IB · DP · Chemistry

50 mins 6 questions

Practice Paper 2

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Total Marks **/50**

1 (a) In a firework, solid potassium nitrate, KNO_3, decomposes to form solid potassium nitrite, KNO_2, and oxygen, O_2.

(i) Write a balanced symbol equation for this reaction.

(ii) Use section 6 of the data booklet to calculate the amount, in g, of potassium nitrate, KNO_3, required to make 1.5 g of oxygen. Give your answer to 2 significant figures.

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(4 marks)

(b) Use section 2 of the data booklet to calculate the volume of gas at STP, in dm^3, that is produced in the reaction outlined in part (a). Give your answer to 2 significant figures.

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(1 mark)

(c) Potassium can form a superoxide, KO_2 (s), which will react with carbon dioxide, CO_2 (g), to produce potassium carbonate, K_2CO_3 (s) and oxygen, O_2 (g), as shown in the equation below.

$$4KO_2\,(s) + 2CO_2\,(g) \rightarrow 2K_2CO_3\,(s) + 3O_2\,(g)$$

(i) Calculate the amount, in moles, of 5.00 g of potassium superoxide. Give your answer to 3 significant figures

(ii) Calculate the amount, in moles, and therefore volume, in dm^3, of carbon dioxide which will react with the superoxide. Give your answer to 3 significant figures.

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(3 marks)

(d) A student calculated that 4.86 g of potassium carbonate, KCO_3, should be produced during the reaction outlined in part (c), 2.61 g of potassium carbonate, KCO_3, was produced when the experiment was carried out. Calculate the percentage yield for the production of potassium carbonate. Give your answer to 2 decimal places.

(1 mark)

2 (a) Ammonia gas can be synthesized by the direct combination of nitrogen gas and hydrogen gas. When the two gases are reacted together in a sealed container the following equilibrium reaction takes place:

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g) \qquad \Delta H = -92.6\ kJ$$

Describe two characteristics of a reaction in a state of *dynamic equilibrium*.

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(2 marks)

(b) Write the equilibrium constant expression, K_c, for the reaction in part (a).

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(1 mark)

(c) Explain, with a reason, how each of the following changes can affect the position of equilibrium in part (a).

i) The volume of the container is increased.

ii) Ammonia is removed from the container.

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(4 marks)

(d) Ammonia is manufactured industrially by the Haber process in which iron is used as a catalyst. Explain the effect of a catalyst on the position of equilibrium and the value of K_c.

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(1 mark)

3 (a) Molten potassium bromide can be electrolysed using graphite electrodes.

i) Draw the essential components of this electrolytic cell.

[3]

ii) Identify the products at each electrode.

[2]

(5 marks)

(b) State the half equations for the oxidation and reduction processes and deduce the overall cell reaction, including state symbols.

Oxidation half equation .....

Reduction half equation .....

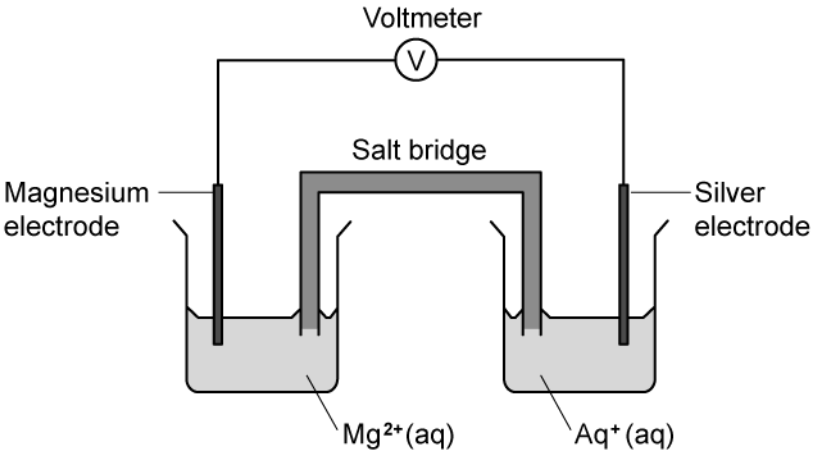
Overall equation .....

(3 marks)

(c) Explain why solid potassium bromide does not conduct electricity.

(1 mark)

(d) A voltaic cell is made from a half-cell containing a magnesium electrode in a solution of magnesium nitrate and a half-cell containing a silver electrode in a solution of silver(I) nitrate.



i) Use section 25 of the data booklet to determine which electrode is positive and to write the equation for the reaction at the positive electrode, including state symbols.

[1]

ii) Compare the processes at the positive electrodes in voltaic and electrolytic cells.

[2]

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(3 marks)

4 (a) Organic compounds are classified into families called a *homologous series*.

State three features of members belonging to the same *homologous series*.

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(3 marks)

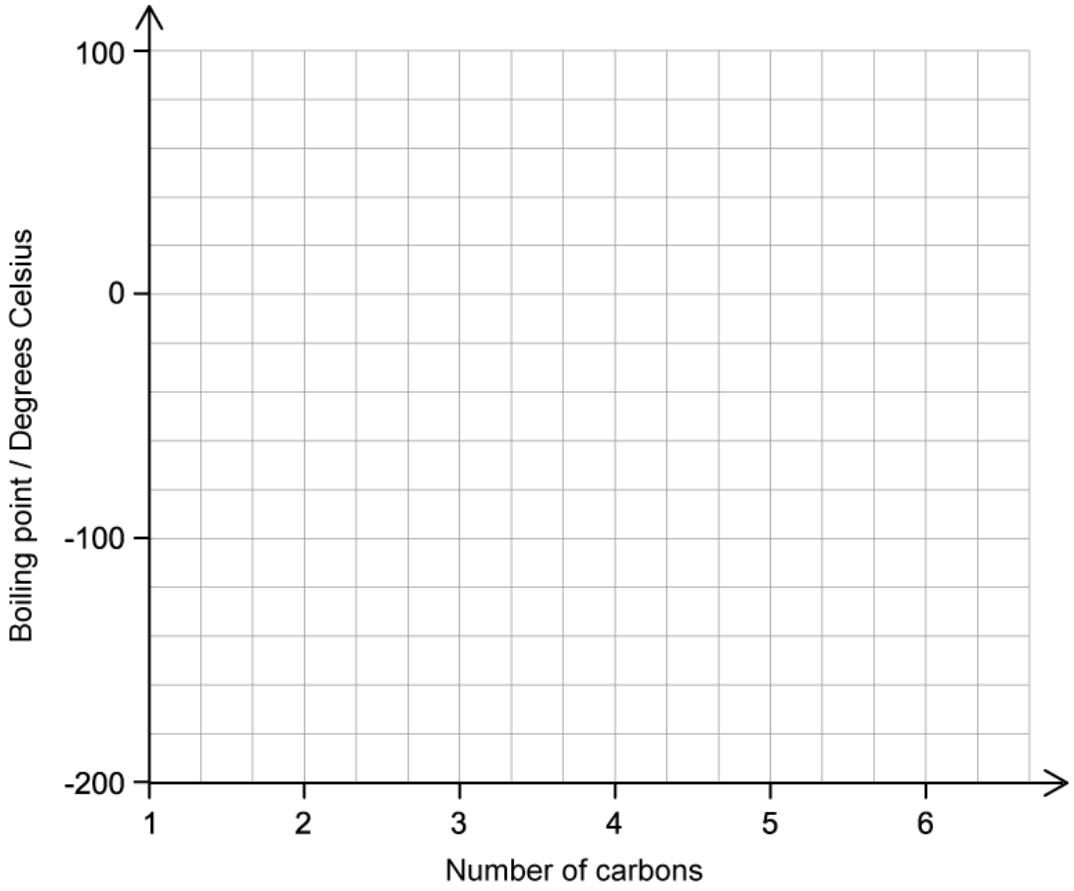
(b) **Table 1** shows the boiling points of the first five members of the alkane family.

Table 1

Alkane	Boiling point/ ^{o}C
methane	-162
ethane	-89
propane	-42
butane	-1
pentane	36

On the axes below in **Figure 1,** draw a graph of boiling point against the number of carbon atoms in the alkanes. Estimate the boiling point of the next member of the homologous series, hexane, C_6H_{14}, and show on your graph how you arrived at your estimated boiling point.

Figure 1



Estimated boiling point of hexane : _____ ^{o}C

(4 marks)

(c) State the general formula for an alkyne and give the molecular formula and name of the fifth member of the alkyne family.

(2 marks)

5 (a) Outline the difference between *quantitative* and *qualitative* data.

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(1 mark)

(b) A student uses a thermometer to measure the temperature of a beaker of water, before and after heating. The smallest thermometer division is 1.0 ^{o}C. The initial temperature of the water is 23.0 ^{o}C.

How should the temperature change be recorded?

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(1 mark)

(c) This question is about precision.

i) Explain what is meant by the term *precision* in recorded data.

[1]

ii) The table shows a set of titration results:

Initial burette reading/ $\pm$ 0.05 cm^3	0.00
Final burette reading/ $\pm$ 0.05 cm^3	23.40
Volume delivered/ cm^3	

How should the volume delivered be recorded?

[1]

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(2 marks)

6 (a) Draw the structure of silicon dioxide and state the type of bonding present.

(2 marks)

(b) The boiling point of diamond is 3550 ℃, but for carbon dioxide it is -78.5 ℃. Both are covalent substances.

Explain this difference with reference to structure and bonding.

(4 marks)

(c) Silicon dioxide has a similar name to carbon dioxide, but its boiling point is 2230 ℃.

Briefly outline the reason for this difference.

(2 marks)