Chemistry paper one

Stretch and challenge booklet

Exam command words

Command words are the words and phrases used in exams that tell students how they should answer a question.

The following command words are taken from Ofqual's official list of command words and their meanings that are relevant to this subject.

Calculate	Use numbers in the question to work these out.	**Draw**	Produce, or add a diagram.
Choose	Select from a range of alternatives.	**Estimate**	Give an approximate value.
Compare	Describe similarities/differences.	**Use**	The answer must include the information in the question.
Define	Specify the meaning of something.	**Work out**	Students should use numbers in the question.
Describe	Recall facts, events or process in an accurate way.	**Write**	Short answer, no explanation or description.
Design	Set out how something will be done.	**Evaluate**	Students should use the information provided as well as their own knowledge and consider evidence for or against.
Determine	Use the data provided to work out your answer.	**Explain**	Students should make something clear, or state reasons for something happening.
Give	Short answer only.	**Identify**	Name or characterise.
Label	Add words to complete a diagram, picture or graph	**Justify**	Use evidence from the information supplied to support your answer.
Measure	Find an item of data for a given quantity.	**Name**	Single word or phrase.
Plot	Mark on a graph.	**Plan**	Write a method.
Predict	Give a plausible outcome.	**Show**	Provide structured evidence to reach a conclusion.
Suggest	Apply your own knowledge.	**Sketch**	Draw approximately.

Scientific key words

These are keywords often used in questions. You need to be able to recognise and use them in your answers.

Hypothesis	A scientific statement that explains certain facts or observations	**Anomaly**	A result that does not fit the pattern
Prediction	This describes what you think will happen in an experiment	**Accuracy**	How close the reading is to the true value
Independent variable	This is the variable that is changed during an investigation. There should only be one of these.	**True value**	This is the real value of a measurement in an experiment
Dependent variable	This is the variable that changes as a result of a change in the independent variable	**Precision**	This is determined by the scale on the measuring apparatus e.g. a ruler marked mm is more precise than one in cm
Control variable	Variables that remain constant, to make sure that an investigation is valid	**Resolution**	The smallest change that can be read from a measuring device for example a ruler measured in mm or cm
Fair test	This is where only the independent variable is changed and the others controlled	**Calibration**	When we make sure that the measuring apparatus is making correct readings e.g. the temperature of melting ice is 0 degrees Celsius
Valid	The results and conclusions will be this if the variables are correctly controlled	**Measurement error**	The difference between the real value and the measured value
Categoric variable	A variable that can be described by a label or category such as colour or surface	**Random error**	This error causes measurements to be spread around the true value – can be reduced by taking repeats and calculating a mean
Continuous variable	A variable which can have any numerical value	**Zero error**	When a piece of measuring equipment should be reading zero but it doesn't
Interval	This is the difference between the values of your independent variable	**Systematic error**	This is an error that is always the same for each repeat – usually because of an error in the equipment used
Range	The maximum and minimum values of the independent or dependent variables e.g. 'from 10cm to 50cm'	**Uncertainty**	When the results obtained are not as accurate as they could be due to the procedure carried out
Data	Information or measurements that you collect	**Repeatable**	If the same person can get the same reading using the same equipment and method
Datum	One piece of information	**Reproducible**	If another person can get the same result (trend/specific results) using the same method and equipment or with different method or equipment.

Chemistry Paper 1 Revision checklist

Atomic Structure & the Periodic Table		
Describe the structure of an atom and calculate numbers of protons, neutrons and electrons given a periodic table		
Describe the development of the nuclear model of the atom from earlier models – e.g the plum pudding		
Describe how mixtures can be separated using filtration, evaporation, distillation and chromatography		
Compare the size of atoms to other items		
Explain what is meant by an isotope and calculate the Atomic mass of an element given the percentage abundance of its isotopes		
Draw the electron configuration for any of the first 20 elements in the periodic table.		
Describe some of the steps in the development of the Periodic Table		
Describe how atoms become ions and represent this using diagrams		
Explain why group 0 do not form ions and describe the properties of group 0 elements		
Describe the properties of the Group 1 metals and their reactions with oxygen and water		
Explain why Group 1 reactivity increases going down the group		
Describe the properties of group 7 elements.		
Describe and explain the trend in reactivity of group 7 down the group		
Interpret practical observations to prove reactivity in group 7 – ie displacement of less reactive halogens		
Bonding & Properties		
Describe the particle arrangement in solids, liquids and gases and explain how changes of state occur		
Describe the formation of ionic bonds between metal and non-metal atoms and represent this in diagrams and models		
Use dot and cross diagrams to show the transfer of electrons in ionic bonding		
Describe the properties of ionic compounds		
Represent covalent bonds using dot and cross diagrams		
Describe the properties of simple and giant covalent substances		
Describe the structure and bonding of carbon in the forms of diamond, graphite and fullerenes and relate their properties to the bonding		
Represent the bonding in polymers using diagrams and explain why most polymers are solids at room temperature		
Describe the bonding in metals and relate the properties of metals to the bonding		

Quantitative Chemistry		
Explain what is meant by 'conservation of mass' and apply it to chemical equations		
Calculate relative formula mass		
Know that a mole represents 6.02 x 10^{23} atoms or molecules and is equal to the atomic or formula mass in grams		
Use the equation Mass = Mr x moles to work out number of moles, mass or formula mass, given the other two		
Calculate the mass of reactants and products in a symbol equation and use these to predict the masses of reactants needed or products expected		
Use moles to balance symbol equations		
Calculate the mass of a given solid in a specified volume of a solution of a given concentration		

Chemical Change		
Define the terms oxidation and reduction in terms of reactions with oxygen		
Identify which substances have been oxidised or reduced in a given equation in terms of gain or loss of oxygen		
Evaluate metal extraction methods given appropriate information		
Describe the reactions of K, Na, Li, Ca, Mg, Zn, Fe and Cu with dilute acids and water		
Derive the reactivity series for metals given information about displacement reactions		
Explain reactivity in terms of a metal's tendency to form ions		
Identify which species has been oxidised and which has been reduced in terms of gain or loss of electrons in given equations		
Write half equations for oxidation and reduction		
Describe the test for hydrogen gas		
Describe the formation of a soluble salt by neutralising acids with metal oxides or metal carbonates		
Describe the reactions of acids and alkalis and the use of indicators		
Explain the meaning of the terms 'strong' and 'weak' acids		
Explain the process of electrolysis in terms of movement of ions to the electrodes and the loss or gain of electrons		
Describe the extraction of Aluminium from its oxide using electrolysis		
Predict the products from the electrolysis of solutions and explain why hydrogen is often given off at the cathode		
Energy Changes		
Describe and recognise exothermic and endothermic reactions		
Describe some of the variables that can affect temperature change in endothermic and exothermic reactions		
Use bond energies to determine whether a reaction will be endothermic or exothermic		

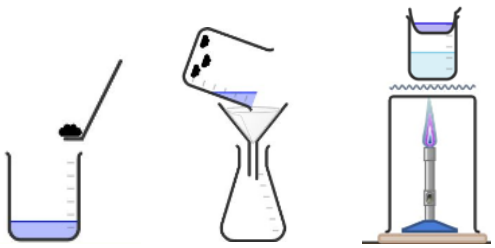
Required practical activities

Method writing frame:

Do what? To what? How?

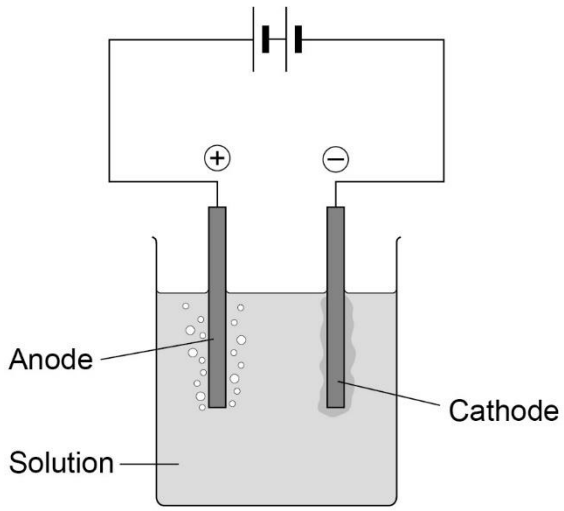
See example for making salts.

Making soluble salts (C5)

Label the diagram:	**Method:**
1) 2) 3) 	1) Measure 50 cm^3 of dilute sulfuric acid using a measuring cylinder. 2) Gently warm the acid using a Bunsen burner. Turn off the heat before it boils. 3) Add copper oxide a spatula at time. 4) Stir the mixture using a stirring rod. 5) Continue adding copper oxide until no more will dissolve. 6) Remove the excess copper oxide by filtration. 7) Pour the filtrate into an evaporating basin. 8) Heat the evaporating basin over boiling water until crystallization starts to occur. 9) Remove the evaporating basin from the heat and leave to crystallise.
Risk assessment:	**Results:** 1) Write the word equation for the reaction between copper oxide and sulfuric acid. _____ + _____ → _____ + _____ _____ _____ _____ 2) Write the balanced symbol equation for this reaction. _____ + _____ → _____ + _____ 3) The reaction of copper carbonate with sulfuric acid will produce the same salt as the reaction above. Write the word equation for this reaction. _____ + _____ → _____ + _____ + _____ _____ _____ _____ _____ 4) For the reaction in Q3, how could you tell when the reaction has stopped? _____

Electrolysis (C6)

Diagram:



Independent variable:
Dependent variable:
Control variable(s):

Method:

1) Pour 50 cm^3 of electrolyte solution into a beaker.
2)

Risk assessment:

Results:

1) Describe how you could determine if the gas produced at the anode is chloride.

   _____
   _____

2) Describe how you could determine if the gas produced at the cathode is hydrogen.

   _____
   _____

3) Predict the products when a molten solution of iron chloride is electrolysed.

   Anode:
   Cathode:

4) Predict the products when an aqueous solution of sodium sulfate is electrolysed.

   Anode:
   Cathode:

5) Predict the products when an aqueous solution of copper bromide is electrolysed.

   Anode:
   Cathode:

Temperature changes (C7)

Label the diagram:

Independent variable:
Dependent variable:
Control variable(s):

Method:

Method (cont):

Results:

Total volume of NaOH added (cm^3)	Maximum temp (°C)		
	First trial	Second trial	Mean
0	25	25	
5	27	28	
10	30	30	
15	32	28	
20	34	35	
25	36	36	
30	36	36	
35	34	35	
40	34	34	

1) Identify the anomaly in the results. Suggest what could have caused this.

_____
_____
_____
_____

2) Calculate the mean maximum temperature for each volume of sodium hydroxide.

Results:

3) Plot a graph using the results.

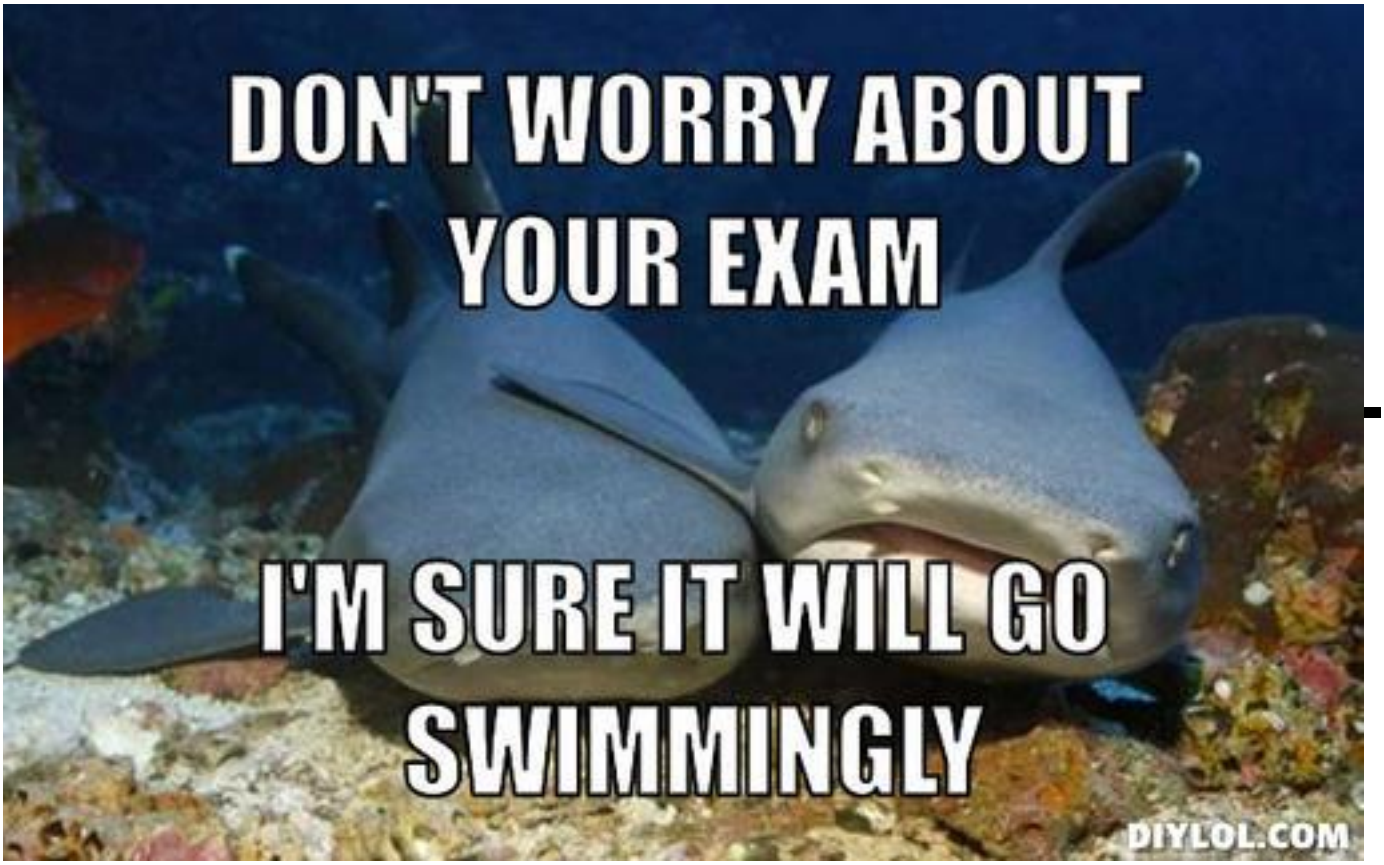
4) Explain the trend between 0 and 25 cm^3 of sodium hydroxide added.

_____
_____
_____

5) Explain the results after 25 cm^3 of sodium hydroxide was added.

_____
_____
_____

Exam questions



1. This question is about elements.

Caesium is in Group 1 of the periodic table.

(a) Explain what happens to caesium atoms and to oxygen atoms when caesium reacts with oxygen to produce caesium oxide.

You should answer in terms of electrons.

(4)

(b) Explain why caesium is more reactive than sodium.

You should answer in terms of electrons.

(4)

(c) The diagram below shows part of Mendeleev's periodic table.

16 **O**	19 **F**
32 **S**	35.5 **Cl**
79 **Se**	80 **Br**
128 **Te**	127 **I**

Explain why the early periodic tables placed iodine (I) before tellurium (Te), but then Mendeleev placed tellurium before iodine.

(3)

(Total 11 marks)

2. This question is about elements in the periodic table.

(a) What order did scientists use to arrange elements in early periodic tables?

(1)

(b) In the early periodic tables some elements were placed in the wrong groups.

Mendeleev overcame this in his periodic table.

Give **one** way Mendeleev did this.

(1)

The table shows the boiling points of fluorine, chlorine and bromine.

Element	Boiling point in °C
Fluorine	−186
Chlorine	−34
Bromine	+59

(c) Explain why the boiling points in the table are low.

(2)

(d) Explain the trend in the boiling points in the table above.

(3)

(e) Explain why neon is unreactive.

Give the electronic structure of neon in your answer.

(2)

(f) How many atoms are there in 1 g of argon?

The Avogadro constant is 6.02×10^{23} per mole.

Relative atomic mass (A_r): Ar = 40

_____

_____

_____

_____

Number of atoms in 1 g = _____

(2)

(Total 11 marks)

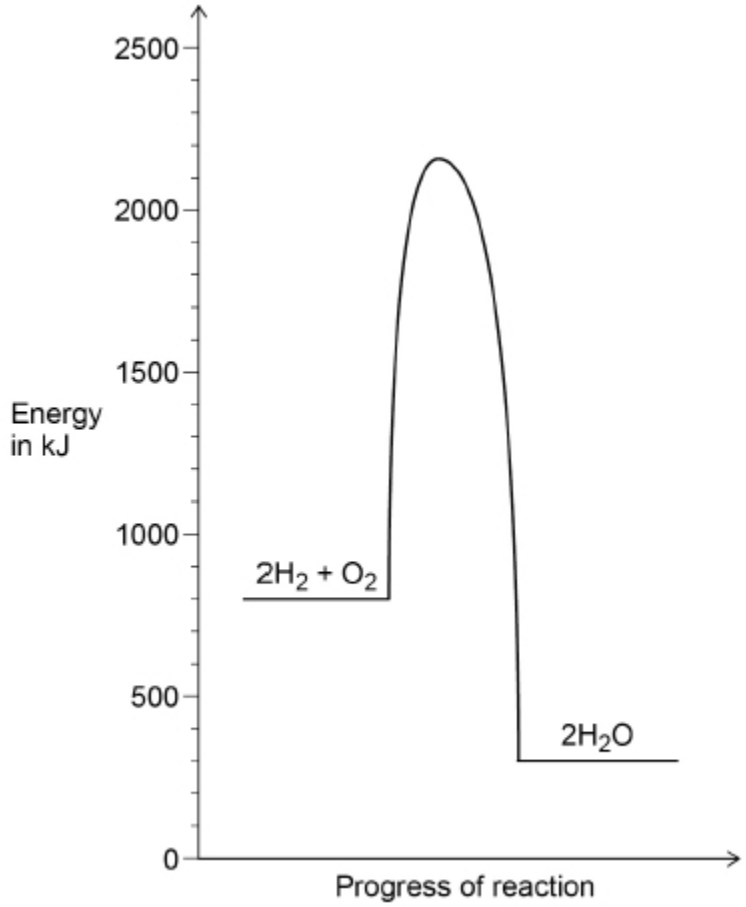
3. This question is about oxygen.

(a) Hydrogen reacts with oxygen.

$$2\ H_2\ (g) + O_2\ (g) \longrightarrow 2\ H_2O\ (g)$$

Figure 1 shows the relative energies of the reactants and products at a certain temperature.

Figure 1



Label the activation energy on **Figure 1**.

(1)

(b) Determine the overall energy change for the reaction between hydrogen and oxygen shown in part (a).

Use **Figure 1**.

_____

_____

_____

_____

Energy change = _____ kJ

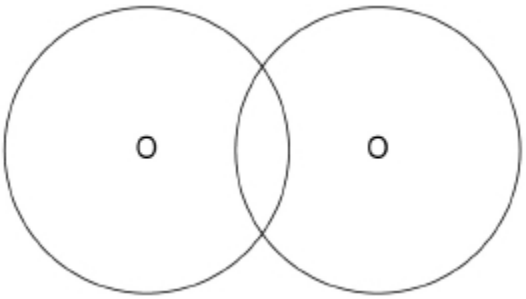
(2)

(c) Oxygen is in Group 6 of the periodic table.

Figure 2 shows the outer energy levels in one molecule of oxygen (O_2).

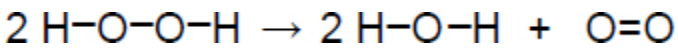
Draw the electrons in the outer energy levels in **Figure 2**.

Figure 2



(2)

(d) The equation shows the decomposition of hydrogen peroxide.



The table shows the bond energies.

Bond	**O–O**	**O=O**	**O–H**
Bond dissociation energy in kJ per mole	138	496	463

Calculate the overall energy change for the reaction.

Energy change = _____ kJ

(3)

(Total 8 marks)

4. Carbon can exist in a number of different structures.

(a) The first fullerene to be discovered was Buckminsterfullerene.

What is the formula of Buckminsterfullerene?

Tick (✓) **one** box.

C40 ☐

C50 ☐

C60 ☐

C70 ☐

(1)

(b) Graphite is a form of carbon.

Explain why graphite conducts electricity.

_____

_____

_____

_____

(2)

Steel is an alloy of iron and carbon.

(c) Explain why steel is harder than iron.

_____

_____

_____

_____

_____

_____

(3)

(d) Iron is alloyed with carbon and other metals to make stainless steel.

A stainless steel fork contains 71.92% iron.

The table below shows the mass of each element in the fork.

Element	Iron	Carbon	Chromium	Nickel
Mass of element in g	**X**	0.05	10.44	5.80

Calculate the mass of iron (**X**) in the fork.

X = _____ g

(4)

(Total 10 marks)

5. This question is about compounds.

(a) The table gives information about the solubility of some compounds.

Soluble compounds
All potassium and sodium salts
All nitrates
Chlorides, bromides and iodides, except those of silver and lead

Use information from the table to answer these questions.

(i) Name a soluble compound that contains silver ions.

(1)

(ii) Name a soluble compound that contains carbonate ions.

(1)

(b) Metal oxides react with acids to make salts.

What type of compound is a metal oxide?

_____

(1)

(c) Lead nitrate solution is produced by reacting lead oxide with nitric acid.

(i) State how solid lead nitrate can be obtained from lead nitrate solution.

_____

_____

(1)

(ii) Balance the equation for the reaction.

$PbO + HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$

(1)

(iii) Give the total number of atoms in the formula $Pb(NO_3)_2$

_____

(1)

(d) An oxide of lead that does **not** have the formula PbO contains 6.21 g of lead and 0.72 g of oxygen.

Calculate the empirical formula of this lead oxide.

Relative atomic masses (A_r): O = 16; Pb = 207

You must show your working to gain full marks.

_____

_____

_____

_____

_____

_____

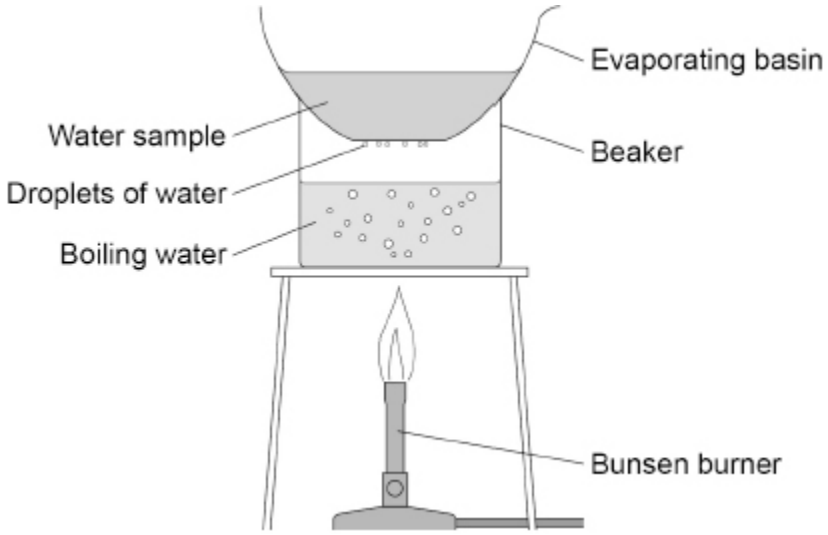
Empirical formula = _____

(4)

(Total 10 marks)

6. A student investigated the mass of dissolved solids in four water samples **A**, **B**, **C** and **D**.

The diagram below shows the apparatus used.



This is the method used.

1. Record the mass of a dry evaporating basin.
2. Pour 25 cm^3 of water sample **A** into the evaporating basin.
3. Place the evaporating basin on the beaker for 10 minutes.
4. Record the mass of the evaporating basin and contents.
5. Repeat steps 1 to 4 with water sample **A** three more times.
6. Repeat steps 1 to 5 with water samples **B**, **C** and **D**.

(a) What type of variable is the mass of dissolved solids?

Tick (✓) **one** box.

Categoric ☐

Control ☐

Dependent ☐

Independent ☐

(1)

(b) The method produced an error in the mass recorded in step 4.

Suggest what caused the error.

How could the error be avoided?

Error _____

_____

Avoided by _____

_____

(2)

Another student carried out the investigation correctly.

The table below shows the results.

Water sample	**Mass of dissolved solids in g**				
	Test 1	**Test 2**	**Test 3**	**Test 4**	**Mean**
A	0.22	0.23	0.20	**X**	0.21
B	0.03	0.08	0.02	0.03	0.04
C	0.45	0.60	0.49	0.58	0.53
D	0.80	0.91	0.79	0.86	0.84

(c) Calculate value **X** in the table above.

_____

_____

_____

_____

X = _____ g

(2)

(d) Which water sample has the greatest range of masses of dissolved solids?

Give the reason for your answer.

Water sample _____

Reason _____

_____

_____

(2)

(e) Water companies measure the volume of water used by households in cubic metres (m^3).

25 cm^3 of a different water sample contained 0.016 g of dissolved solids.

Calculate the mass of dissolved solid in 1 m^3 of this water sample.

1 m^3 = 1000 dm^3

Give your answer in standard form.

_____

_____

_____

_____

_____

_____

_____

_____

Mass (in standard form) = _____ g

(4)

(Total 11 marks)

7. This question is about the electrolysis of aqueous solutions.

Hydrogen gas and chlorine gas are produced when sodium chloride solution is electrolysed.

(a) Hydrogen ions (H^+) are attracted to the negative electrode.

The half equation for the reaction at the negative electrode is:

$$2\ H^+ \quad + \quad 2\ e^- \quad \rightarrow \quad H_2$$

What type of reaction happens at the negative electrode?

Give the reason for your answer.

Type of reaction _____

Reason _____

_____

(2)

(b) Chloride ions are attracted to the positive electrode.

Complete the half equation for the production of chlorine gas (Cl_2).

$$\_\_\_\ Cl^- \quad \rightarrow \_\_\_\_\_ + \_\_\_\_\_$$

(2)

(c) Hydrogen gas and oxygen gas are produced when sodium sulfate solution is electrolysed.

Explain how oxygen gas is produced in the electrolysis of sodium sulfate solution.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

8. A student investigated the temperature change when magnesium was added to copper sulfate solution.

This is the method used.

1. Pour 30 cm^3 of copper sulfate solution into a polystyrene cup.
2. Measure the temperature of copper sulfate solution every minute for 3 minutes.
3. Add magnesium on the fourth minute.
4. Measure the temperature of the mixture at 5 minutes and then every minute up to 14 minutes.

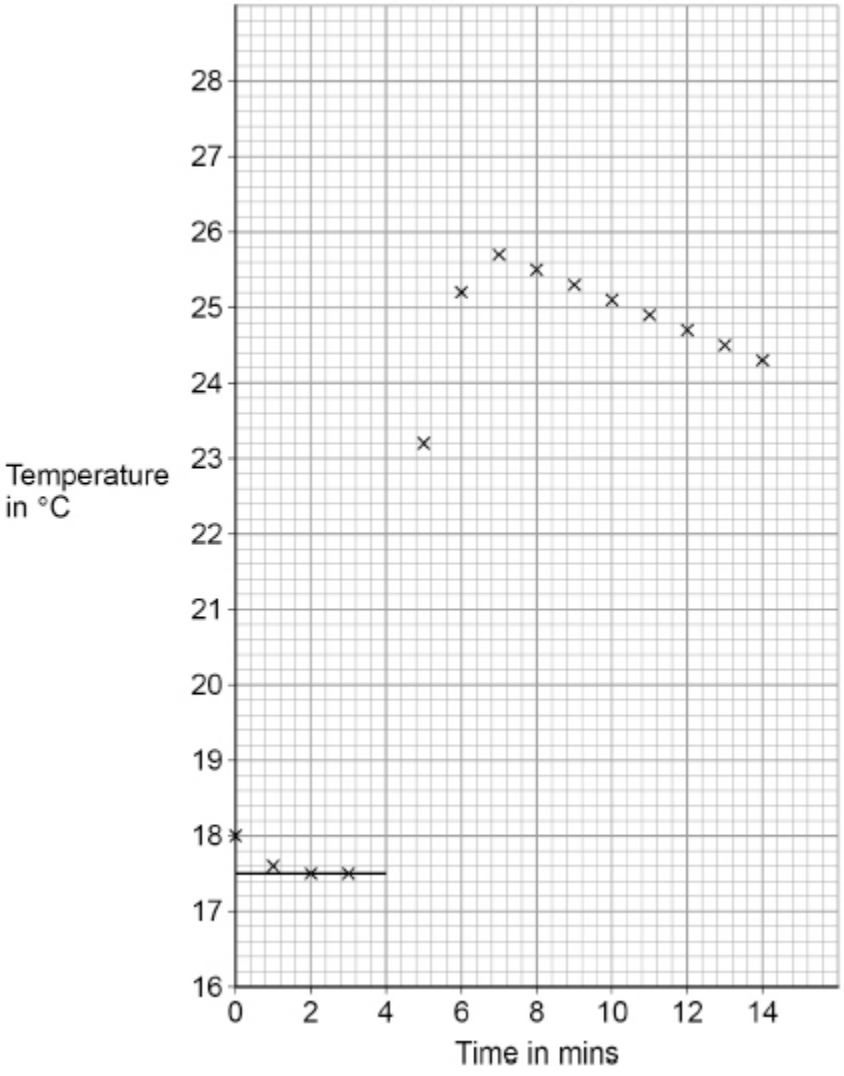
(a) What is the dependent variable in this investigation?

_____

(1)

The student used the results to plot a graph.

The image below shows the graph.



(b) Suggest why the copper sulfate solution was left for four minutes before adding the magnesium.

_____

_____

(1)

(c) Complete the graph above by:

- drawing a line of best fit through all the points after 7 minutes
- extending the line back to 4 minutes.

(2)

(d) The temperature change for the reaction is the temperature difference between the two graph lines at 4 minutes.

Determine the temperature change for the reaction.

Use the graph above.

_____

_____

Temperature change = _____ °C

(2)

(e) Explain why the temperature of the mixture decreases after 7 minutes.

_____

_____

_____

_____

(2)

(f) The student repeated the experiment with an unknown metal **Q** instead of magnesium.

All the other variables were kept the same.

The student recorded a smaller temperature change.

Suggest the identity of metal **Q**.

Give **one** reason for your answer.

Metal **Q** _____

Reason _____

_____

(2)

(g) A copper sulfate solution contained 0.100 moles of copper sulfate dissolved in 0.500 dm^3 of water.

Calculate the mass of copper sulfate in 30.0 cm^3 of this solution.

Relative formula mass (M_r): $CuSO_4$ = 159.5

Mass = _____ g

(4)

(Total 14 marks)

1. (a) caesium atom loses one electron

1

(and) oxygen atom gains two electrons

1

(so) two caesium atoms react with one oxygen atom

allow (to produce) Cs_2O

*max **3** marks if reference to incorrect particles / bonding / structure*

1

any **one** from:

- (to form) Cs^+ and O^{2-}
- (to form) caesium ion(s) and oxide ion(s)
- (to form) ions with full outer shells / levels

1

(b) (caesium has) more energy levels
or
(caesium has) more shells

allow converse for sodium

1

(so the) outer electron / shell is further from nucleus
or
outer electron / shell is more shielded

1

(so) weaker attraction between nucleus and outer electron / shell

1

(so) outer electron is more easily lost

allow (so) less energy needed to remove outer electron

1

(c) early periodic tables were arranged with elements in order of their atomic weights

ignore atomic mass

1

iodine has a lower atomic weight than tellurium

allow converse for tellurium

1

(so) Mendeleev placed iodine with elements with same / similar properties

allow F / Cl / Br for elements

or

(so) Mendeleev placed tellurium with elements with same / similar properties

allow O / S / Se for elements

1

[11]

2.

(a) atomic weight

*do **not** accept atomic mass or A_r*

1

(b) left gaps / spaces

or

changed the order based on atomic weights

allow placed them in correct groups according to properties

*do **not** accept reference to atomic number*

1

(c) weak forces between the molecules

or

weak intermolecular forces

allow weak intermolecular bonds

*do **not** accept incorrect references to covalent bonds*

1

(so) little energy required to overcome / break the forces between molecules

or

(so) little energy required to overcome / break the intermolecular forces

allow (so) little energy required to separate the molecules

allow (so) little energy required to overcome / break the intermolecular bonds

ignore less energy

1

(d)

allow converse explanation in terms of boiling point

(the) molecules get larger going down the group

1

(so the) forces between the molecules increase

or

(so the) intermolecular forces increase

1

(so the) boiling points increase going down the group

or

(so the) boiling points increase with increasing relative atomic mass

allow (so) more energy is needed to separate the molecules

1

(e) 2,8

allow diagram or description

1

(so) stable arrangement of electrons
or
(so) full outer shell

1

(f)

*an answer of 1.51 × 10^{22} scores **2** marks*

$\frac{1}{40} \times 6.02 \times 10^{23}$
or
$0.025 \times 6.02 \times 10^{23}$

1

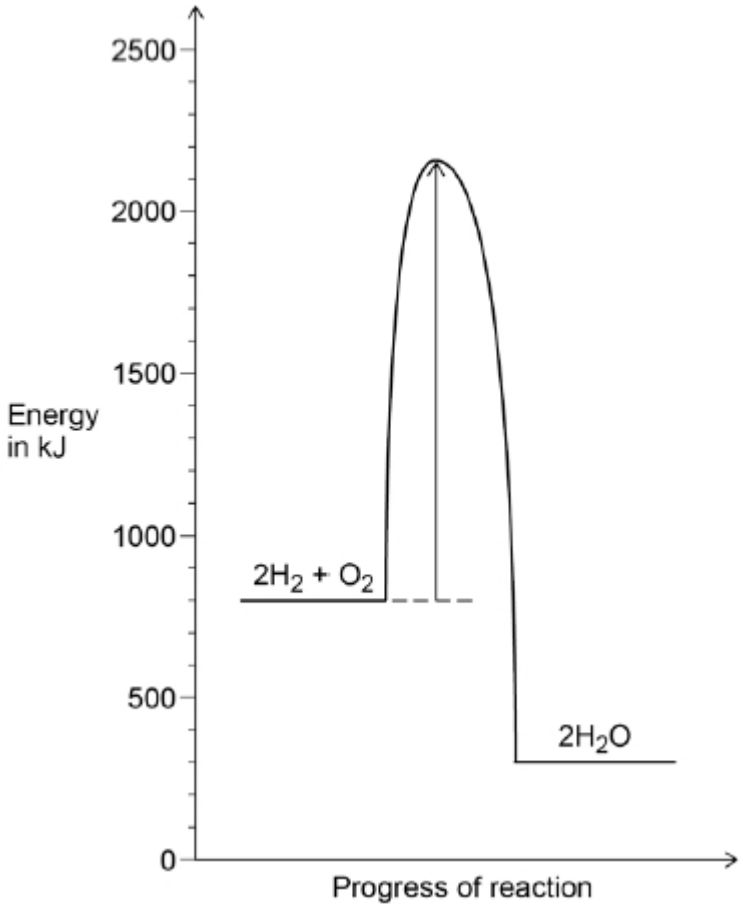
1.51×10^{22}

allow 1.505 × 10^{22}

1

[11]

3. (a) line from reactants to top of curve (i.e. from 800 to 2160)



ignore arrowheads

1

(b) reads levels of reactants (800 kJ) and products (300 kJ)

1

(800 − 300) = 500 (kJ)

allow correct subtraction of one incorrect value determined for the energy change

1

*an answer of (–) 500 (kJ) scores **2** marks ignore sign*

(c)

allow combination of circles, dots, crosses or $e^{(-)}$

two shared pairs in overlap

1

all non-bonding electrons in outer shell (4 electrons on each O atom)

ignore any inner shell electrons

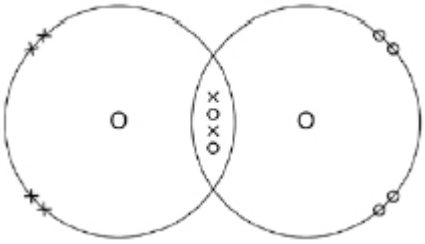


diagram scores 2 marks

1

(d) (bonds broken)
((4 × 463) + (2 × 138) =) **2128**

1

(bonds made)
((4 × 463) + (496) =) **2348**

1

(energy change =
bonds broken – bonds made)
(2128 – 2348 =) (–) **220** (kJ)

ignore energy change sign

allow correct calculation using incorrect values from step 1 and/or step 2

1

alternative approach:

(bonds broken)
(2 × (O–O) = (2 × 138) =) **276** (1)

(bonds made)
(1 × (O=O) =) **496**(1)

(energy change =
bonds broken – bonds made)
(276 − 496 =) (–) **220** (kJ) (1)

*an answer of (–) 220 (kJ) scores **3** marks*

*an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps*

[8]

4. (a) C_{60}

1

(b) (graphite has) delocalised electrons

1

(so the delocalised electrons) carry electrical charge through the structure

allow (so the delocalised electrons) move through the structure

1

(c) carbon atoms have different sizes to iron atoms / ions

1

(so carbon atoms) distort the layers of iron atoms / ions

1

(therefore) the layers cannot slide

1

(d) (percentage and mass of other elements)
28.08 (%) = 16.29 (g)

1

(mass of fork) = $\frac{16.29}{28.08} \times 100$ (g)

1

= 58.01 (g)

1

(mass of iron = $\frac{71.92}{100} \times 58.01$

71.92

allow (mass of fork – mass of other elements) = 41.72 (g)

allow 41.7 (g)

allow correct use of incorrect calculation of mass and / or percentages

1

[10]

5. (a) (i) silver nitrate

allow $AgNO_3$

1

(ii) potassium carbonate **or**

allow K_2CO_3

sodium carbonate

allow Na_2CO_3

1

(b) base

allow ionic

ignore insoluble or soluble

ignore alkali

1

(c) (i) evaporate

or

crystallise

allow heat or boil or leave (to evaporate)

allow cool

ignore filtration unless given as an alternative

*do **not** accept freeze or solidify*

1

(ii) 2 (HNO_3)

accept multiples

1

(iii) 9

accept nine

1

(d) 6.21 / 207 0.72 / 16

***1** mark for dividing mass by A_r*

1

= 0.03 = 0.045

***1** mark for correct proportions (allow multiples)*

1

2 3

***1** mark for correct whole number ratio (allow multiples). Can be awarded from formula.*

1

Pb_2O_3

allow O_3Pb_2

***ecf** allowed throughout if sensible attempt at step 1*

*correct formula with no working gains **1** mark*

1

[10]

6. (a) dependent

1

(b) not all water had been removed from the sample

allow description of process

1

heat to constant mass

1

alternative approach:

mass included (droplets of) water on the bottom of the evaporating basin (1)

allow bottom of evaporating basin was wet
ignore spillages
ignore weighing errors

dry the bottom of the evaporating basin (1)

allow wipe off droplets

(c)

$$\frac{0.22 + 0.23 + 0.20 + X}{4} = 0.21$$

1

(**X** =) 0.19 (g)

1

(d) **C**

*allow ecf from question **(c)***

1

biggest difference between the maximum and minimum values

*allow calculated range if all ranges are shown **A** 0.04; **B** 0.06; **C** 0.15 and **D** 0.12*

1

(e) (conversion m^3 to cm^3) 1 m^3 = 1 x 10^6 cm^3

1

(mass =) 1 x 10^6 × $\frac{0.016}{25}$

allow correct use of an incorrect / no conversion value

1

= 640 (g)

1

= 6.4 × 10^2 (g)

allow a correctly calculated answer in standard form from an incorrect calculation of mass

1

[11]

7. (a) reduction

ignore electrolysis

1

(as H^+ ions) gain electrons

1

(b) $2\ Cl^- \rightarrow Cl_2 + 2\ e^-$

allow $2\ Cl^- - 2\ e^- \rightarrow Cl_2$

ignore state symbols

*allow **1** mark for $Cl_2 + e^-$*

*allow **1** mark for $-e^-$ (on lhs) **and** Cl_2 (on rhs)*

2

(c) water molecules

1

break down to produce OH^- ions

allow dissociate to produce OH^- ions

1

(which are) attracted to the positive electrode

1

(where OH^- ions are) oxidised

or

(where OH^- ions) lose electrons

ignore discharged

ignore oxygen is produced as no halide is present

1

[8]

8. (a) temperature (change)

1

(b) to reach a constant temperature

allow to reach room temperature

1

(c) line of best fit after 7 minutes

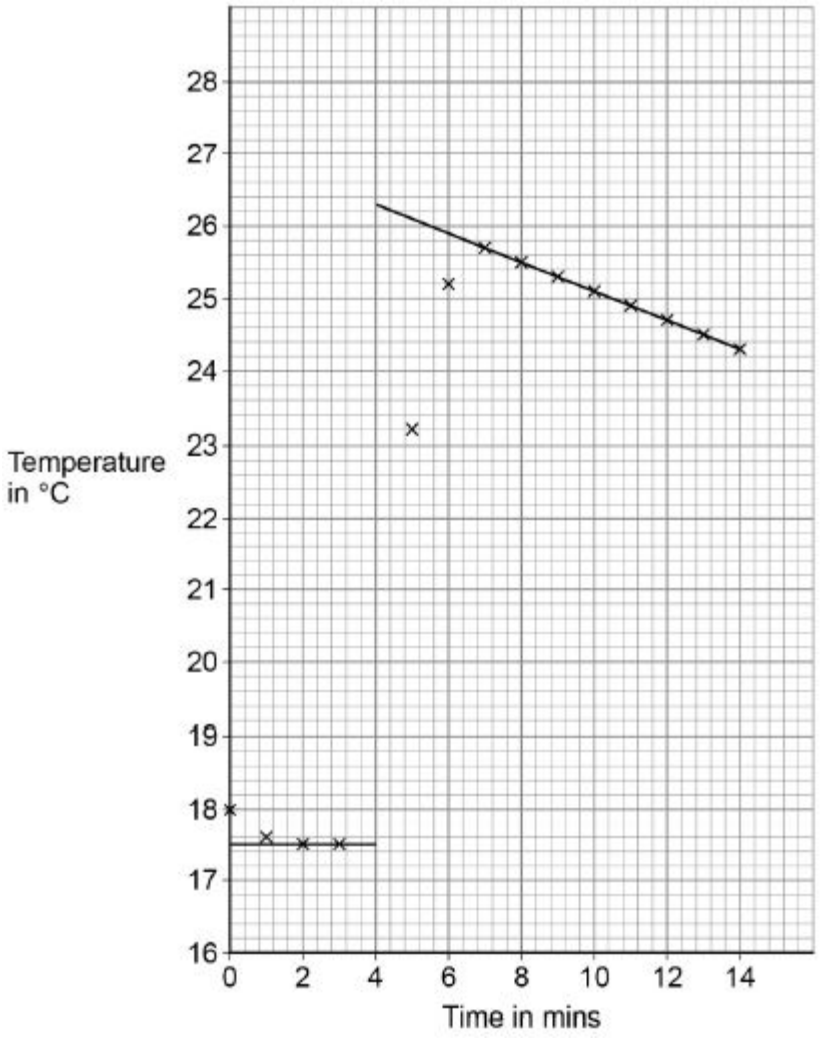
1

extends line back to 4 minutes

ignore extension of line beyond 4 minutes

1

the diagram below scores **2** marks



(d) (maximum **and** minimum values at 4 minutes)
26.3 (^{o}C) **and** 17.5 (^{o}C)

*allow ecf from **(c)***

1

(temperature change at 4 minutes)
= 8.8 (^{o}C)

1

(e) the reaction finished / stopped

allow maximum temperature has been reached

1

(so) energy is lost to surroundings / atmosphere

or

(so the) solution cools (back to room temperature)

allow heat for energy

1

(f) aluminium / zinc / iron / beryllium

allow Al / Zn / Fe / Be

*do **not** accept copper, silver*

MP2 dependent on a correct answer to MP1

1

metal **Q** is less reactive (than magnesium)

or

metal **Q** is lower in reactivity series

allow converse

1

(g) (unit conversion)

$30.0\ cm^3 = 0.030\ dm^3$

or

$0.500\ dm^3 = 500\ cm^3$

1

(moles = $\frac{30}{500}$ × 0.1 =) 0.006

allow correct use of incorrect / no unit conversion

or

(moles = $\frac{0.030}{0.50}$ × 0.1 =) 0.006

1

mass = 0.006 × 159.5

allow correct use of incorrect value for number of moles

1

= 0.957 (g)

allow 0.96 (g)

1

[14]