



Our country, our future

525/1

S6 CHEMISTRY

Exam 31

PAPER 1

DURATION: 2 HOUR 45 MINUTES

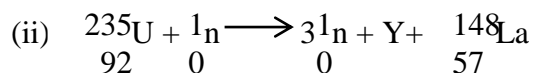
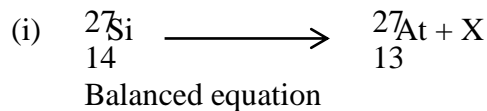
Instructions to candidates:

- Answer all questions in section A and six questions in section B
- All questions must be answered in the spaces provided.
- The periodic table with relative atomic masses will be provided.
- Illustrate your answers with equations where applicable.

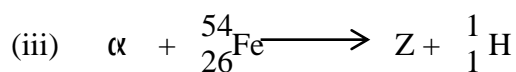
SECTION A:

Answer all questions in this section.

1. (a) Write balanced equations for the following nuclear changes. In each case identify particles X, Y and Z (1 mark)



Balanced equation:



Balanced equation

- (b) A radioisotope was found to have $\frac{1}{8}^{\text{th}}$ of its original activity after 42 days.
Calculate the half-life of the isotope. (2 ½ marks)

2. 20cm³ of a gaseous hydrocarbon Q was exploded with 150cm³ of oxygen in excess. After complete combustion, the volume of residual gas was found to be 110cm³. When concentrated potassium hydroxide was added to the residual gas, the volume reduced to 30cm³.

- (a) Determine the molecular formula of Q

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- (b) Write the structures and IUPAC names of all possible isomers of Q.

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- (c) Ozonolysis of Q leads to the formation of only one product. Write the mechanism of reaction between Q and alkaline potassium manganate (VII) solution.

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3. Explain the following observations:

(a) Both nitrogen and phosphorus belong to group (V) of the periodic table but nitrogen only forms the chloride NCl_3 whereas phosphorus forms PCl_3 and PCl_5

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(b) Hydrogen fluoride boils at 20°C whereas hydrogen chloride boils at -84°C .

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4. Name the reagents that can be used to distinguish between the following compounds. In each case state what would be observed if each compound is separately treated with the reagent.

(a) CH_3COOH and $\text{CH}_3\text{COOCH}_3$

(2 marks)

Reagent(s)

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Observations

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(b) $(\text{CH}_3)_3\text{N}$ and $(\text{CH}_3)_2\text{NH}$

(2 marks)

Reagent(s)

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Observation(s)

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5 (a) State factors that can affect molar conductivity of an electrolyte.

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(b) The molar conductivities at infinite dilution at 25°C for some electrolytes are given in the table below.

Electrolyte	$\lambda_\infty \text{Scm}^2 \text{mol}^{-1}$ at 25°C
Sodium nitrate	122
Nitric acid	421
Sodium ethanoate	91

Calculate the molar conductivity at infinite dilution for ethanoic acid.

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(c) The molar conductivity of a 0.016M CH_3COOH aqueous solution at 25°C is $13.0 \text{ S cm}^2 \text{ mol}^{-1}$. Calculate the acid dissociation constant (K_a for ethanoic acid).

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6 (a) Define the term bond energy.

(01 marks)

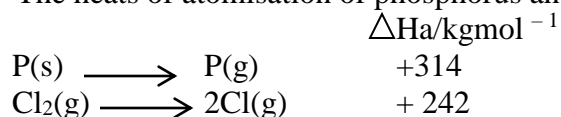
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(b) Draw the structure and name the shape of phosphorus trichloride molecule (1 ½ marks)

(d) The heats of atomisation of phosphorus and chlorine are given below



Calculate the average bond energy for P – Cl bond. (The heat of formation of PCl_3 is -360 KJmol^{-1}) (2 ½ marks)

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7. A gaseous hydride of silicon with a formula $\left(\text{Si}_n \text{H}_{2n+n} \right)$ diffuses through a narrow hole in 27.8s. The same volume of carbon dioxide diffuses through the same hole under identical conditions in 32.6s.

(a) (i) Calculate the relative molecular mass of the hydride. (1 ½ marks)

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(ii) Determine the molecular formula of the hydride (1 ½ marks)

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- (b) Write equation for the reaction between the hydride in a (ii) above with water in the presence of sodiumhydroxide. (1 ½ marks)

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8. The results below were obtained in an experiment to investigate the rate of hydrolysis of methylmethanoate at 298K.

$[\text{HCO}_2\text{CH}_3] / \text{Mol dm}^{-3}$	$[\text{H}^+] \text{ Moldm}^{-3}$	Initial rate $\times 10^3 / \text{mol dm}^{-3} \text{ s}^{-1}$
0.50	1.00	0.56
2.00	1.00	2.24
2.00	0.50	1.13

- (a) Deduce the order of reaction with respect to

(i) Methylmethanoate

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(ii) Hydrogen ions

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- (b) (i) Calculate the overall order of reaction

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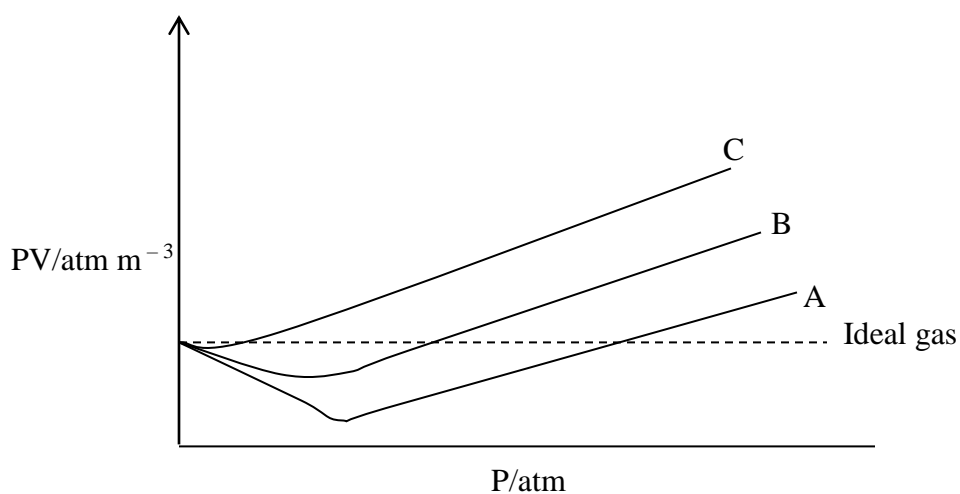
(ii) Write the rate equation

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(c) Calculate the rate constant, K for the reaction at 298k. State its units.

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9. The figure below shows the PV against P plots for three gases, oxygen, nitrogen and carbon dioxide at 273K.



Identify giving reason(s) for your answer which gas is represented by each of the curves

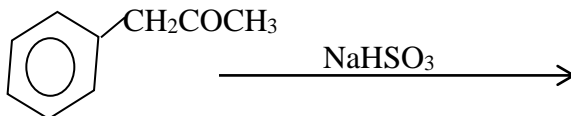
A:

B:

C;

10. Complete the following organic reactions and write the accepted mechanisms (3 ½ marks)

(a)

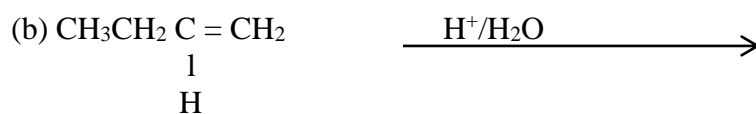


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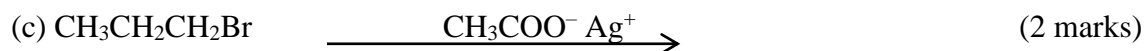


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11.

(a) (i) Write the electronic configuration of manganese. (01 marks)

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

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(b) Draw the structure and name the shape adopted by the manganate (VII) ions (2 marks)

(c) The manganate (vii) ions are strongly oxidizing in both alkaline or acidic media. Write equations to show the oxidizing action

(i) alkaline media

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(ii) acidic media

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(d) Give a reason why potassium manganate (Vii) is not good primary standard. (1 mark)

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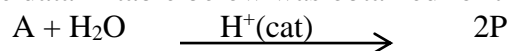
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(e) Name one compound used to standardize the potassium manganate (vii) (½ mark)

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12. The data in table below was obtained for the reaction:



Time/Mins	0	10	20	30	40	50	60
$\log_{10}[A]$	0.398	0.199	0.041	-0.200	-0.377	-0.602	-0.796

(a) Plot a graph of $\log_{10}[A]$ against time. (3 marks)

(b) From the graph, determine the order of the reaction

(c) Calculate:

(i) the rate constant for the reaction

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(ii) the half life of the reaction

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13. Compound Y contains 71.05% silver, 7.89% carbon, the rest being oxygen (vapour density of Y is 152)

(a) (i) Calculate the empirical formula of Y (2 ½ marks)

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(ii) Determine the molecular formula of Y (2 marks)

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(b) In each case state what would be observed and write equation of reaction that took place when the following compounds are added to the aqueous solution of Y.

(i) aqueous potassium chromate:

(2 ½ marks)

Observation

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Equation

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(ii) Hot acidified potassium permanganate solution observation:

(2 marks)

Observation:

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Equation:

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14. Write equations to show how each of the following organic compounds can be synthesized. In each case indicate the reagents and conditions of reactions.

(a) $\text{CH}_3\text{COOC}_2\text{H}_5$ from ethanol

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(b) $\text{CH}_3\text{CONHCH}_2\text{CH}_3$ from Bromomethane.

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(c) $\text{CH}_3\text{C}\equiv\text{CH}$ from $\text{CH}_2=\text{CH}_2$

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15. (a) Define the term molar enthalpy of hydration (01 mark)

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The enthalpy of hydration of ions M^{2+} and standard electrode potentials E^θ/V for group(II) elements are shown in the table below:

Ions	Be^{2+}	Mg^{2+}	Ca^{2+}	Sr^{2+}	Ba^{2+}
Enthalpy of hydration / KJmol^{-1}	—	– 1930	– 1650	– 1480	– 136
Standard electrode potential E^θ/V	– 1.85	– 2.37	– 2.87	– 2.89	– 2.90

(b) State giving reason(s) for your answer which ion is:

(i) the least reducing

(ii) the least oxidizing

(c) Explain

(i) why the enthalpy of hydration of the ions have a negative value

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(ii) the trend in variation of the enthalpy of hydration

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16. Na, Si, P, S and Cl are some of the elements in period III of the periodic table

(a) Write the formula of the hydride of each element.

Element	Formula of hydride
Na	
Si	
P	
S	
Cl	

(b) Compare the reactivity of the hydrides with water. In each case write equation of reaction of any. (6 ½ marks)

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17. (a) Distinguish between thermoplastics and thermosetting plastics

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(b) For each of the following polymers, write the structure(s) of the monomer(s) from which they were synthesized.

Polymer	Structure(s) of monomers
$\left[\text{CH}_2 - \underset{\text{Cl}}{\underset{ }{\text{CH}}} - \underset{\text{C} \equiv}{\underset{ }{\text{CH}_2\text{CH}}} \right]_n$	
$\left[\text{O} - \underset{\text{C}}{\underset{ }{\text{C}}} - \text{C}_6\text{H}_4 - \text{CO}_2\text{CH}_2\text{CH}_2\text{O} \right]_n$	

(c) A solution containing 1.00g of polyphenyl ethane in 100cm³ of benzene is found to have an osmotic pressure of 59 Pa at 27°C. Calculate the average relative molecular mass of polyphenylethene.

End