GCSE EXAMINERS' REPORTS

GCSE
PHYSICS

SUMMER 2019

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UNIT 1: ELECTRICITY, ENERGY AND WAVES – FOUNDATION TIER

General Comments

The paper proved to be accessible to the candidates who sat it this year, with plenty of entry points being available within questions. There is a healthy mean mark but disappointingly, not one of the questions was attempted by all candidates. Within the paper there were questions that tested all aspects of knowledge, understanding application, mathematical skills, there were opportunities to write at length in continuous prose and to take information from tables and graphs and to draw a graph themselves.

The performances of candidates understandably fell away towards the end of the paper where questions that are common with the higher tier paper are contained but in stark contrast to the last question, the previous one was not at all badly answered. The QER was, as is usual nowadays, completely ignored by some candidates and as a result the mean for that part of the question was less than 25% of the 6 marks on offer.

Comments on individual questions/sections

Q.1 **(a)** Disappointingly, only one difference between P and S waves could be identified by the majority of candidates.

(b) Answers to this part just seemed to be guessed by many.

Q.2 Answers to this question were awarded fewer than half marks overall, a disappointment by comparison with other times that questions on this topic have been asked.

(a) Tick marks appeared alongside the Fleming's right hand rule statement but not many opted for the "……two South poles …." statement.

(b) Disappointingly, the candidates could not regularly suggest even two ways of making changes that would alter the **size** of the force on the wire.

(c) This part was poorly answered with the current direction in YZ frequently not even shown along the wire.

Q.3 **(a)** As stated above, the QER was not attempted by far too many candidates, such that the mean mark for this part of the question is below a quarter of the six on offer.

(b) **(i)** Almost all candidates could identify Sweden as the answer.

(ii) Some of the answers to this part beg belief. It seems that a number of young people think that electrical power comes down from the North pole and that Norway gets it first so they choose to use a lot of it!

(iii) There were very few answers that showed the candidates taking information from the question and combining it with information from the diagram to reason that the claim was incorrect.

Q.4 Over half marks earned on a question about electrical circuits is surprising but understandable in that the first part was very straightforward (but some still made a hash of it) and (b)(i) involved plotting points and drawing a straight line. It is pleasing to see that rulers are used almost universally to draw lines these days.
The last part of this question was poorly answered.

Q.5 There were some examples of careless drawing to and from a point not on the satellite and the next two parts to the question were well done on the whole.

Q.6 Despite the fact that the questions directed the candidates to realise that the temperature difference between the lines at 0 °C is less than at 60 °C, a significant number of answers gave that the lines are parallel – presumably because they look to be parallel. Many commented loosely that the gradients were increasing. Few knew the term "absolute zero" and even fewer knew to add 273 to 60.
The pressure calculation was usually correctly answered but a number of answers showed the 1.5 was squared – probably because of the unit of area.

Q.7 Around half marks were gained on this one, despite the fact that the action of fibre-glass on the attic floor was not well understood at all. Part (b)(ii) was generally well done.
The most common mistake in answers to the last part (from amongst those who answered it) was to calculate the savings over 40 years at £84 and £111 per year but then they forgot to subtract the installation cost. There were many routes available to answer this part of the question.

Q.8 In answer to (a)(i), many candidates thought that there exists a specific piece of apparatus for measuring wavelengths of water waves and how dare we suggest that the teacher could be wrong in what was claimed in part (a)(ii)?
The term "total internal reflection" was only rarely seen in answer to (b)(i) but the answers to (ii) were more promising. The relative dangers of having a CT scan against an endoscope being used, was poorly addressed.

Summary of key points

- The ability of candidates to write in extended prose or in making key scientific points in answer to questions is an area that teachers would want to develop within the classroom. The reluctance of candidates to write clear concise accounts in answer to questions needs to be overcome with plenty of practice being offered.

- Mathematical competence is reasonably good at this level with candidates substituting numbers into equations and subsequently manipulating the numbers effectively.

- Graph drawing skills are good showing that scales can be interpolated accurately and points plotted carefully.

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UNIT 1: ELECTRICITY, ENERGY AND WAVES – HIGHER TIER

General Comments

It was apparent that generally high ability candidates had opted for this separate award in Physics and had been entered for the correct tier of paper. The Facility Factor (FF) for the two overlap common questions was significantly greater on the higher tier paper in comparison to the foundation tier. Some candidates displayed a secure knowledge of the subject content and were also able to apply their skills when answering some of the more challenging questions. However, there were some exceptions to this and the tier of entry for a minority of candidates seemed inappropriate.

The vast majority of candidates attempted every question, but not every question part. Candidates often performed better when completing numerically based questions than when writing out Physics definitions or explanations. It was evident that some progress had been made with questions that require candidates to agree or disagree with a judgement about a suggestion or claim. Based on evidence included in their answer, only a few candidates neglected to record an agreement or disagreement with the stated claim. Failure to include this type of statement restricted full marks being awarded. Examples of this type of question included Q1(b)(iv), Q2(a)(ii) and Q8(a).

Comments on individual questions/sections

Q.1 **(a)** Very well answered by the majority of candidates.

(b) **(i)** Historically candidates have always struggled with questions relating to this part of the Unit 1 specification. This year was no different. Many candidates indicated, incorrectly, that fibre-glass would stop conduction or stop convection rather than reduce them. Many candidates were able to identify that fibre-glass was an insulator.

(ii) Almost all candidates attempted this part and scored highly.

(iii) Generally candidates interacted confidently with the data in the table and displayed a secure understanding of payback time.

(iv) The majority of candidates attempted this question and gained marks. Only a few candidates selected a different insulation to the ones stated **in bold** in the stem of the question. This highlights the importance of carefully reading the question.

Q.2 **(a)** **(i)** It was evident from the poor answers observed that many candidates may not have seen or discussed in detail this demonstration. They struggled with answering the question.

(ii) This was poorly answered. It was clear that most candidates had ignored the "frequency of the waves remains **constant**" statement in the stem of the question. Most candidates agreed with the teacher, not realising that wave speed and wavelength are directly proportional.

(b) **(i)** The full name was needed for the mark. The abbreviation 'TIR' was acceptable.

(ii) The two conditions needed for TIR hadn't been learned by most candidates.

(iii) Most candidates appreciated the ionising effects of X-rays as a disadvantage of using CT scans.

Q.3 **(a)** The majority of candidates were able to state one correct property associated with the em spectrum. However, very few managed two correct properties. It was disappointing to observe some candidates stating that speed was different for the em waves.

(b) **(i) and (ii)**

Well answered by candidates.

(c) This part was surprisingly not answered well. The vast majority of candidates failed to interpret the range of numbers given and appreciate that gamma waves have a greater energy than X-rays.

Q.4 **(a)** It was clear that most candidates appreciated the energy efficiency banding display.

(b) Candidates interacted quite successfully with the data displayed on the label. Secure number skills were displayed by many. However, quite a few lost a mark for conversion mistakes.

(c) Generally well answered by most. There were a few candidates who struggled with changing from pounds into pence.

Q.5 **(a)** A very high percentage of candidates attempted this question part but only a few attained full marks. Many failed to recognise the parallel and series parts. As a result, they were unable to apply, in sequence, the correct equations from page 2.

(b) Most candidates were able to use the equation given in the stem and combine this with their answer from (a) to calculate power. However, when calculating time, many candidates failed to understand it would be in the units of seconds. Therefore they neglected to convert their final answer into minutes. This instruction was stated in bold print.

Q.6 **(a)** Some candidates displayed a high level of understanding and knowledge with the question. Any reference to time lag was rarely seen. Too many candidates thought that A, B and C were the waves despite this being clearly stated otherwise in the opening part of the question. Many gave correct descriptions of the properties of P and S waves without linking them to the three stations. This obviously limited their attainment to the bottom level descriptor.

(b) Recall of a definition is an Assessment Objective 1 (AO1) type of question. It was evident that the majority of candidates had not learned a correct definition of either transverse or longitudinal waves.

Q.7 **(a)** Reference to Fleming's left hand rule were quite rare. Those who did correctly identify it then failed to describe in detail how it could be applied to the experiment to prove the candidate was correct.

(b) **(i)** The table was completed correctly by many. Some candidates failed to identify and record the SI multiplier present on the force axis.

(ii) Most candidates identified the positive correlation between the two variables but omitted reference to the constant rate, costing them one mark.

(iii) This part was badly answered by the majority of candidates. It was evident that candidates had little appreciation for the equation of a straight line. It does feature in the higher mathematical skills section (Appendix B) in the specification.

(iv) Many candidates were successful with this question part as they used their initiative and utilised a correct equation from page 2. This was encouraging as many candidates showed a high level of mathematical competency, some even managed to remember the conversion from cm into m.

Q.8 **(a)** Candidates interacted with the information contained on the graph with varying amounts of success. Efficiency seemed to be an area of learning that candidates were familiar with.

(b) Not surprisingly this question part was answered well by most. A few candidates failed to notice that, in the stem of the question, input coil had been placed in bold print. They used data for the other line and as a consequence were awarded zero marks.

(c) Many candidates had little understanding of the term 'laminations' that was referred to in the question stem. Some candidates appreciated it improved the efficiency of transformers but failed to explain that it reduced heat loss. Knowledge of eddy currents was not expected but it was pleasing to observe some candidates referring to it.

(d) Generally this was well answered. However, some candidates stated that reducing the current would stop heating effects rather than reduce it. This was not accepted and not credited.

Q.9 **(a)** The standard of graph plotting was very pleasing. When adding the best fit straight line some candidates didn't include points above and below their line. Failure to carry this out resulted in the line mark not being awarded for a few.

(b) Many candidates were credited for extrapolation of their best fit line. However, they failed to identify that the limit of the syringe was stated as 25 cm^3 in the initial paragraph.

(c) This was reasonably well answered by most but some candidates thought that the molecules expanded rather than their separation increased with heating.

(d) Not as well answered as part (c)**.** Many neglected to mention that there would be more frequent collisions between molecules.

(e) A high percentage of candidates attempted this question. A few impressive, fully correct, answers were observed. It was encouraging to witness some high achieving candidates successfully answering a challenging question. However, many weaker candidates were unable to deal with the numerical demands. Those who guessed an answer, with no workings, of -273 ^{o}C were not awarded marks as the answer worked out as -268.6 ^{o}C.

(f) Well answered by the majority. A common mistake was to omit the word 'absolute' from their response.

Summary of key points

All questions seemed accessible to candidates and it was pleasing to observe such high attempt percentages for the question paper. Literacy based questions seemed to be least popular with candidates and this is highlighted with lower facility factors in comparison to the numerically driven questions.

On reflection, for candidates to improve in the future the following may be considered.

- Identify information in bold print as being important when answering a question.
- Care must be taken when rounding a number used as a final answer.
- To raise awareness and refer to the mathematical skills section (Appendix B) contained within the specification.
- Application of $y = mx + c$ to a linear relationship.
- To have an even spread of data points above and below a straight line of best fit.
- Check at the end of an examination that all instructions contained in the question have been carried out.

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UNIT 2: FORCES, SPACE AND RADIOACTIVITY – FOUNDATION TIER

General Comments

It was disappointing that no question part had a 100 % attempt rate even where candidates had to tick boxes. Candidates' knowledge of moments and half-life were both particularly poor. There was, once again, much evidence of candidates not reading questions carefully and they are generally more secure when completing calculations than when offering explanations.

The quality of the written responses was poor in many cases and basic recall was weak. The quality of extended response question demanded that candidates compared the life cycle of low and high-mass stars; the structure of the writing was generally poor. It is disappointing that this question had almost the lowest attempt rate on the paper.

Comments on individual questions/sections

Q.1 **(a)** This was done well by almost all candidates.

(b) Disappointingly, very few knew the term CMBR.

Q.2 **(a)** **(i)** This simple calculation was well done by almost all candidates.

(ii) This proved problematic for many and rather than the simple subtraction that was required many divided or multiplied values, demonstrating poor knowledge of energy transfer.

(b) Despite the emboldening in the stem it was evident that many did not read the question and gave answers discussing car safety. Where credit was given it was usually for reference to streamlining. Answers were not well-written here.

Q.3 **(a)** At foundation level the vector nature of momentum is challenging and to assist candidates the direction of positive velocity was clearly marked on the diagram. Despite this, it was rare to see candidates subtracting the momenta values, although many were able to gain partial credit.

(b) This simple calculation was one of the most successfully answered questions on the paper with most able to add the masses and obtain a correct answer.

Q.4 **(a)** **(i)** This simple recall question was not well done with very few correct responses seen.

(ii) Almost all candidates were able to complete this calculation correctly.

(iii) Again, this calculation was usually well done.

(b) This question demanded a written explanation exploring the link between moment, force and distance and most candidates struggled here to respond clearly and correctly.

Q.5 **(a)** Foundation tier candidates are required to be able to balance nuclear equations however very few were able to demonstrate any competence in this area, with many random responses.

(b) **(i)** It was surprising to examiners that so few candidates could identify a neutron from the symbol given and a range of responses including element, control rod, nitrogen and carbon dioxide were given.

(ii) Where credit was awarded here it was usually for identifying that control rods prevent overheating, the mechanism for this was not well-understood or explained.

(c) Few candidates could identify the properties of nuclear waste which make it problematic to store. Many answers focussed on cost or described it as explosive or radioactive.

(d) **(i)** It was a surprise that this simple question proved to be beyond the reach of many. All that was required was that candidates identified that nuclear power accounts for only 0.3 % of background radiation. Many did not interact with the pie chart or gave poorly constructed or worded responses.

(ii) Responses here tended to be vague and few gained credit. The idea that decay is random was rarely seen.

Q.6 **(a)** **(i)** Most were able to interpret the graphical data and determine the unstretched length of the spring.

(ii) The term extension may have been problematic here and many failed to subtract the unstretched length in order to determine an extension. It was common to see candidates adding the values.

(iii) Candidates commonly attained one mark here, only a minority converted from cm to m to attain both marks.

(b) This was a more challenging end to the question and it was not well done with many parallel lines drawn.

Q.7 **(a)** This was completed successfully by many candidates.

(b) This quality of extended response question produced a range of answers and examiners were delighted to see some excellent top band responses. As highlighted in previous examinations, many candidates extended writing skills are poor and the recall of basic facts about the life cycles was often lacking. It was very disappointing that the attempt rate for this question was far lower than most other questions on the paper.

Q.8 **(a)** Very few candidates could name both forces and state that they were balanced. It was common to see responses incorrectly discussing energy.

(b) **(i)** This question was set in a practical context and it is pleasing that almost all candidates could recognise an anomalous result.

(ii) Despite identifying an anomaly in (i) most included the anomaly when completing the mean calculation.

(iii) The majority gained credit here for the simple calculation of speed.

(c) **(i)** Candidates were often let down here by poor expression often referring to amount of cake cases rather than mass.

(ii) Many struggled to identify a controlled variable.

(iii) Many candidates were able to convey the idea of videoing and playing back the drop but struggled to explain how this would improve accuracy. Poor expression and vague responses however were often seen with references to use of lasers or computers not worthy of credit.

(d) This was the very last foundation tier only question and required candidates to interact with graphical data and explore ratios. This proved very demanding and only a minority were able to attain full credit. Many did not refer to data at all in their response ignoring the space for calculations.

Q9. **(a)** **(i)** The majority of the foundation tier candidates did not know how to answer this question with few showing any understanding of direct proportion.

(ii) Whilst most candidates did attain some credit here, it was usually for dividing a distance in metres by a time in mph, ignoring the conversion table given for speed. Where candidates did attempt a correct calculation, it was common for them to lose marks for incorrect interpretation of the answer on their calculators giving an answer of 0.6, rather than 0.67, ignoring the dot above the 6 to indicate a recurring digit.

(iii) This was often done really poorly, with many not realising that they had to add thinking and braking distance.

(iv) Many were able to attain marks here for correct plots although the lines were usually poor.

(b) This proved too difficult for almost all foundation tier candidates many of whom ignored the instruction to use data.

Q.10 As one may expect, the final common question proved beyond the reach of the majority of foundation tier candidates.

(a) Many realised that the short half-life precluded iodine-123 from use in brachytherapy but often they failed to develop the answer or didn't describe it as 'too' short.'

(b) Where credit was given it was for identifying that iodine-131 has a longer half-life.

(c) It was rare to see a correct answer; candidates had very poor knowledge of half-life.

Summary of key points

- Check that candidates understand the significance of a dot above a digit on their calculator screens as these are often misinterpreted leading to penalties for incorrect rounding.
- Encourage candidates to read each question part carefully and to consider the mark allocation.
- Allow ample opportunity for candidates to practice half-life calculations.
- Ensure that candidates pay close attention to units.
- Develop confidence in extended writing by allowing sufficient practice in and assessment of this skill.

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UNIT 2: FORCES, SPACE AND RADIOACTIVITY – HIGHER TIER

General Comments

Many candidates appeared to be correctly entered. However, there was a group of candidates who found the demands of the paper too difficult and hence scored low total marks. These would have been better suited to the foundation tier paper. Most question parts were attempted by at least 95 % of candidates. Candidates coped well with the calculations and graph work in the context of stopping distance and also interpreting the H-R diagram. Topics that were not applied well in the context given in the paper included life cycle of stars, design of a fission reactor, conservation of momentum and energy. Manipulation of equations caused problems for a significant minority of candidates.

Conversion of units was often ignored. Candidates need to spend time in reading questions carefully. Candidates often perform better when completing calculations than when writing out descriptions or explanations. Some question parts require a judgement to be made about the validity of a suggestion or claim. If this is not included then full marks are not given. For example, see Q 1(a)(i), 2(c) and 5(b)(i).

Comments on individual questions/sections

Q.1 (a) (i) A minority of candidates earned credit here and this was usually limited to recognising that braking distance is a curve so couldn't be proportional. Most candidates did not understand that to be directly proportional then a straight line through the origin is required.

(ii) Candidates were expected to convert 40 mph into 18 m/s and read the thinking distance from the graph. The majority of candidates achieved this and completed a correct calculation to earn full marks. Others failed to convert the speed but still gained some credit if no other mistakes were made.

(iii) Most candidates interpreted both graph lines to complete the table correctly.

(iv) Most candidates plotted all the points accurately to gain both plotting marks. However, some candidates fail to consistently apply the 2 m/small square scale for all plots. For example, (20,12) was plotted two small squares above 10 m instead of just one. Approximately half of the candidates earned the mark for joining their points with a smooth curve. Reasons for withholding this mark included a series of straight lines joining point to point, failure of the line to pass through the origin, the line missing a point by a small square or more, and obvious wobbles.

(b) Some excellent answers were seen but these were in the minority of cases. Some candidates answered without referring to any data which the question required. Others believed that reducing the speed limit would give drivers more time to think.

Q.2 **(a)** Many candidates recognised that the half-life was too short but could not explain the consequence of this.

(b) Candidates usually referred to the suitability of the half-life or the fact that a combination of beta and gamma radiation would be more penetrating but not both.

(c) Some excellent responses were seen which were clearly set out. It was pleasing to see a few candidates using $½^n$ or 0.5^n. Most other candidates recognised that 80 days is the equivalent of 10 half-lives but then made errors when applying this. For example, a sequence was shown such as: $1 \rightarrow \frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8} \rightarrow \frac{1}{16} \rightarrow \frac{1}{32} \rightarrow \frac{1}{64} \rightarrow \frac{1}{128} \rightarrow \frac{1}{256} \rightarrow \frac{1}{512}$ which shows 10 numbers but only 9 half-lives. To earn full credit, a concluding remark was required, which most candidates who were eligible for three marks included.

Q.3 Some excellent top band answers were seen but these were in the minority of cases. These candidates were able to describe CMBR and cosmological red shift fully and clearly and apply their answer to the Big Bang. Other candidates decided to answer their own (different) question so there were explanations of how an absorption line is produced and how it allows composition of a star to be identified. It was clear that a significant number of candidates do not know what is red shifted. They described how stars and galaxies are stretched and move to the red end of the spectrum. Others spoke of Doppler red shift, the red shift itself being stretched and the red shift of planets. It was also clear that many candidates did not know the origin of CMBR. They stated it was microwave radiation but this is given in the name anyway. They believed it was produced at the time of the Big Bang and not much later on in time.

Q.4 This question was based on a specified practical so the expectation is that candidates are familiar with the procedure.

(a) **(i)** The question was often ignored so a common answer was to use the same cake cases. A minority of candidates stated both distances.

(ii) There are still those candidates who believe that repeating readings eliminates anomalies rather than allowing them to be identified and ignored. They also state that it makes the results more accurate rather than producing a more accurate mean.

(iii) The marking scheme allowed candidates to argue either way. Usually a mark was awarded for recognising there may be slight variations in the mass of each case.

(b) **(i)** Most candidates knew that air resistance increases with speed. The second mark was often not awarded because candidates spoke about the weight and air resistance becoming equal rather than equal and opposite or balanced or the resultant force becoming zero.

(ii) A minority of candidates could suggest a suitable method to check whether terminal speed had been reached. Others stated that a computer or speed monitor should be used without describing how.

(c) The mean mark for these calculations worth 6 marks was as high as the mean mark for the preceding 9 marks which required descriptions and explanations.

(i) About half of the candidates selected the correct equation, manipulated it and arrived at the correct answer. Others made errors in manipulation, substitution, and some attempted to use an equation of motion, especially $x = \frac{u+v}{2}t$. They then used 10 N as one of the speeds.

(ii) Some excellent answers were seen with clear and logical workings shown to earn full credit. Others managed to get part way through the calculations by determining the mass of one cake case but then failed to convert from g into kg or failed to multiply by 10 to arrive at a weight.

Q.5 **(a)** Most candidates interpreted the information in the H-R diagram to score at least two marks.

(b) **(i)** Candidates were required to recall the future stages in the life cycle of our Sun, namely red giant and then white dwarf, to be able to answer the question. It is doubtful all candidates knew this information since a sizeable minority agreed with the statement given in the question. Others failed to provide any data from the H-R diagram so were limited to a maximum of one mark. A concluding remark was required which was usually included by candidates eligible for three marks.

(ii) A minority of candidates provided excellent answers which demonstrated understanding of the forces acting within stars. Others answered their own question and wrote about changes in fusion within stars.

(c) Knowledge of the role of a supernova in this process was limited to a minority of candidates.

Q.6 **(a)** Some perfect answers were seen but, as is often the case with questions requiring explanations, these were from a minority of candidates. Other candidates included references to control rods and the moderator but frequently reversed their roles. Also some candidates think that electrons are involved in the process of fission and it is these that are slowed down by the moderator.

(b) **(i)** The majority of candidates could recall the symbol for a neutron to earn a mark. However, fewer recognised that two are required to balance the equation. In an attempt to balance the equation some candidates completed the equation by writing ${}^{2}_{0}\mathrm{n}$ so failed to earn any credit. There were also instances where the symbol for an electron was given but with +1 given as the mass number.

(ii) The most that candidates usually stated was that the nucleus becomes unstable.

(c) **(i)** Few candidates gained both marks for writing the equation. Some omitted to include the beta particle, some added it to the left-hand side of the equation, and others thought the mass number and atomic number for yttrium were exactly half those of strontium. This must have been due to the inclusion of information about half-life in the introduction to the question.

(ii) The majority of candidates earned credit here for recognising that 'something' halves every 75 s. They were not always successful in identifying an acceptable 'something'.

(iii) Candidates were expected to include strontium and yttrium in their answer as well as the stable product zirconium. Few did this successfully.

Q.7 **(a)** **(i)** The most that candidates could usually state was that momentum before equals momentum after. Few referred to the proviso that this is true only if no external forces act. Other candidates attempted to state one of Newton's laws.

(ii) This was intended to assess understanding of the law of conservation of momentum but most candidates had already omitted any reference to external forces in part (i) so had little success in providing a correct explanation here.

(b) Very few candidates earned any credit for their answers. There were some references to the inelastic collision between the bullet and the block.

(c) The whole question was structured in a way to lead candidates towards using the law of conservation of momentum and conservation of energy to complete the following calculations. It was pleasing to see the work from candidates who earned 7 or 8 marks. However, these were for a minority of candidates.

(i) The expected answer was to recognise and apply KE = PE. Lots attempted this but failed to manipulate correctly to find v or failed to convert 11.9 cm into 0.119 m. Some candidates successfully used $v^2 = u^2 + 2ax$. Slightly confusing, but in this instance, u represents the velocity v shown in the diagram. To earn full credit candidates were required to recognise that v^2 in the equation of motion was zero and a equalled -10. There were attempts to use $\text{speed} = \frac{\text{distance}}{\text{time}}$ but no time was given in the question.

(ii) The velocity calculated in part (i) was carried over into this part. Many candidates recognised that the momentum equation was of relevance here but failed to convert so the masses were in the same units. Others failed to substitute correctly. There were attempts at using equations of motion but these were usually abandoned midway.

Summary of key points

- Encourage candidates to read each question part carefully.
- Use assessment for learning methods to develop candidates' skills in producing and assessing each other's explanations of scientific theory, e.g. life cycle of stars, CMBR, cosmological red shift, the role of moderators and control rods in sustaining a controlled chain reaction.
- Provide further practice in graph plotting, in particular when each small square is a multiple of 2.
- Provide further opportunities for candidates to work through multi-stage calculations.
- Provide further practice in completing calculations with mixed units that require conversions and to take note of units when substituting values into equations.
- Provide further examples of open-ended calculations where candidates must decide on the appropriate method to be used.

PHYSICS

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UNIT 3: PRACTICAL ASSESSMENT

General Comments

It was pleasing that there was again a good spread of marks with the vast majority of candidates attempting most questions. Some positive achievement was seen from candidates across all qualifications and abilities. However, explanations requiring demonstration of scientific knowledge were often poor.

SECTION A

Risk assessment
The nature of the hazard was not always clearly identified (e.g. acid is an irritant) and the risk often lacked an action (e.g. acid splashes on skin whilst pouring into beaker). Where candidates accessed the provided student safety sheets, they did not always select information which was relevant to the task.

Table of results
The majority of tables were well-structured and logically organised although candidates tended to lose marks for incorrect units or putting units in the body of the table.

SECTION B

Graphs
Many candidates were able to plot graphs correctly, although lines of best fit were often poor or not attempted. Many candidates did not start their scale at the origin and should be encouraged to do so.

Variables
Generally, candidates are confident in identifying the independent and dependent variables in different investigations indicating that these terms are well understood. Candidates were usually able to identify controlled variables but stating how they were controlled referencing both instrumentation and the value measured was not done well.

Evaluation of quality of data
Repeatability and reproducibility were generally well understood; however, the terms accuracy and precision are still poorly understood. The idea of random error was not well-known. Calculating uncertainty from a given equation proved very difficult. Suggesting improvements however was often well done.

Comments on individual questions/sections

INVESTIGATING THE EFFECT OF VOLTAGE ON THE POWER TRANSFERRED BY A LAMP
This practical was specific to the separate physics qualification; many candidates demonstrated very good practical skills producing excellent outcomes.

SECTION A

(a) This was usually done well although the risk often lacked an action.

(b) This was a simple table and the majority of candidates scored highly.

SECTION B

(a) This was straightforward and done well by the majority.

(b) **(i)** Most candidates scored well. The most common errors were failing to label values at the origin on both axes and failing to complete a smooth curve of best fit.

(ii) It was common here for candidates to score one mark for describing the relationship between the variables, few developed their answer to explain that the power increase was at an increasing rate.

(b) **(iii)** Some candidates made a good attempt at this question however many answers were not supported by data, ignoring the instruction in the question.

(c) **(i)** Most candidates did not understand that results in a table are recorded to the resolution of the measuring instrument used.

(ii) Although most candidates knew the difference between reproducibility and repeatability evaluating this in the context given was often poor.

(iii) The understanding of the term accuracy was demonstrated by most candidates.

(d) **(i) and (ii)**

Very few candidates could explain what a random error was although many could describe how to mitigate the effect of random errors.

(e) **(i) and (ii)**

Interpretation of the data presented was done well by most candidates.

(iii) This was too challenging for most.

INVESTIGATING THE EFFECT OF TEMPERATURE ON THE REBOUND HEIGHT OF A SQUASH BALL

This proved to be a very popular task both with double award and separate science candidates.

SECTION A

(a) This was usually done well although the risk often lacked an action and many failed to suggest drying the floor as a suitable control instead giving vague responses such as take care and do not run.

(b) This was a simple table and many candidates scored highly. Where candidates lost marks, it was often for missing or incorrect units, with C^{o} often seen.

SECTION B

(a) (i), (ii) and (iii)

Most candidates are secure in their knowledge of independent, dependent and controlled variables. A large number did not read the question carefully however and rather than explaining why a variable was controlled they answered with how.

(b) (i) Many were able to correctly identify the resolution of the ruler used.

(ii) It is disappointing that after carrying out the experiment candidates were unable to identify that measuring a moving object is very difficult and cannot be done accurately.

(c) Most candidates scored well. The most common errors were failing to label values at the origin on both axes, having a y-axis scale which was too small and joining point-to-point.

(d) It was common here for candidates to score one mark for describing the relationship between the variables, few developed their answer to describe the relationship numerically.

(e) (i) The equation for determining uncertainty was given and candidates had to select the correct data to substitute using their data for the lowest temperature. Many were not able to do this correctly and selected their overall highest and lowest values.

(ii) Although most understood the term repeatable being able to discuss repeatability clearly in reference to data proved challenging.

(f) This was done well by many.

(g) (i) and (ii)

Many were able to calculate the potential energy but explaining why it differed to the initial value often yielded vague responses which did not gain credit.

Summary of key points

- Encourage candidates to identify the nature of any hazard and to always link a risk with an action in the method.
- Allow plenty of opportunity for candidates to plot graphs. They should have suitable practice in determining their own scales which include values at the origin and they should develop a clearer understanding of what constitutes a good line of best fit.
- Practice method writing to ensure that candidates write concisely and clearly in a suitable style.
- When undertaking practical work, encourage candidates to draw links between the results collected and scientific theory.

- Give candidates experience of judging the reproducibility and repeatability of given data.
- Ensure that candidates understand the significance of a dot above a digit on their calculator screens so that they do not make errors in rounding.

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