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Examiners' Report
June 2019

GCSE Combined Science 1SC0 2CF

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Introduction

The examination paper was part of the second series of the new 9-1 Combined Science specification, graded 9-1. Just like the 1SC0_1CF, this paper consisted of 6 questions and all these questions were common with the 1CH0_2F paper – Foundation Tier GCSE Chemistry. Similarly, much of the last two questions were common with the 1SC0_2CH paper - Combined Science Chemistry paper. Like other chemistry papers, this paper made use of a wide variety of question types that were suitable for this level. The paper targeted grades 5 to 1 with about half the marks targeted for grades 4 and 5.

Overall it was disappointing to see a poor response to the maths and practical questions. Even the response to quite straightforward items such as Q03a and Q04a did not match expectations. In general, the rates question (Q04) and the hydrocarbons question (Q05) were poorly answered.

Question 1 (b) (i)

Most candidates answered this correctly with the top of the bar being just short of the 22% gridline. Many candidates used a ruler which was a real bonus. Those who did not sometimes spoilt their answers by drawing wiggly lines which went over the 22% gridline. Some shaded in the box and again some of those spoilt their answer by shading above the top horizontal line. A good number of candidates benefited from the wide tolerance allowed and drew really good, fine horizontal lines just touching the 22% gridline.

(b) The atmosphere contains 21% of oxygen.

(i) Figure 1 shows an incomplete bar chart of the main gases in the atmosphere.

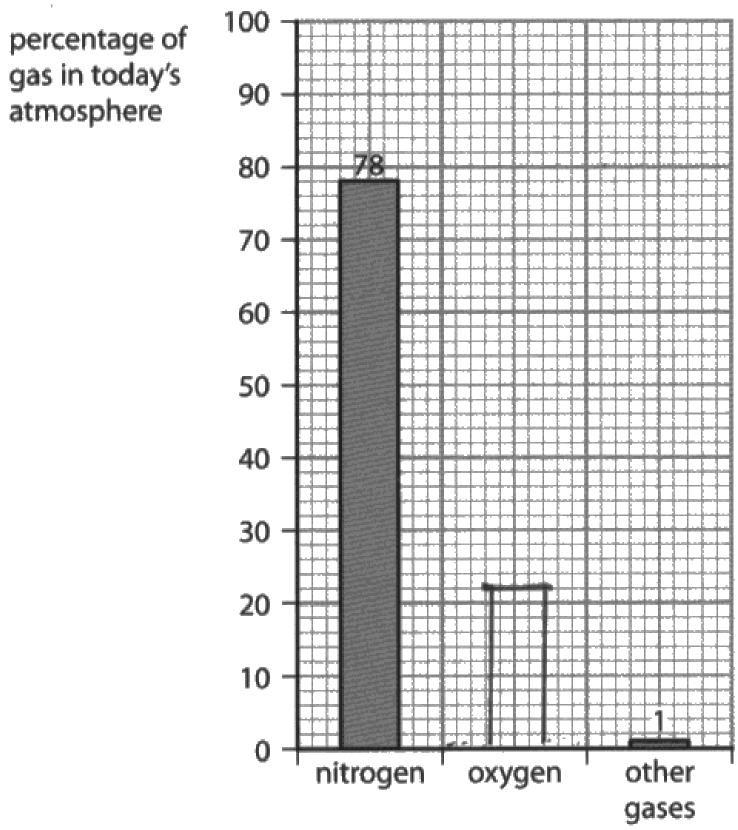


Figure 1

Complete the bar chart by showing the percentage of oxygen in the atmosphere.

ResultsPlus Examiner Comments

The top of the bar was clearly over the 22% grid line and so this did not score.

(i) Figure 1 shows an incomplete bar chart of the main gases in the atmosphere.

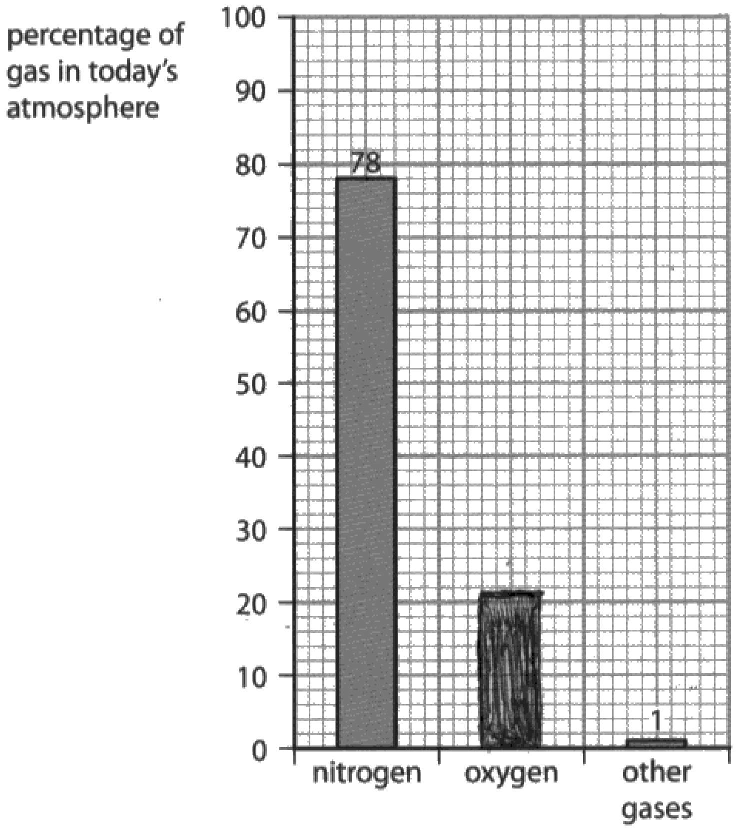


Figure 1

ResultsPlus
Examiner Comments

The top of the bar was clearly between the 20 and the 22% grid lines, so this scored the mark.

Question 1 (b) (ii)

The better candidates completed this calculation easily, many of them without any working. However, this was true for about a quarter of the candidates. Some managed 1 mark for 21 x 300 = 6300 missing out the division by 100. However, far more simply divided 1 number by the other apparently randomly. Some appeared to be confused by the superscripted 3 in the units and used 300^3 in their calculation. Many candidates did not appear to realise that the volume of oxygen had to be less than 300 cm^3.

* (ii) Calculate the volume of oxygen present in 300 cm^3 of air.

(volumes are measured under the same conditions of temperature and pressure)

(2)

$V = \frac{300}{21}$ $d = \frac{m}{V}$ $v = \frac{1}{m}$ $V = \frac{21}{300} = 0.07\ cm^3$

$= 14.2857$ $0.21 \times 300 = 63 cm^3$

volume of oxygen = ~~100~~ 0.07 cm^3

ResultsPlus

Examiner Comments

The candidate erroneously started with the density = mass / volume, and then went on the try 3 different combinations of 300 and 21% only to choose an incorrect outcome (0.07 cm^3). This is an example of a 'list principle' operating in a mathematical situation so this scored 0 marks.

(ii) Calculate the volume of oxygen present in 300 cm^3 of air.

(volumes are measured under the same conditions of temperature and pressure)

(2)

$300^3 \div 21\% = 2.440318408 \times 10^{35}$

volume of oxygen = 2.4 cm^3

ResultsPlus
Examiner Comments

Many candidates did not understand the units cm^3 and cubed the 300 as in this example. This scored 0 marks.

ResultsPlus
Examiner Tip

Make sure you understand how to use a percentage value to calculate a volume or a mass of a substance.

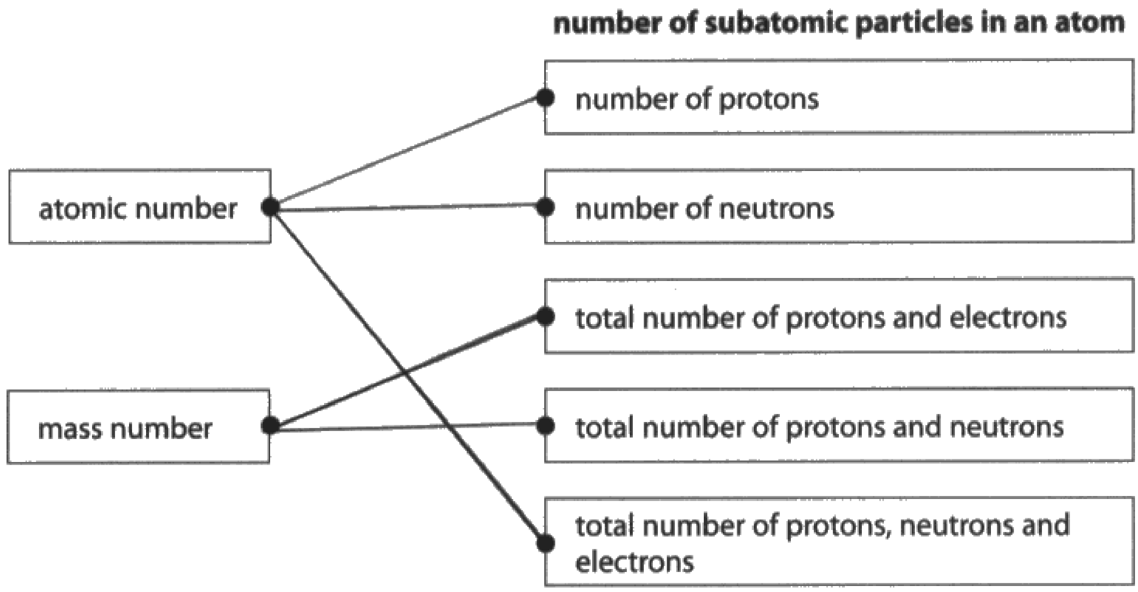
Question 1 (c)

Just over half of candidates scored at least one mark with a correct line leading from either the atomic number or the mass number to its correct description, of which about a quarter of the candidates scored for both numbers linked to correct descriptions.

(c) An atom of an element has an atomic number and a mass number.

Draw one straight line from each of these to the numbers of subatomic particles it shows to be present in an atom.

(2)



ResultsPlus
Examiner Comments

As in paper 1SC0-1CF, a significant number of candidates drew more than one line from each box on the left to those on the right. This did not score.

ResultsPlus
Examiner Tip

Read the instructions for the question.

Question 2 (a) (i)

Only about a third of the candidates could name group 7 as the halogens. The most common error here was to name this group as the alkalis.

2 (a) Complete the following sentences.

(i) The name given to group 7 in the periodic table is Alkalis.

(1)

ResultsPlus
Examiner Comments

The most common error seen.

Question 2 (a) (ii)

Again, only about a third of the candidates could name group 0 as the noble gases. The most common errors here were to name this group as either the halogens or as gases.

(ii) The name given to group 0 in the periodic table is halogens.

(1)

ResultsPlus
Examiner Comments

This along with 'gasses' were the most common errors seen by examiners.

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Examiner Tip

Learn the names to the groups of the periodic table.

Question 2 (d)

Most candidates could use the data in the table of densities to suggest a valid value for the density of krypton.

(d) The densities of some elements in group 0 are shown in Figure 3.

name	density in $g\,cm^{-3}$
helium	0.15
neon	1.2
argon	1.4
krypton	2.6
xenon	3.5

Figure 3

Use the information in Figure 3 to suggest the density of krypton.

(1)

density of krypton = 7- 8. 85 $g\,cm^{-3}$

ResultsPlus
Examiner Comments

The candidate gave a correct value for the density of krypton in the table, but gave an incorrect value on the answer line. This scored 0 marks.

ResultsPlus
Examiner Tip

Examiners do not 'pick' the best answer. If a correct answer and an incorrect answer is given here, then this is given the mark of 0.

Question 2 (e)

This question was poorly answered with only a few showing any real understanding of the situation. It seemed that some recognised that argon was a noble or inert gas and is therefore unreactive but this constituted the majority of the very few 2-mark answers. A few recognised that the filament would not react with argon and some that it would react with air. Many lost the second mark by referring to the argon not reacting with the bulb or the bulb not burning.

There were several misconceptions seen here with many thinking that it was because argon was denser than air or had better insulating properties than air or could conduct electricity. Others seemed to think that this was similar to neon lights and that the argon would somehow increase the light output. Some even thought that the light would be produced when argon reacted with the filament.

(e) For many years, argon was used to fill filament light bulbs.

A filament light bulb is shown in Figure 4.

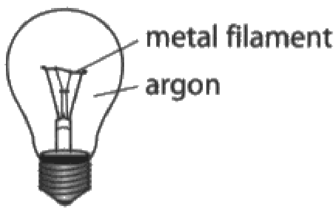

Figure 4

When the bulb is in use the metal filament becomes extremely hot.

Explain why argon, rather than air, was used to fill filament light bulbs.

(2)

Argon was used in the filament light bulb than air, because argon is non-flammable and has fulls outer shell that makes argon inert.

ResultsPlus
Examiner Comments

Both full outer shell and inert are marking point 1. This answer did not quite get the second marking point which could have been for either stating here that argon atoms would not lose / share / gain electrons or that argon does not react with the filament.

(e) For many years, argon was used to fill filament light bulbs.

A filament light bulb is shown in Figure 4.

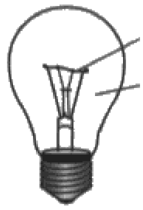

Figure 4

When the bulb is in use the metal filament becomes extremely hot.

Explain why argon, rather than air, was used to fill filament light bulbs.

(2)

One reason why argon maybe used instead of air is because argon gives off more light. another reason why argon maybe used instead of air is because argon will not get as hot as to if you put air in it.

ResultsPlus
Examiner Comments

This was a common error - many candidates thought by using argon a brighter light would be produced or that argon was a better conductor of electricity than air. This scored 0.

(e) For many years, argon was used to fill filament light bulbs.

A filament light bulb is shown in Figure 4.

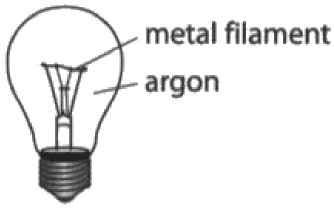

Figure 4

When the bulb is in use the metal filament becomes extremely hot.

Explain why argon, rather than air, was used to fill filament light bulbs.

(2)

Argon is a noble gas (group0) and will not react with ~~away~~ the metal filament as it has ~~0~~8 electrons in ~~t~~ it's outer shell (atom) meaning it doesn't need to lose or gain any to become stable.

ResultsPlus
Examiner Comments

This was a very detailed 2-mark answer which was not often seen.

ResultsPlus
Examiner Tip

Make sure you know how to explain reactivity or unreactivity of the elements of groups 1, 7 and 0.

Question 3 (a)

Surprisingly just over half the candidates scored the mark here with some variant of scales; balance being rarely seen. Some appeared to recognise that a measurement of mass was necessary but did not have the appropriate vocabulary. Some seemed to see just the liquid in the beaker and went for measuring cylinder. It was evident for this group they did not read the whole question. Beyond this, a wide range of possible measuring (and non-measuring) instruments was seen including ruler, thermometer, spatula and spoon.

3 A student poured 50 cm^3 water into a beaker and measured the water's temperature.

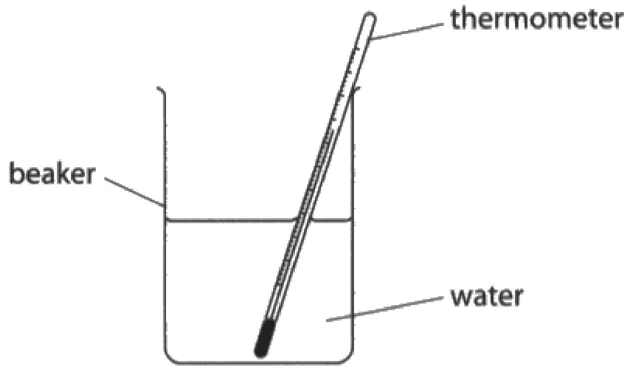

Figure 5

The student added 1.00 g calcium chloride to the water, stirred the mixture and then recorded the temperature.

(a) Give the name of the apparatus that could be used to measure 1.00 g of calcium chloride.

(1)

A balance

ResultsPlus
Examiner Comments

The proportion of candidates giving the answer of 'balance' was quite small. Of the possible correct responses 'scales' was the most common.

(a) Give the name of the apparatus that could be used to measure 1.00 g of calcium chloride.

(1)

measuring cylinder.

ResultsPlus
Examiner Comments

A high number of candidates gave the answer of 'measuring cylinder' presumably because they read the first line and then 'Give the name of the apparatus ...'.

Question 3 (b)

Over half the candidates scored well on the first marking point identifying in some way that the temperature increased. Where they did not, it was often because they thought that heat and temperature are synonymous and described heat increasing. The second marking point was less well scored. Some candidates described the process as creating energy. Candidates clearly find the direction of an energy change difficult to describe, the logic appearing to be that if the water becomes hotter it must have taken in energy and therefore there was an endothermic change.

(b) The student's results were

temperature of water at start	= 21 °C
temperature of mixture after stirring	= 32 °C

Explain, using these results, the type of heat energy change that occurs when calcium chloride dissolves in water.

(2)

endothermic reaction as the heat energy enters the mixture instead of leaving the mixture

ResultsPlus
Examiner Comments

Many candidates identified this as an ednothermic reaction as they assumed heat energy had been taken in to cause the rise in temperature. This scored 0 marks.

(b) The student's results were

temperature of water at start	= 21 °C
temperature of mixture after stirring	= 32 °C

Explain, using these results, the type of heat energy change that occurs when calcium chloride dissolves in water.

(2)

The calcium chloride causes a reaction whic leads to an exdothermic reaction where heat is given off causing tempreture to rise.

ResultsPlus
Examiner Comments

This scored 1 mark for stating that the there was a rise in temperature. The 'exdothermic' reaction did not score.

ResultsPlus
Examiner Tip

Be clear about exothermic and endothermic reactions, and how you can use evidence to identify them.

Question 3 (c) (ii)

The great majority scored marks here with goggles (or sometimes googles) and gloves both mentioned often together. The generic term of eye protection was used fairly frequently, but glasses were only credited if they were described as safety glasses.

A wide range of other safety precautions were mentioned but did not reflect the risk posed by the calcium chloride. These included not working at the edge of the bench, putting bags under the bench and tying long hair back. This group of precautions would not receive credit in an examination at this level.

Suggestions such as washing hands afterwards was frequently seen and candidates need to realise that this action is not a precaution.

(ii) Give a safety precaution that the student should take during the experiment.

(1)

Wear googles

ResultsPlus
Examiner Comments

This was a frequent misspelling, but did score a mark.

(ii) Give a safety precaution that the student should take during the experiment.

(1)

To wear gloves and goggles.

ResultsPlus
Examiner Comments

A case of belt and braces.

Question 3 (d)

Just under half the candidates recognised that reducing heat loss needed some sort of insulation, a lid or cover being the most common answer and insulation or some specific material, cotton wool or a metal foil being most common suggestions. Polystyrene beakers were seen but relatively rarely. Other candidates showed a lack of understanding of the issue suggesting using a water bath, changing the room temperature, changing the quantities of calcium chloride or water or even using a Bunsen burner. Some had the right idea but suggested the rather impractical bung.

(d) State **one** way in which the apparatus could be changed to reduce the amount of heat energy lost during the experiment.

(1)

could of wrapped the beaker in insulation and tinfoil to keep the heat inside the beaker.

ResultsPlus
Examiner Comments

Use of insulation to reduce the heat energy loss here scored a mark.

(d) State **one** way in which the apparatus could be changed to reduce the amount of heat energy lost during the experiment.

(1)

You can add a buser burner to keep the heat ad energy at the same level. Or you can use a loose piece of cotton ontop of the apparatus to achiee this.

ResultsPlus
Examiner Comments

An incorrect answer followed by a correct answer - in these instances the list principle applies and here the answer was given 0 marks.

ResultsPlus
Examiner Tip

A wrong and a right answer does not make a right answer.

Question 3 (e)

This was very poorly answered; it seemed that many candidates simply tried a random combination of 12 and 9, often several combinations and then selected the answer that looked the most promising. Of the incorrect combinations, 9 x 12 = 108 was probably the most common, with 12 / 9 = 1.333 being seen at least as often as the correct 9/12 = 0.75. Very few recognised the need for the use of the 1000 conversion factor to change the units of volume. Some tried to use 100 rather than 1000. As with the earlier calculation, many candidates were confused by the -3 superscript in the units and attempted to used 12^{-3} in their calculation.

(e) The concentration of a calcium chloride solution is $12\,g\,dm^{-3}$.

Calculate the volume of this solution, in cm^3, that contains 9.0 g of calcium chloride.

You must show your working.

(3)

12g ÷ 9.0 = 0.75

12 × 9.0 = 108

volume of solution = 108 cm^3

ResultsPlus
Examiner Comments

Another instance where a candidate tries two different manipulations of the numbers and selects the incorrect response as the final answer. 0 marks scored. Choosing the other answer of 0.75 would have been credited with 2 marks.

(e) The concentration of a calcium chloride solution is 12 g dm^{-3}.

Calculate the volume of this solution, in cm^3, that contains 9.0 g of calcium chloride.

You must show your working.

(3)

conc of calcium chloride = 12 g dm^{-3}

volume of solution contains 9.0g =

9 x 12^{-3} = 0.0052083

volume of solution = 0.01 cm^3

ResultsPlus
Examiner Comments

Another of those instances where a lack of understanding results in 12^{-3} being used in the calculation. 0 marks.

ResultsPlus
Examiner Tip

Make sure you know how to carry out calculations involving concentration of a solution. Also here, a change in units was needed - practise how to do that.

Question 4 (a)

It was disappointing to see that under half the candidates here scored the mark for a correct answer. Measuring cylinder was the commonest correct answer with pipette and burette being seen but rarely. All too commonly seen were measuring jug, beaker, flask or measuring tube, but all these did not receive credit.

(a) Name the apparatus that could be used to measure out 100 cm^3 of dilute hydrochloric acid. **(1)**

Measuring Flask

ResultsPlus
Examiner Comments

Measuring flask, measuring jug, beaker, conical flask were all answers that did not score.

(a) Name the apparatus that could be used to measure out 100 cm^3 of dilute hydrochloric acid. **(1)**

A ruler for measurement of height and width.

ResultsPlus
Examiner Comments

Answers of this type were surprisingly seen quite often.

Question 4 (b)

This item was poorly answered. Some candidates recognised that there was a gas or hydrogen produced and a few recognised that the gas escaped but few managed to get both parts together. Misconceptions were widespread. The two most common seemed to be that there would be evaporation of the acid or mixture and that the magnesium would dissolve or disappear and that its mass would also be lost with it disappearing. A few also suggested that a gas was produced but had less or zero mass.

(b) Explain why there is a loss in mass of the flask and contents.

(2)

Because magnesium oxide gas got realeased into the air and escaped through cotton ~~wall~~ wool.

ResultsPlus
Examiner Comments

An incorrect gas was named (magnesium oxide) despite the word equation for the reaction being given, a mark was given for the gas being released into the air through the cotton wool.

(b) Explain why there is a loss in mass of the flask and contents.

(2)

There is a loss in mass because the dilute hydrochloric acid and magnesium ribbon are reacting. The solution is breaking down the magnesium ribbon, this means less mass.

ResultsPlus
Examiner Comments

Most candidates thought that since the magnesium was reacting, just this action caused a loss in mass.

0 marks

(b) Explain why there is a loss in mass of the flask and contents.

(2)

as the magnesium ribbon and hydrochloric acid had combined together and they also produced hydrogen gas.

ResultsPlus
Examiner Comments

The production of hydrogen scored a mark, but the candidate did not go on to say what happened to that gas to cause a loss in mass.

Question 4 (c)

Another poorly answered item, few candidates recognising that this was all about collision theory. Where a mark was awarded, it was most often for a statement about less reactants expressed in a variety of ways, usually involving the magnesium. The idea that it could have been the acid becoming more dilute did not seem to occur. Many candidates seemed unable to cope with the idea of a reaction slowing down other than to stop. Thus, they would talk about the magnesium all reacting and the reaction having no reactants hence stop. For most candidates, the main factor in slowing down a reaction would be reducing the temperature and thus reducing the energy of the reactant particles, which was not relevant here. It was only the very best candidates who scored the third mark for recognising the time element in the number of collisions.

(c) The graph shows that the rate of reaction slows as the reaction takes place.

Explain, in terms of particles, why the rate of reaction between magnesium ribbon and dilute hydrochloric acid slows as the reaction takes place.

(3)

In terms of particles, the ~~mass~~ reaction eventually slows down due to the number of energy particles present. There becomes less energy particles to speed up the reaction therefore it is slower.

ResultsPlus
Examiner Comments

Most candidates were not clear about thier ideas in their answers. Most candidates thought the reaction slowed down due to a decrease in the energy of the particles.

0 marks

(c) The graph shows that the rate of reaction slows as the reaction takes place.

Explain, in terms of particles, why the rate of reaction between magnesium ribbon and dilute hydrochloric acid slows as the reaction takes place.

(3)

As there is a ~~constant~~ lot of ~~lots~~ particles at the beginning for the hydrochloric acid to react with. But as the particles are being used up there are then less meaning it's harder to react.

ResultsPlus
Examiner Comments

This scored a mark for the decreasing number of reactant particles in the reaction mixture.

Question 4 (d)

While a good number of candidates scored this mark, many saw increased temperature and went into the idea of a faster reaction and did not realise that the question was asking about the size of the mass loss.

(d) The experiment was repeated using the acid at a higher temperature.
All other conditions were kept the same.

State the effect of the higher temperature on the mass loss after two minutes.

(1)

there would be a faster and higher rate of reaction, increasing the mass

ResultsPlus
Examiner Comments

Most candidates saw that there was a higher temperature and immediately wrote about the rate of reaction being greater with nothing about the loss in mass.

0 marks

Question 4 (e)

This item was all too frequently left blank. Markers were not sure whether candidates had missed this item or not since there were no answer lines for them to use. When answers were seen, all too frequently they were showing a curve to the right of the original stopping about half-way up. Also, when the correct slope was shown, too few levelled out at the right horizontal, many levelling out higher than the original.

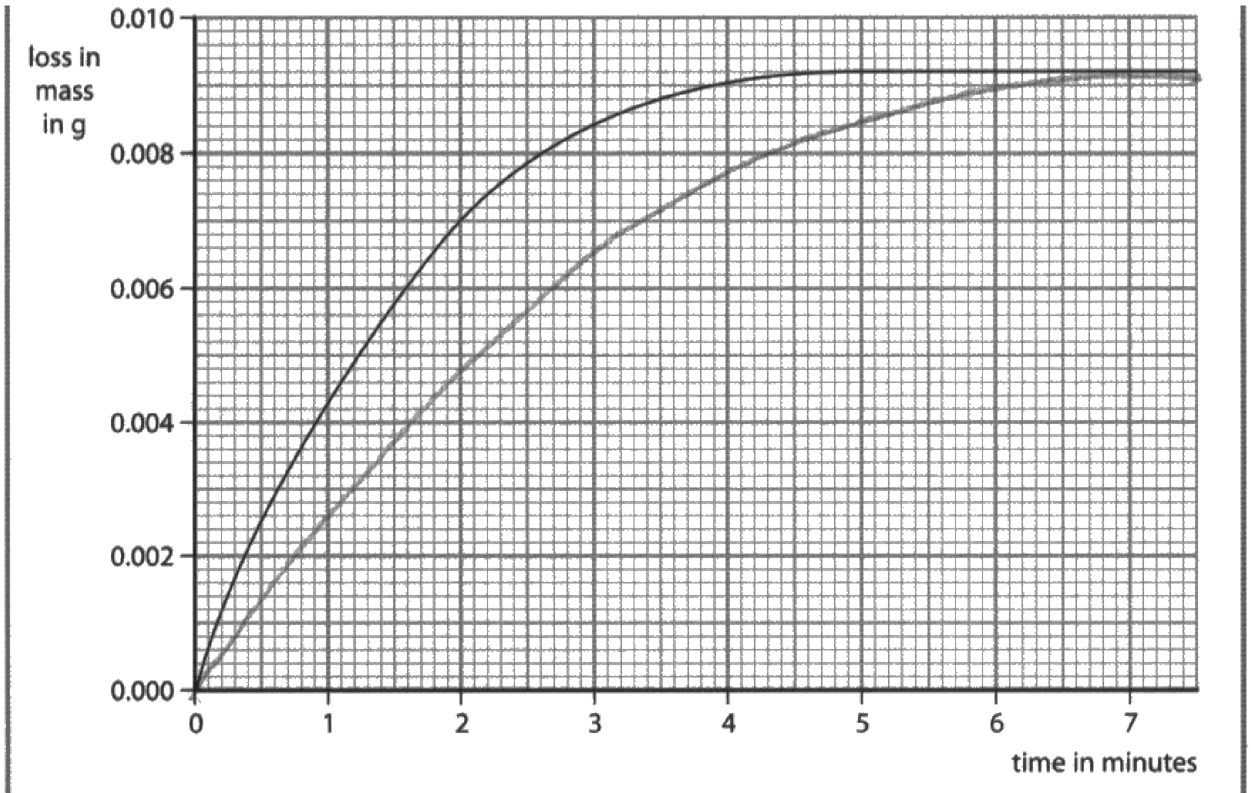

Figure 7

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Examiner Comments

Most candidates who answered this question had the first part of the line to the left of the original. This was one of the few that scored 1 mark for the overall mass loss being the same.

ResultsPlus
Examiner Tip

Practise sketching graphs for changing the conditions of a reaction and how that affects the outcome.

Question 4 (f) (i)

Most candidates seem to know that a catalyst increased the rate of a reaction but a disappointing number thought that it slows a reaction down. Others gave the non-committal answer of that it changed the reaction.

(f) Some reactions are affected by the presence of a catalyst.

(i) State the effect of a catalyst on a reaction.

(1)

A catalyst ~~helps st~~ provides an alternative reaction, where the activation energy is lower, so speeds up the rate of reaction.

ResultsPlus
Examiner Comments

It was not often that an answer of this quality was seen.

1 mark

(f) Some reactions are affected by the presence of a catalyst.

(i) State the effect of a catalyst on a reaction.

(1)

It can stop the reaction from occuring.

ResultsPlus
Examiner Comments

Many candidates thought that a catalyst would cause a reaction to either stop, as here, or for its rate of reaction to decrease.

ResultsPlus
Examiner Tip

Learn the effects of changing the conditions of reaction on its rate.

Question 4 (f) (ii)

Where a candidate did work out what was going on, the first and third marking points were quickly and easily scored. Very few described removing the catalyst and even fewer drying it. The majority of candidates described an experiment in which they added a catalyst, sometimes comparing it with no catalyst. Too many described the catalyst reducing in mass in some way.

(ii) Devise a simple experiment to find out what happens to the mass of a solid catalyst during a reaction.

(3)

place a conical flask on a scale and ~~we~~ measure the weight of the solid catalyst. Then pour reactants in solution into the flask, and allow a reaction to occur (the reactant used must be specific to the catalyst as if they don't match the catalyst will have no effect). once the reaction has occured remove the solid catalyst, dry it, and weigh it again (there shouldn't be any difference, as a catalyst stays the same throughout a reaction).

(Total for Question 4 = 13 marks)

ResultsPlus
Examiner Comments

This was one of the few that scored 3 marks. Most candidates lost the second mark by not removing the catalyst from the reaction mixture and drying it.

(ii) Devise a simple experiment to find out what happens to the mass of a solid catalyst during a reaction.

(3)

add 100cm^3 of hydrochloric acid and a strip of magnesium ribbon and a solid catalyst into a beaker and record how long the reaction takes and then repeat the experi-ment without the catalyst recording the mass and time taken on both.

(Total for Question 4 = 13 marks)

ResultsPlus

Examiner Comments

Many candidates tended to ignore the question about the effect on the mass of the catalyst and wrote about comparing a reaction with and without a catalyst present. Many candidates wrote about how the mass of the catalyst either decreased or increased in mass during a reaction.

(ii) Devise a simple experiment to find out what happens to the mass of a solid catalyst during a reaction.

(3)

If two reactants are put together in a ~~air tight space (sealed flask)~~ ~~and a catalyst is a and measured~~ container (e.g. flask) and ~~a catalyst is put with them~~ they ~~are~~ have their ~~mass~~ mass measured, you could put a catalyst in with them to see how much extra ~~weight~~ mass is added both before and after the reaction, (the difference will be the mass lost from the catalyst, (however this particular experiment only works if the reactants themselves don't loose any mass).

(Total for Question 4 = 13 marks)

ResultsPlus
Examiner Comments

After a rethink, the candidate managed to score 2 marks for knowing the mass of the catatlyst before and after the reaction.

Question 5 (b) (i)

If candidates knew a use of kerosene it was usually for aircraft. A few suggested cooking and lamps. Diesel for cars was most often mentioned although lorries, trucks, trains and large vehicles were also seen frequently. Kerosene was less well known than diesel. Some candidates confused kerosene with bitumen while others just wrote about it being used to start fires or the very general 'for machines'. The most common way the diesel mark was lost was when candidates described it as 'petrol for cars'. Just under half the candidates scored for both uses and about a further third scored for just one use.

(b) Crude oil is separated into several fractions by fractional distillation.
Two of these fractions are kerosene and diesel oil.

(i) State a use for each of these fractions.

(2)

kerosene Fuel for aircrafts

diesel oil Petrol for cars

ResultsPlus
Examiner Comments

Fuel for aircraft scored, but petrol for cars did not score. This error was seen quite often.

1 mark

ResultsPlus
Examiner Tip

Know the uses of the different fractions.

(b) Crude oil is separated into several fractions by fractional distillation. Two of these fractions are kerosene and diesel oil.

(i) State a use for each of these fractions.

(2)

kerosene used in factories

diesel oil used in cars

ResultsPlus
Examiner Comments

Fuel for cars scored a mark but 'used in factories' was too vague for a mark.

1 mark

ResultsPlus
Examiner Tip

Avoid non-specific uses such as machinery, factories etc. when giving a use for a fuel.

Question 5 (b) (ii)

It seemed clear that the majority of candidates simply did not understand what they were being asked to do. Most did not seem to understand the term 'property'. Certainly, very few used the two lines of the question as intended. Where properties were discussed, the most common were boiling point and viscosity, the latter usually being in terms of thickness or runniness. Many, unfortunately, thought that the higher up the fractionating tower, the higher the boiling point. Surprisingly, many seemed to think that this was a repeat of the previous item and answered in terms of uses of the fractions.

(ii) Figure 8 shows where the fractions kerosene and diesel oil are produced in the fractionating column.

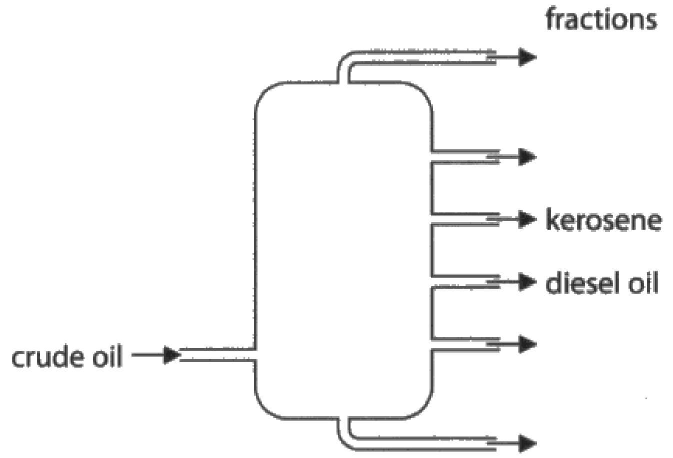


Figure 8

Kerosene is obtained higher up the column than diesel oil.
Kerosene and diesel oil fractions have slightly different properties.

Choose a property.
State how this property for kerosene compares with the property for diesel oil.

(1)

property amount of carbon

comparison kerosene has more than diesel oil.

ResultsPlus
Examiner Comments

Many candidates had a poor understanding of what a property is. Many wrote how much of each fraction there was or kerosene being produced higher up the fractionating tower meant it therefore had a higher temperature.

0 marks

ResultsPlus
Examiner Tip

Learn the trends shown by the properties of the fractions such as melting and boiling points, viscosity and flammability.

(ii) Figure 8 shows where the fractions kerosene and diesel oil are produced in the fractionating column.

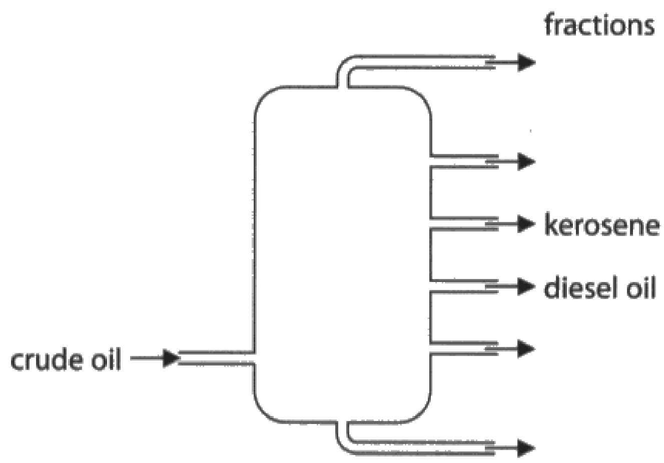


Figure 8

Kerosene is obtained higher up the column than diesel oil.
Kerosene and diesel oil fractions have slightly different properties.

Choose a property.
State how this property for kerosene compares with the property for diesel oil.

(1)

property It is used in planes → Kerosene - highly ~~rea~~ reactive

comparison IS only used for trains & buses → less reactive

ResultsPlus
Examiner Comments

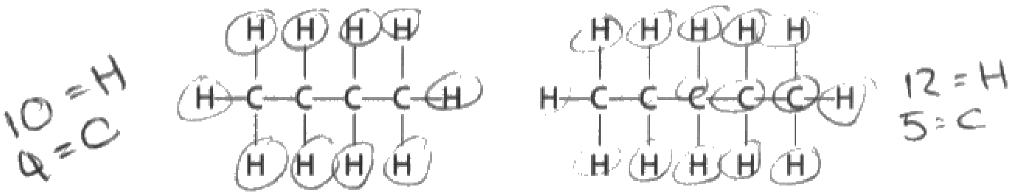
Many candidates made the mistake of thinking that this question was just a repeat of the the previous one and wrote about uses of kerosene and diesel oil.

0 marks

Question 5 (c) (i)

While most candidates attempted this item, few scored marks. In too many cases, candidates effectively gave information from the stem, especially quoting the molecular formulae of the two hydrocarbons, or stating the respective numbers of carbon and hydrogen atoms. Where a mark was scored, it was most often for stating that pentane has one more carbon or that they differed by one carbon and two hydrogens. Sometimes this mark was lost for saying the difference was one carbon and three hydrogens. Although the correct general formula was very occasionally seen, the term general formula was noticeable by its absence often erroneously described as the molecular formula.

(c) Figure 9 shows the formulae of a molecule of butane and of a molecule of pentane. Butane and pentane are neighbouring members of the same homologous series.



butane　　　　pentane

Figure 9

(i) Explain, using these formulae, why butane and pentane are neighbouring members of the same homologous series.

(2)

Because using the alkane formule Cn H2n+2 you can see that 1 carbon and 2 hydrogen has been added.

ResultsPlus
Examiner Comments

2 marks

This scored for the difference being 1 carbon and 2 hydrogen atoms and they fit the alkane formula C_nH_{2n+2}.

Question 5 (c) (ii)

Another calculation poorly done. Where a mark was scored, it was most often for 4 x 12 = 48, however, quite a few lost this mark for simply using that to add to 10 to get 58 (which was already given) and for nothing else. A small minority scored 2 marks for 1.72 or 20.7. Again, as in paper 1, there were issues surrounding the rounding to the correct number of significant figures. Very few scored full marks.

(ii) Butane has the formula C_4H_{10}.

Calculate the mass of carbon in 100 g of butane.

Give your answer to three significant figures.

(relative atomic masses: H = 1.00, C = 12.0;
relative formula mass: C_4H_{10} = 58.0)

You must show your working.

(3)

12 x 4 = 48   48 + 10 = 58

10 x 1 = 10 $\frac{48}{58}$ x 100 = 82.75862

82.70

mass of carbon = 48 g

ResultsPlus
Examiner Comments

The method of calculation was correct, but the answer is spoilt by not giving the answer as required to 3 significant figures.

2 marks

(ii) Butane has the formula C_4H_{10}.

Calculate the mass of carbon in 100 g of butane.

Give your answer to three significant figures.

(relative atomic masses: H = 1.00, C = 12.0;
relative formula mass: C_4H_{10} = 58.0)

You must show your working.

(3)

100g ÷ 58.0 = 1.72g

mass of carbon = 1.72 g

ResultsPlus
Examiner Comments

This candidate had effectively worked out mass ÷ formula mass (ie the number of moles) of butane which scored the first marking point and then corrected to 3 significant figures to score the third marking point.

2 marks

ResultsPlus
Examiner Tip

Practise calculations of this type and learn how to round answers to a given number of signiifcant figures or to a given number of decimal places.

Question 5 (c) (iii)

It was quite disappointing to see that so many could get to this stage of studying chemistry and not be able to construct a word equation with the correct products on the right hand side, having been given those products in the stem of the question. Nearly 40% of the candidates scored 0 marks for this item.

Of those who did score marks, quite a few lost a mark for reacting butane with air and not oxygen. Some tried to mix and match words and formulae, giving CO_2 or H_2O as one of the products. Others tried to give a formula equation, some getting the correct formulae, but none appeared to manage to balance it correctly.

(iii) Butane burns completely in air to form carbon dioxide and water.

Write the word equation for this reaction.

(2)

Butane + air → Carbon dioxide + water.

ResultsPlus
Examiner Comments

1 mark

Many candidates made the error of using air instead of oxygen on the reactants side. This scored for the products side only.

ResultsPlus
Examiner Tip

Practise writing word equations from descriptions of various reactions.

(iii) Butane burns completely in air to form carbon dioxide and water.

Write the word equation for this reaction.

(2)

Butanee + heat + oxygen → CO_2 + H_2O

ResultsPlus
Examiner Comments

The use of formulae, even though correct, did not score for the right and side. 'Heat' was ignored for the left side, but butane and oxygen along with the arrow scored a mark for the reactant side only.

1 mark

ResultsPlus
Examiner Tip

Never mix up words and formulae in a word equation.

Question 6 (b)

Only about a quarter of the candidates scored any marks on this more difficult calculation. Where marks were scored, it was most usually for 40 (formula mass of MgO) or 80 (2 x formula mass of MgO). Having got to this stage, few candidates knew where to go. A few tried combining the 40 or 80 with 1.35 and came up with 54 or 108, which scored the second mark. Only a tiny number of candidates scored the third mark here.

(b) Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

[redacted]

Starting [redacted]m, calculate the maximum mass of magnes[redacted] oxide that could be formed in this reaction.
(relative atomic masses [redacted]

You must show your working.

(3)

M O

$\frac{1.35g}{24.0}$ = ~~0.05625~~ 0.05625

$\frac{0.05625}{0.05625}$ = 1

mass of magnesium oxide = 1 g

ResultsPlus
Examiner Comments

This answer scored 1 mark for taking the mass of magnesium and dividing the relative atomic mass, 1 mark.

Working out the formula mass of magnesium oxide should have the next step and then the mass of magnesium oxide.

(b) Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

Starting with 1.35 g of magnesium, calculate the maximum mass of magnesium oxide that could be formed in this reaction.
(relative atomic masses: O = 16.0, Mg = 24.0)

You must show your working.

(3)

24 x 2 = 48
16 x 2 = 32
48 + 32 = 80

$\frac{1.35}{80}$

mass of magnesium oxide = 59.3 g

ResultsPlus
Examiner Comments

This candidate has worked out 2 x formula mass of magnesium oxide = 80 - scored 1 mark.

The next step was incorrect.

(b) Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

Starting with 1.35 g of magnesium, calculate the maximum mass of magnesium oxide that could be formed in this reaction.
(relative atomic masses: O = 16.0, Mg = 24.0)

You must show your working.

(3)

1.35g of magnisium
Relative atomic masses: O = 16.0, Mg = 24.0
16.0 + 24.0 = 40
40 × 1.35 = 54 g

mass of magnesium oxide = 54 g

ResultsPlus
Examiner Comments

Working out the formula mass of magnesium oxide : 24 + 16 = 40 scored the 1st mark, multiplying that by 1.35 to give 54 scored the 2nd mark.

2 marks total.

The next step should have been to divide this answer by the relative atomic mass of magnesium which would have given the correct answer.

Question 6 (c)

Plenty of candidates clearly did not know what a balanced equation should look like. Of those who attempted one, the most commonly scoring attempt showed HCl (or ClH) as the product. Very few seemed to know that both chlorine and hydrogen were diatomic. Showing both as monatomic was common and very few showed diatomic chlorine. Generally, if the formulae of both the reactants and products were correct, the balancing was also correct.

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

Write the balanced equation for this reaction.

(3)

$2Cl + H_2 \rightarrow 2ClH$

ResultsPlus
Examiner Comments

The formula of chlorine was incorrect but the formula for hydrogen chloride was allowed. The balancing mark is only given where the formulae for all the substances in the equation are correct.

1 mark

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

Write the balanced equation for this reaction.

(3)

chlorine + hydrogen → hydrogen chloride.

$Cl_4 + 2H \rightarrow Cl_4H_2$

ResultsPlus
Examiner Comments

Incorrect formula of both reactants and products meant that this answer scored 0.

Word equations in this type of question are ignored and do not score.

ResultsPlus
Examiner Tip

Learn the formulae of the gaseous elements such as as hydrogen, chlorine and compounds such as hydrogen chloride.

Practise writing balanced equations for a variety of reactions.

Question 6 (d)

In answering this question, it was clear that some candidates have seen the description of the formation of sodium and chloride ions from sodium and chlorine atoms using electron configurations. Unfortunately, in some cases, scientific literacy let them down and they used the word ‘sharing’ to describe what happens to the odd sodium electron when they mean ‘giving’ and show giving in a diagram. They also do not use the term chloride consistently enough to describe the Cl^- ion. Very few candidates even attempted a description of the arrangement of ions in sodium chloride and when they did it was usually very basic. However, one or two remarkably good descriptions, including diagrams were seen.

Inaccuracies which lost candidates marks included using the term atoms instead of electrons and getting the charges on the ions the wrong way round, in spite of these being given in the stem of the question.

What was particularly noticeable here was the large number of complete blanks returned for this item as well as simply repeating information from the stem of the question.

*(d) Sodium chloride is an ionic compound, containing sodium ions, Na^+, and chloride ions, Cl^-.

Figure 10 shows the electronic configuration of sodium and chlorine.

	electron configuration
sodium	2.8.1
chlorine	2.8.7

Figure 10

Explain how sodium and chlorine atoms form the ions in sodium chloride and how the ions are arranged in the solid sodium chloride.

You may wish to use diagrams in your answer.

(6)

- In sodium it has 3 shells
- It contains one electron on the outer shell meaning it is in group 1 of the periodic table
- As it has one on the outer shell it means it is really reactive.
- Chlorine also has 3 shells.
- We can view its in group 7 of the periodic table because it has 7 electrons on its outer shell.
- This means that chlorine is less reactive than sodium.
- Chlorine wants to gain an electron to create a full outer shell whereas sodium wants to loose than 1 electron.

ResultsPlus
Examiner Comments

The description starts with some bullet points that decribes the electron configurations of atoms of the two elements. However, it is the last bullet point that contains the important information and describes the idea of ion formation as a result of loss and gain of electrons by atoms of these two elements. This is enough for level 2 - 3 marks.

*(d) Sodium chloride is an ionic compound, containing sodium ions, Na^+, and chloride ions, Cl^-.

Figure 10 shows the electronic configuration of sodium and chlorine.

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Figure 10

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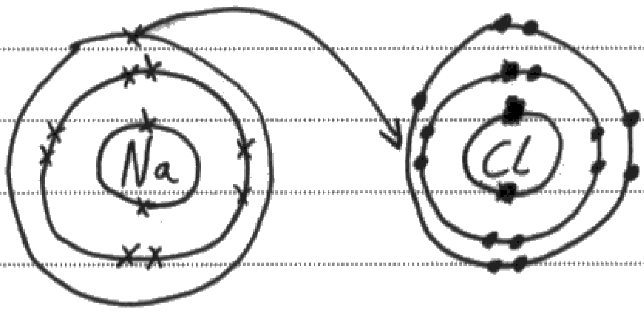

Sodium's orbit containing one electron loses that electron when it ~~makes~~ mixes with chlorine as this allows sodium to then have a full outer shell as the orbit now ~~a~~ on the outside is full with 8 electrons. Chlorine also has an outer orbit that is almost full with one electron missing, and by gaining this electron from sodium, it then forms a full outer shell with 8 electrons orbiting.

As ~~both~~ the charges of both atoms to begin with are neutral (because they are atoms (cannot have a charge)), ~~[illegible]~~ through the exchange in electrons, they both become ions. Sodium is positively charged and chlorine is negatively charged.

ResultsPlus
Examiner Comments

The diagram clearly shows the electron transfer from sodium to chlorine and so obtains electron arrangements with full outer shells. This is also seen in the description that follows. This is a very good answer although there no mention about the structure of sodium chloride it is enough to put it into level 3 with 5 marks.

*(d) Sodium chloride is an ionic compound, containing sodium ions, Na^+, and chloride ions, Cl^-.

Figure 10 shows the electronic configuration of sodium and chlorine.

	electron configuration
sodium	2.8.1
chlorine	2.8.7

Figure 10

Explain how sodium and chlorine atoms form the ions in sodium chloride and how the ions are arranged in the solid sodium chloride.

You may wish to use diagrams in your answer.

(6)

Sodium and chlorine both have 2.8 at the start of their electron configuration this means that they can form together to make sodium chloride.

ResultsPlus
Examiner Comments

This answer contains nothing to credit about the formation of sodium and chloride ions, nor about the structure of sodium chloride. This scored 0 marks.

ResultsPlus
Examiner Tip

Focus the answer on what is being asked. Here it is about the fromation of ions and about the stucture of sodium chloride, an ionic substance.

Paper Summary

Candidates who performed well on this paper

- answered the question using clear language
- used scientific terminology accurately
- set out their calculations in an organised manner
- structured the 6-mark answer very well.

Based on the performance of this year's examination paper, candidates are offered the following advice:

- Practise calculations such as those in this paper, namely calculations involving the concentration of a solution, the empirical formula of a substance and mass-mass calculations using a given balanced equation and relative atomic masses.
- Write word and balanced equations given the relevant information.
- Interpret graphs and suggest a sketch using relevant information.
- Plan simple experiments.
- Know the hazard symbols and suggest precautions based on relevant information.
- Practise answering the longer 6-mark items to know how to structure answers.
- Use past papers as part of the revision process.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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