

The Open University of Sri Lanka  
Foundation Certification Course in Science  
CMF2205 – 2012/2013  
Model Paper

Duration: 3 hours

Date: 05th April 2013

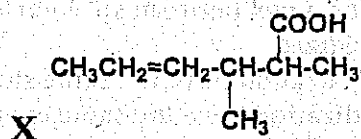
Time 9.30 am – 12.30 pm

Gas constant –  $8.3124 \text{ J mol}^{-1}\text{K}^{-1}$

PART – A

Answer all Questions

- Which period in the periodic table contains the highest number of non-metallic elements ?  
(1) 3      (2) 4      (3) 2      (4) 5      (5) 1
- Of the molecules/ions given below, which one has a different shape from others  
(1)  $\text{SO}_4^{2-}$     (2)  $\text{NH}_4^+$     (3)  $\text{SF}_4$       (4)  $\text{PCl}_4^+$     (5)  $\text{S}_2\text{O}_3^{2-}$
- $\text{MSO}_4 \cdot x\text{H}_2\text{O}$  has 36% of  $\text{H}_2\text{O}$  by mass. The value of x is (H=1, O=16, S=32, M=64)  
(1) 1      (2) 4      (3) 7      (4) 3      (5) 5
- The two elements which are liquids at room temperature are  
(1) Li and Be    (2) Se and Br    (3) Hg and Xe    (4) Br and Be    (5) Hg and Br
- The correct decreasing order of the radii of the ions  $\text{S}^{2-}$ ,  $\text{Cl}^-$ ,  $\text{K}^+$  and  $\text{Ca}^{2+}$  is  
(1)  $\text{Cl}^- > \text{S}^{2-} > \text{K}^+ > \text{Ca}^{2+}$     (2)  $\text{S}^{2-} > \text{Cl}^- > \text{K}^+ > \text{Ca}^{2+}$     (3)  $\text{S}^{2-} > \text{Cl}^- > \text{Ca}^{2+} > \text{K}^+$   
(4)  $\text{Ca}^{2+} > \text{K}^+ > \text{S}^{2-} > \text{Cl}^-$     (5)  $\text{K}^+ > \text{Ca}^{2+} > \text{Cl}^- > \text{S}^{2-}$
- 19.7 kg of gold was recovered from a smuggler. How many atoms of gold were recovered  
(1)  $6.022 \times 10^{23}$     (2)  $6.022 \times 10^{24}$     (3)  $6.022 \times 10^{25}$     (4)  $6.022 \times 10^{26}$     (5)  $6.022 \times 10^{27}$
- Asprin contains 60% C, 4.48% H and 35.52% O. Its empirical formula is  
(1)  $\text{C}_9\text{H}_8\text{O}$       (2)  $\text{C}_9\text{H}_8\text{O}_2$       (3)  $\text{C}_9\text{H}_8\text{O}_3$       (4)  $\text{C}_9\text{H}_8\text{O}_4$       (5)  $\text{C}_9\text{H}_8\text{O}_5$
- 0.16g of an organic compound on complete combustion produced 0.44g of  $\text{CO}_2$  and 0.18 g of  $\text{H}_2\text{O}$ . The percentage of C and H in the compound is respectively.  
(1) 75%, 12.5%    (2) 70%, 12.5%    (3) 70%, 30%    (4) 75%, 25%    (5) 75%, 15%
- Gaseous fuel (LPG) mainly contain  
(1)  $\text{C}_2\text{H}_2$       (2)  $\text{C}_4\text{H}_{10}$       (3)  $\text{C}_2\text{H}_4$       (4)  $\text{CH}_4$       (5) Non of the above
- The IUPAC name of the compound X is



- 1,2-dimethylpent-3-enoic acid
  - 3-methylhex-4-en-2-oic acid
  - 4,5-dimethyl-2-hexenoic acid
  - 2,3-dimethyl-4-hexenoic acid
  - 4-methyl-2-hexenoic acid
- Which molecule or ion from those given below has the highest dipole moment  
(1)  $\text{O}_3$       (2)  $\text{NH}_3$       (3)  $\text{ICl}_4$       (4)  $\text{NO}_2^+$       (5)  $\text{AlCl}_3$
- Which of the following statements is true regarding patterns show in the s and p block elements in the periodic table.
  - Atomic size decreases down a group
  - Ionic radius decreases down a group
  - Atomic size increases across a period from left to right
  - Metallic nature increases across a period from left to right
  - The basic nature of oxides and hydroxides decreases across a period from left to right.

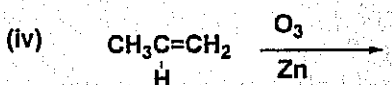
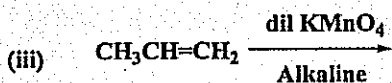
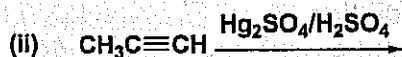
13.  $1.0 \text{ dm}^3$  of an aqueous solution of  $\text{H}_2\text{O}_2$  was heated to complete dissociation. The volume of oxygen evolved was  $8.0 \text{ dm}^3$  at S.T.P. The concentration of the  $\text{H}_2\text{O}_2$  solution in  $\text{mol dm}^{-3}$  is  
 (1) 0.31 (2) 0.35 (3) 0.62 (4) 0.71 (5) 3.2
14. Among  $\text{Na}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{K}^+$  and  $\text{Ag}^+$  Which is a strongest Lewis acid ?  
 (1)  $\text{Al}^{3+}$  (2)  $\text{Mg}^{2+}$  (3)  $\text{Ag}^+$  (4)  $\text{Na}^+$  (5)  $\text{K}^+$
15. Which one of the following compounds has the largest dipole moment ?  
 (1) *cis*  $\text{ClCH}=\text{CHCl}$  (2)  $\text{CO}_2$  (3)  $\text{Cl}_2\text{C}=\text{CCl}_2$  (4)  $\text{CCl}_4$  (5) *trans*  $\text{ClCH}=\text{CHCl}$
16.  $1.0 \text{ dm}^3$  of  $0.2 \text{ mol dm}^{-3}$   $\text{H}_2\text{SO}_4$  and  $1.0 \text{ dm}^3$  of  $0.2 \text{ mol dm}^{-3}$   $\text{HCl}$  were mixed to obtain  $2.0 \text{ dm}^3$  of solution. The  $\text{H}^+$  ion concentration of the resulting solution, if  $\text{H}_2\text{SO}_4$  is full dissociated under these condition is  
 (1)  $0.1 \text{ mol dm}^{-3}$  (2)  $0.15 \text{ mol dm}^{-3}$  (3)  $0.2 \text{ mol dm}^{-3}$  (4)  $0.3 \text{ mol dm}^{-3}$  (5)  $0.4 \text{ mol dm}^{-3}$
17. A  $10.0 \text{ cm}^3$  sample of coconut vinegar (density =  $1.07 \text{ g cm}^{-3}$ ) was titrated with a  $0.0428 \text{ mol dm}^{-3}$   $\text{NaOH}$  solution using a suitable indicator. If the end point was  $25.00 \text{ cm}^3$  the mass percentage (w/w%) of acetic acid (relative atomic mass of  $\text{CH}_3\text{COOH} = 60$ ) in the vinegar, is  
 (1) 0.060 (2) 0.60 (3) 3.0 (4) 12.0 (5) 6.0
18. The number of electrons and the number of neutrons present in  ${}_{12}^{25}\text{Mg}^{2+}$  ion are, respectively  
 (1) 12 and 13 (2) 11 and 13 (3) 10 and 13 (4) 10 and 12 (5) 12 and 11
19.  $0.744 \text{ g}$  sample of a mixture of  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$  (Relative molar mass = 244) and  $\text{KCl}$  was heated to constant mass at  $150^\circ\text{C}$ . The mass of the product was  $0.708 \text{ g}$  the mass of  $\text{KCl}$  in the sample is  
 (1)  $0.500 \text{ g}$  (2)  $0.425 \text{ g}$  (3)  $0.300 \text{ g}$  (4)  $0.250 \text{ g}$  (5)  $0.150 \text{ g}$
20. The valence shell electronic configuration of an element showing the valences 2 and 4 only in its compounds.  
 (1)  $3d^4 4s^2$  (2)  $2s^2 2p^4$  (3)  $2s^2 2p^2$  (4)  $3s^2 3p^4$  (5)  $3s^2 3p^1$
21. The pair of element forming dioxides, which are solids at room temperature, is,  
 (1) Mn, Cu (2) Mn, S (3) Cu, Ni (4) Ti, Si (5) S, N
22. The mass of  $\text{K}_2\text{SO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3 \cdot 24 \text{H}_2\text{O}$  (Relative molar mass = 894) required to prepare  $1.0 \text{ dm}^3$  of  $10.4 \text{ ppm}$   $\text{Cr}^{3+}$  solution ( $1 \text{ ppm} = 1 \text{ mg dm}^{-3}$ ) is  
 (1)  $8.940 \text{ mg}$  (2)  $8.940 \text{ g}$  (3)  $17.88 \text{ mg}$  (4)  $176.8 \text{ mg}$  (5)  $89.40 \text{ mg}$
23. Which one of the following statement is not true about hybridization?  
 (1) Hybrid orbital's may form  $\pi$  bonds (2) The angle between  $sp^2$  hybrid orbitals is  $120^\circ$   
 (3) All carbon atoms in hydrocarbons are hybridized  
 (4) Hybrid orbital's formed from a given hybridization have the same shape  
 (5) Hybrid orbital's formed from given hybridization have the same energy.
24. Which molecule/atom has the highest boiling point?  
 (1)  $\text{CO}_2$  (2)  $\text{SO}_2$  (3)  $\text{N}_2$  (4) He (5) Ne
25. The periods in the periodic table that elements found in all three physical states (solid, liquid and gas) at room temperature and atmospheric pressure are  
 (1) 2 and 4 (2) 3 and 4 (3) 3 and 6 (4) 4 and 5 (5) 4 and 6

Atomic weight: H=1, C=12, O=16, Na=23, S=32, Cl=35.5, K=39, Cr =52, Au=197,  
 Ag=108 Br=80

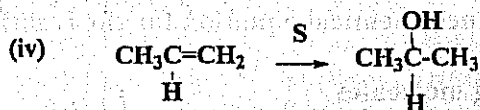
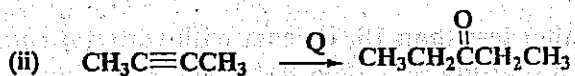
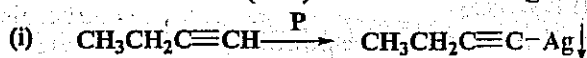
PART B

1. (a) The charge to mass ratio ( $e/m$ ) of an alpha particle is  $2.4112 \times 10^4 \text{ Cg}^{-1}$  mass of an electron is  $3.527 \times 10^{-24} \text{ g}$ . What is the charge of an alpha particle?
  - (b) How many protons neutrons & electrons are present in each of the following atoms?
    - (i) F (ii)  $\text{Cl}^-$  (iii)  $\text{Ca}^{2+}$
  - (c) The energy of electron occupying a particular energy level is given by this equation
 
$$E = -1311/n^2 \text{ kJ mol}^{-1}$$
 Calculate (i) The energy released the transitions of an electron from  $n=4$  to  $n=1$   
 (ii) The wave length in (nm) emission radiation.
2. (a) Consider the following elements of the periodic table and answer the question given below  
 Li, Be, B, C, N, O, F, Ne
  - (i) Which element has the largest atomic radii?
  - (ii) Which element has the largest melting point?
  - (iii) Which element has the largest 1st ionization energy?
  - (iv) Which element has the largest 2nd ionization energy?
  - (v) Which elements are capable of forming a triple bond between two its atoms
  - (vi). Which element do not show any +ve oxidation state
- (b) Give the oxidation state of Cr in the following compounds.
  - (i)  $\text{CrO}_2\text{Cl}_2$  (ii)  $\text{K}_2\text{Cr}_2\text{O}_7$  (iii)  $\text{K}_2\text{CrO}_4$
- (c) Write a balance equation for the ionic half reaction corresponding to the conversion of  $\text{Cr}_2\text{O}_3$  to  $\text{CrO}_4^-$  in basic medium
- (d) U & T are two elements with atomic number less than 18, U react with water at room temperature liberate a gas Y and form a solution X. T does not react with water but reacts with solution X liberate the same gas Y and forming solution Z
  - (i) Using chemical symbols only write all possibilities for U T & Y
  - (ii) Write the observation where excess diluted HCl to added drop wise to solution Z.
  - (iii) Using chemical symbols only write the balance chemical equation for the reaction between X & T
3. (a) Draw a dot and cross diagrams for the following molecules
  - (i) NO (ii)  $\text{NF}_3$  (iii)  $\text{H}_2\text{S}$
- (b) Predict the shapes of the following molecules using VESPER theory
  - (i)  $\text{SF}_4$  (ii)  $\text{XeF}_4$  (iii)  $\text{CH}_4$  (iv)  $\text{BCl}_3$
- (c) Why the molecular solid tend to have lower melting point than covalent solids
- (d) Give types of compounds that could have each of the following attractive forces
  - (i) Covalent bonds (ii) hydrogen bonding (iii) dipole-dipole
4. (a) The density of a liquid (X) is  $1.324 \text{ g cm}^{-3}$ . The density of the liquid (X) in SI unit is,
- (b) Calculate the number of particles/atoms/molecules/ions in each of the following
  - (i) 5.85 g of NaCl (ii) 1.5 moles of  $\text{H}_2\text{SO}_4$  (iii) 112 g of nitrogen gas (iv) 2 moles of electrons
- (c) Dichloromethane is a liquid with a density of  $2.02 \text{ g cm}^{-3}$  How many liters of Dichloromethane must be measured out to contain 10.1 moles of Dichloromethane ( $\text{C}_2\text{H}_2\text{Cl}_2$ )
- (d) 1.395 g of sample of rust containing iron was dissolved in acid and diluted to  $200 \text{ cm}^3$ . A  $25.00 \text{ cm}^3$  aliquot of the diluted solution required  $35.25 \text{ cm}^3$  of  $0.02 \text{ mol dm}^{-3}$  solution of potassium Permanganate during a titration. What was the percentage of iron in the sample. ( $\text{Fe}-55.8 \text{ g mol}^{-1}$ )

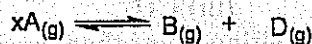
- 5.(a) (i) An unknown compound P contain only C, H, & N combustion of 70.0 mg of the compound produced 67.0 mg of carbon dioxide and 82.2 mg of water. If molar mass of the compound is 93g, What are the empirical and molecular formulae of the compound P?
- (b) (i) Draw the all forms of structures for butene and with their IUPAC names.  
(ii) From above structures select the geometrical isomers and draw separately
- (c). Give the products for the following reactions.



- d. Give the reactants (P-S) for the following conversions



6. (a) At temperature above 400 K A(g) dissociates to give B(g) and D(g) resulting in the equilibrium.



- (i) The equilibrium constant  $K_c$  &  $K_p$  for the above equilibrium have the same numerical Value. Starting with the definitions of  $K_c$  &  $K_p$  for the above reaction. Calculate that the balancing coefficient "x" in the above equilibrium
- (ii) In a certain equilibrium mixture of the gases A, B, & D at 500 K the respective partial Pressure of the gases are as follows  $P_A = 2 \times 10^5 \text{ Pa}$ ,  $P_D = 2 \times 10^5 \text{ Pa}$ ,  $P_B = 8 \times 10^5 \text{ Pa}$  Calculate  $K_p$  for the equilibrium constant at 500 K
- (b) At room temperature  $25.0 \text{ cm}^3$  of  $4.00 \times 10^{-3} \text{ mol dm}^{-3} \text{ AgNO}_3$  solution were mixed with  $75.0 \text{ cm}^3$  of  $8.00 \times 10^{-3} \text{ mol dm}^{-3} \text{ NaBr}$  solution  $K_{sp} [\text{AgBr}] = 5.00 \times 10^{-13} \text{ mol}^2 \text{ dm}^{-6}$
- (i) Show that a precipitate occurred or not
- (ii) If precipitation occurred. Calculate the mass of the dry precipitate obtained in theoretically
- (c) Calculate the pH of the following solutions at  $25^\circ\text{C}$   $K_w = 1 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$
- (i)  $2 \times 10^{-5} \text{ mol dm}^{-3} \text{ HCl}$  solution.
- (ii) From 1.0 ml of above HCl solution diluted to 1000 ml. The resultant solution