Our country, our future

525/1

S6 CHEMISTRY

Exam 19

PAPER 1

DURATION: 2 HOUR 45 MINUTES

Instructions to candidates;

- *Answer **all questions in Section A** and **any six in Section B**.*
- *All questions must be answered in spaces provided.*
- *Illustrate your answers with equations where applicable.*
- *Molar gas constant, R=8.314jk^{-1}mol^{-1}*
- *Molar volume for a gas at s.t.p is 22400cm^{3}*
- *Standard temperature =273k*
- *Standard pressure =101325 Nm^{-2}*

SECTION A

Answer all questions from this section.

1. State the condition(s) and write equation for the reaction of aluminium and;
i) water (2marks)

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ii) Iron (III) oxide (2marks)

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2. a) State what is meant by the term ebullioscopic constant. (1mark)

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b) 0.40g of camphor when disoolved in 33.5g of trichloromethane produces a solution boiling at 0.30^0C above the boiling point of pure solvent. Calculate the ebullioscopic constant of trichloromethane. (Molar mass of camphor = 155).
(3marks)

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3. a) State what is observed and write equation for the reaction when;

i) Ethanal is mixed with a saturated solution of sodium bisulphite. (2marks)

Observation:

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Equation

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ii) Neutral iron(III) chloride solution is added to aqueous solution of hydroxybenzene. (2marks)

Observation;

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Equation;

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b) Write the mechanism for the reaction in a(i). (2 ½ marks)

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4. a) State what is meant by the term electrode potential. (1mark)

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b) The electrode potential of some half cells are given below.

(E$^{\ominus}$V)

$S_2O_8^{2-}(aq) + 2e^- \longrightarrow 2SO_4^{2-}(aq)$ $+2.01$

$I_2(aq) + 2e^- \longrightarrow 2I^-(aq)$ $+0.54$

Write;

i) The cell notation of cell formed when the half cells are combined.

(1mark)

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ii) equation for the overall cell reaction. (1½ marks)

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iii) Calculate the e.m.f of cell. (1mark)

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iv) State whether the cell reaction is feasible or not. Give a reason for your answer. (1mark)

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5. a) State two properties in which beryllium shows diagonal relationship with aluminum. (2marks)

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b) Write equations to illustrate the properties stated in (a) (3marks)

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6. State what would be observed and write equation for the reaction that takes place when

a) Chlorine gas is passed through a solution of potassium manganate(VI) (2 ½ marks)

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b) A few drops of hydrogen peroxide solution is added to acidified potassium dichromate(VI) solution. (2 ½ marks)

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7. Write equations to show how the following conversions can be effected.

(2½ marks)

a) $(CH_3)_2COH$ to $(CH_3)_3COH$

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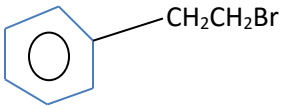
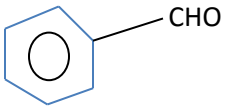
b) 

to 

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8. 30cm^3 of a hydrocarbon Q was exploded with 200cm^3 of oxygen in excess. The volume of the residual gas on cooling to room temperature was found to be 155cm^3. When the residual gas was treated with concentrated potassium hydroxide solution, the volume reduced to 35cm^3.

a) Calculate the molecular formula of Q. (3marks)

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b) Write the structures of all possible open chain isomers of Q. (1mark)

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c) Q reacts with ammoniacal copper(I) chloride solution.

i) State what is observed. (1mark)

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ii) Write equation for the reaction that takes place. (1½ marks)

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9. The molar conductivity of a 0.093M solution of ethanoic acid at 25^0C is 5.34 x 10^{-4} sm^2mol^{-1}. The molar conductivity at infinite dilution of H^+ and CH_3COO^- ions are 3.51 x 10^{-2} and 0.4 x $10^{-2}Sm^2mol^{-1}$ respectively. Calculate the;

i) molar conductivity of ethanoic acid at infinite dilution. (1 ½ marks)

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ii) degree of dissociation , α of ethanoic acid. (1 ½ marks)

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iii) acid dissociation constant, Ka at 25^0C (1 ½ marks)

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SECTION B

Attempt only **six** questions from this Section

10. a) An organic compound Z has a molecular formula $C_3H_6Br_2$.
Write down the structural formula and IUPAC names of all isomers of Z.

(3marks)

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b) When Z was heated with sodium metal in ethanol a compound Y was formed. Y reacts with water in the presences of sulphuric acid and Mercurous sulphate at 60^0C to form a compound X. X does not react with Fehling's solution but forms an orange precipitate with Brady's reagent. Identify compound X, Y and Z.

(1½ marks)

X .....

Y .....

Z .....

c) Write the equation and suggest the mechanism for the reaction between
i) Z and sodium metal in ethanol.

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ii) X and Brady's reagent. (2 ½ marks)

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11. Explain each of the following observations (Your answer should include balanced equations if any). (3marks each)

a) When hydrogen iodide is treated with concentrated sulphuric acid, iodine is liberated whereas when hydrogen chloride is similarly treated, chlorine is not evolved.

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b) An aqueous solution of sodium sulphite has a pH greater than 7 whereas that of sodium hydrogen sulphite is less than 7.

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c) When hydrogen sulphide is bubbled through an aqueous solution of iron(III) chloride a yellow precipitate is observed.

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12. a) State Raoults law as applied to binary liquid systems. (1mark)

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b) The mixture of water and nitric deviates negatively from Raoults law. The mixture form an azeotropic mixture at 68.2% nitric and boiling point 121^0C.

i) Sketch a labeled boiling point – composition diagram for the mixture above. (Bpts of HNO_3 and H_2O respectively are 78.2^0C and 100^0C at 760mmHg pressure.) (3marks)

ii) Describe briefly what happens when a mixture containing 50% nitric acid is distilled. (2½ marks)

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c) Explain why the mixture deviates negatively from Raoults law.

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d) Name one method of obtaining pure nitric acid from the azeotropic mixture. (1mark)

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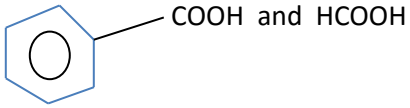
13. Name the reagents that can be used to distinguish between the following pair of organic compounds. In each case state what is observed when the compounds are separately treated with the reagent. (3marks)

a)



Reagent

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Observation

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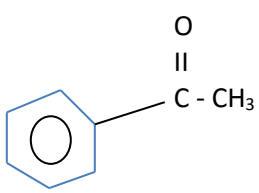
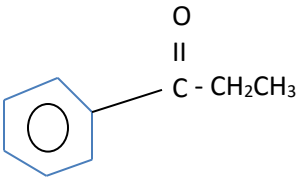
b) 

and 

Reagent

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Observations

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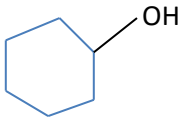
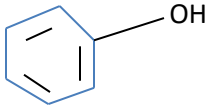
c) 

and 

Reagent

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Observations

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14. a) 0.111g of a vaporized sample of an organic compound R occupied 48.0cm^3 at 20^{0}C and 700mmHg pressure. Calculate the relative molecular mass of R.

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b) R consists 59.9% carbon, 26.6% oxygen and the rest is hydrogen. Determine;

i) the empirical formula of R (2marks)

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ii) the molecular formula of R (1½ marks)

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c) Write down the structural formulae and give the IUPAC names of all isomers of R. (3marks)

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15. a) State two characteristic properties exhibited by manganese as a transition element.

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b) i) Write the electronic configuration of manganese. (½ mark)

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ii) State the common oxidation states exhibited by manganese in its compounds.
(1 ½ marks)

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c) i) Manganese (IV) oxide reacts with concentrated hydrochloric . Write the equation of reaction that takes place. (1 ½ marks)

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d) Lead(V) oxide was added to an aqueous solution of manganese (II) chloride, followed by concentrated nitric acid. The mixture was then heated.

i) State what was observed. (1½ marks)

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ii) Write equation of reaction that takes place. (1½ marks)

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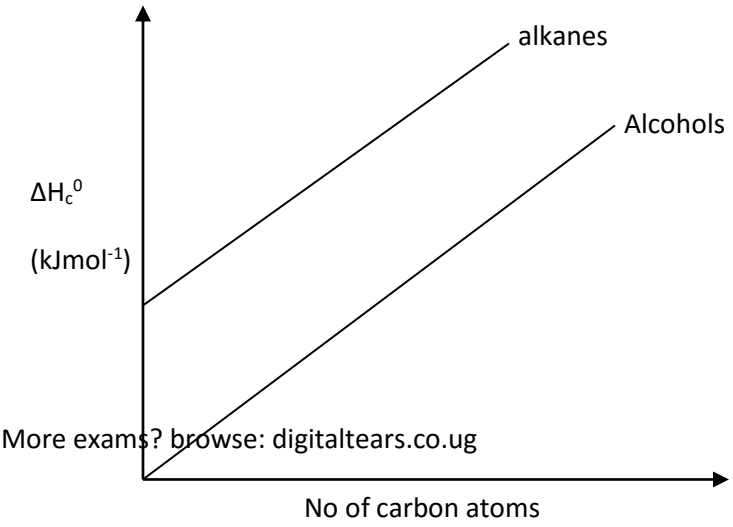
16. a) The standard enthalpies of combustion of some straight chain alkanes and alcohols against number of carbon atoms is shown below.



i) Explain the shape of the graph(s)

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ii) The graph for alcohol passes through the origin. Explain why this is so.
(1½ marks)

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iii) The graph for alkanes has an intercept. What is the siginificance of the intercept? (1 ½ marks)

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b) Energy changes for some reactions are shown below;

			ΔHO/Kjmol^{-1}
i) $CO(g) + ½ O_2(g)$	⟶	$CO_2(g)$	-283
ii) $H_2(g) + ½ O_2(g)$	⟶	$H_2O(l)$	-286
iii) $CH_3OH(l) + {}^3/_2O_2(g)$	⟶	$CO_2(g) + 2H_2O(l)$	-715

Calculate the enthalpy change for the reactions

$CO(g) + 2H_2(g) \longrightarrow CH_3OH(l)$ (3marks)

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17. a) Explain what is meant by the term complex ion. (1mark)

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b) i) Some complex ions are given below. In each case state the coordination number and oxidation state of the central atom. (3marks)

Formulae of complex ion	**Coordination number**	**Oxidation state**
$CoCl_4^{2-}$		
$Fe(CN)_6^{3-}$		

$Ag(NH_3)_2$		

ii) Explain why transition metals form complex ions.

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c) In each case write equation catalyzed by the following ions/species.

(1 ½ marks @)

i) Vanadium pentoxide

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ii) Manganese II ions

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***END** **