KEY

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 = 50+(30x3=)90=140

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) A room has dimensions of 10.0 ft × 20.0 ft × 8.00 ft. Given that there are three feet in a yard, calculate the volume of the room in yd^3? (8 pts.)

1) $\underline{59.3\ yd^3}$
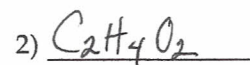
$$V = 10ft \times 20ft \times 8ft$$

$$V = 1600\ ft^3$$

$$1600\ ft^3 \times \frac{(1yd)^3}{(3ft)^3} \Rightarrow 1600\ ft^3 \times \frac{1yd^3}{27ft^3} = 59.259\ yd^3$$
$$59.3\ yd^3$$

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) $\underline{C_2H_4O_2}$

In a 100g sample a) $40g\ C \times \frac{1mol\ C}{12g\ C} = 3.33\ mol\ C$

$C = 40g$

$H = \cancel{53.3g}\ 6.7g$ b) $6.7g\ H \times \frac{1mol\ H}{1g\ H} = 6.7\ mol\ H$

$O = 53.3g$ c) $53.3g\ O \times \frac{1mol\ O}{16g\ O} = 3.33\ mol\ O$

Empirical formula $= C_{\frac{3.33}{3.33}}H_{\frac{6.7}{3.33}}O_{\frac{3.33}{3.33}} \Rightarrow C_1H_2O_1 \Rightarrow CH_2O$

Empirical Mass of $CH_2O = 12g + 2g + 16g = 30g/mol$

Molar Mass = Empirical mass × n $\Rightarrow \frac{60.05\ g/mol}{2} = \frac{30g/mol \times n}{}$
    $2 = n$

Molecular Formula = Empirical formula × n
$$= (CH_2O) \times 2$$
$$= C_2H_4O_2$$

1

3) Calculate the number of atoms in 39.7 g chlorine gas (Note the the formula of Chlorine). (6 pts.) $3sf$

3) $\underline{6.74 \times 10^{23} \text{ atoms } Cl}$

$$39.7 g\,\cancel{Cl_2} \times \frac{1\,\text{mol }\cancel{Cl_2}}{2(35.45)g\,\cancel{Cl_2}} \times \frac{2\,\text{mol }\cancel{Cl}}{1\,\text{mol }\cancel{Cl_2}} \times \frac{6.022 \times 10^{23}\,\text{atoms } Cl}{1\,\text{mol }\cancel{Cl}}$$

$$\frac{(39.7)(2)(6.022 \times 10^{23})}{70.9} = 6.74 \times 10^{23}\,\text{atoms } Cl$$

$3sf$

4) Calculate the amount (in grams) of potassium in a 42.7 gram sample of potassium nitrate. (10 pts.) $K NO_3$

4) $\underline{16.5 g \ K}$

$$42.7 g\,\cancel{KNO_3} \times \frac{1\,\text{mol }\cancel{KNO_3}}{101\,g\,\cancel{KNO_3}} \times \frac{1\,\text{mol } K}{1\,\text{mol }\cancel{KNO_3}} \times \frac{39 g\,K}{1\,\text{mol } K}$$

$$\frac{(42.7)(39 g\,K)}{101} = 16.5 g\,K$$

$2sf$

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) $\underline{11 L}$

Combine Gas Law $\Rightarrow \dfrac{P_1 V_1}{T_1} = \dfrac{P_2 V_2}{T_2} \Rightarrow P_2 V_2 = \dfrac{P_1 V_1 T_2}{T_1} \Rightarrow V_2 = \dfrac{P_1 V_1 T_2}{T_1 P_2}$

$P_1 = 1 atm$

$V_1 = 6 L$

$T_1 = 22 + 273 = 295 K$

$P_2 = 0.45 atm$

$V_2 = ?$

$T_2 = -21 + 273 = 252 K$

$$V_2 = \frac{(1 atm)(6 L)(252 k)}{(295 k)(0.45 atm)} = \frac{1512 L}{132.75}$$

$V_2 = 11.39 L$

$V_2 = 11 L$

$$NaOH + C_2H_4O_2 \rightarrow Na C_2H_3O_2 + H_2O$$

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) $\underline{7.5 \times 10^{-2} \text{ g } C_2H_4O_2}$

$$12.5 \text{ mL } NaOH \times \frac{1 L \ NaOH}{1000 \text{ mL } NaOH} \times \frac{0.100 \text{ mol } NaOH}{L \ NaOH} = 1.25 \times 10^{-3} \text{ mol } NaOH$$

In a neutral solution mol of acid = mol of base $NaOH = C_2H_4O_2$

$$1.25 \times 10^{-3} \text{ mol } C_2H_4O_2 \times \frac{60 \text{ g } C_2H_4O_2}{1 \text{ mol } C_2H_4O_2} = 75 \times 10^{-3} \text{ g} \text{ or } 7.5 \times 10^{-2}$$

or ~~0.075g~~

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) $\underline{pH = -0.407}$

$$M = \frac{\text{mole solute}}{L \text{ solution}} = \frac{1.35 \text{ moles}}{530 \text{ mL} \times \frac{1 L}{1000 \text{ mL}}} = \frac{1.35 \text{ moles}}{0.530 L} = 2.55 \frac{\text{mol}}{L}$$

$M \text{ solution} = 2.55 M$

$M \text{ solution} \Rightarrow [H^+] + [OH^-]$ (strong acid)

2.55M   2.55M

$$pH = -\log [H^+]$$
$$= -\log [2.55]$$
$$= -(0.407)$$
$$pH = -0.407$$

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)

8) Determine the answer to the following equation with correct number of significant figures: 8) ___D___
$13.96 - 4.9102 + 71.5 = $ _____
   A) 81
   B) 80.5498
   C) 80.55
   D) 80.5
   E) none of the above

9) How many calories are there in a 255 Calorie snack bar?   9) ___A___
   A) 2.55×10^5
   B) 1×10^3
   C) 1.07×10^3
   D) 60.9
   E) none of the above

$$255 \, Cal \left(\times \frac{10^3 \, cal}{1 \, Cal} \right) = 255 \times 10^3$$
$$2.55 \times 10^5$$

10) An energy diagram that shows the reactants having greater energy than the products   10) ___C̶ A___
    illustrates an
    A) exothermic reaction.
    B) impossible reaction.
    C) endothermic reaction.
    D) isothermic reaction.
    E) none of the above

11) A 15.0 gram lead ball at 25.0°C was heated with 40.5 joules of heat. Given the specific heat of   11) ___C___
    lead is 0.128 J/g·°C, what is the final temperature of the lead?
    A) 0.844°C
    B) 21.1°C
    C) 46.1°C
    D) 77.8°C
    E) none of the above

$$q = mc\Delta T \qquad \Delta T = \frac{q}{mc}$$
$$= 15 ($$
$$\Delta T = \frac{40.5}{15(0.128)} \quad 1.92$$
$$21.1$$

12) An atom containing 7 protons, 8 neutrons, and 7 electrons   12) ___B___
    A) is an oxygen atom.
    B) is charge–neutral.
    C) is an ion.
    D) cannot exist.
    E) none of the above

13) Identify the element that is a nonmetal, a gas, and has an elemental symbol that starts with the   13) ___C___
    letter "A."
    A) Al
    B) Ac
    C) Ar
    D) Au
    E) none of the above

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14) Ammonium fluoride is considered which of the following? NH_4F
    A) ionic compound
    B) molecular element
    C) atomic element
    D) molecular compound
    E) none of the above

14) ~~D~~ A

15) What is correct name of the compound whose formula is N_2O_4?
    A) dinitrogen oxide
    B) nitrogen tetroxide
    C) nitrogen dioxide
    D) dinitrogen tetroxide
    E) none of the above

15) D

16) How many atoms are in 5.80 moles of He?
    A) 1.03×10^{23}
    B) 3.49×10^{24}
    C) 6.02×10^{23}
    D) 4.00
    E) none of the above

$5.80 \, m \, He \times \dfrac{6.022 \times 10^{23} \, atom}{1 \, m \, He}$

3.34

16) B

17) What is the mass percent of carbon in oxalic acid, $H_2C_2O_4$?
    A) 2.24
    B) 13.3
    C) 34.5
    D) 26.7
    E) none of the above

$\dfrac{24}{90} \times 100$

17) D

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

$$2\,O_2 + \underline{1}\,CH_4 \rightarrow \underline{1}\,CO_2 + 2\,H_2O$$

    A) 1, 3, 2, 1
    B) 2, 3, 2, 2
    C) 2, 1, 1, 2
    D) 2, 1, 3, 1
    E) none of the above

18) C

19) Identify the double displacement reactions among the following:
    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

19) D

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

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

20) __C__

$$3A \times \frac{4C}{2A} = 6C$$

$$10B \times \frac{4C}{5B} = 8C$$

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

21) __B__

$$15.5g \; Na_2S \times \frac{1 mol \, Na_2S}{78g} \times \frac{1 mol \, CuS}{1 mol \, Na_2S} = 0.199 \, mol \, CuS$$

$$12.1g \; CuSO_4 \times \frac{1 mol \, CuSO_4}{159.54} \times \frac{1 mol \, CuS}{1 mol \, CuSO_4} = 0.0758 \; Cu..$$

22) 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)?

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

22) __B__

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

$$V_2 = \frac{3.5L (373k)}{293 k} \qquad 4.46L$$

23) 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?

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

23) __D__

$$453 - 17.5 \qquad 435.5 \times \frac{1}{760}$$

24) When you make ice cubes:

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

24) __D__

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

25) __B__

$$42.8g \times \frac{1 mol \, C_4H_{10}O}{74g} \times \frac{26.5 kJ}{1 mol}$$

6

26) After you have completed the task of diluting a solution, which statement below must be   26) $\underline{A}$
TRUE?
   A) The new solution has more volume but has a lower concentration than before. T
   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

27) Which of the following is NOT an acid–base conjugate pair?   27) $\underline{D}$
   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

28) Which of the following is a weak base?   28) $\underline{A}$
   A) ammonia
   B) calcium hydroxide S_+
   C) sodium fluoride NF
   D) potassium hydroxide S_+
   E) none of the above

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

29) The mass of an object, 4.55×10^{-3} g, expressed in decimal notation is 0.000455 g.

.00455   F

29) B

30) Protons and electrons each have a mass of 1 amu. F

30) B

31) SO_2 is an ionic compound. False

1 mol I_2 x $\frac{2 mol}{1}$

31) B

32) One mole of I_2 has more atoms in it than one mole of Na. True

32) A

33) The percent yield is calculated by dividing the actual yield by the theoretical yield times 100.

33) A

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

34) B

35) Evaporation is an endothermic process.

35) A

36) A saturated solution holds the maximum amount of solute under the solution conditions.

36) A

37) H^+ is called the hydronium ion.

37) B