4.5 CHEMISTRY (233)

4.5.1 Chemistry Paper 1 (233/1)

1. (a) State **one** property that can be used to distinguish between a proton and a neutron. (1 mark)

(b) An ion of element **Y** has the formula:

$^{40}_{20}Y^{2+}$

(i) Write the electron arrangement of the ion. (1 mark)

(ii) Identify the group and period in the Periodic Table to which the element belongs.

Group ..... (½ mark)

Period ..... (½ mark)

2. (a) Complete **Table 1** by writing the formula and naming the structure of the chlorides of the elements.

Table 1

Element	**Sodium**	**Magnesium**	**Silicon**	**Phosphorus**
Formula of chloride				
Name of the Structure of chloride				

(2 marks)

(b) Select from **Table 1** an acidic chloride and write the equation for its reaction with water. (1 mark)

3. (a) Write a thermochemical equation for the formation of carbon(II) oxide. (1 mark)

(b) Use the energy level diagram in **Figure 1** to answer the questions that follow.

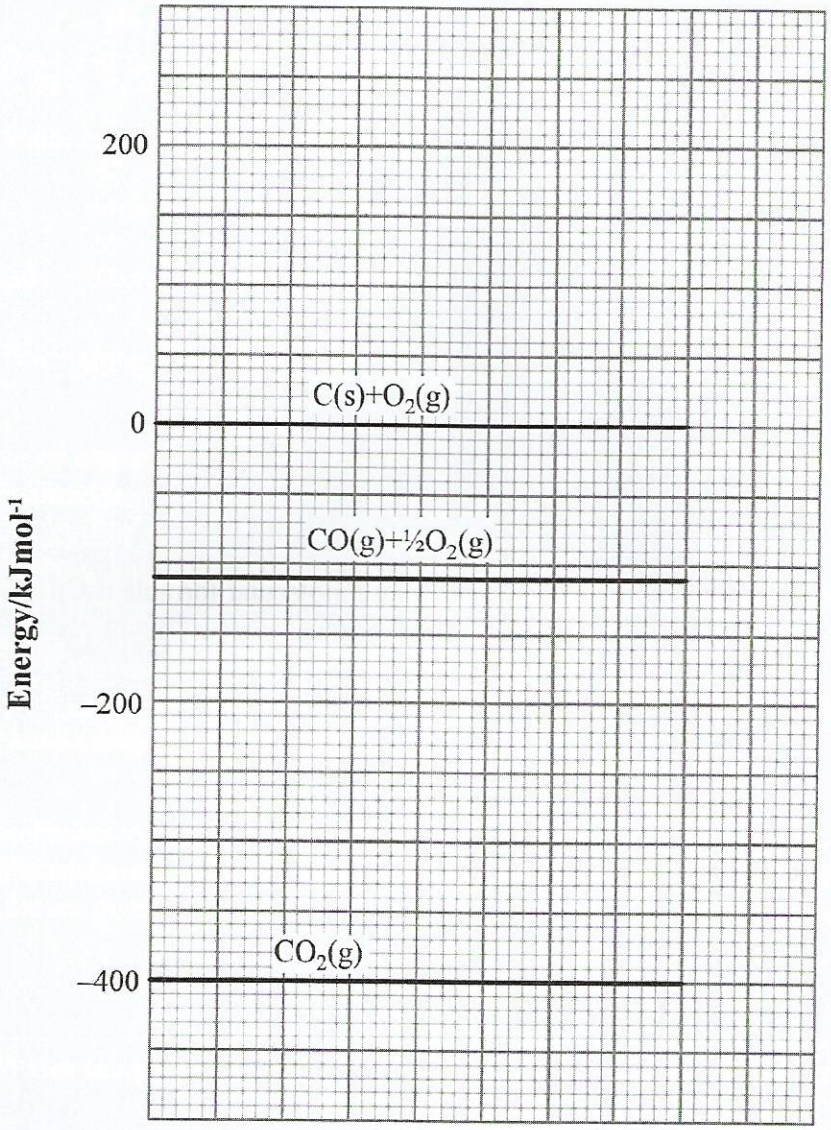


Figure 1 Reaction path

Determine the enthalpy change of:

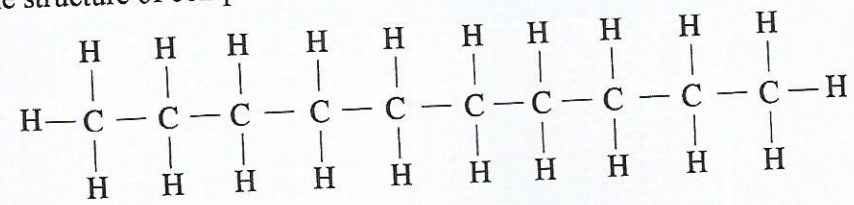
(i) formation of carbon(II) oxide (1 mark)

(ii) combustion of carbon(II) oxide (1 mark)

4. (a) Give a reason why painting or galvanising iron sheets protects them from rusting. (1 mark)

(b) Explain the advantage of galvanising over painting of iron sheets. (2 marks)

5. (a) The structure of compound **A** is:



Give its:

(i) name (1 mark)

(ii) empirical formula (1 mark)

(b) Draw the structure of an alkanoic acid whose molecular formula is $C_5H_{10}O_2$. (1 mark)

6. The following equilibrium exists in a closed system.

$$\underset{\text{(Pale yellow)}}{N_2O_4(g)} \rightleftharpoons \underset{\text{(Brown)}}{2\,NO_2(g)}; \quad \Delta H = +27.5\,kJ$$

State and explain **two** conditions under which the intensity of the brown colour of the equilibrium mixture can be increased.

Condition I (1½ marks)

Condition II (1½ marks)

7. (a) Determine the oxidation numbers of:

(i) hydrogen in $\mathbf{CaH_2}$ (1 mark)

(ii) oxygen in $\mathbf{OF_2}$ (1 mark)

(b) Write an ionic equation for the reaction between aqueous sodium hydrogen carbonate and ethanoic acid. (1 mark)

8. The mass of one molecule of a hydrocarbon is 9.33×10^{-23}g.
(Avogadro's number = 6.0×10^{23} mol^{-1}, C = 12.0; H = 1.0)

(a) Determine its:

(i) molecular mass (1 mark)

(ii) molecular formula (1 mark)

(b) Draw a structure of the hydrocarbon in 8(a). (1 mark)

9. (a) Water reacts with hydrogen ions:

(i) write the formula of the product formed (½ mark)

(ii) Name the type of bond formed (½ mark)

(b) The melting point of iodine is higher than that of chlorine. Explain. (2 marks)

10. A sample of ammonia gas can be prepared by heating a mixture of ammonium bromide and barium hydroxide.

(a) Write an equation for the reaction. (1 mark)

(b) State why the gas cannot be dried using anhydrous calcium chloride. (1 mark)

(c) Name a suitable drying agent. (1 mark)

11. In an experiment to test for hardness of water from different boreholes, soap solution was added to 1000 cm^3 of water and the volume of soap solution required for lather to start forming recorded. The results are given in **Table 2.**

Table 2

Water sample (1000 cm^3)	**Volume of soap solution added (cm^3)**	
	Before boiling	**After boiling**
1	25	3
2	12	8
3	10	10
4	3	3
5	25	24

(a) Select water samples that show:

(i) temporary hardness (½ mark)

(ii) no hardness (½ mark)

(iii) both temporary and permanent hardness (½ mark)

(b) Describe how water hardness can be removed using an ion exchange resin. (1½ marks)

12. Products of electrolysis at the electrodes for aqueous solutions depend on three factors. Two of these factors are concentration of electrolyte and nature of electrode.

(a) State another factor that affects the products of electrolysis. (1 mark)

.....

(b) Complete **Table 3** to show products of electrolysis for dilute calcium chloride and concentrated calcium chloride at the anode and cathode.

Table 3

Electrolyte	Anode	Cathode
Dilute calcium chloride		
Concentrated calcium chloride		

(2 marks)

13. (a) Carbon exhibits different boiling points. Explain. (1 mark)

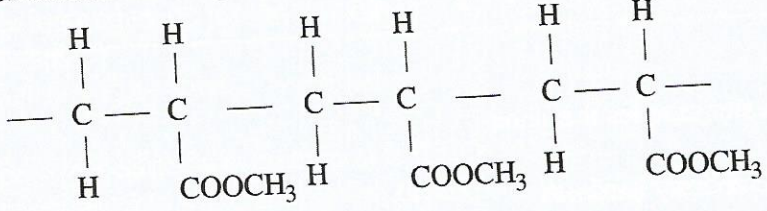
(b) It takes 44 seconds for nitrogen(IV) oxide gas to effuse through an opening. Calculate how long it will take for an equal volume of chlorine gas to effuse through the same opening (2 marks)
(N = 14.0; O = 16.0; Cl = 35.5).

14. (a) Give an example of a natural polymer made of:

(i) cellulose material (½ mark)

(ii) a hydrocarbon (½ mark)

(b) Part of the structure of perspex is:



(i) Draw the structure of the monomer of perspex. (1 mark)

(ii) Give **two** properties of perspex that make it suitable for use in making lenses. (1 mark)

15. Two allotropes of carbon are graphite and diamond.

(a) Explain why the density of diamond is higher than that of graphite. (1 mark)

(b) Give **one** use of each of the allotropes and relate the use to properties of the allotrope.

I. Graphite

use (½ mark)

property (½ mark)

II. Diamond

use (½ mark)

property (½ mark)

16. (a) The graph in **Figure 2** shows radioactive decay curve of a radioactive isotope.

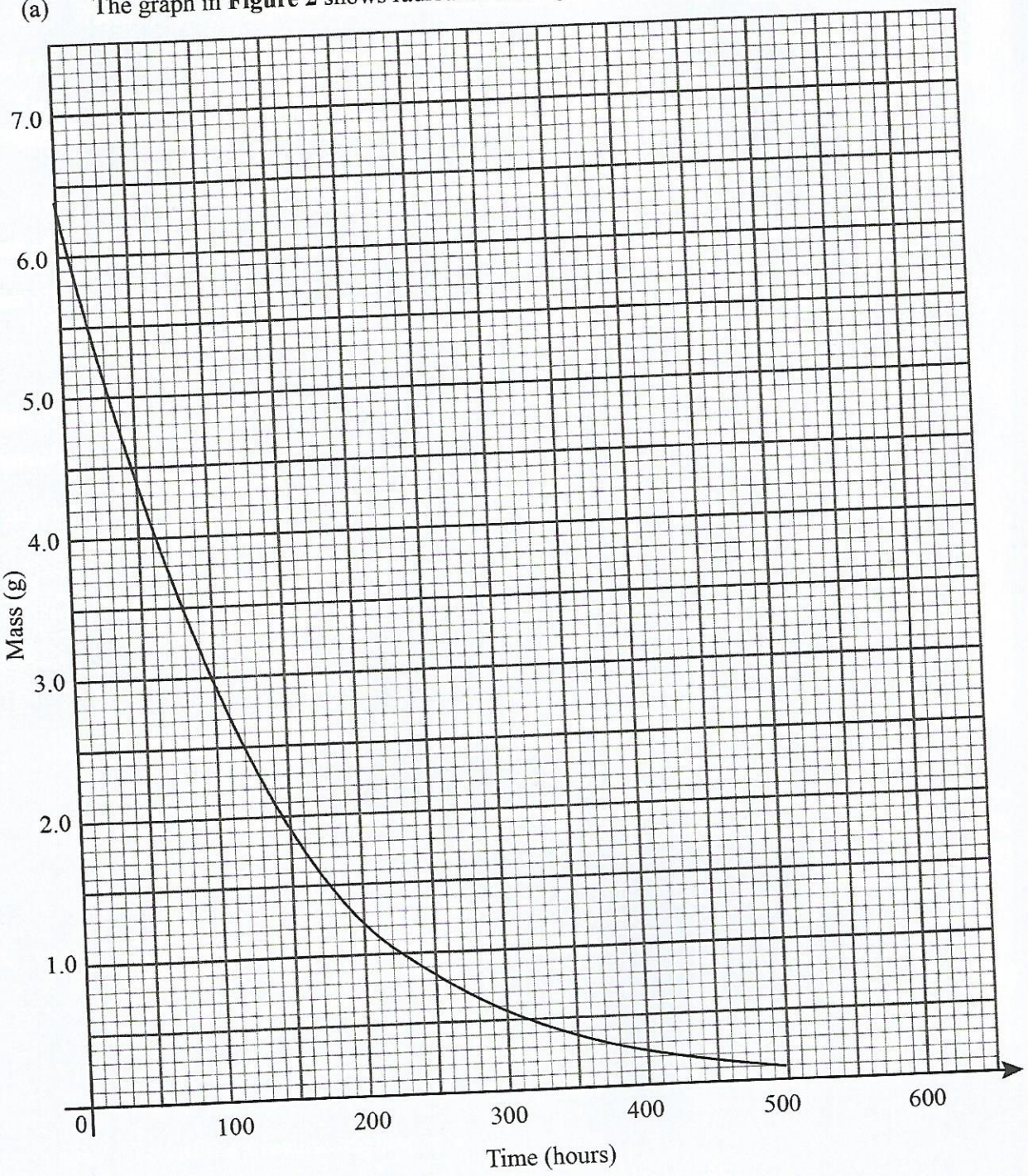


Figure 2

Use the graph to determine the:

(i) half life of the radioactive isotope (1 mark)

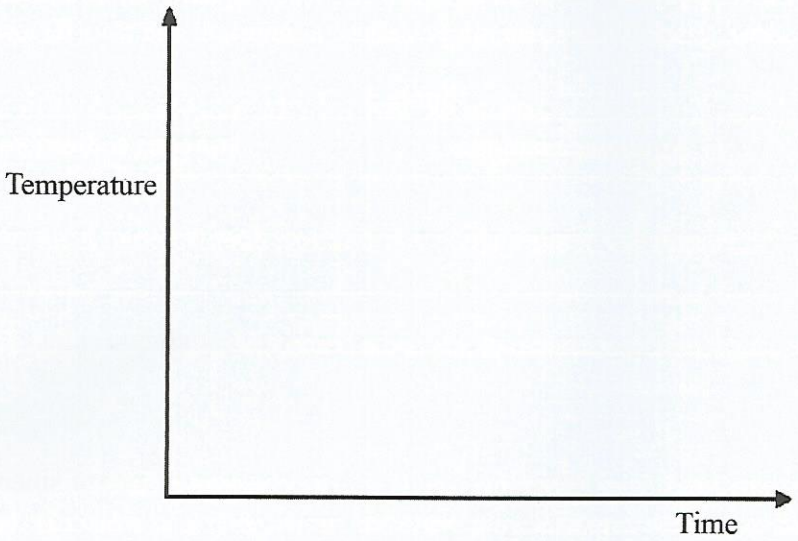
(ii) rate of decay at time 150 hours (1 mark)

(b) The half life of two radioactive isotopes **A** and **B** are 8 days and 5.2 years respectively. Given that both of them emit beta radiation, explain why **A** would be more suitable in the treatment of a disease. (1 mark)

17. The formula of a hydrated salt of manganese is $MnSO_4 \cdot XH_2O$. Given that the salt contains 24.7% manganese, determine the value of **X**. (Mn = 55.0; S = 32.0; O = 16.0; H = 1.0) (3 marks)

18. Describe the correct procedure of heating a liquid in a test tube using a Bunsen burner. (3 marks)

19. The melting and boiling points of naphthalene are 80 °C and 218 °C, respectively. A sample of naphthalene was cooled from 250 °C to 25 °C. On the axes provided, sketch and label the cooling curve that would be obtained. (3 marks)



20. Draw a labelled diagram of a setup that can be used to prepare a dry sample of chlorine gas using potassium manganate(VII) and concentrated hydrochloric acid. (3 marks)

21. **Table 4** gives the boiling points of three liquids.

Table 4

Liquid	Boiling point (°C)
Hexane	68.7
Butanol	99.5
Water	100.0

Describe how the following mixtures can be separated:

(a) hexane and butanol (1½ marks)

(b) hexane and water (1½ marks)

22. Complete **Table 5** by writing the observations made when aqueous ammonia and aqueous sodium sulphate are added to solutions containing calcium, aluminium and iron(II) ions.

Table 5

Ions present	Aqueous ammonia	Aqueous sodium sulphate
Ca^{2+}		
Al^{3+}		
Fe^{2+}		

(3 marks)

23. (a) Iron is extracted from haematite ore. If the ore contains oxides of silicon and aluminium, explain how these impurities are removed. (2 marks)

(b) The extraction process of iron produces waste gases. State how these waste gases can be used to lower the operational cost of the extraction process. (1 mark)

24. When chlorine is bubbled into a sample of water, the solution smells strongly of chlorine. If aqueous sodium hydroxide is added to the solution, the smell of chlorine disappears:

The following equation shows the reaction that occurs.

$$Cl_2(g) + H_2O(l) \rightleftharpoons HCl(aq) + HOCl(aq)$$

With reference to the equation for the reaction, explain why the:

(a) solution smells strongly of chlorine (1 mark)

(b) addition of sodium hydroxide removes the smell (2 marks)

25. **Figure 3** shows how nitric(V) acid can be obtained.

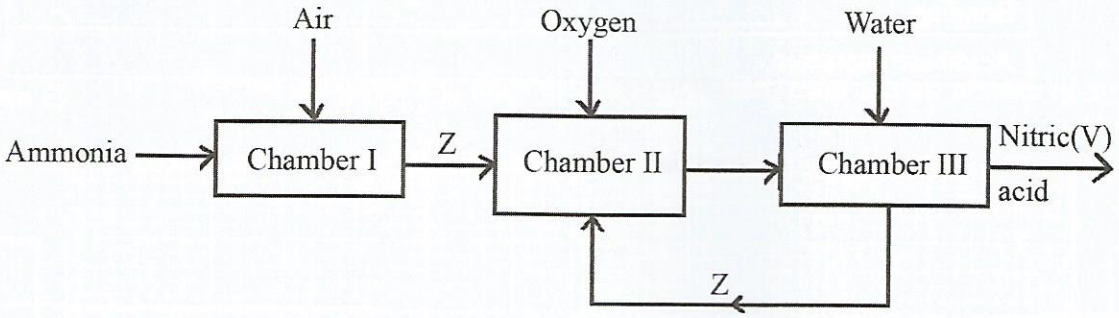


Figure 3

(a) Identify the chamber in which a catalyst is used. (1 mark)

(b) Name substance **Z**. (1 mark)

(c) Write an equation for the reaction that takes place in Chamber **III**. (1 mark)

26. The formula of the complex ion formed when aqueous zinc sulphate reacts with aqueous sodium hydroxide is given as:

$$[Zn(OH)_4]^x$$

Explain how the value of **x** is determined. (2 marks)

27. Copper can be obtained from copper(II) oxide using carbon(II) oxide or coke.

(a) Name another reagent that can be used to obtain copper from copper(II) oxide. (1 mark)

(b) The equation for the reaction with carbon(II) oxide is:

$$CuO(s) + CO(g) \rightarrow Cu(s) + CO_2(g)$$

Calculate the maximum mass of copper that would be obtained using 200 dm^3 of carbon(II) oxide (Cu = 63.5; Molar volume of gas = 24.0 dm^3). (2 marks)