

Q1. Instant cold packs are used to treat sports injuries.



One type of cold pack has a plastic bag containing water. Inside this bag is a smaller bag containing ammonium nitrate.

The outer bag is squeezed so that the inner bag bursts. The pack is shaken and quickly gets very cold as the ammonium nitrate dissolves in the water.

(a) **One** of the statements in the table is correct.

Put a tick (✓) next to the correct statement.

Statement	(✓)
The bag gets cold because heat energy is given out to the surroundings.	
The bag gets cold because heat energy is taken in from the surroundings.	
The bag gets cold because plastic is a good insulator.	

(1)

(b) Draw a ring around the word that best describes the change when ammonium nitrate dissolves in water.

electrolysis endothermic exothermic

(1)

(c) Suggest and explain why the pack is shaken after the inner bag has burst.

.....
.....
.....
.....

(2)
(Total 4 marks)

Q2. Iron is an essential part of the human diet. Iron(II) sulfate is sometimes added to white bread flour to provide some of the iron in a person's diet.



(a) The formula of iron(II) sulfate is FeSO_4

Calculate the relative formula mass (M_r) of FeSO_4

Relative atomic masses: O = 16; S = 32; Fe = 56.

.....
.....

The relative formula mass (M_r) =

(2)

(b) What is the mass of one mole of iron(II) sulfate? Remember to give the unit.

.....

(1)

(c) What mass of iron(II) sulfate would be needed to provide 28 grams of iron?

Remember to give the unit.

.....

(1)
(Total 4 marks)

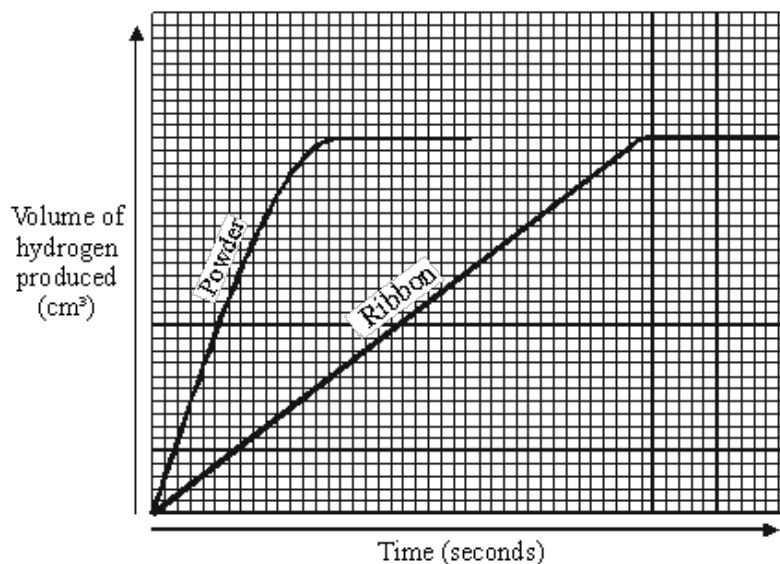
Q3. Some students were investigating how fast hydrogen gas is released in the reaction between magnesium and dilute hydrochloric acid.

To begin with they used 0.1 g of magnesium ribbon.

Next, they repeated the experiment using 0.1 g of magnesium powder.

In each case, they used enough acid to react with all the metal.

(a) Their results are shown on the graph below.



Hydrogen is produced in both the reactions.

Use the information on the graph to describe **two other** ways in which the two reactions are similar.

1.

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2.

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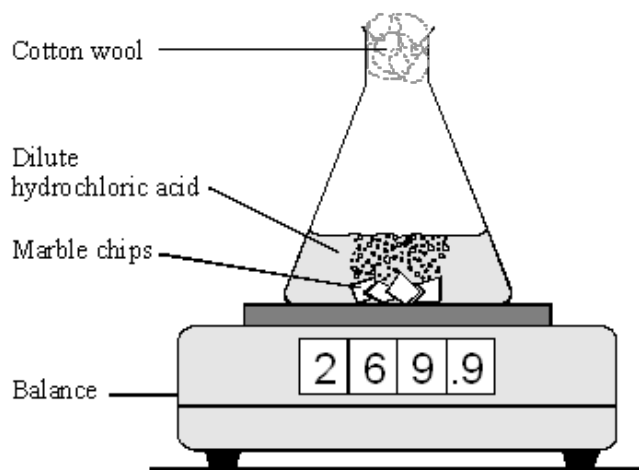
(2)

(b) Describe **one** way in which the reactions are different.

.....
.....

(1)
(Total 3 marks)

Q4. The apparatus shown in the diagram was used to investigate the rate of reaction of excess marble chips with dilute hydrochloric acid, HCl. Marble is calcium carbonate, formula CaCO_3 . The salt formed is calcium chloride, CaCl_2 .



(a) Write a balanced equation for the reaction.

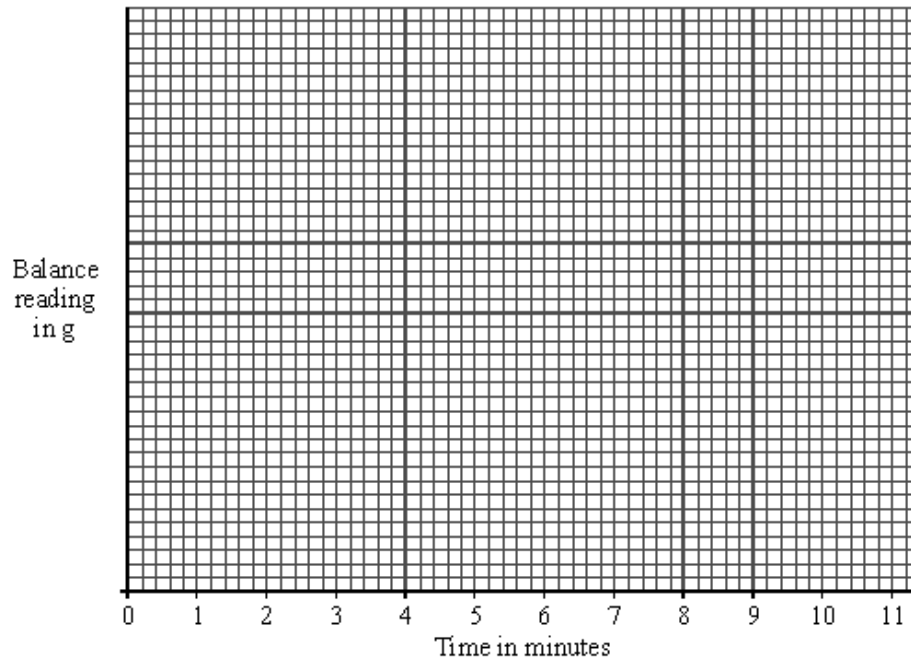
.....
.....

(2)

The following results were obtained from the experiment.

Time in minutes	Reading on balance in g
0.5	269.6
1.0	269.3
2.0	269.0
3.0	268.8
5.0	268.7
9.0	268.6

- (b) (i) Plot the results and draw a graph on the axes below.



(3)

- (ii) Continue the graph you have drawn to show the expected reading after 11 minutes.

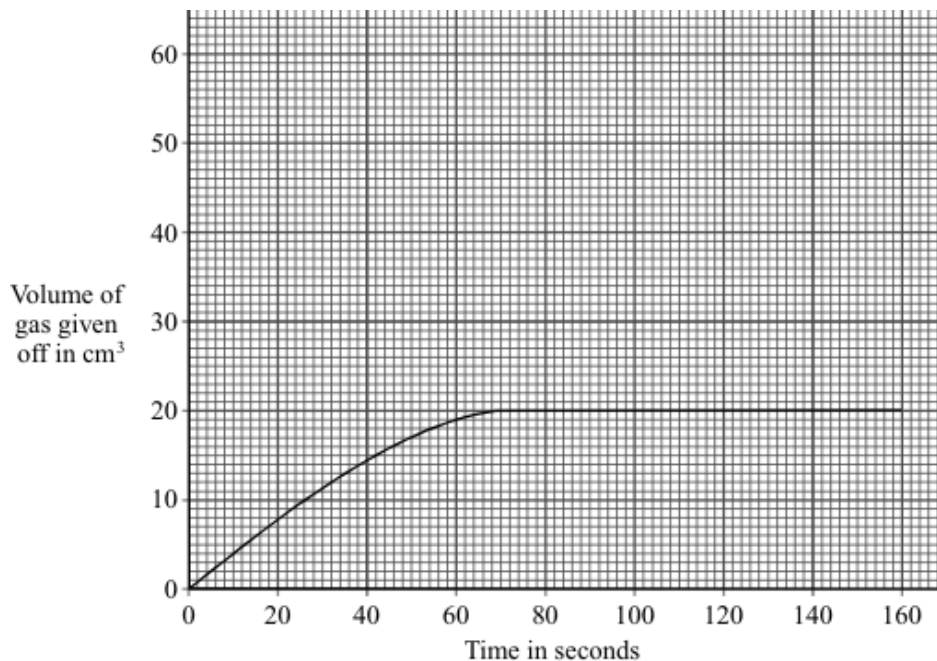
(1)

- (iii) On the axes above, sketch a graph of the result which would be obtained if in a similar experiment the same mass of powdered marble was used instead of marble chips.

(2)

(Total 8 marks)

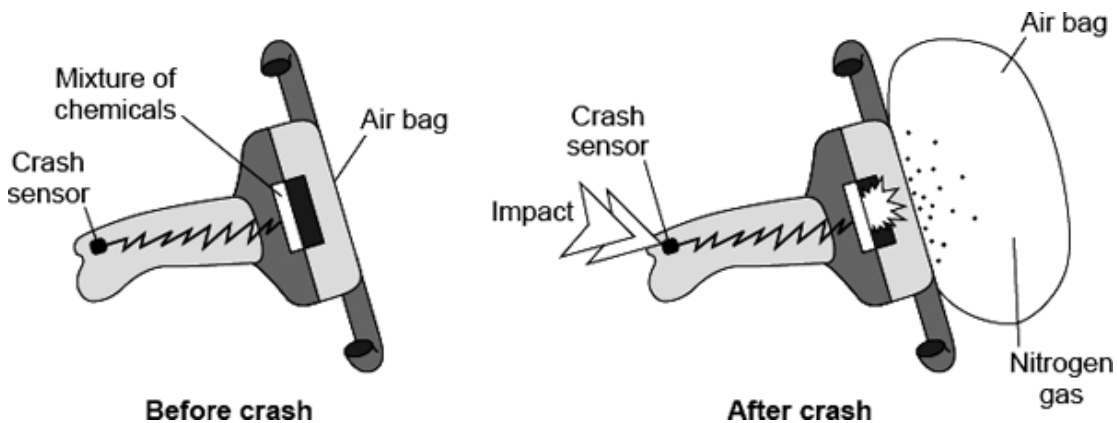
Q5. The graph shows the volume of gas given off during an experiment using hydrogen peroxide solution and manganese oxide.



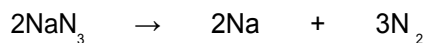
Draw, on the axes above, a graph to show the result you would expect if the volume of hydrogen peroxide solution had been the same, but it was **twice** as concentrated.

(Total 3 marks)

Q6. Air bags are used to protect the passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.



- (a) The mixture of chemicals contains sodium azide (NaN_3) which decomposes on heating to form sodium and nitrogen.



A typical air bag contains 130 g of sodium azide.

- (i) Calculate the mass of nitrogen that would be produced when 130 g of sodium azide decomposes.

Relative atomic masses (A_r): N = 14; Na = 23

.....

Mass of nitrogen = g

(3)

- (ii) 1 g of nitrogen has a volume of 0.86 litres at room temperature and pressure.

What volume of nitrogen would be produced from 130 g of sodium azide?

(If you did not answer part (a)(i), assume that the mass of nitrogen produced from 130 g of sodium azide is 80 g. This is **not** the correct answer to part (a)(i).)

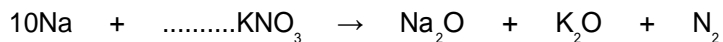
.....

Volume = litres

(1)

(b) The sodium produced when the sodium azide decomposes is dangerous. The mixture of chemicals contains potassium nitrate and silicon dioxide which help to make the sodium safe.

(i) Sodium reacts with potassium nitrate to make sodium oxide, potassium oxide and nitrogen. Complete the balancing of the equation for this reaction.



(1)

(ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

.....

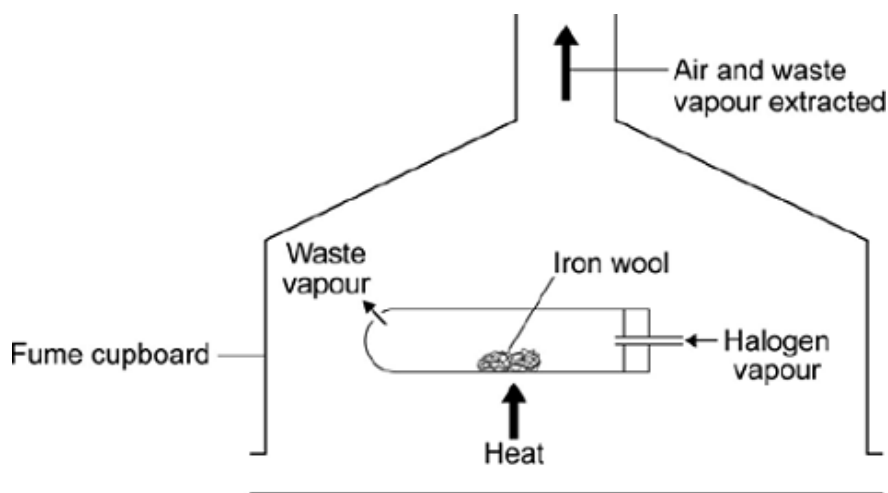
(1)

(Total 6 marks)

Q7. Chlorine, bromine and iodine are all halogens. They belong to Group 7 of the periodic table.

(a) A teacher demonstrated the reactivity of the halogens to some students.

Halogen vapour was passed over heated iron wool in a fume cupboard.



The teacher's observations are shown in the table below.

	Observations	
	During the reaction	After the reaction
Bromine	The iron wool glowed	A red-brown solid had been produced
Chlorine	The iron wool glowed brightly	A dark brown solid had been produced
Iodine	The iron wool did not glow	A black solid had been produced

(i) What is the order of reactivity of these three halogens?

Order of reactivity: *most reactive halogen* 1

2

least reactive halogen 3

(1)

(ii) Explain how you used the teacher's observations to decide your order of reactivity.

.....

.....

.....

.....

(2)

(iii) The students were asked to comment on the teacher's observations.

One student said that the observations were not valid because not all the halogens are vapours – chlorine is a gas, bromine is a liquid and iodine is a solid.

Are the student's comments justified?

Give reasons for your answer.

.....

.....

.....

.....

(2)

(b) Chlorine reacts with hot sodium hydroxide solution.

A sample of a compound formed in the reaction was found to contain 10.8 g of sodium atoms, 16.7 g of chlorine atoms and 22.5 g of oxygen atoms.

Calculate the empirical formula of the compound formed.

.....
.....
.....
.....
.....

(4)
(Total 9 marks)

##

Sando-K is a medicine. It is given to people whose bodies contain too little of a particular element.

Sando-K is a mixture of two compounds. The formulae of the two compounds are given below.



(a) Which metal do people given Sando-K need?

.....

(1)

(b) Sando-K contains the ion, CO_3^{2-} . Which gas would be produced if a dilute acid was added to Sando-K? (The Data Sheet may help you to answer this question.)

.....

(1)

(c) The compounds in Sando-K contain ions.

Complete the two sentences below.

Atoms change into positive ions by one or more

.....

Atoms change into negative ions by one or

more

(4)

(d) Electricity can be used to show that an aqueous solution of Sando-K contains ions.

(i) Draw a diagram of an apparatus that you could use to prove that Sando-K contains ions.

(4)

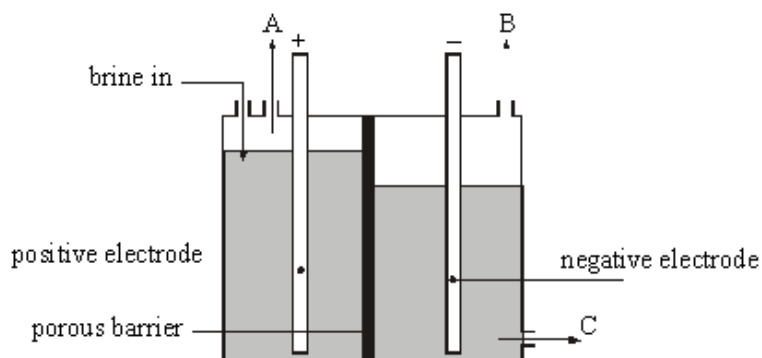
(ii) Explain, as fully as you can, what would happen when the electricity is switched on.

.....
.....
.....
.....

(3)

(Total 13 marks)

Q9. Sodium hydroxide, hydrogen and chlorine can all be made in one industrial process. Electricity is passed through aqueous sodium chloride solution (brine). The diagram below shows a cell that can be used for this process.



(a) Name A, B and C.

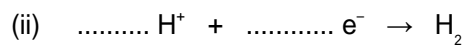
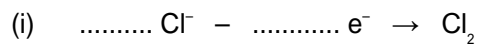
Gas A

Gas B

Solution C

(2)

(b) Balance the equations for the reactions at the electrodes.



(2)

(c) Name the compound in this cell which produces the hydrogen ions.

.....

(1)

(d) Which type of particles must be able to pass through the barrier to allow the electrolysis to take place?

.....

(1)

(Total 6 marks)

- M1.** (a) the bag gets cold because heat energy is taken in from the surroundings 1
- (b) endothermic 1
- (c) any **two** from:
- mix / spread (the ammonium nitrate and water)
 - dissolve faster(*)
 - get cold faster **or** so the whole bag gets cold(*)
(*allow increase rate **or** quicker reaction)
 - particles collide more **or** more collisions 2
- [4]**

- M2.** (a) 152 correct answer with **or** without working = **2 marks**
56 + 32 + (4 x16) gains **1** mark
ignore any units 2

- (b) 152g(rams)
ecf from the answer to (a) and g
must have unit g / gram / gramme / grams etc
*accept g / mol **or** g per mole **or** g mole⁻¹ **or** g/mol **or** g per mol **or** g mol⁻¹*
*do **not** accept g m*
*do **not** accept G* 1

- (c) 76(g)
ecf from their answer to (a) or (b) divided by 2
ignore units 1
- [4]**

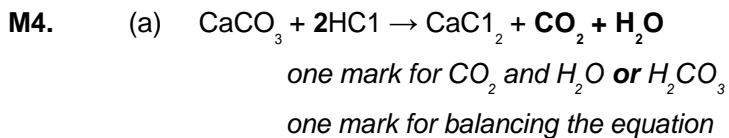
##

- (a) both reactions slow down with time;
both reactions produce same volume of hydrogen
each for 1 mark 2

- (b) *idea* rate is faster with powder
or *idea* rate is slower with ribbon
(allow powder completed before ribbon) for 1 mark

1

[3]



2

- (b) (i) linear suitable scale for y axis
± one small square

1

accurate plots
deduct one mark for each error plot

1

smooth curve through the points **or** a line of best fit
this mark requires a neat smooth curve

1

- (ii) curve becomes almost horizontal at **or** above 268.5
do not credit a straight line reaching 268.5 at 11 mins
accept a plot at 268.6

1

- (iii) steeper initial part to curve

1

becoming nearly horizontal between 268.6 and 268.4 g

1

[8]

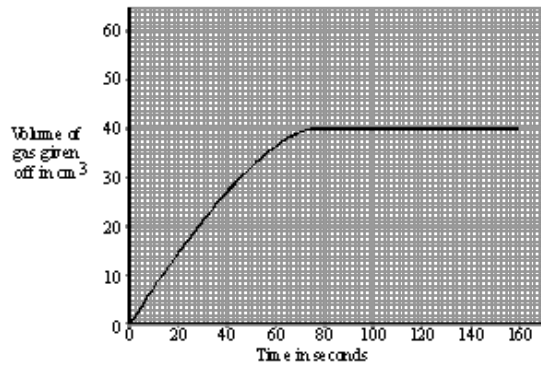
M5. graph steeper

1

becomes horizontal

1

reaches twice the height, $40 \text{ cm}^3 \pm 1 \text{ cm}^3$



1

[3]

M6. (a) (i) 84 / 84.5 / 83.98

correct answer with or without working gains 3 marks

(moles of NaN_3) 130/65 (1)

moles of nitrogen = 3 (1)

mass of nitrogen = $3 \times 28 = 84$ (1)

or

$2 \times (23 + (3 \times 14))$ (1)

$3 \times (2 \times 14)$ (1)

or

$2\text{NaN}_3 = 130$ (1)

$3\text{N}_2 = 84$ (1)

if answer is incorrect then look for evidence of correct working.

allow ecf from previous stage

1 mark lost for each mistake in the working if they do not have the correct answer.

3

(ii) 72 / 72.24 / 72.2

allow ecf from part (i) $\times 0.86$

or

ignore working

69 **or** 68.8

1

(b) (i) 2 **and** 5

1

(ii) any **one** from:

- corrosive / burns
- alkaline / basic
*do **not** accept acidic*
- attacks / destroys / damages living tissue / cells
allow irritant
ignore reference to reactivity
ignore reference to silicates
ignore harmful / toxic

1

[6]

M7. (a) (i) chlorine > bromine > iodine

accept symbols in place of names (Cl_2 or Cl , etc)

1

(ii) any **two** suitable comparisons about the extent to which the iron wool glowed

eg chlorine is more reactive than bromine because iron glowed more brightly with chlorine than bromine

eg bromine is more reactive than iodine because iron glowed with bromine but not with iodine

eg iodine is the least reactive because it is the only one that did not glow

eg chlorine is the most reactive as it was the only one that glowed brightly
or glowed most brightly

2 max.

(iii) NO (no marks)

accept YES (no marks)

because the observations were made using the halogen vapours

because the observations were made using the halogen vapours

1

so the fact that the three elements are naturally solid, liquid or gas is not relevant

so the iodine (and bromine) must have been heated

1

(b) division of masses by A_r values

if division inverted (A_r / mass) then award zero marks

1

correct answers of division

if one slip in A_r values used, do not award first mark, but award remainder consequentially

1

simplification by division by smallest

1

correct formula (NaClO_3)

accept elements in any order (such as ClNaO_3)

correct answer alone with or without working = 4 marks

1

[9]

##

(a) potassium / K

for 1 mark

1

(b) carbon dioxide / CO_2

for 1 mark

1

(c) losing
electrons
gaining
electrons

for 1 mark each

4

(d) (i) power supply, (not mains)
beaker containing solution,
(inert) electrodes and circuit
ammeter or bulb/
(or see bubbling etc. at electrodes written by drawing)

for 1 mark each

4

(ii) reading on ammeter/bulb lights / (solution) conducts (electricity)
bubbling / gas produced
hydrogen produced
chlorine / oxygen produced
ions move
to electrodes (must be linked to ions move)
negative ions move to the positive electrode
and/or positive ions move to the negative electrode
negative ions lose electrons
and/or positive ions gain electrons

any 3 for 1 mark each

3

[13]

M9. (a) Gas A = Chlorine / Cl₂ not Cl and Gas B = Hydrogen / H₂ not H

for 1 mark

Solution C = sodium hydroxide/NaOH/spent brine

for 1 mark

2

(b) (i) 2, 2

for 1 mark

(ii) 2, 2

for 1 mark

2

(c) water/H₂O/hydrogen oxide not hydrogen hydroxide

for 1 mark

1

(d) ions/positive ions/negative ions/cations/anions
not charged particles/positive particles/negative particles

not H⁺ / Cl⁻/Na⁺ / OH⁻

Allow hydrogen ions etc.

not sulphate ions

for 1 mark

1

[6]

