GCSE Chemistry Mock Test 1

Duration 1 hour

Marks: 60

THE PERIODIC TABLE

Period	1	2					Group						3	4	5	6	7	0
1	1 H Hydrogen 1																	4 He Helium 2
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
3	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
4	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
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

P 4 4 2 7 0 A 0 2 2 0

Answer ALL questions.

1 An atom of an element has an atomic number of 6 and a mass number of 12.

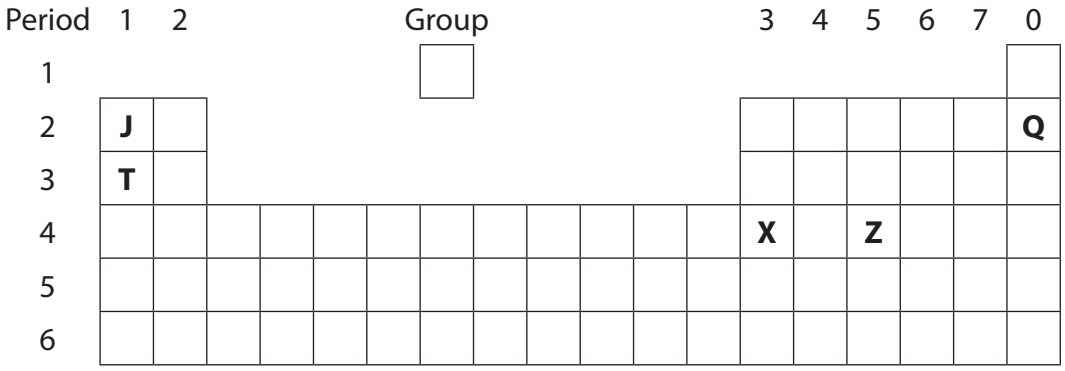
(a) Using this information, complete the table to show the numbers of protons, neutrons and electrons in one atom of this element.

(2)

number of protons	
number of neutrons	
number of electrons	

(b) The Periodic Table shows the positions of five elements, J, Q, T, X and Z.

The letters do **not** represent the symbols for the elements.



(i) How many electrons are there in the outer shell of an atom of X?

(1)

.....

(ii) There are 31 protons in an atom of X.

Using this information, explain how many protons there are in an atom of Z.

(2)

.....

.....

.....

.....

(iii) What is the electronic configuration of an atom of Q?

(1)

.....

(iv) State one similarity and one difference between the electronic configurations of atoms of J and T.

(2)

similarity .....

difference .....

(Total for Question 1 = 8 marks)

2 Ethene is an unsaturated hydrocarbon.

(a) (i) The molecular formula of ethene is

(1)

- ☒ **A** CH_4
- ☒ **B** C_2H_6
- ☒ **C** C_2H_4
- ☒ **D** C_3H_6

(ii) Ethene is bubbled into bromine water until there is no further change.

What is the appearance of the solution formed?

(1)

- ☒ **A** brown
- ☒ **B** colourless
- ☒ **C** purple
- ☒ **D** red

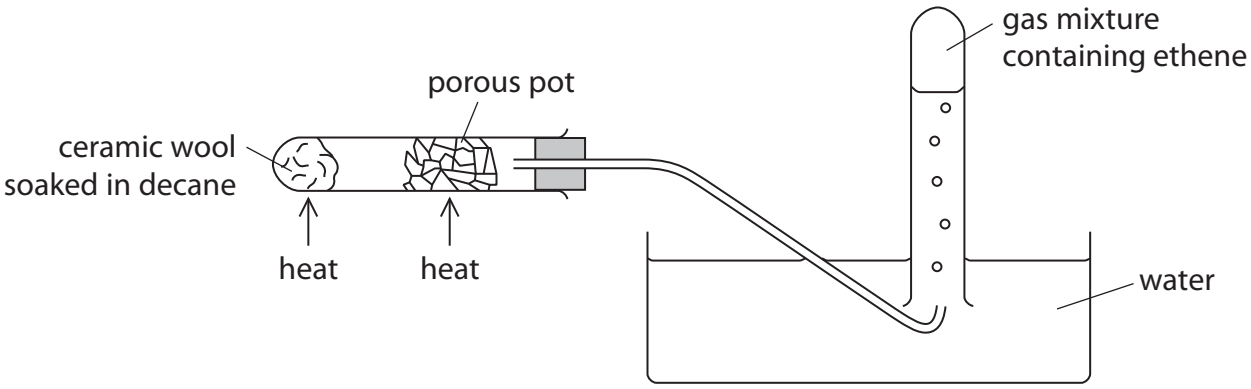
(iii) Ethene can be formed from ethanol.

This type of reaction is called

(1)

- ☒ **A** dehydration
- ☒ **B** oxidation
- ☒ **C** reduction
- ☒ **D** substitution

(b) This apparatus can be used to decompose decane ($C_{10}H_{22}$).



(i) What name is given to this type of thermal decomposition?

(1)

.....

(ii) Porous pot contains oxides such as silica and alumina.

What is the purpose of the porous pot in this experiment?

(1)

.....

.....

(iii) Suggest why the gas collected is a mixture and not pure ethene.

(1)

.....

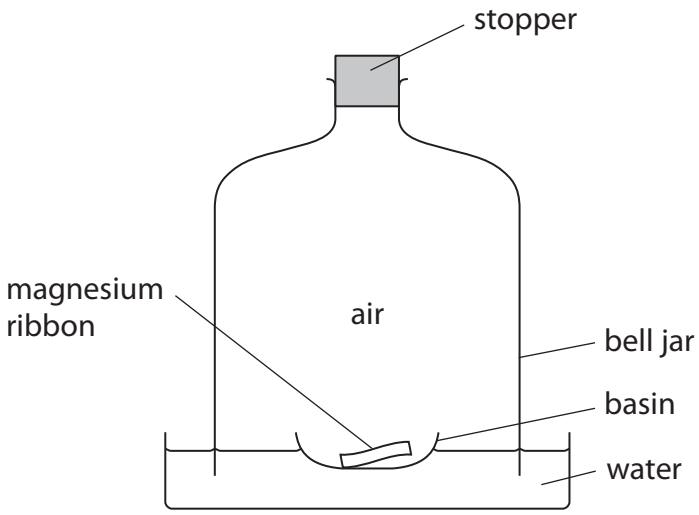
.....

(Total for Question 2 = 6 marks)

3 Magnesium reacts with oxygen in the air to form magnesium oxide.

$$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$$

The apparatus in the diagram can be used to investigate the decrease in the volume of gas when magnesium burns in air.



The stopper is removed and the magnesium is lit. The stopper is then quickly replaced.

After the flame goes out there is some magnesium left in the basin.

After the apparatus has cooled to its original temperature, the water level in the bell jar is higher than shown in the diagram.

(a) What is the colour of the flame produced when the magnesium burns?

(1)

.....

(b) What is the colour of the solid produced when the magnesium burns?

(1)

.....

(c) The volume of air in the bell jar at the start of the experiment is 1000 cm^3.

Calculate the volume of gas you would expect to remain in the bell jar at the end of the experiment. Assume all the oxygen in the air is used up.

(2)

volume of gas remaining = ... cm^3

(d) In another experiment, the mass of magnesium that burned was 0.12 g.

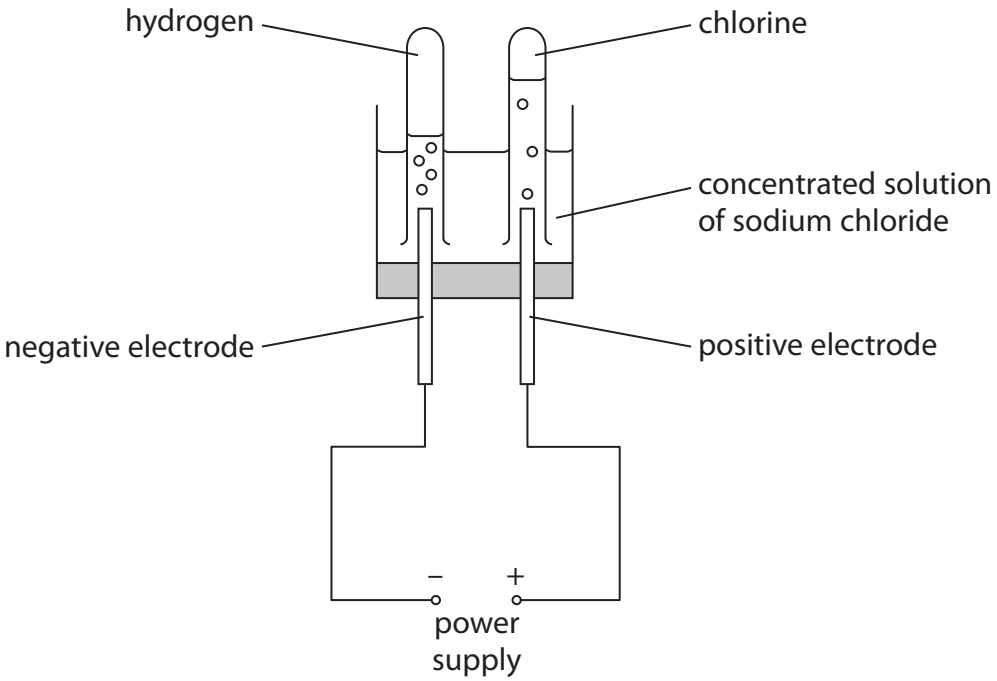
Calculate the maximum mass of magnesium oxide that could be formed in this experiment.

(2)

mass of magnesium oxide formed = ... g

(Total for Question 3 = 6 marks)

4 This apparatus is used to electrolyse a concentrated solution of sodium chloride.



(a) The ionic half-equations for the reactions at the electrodes are

negative electrode $2H_2O(l) + 2e^- \rightarrow 2OH^-(aq) + H_2(g)$

positive electrode $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

(i) State how these ionic half-equations show that equal volumes of the two gases should be collected.

(1)

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.....

.....

(ii) Suggest why the volume of chlorine collected is less than expected.

(1)

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.....

.....

(iii) A sample of the solution near to the negative electrode is tested with phenolphthalein indicator.

Explain why the phenolphthalein turns pink.

(2)

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.....

.....

.....

(b) The table shows two methods of testing for chlorine.

Complete the table by giving the observation made in each test.

(2)

Test	Observation
add damp blue litmus paper	
bubble chlorine into a solution of potassium iodide	

(c) (i) State why chlorine is sometimes added to water supplies.

(1)

.....

.....

(ii) Chlorine is used to manufacture hydrogen chloride gas, HCl(g).

Write a chemical equation to show the formation of hydrogen chloride from hydrogen and chlorine.

(1)

.....

(iii) How is hydrogen chloride gas converted into hydrochloric acid?

(1)

.....

.....

(Total for Question 4 = 9 marks)

5 A teacher investigates the temperature changes that occur when sodium hydroxide solution is added to dilute hydrochloric acid.

This is the method she uses.

- place some of the acid in a glass beaker and measure its temperature
- add a known volume of sodium hydroxide solution
- stir the mixture and record the highest temperature reached
- repeat the experiment with different volumes of sodium hydroxide solution

(a) State two factors that the teacher must keep constant to make this a valid investigation (a fair test).

(2)

1 .....

2 .....

(b) Explain how the use of a polystyrene cup, in place of a glass beaker, will affect the accuracy of the results.

(2)

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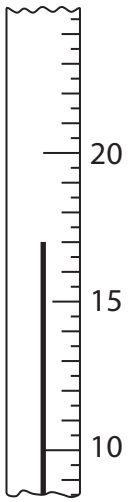
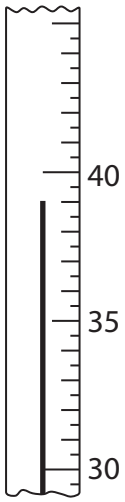
.....

(c) (i) The diagram shows the thermometer readings for one of the experiments.



initial temperature



final temperature

Record the temperatures and calculate the temperature change.

(3)

final temperature of mixture	..... °C
initial temperature of acid	..... °C
temperature change	..... °C

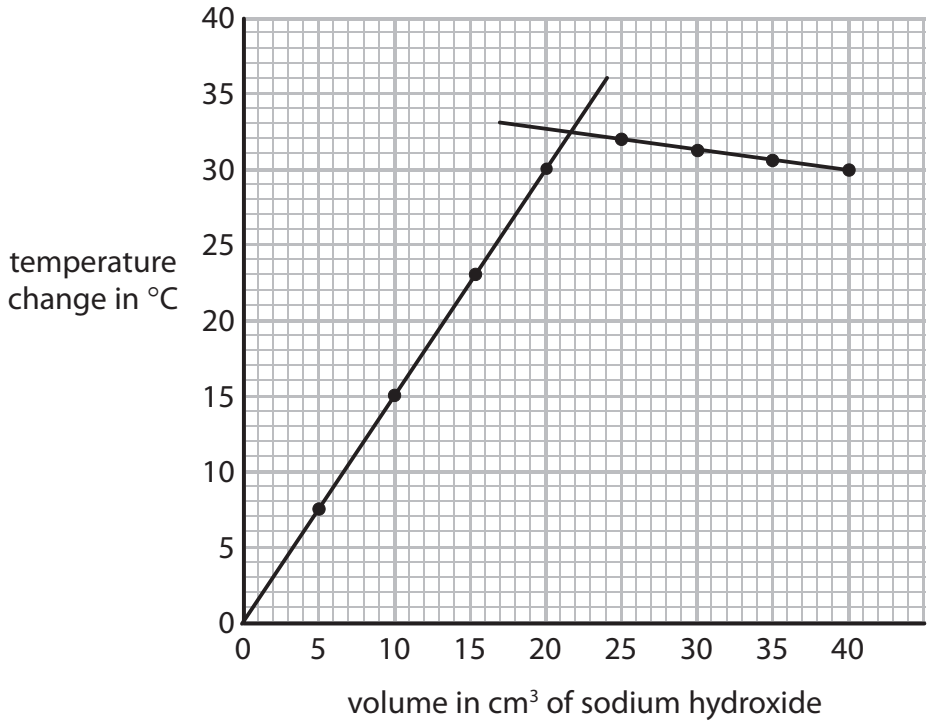
(ii) State how the temperature change shows whether the reaction between sodium hydroxide and hydrochloric acid is exothermic or endothermic.

(1)

.....

.....

(d) The graph shows the result of the teacher's investigation.



Explain the shape of the graph.

(2)

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(Total for Question 5 = 10 marks)

6 This question is about the reactions of compounds of antimony and phosphorus.

(a) Antimony (Sb) can be obtained from its oxide (Sb_2O_4) by heating it with carbon.

The equation for this reaction is

$$Sb_2O_4(s) + 4C(s) \rightarrow 2Sb(s) + 4CO(g)$$

(i) Give the name of the gas produced in this reaction.

(1)

.....

(ii) State why this gas is poisonous to humans.

(1)

.....

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.....

(b) Phosphorus sulfide (P_4S_3) is one of the reactants used in match heads.

When a match is struck, energy is transferred to the reactants in the match head, starting a reaction.

(i) Balance the equation that represents this reaction.

(2)

$6KClO_3(s)$ + ...$S(s)$ + ...$P_4S_3(s)$ → .....$KCl(s)$ + ...$SO_2(g)$ + ...$P_4O_{10}(s)$

(ii) What term is used to describe the energy required to start a reaction?

(1)

.....

(Total for Question 6 = 5 marks)

7 Bromine and iodine are halogens.

(a) Complete the table by giving the colour and physical state of each of these halogens at room temperature.

(2)

Halogen	Colour	Physical state
bromine	red-brown	
iodine		solid

(b) Bromine reacts with phosphorus to form the covalent compound phosphorus tribromide.

Draw a dot and cross diagram to show the outer electrons in a molecule of phosphorus tribromide.

(2)

Br P Br

Br

(c) Phosphorus tribromide reacts with water to form a mixture of two acids, HBr and H_3PO_3

Write a chemical equation for this reaction.

(2)

.....

(Total for Question 7 = 6 marks)

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8 Nickel is an important metal.

(a) Three of the stages in the extraction of nickel from its ore are

stage 1 nickel(II) oxide is reduced by heating with H_2 to produce impure nickel

$$NiO(s) + H_2(g) \rightarrow Ni(s) + H_2O(g)$$

stage 2 the impure nickel is reacted with CO

$$Ni(s) + 4CO(g) \rightleftharpoons Ni(CO)_4(g)$$

stage 3 $Ni(CO)_4$ is decomposed by heating to produce pure nickel

$$Ni(CO)_4(g) \rightarrow Ni(s) + 4CO(g)$$

(i) State why the reaction in stage 1 is described as reduction.

(1)

.....

.....

(ii) Suggest why a low temperature produces a high yield of $Ni(CO)_4$ in stage 2.

(2)

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.....

(b) Nickel has a melting point of 1455 °C and is a good conductor of electricity.

(i) Draw a labelled diagram to show the arrangement of the particles in nickel.

(3)

(ii) Explain, in terms of its structure, why nickel is malleable and is a good conductor of electricity.

(4)

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(Total for Question 8 = 10 marks)

TOTAL FOR PAPER = 60 MARKS

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<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 a</td><td><table><tr><td>Number of protons</td><td>6</td></tr><tr><td>Number of neutrons</td><td>6</td></tr><tr><td>Number of electrons</td><td>6</td></tr></table></td><td>M1 protons and electrons correct

M2 neutrons correct</td><td>2</td></tr>
<tr><td>b i</td><td>3</td><td></td><td>1</td></tr>
<tr><td>ii</td><td>M1 33

M2 Z is two places/columns/groups/positions after X
OR
Z is in Group 5 and X is in Group 3</td><td>Accept has 2 more protons (than X)

Ignore references to atomic number increasing by 2
Ignore number of protons increases with group number
Ignore references to elements being arranged according to number of protons

31 + 5 – 3 = 33 scores 2 marks</td><td>2</td></tr>
<tr><td>iii</td><td>2.8 / 2,8 / 2 and 8 separated by other mark
eg : or / or) or space</td><td>Do not accept 28 (ie no space)
Accept correct sp notation</td><td>1</td></tr>
</table>

Question number	Answer	Notes	Marks
1 b iv	M1 (similarity) one electron/same number of electrons in outer shell M2 (difference) different number of (electron) shells / T has (one) more (electron) shell / J has (one) less (electron) shell /J has 2 shells and T has 3 /J is 2.8.1	Accept rings and energy levels in place of shells in M1 and M2 Accept valence electrons in place of outer shell electrons Accept configuration ends in 1 Accept same outer shell Accept 2 electrons in first/inner shell Accept going down the column there is 1 more shell Ignore T has an extra number Ignore T has 8 more electrons	2
			Total 8 marks

Question number	Answer	Notes	Marks
2 a i	C (C_2H_4)		1
ii	B (colourless)		1
iii	A (dehydration)		1
b i	cracking		1
ii	(to act as a) catalyst OR to increase rate / speed up reaction	Accept (to provide an alternative route with) lower activation energy Accept decomposition / cracking in place of reaction	1
iii	cracking produces 2 or more products OR other products are formed OR identified possible product OR not all decane decomposed OR water vapour present (not just water)	Accept molecules / hydrocarbons /alkanes / alkenes in place of products Accept any hydrogen and any hydrocarbon with 8 or fewer carbon atoms (name or formula) Ignore decane decomposes / decane contains impurities Ignore references to air / oxygen / nitrogen / carbon dioxide Accept equation for cracking of decane showing two or more possible products (even if unbalanced)	1
			Total 6 marks

Question number	Answer	Notes	Marks
3 a	white		1
b	white		1
c	M1 $\frac{1000 \times 21}{100}$ / 210 M2 (1000 – 210) = 790 (cm^3) OR M1 100 – 21 = 79 M2 $\frac{1000 \times 79}{100}$ = 790 (cm^3)	Accept calculation based on any value in range 20 - 21 % M2 CQ on incorrect percentage of oxygen, but this must be stated Correct final answer with no working scores 2 marks	2
d	M1 n(Mg) = 0.12 ÷ 24 / 0.0050 (mol) M2 (0.0050 x 40 =) 0.2(0) (g) OR M1 m(MgO) = $\frac{40 \times 0.12}{24}$ or $\frac{80 \times 0.12}{48}$ M2 = 0.2(0) (g)	Accept fraction 1/200 Correct final answer scores 2 marks	2
			Total 6 marks

Question number	Answer	Notes	Marks
4 a i	correct statement about connection between number of electrons and moles/molecules/amounts (of both gases) OR reference to number of moles/molecules being equal (in both equations)	eg same number of electrons give same numbers of moles eg equal moles of gases have equal volumes / volumes are proportional to numbers of moles	1
ii	(some/chlorine/it) is soluble / dissolves (in water / in the solution) OR (some/chlorine/it) reacts with water	Accept (some) oxygen also collected Reject chlorine reacts with graphite Ignore chlorine gas escapes Reject reacts with sodium chloride / reacts with sodium hydroxide	1
iii	M1 (solution) alkaline / pH greater than 7 M2 (because) hydroxide ions / OH^- (formed)	Mark M1 and M2 independently Ignore basic Accept any value above 7 up to 14 Accept sodium hydroxide formed	2
b	M1 (result of litmus test) bleaches / goes white M2 (result of KI test) brown (solution) / black precipitate or equivalent	 Ignore red as intermediate colour Accept decolourises / colourless Accept yellow and orange in place of brown Accept grey in place of black Ignore shades such as pale / dark Reject red / red-brown / purple / blue-black	2

Question number	Answer	Notes	Marks
4 c i	to sterilise / disinfect (the water) OR to make it safe to drink	Accept kill bacteria / microbes / pathogens / microorganisms / (harmful) organisms / germs / viruses Ignore references to cleaning / purifying / bleaching / changing pH	1
ii	$H_2 + Cl_2 \rightarrow 2HCl$	Ignore state symbols	1
iii	dissolve in / add to water	Accept mixing with water / bubbling through water / react with water / make aqueous Ignore adding to liquid	1
			Total 9 marks

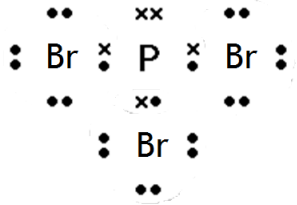
Question number	Answer	Notes	Marks
5 a	Any two of: • (same) volume of acid • (same) concentration of acid • (same) concentration of alkali • (same) rate of stirring / stir for the same time • (same) starting temperature / temperature of acid/alkali/solutions/room	Reject volume(s) of solutions Accept amount of acid as alternative to either of first two bullet points	2
b	M1 correct reference to accuracy / temperature rise	eg accuracy improved or increased / temperature rise greater or more accurate or closer to correct value(s) / final temperatures higher Accept temperatures more accurate Ignore just higher temperatures Ignore results more reliable / valid	2
	M2 correct reference to insulation / heat loss	eg polystyrene is a (better) insulator / poorer conductor (than glass) / reduces heat loss / more heat trapped Ignore no heat loss Accept reverse argument for glass	

Question number	Answer	Notes	Marks
5 c i	M1 (final) 39(.0) M2 (initial) 17(.0) M3(change) (+)22(.0)	Both values correct but in wrong order scores 1 mark (of M1 and M2) M3 CQ on final and initial values	3
ii	<u>exothermic</u> AND temperature has increased / temperature change is positive / final temperature higher than initial temperature	Accept heat / thermal energy given out or transferred to the surroundings Reject just energy has been given out	1

Question number	Answer	Notes	Marks
5 d	Any two of: • correct statement about first part of graph, identified as positive gradient / positive correlation / temperature increase / temperatures up to 30 or 32.5 °C / volumes up to 20 or 22 cm^3 / experiments 1-4 • correct statement about top of graph, identified as where lines cross / intersection / peak / maximum • correct statement about second part of graph, identified as negative gradient / negative correlation / temperature decrease / temperatures after 30 or 32.5 °C / volumes after 20 or 22 cm^3 or up to 40 cm^3 / experiments 5-8	eg reaction continuing or acid being neutralised or some acid still unreacted or heat being produced eg reaction complete or all acid neutralised or neutralisation point reached or shows volume of alkali needed to neutralise acid eg further alkali causes cooling or sodium hydroxide absorbs heat or no reaction occurs or no acid left or alkali in excess Reject reaction becomes endothermic Ignore references to direct proportion / particle collisions / limiting reagents / rate of reaction	2
			Total 10 marks

Question number	Answer	Notes	Marks
6 a i	carbon monoxide		1
ii	decreases capacity of blood (cells) to carry oxygen OR stops blood (cells) from carrying oxygen	Accept CO combines with haemoglobin / forms carboxyhaemoglobin Accept CO displaces/replaces oxygen in haemoglobin Ignore CO combines with red blood cells Ignore references to suffocation / lack of oxygen in lungs stopping breathing / gas exchange Ignore just affects haemoglobin Reject destroys haemoglobin	1
b i	$6KClO_3 + S + P_4S_3 \rightarrow \mathbf{6}KCl + \mathbf{4}SO_2 + P_4O_{10}$	M1 coefficient of 6 for KCl M2 coefficient of 4 for SO_2 Max 1 mark if equation unbalanced Ignore 1 for other coefficients 0 for other coefficients loses M2	2
ii	activation (energy)		1
			Total 5 marks

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>7 a</td><td>
<table>
<tr><th>Halogen</th><th>Colour</th><th>Physical state</th></tr>
<tr><td>bromine</td><td></td><td>liquid</td></tr>
<tr><td>iodine</td><td>black</td><td></td></tr>
</table>
</td><td>M1 (bromine) liquid / (l)

M2 (iodine) black
allow (dark) grey</td><td>2</td></tr>
<tr><td>b</td><td>  </td><td>M1 three bonding pairs of electrons correct

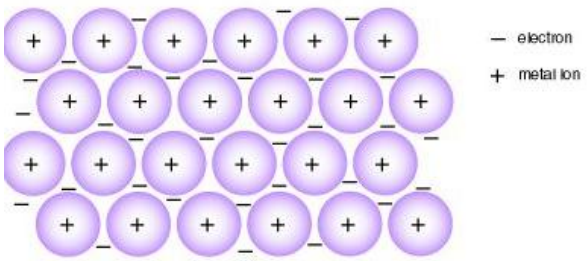
M2 rest of electrons correct

Accept any combination of dots and crosses
Ignore circles</td><td>2</td></tr>
<tr><td>c</td><td>$PBr_3 + \mathbf{3}H_2O \rightarrow \mathbf{3}HBr + H_3PO_3$</td><td>M1 all formulae correct

M2 balanced
M2 DEP on M1</td><td>2

Total 6 marks</td></tr>
</table>

Question number	Answer	Notes	Marks
8 a i	Ni/nickel has lost oxygen (atoms / ions) OR nickel <u>ions</u> gain electrons	Accept NiO/nickel oxide has lost oxygen Accept nickel(II) loses oxygen Ignore <u>it</u> loses oxygen / gains electrons Reject nickel oxide gains electrons Reject nickel loses oxygen molecules Reject any answer that does not refer to Ni or NiO	1
ii	M1 equilibrium (position) shifts to right M2 (forward) reaction is exothermic	Mark independently Ignore forward reaction favoured/occurs more readily/is faster / more product formed Accept heat / thermal energy given out Ignore just gives out energy Ignore because stage 3 is decomposition which is endothermic/takes in heat Ignore references to bond breaking and making and Le Chatelier's principle and different numbers of (gas) moles on each side and rate of reaction	2

Question number	Answer	Notes	Marks
8 b i	diagram showing: M1 minimum of 5 circles in regular pattern in 2 rows M2 +/2+ charges in each circle / appropriate key M3 some indication of electrons between ions / appropriate key	 Accept labelled as cations/positive ions not just ions Reject atoms / protons / nuclei eg e / e^- / – / (shaded) area labelled electrons Do not award M3 if electrons shown in circles more than half the size of the ions Ignore lines between circles Max 1 if negative ions shown Reject electrons shown in pairs between nickel particles for M3 Ignore intermolecular forces label Example:  	3

Question number	Answer	Notes	Marks
8 b ii	malleability (2 marks): M1 layers / sheets / planes / rows AND (positive) ions / atoms / particles M2 slide (over each other) conductivity (2 marks): M3 – delocalised electrons M4 – that flow (when a potential difference is applied)	 Reject molecules / protons / electrons M2 needs reference to either layers or equivalent OR ions/particles/atoms Allow OWTTE, eg slip / flow / shift / roll / move M2 DEP on mention of EITHER layers or equivalent OR mention of ions or equivalent Do not award M2 if protons / electrons / nuclei / molecules in place of ions, etc If reference to ionic bonding / covalent bonding / molecules / intermolecular forces, no M1 or M2 Accept sea of electrons Ignore free electrons Accept move / mobile in place of flow M4 DEP on mention of electrons Ignore reference to intermolecular forces for M3 and M4	4 **Total 10 marks**