Our country, our future

525/1

S6 CHEMISTRY

Exam 10

PAPER 1

DURATION: 2 HOUR 45 MINUTES

For Marking guide contact and consultations: Dr. Bbosa Science 0776 802709,

Instructions

- This paper consists of two sections A and B
- Section A is compulsory
- Attempt only six questions in section B
- Answers must be written in the spaces provided only.

For Examiner's Use Only																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

SECTION A

Answer all questions from this section

1. Oxygen diffused through a porous partition in 1.87 minutes. Under similar conditions the same volume of an alkene T diffused in 2.15 minutes
   (a) Determine the formula of T   (2 ½ marks)

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   (b) Write equation and outline the mechanism for the reaction between T and benzene.

       Indicate the condition (s) for the reaction   (3marks)

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2. (a) define the term heat of reaction   (1mark)

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(c) Calculate the standard enthalpy of hydrogenation of ethane from the data

    (i) $C_2H_6(g) + 3 \frac{1}{2} O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$ $\Delta H= -1550kJmol^{-1}$

    (ii) $C_2H_4(g) + 3 O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)$ $\Delta H= -1390kJmol^{-1}$

    (iii) $H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l)$ $\Delta H= -285.8kJmol^{-1}$ (4marks)

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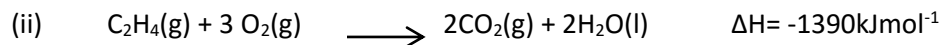
3. (a) Aluminium and phosphorus both form compounds in which the oxidation state of the

element is +3

(a) Briefly explain in terms of electron structure why aluminium conducts electricity but the

common allotropes of phosphorus do not.

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(b) Write equation for the reaction of each of these elements with sodium hydroxide   (3mark)

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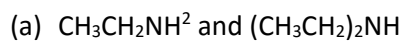
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4. Name one reagent that can be used to distinguish between each of the following pairs of compounds and state what would be observed in each case if the reagent is reacted with the compounds;

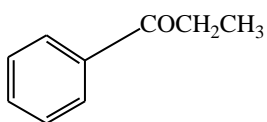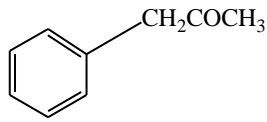(a) $CH_3CH_2NH_2$ and $(CH_3CH_2)_2NH$ (3marks)

Reagent

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Observation:

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(b)

$COCH_2CH_3$ and CH_2COCH_3

Reagent

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Observation:

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5. (a) Explain the order of increasing basicity for the following compounds. (2marks)

$C_6H_5NH_2$ < NH_3 < CH_3NH_2

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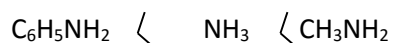
(b) When one mole of methylamine is dissolved in water, the hydrogen ion concentration is found to be 2.5×10^{-10} moldm^{-3}.

(i) Write an equation for the reaction between water and methylamine (1 mark)

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(ii) Calculate the base dissociation constant, Kb, for methylamine. (2 ½ marks)

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6. The convention of a cell is given below.

    $Pt/Fe^{2+}(aq),Fe^{3+}(aq) //MnO_4^-(aq),Mn^{2+}(aq),H^+(aq)/Pt$
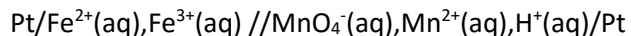
(a) Write equation for the half-cell reaction at:-

   (i)   Anode   (1mark)

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   (ii)   Cathode   (1mark)

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(b) Write the overall equation for the cell reaction.   (1 ½ marks)

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(c) The electrode potentials for the system $Fe^{2+}(aq)/Fe^{3+}(aq)$ and $Mn^{2+}(aq)/MnO_4^-(aq)$ are +0.76V

    and -1.51V respectively. Deduce whether the reaction in (b) is feasible or not and give a reason

    for your answer.   (2marks)

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7. (a)Define the term boiling point elevation constant of a substance. (1mark)

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(b) The boiling point of benzene under certain pressure condition is 80.0^0C. Calculate the boiling point elevation constant of benzene, if a solution containing 5g of 2,4,6-trinitrophenol, $(HOC_6H_2(NO_2)_3$ in 100g of benzene, boils at 80.568^0C. (4marks)

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8. 2.00g of phosphorus pentachloride allowed to reach equilibrium at 200^0C in a vessel of $1dm^3$ capacity. If the equilibrium constant of the reaction $PCl_5 (g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is $0.008moldm^{-3}$ at this temperature and in the conditions stated; calculate the percentage dissociation of phosphorus pentachloride at equilibrium. (4marks)

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9. The first ionization energies of some group II metals of the periodic table and the melting points

of their chlorides are given below.

	Mg	Ca	Sr	Ba
First ionization energy /kJmol^{-1}	738	590	549	505
Melting point of chlorides (^{0}C)	708	772	873	967

Explain

(i)   Why ionization decreases with increase in atomic number.   (2marks)

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(ii)   Why the melting points of the chlorides of these metals increase with increase in atomic

number of the metal.   (2marks)

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SECTION B (54 MARKS)

(Attempt any six questions from this section)

10. (a) (i) Define the term "molar conductivity at infinite dilution, Λ_0.   (1mark)

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   (iii)   State how you would expect the molar conductivity of sodium chloride solution to vary as

            the dilution of the solution is increased. Give a reason for your answer   (2marks)

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   (c) The values of Λ_0 at 25^0C for some electrolytes are as follows

Electrolyte	Λ_0/Sm^2mol^{-1}
HCOONa	104.7
NaCl	126.5
HCl	426.2

   (i)   Calculate Λ_0 at 25^0C for methanoic acid, HCOOH.   (2marks)

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   (ii)   If the value of molar conductivity, Λ, for 0.01M methanoic acid is $50.5Sm^2mol^{-1}$ at 25^0C.

            Calculate the acid dissociation constant, Ka, for methanoic acid.   (4marks)

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11. (a) (i) Explain the term solubility product. (1mark)

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(ii) Write an expression for the solubility product of silver chloride in water (1mark)

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(b) Ionic conductivity of silver ions and chloride ions at infinite dilution are 6.2×10^{-2} and 7.6×10^{-2} Sm^2mol^{-1} respectively at 298K. The electrolytic conductivity of silver chloride at 298K is $1.22 \times 10^{-2} Sm^2mol^{-1}$.

(i) Calculate the solubility in moldm-3 of silver chloride at 298K (3 ½ marks)

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(ii) Calculate the solubility product, Ksp, of silver chloride at 298K (1 ½ marks)

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(c) State the effect of the following actions on the solubility of silver chloride. Explain your answers.

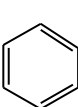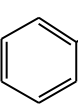(i)   Addition of aqueous ammonia   (1mark)

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(ii)   Addition of potassium chromate (VI) solution.   (1mark)

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12. Write equations to show how the following compounds can be synthesized.

(a)   (3½ marks)

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(b) $(CH_3)_3COH$ from $(CH_3)_2CHOH$ (2½ marks)

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(c) $CH_3CH_2CH=CH_2$ from ethyne   (3marks)

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13. (a) Explain each of the following observations:

(i)   Chromium (III) sulphate dissolves in water to form a solution whose pH is less than

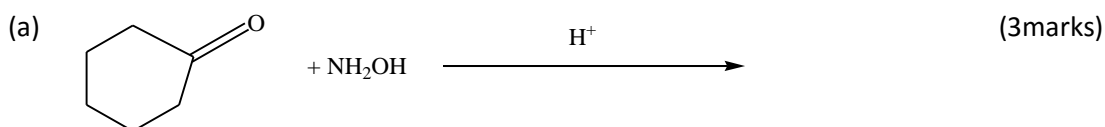seven.   (2 ½ marks)

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(ii)   Lead does not form lead (IV) bromide.   (2marks)

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(b) To a dilute solution of chromium (III) sulphate was added dilute sodium hydroxide drop wise

until in excess followed by 3 drops of hydrogen peroxide and mixture warmed.

State what was observed and use equations to explain the observations.   (4 ½ marks)

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14. Complete the following equations and in each case write a mechanism for the reaction.

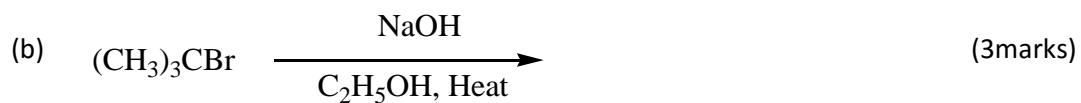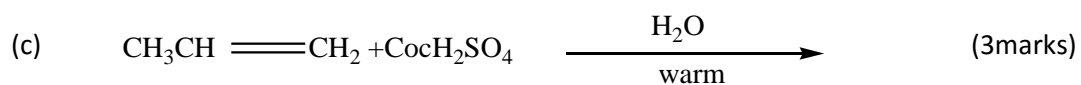(a)   (3marks)

$+ NH_2OH \xrightarrow{H^+}$

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(b) $(CH_3)_3CBr$ $\xrightarrow[C_2H_5OH, \text{ Heat}]{NaOH}$ (3marks)

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(c) $CH_3CH = CH_2 + CocH_2SO_4$ $\xrightarrow[\text{warm}]{H_2O}$ (3marks)

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15. Vegetable oils have great economic and social importance

(a)(i) Explain what is meant by the term <u>vegetable oils</u> (1mark)

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(ii)   Name two main sources of vegetable oils.   (1mark)

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(iii)   Describe briefly how vegetable oil can be obtained on a large scale from one of the

sources you have named in (a)(i) above. (technical details are not required) (2marks)

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(b) (i) State the name given to the reaction leading to the formation of soap from oil. (1mark)

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(ii)   Write a general equation for the formation of soap from oil.   (1mark)

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(iii)   Outline how soap is manufactured, (technical details not required).   (3marks)

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16. State what would be observed and write the equation for the reaction that would take place

when:

(a) Hydrogen sulphide gas is passed through an acidified solution of potassium dichromate (VI).

Observation (2 ½ mark)

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Equation:

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(b) 2,3 drops of ammoniacal copper (I) chloride is added to phenylethyne.   (2marks)

Observation

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Equation:

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(c) Neutral iron (III) chloride solution is added to 1 cm^3 of propanoic acid   (2marks)

Observation

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Equation:

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(d) A spatula end ful of sodium hydrogen carbonate is added to iron (III) chloride solution (2 ½ marks)

Observation

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Equation:

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17. (a) Fluorine is the first member of the halogen group of elements in the periodic table and it shows anomalous behavior among the halogens.

(i) State **three** major differences between fluorine and other halogens. (2½ marks)

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(ii) Give **three** causes for the anomalous behaviour of fluorine. (3mmarks)

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(c) The acid dissociation constants Ka for the hydrides of elements of group (VII) elements are given in the table below:

Hydride	HF	HCl	HBr	HI
Ka (moldm^{-3})	5.6×10^{-11}	1×10^{-9}	1×10^{-7}	1×10^{-4}

State and explain the trend in variation of acid strength of the hydrides   (4marks)

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1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	207 Ti 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
227 AC 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

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