

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 (a) The two most common gases in today's atmosphere are nitrogen and oxygen.

(i) What is the third most common gas in today's atmosphere? (1)

- A argon
- B butane
- C chlorine
- D hydrogen

(ii) What is the percentage of oxygen in today's atmosphere? (1)

- A 0.04
- B 1
- C 21
- D 78

(b) Give the name of the most common gas in the Earth's **early** atmosphere. (1)

.....

(c) This early atmosphere was hot and contained water vapour.
The atmosphere today contains less water vapour.

Explain what caused the amount of water vapour in the atmosphere to decrease. (2)

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- (d) The concentration of carbon dioxide in the atmosphere can be measured in parts per million (ppm).

Figure 1 shows the measurements in January 2018 and January 2019.

	concentration of carbon dioxide in ppm
January 2018	407.96
January 2019	410.83

Figure 1

- (i) Calculate the increase in the concentration, in ppm, of carbon dioxide from January 2018 to January 2019.

Give your answer to the nearest whole number.

(2)

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increase in concentration of carbon dioxide = ppm

- (ii) Give a possible cause for this increase in the concentration of carbon dioxide.

(1)

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.....

(Total for Question 1 = 8 marks)



- 2 (a) Figure 2 shows information about three different materials, a composite, a glass and a metal.

	a composite	a glass	a metal
density	low	high	high
ability to conduct electricity	poor	poor	good
resistance to corrosion	good	good	poor

Figure 2

Explain which material in Figure 2 is the most suitable material to use in electrical circuits.

(2)

.....

.....

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- (b) (i) Nanoparticles are very small.

Some nanoparticles have a radius of 17 nm.
The radius of a magnesium atom is 0.16 nm.

Approximately how many times larger is the radius of these nanoparticles than the radius of the magnesium atom?

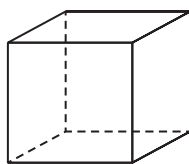
(1)

- A 0.01
- B 0.10
- C 10
- D 100



- (ii) A catalyst contains cube-shaped nanoparticles.
Figure 3 shows a diagram of a cube-shaped nanoparticle.

The length of each side of the cube is 9 nm.



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Figure 3

Calculate the surface area of the cube, in nm^2 .

(2)

surface area = nm^2

- (iii) Nanoparticles have many uses.
Some scientists are concerned about the possible risks of using nanoparticles.

Give **one** possible risk of using nanoparticles.

(1)

(Total for Question 2 = 6 marks)

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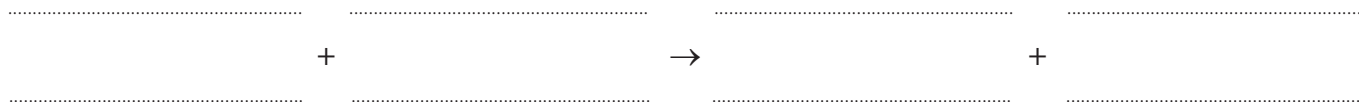


3 (a) A student investigated the reaction between potassium iodide and lead nitrate.

- (i) Solutions of potassium iodide and lead nitrate were mixed together. Lead iodide and potassium nitrate were formed.

Complete the word equation.

(2)



- (ii) The student recorded the total mass of the reactants and the total mass of the products.

The results are shown in Figure 4.

	reactants	products
total mass in g	21.7	21.7

Figure 4

State how the results in Figure 4 show that mass is conserved in this reaction.

(1)

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- (b) In another experiment, a student investigated the temperature decrease when different amounts of ammonium nitrate crystals were dissolved in 100 cm^3 of water.

The apparatus used is shown in Figure 5.

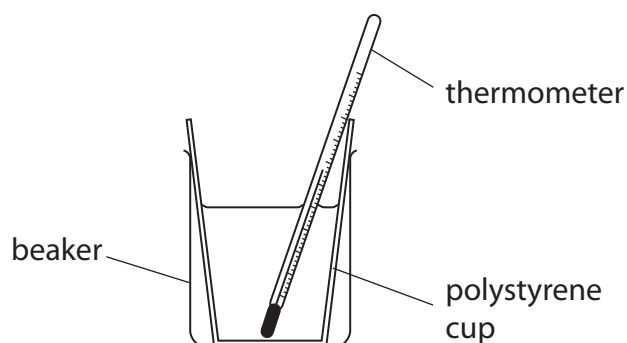


Figure 5

The student used the following method.

step 1 pour 100 cm^3 of water into the polystyrene cup

step 2 add one spatula of ammonium nitrate crystals to the water

step 3 stir the mixture

step 4 use the thermometer to record the lowest temperature reached by the mixture

step 5 repeat steps 1 to 4 using different amounts of ammonium nitrate

- (i) Name a piece of apparatus that should be used to measure the 100 cm^3 of water in **step 1**.

(1)

- (ii) The student cannot work out the temperature decrease using the method described.

State what the student must do before **step 2** to be able to work out the temperature decrease.

(1)

- (iii) State why a polystyrene cup is used in this experiment.

(1)



(iv) Figure 6 shows the reaction profile for this reaction.

Use the words from the box to complete the labels on Figure 6.

activation energy	products	reactants
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(2)

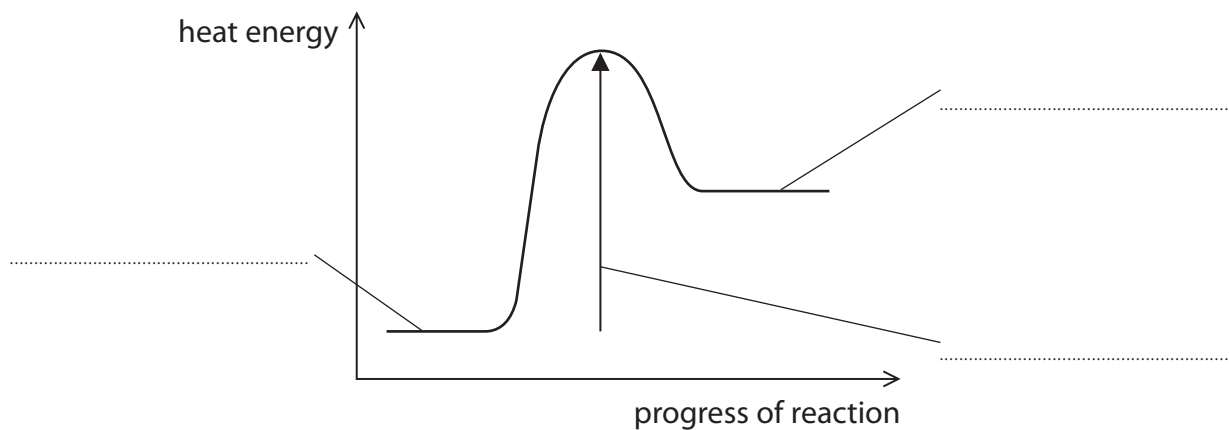


Figure 6

(Total for Question 3 = 8 marks)

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4 Tests are carried out to identify the ions in two solids, **P** and **Q**.

(a) A flame test is used to identify the metal ions in each of these solids.

(i) Describe how to do a flame test.

(2)

.....

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.....

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.....

(ii) Different metal ions produce different coloured flames.

Draw one straight line from each metal ion to its flame colour.

(2)

metal ion

flame colour

	● green
calcium ●	● yellow
	● lilac
potassium ●	● orange-red
	● blue-green



(b) **P** and **Q** dissolve in water to form colourless solutions.

Figure 7 shows the results of tests on these solutions.

test	results	
	solution of P	solution of Q
dilute hydrochloric acid added, then barium chloride solution	a white precipitate	remains colourless
dilute nitric acid added, then silver nitrate solution	remains colourless	a yellow precipitate

Figure 7

(i) The anions in solutions of **P** and **Q** can be identified from the results of the tests shown in Figure 7.

Draw one straight line from each solution to the anion present.

(2)

solution	anion
	<input type="checkbox"/> bromide
<input type="checkbox"/> solution of P	<input type="checkbox"/> carbonate
	<input type="checkbox"/> chloride
<input type="checkbox"/> solution of Q	<input type="checkbox"/> iodide
	<input type="checkbox"/> sulfate

(ii) The formula of barium chloride is BaCl_2 .

Give the total number of ions in the formula BaCl_2 .

(1)

.....



(c) A few drops of sodium hydroxide solution are added to a solution of iron(II) sulfate. Iron(II) hydroxide is formed.

(i) State what would be **seen**.

(2)

(ii) One other product is formed in this reaction.

What is the name of this other product?

(1)

- A iron(II) chloride
- B sodium chloride
- C sodium sulfate
- D water

(Total for Question 4 = 10 marks)



5 Chlorine, bromine and iodine are elements in group 7 of the periodic table.

(a) Chlorine is toxic.

State **one** safety precaution that should be taken when using chlorine in the laboratory. (1)

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.....

(b) Chlorine reacts with hydrogen to form hydrogen chloride.

(i) Write the word equation for this reaction. (1)

..... →

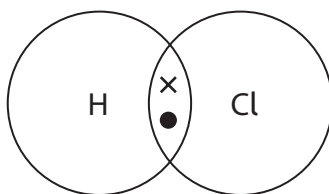
(ii) Hydrogen chloride dissolves in water to form an acidic solution.

State what is **seen** when blue litmus paper is placed into this solution. (1)

.....

(iii) A chlorine atom has seven electrons in its outer shell.
A hydrogen atom has one electron in its outer shell.

Complete the dot and cross diagram of a molecule of hydrogen chloride. Show outer shell electrons only. (1)

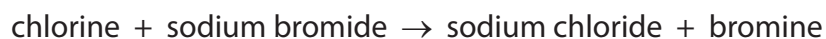


(iv) Name the type of bonding in a molecule of hydrogen chloride. (1)

.....



(c) If chlorine solution is added to sodium bromide solution a reaction occurs.



Give a reason why this reaction occurs.

(1)

(d) Figure 8 shows apparatus used to find out if a solution conducts electricity.

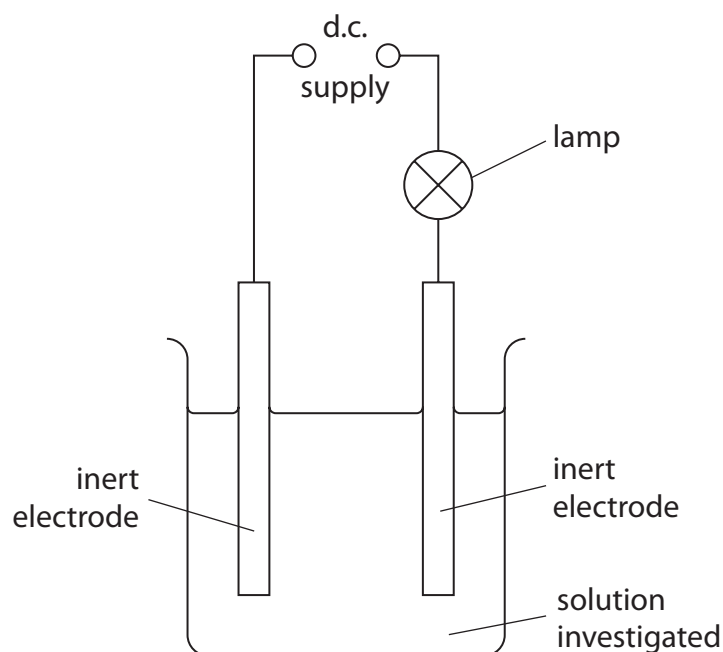


Figure 8

Glucose solution and sodium chloride solution are tested.
Glucose is a typical simple molecular covalent compound.
Sodium chloride is an ionic compound.

(i) State what would happen to the lamp when glucose solution is tested.

(1)

(ii) State what would happen to the lamp when sodium chloride solution is tested.

(1)



(e) Figure 9 shows how the conductivity of one solution changes as its concentration increases.

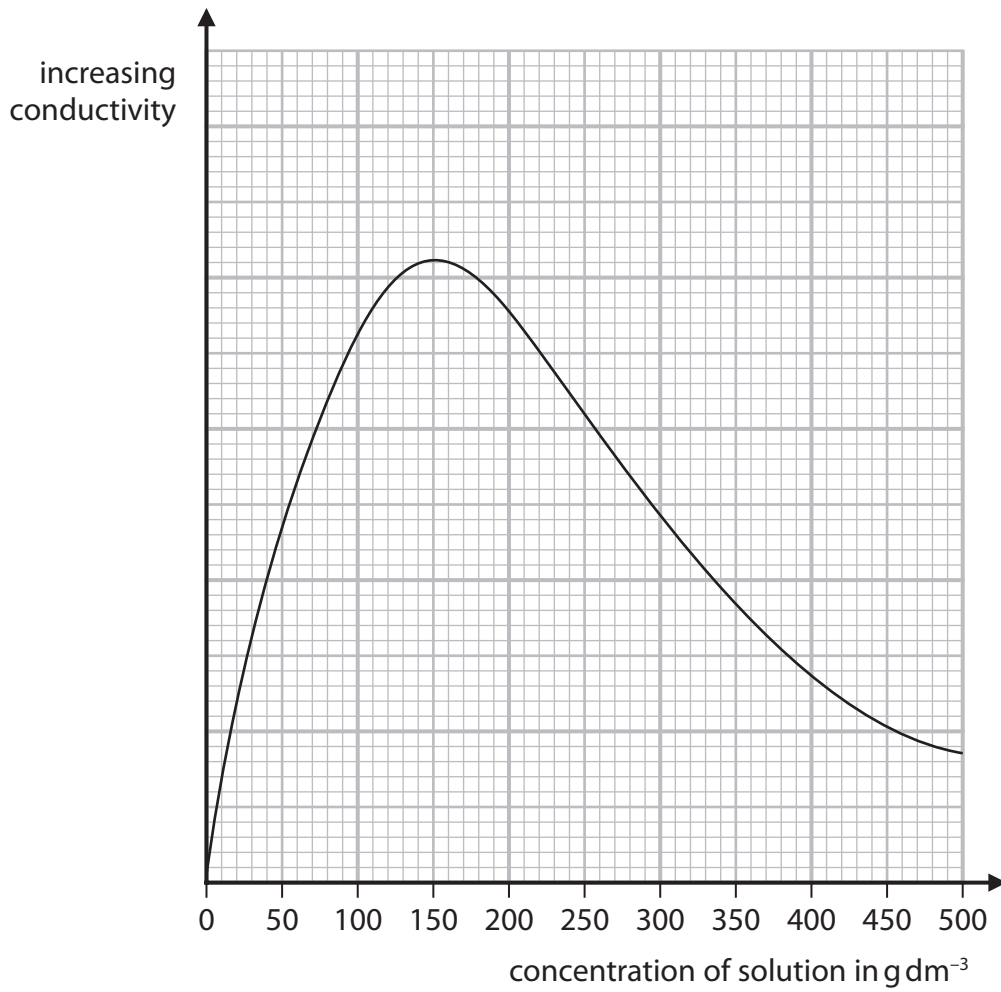


Figure 9

Describe how the conductivity of this solution changes as its concentration increases from 0 to 500 g dm⁻³.

(2)

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(Total for Question 5 = 10 marks)

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6 (a) Methane is a hydrocarbon fuel.

- (i) Complete the word equation for the **complete** combustion of methane in oxygen.

(2)

methane + → water +

- (ii) The **incomplete** combustion of methane can produce carbon and carbon monoxide.

Give the reason why carbon and carbon monoxide are produced in the **incomplete** combustion of methane.

(1)

(b) Crude oil is a complex mixture of hydrocarbons.

Crude oil can be separated into useful fractions by fractional distillation.

Figure 10 shows a fractional distillation column and the fractions produced when crude oil is distilled.

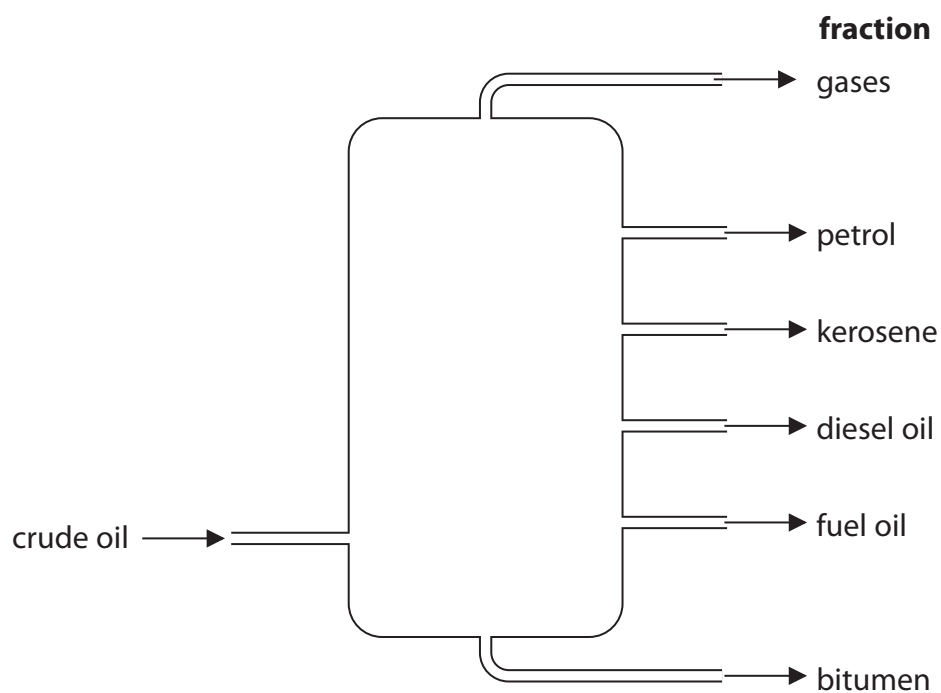


Figure 10

- (i) Name the fraction in Figure 10 that is used to surface roads.

(1)



(ii) Name the fraction in Figure 10 that contains hydrocarbons with the lowest boiling point.

(1)

(c) When crude oil is fractionally distilled, the demand for some fractions is more than the amount produced.

Figure 11 shows the relative amounts of each fraction in a crude oil and the relative demand for each of these fractions.

fraction	relative amount	relative demand
gases	2	6
petrol	12	29
kerosene	16	11
diesel oil	24	29
fuel oil	37	21
bitumen	9	4

Figure 11

Which of the following shows the fractions where the relative demand is greater than the relative amount in the crude oil?

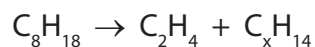
(1)

- A** kerosene, diesel oil, bitumen
- B** gases, petrol, diesel oil
- C** gases, petrol, kerosene
- D** petrol, diesel oil, fuel oil



(d) Cracking involves the breaking down of large hydrocarbon molecules into smaller hydrocarbon molecules.

- (i) Octane, C_8H_{18} , can be cracked to produce one molecule of ethene, C_2H_4 , and one molecule of C_xH_{14} .



Determine the value of x in the molecule of C_xH_{14} .

(1)

x =

- (ii) Dodecane is a large hydrocarbon molecule.
When one molecule of dodecane is cracked the products are one molecule of octane and one molecule of butene.



Calculate the maximum mass of octane that could be produced when 340 g of dodecane is cracked in this reaction.

(relative formula masses: dodecane = 170, octane = 114)

(2)

mass of octane = g

(Total for Question 6 = 9 marks)



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P 6 2 0 8 4 A 0 1 9 3 2

7 (a) Ethanol can be produced by the fermentation of glucose solution.

Which of these shows the word equation for the fermentation of glucose solution?

(1)

- A glucose \rightarrow ethanol + water
- B glucose \rightarrow ethanol + carbon dioxide
- C glucose \rightarrow ethanol + hydrogen
- D glucose \rightarrow ethanol + water + carbon dioxide

(b) The names and formulae of the first four alcohols in the homologous series of alcohols are given in Figure 12.

name of alcohol	formula
methanol	CH ₃ OH
ethanol	C ₂ H ₅ OH
propanol	C ₃ H ₇ OH
butanol	C ₄ H ₉ OH

Figure 12

(i) Pentanol is the next member of this series.
A molecule of pentanol contains five carbon atoms.

Suggest the formula of a molecule of pentanol.

(1)

(ii) Draw the structure of a molecule of ethanol.
Show all bonds.

(2)

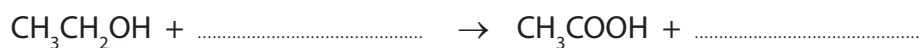


(c) Ethanol is present in alcoholic drinks, such as wine.

When a bottle of wine is left open some of the ethanol reacts with the oxygen in the air to form ethanoic acid, CH_3COOH , and water.

(i) Complete the equation for this reaction.

(2)



(ii) Which calculation shows the percentage by mass of hydrogen in ethanoic acid?

(relative atomic mass of hydrogen, $\text{H} = 1$,
relative formula mass of ethanoic acid, $\text{CH}_3\text{COOH} = 60$)

(1)

A $\frac{1}{60} \times 100$

B $\frac{3}{60} \times 100$

C $\frac{4}{60} \times 100$

D $\frac{60}{1} \times 100$



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(Total for Question 7 = 13 marks)



P 6 2 0 8 4 A 0 2 3 3 2

8 (a) An atom of potassium has atomic number 19 and mass number 39.

(i) Give the electronic configuration of this potassium atom.

(1)

(ii) This potassium atom forms the ion K^+ .

Which row shows the number of protons and the number of neutrons in this potassium ion, K^+ ?

(1)

	number of protons	number of neutrons
<input type="checkbox"/> A	19	19
<input type="checkbox"/> B	19	20
<input type="checkbox"/> C	20	19
<input type="checkbox"/> D	20	20

(b) Potassium and caesium are in the same group of the periodic table.

Explain, in terms of electrons, why potassium and caesium are in the same group.

(2)

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(c) Fluorine boils at -188°C .

There are forces between fluorine molecules.

Explain, in terms of these forces, why the boiling point of fluorine is low.

(2)

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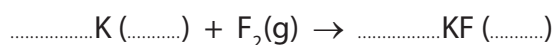
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- (d) Potassium reacts with fluorine to form potassium fluoride.
Potassium fluoride is a solid.

Complete the balanced equation for this reaction and add the state symbols.

(3)



- (e) What are the elements in group 1 of the periodic table called?

(1)

- A alkali metals
 B fullerenes
 C halogens
 D noble gases

- (f) Figure 14 shows the melting points and boiling points of elements in group 7 of the periodic table.

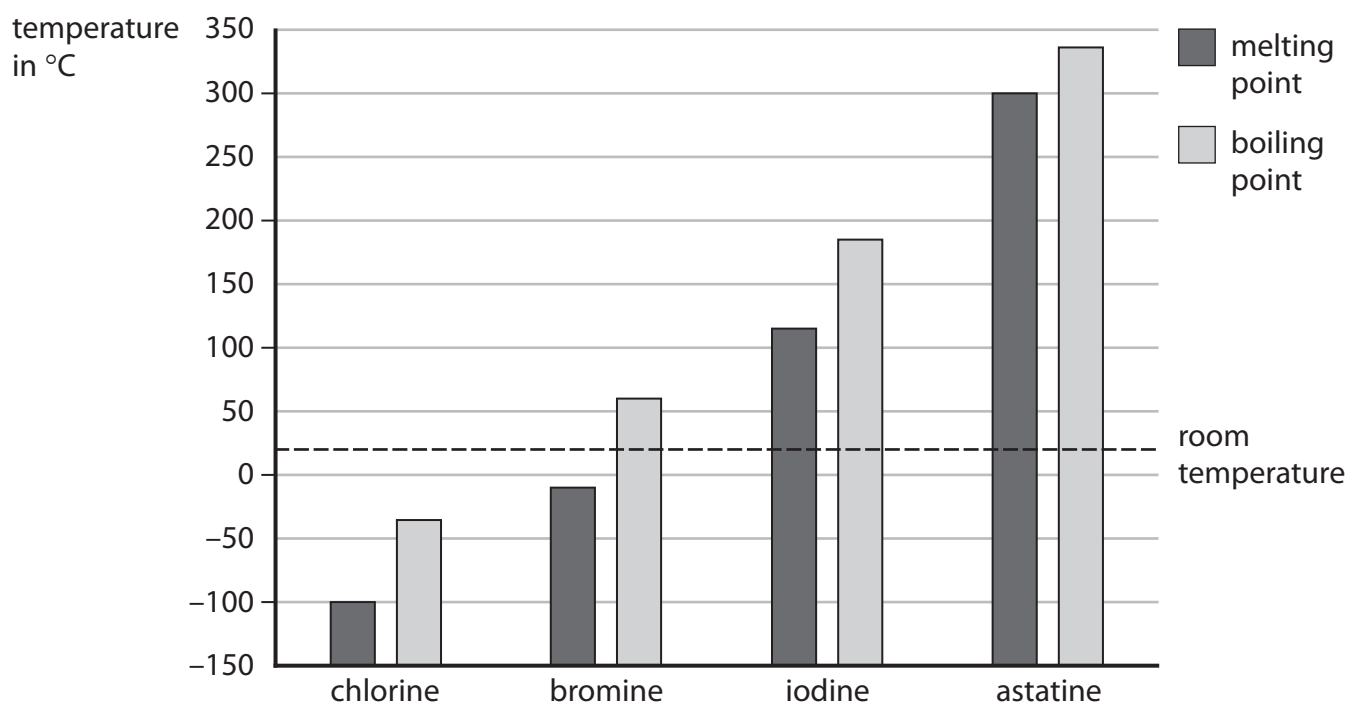


Figure 14

- (i) Give, using Figure 14, the boiling point of bromine.

(1)

boiling point of bromine = °C

- (ii) State which **two** elements from Figure 14 are solids at room temperature.

(1)

(Total for Question 8 = 12 marks)



- 9 (a) Calcium carbonate reacts with dilute hydrochloric acid to produce carbon dioxide gas.

The rate of reaction between calcium carbonate and dilute hydrochloric acid at room temperature was investigated.

- (i) The investigation was carried out with different sized calcium carbonate pieces.

The mass of calcium carbonate and all other conditions were kept the same.

The results are shown in Figure 15.

size of calcium carbonate pieces used	volume of carbon dioxide gas produced in five minutes in cm^3
large	16
small	48
powder	90

Figure 15

State, using the information in Figure 15, the effect of the surface area of the calcium carbonate on the rate of this reaction.

(1)

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- (ii) The calcium carbonate powder produced 90 cm^3 of carbon dioxide in five minutes.

Calculate the average rate of reaction in $\text{cm}^3 \text{ s}^{-1}$.

(3)

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.....

average rate of reaction = $\text{cm}^3 \text{ s}^{-1}$



- (iii) The experiments were repeated at a higher temperature.
The rate of reaction for each experiment increased.

Explain, in terms of particles, why the rate of reaction increased when the temperature was increased.

(3)

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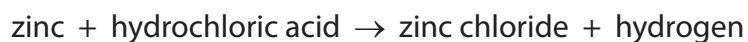
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*(b) Zinc metal reacts with dilute hydrochloric acid to produce hydrogen gas.



A student investigated the effect of doubling the concentration of the hydrochloric acid on this reaction.

The student made the following prediction.

When the concentration of the hydrochloric acid is doubled the rate of reaction will double and the reaction will be more exothermic.

Devise a plan, including the apparatus you would use, to test the student's prediction.

You are provided with pieces of zinc and two bottles of dilute hydrochloric acid. One bottle of hydrochloric acid is double the concentration of the other.

(6)



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(Total for Question 9 = 13 marks)



P 6 2 0 8 4 A 0 2 9 3 2

10 Figure 16 shows the structure of a molecule of dichloroethene.

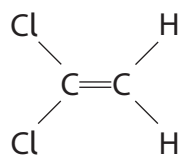


Figure 16

(a) (i) Describe how dichloroethene monomers form a polymer.

(2)

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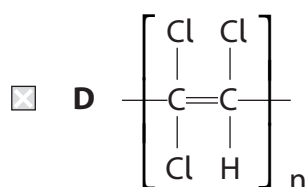
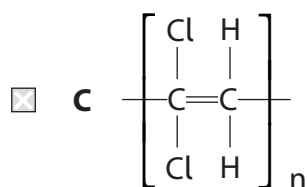
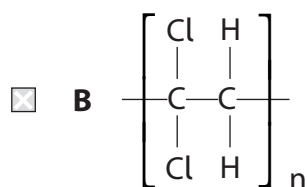
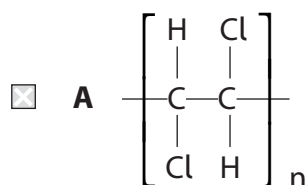
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(ii) Which of these represents the structure of the polymer formed from the monomer in Figure 16?

(1)



(iii) Separate samples of dichloroethene and poly(dichloroethene) are shaken with a few drops of bromine water.

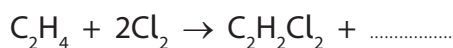
What would be **seen**? (1)

- A both mixtures remain orange
- B only the dichloroethene and bromine water goes colourless
- C only the poly(dichloroethene) and bromine water goes colourless
- D both mixtures go colourless

(b) Dichloroethene is produced from ethene and chlorine.

In the overall reaction, ethene reacts with chlorine and forms dichloroethene and hydrogen chloride.

Complete the balanced equation for the overall reaction. (2)



(c) Poly(dichloroethene) was used to wrap food to keep it fresh.

Explain **one** property that a plastic food wrapping must have. (2)

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(d) An industrial process uses 500 tonnes of dichloroethene.
In the process only 96.5% of the dichloroethene molecules react.

Calculate the mass of dichloroethene that has **not** reacted.

Give your answer to two significant figures. (3)

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mass = tonnes

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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The periodic table of the elements

1	2	3	4	5	6	7	0
7 Li lithium 3	9 Be beryllium 4	23 Na sodium 11	24 Mg magnesium 12	39 K potassium 19	40 Ca calcium 20	85 Rb rubidium 37	133 Cs caesium 55
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
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
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
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
119 Fr francium 87	120 Ra radium 88	121 Ac actinium 89	122 Th thorium 90	123 Pa protactinium 91	124 U uranium 92	125 Np neptunium 93	126 Pu plutonium 94
115 In indium 49	112 Cd cadmium 48	108 Ag silver 47	106 Pd palladium 46	103 Rh rhodium 45	101 Ru ruthenium 44	100 Rh rhodium 45	112 Cd cadmium 48
119 Sn tin 50	112 Cd cadmium 48	108 Ag silver 47	106 Pd palladium 46	103 Rh rhodium 45	101 Ru ruthenium 44	100 Rh rhodium 45	112 Cd cadmium 48
122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51
128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52
127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53
131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54
[222] Rn radon 86	[222] Rn radon 86	[222] Rn radon 86	[222] Rn radon 86	[222] Rn radon 86	[222] Rn radon 86	[222] Rn radon 86	[222] Rn radon 86
207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82
209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83
209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83
204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81
201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80
197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79
195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78
192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77
190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76
186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75
184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74
181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73
178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72
137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56
137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56
133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55
88 Sr strontium 38	88 Sr strontium 38	88 Sr strontium 38	88 Sr strontium 38	88 Sr strontium 38	88 Sr strontium 38	88 Sr strontium 38	88 Sr strontium 38
40 Ca calcium 20	40 Ca calcium 20	40 Ca calcium 20	40 Ca calcium 20	40 Ca calcium 20	40 Ca calcium 20	40 Ca calcium 20	40 Ca calcium 20
45 Sc scandium 21	45 Sc scandium 21	45 Sc scandium 21	45 Sc scandium 21	45 Sc scandium 21	45 Sc scandium 21	45 Sc scandium 21	45 Sc scandium 21
91 Zr zirconium 40	91 Zr zirconium 40	91 Zr zirconium 40	91 Zr zirconium 40	91 Zr zirconium 40	91 Zr zirconium 40	91 Zr zirconium 40	91 Zr zirconium 40
93 Nb niobium 41	93 Nb niobium 41	93 Nb niobium 41	93 Nb niobium 41	93 Nb niobium 41	93 Nb niobium 41	93 Nb niobium 41	93 Nb niobium 41
96 Mo molybdenum 42	96 Mo molybdenum 42	96 Mo molybdenum 42	96 Mo molybdenum 42	96 Mo molybdenum 42	96 Mo molybdenum 42	96 Mo molybdenum 42	96 Mo molybdenum 42
101 Ru ruthenium 44	101 Ru ruthenium 44	101 Ru ruthenium 44	101 Ru ruthenium 44	101 Ru ruthenium 44	101 Ru ruthenium 44	101 Ru ruthenium 44	101 Ru ruthenium 44
103 Rh rhodium 45	103 Rh rhodium 45	103 Rh rhodium 45	103 Rh rhodium 45	103 Rh rhodium 45	103 Rh rhodium 45	103 Rh rhodium 45	103 Rh rhodium 45
106 Pd palladium 46	106 Pd palladium 46	106 Pd palladium 46	106 Pd palladium 46	106 Pd palladium 46	106 Pd palladium 46	106 Pd palladium 46	106 Pd palladium 46
112 Cd cadmium 48	112 Cd cadmium 48	112 Cd cadmium 48	112 Cd cadmium 48	112 Cd cadmium 48	112 Cd cadmium 48	112 Cd cadmium 48	112 Cd cadmium 48
119 Sn tin 50	119 Sn tin 50	119 Sn tin 50	119 Sn tin 50	119 Sn tin 50	119 Sn tin 50	119 Sn tin 50	119 Sn tin 50
122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51	122 Sb antimony 51
128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52	128 Te tellurium 52
127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53	127 I iodine 53
131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54	131 Xe xenon 54
207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82	207 Pb lead 82
209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83	209 Bi bismuth 83
204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81	204 Tl thallium 81
201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80	201 Hg mercury 80
197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79	197 Au gold 79
195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78	195 Pt platinum 78
192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77	192 Ir iridium 77
190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76	190 Os osmium 76
186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75	186 Re rhenium 75
184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74	184 W tungsten 74
181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73	181 Ta tantalum 73
178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72	178 Hf hafnium 72
137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56
137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56	137 Ba barium 56
133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55	133 Cs caesium 55	133 Cs			