CHEMISTRY 110 EXAM 3
Nov. 8, 2010
FORM A

1. If 50.75 g of a gas occupies 10.0 L at STP, what is the volume of 129.3 g of the same gas at STP?

A. 3.92 L  
B. 50.8 L  
C. 12.9 L  
D. 25.5 L  
E. 5.08 L

2. What is the mass of nitrogen dioxide contained in a 4.32 L vessel at 48 °C and 1.40 atm?

A. 5.35 \times 10^4 g  
B. 53.5 g  
C. 10.6 g  
D. 70.5 g  
E. 9.46 \times 10^{-2} g

3. What is the concentration of KCl in a solution made by mixing 25.0 mL of 0.100 M KCl with 50.0 mL of 0.100 M KCl?

A. 0.100 M  
B. 0.0500 M  
C. 0.0333 M  
D. 0.0250 M  
E. 125 M

4. Which of the following are strong electrolytes?

\begin{align*}
\text{HCl} & \quad \text{CH}_3\text{COOH} & \quad \text{NH}_3 & \quad \text{KCl} \\
\text{i} & \quad \text{ii} & \quad \text{iii} & \quad \text{iv} \\
A. & \quad \text{i and iv} & \quad \text{B.} & \quad \text{i, iii, and iv} \\
& & \quad \text{C.} & \quad \text{i, ii, iii, and iv} \\
& & \quad \text{D.} & \quad \text{i, ii, and iv} \\
& & \quad \text{E.} & \quad \text{ii and iv} \\
\end{align*}
5. Which of the following graphs is consistent with the ideal gas law? (Assume the variables shown below each plot are held constant.)

constant: P, T  n, T  n, P

A. i  B. ii  C. iii  D. i and iii  E. i, ii and iii

6. A sample of air from the basement of a home is found to contain 8.3 ppm of radon. What is the partial pressure of radon in the basement if the total pressure is 755 torr?

A. $6.3 \times 10^{-3}$ torr  B. $4.3 \times 10^{-4}$ torr  C. 8.3 torr  D. $8.9 \times 10^{3}$ torr  E. $1.1 \times 10^{5}$ torr

7. The solubility of nitrogen gas in water at 25 °C and 1 atm is $6.8 \times 10^{-4}$ mol/L. If the partial pressure of nitrogen gas in air above water is 0.76 atm, what is the concentration of dissolved nitrogen?

A. $6.8 \times 10^{-4}$ mol/L  B. $5.2 \times 10^{-4}$ mol/L  C. $4.9 \times 10^{-4}$ mol/L  D. $3.8 \times 10^{-4}$ mol/L  E. $1.1 \times 10^{-5}$ mol/L

8. What phases are present at point Y on the phase diagram shown above?

A. gas and solid  B. solid and liquid  C. solid only  D. gas only  E. liquid only
9. Which segment of the heating curve for pure water shown below corresponds to the vaporization?

A. A – B
B. B – C
C. C – D
D. D – E
E. E – F

10. A compound has the empirical formula CHCl. A gaseous sample of this compound in a 256 mL flask at 373 K and 750 torr is found to have a density of 3.125 g/L. What is the molar mass of the compound?

A. 48.5 g/mol
B. 84.9 g/mol
C. 97.0 g/mol
D. 62.5 g/mol
E. 145 g/mol

11. Three flasks each contain one of the following gases under the stated conditions:

- CH₄  T = 40 °C  P = 1 atm
- Ar  T = 21 °C  P = 2 atm
- O₂  T = 50 °C  P = 2 atm

Which of the following statements is FALSE?

A. The Ar gas has a lower average molecular speed than the CH₄ gas.
B. The O₂ gas has the highest average kinetic energy of the three gases.
C. The CH₄ gas has a greater average kinetic energy than the Ar gas.
D. The Ar and O₂ gases have the same average kinetic energy.
E. The O₂ gas impacts the walls of its container with more force than the CH₄ gas.
12. Hydrogen gas was produced in a reaction and collected in a flask over water at 25 °C as shown below. The volume of gas in the beaker was 85.0 mL after adjusting the pressure in the beaker to equal barometric pressure (measured at 745.2 torr). If the vapor pressure of water at 25°C is 23.8 torr, what was the mole fraction of H₂ in the collected gas?

A. 0.968
B. 0.945
C. 0.055
D. 0.032
E. 0.114

13. The plot shown below corresponds to one mole of each gas at 298 K. At low pressure (P = 20 atm) which gas deviates the most from ideal gas law?

A. N₂
B. CH₄
C. H₂
D. CO₂
E. The temperature is too high: at 298 K all gases behave ideally.
14. The rate of effusion of He is found to be 3.31 times greater than the rate of effusion of an unknown gas. Which of the following could the unknown gas be?
A. Xe  
B. Cl₂  
C. Ne  
D. HF  
E. CO₂

15. How does carbon dioxide contribute to greenhouse effects on the Earth?
A. by reducing the concentration of CO in the atmosphere  
B. by undergoing photodissociation  
C. by undergoing exothermic reactions extensively in the stratosphere  
D. by catalyzing decomposition of ozone  
E. by absorbing IR (infrared) radiation emitted from the surface of the earth

16. Which of the following methods is not useful for molecular weight determination?
A. determination of the density of gas  
B. measurement of freezing-point depression  
C. determination of solvent vapor pressure over solution of nonvolatile solute (Raoult’s law)  
D. measurement of gas solubility (Henry’s law)  
E. determination of osmotic pressure

17. What is the maximum wavelength of photons that can dissociate an N=O bond? N=O bond dissociation energy is 598 kJ/mol.
A. 199 nm  
B. 199 µm  
C. 9.93 nm  
D. 1.19 × 10⁻³⁹ m  
E. 3.33 × 10⁻²⁸ m

18. A 10.0 g cube of each of the following metals is heated to 100 °C and dropped (without loss of heat during transfer) into separate but identical beakers containing 100 mL of water at 25 °C. The temperature of the water in the beaker is measured at equilibrium. Which metal will cause the temperature of the water in the beaker to change the most?

<table>
<thead>
<tr>
<th>Specific Heat (J/g K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Al(s) 0.903</td>
</tr>
<tr>
<td>B. Cu(s) 0.385</td>
</tr>
<tr>
<td>C. Au(s) 0.128</td>
</tr>
<tr>
<td>D. Fe(s) 0.449</td>
</tr>
<tr>
<td>E. They would all change the temperature by the same amount.</td>
</tr>
</tbody>
</table>

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19. At constant T, which of the following governs the vapor pressure of a liquid?

A. volume of the liquid
B. surface area
C. intermolecular forces
D. density
E. all of the above

20. Which of the following statements is false?

i. Nonpolar liquids tend to be insoluble in polar liquids.
ii. The weaker the attraction between the solute and solvent molecules, the greater the solubility.
iii. The solubility of N₂(g) in water decreases with increasing temperature.

A. i
B. ii
C. iii
D. i and iii
E. ii and iii

21. A sample of potassium nitrate (50.0 g) is dissolved in 100 g of water at 100 °C, with precautions taken to avoid evaporation of any water. The solution is cooled to 30.0 °C and no precipitate is observed. Which term below best describes the solution?

A. pre-saturated
B. non-dissolved
C. saturated
D. unsaturated
E. supersaturated
22. Which one of the following liquids will have the highest freezing point?

A. pure H₂O  
B. aqueous glucose (0.050 m)  
C. aqueous CoI₂ (0.030 m)  
D. aqueous FeCl₃ (0.030 m)  
E. aqueous NaI (0.030 m)

23. If all of the substances below are in the liquid state at the same temperature, which one will have the greatest viscosity?

A. i only  
B. i and ii  
C. i and iii  
D. ii and iii  
E. none of these are soluble in water.

24. Which of the following molecules is not appreciably soluble in water?

A.  
B.  
C.  
D.  
E. none of these are soluble in water.

25. A sample of 5 moles of a gas with a density of 3.74 g/L is contained in a vessel at STP. What is the root-mean-square speed of molecules of this gas?

A. 3.2 × 10⁻³ m/s  
B. 20 m/s  
C. 0.04 m/s  
D. 112 m/s  
E. 285 m/s

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26. A sample of 1.9 mol of gas is in a flask at 21 °C and 697 mm Hg. The flask is opened and more gas is added to the flask. The new pressure is 795 mm Hg and the temperature is now 26 °C. How many moles of gas are now in the flask?

A. 1.6 mol
B. 2.1 mol
C. 2.9 mol
D. 3.5 mol
E. 0.28 mol

27. A solution is prepared by adding 30.00 g of lactose (milk sugar) to 110.0 g of water at 55 °C. The vapor pressure of pure water at 55 °C is 118.0 torr. The MW of lactose is 342.3 g/mol. What is the partial pressure of water above the solution?

A. 1.670 torr
B. 94.1 torr
C. 169.4 torr
D. 116.3 torr
E. 92.7 torr

28. Which of the following processes are exothermic?

i. evaporation of 10 g of water
ii. melting of 5 g of ice
iii. condensation of water vapor into dew
iv. sublimation of dry ice (CO₂)

A. iv only
B. iii only
C. i and ii
D. ii and iv
E. i, ii, and iv

End of Test
FORM A
1. D
2. C
3. A
4. A
5. D
6. A
7. B
8. A
9. D
10. C
11. D
12. A
13. D
14. E
15. E
16. D
17. A
18. A
19. C
20. B
21. E
22. A
23. D
24. A
25. E
26. B
27. D
28. B