Q1. Hydrogen peroxide is sold commercially as an aqueous solution containing approximately 60 g dm^{-3} of hydrogen peroxide.

(a) Use data from the Periodic Table to calculate the M_r of hydrogen peroxide. Give your answer to the appropriate precision.

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(1)

(b) Calculate the concentration, in mol dm^{-3}, of a solution containing 60.0 g dm^{-3} of hydrogen peroxide.

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(1)

(c) The concentration of hydrogen peroxide in a hair bleach is 0.050 mol dm^{-3}. Use your answer from (b) to calculate the dilution factor needed to make the commercial hydrogen peroxide solution suitable for use in this hair bleach. Show your working.

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(2)

(Total 4 marks)

Q2. A mass spectrometer can be used to investigate the isotopes in an element.

(a) Define the term *relative atomic mass* of an element.

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(2)

(b) Element **X** has a relative atomic mass of 47.9

Identify the block in the Periodic Table to which element **X** belongs and give the electron configuration of an atom of element **X**.

Calculate the number of neutrons in the isotope of **X** which has a mass number 49

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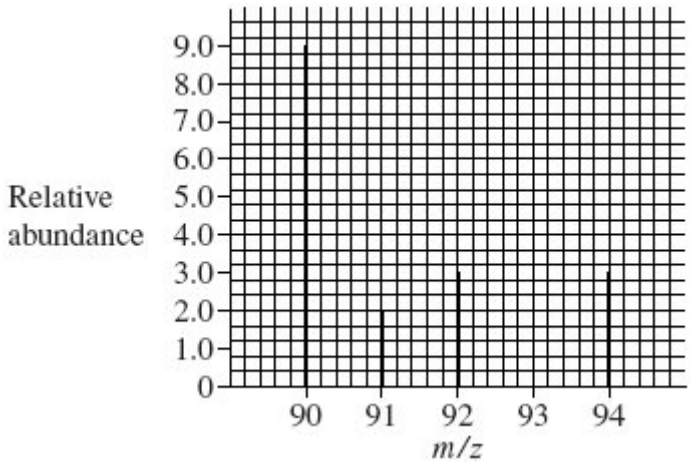
(3)

(c) The mass spectrum of element **Z** is shown below.

Use this spectrum to calculate the relative atomic mass of **Z**, giving your answer to one decimal place.

Identify element **Z**.



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(4)

(d) State how vaporised atoms of **Z** are converted into $\mathbf{Z}^+$ ions in a mass spectrometer.

State and explain which of the $\mathbf{Z}^+$ ions formed from the isotopes of **Z** in part (c) will be deflected the most in a mass spectrometer.

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(4)

(e) Explain briefly how the relative abundance of an ion is measured in a mass spectrometer.

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(2)
(Total 15 marks)

Q3. The reaction of bromine with ethane is similar to that of chlorine with ethane. Three steps in the bromination of ethane are shown below.

Step **1** $Br_2 \longrightarrow 2Br^{\bullet}$

Step **2** $Br^{\bullet} + CH_3CH_3 \longrightarrow CH_3CH_2^{\bullet} + HBr$

Step **3** $CH_3CH_2^{\bullet} + Br_2 \longrightarrow CH_3CH_2Br + Br^{\bullet}$

(a) (i) Name this type of mechanism.

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(ii) Suggest an essential condition for this reaction.

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(iii) Steps **2** and **3** are of the same type. Name this type of step.

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(iv) In this mechanism, another type of step occurs in which free-radicals combine. Name this type of step. Write an equation to illustrate this step.

Type of step .....

Equation.....

(5)

(b) Further substitution in the reaction of bromine with ethane produces a mixture of liquid organic compounds.

(i) Name a technique which could be used to separate the different compounds in this mixture.

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(ii) Write an equation for the reaction between bromine and ethane which produces hexabromoethane, C_2Br_6, by this substitution reaction.

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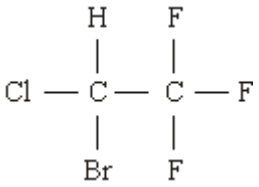
(2)

(c) The compound 1,2-dibromo-1,1,2,2-tetrafluoroethane is used in some fire

extinguishers. Draw the structure of this compound.

(1)

(d) Halothane is used as an anaesthetic and has the following structure.



(i) Give the systematic name of *halothane*.

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(ii) Calculate the M_r of halothane.

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(iii) Calculate the percentage by mass of fluorine in halothane.

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(3)
(Total 11 marks)

Q4. (a) (i) Define the term *relative atomic mass* (A_r) of an element.

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(2)

(ii) A sample of the metal silver has the relative atomic mass of 107.9 and exists as two isotopes. In this sample, 54.0% of the silver atoms are one isotope with a relative mass of 107.1

Calculate the relative mass of the other silver isotope.

State why the isotopes of silver have identical chemical properties.

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(4)

(b) The isotopes of silver, when vaporised, can be separated in a mass spectrometer.

Name the **three** processes that occur in a mass spectrometer before the vaporised isotopes can be detected.

State how each process is achieved.

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(6)

(c) State the type of bonding involved in silver.

Draw a diagram to show how the particles are arranged in a silver lattice and show the charges on the particles.

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(3)

(d) Silver reacts with fluorine to form silver fluoride (AgF).

Silver fluoride has a high melting point and has a structure similar to that of sodium chloride.

State the type of bonding involved in silver fluoride.

Draw a diagram to show how the particles are arranged in a silver fluoride lattice and show the charges on the particles.

Explain why the melting point of silver fluoride is high.

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(5)
(Total 20 marks)