Chem25, Spring 2013, Foothill College, FinalTest Name Marita Tanamas Section 5

Please read all the questions VERY carefully before answering. If you do not understand any question, please ask. Use the reverse side of the question paper as scratch. Use the periodic table and constant chart in the last page. No outside paper is allowed. Total points = 48+(30x3=)90=138

SHORT ANSWER. Please write the set-up equation and insert the raw data with units in the equation before doing your calculations. Write the word or phrase that best completes each statement or answers the question.

1) Calculate (with units) how many cubic inches (in^3) are in 15615 cubic decimeter (dm^3) (given 1 dm = 0.1 m, 1 cm = 0.01 m, and 2.54 cm = 1 in)? (8 pts.)

1) $9.5289 \times 10^5\ in^3$

$$15615\ dm^3 \times \left(\frac{10\ cm}{1\ dm}\right)^3 \times \left(\frac{1\ in}{2.54\ cm}\right)^3$$

$$= 15615\ dm^3 \times \frac{1000\ cm^3}{1\ dm^3} \times \frac{1\ in^3}{16.387064\ cm^3}$$

$$= 9.5289 \times 10^5\ in^3$$

$\frac{1\ dm}{0.1\ m} \times \frac{0.01\ m}{1\ cm} = \frac{1\ dm}{10\ cm}$

2) An acid has 40% C, 6.7% H, 53.3% O and its molar mass is 60.05 g/mol. Show your calculation to find the molecular formula of the acid? (10 pts.)

2) $C_2H_4O_2$

In a 100 g of acid,

Mass of C = 40 g → moles of C = $\frac{40}{12}$ = 3.33 mol

" H = 6.7 g → " H = $\frac{6.7}{1}$ = 6.7 mol

" O = 53.3 g → " O = $\frac{53.3}{16}$ = 3.33 mol

Mole ratio C : H : O

$\frac{3.33}{3.33}$: $\frac{6.7}{3.33}$: $\frac{3.33}{3.33}$

= 1 : 2 : 1

→ The empirical formula is CH_2O

Molar mass of CH_2O = 12 + 2(1) + 16 = 30 g/mol

The molecular formula is $C_nH_{2n}O_n$

$\therefore n = \frac{60.05}{30} \approx 2$

$\therefore$ The molecular formula of the acid is $C_2H_4O_2$

3) Calculate the mass (in grams) of 1.56×10^{21} atoms of magnesium. (6 pts.)

3) 0.0630 g Mg

No. of moles of Mg = $\frac{1.56 \times 10^{21}}{6.022 \times 10^{23}}$ = 0.00259 mol

Mass = 0.00259 × 24.305

= 0.062962138 8 g Mg

$\approx$ 0.0630 g Mg

4) Calculate the mass percent of carbon in oxalic acid, $H_2C_2O_4$. (8 pts.)

4) 26.7 %.

$$\text{Mass percent of C} = \frac{2(12.011)}{2(1.0079)+2(12.011)+4(15.999)} \times 100\ \%$$

$$\approx 26.7\ \%$$

5) An inflated baloon has a volume of 6.0 L at 1.0 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

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{1.0(6.0)}{(273+22)} = \frac{0.45(V_2)}{(273+(-21))}$$

$$V_2 = 11.38983054\ \text{L}$$

$$\approx 11\ \text{L}$$

6) If 12.5 mL of a 0.100 M sodium hydroxide solution is needed to completely neutralize a sample of acetic acid, then calculate the grams of the acetic acid($C_2H_4O_2$) in the sample (6 pts.)

6) 0.0751 g

$$NaOH + CH_3COOH \longrightarrow CH_3COO^- Na^+ + H_2O$$

$$\text{No. of moles of NaOH} = 0.100 \times \frac{12.5}{1000} = 0.00125\ \text{mol}$$

$\because$ 1 mole of NaOH : 1 mole of CH_3COOH

$$\text{No. of moles of } CH_3COOH = 0.00125\ \text{mol}$$

$$\text{Mass of acetic acid} = 0.00125\ [2(12.011)+4(1.0079)+2(15.999)]$$

$$\approx 0.0751\ \text{g}\ C_2H_4O_2$$

7) Calculate the pH of a solution if 1.35 moles of a strong acid is in 530.00 mL of water. (4 pts.) [Hint: First calculate the concentration of the strong acid in molarity, which is the conc. of hydrogen ion]

7) -0.406

$[H^+] = 2.547\ mol/L$

$pH = -\log[H^+]$

$= -\log(2.547)$

≈ -0.406

8) **(Extra point Question)** 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.).

8) -2.78 °C

$$\frac{8.0}{2(1)+16} \times (-6.02) \times 1000 = 230 \times 4.18 \times \Delta T$$

$$\Delta T = -2.78\ ^\circ C$$

The temp. of water decreased by 2.78 °C

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

9) Determine the answer to the following equation with correct number of significant figures: $(4.123 \times 0.12) + 24.2 =$ _____ 9) C

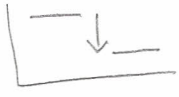
A) 24.70
B) 25
C) 24.7
D) 24.695
E) none of the above

10) How many calories are there in a 255 Calorie snack bar? 10) A

A) 2.55×10^5
B) 1×10^3
C) 1.07×10^3
D) 60.9
E) none of the above

11) An energy diagram that shows the reactants having greater energy than the products illustrates an 11) A

A) exothermic reaction.
B) impossible reaction.
C) endothermic reaction.
D) isothermic reaction.
E) none of the above



12) A 15.0 gram lead ball at 25.0°C was heated with 40.5 joules of heat. Given the specific heat of lead is 0.128 J/g•°C, what is the final temperature of the lead? 12) C

A) 0.844°C
B) 21.1°C
C) 46.1°C
D) 77.8°C
E) none of the above

13) An atom containing 7 protons, 8 neutrons, and 7 electrons 13) B

A) is an oxygen atom.
B) is charge-neutral.
C) is an ion.
D) cannot exist.
E) none of the above

14) Identify the element that is a nonmetal, a gas, and has an elemental symbol that starts with the letter "A." 14) C

A) Al
B) Ac
C) Ar
D) Au
E) none of the above

15) Ammonium fluoride is considered which of the following? 15) A

A) ionic compound
B) molecular element
C) atomic element
D) molecular compound NH_4F
E) none of the above

16) What is correct name of the compound whose formula is N_2O_4? 16) D

A) dinitrogen oxide
B) nitrogen tetroxide
C) nitrogen dioxide
D) dinitrogen tetroxide ✓
E) none of the above

17) How many atoms are in 5.80 moles of He? 17) B

A) 1.03×10^{23}
B) 3.49×10^{24}
C) 6.02×10^{23}
D) 4.00
E) none of the above

18) What is the mass percent of chlorine in hydrochloric acid? 18) D

A) 70.1
B) 2.8
C) 35.5
D) 97.2
E) none of the above

19) What are the coefficients for the following reaction when it is properly balanced? 19) B

2 NO nitrogen monoxide + 2 CO carbon monoxide → 1 N_2 nitrogen + 2 CO_2 carbon dioxide

A) 1, 1, 2, 2
B) 2, 2, 1, 2
C) 2, 2, 2, 1
D) 2, 1, 1, 2
E) none of the above

20) Identify the double displacement reactions among the following: 20) D

1. $KCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + KNO_3(aq)$ ✓
2. $Na_2SO_{4(}aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$ ✓
3. $H_2SO_{4(}aq) + 2NaOH(aq) \rightarrow Na_2SO_{4(}aq) + 2H_2O(l)$ ✓

A) 1 and 3 only
B) 1 and 2 only
C) 2 and 3 only
D) All of 1, 2, and 3
E) None of 1, 2, and 3

21) Determine the theoretical yield of C when 3 units of A and 10 units of B are reacted in the following generic chemical equation: $2A + 5B \rightarrow 4C$. 21) C

A) 4
B) 3
C) 6
D) 8
E) none of the above

22) Which is the limiting reactant in the following reaction given that you start with 15.5 g of Na_2S and 12.1 g $CuSO_4$? 22) B

Reaction: $Na_2S + CuSO_4 \rightarrow Na_2SO_4 + CuS$

A) CuS
B) $CuSO_4$
C) Na_2S
D) Na_2SO_4
E) not enough information

23) A gas sample occupies 3.50 liters of volume at 20.°C. What volume will this gas occupy at 100.°C (reported to three significant figures)? 23) B

A) 0.224 L
B) 4.46 L
C) 2.75 L
D) 17.5 L
E) none of the above

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{3.5}{293} = \frac{V_2}{373}$ $V_2 = 4.46\,L$

24) 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? 24) D

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

25) When you make ice cubes: 25) D

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

26) How many kilojoules of heat are needed to completely vaporize 42.8 grams of $C_4H_{10}O$ at its boiling point? 26) B

Given $\Delta H_{vap} = 26.5 kJ/mol$

A) 74.12
B) 15.3
C) 16.3
D) 9.49
E) none of the above

27) After you have completed the task of diluting a solution, which statement below must be TRUE? 27) A

A) The new solution has more volume but has a lower concentration than before.
B) The new solution has more volume but has a higher concentration than before.
C) The new solution has less volume but has a higher concentration than before.
D) The new solution has less volume but has a lower concentration than before.
E) none of the above

28) Which of the following is NOT an acid-base conjugate pair? 28) D

A) NH_4^+ and NH_3
B) H_2O and OH^-
C) H_2CO_3 and HCO_3^-
D) H_2S and OH^-
E) none of the above

29) Which of the following is a weak base? 29) A

A) ammonia
B) calcium hydroxide
C) sodium fluoride
D) potassium hydroxide
E) none of the above

TRUE/FALSE. On scantron, choose "A" for a true answer and "B" for wrong answer. (3 points each)

30) Zeros located between two numbers are not significant. 30) B

31) Solids have indefinite shape and volume. 31) B

32) The charges on electrons and neutrons cancel each other to give neutral atoms. 32) B

33) The formula of a compound comprised of two nitrogen atoms and one oxygen atom should be written properly as ON_2. 33) B

34) One mole of chlorine gas has a mass of 35.45 grams. 34) B

35) When compounds containing polyatomic ions dissolve, the polyatomic ions usually dissolve as intact units. 35) A

36) The limiting reactant is the product that is completely consumed in a chemical reaction. 36) B

37) H^+ is called the hydronium ion. 37) B

38) Acids turn litmus paper blue. 38) B