



GCSE EXAMINERS' REPORTS

**SCIENCE (DOUBLE AWARD)
GCSE
SUMMER 2023**

Introduction

Our Principal examiners' reports offer valuable feedback on the recent assessment series. They are written by our Principal Examiners and Principal Moderators after the completion of marking and moderation, and detail how candidates have performed.

This report offers an overall summary of candidates' performance, including the assessment objectives/skills/topics/themes being tested, and highlights the characteristics of successful performance and where performance could be improved. It goes on to look in detail at each question/section of each unit, pinpointing aspects that proved challenging to some candidates and suggesting some reasons as to why that might be.ⁱ

The information found in this report can provide invaluable insight for practitioners to support their teaching and learning activity. We would also encourage practitioners to share this document – in its entirety or in part – with their learners to help with exam preparation, to understand how to avoid pitfalls and to add to their revision toolbox.

Further support

Document	Description	Link
Professional Learning / CPD	WJEC offers an extensive annual programme of online and face-to-face Professional Learning events. Access interactive feedback, review example candidate responses, gain practical ideas for the classroom and put questions to our dedicated team by registering for one of our events here.	https://www.wjec.co.uk/home/professional-learning/
Past papers	Access the bank of past papers for this qualification, including the most recent assessments. Please note that we do not make past papers available on the public website until 6 months after the examination.	www.wjecservices.co.uk or on the WJEC subject page
Grade boundary information	Grade boundaries are the minimum number of marks needed to achieve each grade. For unitised specifications grade boundaries are expressed on a Uniform Mark Scale (UMS). UMS grade boundaries remain the same every year as the range of UMS mark percentages allocated to a particular grade does not change. UMS grade boundaries are published at overall subject and unit level. For linear specifications, a single grade is awarded for the overall subject, rather than for each unit that contributes towards the overall grade. Grade boundaries are published on results day.	For unitised specifications click here: Results, Grade Boundaries and PRS (wjec.co.uk)

Exam Results Analysis	WJEC provides information to examination centres via the WJEC secure website. This is restricted to centre staff only. Access is granted to centre staff by the Examinations Officer at the centre.	www.wjecservices.co.uk
Classroom Resources	Access our extensive range of FREE classroom resources, including blended learning materials, exam walk-throughs and knowledge organisers to support teaching and learning.	https://resources.wjec.co.uk/
Bank of Professional Learning materials	Access our bank of Professional Learning materials from previous events from our secure website and additional pre-recorded materials available in the public domain.	www.wjecservices.co.uk or on the WJEC subject page.
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Subject Officer's Executive Summary

Advance information was provided for all theory units. The sub-topic areas were listed in rank order, it was mentioned that for some units this had aided revision.

A number of comments were made about candidates being entered for the incorrect tier. Noticeable differences between higher tier and foundation tier candidates were seen, with many positive comments about the performance of higher tier candidates.

Recall of knowledge was a problem for many – this has been an issue for a number of years. Certain topics every year candidates have issues with and the same pattern was seen this summer such as heat transfer and chemical formulae.

Handwriting was noted as being an issue on a number of occasions. Answers requiring qualitative responses, candidates struggled with. There were many examples of candidates not reading the question carefully, this was shown in contradictory answers. Lack of understanding of command words was often seen. It was apparent that many foundation tier candidates have very basic literacy skills.

There were a number of positive comments about the performance on the QER questions. Some were based on specified practicals and a higher attempt rate was noted compared to previous series.

Maths skills were variable. It was noted that a lack of access to a calculator caused problems for some. Single stage calculations were managed much better than multi-stage calculations, converting units was noted as a problem. Rearranging equations is a weak area and ecf then becomes crucial for these candidates. Not showing any workings is a high risk approach that many candidates are taking.

Unfamiliar practical contexts candidates struggle with far more than familiar contexts. In the practical assessment unit it was apparent that instructions in the method were sometimes not read. Identifying the resolution was problematic for a number of candidates. Candidates have a good understanding of practical terms e.g. reproducibility etc. Plans were variable with lack of clarity being an issue sometimes. Question parts requiring science theory were often not well answered, candidates showed a broad understanding but they didn't provide enough detail in their answers.

Areas for improvement	Classroom resources	Brief description of resource
Qualitative responses	<u>TEXT TOOLS</u>	A bank of tools that allow teachers to use their own piece of text to generate a range of activities.
Heat transfer	<u>HEAT TRANSFER</u> <u>HEAT TRANSFER</u>	Knowledge organiser Blended learning
Chemical formula and equations	<u>FORMULAE AND EQUATIONS</u>	Blended learning
Glucose levels	<u>RESPONSE AND REGULATION</u>	Knowledge organiser

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UNIT 1: BIOLOGY 1 – FOUNDATION TIER

Overview of the Unit

The first four questions on Low Demand (i.e. 39 out of 45 marks), were split into short sections calling for short answers, simple arithmetic, or data plotting on a grid. Questions calling for specification knowledge were generally supplied with prompts to facilitate recall, such as Cloze comprehension style word selection from a limited list of options, or a True/False exercise. Questions on Standard Demand (i.e. the remaining 15 marks) were somewhat more challenging.

- Basic literacy was generally limited. Candidates often appeared not to comprehend the questions, and therefore gave irrelevant, confused or totally unintelligible answers. There was widespread failure to distinguish between the command words 'Describe' and 'Explain', 'State' and 'Suggest'. Spelling was often far off the mark. Vocabulary was generally limited, so that many candidates appeared to struggle to express their ideas.
- There was an increased number of candidates handicapped by illegible handwriting, due to failure to form recognisable letters or numbers, excessively small writing or the use of pale-colours, rather than black biro as instructed.
- Skill in basic numeracy, was patchy. Most candidates coped well at Low Demand but many did struggle with even basic arithmetic. Candidates would be well advised to avoid using the term 'amount' when answers require reference to a specific measurable quantity, such as volume, concentration or mass.

Comments on individual questions/sections

Question 1

A substantial proportion of the candidates answered incorrectly when asked to state the source of the light used by plants in photosynthesis in (a). Many answers appeared random, such as 'the earth' or 'osmosis'. Most candidates scored in part (b).

Question 1 was all about light and photosynthesis, so it was disappointing that many gave unrelated answers, such as 'to help animals hide' in part (c).

Question 2

The roles of peristalsis and bile were unknown to many in answers to parts (b) and (c). Candidates were informed in bold in (e), that Chitosan stops the digestion of fat. They were expected to use that information in their answer. Those few who did, gained one mark, though very few then went on to state that fat would thus not be absorbed.

Question 3

Given the choice of three options in (a), the most popular answer was to assert that enzymes are made of lipid.

In previous years, most candidates would have performed well on a simple description, shown in a graph, of the effect of increasing pH on enzyme activity in part (b). Not so this year. Many appeared baffled by the question and offered unintelligible attempts to explain.

Most candidates did not use the cues given both in the diagram and in the text in (c)(ii) and were unable to explain why the denatured enzyme could not produce products.

The term 'variable' seemed to be unknown to many in part (d).

Question 4

Having attempted to remind candidates in (a) that oxygen is required for aerobic respiration, it was disappointing that the overwhelming majority selected Method 1 in (b)(i), with its air-tight bung. It appeared that very few could recall this specified demonstration.

In (b)(ii) most candidates scored at least one mark, usually both plotting marks, and often also the line mark. Candidates should be advised to complete graphs in pencil.

Question 5

A pleasing finding this year was an improved performance on the extended writing question (QER). Most candidates who attempted an answer recalled this specified investigation and achieved middle or top band marks. Well structured and correctly sequenced accounts were common. However, in many cases the mark was limited to the lesser of the two marks available in each band due to poor grammar and/or poor spelling.

Given the extensive structuring and accessibility of the question, it was disappointing that many candidates did not attempt an answer.

Question 6

In part (a)(i) several candidates scored one and a few got both marks, although many failed to score.

Hardly any candidates demonstrated an understanding of the principles of inspiration as illustrated by this specified demonstration in part (ii). The vast majority asserted that air pressure in the bell jar would *increase*, or simply change when the rubber sheet was pulled down.

Question 7

The percentage calculation in (a)(i) was beyond all but a very small minority - the most

common error being: $\frac{1.9}{3.8} \times 100 = 50$ [%]

Many candidates did not make use of the information provided in the first bullet point of the text in (a)(ii) and gave vague or unwarranted answers.

Many candidates did not understand the term 'pollutant' in (c)(i). Many of those who did scored at least one mark. Interestingly, reference to carbon dioxide/methane and climate change was commonly seen.

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UNIT 1: BIOLOGY 1 – HIGHER TIER

Overview of the Unit

This paper assessed all topic areas outlined in the specification, with the highest number of marks assessing understanding of section 1.6.

There were a range of questions, assessing theoretical knowledge, mathematical and practical skills.

Some excellent responses were seen, where candidates demonstrated a clear knowledge and understanding of biological concepts. Only a minority of candidates failed to attempt the questions, demonstrating that the paper was of suitable accessibility.

However, quality of written communication continues to be an issue as some responses were unclear or contradictory.

Whilst many candidates were able to recall the method for a specified practical, questions which assessed general practical skills such as identification of variables were more of a challenge and few candidates gained credit.

Candidates generally coped well with the mathematical demands of the paper.

Comments on individual questions/sections

Question 1

Part (a)(i) was answered well, with nearly all candidates correctly identifying the trachea and bronchus. Whilst many correct answers were seen in (ii), common errors were the idea of pressure increasing rather than decreasing when the rubber sheet is pulled down. Answers stating air enters were not enough to gain credit, candidates needed to describe a forced movement.

Part (b) required candidates to use the information provided and their own knowledge of the respiratory system to explain why a person with a hole in the chest cannot fully inflate their lungs. Few recognised that there would be no change in pressure or that the pressure in the chest cavity would be the same as the surrounding air pressure. Some incorrectly stated that air will leave the chest cavity rather than enter.

Question 2

A common incorrect answer seen in (a)(i) was 50%, as candidates calculated $\frac{1.9}{3.8} \times 100$,

dividing 1.9 by the final value rather than the initial value of 1.9.

In order to gain the first mark in (ii) candidates were required to use the information provided to identify that temperatures are kept high or that there is limited space for the animals. The second mark point required a comparative statement, as a result, answers stating 'no movement' or 'no heat lost' did not gain credit.

In part (b), many candidates correctly identified animal welfare as a reason for people buying free-range eggs but vague answers relating to eggs such as 'better eggs' or 'fresher eggs' did not gain a mark. Answers relating to the quality or taste of chickens were also rejected as the question referred to eggs.

Answers to (c)(i) were generally of a good quality, with many candidates correctly identifying a pollutant and its effect on the environment. Responses to (ii) were more varied, very few showed an understanding of the role of biologists at Natural Resources Wales.

Question 3

The QER question assessed knowledge of a specified practical outlined in section 1.5 of the specification. Some excellent answers were seen, where candidates wrote clearly, in a logical sequence to convey how to carry out the experiment, therefore gaining 5 or 6 marks. However, a common misconception seen was the idea that it is possible to measure volume of gas produced using the apparatus provided.

In part (b) where credit was not awarded it was often because candidates simply restated the question.

Question 4

Nearly all candidates correctly identified the right atrium and left ventricle in (a)(i). However, the quality of responses to (ii) were disappointing. Few candidates could recall the definition of a double circulation.

In part (b)(i) the maths did not pose a problem and nearly all correctly calculated 96 mm Hg. In II a comparison was required to gain credit. Answers such as 'thick muscle' were not credited.

In order to gain the mark in (b)(ii), candidates were required to recognise that blood flows from the left ventricle directly into the aorta. Vague answers that linked the aorta and left ventricle without a direction did not gain credit.

There were four possible mark points in (c), and many candidates successfully identified two, in the majority of cases the first two mark points were stated, thus gaining full credit. While many good answers were seen in (d), a significant number of candidates did not recognise that the coronary vessels supply the heart, so widening would lead to improved blood flow to the heart as opposed to around the body. Those that did gain the first mark point generally went on to gain the second, either by stating there would be no restriction on glucose or oxygen supply reaching the heart or that it would be less likely for the artery to become blocked. Answers stating that the artery would not become blocked were not credited.

Question 5

Most candidates could correctly identify parts A-C in (a), making this the most accessible question on the paper.

However, lots of vague answers were seen in (b) and, in some cases, candidates could not distinguish between enzymes and substrates. To gain the mark reference to the active site was required, this was rarely seen.

In (c)(i) nearly all candidates correctly identified that glucose was absorbed by active transport, but few gained all marks as they did not fully explain their decision. Some responses referred to a change in uptake of glucose in the presence of cyanide rather than a decrease. In addition, few responses were seen which identified the need for ATP or the lack of ATP availability to move glucose from a low to high concentration. The stem of the question in (c)(ii) stated that all three sugars could be absorbed by diffusion. However, in many cases candidates simply restated this information and did not use the evidence provided in table 5.2.

Most candidates used the information provided in image 5.3 to identify that the decreased surface area of the villi would impact absorption of digested food in (d).

Question 6

Nearly all candidates were able to identify that the humans had eaten the fish or shellfish in (a)(i), but fewer correctly identified bioaccumulation as the cause of the poisoning. The maths in (ii) did not pose any significant issues.

In many cases the knowledge to answer (b) had clearly been learned well and many candidates gave more than the maximum number of mark points available. However, one error often seen, was reference to microbes rather than decomposers or named decomposers.

Question 7

Very few candidates were able to correctly identify the variables in (a)(i). However, many correctly identified the enzyme in (a)(ii) and that it breaks down protein but fewer candidates named amino acids as the product. Part (iii) was the second most challenging question on the paper, rarely did candidates correctly identify the uncertainty and fewer were able to suggest a suitable improvement.

Question 7(b) required candidates to use data from graph 7.2 to explain why the weight lifter concluded he should use whey powder rather than dried milk powder in his diet to improve his performance. Unfortunately, very few candidates referred to the data, most answers stated whey powder contained more protein than milk powder and did not go on to state the role of protein in the diet of the weight lifter, making it the most challenging question on the paper.

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UNIT 2: CHEMISTRY 1 – FOUNDATION TIER

Overview of the Unit

Content from all topic areas in the unit was assessed in a range of theoretical and practical contexts.

The foundation tier-only part of the paper included many multiple-choice questions and all candidates found these accessible. The PISA-style question was attempted by the vast majority although not well answered.

Foundation tier candidates struggled on the common questions where they were required to recall knowledge of atomic structure, write descriptions and explanations and carry out a calculation. Questions which required direct recall of knowledge were poorly answered.

Mathematical questions on the foundation tier were generally well attempted and well answered. However, candidates struggled with writing chemical formulae and balancing symbol equations.

The quality of extended response (QER) question was better than in previous years with far fewer candidates not attempting it.

Comments on individual questions/sections

Question 1

Parts (a) and (b) were well answered by most candidates. Part (c)(i) was poorly answered with many giving the symbols for the elements rather than the ions or simply naming the elements. The expected answers should have been selected from the table of ions at the back of the paper.

Parts (c)(i) and (ii) demonstrate the weakness in combining ions to write a chemical formula and in balancing chemical equations. Many candidates did not know that oxygen exists as O₂ molecules.

Question 2

This was well answered and most candidates recognised the correct answers to questions on continental drift and global warming. Many scored 1 out of 2 for part (b)(ii) because answers were not specific enough.

Question 3

Most plotted the points correctly in (b)(i) but fewer gained mark for the line. A suitable line is a curve here and no credit was awarded for joining the plots using a ruler or drawing a straight.

Most candidates demonstrated good numerical skills by reading a value from the line graph in (b)(ii) but significantly fewer were able to calculate the mass of crystals formed when a saturated solution cooled. Many read values from the graph but they did not understand the effect of cooling and simply quoted the solubility at the lower temperature.

The equation in part (c)(i) was correctly balanced by around half the candidates but very few calculated the percentage yield. The most common error was dividing the expected mass by the actual mass leading to a yield of 139% and showing a complete lack of understanding of the idea of percentage yield. Some lost a mark for not giving the answer to the nearest whole number.

Question 4

Parts (a)(i) and (ii) were correctly answered by the majority of candidates. The most common error in part (ii) was an answer of 6 minutes. Half of candidates recognised the steepest part of the curve in part (iii). Significant numbers failed to correctly convert a $\frac{1}{2}$ minute into 30 seconds to find the correct answer in part (iv).

Part (b) was well answered.

Question 5

The majority of candidates dealt mainly with the safety aspects of Group 1 metals reacting with water. This resulted in marks mainly in the lower band. Many candidates addressed the question with basic laboratory safety rules rather than considering these reactions. Candidates who scored marks in the middle band included limited observations for each metal. Very few went on to link observations to the trend in reactivity in Group 1 metals. Very few candidates scored top band marks and the mean mark was 2 out of 6.

Question 6

Parts (a) and (b) were reasonably well answered but part (c) was very poorly done. Only around 1 in 7 gained this mark with vague or irrelevant answers often given.

Question 7

Parts (a), (b) and (c) showed that the majority of foundation tier candidates had little idea of the basics of electronic structure and how it is linked to the Periodic Table. These are very important ideas and required to access other topic areas.

Barely any candidates were able to write the chemical formula of potassium oxide to gain the first mark in part (d). This is extremely disappointing given the emphasis placed on this skill throughout all chemistry papers.

Question 8

Some candidates gained a mark in part (a) for an answer containing '42' as the first two significant figures. Very few managed the correct answer of 0.42.

In part (b), very few gave the correct answer of distillation. A number restated 'desalination' which was given in the question. Common incorrect answers included filtering, boiling, evaporating and condensing.

Part (c) required reference to adding soap to the water samples, an element of fair testing and a conclusion. The first mark was fairly commonly awarded but few responses were well enough written to gain any further marks.

Very few candidates were able to give the correct formula in part (d).

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UNIT 2: CHEMISTRY 1 – HIGHER TIER

Overview of the Unit

Content from all topic areas in the unit was assessed in a range of theoretical and practical contexts.

Higher tier candidates performed reasonably well on the common section but the mean mark was still well below half the available marks.

The PISA-style question was well attempted and quite well answered.

As for the foundation tier paper, many candidates struggled to answer questions where they were required to write descriptions and explanations. Many also struggled on questions which required direct recall of knowledge. The quality of expression was better on the higher tier paper.

The mathematical questions at the higher tier were not very well answered in general and again, candidates struggled with writing chemical formulae and equations.

The quality of extended response (QER) question was better than in previous years with far fewer candidates not attempting it.

Comments on individual questions/sections

Question 1

The majority of candidates showed some knowledge of electronic structure and how it is linked to the Periodic Table. In part (a) around half of candidates recognised that the period number is the number of shells. Many incorrectly linked it to the number of outer shell electrons. Part (b) was well answered and most correctly identified element **D** as being in Group 0. The reasons given were often incorrect. No credit was awarded for stating that **D** has 8 electrons in its outer shell. Many lost marks in part (c) for an incomplete answer. For both marks, reference had to be made to electrons, protons and atomic numbers.

Part (d) was poorly answered with many candidates unable to determine the formula of potassium oxide.

Question 2

In part (a) many candidates attempted to write 35 million out in full and introduced errors in order of magnitude. One mark was awarded for all answers including '42' as the first two significant figures.

Fewer than half of candidates gave distillation as the correct answer in part (b).

Part (c) required reference to adding soap to the water samples, an element of fair testing and a conclusion. Many lost a mark for insufficient fair test details. Some gave good answers to a different question about temporary and permanent hardness. Questions on this topic must be read very carefully to ensure that answers include the relevant information.

Only 1 in 4 candidates were able to determine the correct formula of sodium carbonate in part (d).

Question 3

In part (a) some candidates gained credit either by stating that the samples had similar R_f values or similar solubility. Most candidates who were not awarded the mark referred to the colours mixing or the green and yellow colours being similar. In part (b) some candidates gained credit for recognising that the yellow dye did not move but the green one did. The most common error was stating that the yellow dye would not be seen or would disappear rather than recognising it would remain on the start line. Many stated that the dyes would separate without further explanation and this did not gain any credit.

In part (c) most candidates gained both marks or none; very few just scored just 1 mark. As the R_f equation was not given, many candidates were unable to calculate the correct R_f values.

Question 4

This QER question was well answered with many candidates giving answers accessing the middle and top bands. Most could name the plate boundary types and correctly describe events or features that occurred at each. Stronger candidates referred to the relative densities of the two plates at the destructive plate boundary and magma rising and cooling to form new rock at the constructive plate boundary. Candidates who gained lower band marks often named the boundaries incorrectly or were unable to provide detail of old rock is destroyed or how new rock is formed.

Question 5

Fewer than 1 in 10 gained the mark in part (a). Many stated that the marble chips were running out but very few indicated that this was because the acid was in excess. There were many references to the acid dissolving the marble chips and the acid and marble chips reacting to give carbon dioxide without any further explanation.

About 1 in 3 gained the mark in part (b). Most candidates drew a steeper line as they had identified the reaction would be faster but many missed the fact that the mass of marble chips had not changed and that for this reason there would be no increase in the total volume of carbon dioxide produced.

In part (c) only a few candidates gained both marks. Common errors included dividing 7.8 by 111 instead of 100 and adding the M_r values to give 211 and then dividing 7.8 by this number. Part (d) was poorly answered with few candidates gaining two marks. The most common error was candidates multiplying 14.3 by 53.7. Some calculated 53.7% of 14.3 g.

Part (e) was very poorly answered however some candidates gained 1 mark for linking the use of a catalyst to increasing numbers of successful collisions. Very few candidates could explain that this is achieved by lowering the activation energy. Simply stating that catalysts speed up reactions or that catalysts are reformed at the end of the reaction gained no credit.

Question 6

Very few candidates in (a) gained more than 2 marks. Most were awarded one or two marks for identifying a trend in the data or for realising that below 1 mg of fluoride there was a significant rise in DMFT and above 1 mg there was a significant rise in fluorosis levels. Some candidates identified that 1 mg of fluoride was the best value to use as this gave the benefit of acceptable levels of DMFT and fluorosis.

Part (b) was generally well answered and a some candidates gained both marks. No credit was awarded for vague answers stating that fluoride caused unwanted side effects or ill-health with no direct reference to illnesses that have been linked to fluoride. A number of candidates continue to state that chlorine cleans water rather than that it kills bacteria.

The mean mark in part (c) was less than 1 out of 3 and few candidates gave the correct formula. Many were able to calculate the number of moles of titanium and fluorine but fewer were able to calculate a ratio. A common error was candidates dividing the A_r by the mass when trying to calculate the number of moles. This error is repeated each year and leads to the inverse ratio. No credit was awarded for an answer with no working.

Question 7

Questions such as (b) and (c) must be read carefully in order to select the appropriate information on which to base an answer. Many candidates made genuine attempts but lacked the ability to express themselves clearly enough to gain credit. Some focused on the wrong information and gave answers that were not relevant the question.

Only about 1 in 6 candidates referred to carbon capture and storage in part (d). Many referred to wind turbines and electric cars but these answers gained no credit.

Part (e) was reasonably attempted with most candidates referring to photosynthesis reducing the amount of carbon dioxide in the atmosphere following the evolution of plants. Few candidates gained more than one mark. Those who did usually stated that the oceans trapped or absorbed carbon dioxide. Very few candidates stated that some carbon dioxide was locked into fossil fuels or the shells of marine organisms.

Yet again, only 1 in 5 candidates could write the chemical formula of calcium hydroxide in part (f). CaOH_2 was the most understandable error.

Question 8

Only a few candidates correctly identified one of the products in part (a)(i). Very few identified both. The most common correct answer was iodine. In (a)(ii) some candidates gained credit by stating that bromine is more reactive than iodine but fewer went on to mention that displacement was occurring in the reaction. The most common error was giving an incorrect trend in reactivity of Group 7 elements.

The equation in part (b) was very poorly done. Few gave the correct formula for iron(III) bromide and even fewer were able to balance the equation. Note that the formula of bromine is given in the diagram at the top of the page and in the question stem to help candidates.

Very few candidates gained credit for a yellow precipitate in part (c)(i). A good number gave the correct colour but with no reference to the precipitate. That was not credited. Many had no idea and referred to fizzing or temperature change. Part (c)(ii) was marked generously with a mark being awarded for the formula AgI appearing on the right-hand side, even if other products were included. Very few gained both marks.

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UNIT 3: PHYSICS 1 – FOUNDATION TIER

Overview of the Unit

This paper was based on the Unit 3 content, and included questions set in a practical context. Questions allowed candidates to demonstrate their knowledge, application of knowledge, and evaluation, and included graph plotting and analysis of graphical data. This paper also tested candidates' ability to substitute correctly into equations and calculate answers. The quality of extended response was tested in a practical question exploring controlled variables.

Numerical work was done well by many on this paper, especially in the earlier questions where equations are given. It was evident that some candidates did not have access to calculators, and this meant that they lost marks unnecessarily. Most question parts had a reasonable attempt rate, especially in the early section of the paper. Graph plotting was usually sound. Handwriting showed a slight improvement from last year although a substantial number of illegible responses were still evident.

Comments on individual questions/sections

Question 1

This straightforward question tested candidates' recall of the electromagnetic spectrum. In part (a) most candidates could select the two missing regions of the spectrum from the list given to them but often did not order them correctly. Ultrasound was selected by a number of candidates in place of ultraviolet. In part (b) it was pleasing that most candidates selected either frequency or wavelength with around half of candidates selecting the correct response. Most candidates were able to attain some marks in part (ii) usually selecting "all transfer energy" as one of their correct responses.

Question 2

There were many pleasing responses to this question on circuits and domestic electricity, with the calculation work being the most secure.

Part (a)(i) required candidates to interpret a circuit diagram and read the information in the question. This was often done poorly. It was common to see 'both switches are open' selected, matching the diagram, suggesting that the other information had not been considered.

The simple power calculation in (b)(i) was answered correctly by most of the candidates. The other parts of (b) explored candidates' knowledge of fuses. Many were able to select the correctly rated fuse from the information given. In (iii) many candidates identified when fuses operate but did not realise that fuses prevent circuits overheating instead linking fuses to the prevention of electric shocks.

Part (c) required candidates to calculate the cost of using a hairdryer. This was usually done well and lots of correct responses were seen. Where candidates made mistakes, it was often because they converted units unnecessarily.

Question 3

This practically based question required candidates to take measurements from the diagrams provided and to use them to calculate the density of a piece of iron. This was done correctly by most candidates.

In (iii) candidates had to select the correct unit for density. A common incorrect answer was cm^3/g .

The most challenging part of this question was (iv). Very few candidates recognised that to improve the accuracy in measuring the mass a balance with a better resolution should be used. Many vague answers referring to changing the iron, or those relating to the displacement can, were seen.

Question 4

This question on electric circuits explored candidates' knowledge of sensing circuits.

The calculations in part (a) were answered correctly by many candidates. In (iii) they were required to select an equation from page 2 for the first time on the paper and this proved to be a discriminator with better candidates handling this well. It was surprising that so many did not get credit in (iv) as they did not link the current from (iii) with the ammeter reading. The use of the command word 'state' in this question should alert candidates that no further calculation is required.

Part (b) was often incorrect. Candidates did not consider the role of the thermistor in the circuit shown and could not correctly link changes in temperature, total resistance and current.

Part (c) was answered the most poorly with very few candidates identifying that an LDR should be used in place of a thermistor. Those who were able to suggest an LDR usually could not explain why in terms of its resistance. Many candidates did not attempt this question.

Question 5

This question was set in a practical context and explored the topic of heat radiation, an area that is often poorly answered by candidates.

The QER question in part (a) was attempted by a higher percentage of candidates than has been seen in previous series. Candidates are far better at interpreting information from a diagram than they are at recall. Most candidates were able to identify some controlled variables from the diagram but explaining why these variables needed to be controlled was poorly expressed. A common response was simply to make the test fair. The quality of candidates' written expression was often poor as was the use of correct scientific vocabulary. The volume of water was more commonly referred to using the term amount.

The plotting of a single point in (b)(i) was usually correct although in some cases excessively big plots made it hard to judge the tolerance on the point and credit could not be given.

There were many good attempts at curves of best fit, but hairy, disjointed, or point-to-point lines could not be credited. In common with other papers across the suite this year examiners were more tolerant of a wobble on the curve of best fit allowing more candidates to gain credit for what were otherwise good attempts at curves.

In (b)(ii) many candidates were able to gain some credit here for comparing the graphical data although explanations in terms of heat radiation were less well done. The lack of comparative language in responses reduced the marks awarded for some. Many responses incorrectly stated black 'attracts' more heat or is a better conductor.

Question 6

This was the first of the common questions on this paper. In this section fewer candidates completed every question part. The question explored data on CO₂ emissions and required candidates to analyse and evaluate graphical data and demonstrate understanding of the effect of CO₂ in our atmosphere.

Part (a) required candidates to interpret a scale to take readings from a graph. Many were able to do this correctly. However, part (b) was more demanding as they had to realise that where emissions fell at the same rate the gradient of the graph would be the same, so many, incorrect responses were seen.

Part (c) demanded that candidates explained the benefit of reducing CO₂ in the atmosphere. Many candidates were able to attain one mark. The most common errors were due to vague responses about air pollution or for incorrectly stating that the reduction would stop global warming completely.

Part (d)(i) was an evaluation question that proved too demanding for foundation tier candidates. The fact that nuclear power stations don't produce CO₂ emissions was not well understood with many believing that there is more CO₂ from a nuclear power station. Lots of candidates did not attempt this question.

The evaluation required in (d)(ii) was attempted much more successfully with many candidates attaining both marks here. Pleasing responses were seen.

Question 7

This question explored the refraction of water waves and few foundation tier candidates produced good responses. It was common to see question parts not attempted here.

In completing the diagram in (a) many candidates just showed the waves continuing in the same direction. The direction of the refracted wavefronts was shown on the diagram but very few candidates realised that the wavefronts had to be perpendicular to this line. It was not uncommon to see candidates produce their own diagram rather than complete the diagram given to them. Part (b) was a very demanding evaluation question. Where credit was given, it was usually for identifying that the wavelength had increased.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2023

UNIT 3: PHYSICS 1 – HIGHER TIER

Overview of the Unit

Questions based on each of the assessment objectives were distributed throughout the paper, with a gradation in difficulty through the paper. The interpretation of data was examined throughout the paper and graph work is ever present, though the need to plot points from given data and line drawing was not examined this time.

The performances of candidates were very varied, ranging from most limited to capable execution of more demanding calculations involving numbers given in standard form and summing fractional quantities with the reciprocal of the outcome (as in the case of combining parallel resistances). The evidence shows that numerical skills were of a higher calibre than the abilities to explain concepts and their understanding. Extended prose answers were often convoluted and confused, frequently contradictory and often pithy.

The issue of advance information would have helped candidates to concentrate their revision on the most represented areas of the specification when preparing for this examination. The area of the spec that was examined most was that of **making use of electricity** and least was that of **domestic electricity**, with a whole question near the end of the paper (therefore of high demand) on analysing an electrical circuit involving a parallel combination of resistors in series with a single resistor in a circuit. It was encouraging to see that this question was largely well answered.

Comments on individual questions/sections

Question 1

The first part required candidates to interpolate between scale values on the emissions axis for the two drawn graph lines. Whilst the success of candidates in reading values of 33 000 and 9 000 was better than that of foundation tier candidates on the same question, there was by no means a 100% success rate.

The skill in answering part (b) lay in recognising that similar rates of change shown by the lines on the graph are identified by lines of identical gradient. The most common mistake lay in candidates looking for the wrong pair of years to make their comparison from. It would seem that in giving answers of 2015 to 2016, they had made the comparison with 2013 to 2014 instead of 2014 to 2015. There were many correct answers.

Part (c) asked for two answers on the very topical principle of the benefits of reducing CO₂ in the atmosphere. Reduction in global warming was seen most frequently but **stopping** global warming was not accepted.

In part (d)(i), agreement or not with a given statement was not considered adequately by the majority of candidates. Given a question on the CO₂ emissions from nuclear power stations, the answer would probably have been that there are none, but wrapped up in a statement which required agreement or not, the candidates failed to fully consider their answers.

A large number of wrong answers were given. Reading and re-reading such questions should be encouraged before setting pen to paper.

The last part of the question gave partial data on the waste energy from a power station with a question on its efficiency. The numbers presented in the question fitted the suggestion that it is 63% efficient. A good number of candidates showed that it was in fact 37% efficient (or argued that it was 63% **inefficient**).

Question 2

The careful drawing of wavefront diagrams has, in the past, been problematic but most diagrams now are thankfully completed using a ruler. Not all wavefronts in the deep water were joined to those in the shallow water at the boundary but we only needed to see one to award the mark. Whether they were perpendicular to the wave direction and whether they had uniform(ish) reduced separation decided the other two marks. Candidates should be given more practise at drawing such diagrams in lessons. They should be drawn carefully, measuring out identical separations and employing a means of obtaining a right angle between the wavefronts and wave direction.

In part (b) a carefully considered answer was required. The lines (which represent the wavefronts) in the deep water were clearly of greater separation than those in the shallow water. This should have given rise to the answer that the wavelength is greater in the deep water. A little knowledge that the frequency (number of waves occurring per second) is unchanged leads to the idea that the frequency is larger in deep water with reference to the equation $v = f\lambda$. Very few could present a comprehensive well-structured answer to the question.

Question 3

Two parts to the question simply required an application of number with care being given to working in the correct units. The answer of £32.40 was often seen and given full credit in the first part.

In the second part of the question, it was not unusual to see the number 108, developed in part (a), leading to an answer of 27, to appear in the calculation here. This earned no marks (just one available for this part).

Question 4

Concise answers to this question were at a premium for what is a standard class demonstration of thermal conductivity in metals. Many answers satisfied the criteria in the mark scheme and gained all three marks though some thought that the time for the metals to melt was important! Occasionally the presence and relevance of the drawing pins was overlooked.

In (a)(ii), the demand increased with the candidates being required to convey their understanding of particle behaviour involved in the process of heat conduction in metals. A clear explanation of the two processes given in the mark scheme was required for the two marks to be given but very rarely were two marks awarded.

Part (b)(i) took a move away from conduction into convection in occurring in water. Simply, hot water rising earned the first mark and giving the reason of decreased density would have earned the second mark. Instead, hot **air** rising was frequently seen as an answer and concentration on the purple crystal moving was not uncommon.

Following the straightforward question on convection, came the last part which increased the demand by some degree. Clear, physics-based answers were few and far between on this one.

Question 5

The word 'stationary' in geostationary leads to answers of such satellites being still (not moving) in space, instead of being over a fixed point on Earth and thus **appearing** stationary. In the context of the question, the simplest answer is that the orbits are always directly over the equator.

In (b) parts (i) and (ii) presented a move to number work, successfully for the majority of candidates. Feeding numbers into the given equation in the first of the two parts involving standard form and giving the answer was straightforward but too many failed to double the distance or the time to account for the signal reaching the satellite and coming back to Earth – in the way shown in the diagram (big clue for the candidates here). The second part would have produced an answer of 1.5×10^{15} Hz if the appropriate shortest wavelength had been chosen – a definite need to use standard form carefully. Most answers were correct but an area can be identified here for improvement lying in the relationship between values of maximum frequency arising from minimum wavelength.

In the last part, radio waves have a smaller frequency than microwaves, was a fact that was lost on a significant number of candidates.

Question 6

There were a number of good answers to this QER question describing a simple experiment to find the density of an irregular shaped small piece of rock. Occasionally the weighing came after the rock was wetted but more frequently, the piece of apparatus used that should have been a measuring cylinder was described as a measuring thing, a cylinder or a beaker with a consequent loss of credit. Only occasionally did examiners read of the units in which the answer is obtained. There were many good answers but too many candidates shy away from the challenge of writing factually at length.

Question 7

Part (a) required putting the given values from the circuit diagram into the given equation. It was often successfully done up to the point of getting to 0.25 in the calculation but only a minority remembered to invert the answer to get an answer of 4 – a not-too-uncommon mistake.

Part (b) candidates found challenging. The numbers given in the question nicely fitted into using 45 divided by 10 to give 4.5. However, the more astute candidates realised that dividing an energy by a time does not give a value for current. There were a number of routes that could have been taken through this question and from among the large number of candidates, all approaches were seen. There were some partial answers that gained two out of the three marks.

Question 8

For answers to part (a), the vast majority of candidates could identify that the biggest drawback to relying on energy from wind turbines is the variability of wind strength (however expressed) but a good number of answers stated that just weather is the problem. They do continue to work in the rain.

The answer to (b)(i) could have been anything sensible, such as it was a warmer than average year, the public trying to reduce their energy bills, introduction of more energy efficient appliances etc but not the reduced use of electrical energy which was given and was the point of the question.

Part (b)(ii) just involved a simple division with a mind to the fact that the quantities were given in different multiples of watts, so a conversion was required to gain full marks. Many were successful.

The hint given in the last part by considering the given equation was lost on many candidates. The importance that the water can release the same amount of energy as was supplied to it when pumped uphill by the wind turbine was not recognised. From there, it is a matter that more power output than input is possible if the energy is released in a shorter time than that taken to pump it up into the reservoir. Very few answers made this point.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2023

UNIT 4 – BIOLOGY 2 – FOUNDATION TIER

Overview of the Unit

The first five questions on Low Demand (i.e. 39 out of 45 marks), were split into short, one-mark sections (with one exception) calling for short answers, simple arithmetic, or data plotting on a grid. Questions calling for specification knowledge were generally supplied with prompts to facilitate recall, such as Cloze comprehension word selection from a limited list of options, or a tick box exercise. Questions on Standard Demand (i.e. the remaining 15 marks) were similarly structured, though somewhat more challenging.

Basic literacy was generally limited, so that candidates often appeared to struggle to comprehend the questions, and therefore gave irrelevant or confused answers. As reported previously, insufficient knowledge was a problem once again for the majority of candidates. It is difficult to score marks on technical questions if knowledge of the terms is lacking. Vocabulary was generally very limited, so that many candidates appeared to struggle to express their ideas.

As in previous years, most candidates struggled with the extended writing QER question 6. Here candidates often appeared hampered as a result of poor language skills, both to comprehend the information given and to construct coherent answers.

Skill in basic numeracy, was rather patchy. Many coped well on both Low and Standard Demand questions, though there were clearly some candidates who struggled with even simple arithmetic. Candidates would be well advised to avoid using the term 'amount' when answers require reference to a specific measurable quantity, such as volume, concentration or mass.

Comments on individual questions/sections

Question 1

Almost all candidates measured the line X-Y accurately in part (a)(i) and most went on to calculate correctly (part ii) and place the remaining two insects in the correct order of length.

Although many scored all three available marks on the tick-box exercise in (b), a large proportion scored just two, and several scored just one or even zero. The most common misconceptions were that insects are not animals and that they have backbones.

Question 2

Most candidates performed the calculation accurately in (a)(i). Candidates should always show their working on numerical questions in which two or more marks are awarded. Here

the correct method (i.e. $\frac{40}{8}$) with an incorrect answer would still receive one mark.

The scattergraph was generally performed well in (a)(ii), with clear, neat, accurate plots plus a correct vertical axis label. As always, candidates should be advised to construct their graphs in pencil, which many appeared to do here.

In part (iii) many candidates gave a correct, often concise response to interpret the trend shown in their graphs. However, it appeared that a number of candidates did not understand the term 'relationship'.

Many candidates recognised that random sampling and an increased number of samples would increase confidence in (iv), although 'measuring the pod length in millimetres' and 'count again' were both commonly seen.

Approximately half of the candidates realised that variation in (b) was due to both genetic and environmental factors.

Question 3

In part (a) knowledge of the basic structure and function of the nervous system was very patchy and in particular, the words 'signals' or 'messages' were often offered instead of 'impulses'.

Candidates were asked to draw two conclusions from the results shown in the table in (b)(i) (Table 3) about the effects of alcohol on reading viz; 'took longer' and 'made errors'. While many answers were cogent and succinct, a large proportion failed to address the question and gave vague answers about the general effects of alcohol on individuals, such as blurred eyesight and slurred speech.

Part (b)(ii) was an attempt to elicit from candidates the twin components of the word 'amount' in this context (i.e. 'same volume and % of alcohol' as given in bullet point 1 of the method). A large proportion of the answers seen were irrelevant (e.g. 'same brand of beer'), too vague (e.g. 'they measured exactly') or just referred once again to 'amount' (e.g. 'they had the same amount to drink').

Many candidates answered part (iii) well for the idea of comparison, or to show that the effects were due to alcohol. Many confined their answers to the idea of fair testing, which while true of this investigation, did not answer the question.

Question 4

Basic cell structure in (a) was not well known to a large proportion of candidates. All options from the word list were seen in both parts (i) and (ii).

Most candidates gave the correct ratio of 3:1 in (b)(i). A common incorrect answer was 21:7. A significant minority appeared not to be aware of ratios at all.

The term 'heterozygous' in (ii) appeared to be unknown in a large majority of candidates. By far the most common term underlined was 'homozygous dominant'. However, the correct answer of 'Homozygous recessive' was commonly seen.

In part (c)(i) the genetic basis for the inheritance of sex was very poorly known. Most candidates scored the probability mark in (ii), although a wide variety of other suggestions, were offered.

Question 5

Many candidates scored at least one of the two marks available in (a) for explaining the importance of sealing wounds. Examples included to 'stop bacteria getting in / stop infection / so you don't bleed.' Many candidates went further, with, for example, to 'stop bacterial infection' which was worth both marks.

Only a very small minority of candidates were able to give a named antibiotic in part (b). By far the most commonly seen answer was to give one form of analgesic (mostly Paracetamol) and then give pain relief as the purpose of an antibiotic. Incorrect spelling of Penicillin was awarded the mark, providing it was phonetic.

In part (c) many candidates correctly referred to 'less chance of rejection' or 'no need to wait for a donor' as a benefit of using stem cells from the patient rather than a donor. Vague answers such as 'it's the patient's own cells' did not score.

The term 'genome' appears to be almost unknown in (d)(i). The vast majority underlined 'genotype' - possibly the only one of the three options within their experience. The key to answering (d)(i) lay at the end of the sentence '....around the world'. It was hoped that candidates would offer two different methods by which information is spread globally, such as via the internet / by (paper) publications / attending meetings. Many scored at least one of the two marks available. Vague answers such as 'telling / showing' were not credited unless the method for doing these was also given.

Question 6

In this QER, the candidates were asked to plan an investigation of two species of plant (A and B) between two points, X and Y, joined by a line shown in the photograph, using the materials provided. This question was designed to allow candidates with no knowledge of ecology to score marks by stating the investigative principles involved – i.e. 'count the number of A and B, note it down, then draw a graph'. Such an answer would achieve middle band, most likely 3 marks. It is disappointing therefore that a number of the entry did not even attempt the question.

A large proportion of the candidates ignored the transect line, shown in the photograph and described an investigation of the distribution of the species over *an area* of the moorland, with much description of placing (often throwing) the quadrat at random. Candidates who used the information correctly often scored well, many gaining top band.

Question 7

Knowledge of structures found in the skin in part (a) was very patchy. Many candidates failed to score either of the two marks.

Most candidates correctly calculated the mean in (b)(i), rounding up the answer to 39.5. However, those who entered '39.46' did not score as this failed to meet the convention shown in the table.

In part (b)(ii) most candidates scored at least one and often two marks for neat, accurate point plotting and went on to draw a precise line. However, determining a reading from the graph was more challenging.

Many candidates described the relationship correctly, but the inclusion of a reference to air temperature negated the mark. Commonly seen answers such as 'they both rise / one is higher' indicate a lack of understanding of the term 'relationship', as noted above.

Most candidates scored at least one mark for ticking the correct two boxes in part (c).

Question 8

Only a small minority of candidates could state the meaning of the term 'biological control' in part (a). Most answers were vague, incomplete or well wide of the mark.

In part (b)(i) many candidates correctly suggested the species best suited in this case and some went on to point out that it targets the eggs, so that there are no caterpillars.

A few candidates were able to state a factor that should be investigated prior to the release of the wasp in Peru for (b)(ii), but most were too vague, such as 'will it work'. Very few candidates produced an acceptable answer to the more challenging question in (iii).

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2023

UNIT 4: BIOLOGY 2 – HIGHER TIER

Overview of the Unit

Questions were set on AO1 (24 marks), AO2 (24 marks) and AO3 (12 marks).

Topics included:

- skin structure and body temperature control
- biological control
- DNA profiling and their use in paternity testing and in other areas
- genetics and animal adaptation
- estimation of population size and the capture-recapture technique (QER)
- pest control and GM technology
- hormone involvement in blood glucose control
- antibiotics, vaccines and the case for and against vaccination.

Skills tested included:

- mathematical skills including graphical work (6 marks)
- practical skills (10 marks)

Performance on AO1 questions involving pure recall of information, with no prompting, was disappointing. Where AO1 questions included an element of prompting, such as choosing the correct answer from a list, then performance improved.

Performance seemed better on AO2 and AO3 type questions where many candidates seemed to achieve at least half marks on the questions.

Maths skills – in question 1(b)(i) candidates were presented with table with over 40 figures all of which were given to 1 decimal place. They were asked to calculate a mean using some of the figures given. The answer came to 39.46. Candidates were expected to follow the 'pattern' in the table and present this answer to 1 d.p. Unfortunately, many candidates did not do this. There was no instruction to present the answer to 1 d.p., it was an expectation which is not unreasonable at this level.

Graphical work was generally satisfactory especially when it came to plotting data and drawing a line joining the plotted points. The graph in question 1(b) was presented with 2 y-axes. In some candidates a lack of care in plotting data against the correct axis was evident. This lack of care was also evident in the careful reading and **re-reading** of the information and instructions given in questions. Examples of this lack of care are outlined in the comments below.

Comments on individual questions/sections

Question 1

Almost every structure in the diagram was used to label either the sweat duct or a blood vessel in (a). The sweat gland was very often labelled the sweat duct as was the sweat pore. Some candidates took the instruction **to use arrows to label** quite literally and drew arrows only – no written label. No ambiguity with regard to the placing of the arrows was accepted.

If the arrow landed on the junction of a blood vessel and another structure, for example, no mark was awarded.

Part (b)(i) was generally well answered. 39.5 was the only acceptable answer. All data in the table were written to 1 d.p. and candidates were expected to do the same with this calculation. Many well drawn and accurately plotted graphs were seen in (b)(ii). In the plotting of the points and in the drawing of the line through the points a tolerance of < 1 small square was allowed. Many candidates struggled with the plotting of the points on a chart with 2 y-axes. Some candidates plotted points off both the y-axes whilst drawing a single line. A common error seen was to plot the first 4 points correctly against the left-hand y-axis but to plot the last point against the right-hand y-axis. The final reading to be plotted was 39.5 and 39 appeared on the scale of the right-hand y-axis and this threw many of the candidates. Those candidates that do everything on the chart in ink are at a distinct disadvantage. If they make an error and try to correct it, the position of the plotted point is very difficult to establish, and marks are often lost.

Many struggled to gain the mark for (b)(ii)III. The most common error was to take the reading off the incorrect y-axis. A value within the range of 36.75 – 36.85 was required.

The answer examiners looked for in (b)(ii)IV was **as skin temperature increases body temperature increases** and many candidates gained a mark here. The following answer, although not biologically sound, was also accepted – **as body temperature increases skin temperature increases**. Some candidates tried to introduce air temperature in their answers but these failed to gain the mark.

Question 2

Part (a) was not very well answered. Most answers centered around the use of a **species / animal to control / kill another species / animal**. In order to gain this mark, it was essential that the answer referred to the organism being controlled as a pest, invasive species or alien species.

Two marks were available in (b)(i). One for correctly naming the species of wasp and the other for the reason for choosing this species. One mark was awarded for *pretiosum*. The majority of candidates gained the first mark, but few gained the second. For the second mark candidates had to state that *pretiosum* attacks the eggs and that therefore there are **no caterpillars** to eat the potatoes.

Candidates found (b)(iii) very difficult and very few gained the mark. Any answer relating to the fact that the table lacks information on the:

- area of the land where crops are grown
 - the amount of crops grown in each country / region
 - the percentage of damage to crops
- would have gained the mark.

Question 3

In part (a) most candidates had the idea that the gloves prevented the transfer of DNA / cells from the person using the swab. An answer which simply stated that the gloves prevented contamination did not gain the mark. DNA or cells was required in the answer.

A whole range of answers were seen in part (b), but many of these failed to score. Quite a few candidates had the idea that the DNA had to be cut up or fragmented. Some mentioned the use of enzymes in this process.

Most answered Male 2 and gained the mark in (c)(i) and (c)(ii) was also quite well answered. Circling any 3 of bands 1, 4, 5 and 7 on Male 2 would have gained 2 marks. Band 6 is incorrect as this band is found in both the mother and the child.

The most common answers in part (d) related in some way to the use of DNA profiles in taxonomy and in crime scene forensics. The use of DNA profiles in the identification of criminals gained a mark but the use of DNA profiles for catching criminals was insufficient. This answer needed qualification. Other acceptable answers are outlined in the mark scheme.

Question 4

The Punnett square in (a)(i) was generally well answered. Very few candidates used letters other than those they were asked to use. All four gametes correct gained 1 mark as did the mechanics of the cross if correctly related to the gametes. The mechanics mark was available even if the gametes were incorrect. There were a few instances of the use of dihybrid gametes. In (a)(ii) If the genetics cross was correct then most candidates correctly circled the recessive genotype. If the cross was incorrect then this mark was also usually lost. Many candidates found it difficult to express a creditworthy answer for (a)(iii). The first mark was quite often awarded but the second much less so. A creditworthy answer needed to state that the Punnett square shows the probability of the appearance of the different genotypes in the offspring and not the numbers of offspring produced.

The first mark in part (c) was awarded for recognising that polar bears live within the Arctic Circle or in a colder climate. Most candidates gained this mark. Those candidates who gained the second mark did so because they stated that the polar bear had a thicker layer of fat. (No reference to insulation was required). Very few candidates gained a mark for correctly explaining surface area : volume ratio as applied to the bears. Both marks could be awarded for the reverse argument applied to the North American brown bear.

Question 5 - QER

Some very good answers were seen where candidates scored in the top band of marks. Statements of indicative content often missed from answers included a failure to:

- check the traps on the 1st and 2nd day.
- count the number of voles in the 1st and 2nd sample.
- count the number of marked voles in the 2nd sample.
- release the voles after the 1st and 2nd sample.

Incorrect statements often seen included:

“... after all the traps have captured a vole, count how many voles there are”.

“... don't recapture any marked voles in the 2nd sample”.

Candidates must be encouraged to carefully read the stem of a question. Too many candidates discussed the use of random number tables in the placing of the Longworth traps. They were told that the traps were set at the same coordinates for the whole time of the investigation.

Question 6

Many candidates found part (a) difficult. Those that mentioned mitosis (in its correct context) gained a mark and then invariably went on to gain the second mark by mentioning genetically identical daughter cells.

The most common error was to discuss the plant 'reproducing by mitosis' and all of the 'offspring' being genetically identical. There is possibly another incidence here of a failure to carefully read the question.

Many candidates seemed unsure of the meaning of the word selective in part (b). A careful reading of the question would provide the answer to the question – **Bt is not harmful to humans, other mammals, birds, fish or beneficial insects** was written in the question. Most candidates who gained the mark stated that Bt only kills the corn borer.

In part (c)(i) candidates needed to understand that it is the increased use of Bt corn which decreases the use of insecticide. Rather than the decreasing use of insecticide increasing the use of Bt corn. The correct reference to this gained the first mark. The first mark could also be obtained by stating that Bt corn is killing the corn borer / pest / harmful insect. Therefore, less insecticide is needed – this gained the second mark if it was linked to the statement immediately above.

Part (c)(ii) was fairly well answered. A correct reference to resistance gained the mark. Reference to immunity failed to score.

The potential disadvantage / danger of GM technology is, of course, the transfer of genetically modified genes to wild populations. This is what the diagram shows but most candidates found difficulty in expressing in words what was shown in the diagram. The answer examiners were looking for in part (d) was that the (Bt) gene escapes / passes / transfers / goes / spreads from Bt corn into wild corn.

Question 7

Many candidates failed to gain either both or even one of the marks on part (a). A general understanding of the meaning of the term hormone was not known. If a mark was awarded it was usually for stating that hormones are chemical messengers. Rarely was a mark awarded for stating that hormones control functions or actions in the body. Some candidates attempted to answer the question by stating the function of a named hormone (usually insulin). This answer failed to score.

Candidates found difficulty in (b)(i). The answer which gained credit was 'the normal range or level of glucose in the blood'. Some incorrectly answered that the band represented the normal levels of all three hormones shown in the chart. Again many candidates found it difficult to gain the mark for (b)(ii)I. Examiners were looking for a recognition that when the glucose level rises, the insulin level rises. The reverse of this was incorrect. Candidates should know and understand that an increase in insulin in the blood does not bring about an increase in the level of glucose in the blood. However, negative feedback was quite well known in (b)(ii)II. A good understanding of blood glucose control was needed to gain the 3 marks available in (b)(iii). Normally examiners credit the phonetic spelling of biological terms. However, there are exceptions. The spelling of glucagon and glycogen is one of those exceptions. Any answer containing the incorrect spelling of either of these terms failed to score. One mark was awarded for recognising the drop in or low blood glucose level towards 1 hour.

This would bring about the production of glucagon by the pancreas. (1 mark) (Pancrease is not an acceptable spelling for pancreas – candidates should know that a biological chemical ending in – ase, indicates an enzyme.)

Glucagon would convert glycogen into glucose. (1 mark)

Candidates found (b)(v) very difficult. A common problem encountered in the marking of this question was the drawing of lines which were not labelled. This, yet again, comes down to the careful reading of the question. The emboldened instruction given is to **Add labelled lines**. If the lines were not labelled, examiners could still award marks if the 'pattern' of the existing lines was copied exactly by the candidates.

The glucose line needed to be drawn between 2 – 4 hours (with a tolerance of 0.5 hour either side). The line needed to be above the peak of the existing glucose line. It could touch the top of the graph paper but not pass through it. If the line descended it could not fall below the 150 a.u. level.

Candidates needed to know that Type 1 diabetics do not produce any insulin (specification statement). The insulin line therefore needed to be drawn, between 1 – 4 hours (with a 0.5 hour tolerance), **on the x-axis**.

Question 8

Both parts (a) and (b) were well answered. When answering part (b), it was essential that the candidates either numbered the graph they were talking about or named the disease. A few candidates did neither and failed to score.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2023

UNIT 5: CHEMISTRY 2 – FOUNDATION TIER

Overview of the Unit

Content from all topic areas except Chemical Reactions and Energy was assessed in a range of theoretical and practical contexts.

The foundation tier only section of the paper was generally well attempted. The style of the questioning used in most of this section consisted of multiple-choice style questions, making it more accessible. Despite this, many candidates lacked basic knowledge and understanding of the topics assessed and therefore made random guesses. A number of candidates did not read questions carefully enough and selected more answers than required.

Performance in questions that required descriptions and / or explanations was poor, particularly when they required direct recall of knowledge. This included questions relating to practical work. Many candidates gave explanations that were either too vague or that did not specifically relate to the question.

As in previous years, very few candidates demonstrated the skills required to successfully answer questions relating to understanding chemical reactions and writing equations. These questions continue to be poorly answered, despite being a key part of the assessment of chemistry and therefore having a significant number of marks allocated to them in each examination paper.

Comments on individual questions/sections

Question 1

In part (b) the overall mean mark was less than half and some lost marks for drawing an incorrect number of lines.

Question 2

Poor knowledge from many candidates resulted in lots of random guesses in (a).

In (b) half of candidates put the correct number in the box to balance the equation.

The majority of candidates failed to calculate a simple percentage in (d).

Question 3

Part (a)(i) was very poorly answered with many candidates not reading the question carefully and a surprising number not able to mention either the temperature or the concentration of the acid. Most managed to give the correct order in part (ii) and explain with reference to the number of bubbles.

In (b) many candidates failed to clearly describe the error or its effect on the results. Barely any candidates were able to give the correct formula for magnesium chloride in part (c)(i) so they could not access the second mark. Two candidates in five gave the name of the salt in part (ii).

Question 4

This was quite well answered with more than half of candidates correctly answering parts (a) and (c). Part (b) proved the most difficult part of the question.

Question 5

A good number showed knowledge of salt preparation in (a) but there was strong suggestion that hands-on experience of this method was limited. Very few candidates referred to overshooting the end-point as expected.

Only one in five could name the acid in part (i) and fewer than one in ten gave the correct formula in (ii).

Question 6

The mean mark for this QER question was in the bottom band. This was disappointing for a question that did not require recall of any complex ideas. Many candidates referred generally to metals rather than focusing on aluminium, copper and titanium and the properties listed. It was common to see quite long responses gaining very few marks. It is essential to read the question carefully.

Question 7

Very poor knowledge of alkanes and alkenes was evident in parts (a)(i) and (ii). Barely any candidates gave the correct name for propene. Almost half were able to draw the structure of propane.

In (b) recall of the required knowledge of addition reactions was non-existent and many candidates did not attempt these questions.

The calculation in part (c)(i) was not well done but the majority of candidates plotted a good graph and interpreted it well in part (iii). Reasons for the reduction in plastic bag usage were often vague.

SCIENCE (DOUBLE AWARD)

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UNIT 5: CHEMISTRY 2 – HIGHER TIER

Overview of the Unit

Content from all topic areas in this unit was assessed in a range of theoretical and practical contexts.

The common question was better answered than it was by foundation tier candidates but there were again significant gaps in knowledge.

Mathematical skills tested on this paper were very straightforward but many made basic errors e.g. in substituting into an equation. Knowledge of calculations based on chemical formulae and equations was not good. This is specified in Unit 2 but needed in this unit also. The same applies to flame tests and other chemical tests from Unit 2.

This paper includes at least 7 marks based on chemical formulae and equations. This is more than 10% of the total mark and a similar proportion appears each year. Candidates should practice these skills regularly in chemistry lessons.

Comments on individual questions/sections

Question 1

In (a) most candidates showed some knowledge of hydrocarbons but only very few could name propene.

Knowledge of the addition reactions of alkenes was surprisingly poor in (b).

No recall was required for part (c) and it was done well by the majority.

Question 2

The more structured part (a)(i) was much better answered than part (ii).

In (b) most candidates showed some awareness of the structure of graphite but correct terminology was essential to gain credit here. Reference to a 'sea of electrons' was not credited. Correct use of terms such as atoms, ions and electrons is essential in questions on bonding, structure and properties.

Question 3

Most coped well with the bond energy calculation in (a) and selected the correct overall energy change.

Not many candidates gained the mark in part (b)(i) where the most common error was to fail to change 220 kJ into 220 000 J in the equation. The appropriate unit was given in the equation in order to help candidates but many failed to notice this.

In (c) the activation energy was more often correct than the overall energy change and the overall mean mark was 0.9 out of 2.

Question 4

In (a) the majority of marks were awarded for reference to coke as a fuel. Few candidates described its role as a source of carbon monoxide which is the main reducing agent. Credit was also available for reference to coke itself as a reducing agent.

There were several ways to answer part (b)(i) but each of them required some reasoning. Many didn't know where to start and randomly multiplied and divided various numbers from the question. Only about two in five could combine the two formulae to give the correct formula for slag.

As was the case on the foundation tier paper, the ability to write a chemical formula was mostly missing in (c). Fewer than one in three candidates gave the correct formula. Balancing the equation was beyond all but the most able.

Question 5

Candidates showed reasonable knowledge in parts (a)(i) and (iii) but few equations in part (ii) gained any credit. The formula of nitric acid and the names of both products were given in the diagram but this was missed by many. Some gave the correct formula for magnesium nitrate but gave hydrogen gas as 'H'.

In (b) the correct ionic equation was selected by half of candidates but knowledge of ion tests was very rare indeed. This is simple recall knowledge.

Question 6

Parts (a), (b) and (c) of this PISA-style question were not well done with an overall mean of less than 1 out of 4. The conclusion drawn from the data in Table 2 was better done.

Question 7

This QER question is based on a complex idea and only A/A* candidates would be expected to give a complete and correct answer. Many showed an understanding that ions move to oppositely charged electrodes and some referred to loss or gain of electrons and oxidation or reduction. Correct electrode equations were very rarely seen.

SCIENCE (DOUBLE AWARD)

GCSE

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UNIT 6: PHYSICS 2 – FOUNDATION TIER

Overview of the Unit

This paper was based on the unit 6 content.

Questions allowed candidates to:

- demonstrate and apply their knowledge and understanding of scientific ideas, processes, techniques and procedures;
- analyse, interpret and evaluate scientific information and evidence, including making judgements and reaching conclusions;
- demonstrate their proficiency in recognising anomalous data, determining mean values, handling ratios, calculating uncertainties, substituting numerical values into equations and solving them, graph plotting and analysis of data in graphical, tabular and diagrammatical forms.

The quality of extended response was assessed in a question about investigating the extension of a spring. Two other questions set in a practical context were also included. These were investigating terminal speed using paper cases and modelling radioactive decay using dice.

Questions based on recall tend to be less well answered due to candidates' insecure knowledge of subject content e.g. Q4(a) – describe how to investigate the extension of a spring. Questions based on application of knowledge tend to be better answered e.g. Q 2 – interpreting a velocity-time graph and use of equations. However, some candidates are losing marks for failure to show their workings. Candidates also answer questions based on analysis and evaluation quite well but sometimes fail to state a conclusion or include data in their response e.g. Q6(b) – road safety. Recall questions tend to have lower mean marks than other types. A substantial number of illegible responses were evident. Candidates must read questions carefully and follow instructions.

Comments on individual questions/sections

Question 1

In (a) many candidates correctly completed at least one of the stages in the Sun's life cycle to earn credit. Common errors are shown below:

asteroid → *main sequence* → supernova → red giant
asteroid → *main sequence* → white dwarf → red giant

In (b) candidates were required to recall the forces acting on the Sun to maintain its stability. Usually, one of these forces could be identified, gas pressure more often than gravity. The incorrect choice, magnetic, was a popular selection, more so than friction. Few candidates ignored the instruction to tick two boxes by selecting three or, very rarely, four.

Question 2

Part (a) was well answered by many candidates who gained full marks. Others lost a mark for selecting the bus was stationary in region B. Occasionally, a candidate would place two ticks in a row despite being instructed to place only one. This prevented the awarding of a mark for that row.

Candidates were required in (b) to select numbers from a box to answer questions about the graph. Many candidates did this successfully. It is unclear whether other candidates misread the question or misunderstood the graph. For example, the maximum velocity of the bus was often quoted as 50 (m/s) which was the time at which the journey ended. In this example units were ignored. A common answer for the change in velocity in region C was 8 (m/s) since the line went up 8 small squares on the velocity axis. Candidates saw the emboldened **total time** in part (iii) and answered 50 (s) and must have ignored the start of the question which stated 'The bus accelerates for.....'.

The calculation in (c) required candidates to extract information from the graph to substitute into the given equation. Many candidates successfully achieved this and arrived at the correct answer. However, some candidates substituted incorrectly and calculated $\frac{10}{6}$ or unnecessarily rearranged the equation to work out 10×6 . Even after correct substitution the answer was not always correct. Some candidates continued to perform another operation such as multiplying by another number. Occasionally the following was seen, $\frac{6}{10} = 1.67$. It is important to state here that workings should be shown. If the correct answer is seen without workings, then usually full marks are awarded. A mark was available for extracting each of the values 6 and 10 from the graph. If the answer was incorrect and no workings were shown then these marks were unavailable.

Mostly correct calculations earning full marks were seen in part (d). Although similar errors were seen as in the previous part, e.g. a substitution error, $\frac{50}{270}$ and calculation errors, $\frac{270}{50} = 13\ 500$ and $\frac{270}{50} = 5.2$.

Question 3

The fact that an alpha particle is a helium nucleus was not well known in (a).

The initial stem stated that americium-241 emits alpha particles. This was relevant to part (b). A minority of candidates referred to alpha particles. It was clear that other candidates did not make this link and their answers did not refer to alpha particles. Many answers referred to americium being unable to get out of or pass through the detector. Candidates who referred to alpha particles usually recalled that 'alpha can't penetrate the skin'. This did not answer the question since it asked why there was no risk to humans when the detector is on the ceiling.

Responses to part (c) were poor. Few candidates understood the implications of using an isotope that only emitted gamma rays. Many candidates' explanations were confused. Answers such as smoke can't pass through gamma, gamma can't absorb smoke, gamma can't detect smoke and the use of emit rather than penetrate were seen. However, another group of candidates reasoned, from the information, that gamma rays would not change the current.

A minority of candidates earned any credit in the three parts of (d)(i). A common error was completing the equation in part I with ${}^{241}_{94}\text{Am}$. Many candidates were unable to use the symbol ${}^{241}_{94}\text{Pu}$ to determine the number of protons and neutrons in a nucleus of Pu-241.

About half of the candidates selected the correct option in the last part. It was a common error to see gamma particles underlined despite the fact that candidates would have usually heard the term gamma rays.

Question 4

The QER question in part (a) required recall of a specified practical. Candidates were more comfortable when describing the apparatus set up or a description of the method. However important details such as measuring the initial length of the spring, how to work out extension and taking repeats were not always specifically mentioned. So a typical response might say 'add a weight and then another one and find out how much it had stretched'. The answers were sometimes not expressed in a logical manner. Describing how the results are analysed was the weakest part of answers. If candidates included the analysis it was usually limited to producing a graph with no details of the variables to be plotted.

In (b)(i) many candidates calculated the extension from the data provided. Other candidates failed to do this because of incorrect working such as the methods shown below:

$$3 + 18 = 21, \frac{18}{3} = 6 \text{ and } \frac{3}{18} = 6.$$

An ecf was allowed for parts (ii) and (iii) unless this answer was zero.

In (iii) one of the quantities to be substituted was the weight. The stem of the question informed candidates that the force that was calculated in part (ii) was the weight. Despite this just under half of candidates substituted other values, most commonly 100 g which was one of the labels on the diagram in part (a). Sometimes substitution into the equation was incorrect.

Question 5

Most candidates identified the anomalous result in (a)(i). In the next part, candidates could calculate the mean excluding the anomaly and conclude Tom is correct for both marks. Alternatively, they could calculate the mean including the anomaly and state Tom is correct because the anomaly was included. Either way, to score two marks the conclusion needed to be stated. A minority of candidates earned both marks. Some candidates used a method that included the mean in the calculation, i.e. $0.52 + 0.26 + 0.54 + 0.44 = 1.76$ so the mean is 0.44 so Tom is incorrect.

A minority of candidates managed to evaluate the claim correctly in (b). They extracted data for a pair of cases which showed doubling and compared the recorded speeds with those that would also show doubling. Others extracted relevant data but did not continue to disprove the doubling claim. Many candidates misinterpreted the question and compared, for example, one case with three cases or four with six.

A majority of candidates answered (c)(i) correctly. Some made a final error by quoting the uncertainty as 0.2 instead of 0.02. This was another example where some candidates devised their own incorrect method despite being given the equation to use. Some candidates ignored the division by two so ended up with an answer 0.04. Others ignored the requirement to use maximum and minimum and used other pairs of values from the three given to them. Some added all three values and then divided by three as if they were finding a mean. In the last part most answers stated drop height. Few candidates referred to human error in timing.

Question 6

About half of candidates did not read the question carefully in (a) so did not earn credit for their responses. In parts, (i) and (ii), the questions began with 'State one factor, other than speed.....'. This was sometimes ignored so answers of 'how fast the car is going' were seen. The questions demanded answers stating factors that increased the distances. Therefore answers such as age, road or brake conditions were not creditworthy.

Part (b) was not answered well. Most candidates ignored the instruction to 'include data' and gave answers that were too vague for credit. Others ignored the requirement to compare the distances at speeds of 40 mph and 20 mph and used data for other speeds instead. There were few responses that compared the expected value with the value in the table and commented whether these distances did halve or not. A limited number calculated the fractions that applied in this scenario.

Question 7

This question was set in a practical context and explored the use of dice to model radioactive decay.

In the first part very few candidates appreciated that a large sample size is required because decay is a random process. Most answers referred to better accuracy. In (a)(ii) few candidates realised the significance of 8-sided dice and the relevance to probability here.

About half of candidates earned some credit for plotting points and drawing a smooth curve in (b)(i). The scale on the y -axis was sometimes misread. Each small square represented 5 dice but during plotting some clearly changed from reading this as 5 to 10. In (b)(ii) a minority of candidates were able to determine the half-life successfully but not all added lines to the graph. Even when lines were added they were in places other than the most obvious choice of 250 dice. A minority of candidates earned any credit in the last part. Most believed more dice will 'decay' on each throw. Others agreed with the suggestion but then their reasoning clearly disagreed.

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Summer 2023

UNIT 6: PHYSICS 2 – HIGHER TIER

Overview of the Unit

This paper was based on the Unit 6 content, and included questions set in a practical context. Questions allowed candidates to demonstrate their knowledge, application of knowledge, and evaluation, and included graph plotting and analysis of graphical data. This paper also tested candidates' ability to substitute into equations and rearrange them. The quality of extended response was tested in a question on the storage of nuclear waste.

Many candidates seemed well prepared for the paper, and it was pleasing to see most questions attempted. Graph plotting was usually sound. Some very well-written responses to the QER question were seen with candidates producing coherent and well-structured responses demonstrating excellent knowledge of the topic tested. Rearranging equations was one area of the paper that was often poor and, in many cases, candidates lost marks for failure to show their workings. Handwriting showed a slight improvement from last year although a substantial number of illegible responses were still evident.

Comments on individual questions/sections

Question 1

Part (a) tested candidates' knowledge of the factors affecting thinking and braking distance. This was generally well done although a minority of candidates did not read the question carefully and lost marks for responses that did not answer the question which demanded factors that increased the distances.

Part (b) was well done by many with very clear evaluation of the data seen. The best responses determined by what factor the braking distance and overall stopping distance changed or they compared the expected value with the value in the table if these distances did halve. Less successful responses did not engage with the data and gave answers that were too vague for credit.

Question 2

This question was set in a practical context and explored the use of dice to model radioactive decay. Many candidates demonstrated a clear understanding of the ideas of probability in (a)(ii) and (b)(iii). Graph plotting was usually well done, and many candidates were able to determine the half-life successfully from the graph.

An area of this question that was not successfully answered was (a)(i). Very few candidates appreciated that a large sample size is required because decay is a random process.

Question 3

This question was the first of the higher tier questions on the paper and explored Newton's laws.

Part (a) explored Newton's third law. Part (i) simply required candidates to select the correct words to identify the Newton's third law force shown. This is an area of the specification that candidates have found challenging on previous papers, and even asked in this format this question was no exception. Part (ii) was much more widely known with many candidates gaining credit here. The most common mistake was for candidates to describe the forces as equal rather than equal and opposite.

Part (b) included calculation work exploring Newton's second law. Part (i) required candidates to state the initial acceleration of the apple. Many correct responses were seen with common incorrect responses including 0 or the previously calculated value of the mass.

In (ii) candidates were asked to determine a resultant force – many candidates successfully subtracted the forces shown, however it was not uncommon to see a calculation attempted here. The most common error was to add rather than subtract. The command words in the questions should help as a guide for candidates.

(b)(iii) (along with the calculation work in (a)(iii)) required candidates to substitute into and then rearrange the equation. It was common to see candidates substituting into an incorrectly rearranged equation and hence all the marks were lost. This was often seen where candidates attempted to use a 'triangle' to assist with rearranging. Many candidates confused mass and force and did not bring their previously calculated mass into the calculation, instead selecting a force. Some candidates simply multiplied their values.

Part (c) was only successfully completed by a minority of candidates, and it was common to see reference to the gravitational force, or lack of, on the moon in response to this.

Question 4

The most successful responses to the QER were well-written and addressed all 3 areas as outlined. It was encouraging to see that many candidates had good recall of this section. The nature and properties of alpha, beta and gamma radiation were usually addressed more successfully than the description of the safe storage of nuclear waste. The quality of writing, and the organisation of their response, did cause many candidates to drop 1 mark within a band.

In (b) many candidates gained all 4 marks, however those who could not recall the values associated with the alpha and beta particles could gain no credit. Candidates who did recall these values usually went on to complete the equation successfully.

Question 5

This question required knowledge of light-years, the Hertzsprung-Russell (HR) diagram and the life cycle of a star.

Part (a)(i) demanded that candidates state how long light from Arcturus would take to reach the Earth. Many correct responses were given here. Common errors included missing the unit with the response or incorrectly stating the unit as a light-year. A significant number of candidates converted their answer to seconds which was not required of them.

In (a)(ii) many candidates were successful in converting light-years into metres. Common errors included only converting 1 light-year and forgetting to multiply by 37 or failing to convert years into seconds using the multiplication factor given in the question, both mistakes lost 1 mark of the 3 available. Incorrect rearranging without any workings shown however caused some candidates to lose all three of the available marks.

The best responses in (b)(i) used comparative language when referring to the properties on the HR diagram. Weaker responses used numerical values without a comparison or failed to name properties such as temperature or luminosity and instead gave units. A very commonly seen incorrect response was that Arcturus is hotter than the Sun with the temperature scale causing confusion.

The last part was often very poorly done with answers lacking detail on the role of forces and fusion in the life cycle of the Sun. Most responses seen were confused and did not consider the shift from hydrogen to helium fusion and the subsequent change in the forces acting.

Question 6

This question investigated the work-energy relationship and considered the energy stored in a stretched spring.

The first part was answered incorrectly by many candidates who did not realise that the equation for the work done in stretching is given on page 2 and incorrectly selected the work done equation ($W = Fd$).

Part (a)(ii) was a demanding question that required candidates to rearrange the kinetic energy equation. In common with other sections of the paper that required rearranging, many candidates lost marks for not showing their substitution. It was surprising that the unit for velocity was not well known with m/s^2 being a very common incorrect response.

In part (a)(iii) there were lots of well-written response and the idea of work done against external forces was clearly expressed by many.

The calculation in part (b) was attempted successfully by many candidates although again issues with rearranging and not showing substitutions were evident.

Part (c) was a demanding end to the paper and few candidates were able to articulate their ideas clearly. Using equations to structure their thinking and referring to previous question parts would have helped candidates to structure their responses.

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UNIT 7: PRACTICAL ASSESSMENT

Overview of the Unit

In this unit candidates are assessed on their practical skills including, forming hypotheses, recognising and preventing hazards and risks, recording and presenting data, understanding the variables that are involved in experiments, evaluating the success of the experiment and planning improvements.

The tasks all proved to be accessible for most candidates who usually attempted all sections of the tasks. Certain tasks proved more popular than others within the suite in particular the resistance of the wire task probably due to the familiarity with the experiment itself.

Comments on individual questions/sections

Section A - Hypotheses and risk assessments

Most candidates were able to make a sensible hypothesis in each of the 9 tasks, which linked the independent and dependent variables. In producing risk assessments, the most successful candidates linked the risk with a particular action in the method, such as spilling chemicals onto skin whilst pouring, and were able to suggest a sensible control measure for that risk. Less successful candidates often did not link the risk to an action or referred to chemicals splashing into eyes which could not be credited. In the springs task and in the yeast task it was rare to see no significant risk as a response and many spurious risks were seen.

Section A - Tables of results

Most candidates produced well organised tables of results and recorded all their data. It was pleasing to see that most candidates included units in the table headings and not in the body of the table. Although not commonplace, incorrect units or use of incorrect abbreviations of units (e.g. secs for s / seconds) were seen. In some cases, headings lacked detail and could not be credited. In the sodium thiosulfate task, many candidates simply had the heading concentration and did not refer to sodium thiosulfate. This was required to distinguish between this and hydrochloric acid. There was evidence that candidates often do not read the instructions provided, for example in the springs task candidates were instructed to record the length at 0 g which many failed to do. Where required, means were generally calculated correctly. In the spring task, some candidates calculated and recorded extensions which was not required of them.

Section B – Variables

Each of the 9 tasks included a section on variables. Candidates were able to identify the independent and dependent variables across all the tasks and most were able to state the range of these variables. Less successful candidates simply listed all the values of the variable when asked for a range, but this was seen less often than in previous series.

One area for development that was noted was the resolution of the instruments used. Where this was asked it was common to see incorrect values given. Many of the tasks explored either how or why certain variables were controlled, and this was less well-answered than other areas of the section on variables. For example, in the sodium thiosulfate task, candidates were required to explain how the volume of the sodium thiosulfate was controlled but most candidates didn't state either the volume of the of the solution used or the instrument used to measure this volume. In the resistance in a wire task, candidates were asked to explain why the thickness of the wire was controlled. This was poorly answered with most candidates not linking a change in thickness with a change in resistance and current.

Section B – Graphs

Graphs continue to produce a mixture of results with the same errors consistently appearing:

- Axes labels missing or without units or with incorrect units (see tables above);
- Less than half the graph paper area being used for scales, the origin left blank, using scales with multiples of 3 or 7, (this was not enforced for the x -axis in the resistance of the wire practical).
- Line of best fit was varied in standard with thick or wispy lines common place.

The subsequent description of the graphs was generally well answered when a basic description of the relationship between independent and dependent variables was required. However, when a second mark was sought for a more detailed description of the curve many candidates found this more difficult and often did not attempt to do so.

Section B - Calculations

Across all the tasks, where candidates were asked to use equations, calculations were answered well by most candidates, this included calculations of spring constants, resistance, power, RQ values, heat energy released and uncertainty.

Section B – Analysis and evaluation of results

Compared to previous series, it was far more common to see candidates describing their data in detail. In the resistance in a wire task, many were able to describe the current decreasing at a decreasing rate. Similarly, the meaning of the term proportional was better understood, with a pleasing number of candidates able to analyse data from the same task to determine if two quantities were proportional. In the sodium thiosulfate task, many candidates were able to select and use appropriate data to evaluate a claim about reaction time halving as concentration doubles. Similarly, in the best responses candidates were able to sensibly compare spring constants in series and in parallel. Weaker candidates tended to be vague in their responses and needed to consider the specific factor by which variables change in relation to each other to make valid conclusions.

Section B – Improvements

Many candidates were able to suggest suitable improvements, for example using a thermostatically controlled water bath to control temperature in the sodium thiosulfate task or ensuring that they work at eye level when measuring a spring. Where candidates were less successful, they suggested invalid improvements such as only measure the spring when it has stopped moving, which they should have done anyway or referencing controlling the temperature of the entire room in the rates of reaction task.

Section B – Use of practical terms

Most candidates demonstrated clear understanding of practical terms such as repeatability, reproducibility, and accuracy. Similarly, candidates were confident in identifying anomalous results. Other terms, such as systematic error, were not well understood and most candidates had difficulty in clearly explaining the effect of a systematic error. The glossary of practical terms is a good reference that candidates should use when revising for these tasks.

Section B – Planning

The most effective responses to questions that asked candidates to plan another experiment, included: investigating the effect of a different variable, a list of apparatus, controlled variables and a clear and valid method that could be followed. Less successful attempts at this type of question provided more of a narrative response and frequently did not identify how the independent variable was to be changed and did not state the variables to be controlled and it would not have produced valid data. Simply stating 'repeat the experiment from section A' and then stating one change is not detailed enough to be credited. Candidates should be encouraged to include a chronological list of steps, including stated values of the independent variable, along with reference to what measurements are required.

Section B - Science theory

Theory based questions, such as those involving collision theory in the rates of reaction and enzyme tasks, were often not well answered. Although candidates had a broad understanding, they often didn't use detail and correct terminology in the answers to gain credit. For example, the distinction between collisions and successful collisions was not clearly distinguished or understood.

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ⁱ Please note that 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.