GCSE
PHYSICS

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Report on the Examination

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General

Grade 4-5 calculation questions ask for students to recall an equation first before using it in a subsequent calculation, these were generally well answered with more than three quarters of students successfully recalling the equation. The ability of students to then use the equation varied greatly, the recall of P = VI led to 65% of students answering the subsequent calculation correctly, whereas the recall of the efficiency equation led to 96% of students answering the subsequent calculation correctly, while the recall of $E_k = ½ mv^2$ led to 78% of students answering the subsequent calculation correctly. All three calculations involved a rearrangement, rather than a unit conversion, so the differences are noteworthy. The stem of the question lists the quantities in alphabetical order, so that there is no suggestion of the correct order. Students can recall the equation in any correct rearrangement, and it is possible that this provides an explanation of the less successful recall of the P = VI equation.

The grade 8-9 multistep calculations, questions 8.4, 9.3 and 10.3, were well attempted with many students answering correctly. Of these three questions, 8.4 was least well answered with only 9% scoring 5 marks. For question 9.3, 43% and 24% of students scored 5 and 4 marks, respectively. For question 10.3, 24% and 28% of students scored 5 and 4 marks, respectively.

Question 2.1 was generally well attempted and students who had carried out Required Practical Activity 2 would have had a material advantage over those who hadn't.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. Students who have handwriting that is difficult to read may benefit from a scribe or from word processing their answers in exams.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Question 1 (Standard demand)

01.1 Students found this question straightforward with 80% correctly identifying the meaning of power input.

01.2 76% of students answered this question correctly. Grade 4-5 questions will prompt for the correct equation with the quantities listed alphabetically; there is no need to write the equation in the order given in the question. Any correct rearrangement of the equation was allowed. Voltage or p.d. was acceptable for potential difference.

01.3 66% of students scored 3 marks for this question. If students rounded their answer, it needed to be correct eg 0.174 would score 3 marks, but 0.173 would score only 2 marks for the previous steps in the calculation (substitution and rearrangement).

01.4 84% of students answered this question correctly. A common mistake was writing output or input in both the numerator and the denominator.
Grade 4-5 questions will prompt for the correct equation with the quantities listed alphabetically; there is no need to write the equation in the order given in the question. Any correct rearrangement of the equation was allowed.

01.5 96% of students scored 3 marks on this question.

01.6 Students were more likely to score the second marking point relating to efficiency than identifying the unwanted energy transfer. Some students simply restated the stem: To see how much light they emit, rather than going the extra stage in the reasoning and linking to efficiency because thermal energy is also transferred by the light bulb. 5% of students scored 2 marks, 36% scored 1 mark.

Question 2 (Standard demand)

02.1 Students answered this question well; their experience of carrying out a similar practical appeared to help their understanding of the context. The indicative content are examples of what students may write in their answers, it is not an exhaustive list, neither do all points need to appear for a student to score 6 marks. A level 3 response should have described a method that could be followed where the number of layers of newspaper was varied and a suitable control variable identified; volume of water or initial temperature of hot water. For 6 marks a student should have also referred to either the interval on the graph (8 layers) or that the experiment should also have been completed with zero layers.

The mean mark for the question was 4.3. 22% of students scored 6 marks.

02.2 Most students did not recognise that the resolutions of the two instruments were the same. Some students correctly identified that as you only needed to know the temperature change, only two temperature measurements were needed. Answers that referred to the datalogger recording too much data or too frequent measurements were insufficient to score a mark. Some students referred to ‘precision’ rather than ‘resolution’, which did not gain a mark. 5% of students scored 2 marks, 53% scored 1 mark.

Question 3 (Standard demand)

03.1 84% of students scored 3 marks. Students who didn't score 3 marks usually scored 1 mark for the correct substitution. The substitution scored the first marking point, followed by the rearrangement for the second marking point. It wasn't necessary to give the final answer to an appropriate number of significant figures, so answers of 0.502, 0.50 and 0.5 were all creditworthy.

03.2 A common incorrect answer was E_k = mass × speed, since these were the quantities given in the question. A number of students also left out the 0.5 value even if they remembered that speed should be squared. Velocity was allowed instead of speed in the equation. Correct symbols were acceptable for the quantities in the equation. 86% of students answered this question correctly.

03.3 Most students found this calculation straightforward, with 78% of students scoring 3 marks.

03.4 Many students made good comparisons; the mean score for the question was 3.0. Common correct answers included identifying peak muscle power age / values. Muscle strength and muscle mass were insufficient for muscle power.

Students needed to include a similarity as well as differences for 4 marks. The AQA GCSE Science Command Words document states that both similarities and differences should be noted when the command word is compare. 28% of students scored 4 marks, 49% of students scored 3 marks.

03.5 46% of students answered this question correctly. Some students failed to score a mark because they simply restated the question, 'the scientist wanted the highest muscle power reading' without adding any value. The answer either needed to refer to the effect of repetition on performance (improvement or worsening) or that it was the maximum (or peak) muscle power that the scientist was investigating.

Question 4 (Standard demand)

04.1 Some students failed to point out that the electric car's journey time would be longer (or that the diesel car's journey time would be shorter), not scoring the 1st marking point. Most students who scored 1 mark scored the 2nd marking point. 68% of students scored 2 marks, 24% of students scored 1 mark.

04.2 Most students who calculated the energy stored in the fuel / battery scored the conclusion mark. Some students did spurious calculations that scored zero, eg calculating the energy density divided by the mass. 37% of students scored 3 marks, 50% of students scored zero.

04.3 Many students didn't score marks as their answers were too vague, 'quicker process' was a common insufficient response. Students were often unclear whether they were referring to the car's range or the journey time. 11% of students scored 2 marks, 70% of students scored 1 mark.

04.4 Many students understood that the energy could be used to power homes or fed back into the National Grid. Fewer students understood that there would need to be a physical connection ie a lead. Some students simply thought that you could charge your mobile phone in the car, rather than using a plug socket, which was insufficient. 19% of students scored 2 marks, 31% of students scored 1 mark.

Question 5 (Standard/High demand)

05.1 Students found the decay equation straightforward, with 91% of students scoring 2 marks. 4% of students scored 1 mark.

05.2 60% of students scored 2 marks for the first 2 marking points. Only 1% of students scored 3 marks - the majority of the students ignored the contamination aspect of the question. Some responses were insufficient to score the second marking point. Some common insufficient responses included: ionises cells, destroys cells, and mutates cells.
A number of students stated that alpha emitters have long half-lives, but this is not always the case. Radium-207 which emits 90% alpha radiation has a half-life of only 1.3 seconds.

05.3 The majority of students identified that 3 half-lives had occurred. Only 52% of students could then correctly calculate the initial mass to score 3 marks.

Question 6 (Standard/High demand)

06.1 60% of students scored 2 marks, indicating that if students knew the value of the frequency they also knew the unit. Only 16% of students scored 1 mark.

06.2 Some students focused on the safety aspects needed for two hands on the handle, rather than the circuit diagram. 50% of students scored 2 marks, 34% scored 1 mark.

06.3 The use of an incorrect equation scores zero. The substitution mark is only credited when the correct equation has been used. The second mark is for the rearrangement, the third mark is for the correct answer. An answer of 56.25 from the calculation of power divided by resistance scores zero, as this is not a correct equation. An answer of 0.237 or 0.24 would score 2 marks for not converting the power into W. An incorrect conversion (power of ten error) would score 2 marks. 57% of students scored 3 marks. 8% of students scored 2 marks. 33% of students scored zero marks.

06.4 The use of an incorrect equation scores zero. The substitution mark is only credited when the correct equation has been used. The second mark is for the rearrangement, the third mark is for the correct answer. An answer of 300 000 (s) would score 2 marks for not converting the power into W. An incorrect conversion (power of ten error) would score 2 marks. 75% of students scored 3 marks, 9% scored 2 marks usually for not converting the power. 14% of students scored zero marks.

Question 7 (Standard/High demand)

07.1 The use of an incorrect equation scores zero. The substitution mark is only credited when the correct equation has been used. The second mark is for the rearrangement, the third mark is for the correct answer. An answer of 0.0025 (m) would score 2 marks for not converting the energy into J. An incorrect conversion (power of ten error) would score 2 marks. 77% of students scored 3 marks. 9% of students scored 2 marks. 12% of students scored zero marks.

07.2 Both points seemed to score equally well, but very few students referred to the work done by the resistive forces. 19% of students scored 2 marks. 21% scored 1 mark. Sound energy was ignored.

07.3 Since the question concerned the transfer of gravitational potential energy to kinetic energy, a difference in mass would have no effect on the final kinetic energy, $mgh = ½\ mv^2$ therefore, $v^2 = 2gh$. So a student's explanation identifying a different mass leading to a different speed from energy considerations only, would score zero. An explanation that involved terminal velocity could score 2 marks. If a student stated that a higher mass would affect the speed, this would score 1 mark. Only 2% of students scored 2 marks. 39% of students scored 1 mark. 59% of students scored zero marks.

Question 8 (Standard/High demand)

08.1 88% of students identified that the initial temperature was a control variable.

08.2 Many students found this question straightforward. 80% of students scored 2 marks, 5% of students scored 1 mark. 15% of students scored zero marks.

08.3 Common correct responses referred to melting ice while handling or a change in room temperature. Variation in mass of ice cube was insufficient, students needed to refer to the <u>initial</u> mass varying. 46% of students answered this question correctly.

08.4 This was the first grade 8-9 calculation in the exam. Students found it difficult to combine the equations needed. Most students used either the specific heat capacity or the specific latent heat equation and the value of 5848 J. A maximum of 2 marks could be scored by using either of the equations with the energy value of 5848 J. 55% of students scored 2 marks for this compensation calculation. Some students failed to round their values of 0.186 or 0.0175 correctly and only scored 1 mark for the substitution.
9% of students scored 5 marks. 20% of students scored zero marks.

Question 9 (High demand)

09.1 39% of students scored 2 marks, while 40% of students scored 1 mark. Many students showed confusion over the difference between high and low resolution. Resolution is the ability to distinguish different values; a higher resolution means that an instrument has the ability to distinguish between smaller values. The reference to accuracy in the question was ignored by some students.

09.2 Taking repeats and calculating a mean was a common incorrect answer. Some students stated 'to record the reading when nothing was on the balance' scoring 1 mark. Of the two marks available, most students scored the second mark. Some students ignored the stem and said reset the balance or use a different balance. 30% of students scored 2 marks, while 23% scored 1 mark.

09.3 The use of an incorrect equation scores zero. So, for a calculation of volume, a value cubed needed to be seen to score 1 mark for the first part of the calculation. The second mark only scored if the answer was correct. The third mark was for a correct substitution into the correct equation for density, using a calculated value for volume. The fourth mark was for the rearrangement and the fifth mark for the correct final answer. 43% of students scored 5 marks. 24% of students scored 4 marks, which is likely to have been caused by not converting the width into metres, or an incorrect conversion into metres, which is usually a power of ten error. 20% of students scored zero marks.

Question 10 (High demand)

10.1 31% of students scored 2 marks, while 48% of students scored 1 mark for describing the force.

10.2 40% of students scored 3 marks. A number of students couldn't recall the correct equation. Few students converted kV successfully, but would have scored 2 marks if the calculation was correct. 51% of students scored zero.

10.3 24% of students scored all 5 marks. For the second part of the calculation to score, students needed to use the correct equation to calculate the current ($Q = It$). Students who incorrectly or didn't convert the time into seconds could still score 4 out of the 5 marks for the calculation, and this was scored by 28% of students. A number of students appeared to have trouble recalling correct equations relating the quantities given in the question, 37% of students scored zero. Alternative methods using other electricity equations were also creditworthy

Question 11 (High demand)

11.1 30% of students scored 2 marks, while 47% of students scored 1 mark. Some students just discussed thermal energy which was insufficient. Discussion of particles vibrating did not score the first marking point. Students needed to specify that the kinetic energy of the particles increased, rather than simply the kinetic energy of the water increasing.

11.2 82% of students chose the correct answer.

11.3 This question discriminated well between students with 12% scoring 4 marks and 38% of students scoring zero. Lower-attaining students tried to explain how the specific heat capacity of the water could be used to determine the power output, which stopped them scoring the first 2 marking points. Most students who managed to link the two equations and describe how they should be used also knew that time should be in seconds, meaning that few students scored 3 marks.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.