PEARSON EDEXCEL IGCSE CHEMISTRY · 4CH1

CHEMISTRY



EXAM QUESTION PACK

SECTION 1: PRINCIPLES OF CHEMISTRY (PACK 2)

SCORE	PERCENTAGE
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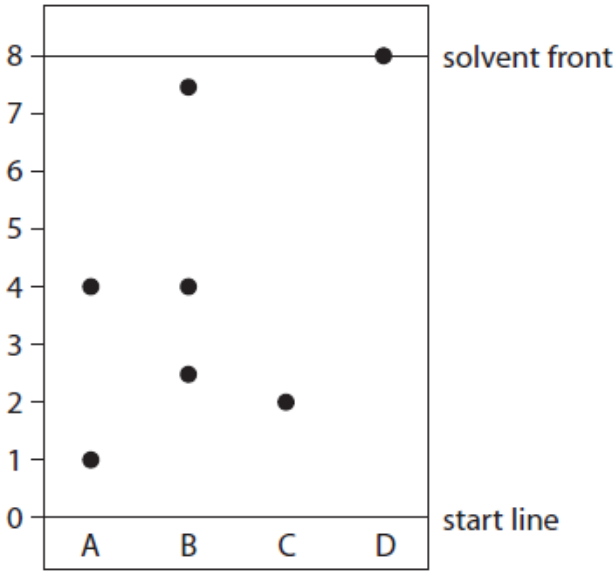
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Q1.

The diagram shows a chromatogram of the food dyes in four different food colourings, A, B, C and D.



(a) (i) Give the letter of the food colouring that contains three different food dyes.

(1)

.....

(ii) Give the letters of the two food colourings that contain the same dye.

(1)

.....

(iii) Using the scale on the diagram, determine the R_f value of the dye in food colouring C.

(2)

R_f = ...

(iv) Give a reason why the dye in food colouring D moves the furthest from the start line.

(1)

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(b) Describe how a student could obtain a chromatogram similar to the one shown in the diagram.

(4)

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(Total for question = 9 marks)

Q2.

This question is about acids, alkalis and indicators.

(a) Which of these is the colour of litmus indicator in an acidic solution?

(1)

☒ **A** blue

☒ **B** orange

☒ **C** red

☒ **D** yellow

(b) Which of these is the pH value of a neutral solution?

(1)

☒ **A** 0

☒ **B** 4

☒ **C** 7

☒

D 14

(c) Which of these describes a solution with a pH value of 9?

(1)

☒ **A** strongly acidic

☒ **B** strongly alkaline

☒ **C** weakly acidic

☒ **D** weakly alkaline

(d) Which of these is the chemical formula of an acid?

(1)

☒ **A** HNO_3

☒ **B** H_2O

☒ **C** NaCl

☒ **D** NaOH

(e) Name the type of reaction that occurs when an acid reacts with an alkali.

(1)

.....

(f) Name the two products of the reaction between hydrochloric acid and potassium hydroxide.

(2)

1 .....

2 .....

(Total for question = 7 marks)

Q3.

This question is about alkanes and alkenes.

(a) (i) Complete the boxes by giving the missing information about the alkane with the molecular formula C_2H_6

(3)

molecular formula	C_2H_6
name	
empirical formula	
displayed formula	

(ii) Complete the chemical equation for the complete combustion of the alkane C_2H_6

(1)

.....C_2H_6 + ...O_2 → .....CO_2 + ...H_2O

(iii) Incomplete combustion occurs when the air supply is limited.

Give the names of two products of incomplete combustion.

(2)

1 .....

2 .....

(b) An alkene with molecular formula C_4H_8 reacts with bromine to form a compound with molecular formula $C_4H_8Br_2$

(i) What is the name of this type of reaction?

(1)

☒ **A** addition

☒ **B** decomposition

☒ **C** precipitation

☒ **D** substitution

(ii) Draw displayed formulae for two different alkenes with the molecular formula C_4H_8

(2)

alkene 1	alkene 2

(iii) State the term used for compounds with the same molecular formula but different structural formulae.

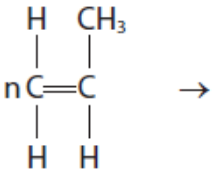
(1)

.....

(c) The alkene C_3H_6 can be polymerised to form the polymer poly(propene).

(i) Complete the equation for this polymerisation reaction.

(2)



(ii) Two ways of disposing of polymers such as poly(propene) are

- burying them in landfill sites
- burning them to release heat energy

Discuss the environmental problems caused by these two methods of disposal.

(3)

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(Total for question = 15 marks)

Q4.

This question is about alkanes and alkenes.

(a) The alkane C_5H_{12} has three isomers.

(i) State what is meant by the term **isomers**.

(2)

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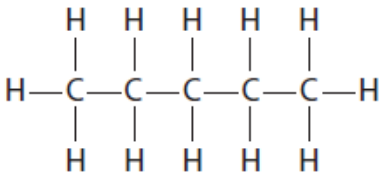
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(ii) Calculate the relative formula mass (M_r) of C_5H_{12}

(1)

M_r of C_5H_{12} = ...

(iii) This is the displayed formula of one of the isomers.



Give the name of this isomer.

(1)

.....

(iv) Draw the displayed formulae of the other two isomers.

(2)

Isomer 1	Isomer 2

(b) Ethane (C_2H_6) and ethene (C_2H_4) both react with bromine.

Describe the differences in the reactions of ethane and ethene with bromine.

Refer to the conditions, the products and the types of reaction involved.

(5)

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(Total for question = 11 marks)

Q5.

Crude oil is a mixture of organic compounds.

Most of these compounds are members of the same homologous series.

(a) State the name of this homologous series.

(1)

.....

(b) An industrial process is used to separate crude oil into fractions.

(i) The process depends on a difference in a property of the fractions.

What is this property?

(1)

☒ **A** boiling point

☒ **B** density

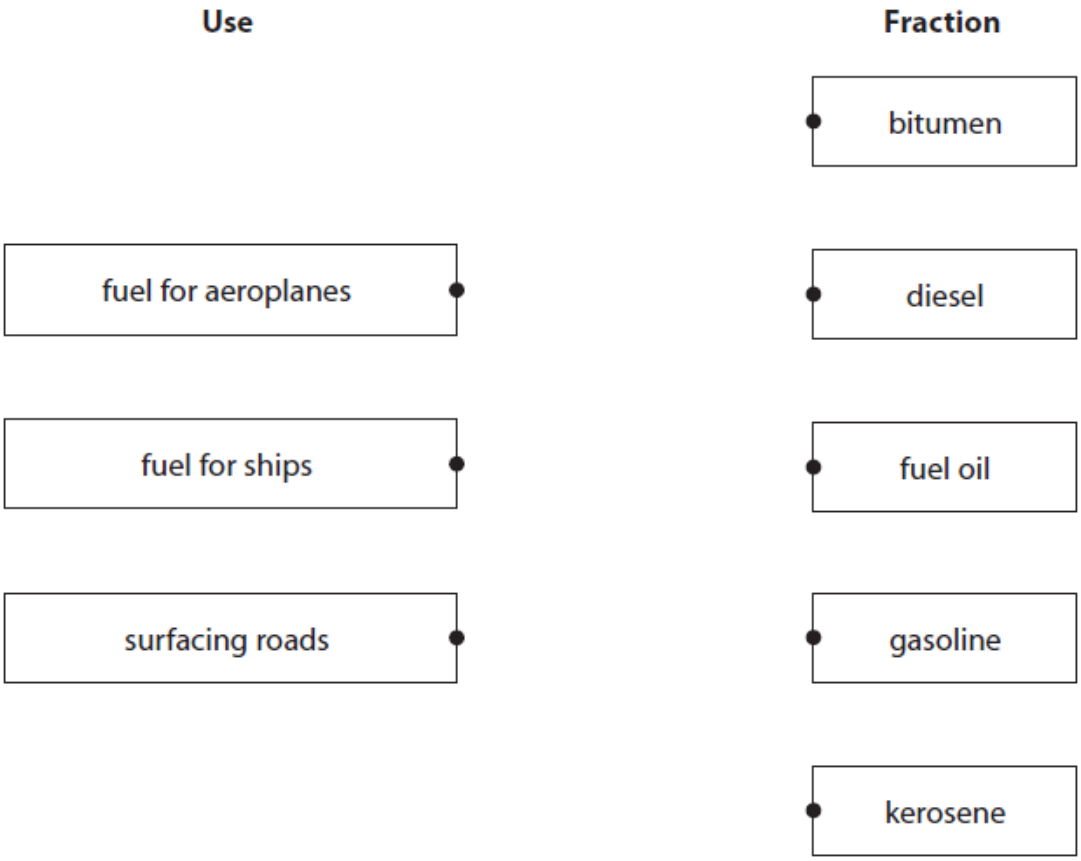
☒ **C** melting point

☒ **D** solubility

(ii) The boxes give some uses of fractions and some names of fractions.

Draw one straight line from each use to its correct fraction.

(3)



(c) Fuels obtained from the fractions may contain impurities.

Explain how the combustion of a common impurity in fuels may cause an environmental problem.

(3)

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(d) Some of the fractions contain long-chain molecules which are not very useful.

(i) Give the name of the process used to convert long-chain molecules into more useful shorter-chain molecules.

(1)

.....

(ii) Give the catalyst and temperature used in the industrial process to convert long-chain molecules into
shorter-chain molecules.

(2)

catalyst .....

temperature. .....

(iii) When $C_{13}H_{28}$ is used in this process, three different molecules are formed.

Complete the equation for this reaction.

(2)

$$C_{13}H_{28} \rightarrow C_8H_{18} + \text{.....} + \text{.....}$$

(Total for question = 13 marks)

Q6.

(a) An alkane has the molecular formula C_3H_8

(i) Give the name of this alkane.

(1)

.....

(ii) Draw the displayed formula of this alkane.

(1)

(iii) Give the general formula for the alkanes.

(1)

.....

(b) The alkanes C_2H_6 and C_4H_{10} contain covalent bonds and have simple molecular structures.

(i) State what is meant by the term **covalent bond**.

(1)

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(ii) Explain why C_4H_{10} has a higher boiling point than C_2H_6

(3)

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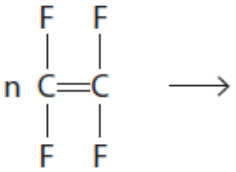
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(c) The organic compound tetrafluoroethene (C_2F_4) can be polymerised to form poly(tetrafluoroethene).

(i) Complete the equation for this polymerisation reaction.

(2)



(ii) Poly(tetrafluoroethene) is used as a coating on non-stick frying pans.

The C—F covalent bonds in poly(tetrafluoroethene) are very strong.

Suggest a reason why poly(tetrafluoroethene) is suitable as a coating on non-stick frying pans.

(1)

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(Total for question = 10 marks)

Q7.

This question is about alkenes and alkanes.

(a) Complete the table by giving the missing information about the alkene with the molecular formula C_3H_6

(4)

Molecular formula	C_3H_6
Name	
Empirical formula	
General formula	
Displayed formula	

(b) Alkenes are unsaturated compounds.

(i) State what is meant by the term **unsaturated**.

(1)

.....

.....

(ii) Describe a test to show that a compound is unsaturated.

(2)

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(c) When the alkane methane reacts with chlorine, the products are chloromethane (CH_3Cl) and hydrogen chloride gas.

(i) Give a chemical equation for this reaction.

(1)

.....

(ii) What is the name of this type of reaction?

(1)

☒ **A** addition

☒ **B** decomposition

☒ **C** neutralisation

☒ **D** substitution

(iii) State the condition needed for this reaction to occur.

(1)

.....

(d) When ethane reacts with chlorine, one of the products of the reaction has the formula $C_2H_4Cl_2$

There are two isomers with this formula.

(i) State what is meant by the term **isomers**.

(2)

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.....

(ii) Draw the displayed formulae of the two isomers with the formula $C_2H_4Cl_2$

(2)

isomer 1	isomer 2

(Total for question = 14 marks)

Q8.

This question is about ammonia and ammonium compounds.

(a) Ammonia (NH_3) is a simple covalent molecule.

Draw a dot-and-cross diagram to show the bonding in a molecule of ammonia.

(2)

(b) The table shows the names and formulae of some ammonium compounds.

Name	ammonium sulfate		ammonium carbonate
Formula	$(NH_4)_2SO_4$	NH_4Cl	

(i) Complete the table by giving the missing information.

(2)

(ii) When ammonia reacts with sulfuric acid, ammonium sulfate is formed.

Write a chemical equation for this reaction.

(1)

.....

(iii) Describe a test for ammonium ions.

(3)

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(c) The table gives some information about ammonia and ammonium compounds.

Name	Formula	Percentage of nitrogen (%)	Approximate pH in solution
ammonia	$NH_3(g)$	82	11
ammonium nitrate	$NH_4NO_3(s)$		5.5
ammonium sulfate	$(NH_4)_2SO_4(s)$	21	5.5

(i) Calculate the percentage of nitrogen in ammonium nitrate.

[M_r of NH_4NO_3 = 80]

(2)

percentage of nitrogen = ... %

(ii) Fertilisers add nitrogen to the soil to help plants grow.

Ammonia and ammonium sulfate can both be used as fertilisers.

Discuss the advantages and disadvantages of using each of these compounds as fertilisers.

Use information from the table in your answer.

[pH of rainwater is approximately 5.6]

(4)

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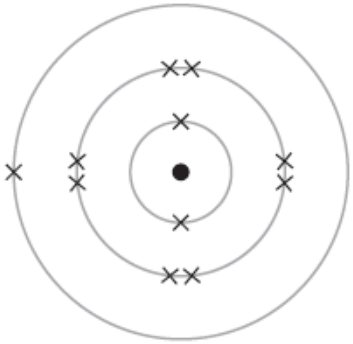
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(Total for question = 14 marks)

Q9.

The diagram shows the electronic configuration of an atom of an element.



(a) Name the part of the atom that contains the protons and neutrons.

(1)

.....

(b) Give the number of protons in this atom.

(1)

.....

(c) Give the number of the group that contains this element.

(1)

.....

(d) Give the number of the period that contains this element.

(1)

.....

(e) Give the charge on the ion formed from this atom.

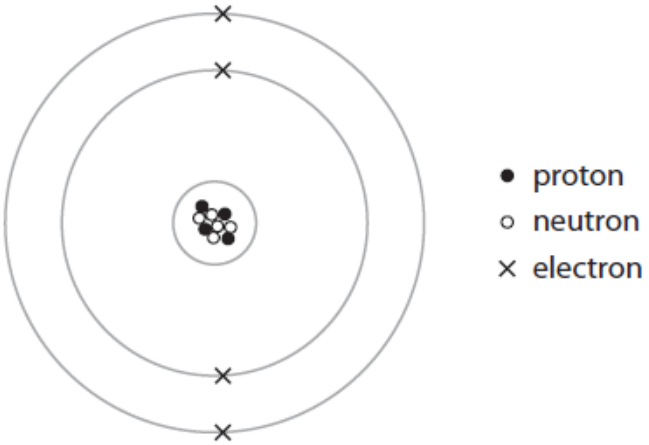
(1)

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(Total for question = 5 marks)

Q10.

(a) The diagram represents an atom of an element.



Use numbers from the box to complete the table.

You may use each number once, more than once or not at all.

2	4	5	9	10

(4)

Atomic number of this atom	
Mass number of this atom	
Period number of this element	
Number of electrons in the 2+ ion formed from this atom	

(b) In terms of sub-atomic particles, state a similarity and a difference for isotopes of the same element.

(2)

similarity

.....

.....

difference

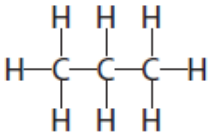
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(Total for question = 6 marks)

Q11.

The table shows the formulae of six organic compounds, **A**, **B**, **C**, **D**, **E** and **F**.

A	B	C
CH_4	C_2H_4	C_2H_6
D	**E**	**F**
	$CH_2{=}CH{-}CH_3$	C_4H_{10}

(a) State why each of these compounds is a hydrocarbon.

(2)

.....

.....

(b) State why the formula given for **D** is called a displayed formula.

(1)

.....

.....

(c) Give the letters that represent the four compounds with the general formula C_nH_{2n+2}

(1)

.....

(d) Many of the compounds in the table are found in a fuel called shale gas.

Shale gas contains many different compounds, including methane, propane and hydrogen

sulfide (H_2S).

(i) Complete the equation to show the complete combustion of propane.

(2)

$$C_3H_8 + 5O_2 \rightarrow \text{.....} + \text{.....}$$

(ii) When shale gas is burned, the hydrogen sulfide reacts with oxygen.

$$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$$

Explain how the combustion of shale gas can lead to the formation of acid rain.

(2)

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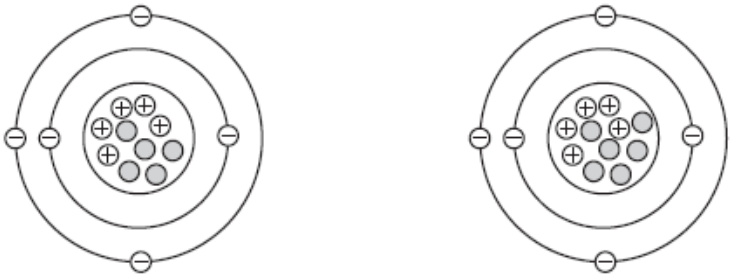
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(Total for question = 8 marks)

Q12.

The diagram shows the structures of two different atoms.



atom 1 **atom 2**

(a) State how the diagram shows that both of these atoms are neutral.

(1)

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(b) Explain how the diagram shows that these atoms are isotopes.

(2)

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(c) Complete the table to show the atomic number and mass number of atoms **1** and **2**.

(2)

	Atomic number	Mass number
atom 1	5	
atom 2		11

(d) The table shows the mass number and percentage of two different atoms of another element.

Mass number	Percentage of atom
6	7.0%
7	93.0%

Calculate the relative atomic mass (A_r) of this element.

Give your answer to one decimal place.

(2)

relative atomic mass = ...

(Total for question = 7 marks)

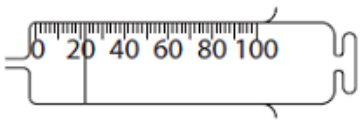
Q13.

This question is about apparatus used in the laboratory.

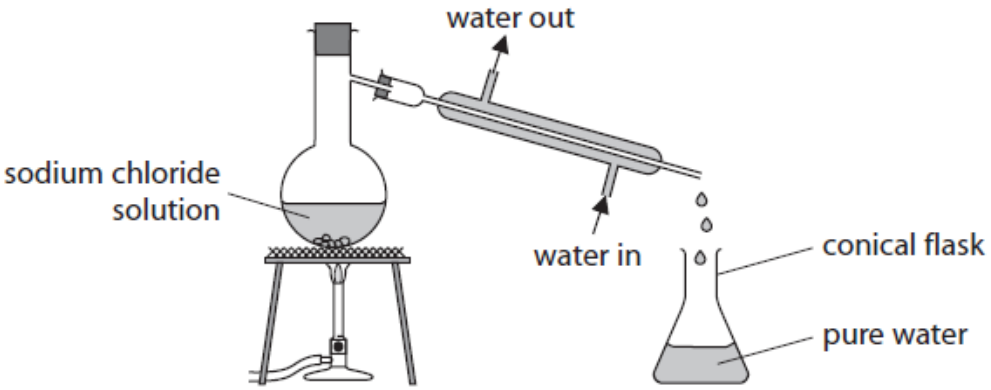
(a) Complete the table by giving the name of each piece of apparatus and a unit used for the

quantity it measures.

(2)

Apparatus	Name	Unit
		
		

(b) The diagram shows apparatus used to obtain pure water from sodium chloride solution by simple distillation.



(i) Explain why it is necessary for water to flow continuously in and out of the apparatus.

(2)

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(ii) Describe a chemical test to show that the sodium chloride solution contains chloride ions.

(2)

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(iii) Describe a physical test to show that the liquid in the conical flask is pure water.

(2)

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(Total for question = 8 marks)

Q14.

(a) State the meaning of the term **atomic number**.

(1)

.....

.....

(b) An atom of element X contains 14 protons, 14 electrons and 15 neutrons.

(i) Which of these is the mass number of this atom?

(1)

☒ **A** 14

☒ **B** 15

☒ **C** 28

☒ **D** 29

(ii) Explain which group of the Periodic Table element X belongs to.

(2)

.....

.....

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.....

(c) The table shows the composition of a sample of a different element, Y, containing three isotopes.

Mass number of isotope	Percentage of isotope in sample
32	95.0
33	0.75
34	4.25

Using information from the table, calculate the relative atomic mass (A_r) of this sample of element Y.

Give your answer to one decimal place.

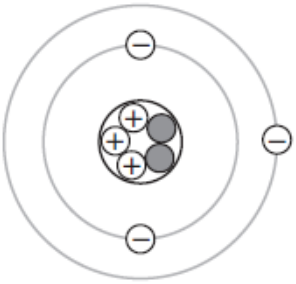
(3)

A_r = ...

(Total for question = 7 marks)

Q15.

The diagram shows the structure of an atom.



(a) Name the central part of an atom.

(1)

.....

(b) Name the positively charged particles in an atom.

(1)

.....

(c) State how the diagram shows that this atom is neutral.

(1)

.....

.....

(d) Give the mass number of this atom.

(1)

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(e) Give the name of the element containing this atom.
Use the Periodic Table to help you.

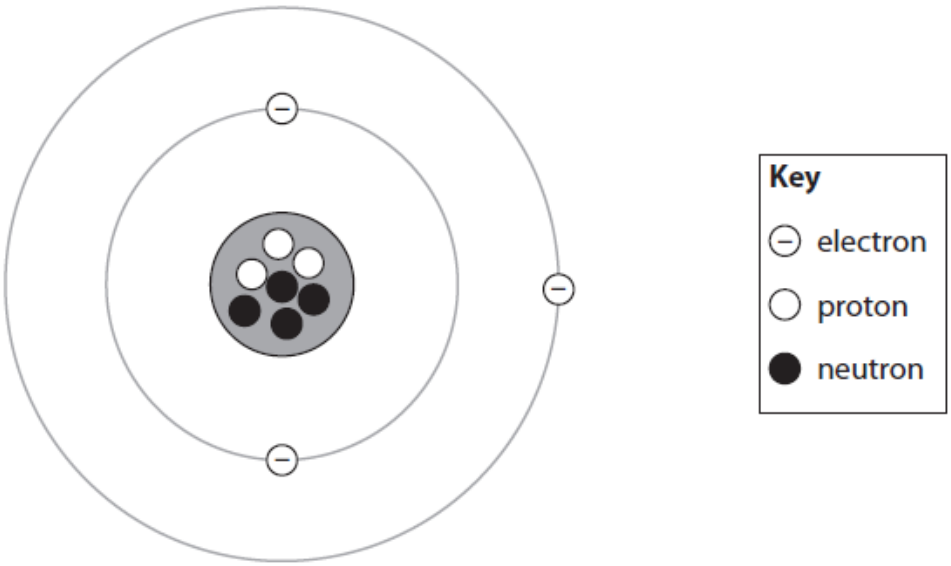
(1)

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(Total for question = 5 marks)

Q16.

The diagram represents an atom of an element.



(a) Use information from the diagram and the Periodic Table to answer these questions.

(i) Give the atomic number of the atom.

(1)

.....

(ii) Name the part of the atom that contains protons and neutrons.

(1)

.....

(iii) Give the group in the Periodic Table that contains this element.

(1)

.....

(iv) Give the period in the Periodic Table that contains this element.

(1)

.....

(v) Give the name of this element.

(1)

.....

(vi) Give the charge on the ion formed from this element.

(1)

.....

(b) A sample of the element contains two isotopes, X and Y.

(i) Explain what is meant by the term **isotopes**.

(2)

.....

.....

.....

.....

(ii) The table shows the mass number and percentage abundance of each isotope in this sample of the element.

Isotope	Mass number	Percentage abundance (%)
X	6	7.8
Y	7	92.2

Calculate the relative atomic mass (A_r) of the element.

(2)

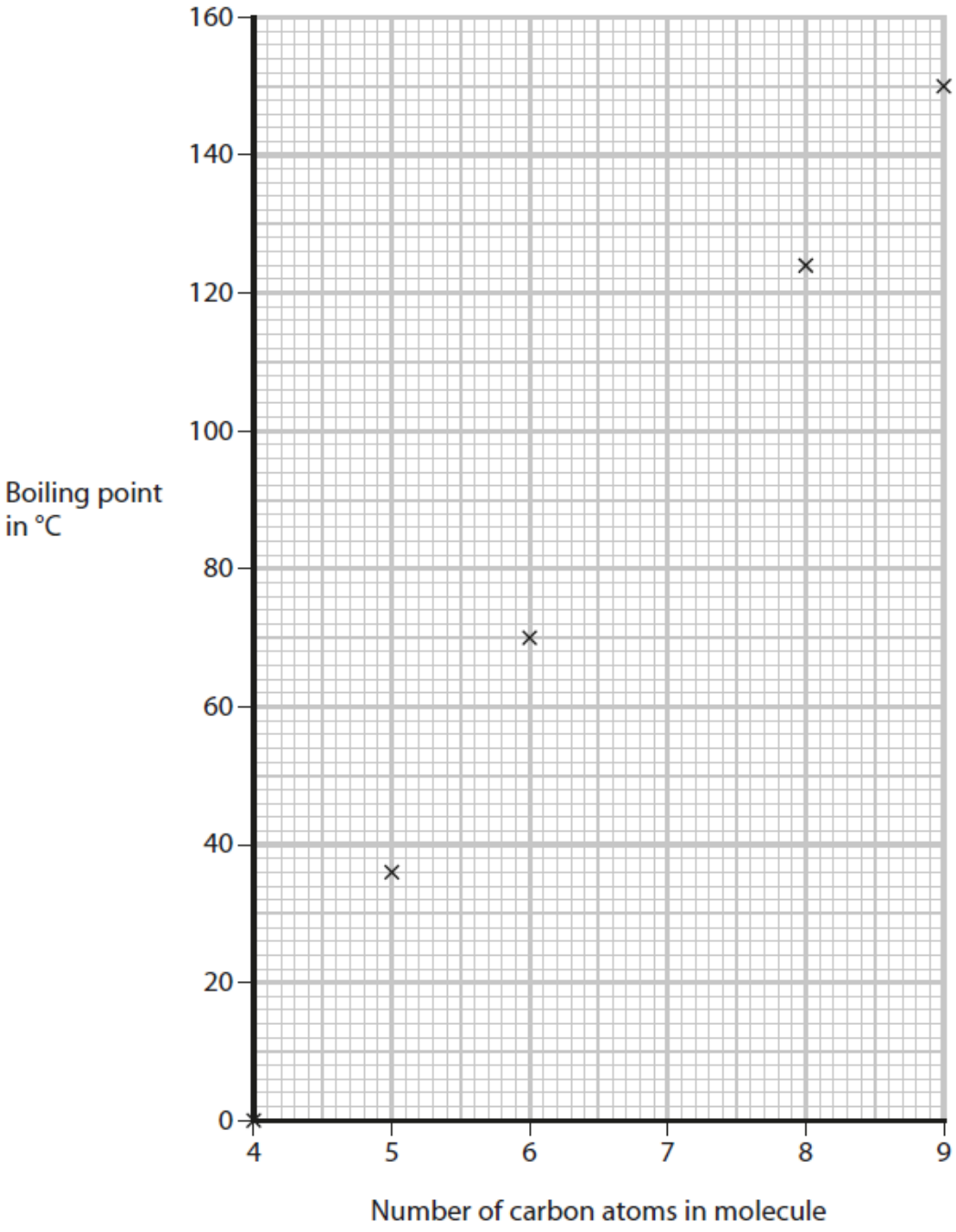
A_r = ...

(Total for question = 10 marks)

Q17.

This question is about alkanes.

(a) The graph shows the boiling points of several unbranched alkanes.



(i) Draw a curve of best fit.

(1)

(ii) Use the graph to find the boiling point of the alkane with 7 carbon atoms in its molecule.

Show on the graph how you obtain your answer.

(2)

boiling point = ... °C

(iii) Explain the trend shown by the graph.

(3)

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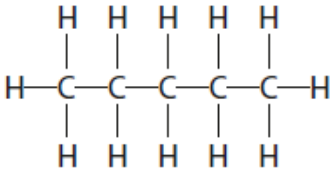
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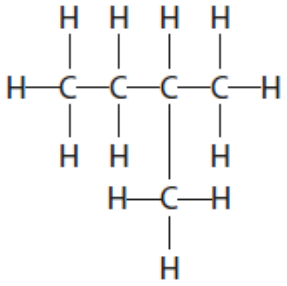
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(b) The diagram represents two isomers with the formula C_5H_{12}





Explain why these compounds are isomers.

(2)

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(c) (i) An alkane contains 82.8% carbon and 17.2% hydrogen by mass.

Show by calculation that the empirical formula of this alkane is C_2H_5

(2)

(ii) Deduce the molecular formula of this alkane.

(1)

.....

.....

(d) The equation for the complete combustion of one mole of an alkane can be represented by

$$\text{alkane} + ZO_2 \rightarrow XCO_2 + YH_2O$$

Complete combustion of one mole of the alkane produces 308 g of carbon dioxide and 144 g of water.

X, Y and Z are the numbers used to balance the equation.

Calculate the values of X, Y and Z.

[M_r of CO_2 = 44, M_r of H_2O = 18]

(3)

X = ...

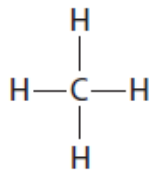
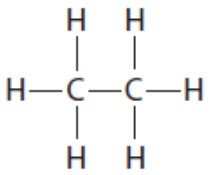
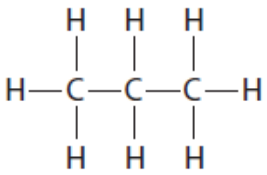
Y = ...

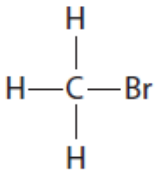
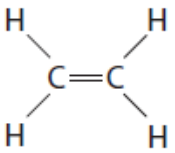
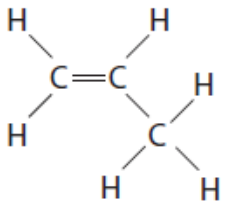
Z = ...

(Total for question = 14 marks)

Q18.

The boxes show the displayed formulae of six organic compounds, P, Q, R, S, T and U.

		
P	**Q**	**R**

		
S	**T**	**U**

(a) Use the letters P, Q, R, S, T and U to answer these questions.

Each letter may be used once, more than once or not at all.

(i) Give the letter of the compound that is **not** a hydrocarbon.

(1)

.....

(ii) Give the letters of the two compounds that have the same empirical formula.

(1)

.....

(iii) Give the letter of the compound that is used to manufacture poly(propene).

(1)

.....

(b) Describe a test that can be used to distinguish between compounds Q and T.

(3)

test

.....

.....

result with compound Q

.....

.....

result with compound T

.....

.....

(c) Compounds P, Q and R are members of the same homologous series.

Give two characteristics of a homologous series.

(2)

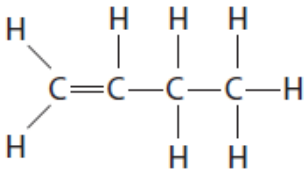
1 .....

.....

2 .....

.....

(d) This is the displayed formula of an alkene, V.



(i) Give the name of alkene V.

(1)

.....

(ii) Draw the displayed formula of another alkene that is an isomer of alkene V.

(1)

(e) An organic compound has the percentage composition by mass

C = 36.36% H = 6.06% F = 57.58%

(i) Show that the empirical formula of the compound is CH_2F

(2)

(ii) The relative molecular mass (M_r) of the compound is 66.

Determine the molecular formula of the compound.

(2)

molecular formula = ...

(Total for question = 14 marks)

Q19.

Halon 1301 is a compound used in some fire extinguishers.

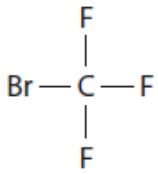
Halon 1301 has the percentage composition by mass of

C 8.05% Br 53.69% F 38.26%

(a) Show, by calculation, that the empirical formula of this compound is $CBrF_3$

(2)

(b) The diagram shows the displayed formula of a molecule of Halon 1301.



Draw a dot-and-cross diagram to show all the outer electrons in this molecule.

(2)

(c) The boiling point of Halon 1301 is −58 °C.

Explain why Halon 1301 has a low boiling point.

(2)

.....

.....

.....

.....

(Total for question = 6 marks)

Q20.

Nitric acid (HNO_3) is used in the production of fertilisers.

Nitric acid is manufactured in three stages.

Stage 1 ammonia reacts with oxygen in the presence of a platinum catalyst to produce nitrogen monoxide gas, NO, and water.

Stage 2 nitrogen monoxide gas reacts with more oxygen to produce nitrogen dioxide gas, NO_2.

Stage 3 nitrogen dioxide gas reacts with water to produce nitric acid and more nitrogen monoxide gas.

(a) (i) Complete the chemical equation for the reaction in stage 1.

(1)

..... NH_3 + ... O_2 $\rightleftharpoons$ ..... NO + ... H_2O

(ii) Give the meaning of the symbol $\rightleftharpoons$

(1)

.....

.....

(iii) State the purpose of the platinum catalyst.

(1)

.....

.....

(b) Give a chemical equation for the reaction of nitrogen monoxide and oxygen in stage 2.

(1)

.....

(c) (i) The equation for the reaction in stage 3 is

$$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$$

Calculate the maximum mass, in tonnes, of nitric acid that could be produced in this reaction from 11.5 tonnes of nitrogen dioxide.

[1 tonne = 1.0×10^6g]

(4)

mass of nitric acid = ... tonnes

(ii) Suggest what use can be made of the nitrogen monoxide gas formed in stage 3.

(1)

.....

.....

.....

(d) When copper(II) oxide reacts with dilute nitric acid, copper(II) nitrate is produced.

The equation for the reaction is

$$CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$$

0.200 mol of nitric acid reacts with excess copper(II) oxide.

A mass of 15.3 g of copper(II) nitrate is produced.

Calculate the percentage yield of copper(II) nitrate.

[M_r of copper(II) nitrate = 187.5]

(3)

percentage yield = ... %

(Total for question = 12 marks)