Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Chemistry

Paper 2

Higher Tier

Sample Assessment Materials for first teaching September 2016	Paper Reference
Time: 1 hour 45 minutes	**1CH0/2H**

You must have:
a calculator
a ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 This question is about changes to the Earth's atmosphere.

(a) Which of the following is a correct statement about the relative amounts of carbon dioxide and oxygen in the Earth's early atmosphere?

(1)

☒ **A** large amount of carbon dioxide and large amount of oxygen

☒ **B** large amount of carbon dioxide and small amount of oxygen

☒ **C** small amount of carbon dioxide and large amount of oxygen

☒ **D** small amount of carbon dioxide and small amount of oxygen

(b) Several processes change the composition of the Earth's atmosphere.

Describe how the composition of the atmosphere is affected by burning fossil fuels.

(2)

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(c) The graphs in Figure 1 and Figure 2 show the concentration of carbon dioxide in the atmosphere and the mean global temperature between 1960 and 2000.

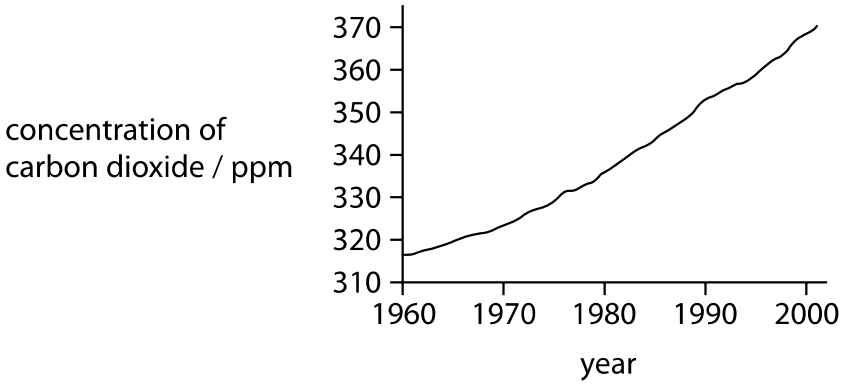

Figure 1

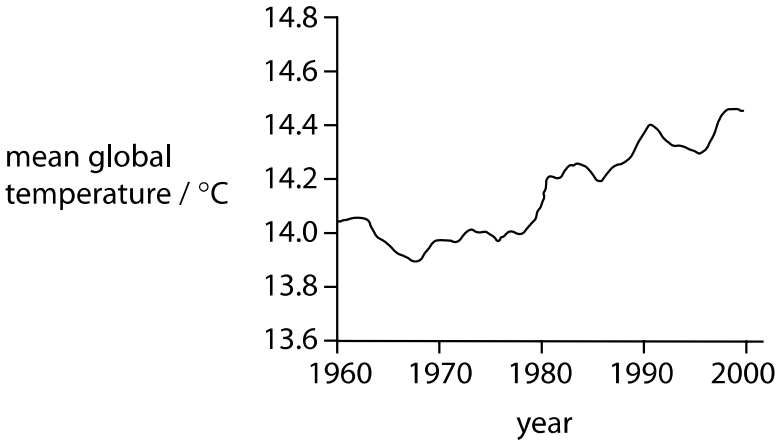

Figure 2

Explain whether these graphs provide evidence that an increase in carbon dioxide is causing the Earth's temperature to rise.

(2)

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.....

(d) Which of these pairs of gases are both greenhouse gases?

(1)

☒ **A** nitrogen and methane

☒ **B** nitrogen and oxygen

☒ **C** oxygen and water vapour

☒ **D** water vapour and methane

(Total for Question 1 = 6 marks)

2 Magnesium and calcium are in group 2 of the periodic table. They are less reactive than the metals in group 1.

(a) Calcium reacts with water to form calcium hydroxide, $Ca(OH)_2$, and hydrogen, H_2.

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$$

Describe what would be **seen** when a piece of calcium is dropped into a container of water.

(2)

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(b) Magnesium reacts very slowly with cold water but it reacts faster with steam, H_2O, and forms magnesium oxide, MgO, and hydrogen.

Write the balanced equation for the reaction between magnesium and steam.

(2)

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(c) The electronic configurations of magnesium and calcium are

magnesium 2.8.2
calcium 2.8.8.2

When magnesium and calcium react with water they form positive ions.

Suggest an explanation, in terms of their electronic configurations, why calcium is more reactive than magnesium.

(2)

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(d) A sample of calcium bromide contains 0.2 g calcium and 0.8 g bromine by mass.

Calculate the empirical formula of calcium bromide.

(relative atomic masses: Ca = 40, Br = 80)

(3)

empirical formula = ...

(Total for Question 2 = 9 marks)

3 Crude oil is a mixture of hydrocarbons.

It can be separated into fractions.

(a) Which of these mixtures shows formulae of substances that could be in the gaseous fraction of crude oil?

(1)

☒ **A** C_2H_4, C_3H_8, $C_4H_{10}O$

☒ **B** C_2H_4, C_3H_7Br, C_4H_{10}

☒ **C** C_2H_6, C_3H_8, C_4H_{10}

☒ **D** C_2H_6, C_3H_7Br, $C_4H_{10}O$

(b) Figure 3 shows the percentages of the fractions in crude oil from three different oil wells.

	percentage of fraction in crude oil from		
fraction	**oil well A**	**oil well B**	**oil well C**
gases	1	6	9
petrol	2	15	24
kerosene	6	14	20
diesel oil	7	10	16
fuel oil	26	28	30
bitumen	58	27	1

Figure 3

(i) State which oil well contains the greatest combined total of diesel oil and fuel oil.

(1)

.....

(ii) State which oil well produces a crude oil containing the highest percentage of the high boiling point fractions.

(1)

.....

(c) Fractions of crude oil contain alkanes.

A sample of decane, $C_{10}H_{22}$, cracked using the apparatus in Figure 4.

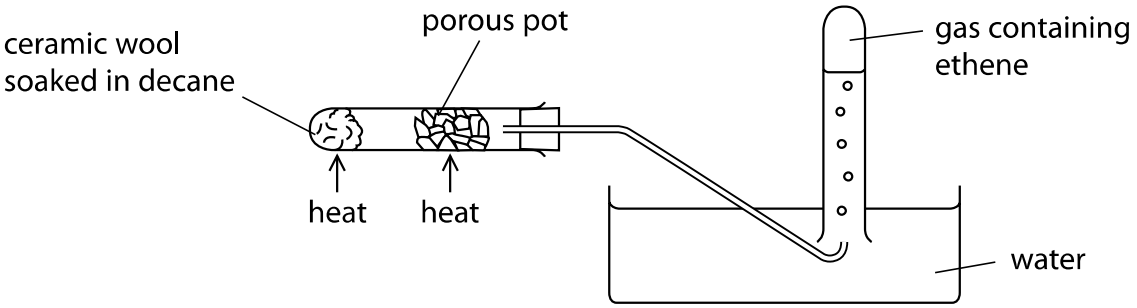

Figure 4

(i) Explain how ethene is produced using the apparatus in Figure 4.

(3)

(ii) One molecule of decane produced two molecules of propene, C_3H_6, and one molecule of product **Z**.

$C_{10}H_{22} \rightarrow 2C_3H_6$ + product **Z**

What is the formula of product **Z**?

(1)

- ☒ **A** C_4H_8
- ☒ **B** C_4H_{10}
- ☒ **C** C_7H_{14}
- ☒ **D** C_7H_{16}

(iii) When decane undergoes complete combustion, a mixture of carbon dioxide and water is formed.

Complete the balanced equation for this reaction.

(2)

$2C_{10}H_{22}$ + ... O_2 → ..... CO_2 + ... H_2O

(Total for Question 3 = 9 marks)

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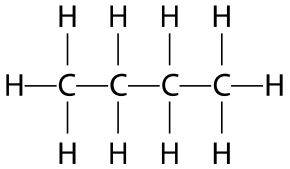
4 Alkanes and alkenes are hydrocarbons.

The structure of a molecule of butane is shown.



(a) Which of the following is the empirical formula for butane?

(1)

☒ **A** CH

☒ **B** CH_2

☒ **C** C_2H_5

☒ **D** C_4H_{10}

(b) Figure 5 shows some information about the alkenes, ethene and propene.

Complete the table. The structure of propene must show all covalent bonds.

(2)

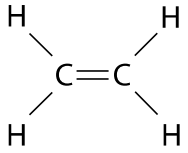
name of alkene	molecular formula	structure
ethene		
propene	C_3H_6	

Figure 5

(c) Butene reacts with steam to produce butanol.

$$C_4H_8 + H_2O \rightarrow C_4H_9OH$$

(i) Calculate the maximum mass of butanol, C_4H_9OH, that can be produced when 1.4 kg of butene, C_4H_8, reacts with excess steam.

(relative atomic masses: H = 1, C = 12, O = 16
relative molecular mass of butene, C_4H_8 = 56)

(3)

mass of butanol = ... kg

(ii) What type of reaction takes place between butene and steam?

(1)

☒ **A** addition

☒ **B** dehydration

☒ **C** neutralisation

☒ **D** substitution

(d) A sample of each of three hydrocarbons, **X**, **Y** and **Z**, was shaken with bromine water. Bromine water is orange coloured.

The results are:

X orange mixture becomes colourless

Y orange mixture becomes colourless

Z mixture remains orange

Using the results, comment on the structures of the hydrocarbons **X**, **Y** and **Z**.

(2)

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(Total for Question 4 = 9 marks)

5 Qualitative tests are used to identify ions.

(a) A student carries out a flame test on an unknown solid.
A red flame is seen.
The student concludes that the solid is lithium carbonate.

Explain why this conclusion is **not** justified.

(2)

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(b) The following tests were carried out on a substance containing two ions.

1. A flame test on the solid substance produced a yellow colour.

2. Dilute hydrochloric acid was added to a solution of the substance followed by a few drops of barium chloride solution.
A white precipitate formed.

Give the name and formula of the substance.

(2)

Name of substance .....

Formula of substance .....

(c) The test for chloride ions was carried out on a solution.
Dilute nitric acid was added to the solution, followed by a few drops of silver nitrate solution.
A white precipitate formed.

Why is it necessary to add dilute nitric acid in this test?

(1)

☒ **A** To neutralise the solution

☒ **B** Nitrate ions are needed for the test to work

☒ **C** To make sure that no carbonate ions are present

☒ **D** The test only works in alkaline conditions

(d) Sodium hydroxide solution is used to identify some cations present in compounds.

(i) Sodium hydroxide solution is warmed with a solution of ammonium ions. Ammonia gas is given off.

Describe the test to show the gas is ammonia.

(2)

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(ii) Sodium hydroxide solution is also used to distinguish between iron(II) ions, Fe^{2+} and iron(III) ions, Fe^{3+}, in solution.

You are given a solution containing iron(II) ions and another solution containing iron(III) ions.

Describe what is seen when sodium hydroxide solution is added to each of these solutions.

(2)

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(iii) Iron(III) ions, Fe^{3+}, react with hydroxide ions in solution to form iron(III) hydroxide.

Complete the ionic equation for this reaction.

(1)

$Fe^{3+} + 3OH^- \rightarrow$ .....

(Total for Question 5 = 10 marks)

6 This question is about properties of materials.

(a) Figure 6 shows some properties of steel and Kevlar®.

property	steel	Kevlar®
density / g cm^{-3}	7.85	1.44
relative strength	1	5
flexibility	low	high
resistance to corrosion	low	high

Figure 6

Body armour, such as a bullet-proof vest, could be manufactured using either of these materials.

Explain **two** reasons why Kevlar® is preferred to steel as the material for body armour.

(4)

(b) The use of nanoparticles has increased in recent years.

(i) The length of one side of a cube of silver is 2 cm as shown in Figure 7.

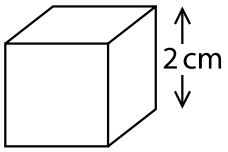

Figure 7

Calculate the surface area to volume ratio of this cube of silver.

(3)

surface area to volume ratio = ...

(ii) Suggest an explanation of why a given mass of silver is more effective as a catalyst when used as nanoparticles rather than in a powder form.

(3)

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(Total for Question 6 = 10 marks)

7 A student investigated the rate of reaction between dilute hydrochloric acid and marble chips (calcium carbonate).

Calcium chloride, carbon dioxide and water are formed.

(a) Complete and balance the equation for the reaction.

(2)

$CaCO_3 + HCl \rightarrow$ ..... + ... + ...

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(b) The student investigated the rate by using different sizes of marble chips. In their investigation, the same mass of marble chips was used in each experiment.

The volume of gas given off was measured.

The graph in Figure 8 shows the results.

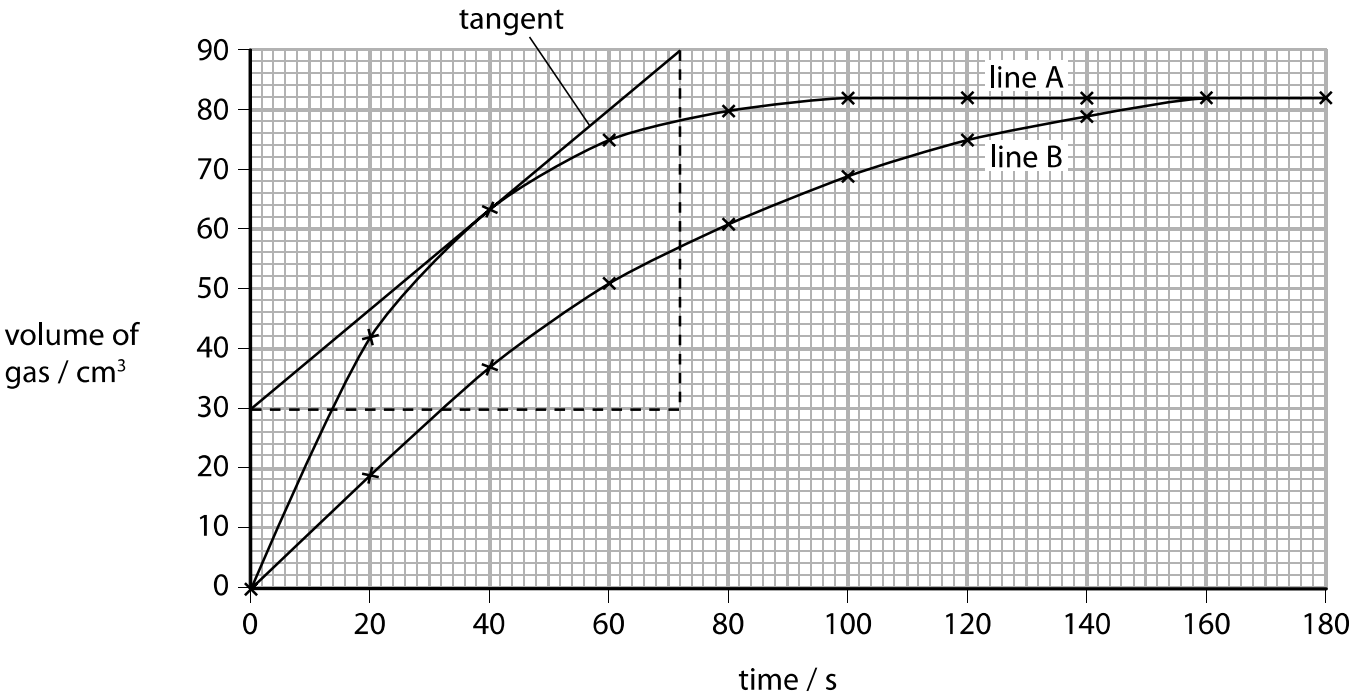

Figure 8

(i) State how the graph shows that line B gives the results for the larger marble chips.

(1)

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(ii) A tangent has been drawn on line A.

Calculate the rate of reaction at this point.

(2)

rate of reaction = ... $cm^3 s^{-1}$

(c) During any reaction, reactants are used up and the rate of reaction decreases.

Explain, in terms of particles, why the rate of reaction decreases.

(2)

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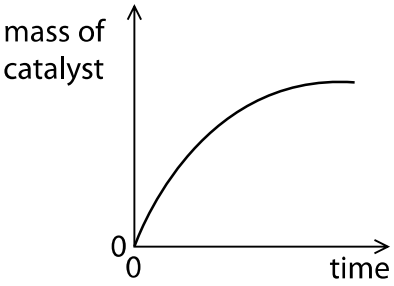
(d) The decomposition of hydrogen peroxide is catalysed by adding a small amount of manganese(IV) oxide.

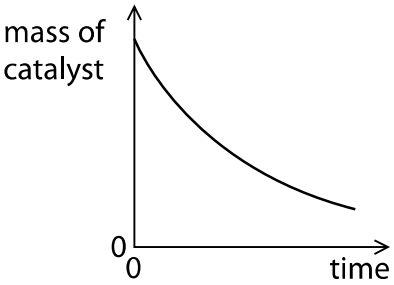
Which of these graphs shows the mass of the catalyst as the reaction takes place?

(1)

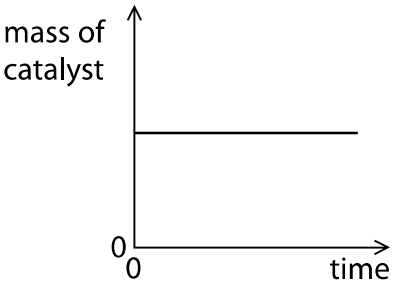
☒ **A**



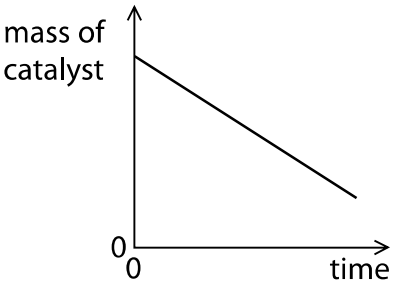
☒ **B**



☒ **C**



☒ **D**



(e) Two gases, **X** and **Y**, react to give a gaseous product **Z**.

The reaction is carried out under two different sets of conditions in experiments 1 and 2 as shown in Figure 9.

condition	experiment 1	experiment 2
temperature / °C	30	20
pressure / atm	1	2

Figure 9

Explain why it is not possible to predict what the rate of Experiment 2 will be compared with Experiment 1.

(3)

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(Total for Question 7 = 11 marks)

8 The elements chlorine, bromine and iodine are part of group 7 in the periodic table.

(a) The appearances of chlorine, bromine and iodine at room temperature are shown in Figure 10.

halogen	appearance
chlorine	green gas
bromine	red-brown liquid
iodine	grey solid

Figure 10

Astatine is the element below iodine in group 7.

Predict the appearance of astatine.

(1)

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*(b) The order of reactivity of chlorine, bromine and iodine can be determined by carrying out displacement reactions.

Explain how displacement reactions can be used to show the reactivity of these three elements.

(6)

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(c) When iron wool is heated in bromine vapour, it reacts to form iron bromide.

(i) In an experiment, 5.60 g of iron reacted exactly with 24.0 g of bromine, Br_2.

[relative atomic masses: Fe = 56.0, Br = 80.0]

Determine, using this information, the balanced equation for the reaction between iron and bromine.
You must show your working.

(4)

(ii) When iron reacts with bromine, bromide ions are formed.

Explain the type of reaction bromine atoms undergo when they are converted to bromide ions.

(2)

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(Total for Question 8 = 13 marks)

9 (a) A student carried out an experiment to prove that candle wax, a hydrocarbon, produces carbon dioxide and water vapour when it burns.

The equipment used is shown in Figure 11.

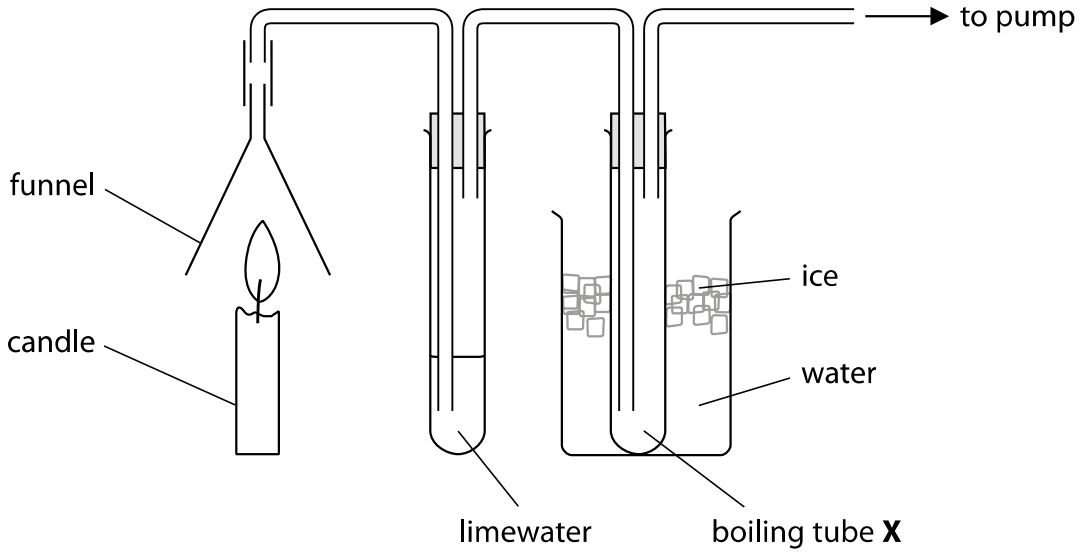

Figure 11

The gas produced from the burning candle is drawn through the apparatus.
The limewater turned milky showing that carbon dioxide had been formed.

A small amount of a colourless liquid condensed in boiling tube **X**.
The student claimed that this proved that burning candle wax produced water.
The teacher said the apparatus had been set up incorrectly and therefore this conclusion about water was not valid.

Explain how the student could modify the equipment to prove that water is produced by burning candle wax.

(2)

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*(b) Polymers are addition or condensation polymers.

Polymers can be formed by using the monomers shown in Figure 12.

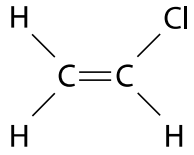
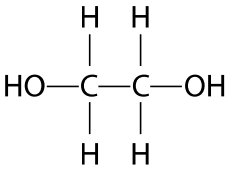
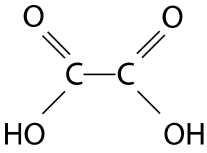
monomer	structure
chloroethene	
ethane-1,2-diol	
ethanedioic acid	

Figure 12

Explain, using appropriate monomers from Figure 12, how different polymers can be formed.

(6)

(c) An alcohol **A**, with molecular formula C_2H_5OH is oxidised to a compound **B** with molecular formula $C_2H_4O_2$.

(i) Compound **B** is not an alcohol and is a member of another homologous series.

State the name of this homologous series.

(1)

.....

(ii) Draw the structure of a molecule of compound **A** and a molecule of compound **B**, showing all covalent bonds.

(2)

Compound **A**

Compound **B**

(Total for Question 9 = 11 marks)

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10 (a) Each of these substances forms ions in solution.

One mole of the following substances is dissolved in 1 dm^3 of water.

Which solution contains the greatest number of ions?

(1)

☒ **A** ammonium sulfate, $(NH_4)_2SO_4$

☒ **B** iron(III) chloride, $FeCl_3$

☒ **C** magnesium nitrate, $Mg(NO_3)_2$

☒ **D** potassium bromide, KBr

(b) When sodium hydroxide solution is neutralised with an acid there is a temperature change.

A student is given dilute hydrochloric acid and dilute ethanoic acid of the same concentration in mol dm^{-3}.

Devise a plan to compare the temperature changes produced when sodium hydroxide solution is neutralised with each of these two acids.

(4)

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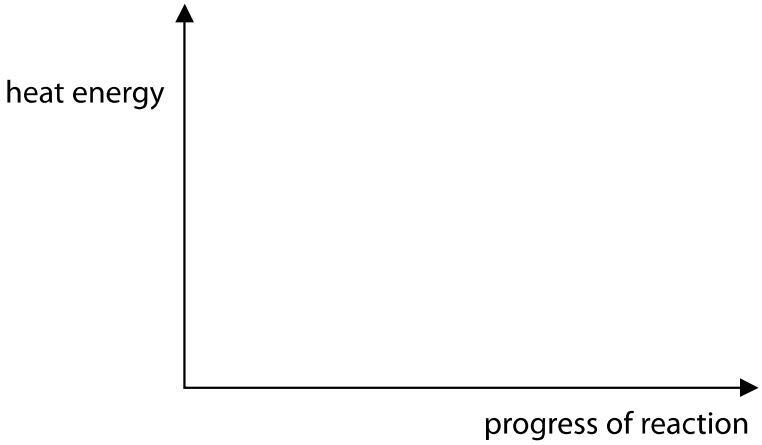
(c) Hydrogen reacts with chlorine to form hydrogen chloride.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

The reaction is exothermic.

Draw and label the reaction profile diagram for this reaction, identifying the activation energy.

(3)



(d) The energies of some bonds are shown in Figure 13.

bond	energy of bond / kJ mol^{-1}
H—H	436
Cl—Cl	243
H—Cl	432

Figure 13

Hydrogen reacts with chlorine to form hydrogen chloride.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

Calculate the energy change, in kJ mol^{-1}, for the reaction of 1 mol of hydrogen gas, H_2, with 1 mol of chlorine gas, Cl_2, to form 2 mol of hydrogen chloride gas, HCl.

(4)

energy change = ... kJ mol^{-1}

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.