GCSE Examiners' Report

Physics

GCSE

Summer 2024

Introduction

Our Principal examiners' report provides valuable feedback on the recent assessment series. It has been written by our Principal Examiners and Principal Moderators after the completion of marking and moderation, and details how candidates have performed in each unit.

This report opens with a 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 then looks in detail at each unit, pinpointing aspects that proved challenging to some candidates and suggesting some reasons as to why that might be.[1]

The information found in this report provides valuable 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 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 12 months after the examination.	Portal by WJEC 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 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)

[1] ***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.***

Exam Results Analysis	WJEC provides information to examination centres via the WJEC Portal. This is restricted to centre staff only. Access is granted to centre staff by the Examinations Officer at the centre.	Portal by WJEC
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Executive Summary

This qualification continues to be very popular with centres. The majority of the cohort sit the Higher Tier. The easing of the Foundation Tier papers which has occurred for a number of series continued to have an effect on the means and it is pleasing to see the majority of candidates attempting most of the paper. It is particularly noticeable in the performance in the first few questions. The performance on the Higher Tier papers was encouraging too. Some very able candidates sit this qualification.

There were many examples of candidates not reading the questions carefully and / or taking note of information and instructions. Also some candidates missed out question parts without answer lines even though they were in bold.

Recall of knowledge (AO1 questions) continues to be an issue for many candidates.

Candidates exhibit much better quantitative skills than qualitative skills.

The mathematical skills of candidates were generally good, some particularly good performances were seen on the Higher Tier papers. Some incorrect substitutions were seen and this highlighted that units hadn't been considered or converted properly. Incorrect rounding was often seen. Candidates should be encouraged to show their workings, if incorrect answers are given they may be able to attain some method marks. Only the very able were able to answer questions based on calculating gradients, proportionality and ratios.

The literacy skills of the candidates highlighted a number of issues, frequent spelling, punctuation and grammar errors were seen. Also the inability of candidates to communicate clearly and effectively was often seen e.g. incorrect terminology, vague responses. The presentation of responses often caused problems to examiners. The legibility of the numbers 1, 2, 4 and 7 in candidate responses were very difficult at times to read. When candidates were asked to give a qualitative response and to include data, often they didn't include the data.

QER questions continue to cause issues for many of the reasons listed above, namely the recall of knowledge and the literacy skills of candidates. Scaffolding in these questions does increase the attempt rate.

Performance in the practical unit was very good, the mean between all the separate sciences was comparable. The areas for development are very similar to those listed above – qualitative responses weren't clear, issues with units and incorrect rounding. Candidates are familiar with the key practical terms but it is the application to a situation they tend to struggle with.

Performance in practical questions on the theory written papers was not as good at times as in the Unit 3 assessment. Interestingly if these questions had appeared in the practical task it is likely they would have coped with them well, e.g. variables, anomaly, repeatability etc. It is the transfer of skills between units which is the issue.

Areas for improvement	Classroom resources	Brief description of resource
How transformers work	ELECTROMAGNETISM	Knowledge organiser
The principles of em induction and Flemings RH rule	ELECTROMAGNETISM	Blended learning
How power stations work	GENERATING ELECTRICITY	Knowledge organiser
Qualitative responses	TEXT TOOLS	A bank of tools that allow teachers to use their own piece of text to generate a range of activities.

Click here to enter FIRST report.

PHYSICS

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Unit 1: Electricity, energy and waves – Foundation tier

Overview of the Unit

The exam paper included question based on all three assessment objectives so tested recall of knowledge, (40%), application and understanding of knowledge, (40%), and analysis, interpretation and evaluation of information (20%).

The demand of the early questions was less than in previous series due to an increase in objective style questions and straightforward calculations. The remainder of the paper was comparable with previous series. It provided a fair test for the candidates at Foundation Tier and differentiated well. The degree of difficulty of questions increased throughout the paper.

The early question parts were generally well attempted. Candidates need to take more care in reading the questions, taking note of information and following instructions.

The performance of candidates in recall questions tended to be poor. This is nothing new and has been commented on in exam reports for several series.

Questions that assessed mathematical skills were generally well attempted with candidates gaining full marks in some calculations. Mostly, equations are given in the appropriate form in the question part, others have to be selected from page 2. However, too many candidates substitute incorrectly into given equations. They do not consider units during the substitution process. Errors were seen in simple addition and subtraction. Another problematic area is the incorrect rounding of final answers especially when an ecf applies. This always attracts a penalty. It is emphasised that workings should be shown in the provided spaces when answering calculation questions. Marks are often provided for selection of values and substitution. These marks cannot be awarded if all that is shown is an incorrect answer on the answer line. It must be mentioned that it is becoming increasingly difficult to differentiate between certain numbers in candidates work particularly 1, 2 and 7. Some questions ask candidates to use data in their answer. Failure to do so often results in zero marks being awarded.

The quality of graph work was very good. Most candidates were able to successfully plot points onto the grid and join them with a straight line.

Responses to the QER question were very disappointing. Knowledge of the electromagnetic spectrum was very poor. Too many responses were very difficult to read, and too many spelling, punctuation and capitalisation errors were seen.

Comments on individual questions/sections

Q.1 This objective style question was a straightforward start to the exam and about half of candidates earned 2 or 3 marks. Some candidates ignored the instruction and placed more than one tick in each row.

Q.2 This question contained five calculations. The three in part (a) were straightforward, single stage calculations with data introduced in each part as required. They were very well done. However, errors were still seen. For example, a common error was $700 \times 30 = 2100$. Part (b) calculations required more thought and they were not so well done. In (b)(i) there were errors in multiplying by 50 and in (ii) the payback time equation was often inverted and the answer from (i) was not used.

Q.3 (a) These circuit calculations were all single step with additional values introduced at each stage. They were very well done. The most common errors were made in (i). These were either due to addition errors or one of the resistors omitted from the calculation. An incorrect answer here was allowed to follow through into the following calculations. Where an ecf occurred, there was sometimes incorrect rounding of the final answer.

(b) (i) Answers were evenly divided between the correct answer (LED) and the LDR.

(ii),(iii) These questions relied on ability to apply the rules for a parallel circuit. About half of candidates managed to achieve this to determine the currents in L_3 and L_1. In other instances, some answers were not related to the 8 mA in L_2. The questions about voltage were better answered.

Q.4 (a) (i),(ii),(iii) These calculations were all single step with additional values introduced at each stage. They were very well done. In part (ii), some incorrect subtractions of 35 – 20 were seen. Another error seen was $\frac{7500}{15} = 112\ 500$. If the substitution was shown then 1 mark was awarded, but if not, an incorrect answer on the line scored zero.

(iv) This was a fresh start with two more single step calculations which were, again, done very well. Some errors in the subtraction, 455 – 385, were seen. In the final calculation, some candidates failed to multiply by 100.

(b) It was rare to award 2 marks here. Some candidates ignored the instruction and ticked 3 boxes.

Q.5 (a) (i) - (iii) The questions instructed candidates to use the letters A, B, C, D, E or F as their answers. Failure to do so resulted in no marks. Responses were poor.

(iv) These question parts related to a graph of output voltage from an a.c. generator. Most candidates were able to read the maximum voltage from the graph but less determined the time for one rotation correctly. Some candidates misread the value as 0.2 instead of 0.02. Others stated 0.01. In part III, candidates were instructed to use certain words when completing the table. This was strictly adhered to so when other words were used they scored zero. Many candidates identified the effect on maximum voltage caused by making the changes but a minority did so for the time of one rotation.

(b) (i) This question exposed a lack of knowledge about transformers. Most candidates could identify one correct statement about a transformer and some two. It was rare to award 3 marks. A common error was to select the statement 'Transformers change a.c. to d.c.'.

(ii) The equation was given in the required format. Candidates needed to realise the significance of the subscripts 1 and 2 which are always stated on page 2. Over half of candidates obtained the correct answer. Others made substitution errors by confusing V_1 and V_2.

Q.6 The QER question required recall of knowledge of the electromagnetic spectrum. As is common with other recall questions, it exposed a lack of knowledge. The mean mark was in the lower band and the not-attempt rate was about 30%.

The candidates were instructed, in bold print, that the description of uses was not required. This was ignored, since most answers gave a partial list of the em regions together with their uses. The region radio waves was given in the question and candidates were instructed to list the other regions and yet many candidates wrote at length about radio waves. Candidates included types of waves other than em waves in their list. These included seismic, sound and longitudinal waves. Candidates referred to the regions having different volumes, speeds and strength. On rare occasions, candidates referred to a similarity and / or a difference.

Q.7 (a) Graph work was very good. Although it is a mystery why some candidates plotted all the points correctly and then failed to join them with a straight line as instructed. Candidates were very unlikely to gain the line mark if a ruler had not been used.

(b) Once again, instructions (in bold print) were ignored. Most candidates did not use a value from the graph to answer the question. In these instances, zero marks were awarded. Occasionally the value of 0.045 was written down but the conclusion was invalid.

Q.8 The calculations in parts (a) and (b) were well done. Candidates need to be reminded that a value of 10 cm^2 does not require 10^2 to be substituted in the pressure equation. Part (c) was poorly answered.

Q.9 (a) (i) It was surprising that only about half of candidates determined the correct volume. Subtraction errors were seen plus some candidates added 20 + 25. It remains unclear, in the absence of workings, how some answers were derived.

(ii) Mostly correct answers seen. Otherwise, incorrect substitutions were made.

(iii) The instruction was to use data to explain but this was often ignored. Poor responses seen.

(b) This was the least well answered question on the paper. The question stated that the same measuring cylinder partly filled with water was used. This was often ignored since some suggestions included weighing the object and measuring it with a ruler. Others just described the method used for an object that sinks. The most imaginative response was to drop the object from a height and take a volume reading as it sinks below the surface before bobbing back up.

Q.10 (a) (i) It was extraordinary how poor knowledge is of the processes in a fossil fuel power station even when a block diagram is provided. Some of the descriptions included statements such as:

- Fossil fuels get boiled
- Fossil fuels enter the turbine
- Heat turns the turbine
- Electricity is heated in the boiler

(ii) Under half of candidates included workings to make the correct conclusion. Others made addition and subtraction errors or selected wrong values in their calculations.

(b) (i) Less than half of candidates could state the meaning of base load.

(ii) Nearly all candidates read the graph correctly.

(iii) This question proved too difficult for the candidates on this paper and very few scored any marks at all. Once again, an instruction was ignored i.e. include data in the answer.

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Unit 1: Electricity, energy and waves – Higher tier

Overview of the Unit

The exam paper included question based on all three assessment objectives so tested recall of knowledge, (40%), application and understanding of knowledge, (40%), and analysis, interpretation and evaluation of information (20%).

The paper was of comparable standard with previous series. It provided a fair test for the candidates and differentiated well. The degree of difficulty of questions increased throughout the paper. Most question parts had very high attempt rates. Where these rates were lower, it was generally for questions requiring recall. Candidates need to take more care in reading the questions, taking note of information and following instructions.

The performance of candidates in recall questions tended to be poor. This is nothing new and has been commented on in exam reports for several series.

Questions that assessed mathematical skills were generally well attempted with candidates gaining full marks in some calculations. Some equations are given in the appropriate form in the question part, others must be selected from page 2 and others need to be rearranged. Rearranging caused problems for some candidates. Too many candidates substitute incorrectly into given equations. They do not consider units during the substitution process. It is emphasised that workings should be shown in the provided spaces when answering calculation questions. Marks are often provided for selection of values and substitution. These marks cannot be awarded if all that is shown is an incorrect answer on the answer line. Some textbook examples of how to present numerical answers were seen. Clear workings were shown and they were well set out.

In each part that required it, the recommended order of carrying out calculations is:

- Write down the equation (if not given)
- Make substitutions
- Simplify if possible
- Rearrange
- Complete calculation

When candidates do not adopt this style, mistakes are frequently made. Too often the first step shown is an incorrect rearrangement of values which earn no credit.

Errors were seen in simple addition and subtraction. Many candidates found handling a ratio difficult. Another problematic area is the incorrect rounding of final answers especially when an ecf applies. This always attracts a penalty. It must be mentioned that it is becoming increasingly difficult to differentiate between certain numbers in candidates work particularly 1, 2 and 7.

Some questions asked candidates to include data in their answers, which could be from a graph or table. Failure to do so attracts a penalty which could be as high as all the available marks.

Responses to the QER question were very disappointing. Knowledge of the specified practicals was very weak. Too many responses were very difficult to read.

Comments on individual questions/sections

Q.1 (a) (ii) Mostly correct answers seen. Otherwise, incorrect substitutions were made.

(iii) Over half of candidates answered correctly. The instruction was to use data to explain but this was ignored by others.

(b) This was not answered well. The question stated that the same measuring cylinder partly filled with water was used. This was often ignored since some suggestions included weighing the object and measuring it with a ruler. Others just described the method used for an object that sinks. One candidate attempted to describe how Newton's 3rd Law could be used.

Q.2 (a) (i) It was extraordinary how poor knowledge is of the processes in a fossil fuel power station even when a block diagram is provided. The instruction to use words in the block diagram was often ignored.

(ii) Most candidates included workings to make the correct conclusion.

(b) (i) Over half of candidates could state the meaning of base load.

(ii) Nearly all candidates read the graph correctly.

(iii) Once again, an instruction was ignored by about a third of candidates i.e. include data in the answer. They scored zero marks. The remaining candidates gained the full range of marks in approximately equal measures. It was pleasing to read the reasoning of those earning 3 and 4 marks.

Q.3 (a) It is doubtful that the term 'nature' is understood by all candidates.

(c) Just over half of candidates made the correct comparison. References to parts of the Earth were not accepted.

Q.4 (a) (i) Correct answers were seen in the majority of instances. However, errors were also seen. These included subtraction errors (42 – 19.5), rearranging errors, and omitting 0.5 in the final rearrangement. Where no workings were shown and an incorrect answer was seen, then no marks were awarded. If the recommended order of setting out a calculation had been followed, it is possible some credit could have been given.

(ii) This was poorly answered. Most candidates were unable to comment on the accuracy of data.

(iii) This was also poorly answered. One obvious issue with the set-up shown in the diagram was the heater not fully inserted into the block. Few candidates commented about this.

(b) Knowledge of this theory was poor. Misconceptions included:

- Atoms start to vibrate
- Atoms move around faster
- Atoms heat up
- Atoms expand
- Atoms conduct electricity

Additionally, some candidates spoke about electrons despite the question asking about atoms.

Q.5 (a) Mostly correct answers seen. However, some rearrangement errors were evident. Candidates need to be mindful of what is being asked. They should have known the answer could not have been greater than 24 hours, yet such values were seen, the greatest one being 192 720 000 hours.

(b) This part was not done very well. Firstly, some candidates did not perform the subtraction 22 000 – 20 500. There were conversion into £ errors, plus the payback time equation was sometimes inverted. Finally, rounding errors were common.

In both parts, too frequently, no workings were shown.

Q.6 Knowledge of this specified practical was very poor. The mean mark was in the lower band. Even with the circuit diagram, candidates could not describe the purpose of each component, which would have earned credit.

Q.7 **(a)** Mostly correct answers seen.

(b) Few candidates were able to calculate the total resistance of a parallel combination. A common answer was 750 Ω. In other methods, the answer in part (a) was ignored, and the method showed $\frac{1}{300} + \frac{1}{160} + \frac{1}{120} + \frac{1}{170}$.

(c) Most answers arose after allowing for an ecf.

Q.8 (a) Under half of candidates earned full credit here. It was common to see the wave speed of microwaves having a different value to infra-red. This was despite the property being labelled as wave speed in space. Many candidates made errors when dividing powers of 10.

(b) (i) Responses were very poor. Candidates were unsure how to use the ratio 1.5:1. Despite space being given for working, frequently none were shown.

(ii) A minority of candidates stated acceptable advantages.

(iii) Few correct answers seen. Two common errors were stating the satellite must travel at the same speed as the Earth and have a 365-day orbit.

Q.9 (a) (i) Fleming's right-hand rule was not well known.

(ii) A majority of candidates earned 1 mark but fewer obtained 2 or 3. The instruction to place 2 (in bold) ticks in each row was often ignored.

(b) (i) Knowledge of transformer theory was very poor. This was the least well answered question on the paper.. Candidates described how current or voltage travels through the iron core.

(ii) Mostly correct answers seen. A minority of candidates made errors when rearranging the equation.

Q.10 (a), (b) Mostly correct answers seen. However, some addition errors seen in (b).

(c) The use of the gas equation proved difficult for most candidates. The mean mark was very low. Most candidates did not equate the gas equation for each set of conditions. Those that did usually made substitution errors. For those who arrived at a final answer, rounding errors were sometimes seen.

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Unit 2: Forces, space and radioactivity – Foundation tier

Overview of the Unit

The paper gave candidates the opportunity to demonstrate their skills and understanding of the subject in all three of the assessment objectives. Most candidates attempted all sections of the paper.
Many candidates displayed good mathematical skills and confidently used the provided equations although rounding incorrectly was a common error. This contrasted with recall questions that required candidates to express their subject knowledge which was usually poor. The quality of writing in a significant number of cases was poor, causing examiners to spend some considerable time in deciphering the wording.

Questions allowed candidates to: apply their knowledge and understanding of scientific ideas; analyse, interpret and evaluate data; use equations to solve questions; and apply their knowledge of practical techniques. The quality of extended response was assessed in a question about thinking distance and braking distance.

Comments on individual questions/sections

Q.1 This proved to be a very accessible introduction to the paper with most candidates able to match energy stores and examples of those stores. The use of the work done equation was almost always correct. In (b)(ii) however few candidates realised that the energy transferred by the force was equal to the work done, and many could not give the unit for energy.

Q.2 This question required candidates to recall information about the life cycle of a high-mass star. Despite the word prompts that were given many candidates had not learnt this information, so their performance was disappointing.

Q.3 In (a) most candidates could successfully name a car safety feature, and many were able to select the correct responses from the brackets to explain how an air bag works. Part (b) required the first full written response on the paper. Very few candidates linked the more aerodynamic shape to a reduction in air resistance and consequent reduction in fuel use. Many answers were poorly expressed.

Q.4 This question required candidates to analyse and evaluate absorption spectra. Part (a)(i) was done well by most candidates, with many correct responses. In (a)(ii) whilst many recognised that galaxy D was furthest from the Sun very few could clearly explain how they knew this. Part (b) was more successfully answered with some pleasing responses.

Q.5 This question was about conservation of momentum. The calculation work in parts (a)(i), (iv) and (v) was done well by many, often with error carried forwards. Rounding errors in part (a)(iv) were very common. Most incorrect responses were in (a)(iii) where the question simply required them to state the value of the total momentum after the collision. The use of the command word 'state' rather than 'calculate' should have been an assistance here, but it was common to see new calculations. The evaluation work in (b) was often poor, but some good responses were seen where candidates had clearly recognised that to double the total momentum both skaters would need to double their individual velocity before the collision.

Q.6 Part (a) of this question introduced some data on thinking and braking distances. Most candidates could determine the overall stopping distance in (a) and go on to establish the relationship between speed and thinking distance in (b). Of the two marks available in (b) most only attained the first mark, the proportional nature of the relationship between the variables was rarely identified.

Part (c) tested the quality of extended response. Candidates were asked to state the meaning of the terms thinking and braking distance, and to identify factors that could affect each distance. The most common error in the descriptions was to refer to either distance being a 'time'. It was also common to see age discussed as a factor despite that being referred to in the question. Poorly expressed answers often limited candidates to the bottom band.

Q.7 This question tested knowledge and skills in the context of nuclear fission and fusion. Part (a)(i) required candidates to balance a simple equation for a fusion reaction. This was very poor with the basic principle not understood in most cases. Part (a)(ii) required candidates to link mass and nucleon number with the number of protons and neutrons. This was rarely correct. Knowledge of the conditions that make fusion difficult to achieve were not well-recalled. Part (b) tested basic knowledge of the function of parts of a nuclear reactor, and this was not well-done.

Q.8 This short question presented data on the use of radioactive pellets in brachytherapy. It was pleasing that the concept of half-life was well-understood and there were many correct calculations seen in (a)(i) and (ii). Written responses in (b) were the poorest answered part to this question and whilst many recognised that the short half-life of iodine-123 would make it unsuitable for use in brachytherapy, few could articulate why it was too short.

Q.9 This, the first of the common questions, required that candidates analyse and evaluate data about background radiation, first by comparing pie charts of background radiation from different locations with a radon map. In (a)(i) many could match the pie chart for location A with Aberystwyth, but their explanation of how they did this was often poor. The numerical work in (a)(ii) was successfully handled by a pleasing number of candidates. In (a)(iii) it was evident that few candidates could recall which were the man-made and which were the natural sources of background radiation, leading to poor responses here. The data evaluation in (b)(i) was handled well by many candidates, although (b)(ii) was often incorrect. The best candidates realised that just one return flight for a pilot would equate to the same exposure as a power station work received in a whole year and subsequently gave sensible answers.

Q.10 This question was set in a practical context and tested what should have been some familiar practical techniques. In (a)(i) very few Foundation Tier candidates recognised that the anomaly in the second trial had been disregarded when calculating the mean. They also struggled to evaluate the repeatability of the data in (a)(ii), a familiar question in the practical unit that all had sat. Identifying that timing a moving object would lead to inaccuracies in timing and suggesting how that inaccuracy could be reduced was also poorly done. Part (c) proved to be too challenging for Foundation Tier candidates. Few could identify where, on the distance-time graph, the ball attained terminal speed, despite being told in the question that it was where the line is straight. It was rare for candidates to be able to determine the gradient of the graph from the triangle given. Almost no Foundation Tier candidates could describe, in (b)(iii) acceleration decreasing as the ball fell.

PHYSICS

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Summer 2024

Unit 2: Forces, space and radioactivity – HIgher tier

Overview of the Unit

The paper gave candidates the opportunity to demonstrate their skills and understanding of the subject in all three of the assessment objectives. Most candidates attempted all sections of the paper.
Many candidates displayed good mathematical skills and confidently used the provided equations although rounding incorrectly was a common error. Many handled complex equations well and rearranged them correctly. In contrast, questions requiring recall were not so well done, although it was evident that these Higher Tier candidates had made more attempt to learn key information than their Foundation Tier counterparts.

Questions allowed candidates to: apply their knowledge and understanding of scientific ideas; analyse, interpret and evaluate data; use equations to solve questions; and apply their knowledge of practical techniques. The quality of extended response was assessed in a question about nuclear fission.

Comments on individual questions/sections

Q.1 This, the first of the common questions, required candidates to analyse and evaluate data about background radiation, first by comparing pie charts of background radiation from different locations with a radon map. It was apparent that Higher Tier candidates handled this question more effectively than Foundation Tier candidates, suggesting that entry decisions had been correctly made. In (a)(i) many could match the pie chart for location A with Aberystwyth, and many could clearly explain their reasoning. The numerical work in (a)(ii) was successfully handled by most candidates. Even for Higher Tier candidates, in (a)(iii) it was evident that few could recall which were the man-made and which were the natural sources of background radiation, but many gave sensible judgements often linked to how much they knew to be from natural sources such as radon and cosmic rays. The data evaluation in (b)(i) was handled well by many candidates. Many realised that just one return flight for a pilot would equate to the same exposure as a power station work received in a whole year and subsequently gave sensible answers to (b)(ii).

Q.2 This question was set in a practical context and tested what should have been some familiar practical techniques. In (a)(i) most recognised that the anomaly in the second trial had been disregarded when calculating the mean. However, even these Higher Tier candidates struggled to evaluate the repeatability of the data in (a)(ii), with poor language often causing them to not gain credit. Part (c) proved to be challenging for many candidates. Only a small percentage could determine the gradient of the graph from the triangle given. Of those who did, rounding was often incorrect. Very few could describe, in (c)(iii) acceleration decreasing as the ball fell.

Q.3 This question tested candidates' knowledge of the life cycle of a high-mass star. The calculation in (a)(i) required a conversion from light-years to metres, was generally pleasingly done, with many correct responses. It was evident in (b)(i) that many could recall the stages in the life cycle of a high-mass star correctly. However, the explanations in (b)(ii) and (iii) of the role that high mass stars play in the formation of new solar systems and a brief description of how solar systems form, was not well-known or explained.

Q.4 This question was entirely calculation based and tested the use of the equations for potential energy, kinetic energy, work done and the correct selection and use of an equation of motion. It was pleasing to see many fully correct responses. Part (a)(iii) required that candidates determined velocity by rearranging the kinetic energy equation. Many handled this well.

Q.5 This question tested the knowledge and application of the uses of radioisotopes. Part (a)(i) required the recall of the definition of an isotope and there were many fully correct responses. In part (b) candidates had to evaluate the use of americium-241 in a smoke detector, compared to other isotopes. Many good responses were seen here with the best responses clearly using all the given information, and clearly comparing the isotopes. A common error was only to consider the half-life and not state that only alpha would be absorbed by the smoke. The calculation in (c)(i) was done well with most showing a good understanding of half-life although a common slip was to count 6 rather than 5 half-lives. Well-written responses to (c)(ii) were also commonly seen with the penetrating and ionising powers of gamma correctly referenced in the context given.

Q.6 This question tested candidates' knowledge of fission and fusion. Part (a) was entirely recall based and demanded that candidates explain what an uncontrolled chain reaction is and how a controlled chain reaction is achieved in a fission reactor. In the best responses candidates had clearly learnt this carefully and were able to communicate this effectively. Weaker candidates attempted to talk about all the labelled features in the diagram, even if not relevant. Despite neutrons being mentioned in the question stem, a few candidates referred to electrons in their answer.

In (b)(i) candidates were required to produce and balance a nuclear equation, using information on the number of neutrons and protons in the nuclei of deuterium and tritium. Those who had not learnt the terms proton and nucleon number were unable to be successful.

Q.7 This question required candidates to analyse and evaluate absorption spectra. In (a)(i) most were able to name the evidence that supports the Big Bang model. Part (a)(ii) was poorly done – most just described the line moving to the red end of the spectrum, rather than considering the light travelling through expanding space or the galaxy moving away from us. Many pleasing responses were seen in (b) where many candidates realised that hydrogen was present, but carbon was not and they could explain it in terms of the absorption lines.

Q.8 This practical based question required candidates to extract the relevant variables from a method for investigating Newton's second law. Responses here were often disappointing. In part (b)(iv) it was surprising that many did not understand the concept of proportionality of how to check if variables are proportional to each other. The calculation in (b)(v) was often correct although some candidates incorrectly recorded their answer as 1.6 recurring and another common error was in rearranging. Many candidates displayed good knowledge of the term inertia, and a statement of Newton's first law in part (a).

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UNIT 3 – 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 performance of candidates across all the tasks was pleasing with good evidence that candidates are familiar with practical work and the analysis of practical results. The tasks all proved to be accessible for most candidates who usually attempted all sections. Hypotheses were usually well done. Risk assessments were not well done. Candidates were usually able to record their results logically although units were often incorrect and correct rounding was an issue for many candidates. Many produced suitable graphs although many did not produce linear scales or suitable lines of best fit. Key terms such as repeatability and reproducibility were well-known, but many candidates were not clear in their responses and consequently lost marks in explanations.

Comments on individual questions/sections

Most candidates were able to make a sensible hypothesis in each of the 9 tasks, which linked the independent and dependent variables. The exception to this was the exothermic reactions experiment, where many candidates simply stated that the temperature would rise when zinc was added and did not link temperature and time.

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, for example stating simply that water can burn you with no reference to either the action of pouring or the affected body part. It is still common to see reference to chemicals splashing into eyes which earns no credit. It was also very common for candidates to create a risk for experiments where there were no significant risks.

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. Incorrect units such as C° or use of incorrect abbreviations of units (e.g. secs for s / seconds) was commonly seen, especially in the sweating tubes practical. In that task many candidates struggled to organise their table of results sensibly. In the exothermic reactions task, candidates were instructed to record the time every 30 seconds for 3 minutes. It was common to see the time recorded incorrectly with candidates recording 1.3 minutes for a time of 1 minute 30 seconds. Handwriting was an issue for many candidates, and particularly the legibility of numbers. In the cake cases experiment, candidates were required to determine the mean from 3 numbers. Almost all candidates knew how to calculate the mean, but errors in rounding their final answer meant that this mark was withheld.

Section B – Variables

Each of the 9 tasks included a section on variables. Candidates were usually able to identify the independent and dependent variables, and most were able to state the range of these variables when required. Many of the tasks explored how certain variables were controlled, and in common with previous series this was not well answered, with no clear indication of the apparatus used or the required measurement of that variable.

Section B – Graphs

The most successful candidates obtained most of the available marks in this section. However, a significant number of candidates made common errors that have been seen in past series. The choice of non-linear scales, particularly in the cake cases task, was commonly seen with many candidates scaling their x-axis in reverse. Many candidates also lost the scale mark as they failed to record a value at the origin. Where candidates chose sensible scales, plotting was usually accurate with errors mainly seen in plotting where multiples of values such as 0.15 were used. Lines of best fit continued to be problematic as many candidates simply joined the first and last point with no consideration of the spread of data above and below the line. Joining point-to-point is only usually acceptable in Biology tasks but this was seen commonly in all tasks.

Description of the results was often quite limited. Whilst the majority of candidates were able to describe a relationship between the independent and dependent variables in the graph, a description of the shape of the graph, where it was required for the second mark, was poor. A significant number of candidates do not understand “directly proportional” correctly.
In the exothermic practical, candidates would link the temperature increase to time but not follow this with a description of the subsequent decrease or levelling off.

Section B - Calculations

Across all the tasks, where candidates were asked to use equations, calculations were answered well by most candidates; these included calculations of speeds, heat energy released and uncertainty. Some candidates did confuse units particularly in the cup case speed calculation where m/s was used for cm/s calculations and vice versa.

Section B – Explanation of results

Linking practical results to underlying theory proved again to be challenging for many candidates. In the exothermic reaction task, many candidates failed to clearly link their results to the reaction pathway. Similarly, in the cake cases task, only the most successful candidates recognised that the speed should have been consistent and could sensibly comment on their results.

Section B – Use of practical terminology

It was evident that most candidates understood practical terminology such as repeatability, reproducibility and precision and understand what an anomalous result is. The most successful candidates were able to evaluate repeatability and use data to justify their responses. However, many candidates, whilst clearly understanding the meaning of the terminology, gave answers to questions that were too vague for credit, with responses such as all the results are similar, rather than focusing on the similarity of repeats. Poorer responses were characterised by a lack of reference to the data collected or presented.

Section B – Improvements

Many candidates were able to suggest suitable improvements, for example using a lid for insulation in the exothermic reaction experiment or video recording the drop in the cake cases experiment. Where candidates were less successful, they often used vague descriptions of improvements with no suggestion of how these would be used.

There seemed to be a lack of knowledge or experience of higher precision instruments such as a burette or graduated pipette from many candidates in some centres.

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