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GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250
For first teaching in 2016

J250/03 Summer 2019 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 3 series overview

J250/03 is the first of two foundation tier papers for the Chemistry content of Gateway Combined Science A. This component assesses topics C1-C3 and CS7 (PAGs C1-C5).

To do well on this paper, candidates need to demonstrate knowledge and understanding of scientific ideas, techniques and procedures across all four topics. They need to be able to apply their knowledge and understanding to unfamiliar contexts as well as displaying the ability to analyse information. Candidates also need to be familiar with a range of experimental procedures.

J250/03 has an equal emphasis on knowledge and understanding of the assessment outcomes from the specification and application of this knowledge.

In general, the paper was accessible to most candidates but also gave higher ability candidates plenty of opportunity to demonstrate their knowledge. Candidates achieved a wide range of marks up to 53 out of 60.

Candidate performance overview

Candidates who did well on this paper generally:

- Were able to analyse information to make judgements and suggest improvements to experimental procedures: 14 (d)
- Were able to balance equations correctly: 13 (d)
- Knew definitions of scientific terms: pure: 14 (b) (i); endothermic: 16 (a); oxidation: 16 (d) (i)
- Performed calculations competently (7 and 9), showing working clearly and giving answers to the required number of significant figures: 15 (b) (i)
- Linked observed properties, e.g. conductivity and melting points to the structure and bonding in elements and compounds: 11 (d) and 12 (c)

Candidates who did less well on this paper generally:

- Did not attempt all the questions, in particular 14 (d) was omitted
- Struggled to analyse information to make judgements and suggest improvements to experimental procedures: 14 (d)
- Did not understand what was required when balancing an equation or know how to write a chemical formula correctly using subscripts: 13 (d), 14 (a)
- Did not show working clearly in their calculations and were unable to give answers to the required number of significant figures: 15 (b) (i)
- Struggled to make and explain the link observed properties, e.g. conductivity and melting points to the structure and bonding in elements and compounds: 11 (d) and 12 (c)

The majority of candidates were unable to:

- Complete and label an energy level diagram
- Draw a labelled diagram of the bonding in a metal

Most candidates had sufficient space to write their answers, with few using the extra answer space. There was no evidence that candidates did not have time to finish the examination.

Section A overview

Virtually no candidates omitted any of the multiple-choice questions.

Questions 2, 5 and 9 proved to be the most difficult for candidates.

Question 1

1 Which of these processes is an example of a **physical** change?

A Combustion

B Freezing

C Neutralisation

D Oxidation

Your answer ☐ **[1]**

The majority of candidates correctly selected freezing. A few chose combustion or neutralisation.

Question 2

2 The equation shows the reaction of sodium with water.

Sodium hydroxide and hydrogen are made.

Two of the **state symbols** are missing.

$2Na(s) + 2H_2O..... \rightarrow 2NaOH(aq) + H_2.....$

What are the missing state symbols?

A (l), (l)

B (s), (g)

C (aq), (g)

D (l), (g)

Your answer ☐ **[1]**

All candidates knew that hydrogen was a gas, but most did not realise that water was a liquid and gave (aq) instead. Only a few thought water was solid.

Question 3

3 A student tests which gas is produced in a reaction using a glowing splint. The gas re-lights the glowing splint.

What is the name of the gas?

A Carbon dioxide

B Chlorine

C Hydrogen

D Oxygen

Your answer ☐ **[1]**

Less than half of candidates knew the test for oxygen. All the other options were seen with hydrogen being the most popular incorrect choice.

Question 4

4 What is the **relative formula mass** of sulfuric acid, H_2SO_4?

The relative atomic mass, A_r, of H is 1.0, of S is 32.1 and of O is 16.0.

A 49.1

B 81.2

C 98.1

D 129.2

Your answer ☐ **[1]**

Around half of candidates correctly chose C. The most common error was to simply add the three relative atomic masses giving 49.1 as the answer.

Question 5

5 Na^+ is a **positively** charged ion.

What is the name given to a positively charged ion?

A Anion

B Cathode

C Cation

D Electrolyte

Your answer ☐ **[1]**

Very few candidates correctly chose cation. Anion and cathode were the commonest answers.

Question 6

6 Fluorine is in Group 7 of the Periodic Table.

Which statement best describes fluorine?

A It has a full outer shell of electrons

B It is a metal

C It is a non-metal

D It is a solid at room temperature and pressure

Your answer ☐ **[1]**

This was well answered as most candidate knew that fluorine was a non-metal. All of the other options were selected by some candidates.

Question 7

7 Calcium carbonate, $CaCO_3$, decomposes when heated. Calcium oxide, CaO, and carbon dioxide, CO_2, are made.

Look at the equation for the reaction.

$CaCO_3 \rightarrow CaO + CO_2$

In an experiment, 20.0 g of $CaCO_3$ are used. 11.2 g of CaO are made.

What is the mass of CO_2 made?

A 8.8 g

B 11.2 g

C 20.0 g

D 31.2 g

Your answer ☐ **[1]**

Over half of candidates correctly chose A. The most common error was to add the numbers instead of subtracting.

Question 8

8 The molecular formula of a compound is $C_{12}H_{26}$.

What is its **empirical formula**?

A C_2H_4

B C_2H_6

C C_4H_6

D C_6H_{13}

Your answer ☐ **[1]**

The majority of candidates understood what is meant by an empirical formula, so correctly chose D.

Question 9

9 Phosphorus sulfide, P_4S_3, has a relative formula mass of 220.3.

What is the percentage, by mass, of phosphorus in P_4S_3?

Use the Periodic Table to help you.

A 6.8

B 14.1

C 27.2

D 56.3

Your answer ☐ **[1]**

Candidates struggled with this question but many attempts at a calculation were seen. C was the most common answer where the atomic number of phosphorus was been used instead of the relative atomic mass.

Question 10

10 Which statement best describes an atom?

A The nucleus is small compared to the atom and contains little of the atom's mass.

B The nucleus is large compared to the atom and contains little of the atom's mass.

C The nucleus is small compared to the atom and contains most of the atom's mass.

D The nucleus is large compared to the atom and contains most of the atom's mass.

Your answer ☐ **[1]**

Almost half of candidates correctly selected C. A common misconception is that the nucleus is large compared to the size of the atom with B and D being common choices.

Section B overview

There was no evidence that candidates did not have enough time to complete the paper. The majority of candidates attempted all of the questions.

Question 11 (a)

11 Atoms are made of particles called protons, neutrons and electrons.

(a) Complete the table to show the **relative charges** of protons, neutrons and electrons.

Particle	Relative charge
Proton	.....
Neutron	0
Electron	.....

[2]

Most candidates knew that both numbers should be 1, but lost marks by omitting the plus and minus signs. Where a single mark was given it was usually for -1 for the electron with the charge for the proton missing. A few confused it with mass and some random numeric values were seen.

Question 11 (b) (i)

(b) Sodium is a metal in the Periodic Table.

(i) Use the Periodic Table to work out the following:

The **relative atomic mass** of sodium = ...

The number of **protons** in an atom of sodium = ...

The number of **electrons** in an atom of sodium = ...

[3]

Around a third of candidates gained 3 marks on this question. Most were able to use the periodic table to find the relative atomic mass of sodium. More able candidates knew the number of protons but some either mis-read the question or confused electrons and neutrons so subtracted 11 from 23.

Question 11 (b) (ii)

(ii) Sodium is an example of an atom that can form an ion.

Describe what happens to a sodium atom when it becomes an ion.

.....

..... **[1]**

This question was not well answered. The mark was as often given for 'becoming positively charged' as for the idea of losing an electron. The most common mistake was to give the definition they had learnt for formation of an ion – gains or loses electrons – rather than rather than applying it to the question and relating to sodium. Other incorrect responses included 'gains protons' and 'gets charged'.

Question 11 (c)

(c) Look at this statement about the Periodic Table.

'Atoms are placed in groups according to the total number of electrons they have.'

Explain why this statement is incorrect.

.....

..... **[1]**

This question was poorly answered. Only higher ability candidates knew that the group number relates to the number of electrons in the outer shell. Incorrect answers included the idea that elements are arranged by atomic number, number of protons or atomic weight. Some thought it was the number of shells, or the number of outer shells. Others discussed grouping as metals and non-metals or grouping due to reactivity. A few candidates stated that elements or atoms did not have electrons.

Question 11 (d)

(d) A new element has been discovered and has these properties:

- a high melting point
- reacts with oxygen to form oxides
- conducts electricity
- solid at room temperature.

Suggest what type of **bonding** the new element has.

Explain your answer.

Type of bonding .....

Explanation .....

.....

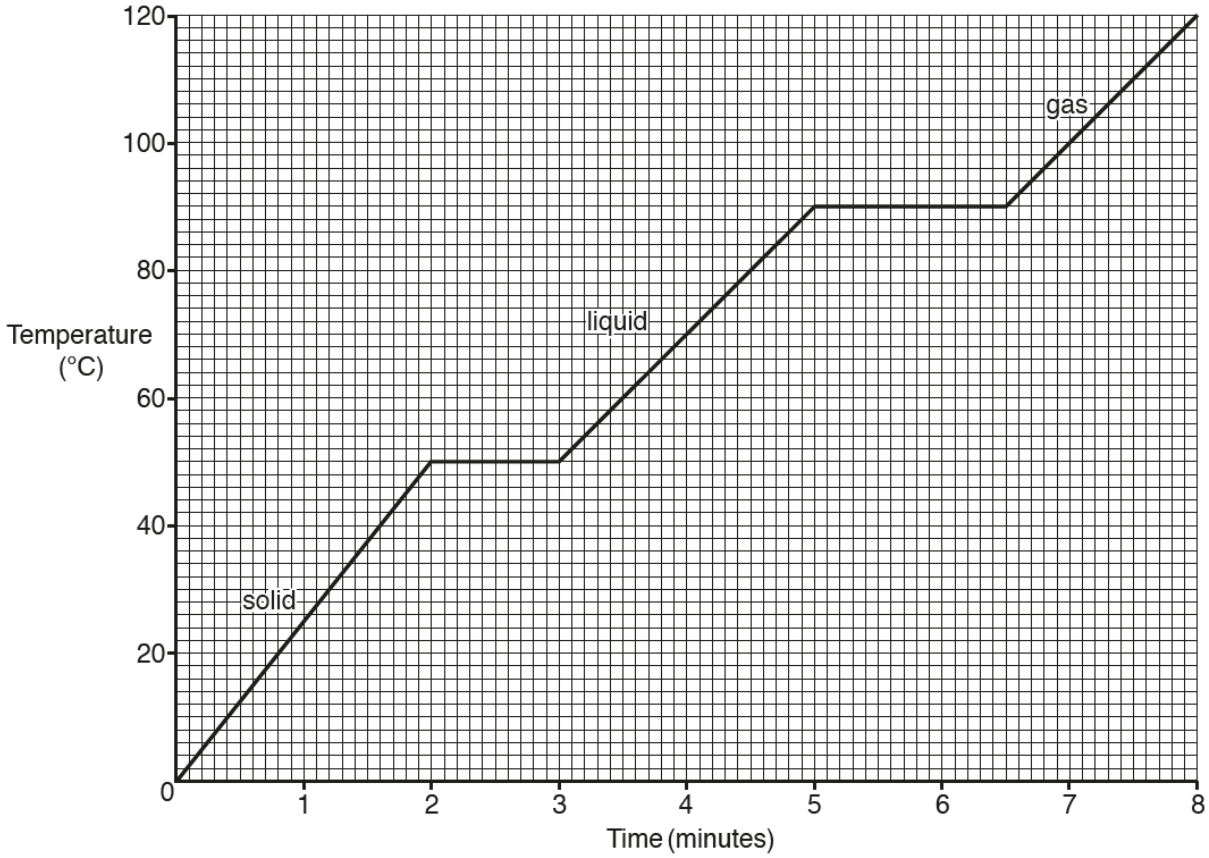
..... **[2]**

Few candidates gained any marks on this question, with many omitting it. The type of bonding was commonly given as ionic or covalent, but metal, strong, tight and strong covalent were also seen. Metallic was occasionally seen, but giant covalent was rarely seen.

Those who named the correct type of bonding almost invariably gave a correct reason, but 'forms oxides' was hardly ever given. If the type of bonding was incorrect then no credit could be given for the explanation.

Question 12 (a) (i)

12 Look at the graph. It shows how the temperature changes as substance **X** is heated.



(a) (i) What is the **melting point** of substance **X**?

Melting point = ... °C **[1]**

This question was mostly answered correctly. Common incorrect answers were 45° and 90°.

Question 12 (a) (ii)

(ii) What is the **state of matter** of substance **X** at 70 °C?

Tick (✓) **one** box.

Solid ☐

Liquid ☐

Gas ☐ **[1]**

Almost all candidates answered correctly.

Question 12 (b)

(b) In which state of matter do the particles of **X** have the **most** energy?

Tick (✓) **one** box.

Solid ☐

Liquid ☐

Gas ☐ **[1]**

Over half of candidates knew that gas particles have most energy, with the most common wrong answer bring solid.

Question 12 (c) (i)

(c) Another substance, **Y**, is heated.

Substance **Y** is an **ionic** compound.

Substance **Y** has a much higher melting point than substance **X**.

Substance **X** is a **simple covalent** compound.

(i) Which substance, **X** or **Y**, is made up of **molecules**?

Tick (✓) **one** box.

X ☐

Y ☐

Explain your answer.

.....

..... **[1]**

This question was not answered well with X and Y being selected about equally. The mark was for the explanation, but few realised that they simply had to select their answer from the question. Very few could link molecules to simple covalent compounds, with more scoring the mark for the idea that X had a lower melting point than Y.

Common errors were to discuss boiling points or to refer to simple covalent bonds.

Question 12 (c) (ii)

(ii) Explain the difference between the melting points of substances **X** and **Y**.

Use ideas about the forces between the particles.

.....

.....

.....

..... **[2]**

This question was not well answered; many did not write about forces between particles. Candidates did not seem to realise that ionic compounds had electrostatic forces, whereas simple covalent compounds had intermolecular forces. Where intermolecular forces were mentioned they were generally attributed to both compounds, but with the strength of them being different, e.g. strong intermolecular forces in Y and weak intermolecular forces in X.

Both marks were rarely given. Where a mark was given it was generally for comparison of force strengths. A few candidates made the energy comparison but gained only one mark, as they omitted reference to strength of forces. Other candidates discussed bonds/forces that were easy or hard to break, or took more time to break rather than weak or strong.

Some Lower ability candidates referred to spacing of particles, and often misunderstood the idea of force strengths by talking about the particles having force or the force needed to break particles apart.

Exemplar 1

Y has a higher melting point meaning the force of the particles isn't as strong as X as x has a lower melting point meaning the force of the particles are stronger **[2]**

This candidate has referred to particles and to forces, but not to the forces between particles so gains no credit.

Exemplar 2

Substance Y has a higher melting point which means the forces between the particles are stronger and take more to break ..... [2]

This response scored 1 mark, but if they had said that **more energy was required** to break the forces, they would have gained a second mark. Candidates did not need to refer to both X and Y in their answers, but they must compare the forces, not merely state that was one was weak or strong.

Question 13 (a) (i)

13 A student tests three solutions **A**, **B** and **C**. He wants to identify which solution is acidic.

The student adds a metal carbonate to each solution.

Table 13.1 shows his results.

Solution	Observations with metal carbonate
A	no reaction
B	bubbles and fizzing
C	no reaction

Table 13.1

(a) (i) Which solution, **A**, **B** or **C**, is acidic?

Tick (✓) **one** box.

A ☐

B ☐

C ☐ **[1]**

Almost all candidate answered correctly.

Question 13 (a) (ii)

(ii) Suggest a **pH value** for the acidic solution.

pH value = ... **[1]**

Just over half of candidates could suggest an appropriate pH value. Almost all knew that pH values ranged from 1 to 14. A common wrong answer was 7, with values above 7 often being given. Some gave correct ranges, but ranges like 6 – 8 could not be credited.

Question 13 (a) (iii)

(iii) Write down **two** other tests the student could use to identify that the solution is acidic.

1 .....

2 .....

[2]

This question was poorly answered, with very few candidates scoring both marks. A number of candidates did not give any answer. The most common correct answer was universal indicator followed by a pH meter/probe, but litmus and a few other indicators were seen.

A common incorrect answer was to use a pH scale, or pH paper. Some added metal but did not say that it would fizz, added alkali or neutralised it. A wide variety of other tests were suggested including heat it, see what colour it is (but no indicator), see how it reacts, dip your finger in to see if it burns.

Question 13 (b)

(b) The student adds the acidic solution to a solution of sodium hydroxide. A neutralisation reaction takes place.

He records the pH of the mixture.

Table 13.2 shows his results.

Volume of acidic solution added (cm^3)	pH of mixture
0	12.2
5	11.0
10	9.0
15	7.5
20	7.0

Table 13.2

Describe the relationship between the volume of acidic solution added and the pH of the mixture.

.....

..... **[1]**

Many gained the mark for this question, but lower ability candidates struggled to express their answer clearly. Some just said 'as the volume of acid added, pH decreases' and did not mention the volume of acidic solution increasing so lost the mark. Instead of writing about the pH decreasing some used phrases including there was less pH mixture, it got more neutral, got more acidic.

Question 13 (c)

(c) Sodium hydroxide is an **alkali**.

Which ion do solutions of alkalis contain?

Put a (ring) around the correct answer.

H^+ **Na^+** **OH^-** **SO_4^{2-}**

[1]

Few candidates could link OH^- ions to alkalis. The most common incorrect answer was Na^+ followed by H^+ and SO_4^{2-} . Some selected more than one answer.

Question 13 (d)

(d) In a different neutralisation reaction sulfuric acid, H_2SO_4, reacts with sodium hydroxide, NaOH.

Complete the **balanced symbol** equation for this reaction.

$$H_2SO_4 + \text{.....} NaOH \rightarrow Na_2SO_4 + \text{.....} H_2O$$

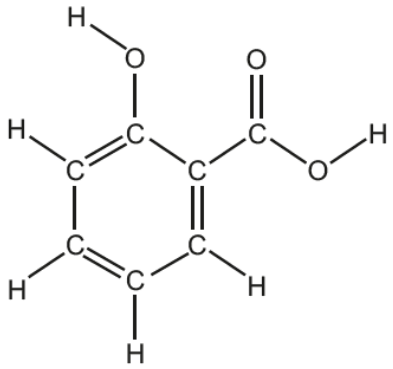
[1]

Less than half of candidates answered correctly, with a number not attempting it. Lots of ways of working out balancing were evident. Less able candidates often included symbols or formulae on the dotted lines. Multiples, often 6 and 6, were seen but generally candidates then forgot to apply the multiple to the rest of the equation.

Question 14 (a)

14 Aspirin is a widely used painkiller and is sold as tablets.

One of the chemicals in aspirin is salicylic acid. The structure of salicylic acid is shown below.



Salicylic acid

(a) What is the **empirical formula** of salicylic acid?

.....

[1]

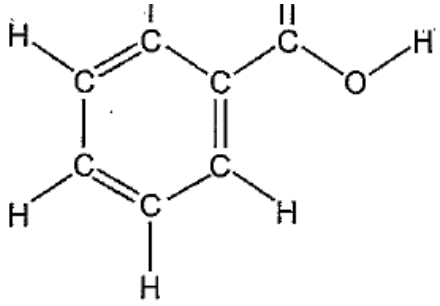
Less than half of candidates could write the empirical formula correctly, with a substantial number not attempting this question. Many counted the number of atoms correctly, but many did not use subscripts. Many correct answers had the elements in the wrong order, but this was not penalised.

Exemplar 3

~~C7H6O3~~ $C_7+O_3+H_6$

A significant number of candidates put + signs or other symbols in between the three elements, so could not gain the mark.

Exemplar 4



Salicylic acid

$C_7H_6O_3 = C_7H_2O$

(a) What is the **empirical formula** of salicylic acid?

C_7H_2O **[1]**

Some candidates worked out the formula correctly but went on write a different formula. They did not seem to realise that the empirical formula can be the same as the molecular formula. The writing on the answer line takes precedence so no marks could be given here.

Question 14 (b) (i)

(b) It is important that aspirin is **pure** for it to be safely used in tablets.

(i) Explain the meaning of the term pure.

.....

..... **[1]**

This question was not well answered. Candidates need to learn the definition of pure as 'containing only one type of atom/element or compound/molecule'. Since aspirin is a compound, we accepted answers that referred only to containing just one type of compound/molecule, or containing only aspirin (molecules).

'Not mixed with anything' was not credited, but 'not a mixture' was allowed. Many candidates wrongly referred vaguely to 'substances' or to the absence of contaminants, harmful substances, bacteria etc.

Question 14 (b) (ii)

(ii) Three students, **A**, **B** and **C** make aspirin and check its purity. The students test the purity of the aspirin by measuring the melting point.

Their results are shown in the table.

Student	Melting point (°C)
A	160
B	139
C	137

The melting point of pure aspirin is in the range 138–140 °C.

Which student made pure aspirin?

Tick (✓) **one** box.

A ☐

B ☐

C ☐ **[1]**

Mostly answered this question correctly.

Question 14 (c)

(c) Another method of checking the purity of a substance is paper chromatography.

Look at the diagram of the apparatus used for paper chromatography.

Label the chromatography diagram.

Choose your labels from the list.

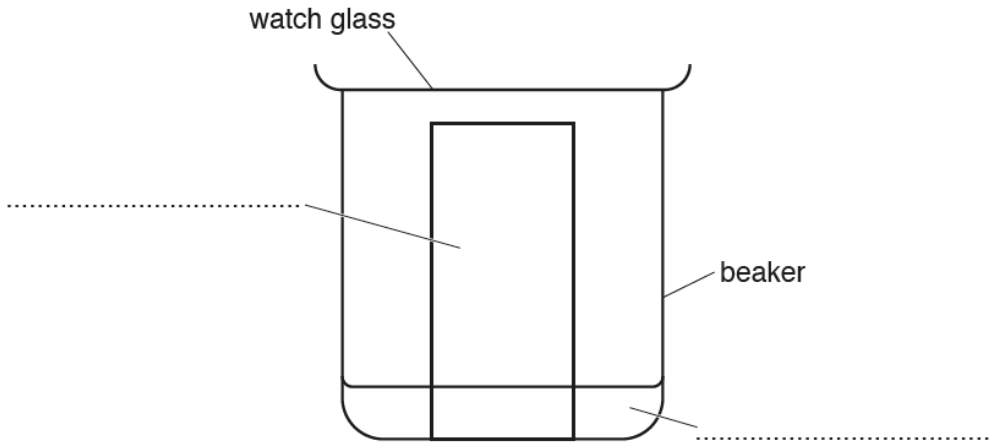
active phase

inactive phase

gas phase

mobile phase

stationary phase



[2]

This question was not well answered. Most candidates did not select the terms 'mobile phase' and 'stationery phase'; when they did, they frequently labelled them the wrong way around. Many incorrect options were chosen, not all from the list, with active and inactive phases being most popular.

Question 14 (d)

(d)* This is the method the students follow for the paper chromatography experiment.

1. Draw a pen line near the bottom of the paper.
2. Put a spot of the substance to be tested onto the line.
3. Stand the paper in the solvent. The solvent should be at the same level as the spot.
4. Cover the beaker.
5. Remove the paper from the beaker before the solvent reaches the top.
6. Calculate the R_f value of the substance by using this equation:

$$R_f \text{ value} = \frac{\text{distance moved by solvent}}{\text{distance moved by spot}}$$

Their teacher notices some mistakes with this method.

Describe and explain the **mistakes** in the method and suggest improvements that could be made.

.....

.....

.....

.....

.....

..... **[6]**

Many candidates made a good attempt at this question with the full range of marks being given. Although some omitted this question, well over half of all candidates gave a creditworthy answer. The majority of candidates suggested using pencil for the line instead of pen, thus achieving Level 1 with 2 marks. Many also realised that the solvent should be below the level of the spots.

To progress to Level 2 candidates needed to explain at least one of the mistakes. Some managed to do this. Others could not explain their ideas coherently enough to gain credit, often they just said it would 'interfere with the results'. To progress to Level 3 most of the mistakes had to be explained including the error in the Rf equation.

Higher ability candidates were able to explain the mistakes they identified, and realised that the Rf equation was upside down. Lower ability candidates were mostly not able to explain any of the mistakes.

Many had been taught the word solute rather than spot in the Rf equation and so thought this was the problem, not noticing that the equation was upside down. Despite the labelled diagram in 14 (c) with a watch glass covering a beaker, many candidates stated that covering the beaker was an error, often because the experiment/reaction required oxygen or that the cover would stop the solvent rising. A few candidates identified a 'mistake' in all six steps. Some commented that 'the paper should be left in until the solvent reaches the top' or thought that removing the paper was wrong. Other 'mistakes' included good scientific practice like repetitions, safety goggles, timing the experiment, using controlled quantities or changing the temperature.

Exemplar 5

- Draw a pencil line instead of a pen line
- The solvent should be at the same level as the line drawn
- Dont cover the beaker
- leave the paper in the beaker until there is a change
- ~~distance from the line to the spot~~ distance from line bottom from the bottom
- distance from line to bottom distance from line to moved spot [6]

A significant number of candidates tried to find a mistake in each step of the instructions. Here they have realised that pencil should be used instead of pen and that the solvent should be below the spots. Since they have offered no explanations, they are limited to Level 1 and gained 2 marks.

Exemplar 6

First mistake would be in step one and when they drawn the line in pen this is wrong because the line will move. An improvment would be to draw the line in pencil. Second Mistake was that the Solvent Should be of the Same Level of the Spot in Step 3, this is wrong as there would be a chance that the Spot could diffuse into the Solvent in the beaker. An improvment would be to lower the level of Solvent Just below the pencil line. The Final mistake would be in Step 6. The problem is the equation is incorrect and this will not give you the correct result So to improve this I would use the equation: $Rf = \frac{\text{distance moved by Spot}}{\text{distance moved by Solvent}}$ [6]

This candidate has achieved Level 3 to get 6 marks as they have identified three mistakes and explained them clearly.

Question 15 (a)

15 A student does an experiment to identify an unknown metal **M**.

The student weighs metal **M**. Then the student adds metal **M** to a solution of copper sulfate, $CuSO_4(aq)$.

A reaction takes place forming copper metal, Cu:

$\mathbf{M}(s) + CuSO_4(aq) \longrightarrow Cu(s) + \mathbf{M}SO_4(aq)$

The student separates the copper and then weighs the copper.

These are the student's results:
Mass of metal **M** = 8.10 g
Mass of copper = 21.2 g

(a) How could the student separate the copper from the solution?

..... **[1]**

A small number of candidates knew that a solid can be separated from a solution by filtration. A wide variety of incorrect techniques were suggested including heating, evaporation, electrolysis, distillation or crystallisation. Some of the answers given were not separation techniques.

Question 15 (b) (i)

(b) (i) Calculate the relative atomic mass of metal **M**.

Use the equation:

$$\text{relative atomic mass of metal } \mathbf{M} = \frac{\text{relative atomic mass of copper} \times \text{mass of metal } \mathbf{M}}{\text{mass of copper}}$$

The relative atomic mass of copper is 63.5.

Give your answer to **3** significant figures.

Relative atomic mass of metal **M** = ... **[3]**

Many candidates were able to give a correct answer to 3 significant figures to gain 3 marks. Most could calculate the answer, but some struggled to round their answer correctly: 24.2617925 was often rounded to 24.261 or 24.2. Converting to 3 significant figures proved more problematic for some; some gave answers to 3 decimal places. 24.26 was a common incorrect answer.

Some lower ability candidates seemed to have no idea how to tackle this calculation and were unable to substitute the data into the equation.

Question 15 (b) (ii)

(ii) Use your answer from **(b)(i)** and the Periodic Table to identify the metal **M**.

..... **[1]**

Candidates who had obtained an answer of 24.2 or 24.3 for 15 (a) (i) were mostly able to identify Magnesium. A few candidates confused atomic number with relative atomic mass, so their choice was incorrect. Some who had obtained an incorrect answer did not gain an ECF mark as their choice was not a metal.

Question 16 (a)

16 A student investigates three reactions.

She wants to find out if the reactions are exothermic or endothermic.

Look at her results.

Reaction	Start temperature (°C)	Final temperature (°C)
X	21	25
Y	20	18
Z	22	24

(a) Which reaction, **X**, **Y** or **Z**, is **endothermic**? .....

Explain your answer.

.....

..... **[2]**

More than half of candidates chose Y and gave a correct explanation to gain 2 marks. The most common correct answer was that Y was endothermic because the temperature had decreased. Many gave contradictory answers because they confused the ideas of 'decrease in temperature' with 'gain of energy'.

?	**Misconception**	There is a common misconception that when heat energy is taken in from the surroundings the temperature increases.

Exemplar 5

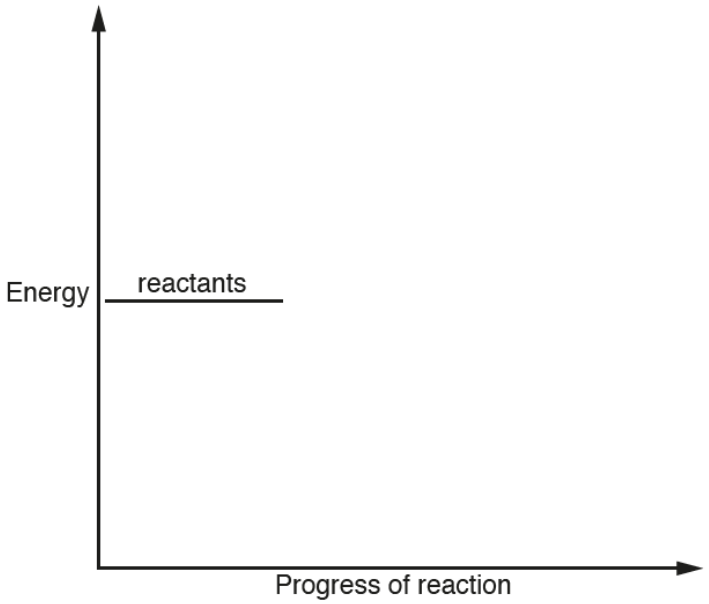
As an endothermic reaction gives takes in heat and therefore the temperature will rise. [2]

This candidate knows that endothermic reactions take in energy; if they had stopped writing here, they would have gained a mark, despite X being wrong. They lost the mark because they also stated that temperature rises.

Question 16 (b)

(b) Draw a labelled reaction profile for an **endothermic** reaction.

Use the following labels on your reaction profile:
- products
- energy change
- activation energy.



[4]

A small number of candidates gained one mark for drawing a curve linking the reactants and products lines. A few gained an extra mark for drawing the products line higher than the reactants line. Almost none gained 3 or 4 marks.

Some candidates knew where the activation energy should be shown but mostly did not gain credit. This was either because their arrow did not reach the full distance from the reactants line to the top of the curve, or because it had arrowheads at both ends of the line. The majority of candidates did not draw the energy change arrow correctly, often because they had drawn a diagram for an exothermic reaction.

Many lower ability candidates either did not attempt this question or merely drew a few random lines on the diagram as they appeared to have no idea what was required.

Question 16 (c)

(c) Another student repeats the same reactions.

The student does the experiment in a polystyrene cup instead of a beaker.

Explain why using a polystyrene cup is an improvement to the method.

.....

.....

..... **[2]**

This question was not well answered. Some candidates knew that polystyrene is a good insulator, but most struggled to explain this coherently. Those who gained one mark had the idea that it kept heat in, but few used the word insulator. Very few candidates mentioned accuracy to gain a second mark.

Several candidates incorrectly stated that polystyrene was a good conductor of heat. Others referred to it being cheaper, the idea of it being a cleaner vessel or less likely to break. Some got confused and wrote 'it's a good conductor so it keeps the heat in'.

Question 16 (d) (i)

(d) The reaction between iron oxide and aluminium is very exothermic.

Look at the equation for the reaction.

$Fe_2O_3(s) + 2Al(s) \longrightarrow Al_2O_3(s) + 2Fe(l)$

(i) During this reaction the aluminium is **oxidised**.

Explain what is meant by the term oxidised.

.....

..... **[1]**

Many candidates knew that oxygen was involved in oxidation, but they could not all explain well enough to gain credit. Despite writing OIL RIG in the answer space not all candidates were sure what was being lost, so some wrote 'loss of oxygen'. Mostly the mark was gained for the idea of gain of oxygen, with only a few mentioning loss of electrons

Answers that gained credit included gain of oxygen, loss of electrons, reaction with oxygen. Incorrect answers included 'it has oxygen in it', uses oxygen, mixing with oxygen, references to heating and to changing state.

Question 16 (d) (ii)

(ii) Pure iron metal is produced in the reaction.

Draw a diagram to show the bonding in a metal.

Label your diagram clearly.

[3]

A very few candidates were able to draw rows of spheres to gain one mark, but most had no idea what was required so did not attempt to answer. Some candidates put + signs in their circles but did not label them as positive ions so did not score a second mark. The electrons were correctly labelled more frequently than the metal ions.

Common incorrect answers were dot and cross type diagrams of either metal atoms, covalent molecules or ionic compounds. Examiners also saw some diagrams of random circles joined by lines and a few energy level diagrams.

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