
   Azides form explosive salts with metals such as iron and copper. Buildup of these metallic salts in laboratory sinks and sewers can be detonated by mechanical shock.

   DIF: 1 REF: 27

13. What dilution is necessary to make an 18 mg/L solution from a 30 mg/L solution?
   a. 1:5 dilution
   b. 3:5 dilution
   c. 2:3 dilution
   d. 1:3 dilution

   ANS: B
   A useful technique to determine what dilution is needed when converting from one concentration to a lower concentration when given only the beginning and ending concentrations is to create a fraction of the concentration wanted over the concentration needed and reduce. (If you divide, this will not work!) In this case, 18/30 can be reduced to 3/5, thus the required dilution is a 3:5 dilution.

   DIF: 2 REF: 32

14. How many mL of a 10 mg/L solution must be diluted to 100 mL to produce 100 mL of a 0.1 mg/dL solution?
   a. 1 mL
   b. 5 mL
   c. 10 mL
   d. 50 mL

ANS: C
The equation $V_1C_1 = V_2C_2$ would be used to solve this problem. When using this equation, the units for concentration must match. Thus the first step in this problem is to convert 0.1 mg/dL to 1 mg/L. Now V_1 is unknown, C_1 = 10 mg/L, V_2 = 100 mL, and C_2 = 1 mg/L. Solving the equation, V_1 = 10 mL.

DIF: 2 REF: 32

15. How would you prepare 400 mL of 0.85% NaCl?
 a. place 0.85 g of NaCl in a flask and dilute to 400 mL
 b. place 3.4 g of NaCl in a flask and dilute to 400 mL
 c. place 8.5 g of NaCl in a flask and dilute to 400 mL
 d. place 34 g of NaCl in a flask and dilute to 400 mL

ANS: B
When the type of percentage solution is not specified, it is assumed to be weight per unit volume, g/100 mL. Thus the concentration needed is 0.85g/100 mL. However, 400 mL of this concentration is needed. Multiplying the numerator and denominator by 4, this solution would be prepared by placing 3.4 g NaCl in a flask and diluting to 400 mL.

DIF: 2 REF: 33

16. What is the molarity (M) of a solution prepared by placing 10 g of NaOH (MW = 40) in a flask and diluting to 500 mL?
 a. 0.25 M
 b. 0.5 M
 c. 1.0 M
 d. 2.5 M

ANS: B
The solution prepared in the problem has a concentration of 10 g/500 mL. The definition of a molar (M) solution is the number of moles of solute per liter of solution, mol/L. This problem requires converting g/mL to mol/L. For the numerator, the molecular weight is used to convert 10 g to 0.25 mol. At this point, 10 g/500 mL is equal to 0.25 mol/500 mL. These units do not, however, meet the definition of the units for a molar solution. For the denominator, the desired unit is L (which is equal to 1000 mL). To make this conversion, multiply the numerator and the denominator by 2. This gives 0.5 mol/1000 mL which equals 0.5 mol/L, the proper units for molarity. This solution is a 0.5 M solution.

DIF: 2 REF: 33

17. How many mL of a 17.6 % solution of compound X (MW 142) would be required to prepare 450 mL of a 0.75 M solution?
 a. 1.24 mL
 b. 142 mL
 c. 176 mL

d. 272 mL

ANS: D
The equation to use to solve this problem is $V_1C_1 = V_2C_2$. However, the units for concentration do not match. The first step is to convert % to M: 17.6 % = 17.6 g/100 mL = 176 g/L. The definition of a 1 M solution is the number of gram molecular weights per liter of solution. Thus 1 M compound X equals 142 g/L.

$$\frac{142 \text{ g/L}}{176 \text{ g/L}} = \frac{1 \text{ M}}{x} \quad x = 1.24 \text{ M}$$

The 17.6 % solution of compound X is equal to a 1.24 M solution. Now, solving for V_1: V_1(1.24M) = 450 mL (0.75M), V_1 = 272 mL of the compound X solution.

DIF: 2 REF: 32-33

18. The units for specific gravity are:
a. g/mL
b. mol/L
c. mg/L
d. %

ANS: A
The units for specific gravity are g/mL.

DIF: 1 REF: 34

19. A solution of unknown concentration of compound X (MW = 150) has an absorbance of 0.600. It had an absorbance of 0.300 at a concentration of 9 mg/dL. What is the molarity of the solution?
a. 0.0012 M
b. 0.18 M
c. 1.2 M
d. 18 M

ANS: A
Given the information in the problem, the equation $C_u = A_u/A_s \times C_s$ can be used to solve for the unknown concentration of compound X. From the equation, C_u = 18 mg/dL. The following steps will convert from mg/dL to mol/L, using the molecular weight: 18 mg/dL = 0.18 g/L × 1 mol/150 g = 0.0012 mol/L.

DIF: 2 REF: 35-36

20. How many mL of 0.819 M acetic acid (MW = 60; pK_a = 4.76) should be added to 350 mL of 0.368 M sodium acetate (MW = 82) to produce a final pH of 4.89?
a. 95.41 mL
b. 116.5 mL
c. 128.8 mL

d. 130.6 mL

ANS: B
Plugging the pK_a and desired pH into the Henderson-Hasselbalch equation, the ratio of [Salt]/[Acid] is determined to be 1.35/1. As long as this ratio of salt to acid is maintained for this buffer, the pH of the buffer will be 4.89. In the problem, it is given that there are 350 mL of 0.368 M salt. Thus there are a total of 128.2 mmol of salt. Given that the required ratio of salt to acid is 1.35 to 1, and there are 128.2 mmol of salt, the following ratio can be set up:

$$\frac{1.35}{1} = \frac{128.2 \text{ mmol}}{x} \quad x = 95.41 \text{ mmol}$$

In this equation, 95.41 mmol of acid is necessary to maintain the 1.35-to-1 ratio. As per the problem, the 95.41 mmol of acid is to be derived from a solution of 0.819 M of the acid. Thus:

$$\frac{95.41\text{mmol}}{0.819 \text{ mmol/mL}} = 116.5 \text{ mL}$$

DIF: 2 REF: 37-38