Chem25, Win 2013, Foothill College, Test3 Name KEY

Please read all the questions VERY carefully before answering. Ask your instructor if you don not understand. No outside paper is allowed. The last page is a periodeic table with constants. Total points = 72 + (28 * 3 =) 84 = 156

SHORT ANSWER. Please write the set-up equation first, then put the raw data with units before calculating. Write the word or phrase that best completes each statement or answers the question.

1) Calculate the amount of a 5% (w/v) acetic acid (CH_3CO_2H) needed to react with enough sodium bicarbonate ($NaHCO_3$) to produce 500.0 mL of carbon dioxide (CO_2) gas at 20°C and 760 mmHg pressure. (MW of CH_3CO_2H = 60 g/mol). The balanced chemical equation is :
$NaHCO_3$ (s) + CH_3CO_2H (aq) ------> CH_3CO_2Na (aq) + H_2O (l) + CO_2 (g) (10 pts.)

1) 25.0ml

CO_2

$V = 500.0ml \cdot \frac{1l}{1000ml} = 0.5000l$

$P = 760mmHg \cdot \frac{1atm}{760mmHg} = 1atm$

$T = 20°C + 273 = 293K$

Molar Mass $CH_3CO_2H = 12+3\cdot1+12+2\cdot16+1 = 60g$

$PV = nRT$

$n = \frac{PV}{RT}$ $n = \frac{(1atm)(0.5000l)}{(0.082 \frac{l\cdot atm}{mol\cdot K})(293K)}$

$0.0208mol\ CO_2 \cdot \frac{1mol\ CH_3CO_2H}{1mol\ CO_2} \cdot \frac{60g\ CH_3CO_2H}{1mol\ CH_3CO_2H}$

$n = \frac{(1)(0.5000)}{(0.082)(293)} mol = 0.0208mol\ CO_2$ $\Rightarrow \cdot \frac{100ml}{5g} = 24.96 \approx 25.0ml$

2) A gas tank is is maintained at 2.20 atm pressure. If the volume of the gas in the tank is 3250.0 m^3, at -15°C then what is the volume (in m^3) of the same quantity of the gas at 31°C. (6 pts.)

2) $3.83 \times 10^3 m^3$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$P_1 = 2.20atm$

$V = 3250.0 \times 10^3 l$

$T_1 = -15°C + 273 = 258K$

$T_2 = 31°C + 273 = 304K$

$V_2 = ?$

$P_2 = 2.20atm$

$V_2 = \frac{(P_1V_1)(T_2)}{P_2 \cdot T_1}$

$= \frac{(2.2atm)(3250m^3)(304K)}{(2.2atm)(258K)}$

$V_2 = \frac{3250 m^3 \cdot 304}{258}$

$V_2 = 3.83 \times 10^3 m^3$

$\frac{2.20atm \cdot 3250.0 \times 10^3 l}{258K} = \frac{2.20atm \cdot V_2}{304K}$

$V_2 = \frac{3250.0 \times 10^3 \times 304}{258} l = 3829457.364$

$\approx 3.83 \times 10^6 l$

$3250.0m^3 \cdot \left(\frac{100cm}{1m}\right)^3$

$= (3250.0)(100)^3 cm^3$

$= 3250.0 \times 10^6 cm^3$

$= 3250.0 \times 10^6 ml \cdot \frac{1l}{1000ml} = 3250.0 \times 10^3 l$

$3.83 \times 10^0 l \cdot \frac{1000ml}{1l} \cdot \frac{1cm^3}{1ml} \cdot \frac{m^3}{(100cm)^3}$

$= 3.83 \times 10^6 \cdot 10^3 \cdot 10^{-6}$

$= 3.83 \times 10^3 m^3$

3) To determine the empirical formula of a compound made of Fe and Cl, a student added 2.15 g Zinc to a solution containing 1.750 g of Fe_xCl_y. After the reaction was over, the student isolated 0.771 g of Fe. Use these data to answer the following questions (16 pts total): 3) _____

(a) Calculate the mass of Cl in the Fe_xCl_y solution (2 pt.):

$1.750 - 0.771 = \boxed{0.979\,g}$

Total − Fe

(b) Calculate the number of moles of Fe present in the Fe_xCl_y solution (4 pt.):

$0.771\,g\,Fe \cdot \frac{1\,mol\,Fe}{55.845\,g\,Fe} = \boxed{0.0138\,mol\,Fe}$

(c) Calculate the number of moles of Cl present in the Fe_xCl_y solution (4 pt.):

$0.979\,g\,Cl \cdot \frac{1\,mol\,Cl}{35.453\,g\,Cl} = 0.0276\,mol\,Cl$

(d) Determine the molar ratio of Fe to Cl in the compound (4pts.).

Fe : Cl

$\boxed{1:2}$

0.0138 : 0.0276

$\frac{0.0138}{0.0138} : \frac{0.0276}{0.0138}$

(e) Use the above ratio to write the empirical formula of the compound containing Fe and Cl (2 pt.)

$\boxed{FeCl_2}$

4) Calculate the volume of NH_3 (g) in liters at 729°C and 4.5 atm pressure that is required to react with 2.52 moles of O_2(g) according to reaction, 4 NH_3(g) + 5 O_2(g) -----> 4 NO(g) + 6 H_2O(g) (8 pts.) 4) 37L

$2.52\,moles\,O_2 \cdot \frac{4\,mol\,NH_3}{5\,mol\,O_2} = 2.016\,mol\,NH_3$

$P = 4.5\,atm$

$V = ?$

$T = 729°C + 273 = 1002K$

$n = 2.016\,mol$

$PV = nRT$

$V = \frac{nRT}{P}$

$V = \frac{(2.016\,mol)(0.082\,\frac{L\cdot atm}{mol\cdot K})(1002K)}{4.5\,atm}$

$V = \frac{(2.016)(0.082)(1002)}{4.5}\,L$

$V = 36.809\,L$

$\simeq 37L$

5) An inflated baloon has a volume of 6.0 L at 1 atm pressure and at 22°C. Calculate its volume when it ascends to an altitude where the pressure is 0.45 atm and the temperature is -21°C. (6 pts.)

5) 11 L

$P_1 = 1 atm$
$V_1 = 6.0 L$
$T_1 = 22 + 273 = 295 K$

$P_2 = 0.45$
$V_2 = ?$
$T_2 = -21 + 273 = 252 K$

$$\frac{(1 atm)(6.0 L)}{295 K} = \frac{(0.45 atm)(V_2)}{252 K}$$

$$V_2 = \frac{(1)(6.0)(252)}{(295)(0.45)} = 11.38983051 L \Rightarrow 11 L$$

6) When nitrogen (N_2) gas is collected by decomposing NH_4NO_2 (s) ------> N_2(g) + 2 H_2O(g), its volume is 3.27 mL at 19.5°C and 753.0 mm of mercury pressure. Calculate how many grams of NH_4NO_2 was decomposed. Vapor pressure of water at 19.5°C is 17.0 torr. (10 pts.)

6) 1.319×10^{-4} mol NH_4NO_2
0.00845 g NH_4NO_2

$17.0 torr \cdot \frac{1 mmHg}{1 torr} = 17.0 mmHg$

$P = (753.0 mmHg - 17.0 mmHg) \cdot \frac{1 atm}{760 mmHg}$
$= 736.0 mmHg \cdot \frac{1 atm}{760 mmHg} = 0.968 atm$

$V = 3.27 ml \cdot \frac{1 L}{1000 ml} = 0.00327 L$

$T = 19.5 + 273 = 292.5 K$

N_2

$PV = nRT$

$n = \frac{PV}{RT}$

$$n = \frac{(0.968 atm)(0.00327 L)}{(0.082 \frac{L \cdot atm}{K \cdot mol})(292.5 K)}$$

$n = 1.319 \times 10^{-4}$

$= 0.0001319 mol\ N_2 \cdot \frac{1 mol\ NH_4NO_2}{1 mol\ N_2} = 0.0001319$

$= 1.319 \times 10^{-4} mol\ NH_4NO_2$

$= 1.319 \times 10^{-4} mol \times \frac{64 g\ NH_4NO_2}{1 mol}$

$= 0.00845 g$

7) an 8.0 g ice cube is placed into 230 g water. Calculate the temperature change in the water upon complete melting of the ice. Given, the heat of fusion of ice is 6.02 kJ/mole and specific heat of water = 4.18 J/(g. °C) (Hint: Determine how much heat is absorbed by the melting ice and then use q = mCΔT to calculate the temperature change of 230 g of water. Be sure to include proper sign for the temperature change: positive for increase and negative for decrease) (8 pts.).

7) $-2.78\,^{\circ}C$

$$8.0\,g \times \frac{1\,mol\,H_2O}{18\,g\,H_2O} \cdot \frac{6.02\,kJ}{1\,mol\,H_2O} = 2.676\,kJ$$

$$2.676\,kJ \cdot \frac{1000\,J}{1\,kJ} = (230\,g)\left(\frac{4.18\,J}{g \cdot C}\right)(\Delta T)$$

$$\Delta T = \frac{(2.676 \cdot 1000)}{(230)(4.18)}\,C = 2.78-$$

8) A gas sample weighing 0.622 g has a volume of 0.450 L at 55°C and 1.17 atm pressure. Calculate its molar mass. (8 pts.)

8) $31.77\,g$

$PV = nRT$

$n = \frac{PV}{RT}$

$\frac{0.622\,g}{\text{molar mass}} = n$

$V = 0.450\,L$

$P = 1.17\,atm$

$T = 55^{\circ}C + 273 = 328\,K$

$$\left(\frac{0.622\,g}{\text{molar mass}}\right) = \frac{(1.17\,atm)(0.450\,L)}{\left(0.082\,\frac{L \cdot atm}{mol \cdot K}\right)(328\,K)}$$

$$\text{molar mass} = \frac{(0.622)(0.082)(328)}{(1.17)(0.450)}\,g$$

$$\text{molar mass} = 31.77\,g$$

MULTIPLE CHOICE. On the scantron, fill up the circle with the same number as the question number. Choose the one alternative that best completes the statement or answers the question (3 pts each).

9) A precipitate is expected to be formed when an aqueous solution of sodium sulfate is added to an aqueous solution of 9) A
A) barium chloride.
B) potassium chloride.
C) iron(III) chloride.
D) magnesium chloride.
E) none of the above

$Na_2SO_4 + BaCl$

10) What type of a reaction occurs when a silver nitrate solution is mixed with sodium chloride solution? 10) C
A) oxidation-reduction
B) acid-base neutralization
C) precipitation
D) gas evolution
E) no reaction

$AgNO_3 + NaCl$

11) What type of reaction is the generic equation AB → A + B? 11) A
A) decomposition
B) synthesis/combination
C) single displacement
D) double-displacement
E) none of the above

12) If the theoretical yield of the reaction below corresponds to 99.2 g and the actual yield was 60.9 g, calculate the percent yield. 12) A
Given: $Li_2O + H_2O \rightarrow 2\ LiOH$
A) 61.4 %
B) 71.8 %
C) 16.0 %
D) 38.0 %
E) none of the above

13) Starting with 156 g Li_2O and 33.3 g H_2O, decide which reactant is present in limiting quantities. 13) C
Given: $Li_2O + H_2O \rightarrow 2\ LiOH$
A) lithium oxide
B) lithium hydroxide
C) water
D) insufficient data
E) none of the above

$Li_2O = 2 \cdot 7 + 16 = 30g$

$H_2O = 18g$

$156g\ Li_2O \cdot \frac{1mol\ Li_2O}{30g} \cdot \frac{2mol\ LiOH}{1mol\ Li_2O} = 10.4\ mol\ LiOH$

$33.3g\ H_2O \cdot \frac{1mol\ H_2O}{18g\ H_2O} \cdot \frac{2mol\ LiOH}{1mol\ H_2O} = 3.7\ mol\ LiOH$

14) Which of the following types of compounds will NOT undergo a gas evolution reaction when acid is added? 14) D

A) carbonates
B) bisulfites
C) sulfides
D) hydroxides
E) none of the above

15) Which of the following statements about pressure is FALSE? 15) E

A) After creating a pressure difference, the atmospheric pressure can push liquid up a straw.
B) A deep well dug in the ground must have the pump located at the bottom of well in order to have the water come to the surface.
C) Pressure is caused by gas molecules colliding with surfaces.
D) The atmosphere has a pressure as the components of air collide with surfaces.
E) All of the above statements are true.

16) What is the equivalent pressure of 0.905 atm in units of mm Hg? 16) A

A) 688
B) 0.905
C) 13.3
D) 840
E) none of the above

$0.905 \text{ atm} \cdot \frac{760 \text{ mmHg}}{1 \text{ atm}} = 688$

17) If the initial pressure of a system was 1.00 atm and the volume was halved and the temperature was tripled, what is the final pressure? 17) D

A) 0.667 atm
B) 2.00 atm
C) 1.50 atm
D) 6.00 atm
E) not enough information

$\frac{(1.00 \text{ atm})(2V)}{1T} = \frac{P \cdot V}{3T}$

6 atm

18) A 3.76 g sample of a noble gas is stored in a 2.00 L vessel at 874 torr and 25°C. What is the noble gas? 18) C
(R= 0.0821 L atm/ mol K)

A) He
B) Ne
C) Ar
D) Kr
E) not enough information

$n = \frac{PV}{RT}$

$\frac{874}{760} = 1.15 \text{ atm}$

$25 + 273 = 298 \text{ K}$

$\frac{3.76}{\text{molar mass}} = \frac{1.15 \text{ atm} \cdot 2}{0.082 \cdot 298}$

$\text{molar mass} = \frac{3.76 \cdot 0.082 \cdot 298}{1.15 \cdot 2} = 39.9$

19) The vapor pressure of water at 20.0°C is 17.5 mm Hg. If the pressure of a gas collected over water was measured to be 453.0 mm Hg. What is the pressure of the pure gas? 19) D

A) 0.596 atm
B) 0.0230 atm
C) 0.619 atm
D) 0.573 atm
E) none of the above

$\frac{453 - 17.5}{760} = 0.573$

20) What is the theoretical yield of waffles if you have 5 cups of flour, 9 eggs and 3 tbs of oil? 20) A

Given: 2 cups flour + 3 eggs + 1 tbs oil → 4 waffles

A) 10

B) 12

C) 4

D) 6

E) not enough information

2.5ft 3egg 3oil

2.5 -4

21) Which state of matter has a low density and is easily compressed? 21) B

A) solids

B) gases

C) liquids

D) both solids and liquids

E) none of the above

22) The measure of the resistance to the flow of a liquid is called: 22) B

A) condensation.

B) viscosity.

C) vapor pressure.

D) sublimation.

E) none of the above

23) Increasing the intermolecular forces of a liquid will do which of the following? 23) E

A) decrease the vapor pressure

B) decrease the evaporation rate

C) increase the surface tension

D) increase the viscosity

E) all of the above

24) The rate of vaporization of a liquid can be increased by 24) D

1. increasing the surface area
2. increasing the temperature
3. increasing the strength of the intermolecular forces

A) 1 only

B) 2 only

C) 3 only

D) 1 and 2 only

E) 2 and 3 only

25) The amount of heat required to melt one mole of a solid is called the: 25) C

A) cooling curve.

B) heat of vaporization.

C) heat of fusion.

D) heating curve.

E) none of the above

26) When you make ice cubes: 26) C

A) the process is referred to scientifically as sublimation.
B) the heat of vaporization must be removed.
C) it is an exothermic process.
D) it is an endothermic process.
E) none of the above

27) How many kJ of heat are needed to completely vaporize 23.4 g of H_2O? The heat of vaporization for water at the boiling point is 40.6 kJ/mole. 27) A

A) 52.8
B) 31.2
C) 23.4
D) 2.26
E) none of the above

$$23.4\,g\,H_2O \cdot \frac{1\,mol\,H_2O}{18\,g\,H_2O} \cdot \frac{40.6\,kj}{mol} = 52.78\,kj$$

TRUE/FALSE. On the scantron, fill up circle "A" for a true answer and "B" for wrong answer (3 pts each).

28) Combustion reactions are a subcategory of oxidation-reduction reactions. 28) A

29) There is a large distance between gas particles as compared to their relative size. 29) A

30) Gas particles lose energy every time they collide with each other or the container wall. 30) AB

31) Pressure is calculated by: $P = \frac{\text{Area}}{\text{Force}}$. 31) B

32) The conversion factor for pressure is 1 mm Hg = 1 atm. 32) B

33) Intermolecular forces are the attractive forces between atoms within a compound. 33) B

34) Evaporation is decreased by increasing the intermolecular forces. 34) A

35) The boiling point is the temperature at which the vapor pressure of a solution is equal to the intermolecular forces. 35) B

36) Evaporation is an endothermic process. 36) A