COURSE CODE: PCHEM 011

COURSE TITLE: BASIC PHYSICAL AND INORGANIC CHEMISTRY

STREAM:
SEMESTER ONE

DAY:
THURSDAY

TIME:
2.00-4.00 P.M.

DATE:
12/08/2010

INSTRUCTIONS:

- Answer all questions: (70 \% Marks)
- Each Question = 17.5 Marks

PLEASE TURN OVER

1. (a) (i). Define matter and energy.
(ii). Explain the difference between mass and weight?
(iii). Name two intensive properties that you could use to distinguish between water and gasoline?
(6 Marks)
(b) (i) Define an element, a compound and a mixture. Give examples of each.
(ii) What is the difference between an atom and a molecule?
(iii) How many electrons, protons, and neutrons are in each of the following particles?

$$
\begin{equation*}
{ }_{35}^{81} \mathrm{Br}^{-} \quad \text { and } \quad{ }_{26}^{58} \mathrm{Fe}^{3+} \tag{6Marks}
\end{equation*}
$$

(c) (i) The percentage by mass of carbon in carbon dioxide is $27.29 \%$. What is the percentage of oxygen? How many grams of carbon are in 50.0 g of carbon dioxide gas?
(ii) Balance the following equation:

$$
\mathrm{Pb}\left(\mathrm{NO}_{3}\right)_{2}+\mathrm{Na}_{2} \mathrm{SO}_{4} \longrightarrow \mathrm{PbSO}_{4}+\mathrm{NaNO}_{3}
$$

(iii) The octane in gasoline burns according to the following equation:

$$
2 \mathrm{C}_{8} \mathrm{H}_{18}+25 \mathrm{O}_{2} \longrightarrow 16 \mathrm{CO}_{2}+18 \mathrm{H}_{2} \mathrm{O}
$$

I. How many moles of $\mathrm{O}_{2}$ are needed to react fully with 6 mol of octane?
II. How many moles of CO 2 can form from 0.5 moles of octane? (5.5 Marks)

2 (a) (i) Calculate the molarity of a solution containing 6.45 g . of $\mathrm{NH}_{3}$ in 125 ml of the solution. $(\mathrm{N}=14, \mathrm{H}=1)$
(ii) Calculate the number of grams of a solute that has been used to make 250 ml of $0.4 \mathrm{M} \mathrm{NaCl}(\mathrm{Na}=23, \mathrm{Cl}=35.5)$
(iii) What is the molarity of an aqueous sulphuric acid solution if 12.88 ml is neutralized by 26.04 ml of 0.1024 M NaOH ? Write a balanced equation for the reaction.
(b) (i) What is co-ordinate covalent bond? Give an example.
(ii) Define a single, double and triple bond.
(iii) Define electronegativity? Which elements in the periodic table have low and high electronegativity?
(iv) Name two types of intermolecular bonds that can be formed by covalent compounds?
(8.5 Marks)
3. (a) (i) What does the "periods" and 'groups' represent in the periodic table?
(ii) Given that an atom $\mathbf{T}$ has atomic number of 23, give its electronic configuration, the group and the period of the element in the periodic table.
(iii) Arrange the following cations in order of their increasing ionic radii:

$$
\mathrm{K}^{+}, \mathrm{Ca}^{+} \text {and } \mathrm{Ga}^{+3}
$$

(iv) Compare and explain the relative sizes of $\mathrm{H}^{+}, \mathrm{H}$, and $\mathrm{H}^{-}$.
(b) (i) What is an electrolyte? Give an example.
(ii) Write ionic and net ionic equations for the following reactions.

$$
\left(\mathrm{NH}_{4}\right)_{2} \mathrm{CO}_{3(\mathrm{aq})}+\mathrm{MgCl}_{2(\mathrm{aq})} \longrightarrow 2 \mathrm{NH}_{4} \mathrm{Cl}_{(\mathrm{aq})}+\mathrm{MgCO}_{3(\mathrm{~s})}
$$

(iii) State the following laws both in words and in the forms of equations. By what name is each law known?
I. Temperature - volume law
II. Temperature - pressure law.
(iv) If 625 ml of Oxygen at 925 mmHg is allowed to expand at constant temperature until its pressure is 748 mmHg , what will be the volume?
(9.5 Marks)
4. (a) Give the factors that affect rate of reaction?
(b) The following data were collected for the reaction below at a temperature of

$$
530{ }^{\circ} \mathrm{C}: \quad \mathrm{CH}_{3} \mathrm{CHO} \longrightarrow \mathrm{CH}_{4}+\mathrm{CO}
$$

## $\left[\mathrm{CH}_{3} \mathrm{CHO}\right](\mathrm{mol} / \mathrm{l})$

0.200
0.153
$0.124 \quad 40$
$0.104 \quad 60$
$0.090 \quad 80$
0.079100
$0.070 \quad 120$
$0.063 \quad 140$
$0.058 \quad 160$
0.053180
0.049200

Plot a graph of concentration versus time and determine the rate of $\mathrm{CH}_{3} \mathrm{CHO}$ at 60 seconds and at 140 seconds.
(8 marks)
(c) (i) State Le Chatelier's principle in your words.
(ii) How will the equilibrium of the following reaction are affected by addition of $\mathrm{H}_{2}$ gas and the removal of $\mathrm{CS}_{2}$ gas respectively?

$$
\mathrm{Heat}+\mathrm{CH}_{4(\mathrm{~g})}+2 \mathrm{H}_{2} \mathrm{~S}_{(\mathrm{g})} \rightleftharpoons \mathrm{CS}_{2(\mathrm{~g})}+4 \mathrm{H}_{2(\mathrm{~g})}
$$

(iii) At $773{ }^{\circ} \mathrm{C}$, a mixture of CO gas, $\mathrm{H}_{2}$ gas, and $\mathrm{CH}_{3} \mathrm{OH}$ gas was allowed to come to equilibrium. The following equilibrium concentrations were then measured: $[\mathrm{CO}]=0.105 \mathrm{M},\left[\mathrm{H}_{2}\right]=0.250 \mathrm{M},\left[\mathrm{CH}_{3} \mathrm{OH}\right]=0.0050 \mathrm{M}$. Calculate $\mathrm{K}_{\mathrm{c}}$ for the reaction:

$$
\mathrm{CO}_{(\mathrm{g})}+2 \mathrm{H}_{2(\mathrm{~g})} \rightleftharpoons \mathrm{CH}_{3} \mathrm{OH}_{(\mathrm{g})}
$$

