GCSE
PHYSICS

8463/1F
Report on the Examination

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General

- It appeared that most students had sufficient time to complete this paper.
- Although some students left a lot of blank spaces, the vast majority attempted to answer most questions.
- The writing of some students was extremely difficult to read, which made marking their responses challenging, particularly in the longer questions.
- In the low demand calculation questions, the equation is given to students in the form they will need to use it. A large percentage of students were able to substitute the given values correctly into the given equation, and in most cases, to perform the calculation correctly.

Levels of demand

Questions are set at two levels of demand on this paper:

- **Low demand** questions are targeted at students working at grades 1–3
- **Standard demand** questions are targeted at students working at grades 4–5.

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 (low demand)

01.1 Approximately half the students scored both marks for correctly identifying that the cyclist's chemical energy store decreases and the kinetic energy increases. A further 30% scored one mark, usually for identifying the kinetic energy. A common mistake was to say that the gravitational potential energy store decreases.

01.2 Almost 90% of students scored the two marks for this question by substituting the given values into the given equation and correctly working it out. Many students showed the substitution of numbers into the equation before working out the answer. Some students were able to gain one mark by doing this, even though their subsequent calculation was incorrect.
The most common error was not realising that the speed value should be squared.
Kinetic energy = ½ x 80 x 12 was therefore an incorrect substitution into the equation and no marks could be awarded.

01.3 As in the previous question, most students scored two marks. A few students were able to score one mark for showing the correct substitution of numbers into the equation even though their subsequent calculation was incorrect. A common error amongst those who scored no marks was to convert the given mass into grams.

01.4 More than three quarters of students correctly identified that the internal energy of the particles in the brake pads would increase.

Question 2 (low demand)

02.1 Around 60% of students scored the mark for an answer of 0.08 s. A common incorrect answer was 0.09 s. This is the value on the time axis where the current levels off to 1.5 A.

02.2 Just over one quarter of the students gained this mark. Those who did so were able to answer in terms of the information given. Statements which gained credit, such as 'the current goes higher than the normal current of 1.5A' and 'the current goes too high' indicated that students were referring to the graph and other given data. Whilst it was clear that some students had the right idea, they referred to the large amount of 'electricity' or sometimes 'voltage', which did not gain the mark. Students who referred to 'a high temperature' did not gain credit, as this was not using the information given.

02.3 Nearly 90% of students scored the two marks for this calculation.
The most common error was to think that 24 V was the power, possibly because the question referred to a '24 V power supply'. Hence, some students tried to re-arrange the given equation; no marks were awarded because of the incorrect substitution and wrong answer. Another error seen a number of times was to subtract 1.5A from 24V and use the subsequent value as either power or potential difference.

02.4 Over 80% of students chose the correct statement. Of those who gave an incorrect answer, the most common choice was 'LED lamps have a higher power input than filament lamps'.

Question 3 (low demand)

03.1 Nearly 14% of students did not attempt this question. This could have been because they did not know the answer, or possibly because they didn't realise it was a question as there were no lines for writing an answer. Of those who made an attempt, around half were able to score one mark for drawing at least one cell using the correct symbol.
Some students copied the circuit diagram from the following question (Q3.2), but wrote 4.5 V across the battery symbol. They were awarded one mark for the cell symbol contained within it. A few others realised that they needed three cells to produce 4.5 V, but did not always draw them correctly arranged. Errors included connecting the cells in parallel, connecting in series but not joined together, or with one of them wrongly orientated.
Some students did not know the symbol for the cell and mistakenly thought the voltmeter or some other component was the cell, by indicating '1.5 V' next to it and drawing 3 of them.

03.2 This calculation was not as well answered as previous calculations because three quantities were shown on the diagram and students needed to choose the correct values for potential difference and current. Nearly two thirds of students were able to do this and arrive at the correct answer to score both marks.
Some students correctly worked out the resistance, but then added or subtracted the value of the given resistor. In this case, one mark was awarded for correct substitution into the equation.
Other errors involved calculations multiplying, dividing and / or adding two or more of the given values.

03.3 Less than half the students scored this mark. Most of these had arrived at the correct value in the previous question. Credit was also given to those students who had an incorrect value in the previous question but who correctly subtracted 3.5 Ω from it, unless a negative value resulted, in which case the mark was not awarded.
Some students decided that another complex calculation was needed to answer this question. It would benefit students to note the number of marks available, in this case only one, indicating that a complex calculation would not be required.
A common answer was 3.5 Ω, usually shown without working, or with a statement that the two resistors must be equal. Another commonly seen answer was 8.5 Ω, obtained by subtracting 3.5 Ω from 12 V.

03.4 Around one third of students chose the correct option that the resistance would decrease. However few of these were able to explain coherently why this was so.
Some students gave answers in terms of what would happen to the current, rather than the resistance. Such answers, having ticked the 'resistance will decrease box' then went on to contradict themselves by saying that this was because the resistance increased.

Question 4 (low demand)

04.1 The stem of the question referred to determining the density of the piece of rock; this was to set the context for the question. This part asked for a way of measuring the volume of the rock, but many students described the whole density experiment. Nevertheless, they were able to gain full marks if they described the volume measurement correctly.
A large number of students described measuring the length, width and height of the rock; no marks were given for this, as a piece of rock would not be a regular shape.
Students who described a displacement method were usually able to gain some marks. However, not all descriptions were detailed enough to lead to a valid outcome so were unable to score more than one or two marks. A common statement was 'see how much the water rises' without reference to volume. Another imprecise answer was 'collect the water that overflows', without specifying a suitable vessel to collect it in, or how to measure the volume of the water displaced.

04.2 Around 90% of students scored both marks for this calculation. Amongst those who did not score a mark, a fairly common mistake was thinking that the volume of 18.0 cm^3 meant 18^3.

04.3 Limestone was the type of rock whose density was closest in value to the calculated value of 2.7 g/cm^3. Although 90% of students obtained the correct value in the previous question, only 70% chose limestone here. Granite was the most popular incorrect choice.

04.4 This mark was only accessible to students who had described a displacement method. Many referred to the student mis-reading the measurement, which did not gain credit. Just under one fifth of students scored the mark, usually for referring to water not being up to the level of the spout of the eureka can or water splashing out of the measuring cylinder.

04.5 This was marked along with the previous question, so the effect on the volume measurement had to tie in with the source of error described. Approximately two thirds of those who scored the mark in the previous question were also able to score the mark here.

Question 5 (low demand)

05.1 Approximately three quarters of students scored the mark for identifying isotope B, with many scoring the second mark for stating that its atomic number was different to that of Americium. Incorrect reasons given stated that there were a different number of electrons or neutrons.

05.2 Around 84% of students scored this mark. The most common error was reading the scale on the x-axis incorrectly.

05.3 About one third of students realised that the value they had read from the graph in the previous question was, in fact, the half-life of the isotope.
A common error was to halve the value from the previous question. Another incorrect answer was 800 years (half of the final value on the x-axis).

Question 6 (low demand)

06.1 More than 90% of students were able to gain at least one mark, usually for identifying gamma rays as the radiation released. Around one quarter scored all three marks. Common incorrect answers were ‘a uranium neutron’ along with ‘absorbs a proton’.

06.2 Around two thirds of students scored both marks. The value obtained by dividing the given values was 10.4 and many students thought about the context of the question and realised that therefore 11 power stations would be needed. The main error was rounding down to 10, which allowed a further 20% of students to score one mark.
A few students multiplied the two numbers given to get an answer of 6×10^{13} power stations.

06.3 Only 6% of students scored both marks, with a further 25% scoring one mark. The most common correct answer was a reference to radioactive waste. Some referred to the potential for a catastrophic accident to score a mark.
Those who failed to score marks often referred to the waste as being ‘harmful’ without specifying why this was the case. Many students seem to think that ‘harmful radiation’ is given off all the time from a nuclear power station. There is also a common misconception, that nuclear power stations produce carbon dioxide.

06.4 Just under half of students scored both marks by stating the similarity as the increase in both carbon dioxide concentration and global temperature and the difference in the pattern after the year 2000.
A number of students failed to score marks because they selected spurious data, for example that they both graphs went from the year 1900 to past 2000 but had different numbers on the *y*-axis.

Question 7 (low and **standard** demand)

07.1 About two thirds of students correctly identified the circuit symbol for the fuse.

07.2 Over 90% of students scored both marks for this calculation.

07.3 Around two thirds of students knew this equation. Most students wrote it down in words. Credit was given for using symbols, but only if the correct symbols were used, ie *Q* for charge flow, *I* for current and *t* for time. Students should be made aware that writing the ‘equation triangle’ will not gain them credit.

07.4 About two thirds of students scored full marks for this calculation. The common mistakes made were either to multiply the given values, or to divide them incorrectly.

07.5 Almost 90% of students were able to select the correct equation and multiply the two values correctly. Common mistakes made were dividing the numbers, or attempting to convert the mass from kg to g.

Question 8 (low and standard demand)

08.1 Around two thirds of students correctly selected ‘higher’ for the rate of energy transfer through copper compared to that through other metals.

08.2 Some students stated incorrectly that the rate of energy transfer from an insulated hot water tank would be greater than from one without insulation. Nevertheless, around 90% of students scored the mark for realising that the water in the tank would stay warm for longer.

08.3 A large number of students did not take note of the instruction to use only information from the two graphs. Hence there were many answers relating to the water being cold at night time, or not being very hot if it was a cloudy day. Such answers gained no credit. Those who used the given information were usually able to score a mark for stating the disadvantage that the water takes until about mid-day to get to the same temperature as that produced by the immersion heater.

08.4 This question proved challenging for students, with nearly 10% not attempting an answer. Most students who made an attempt merely subtracted the two given values, rather than working out a proportion or percentage.

08.5 Around two thirds of students wrote down the equation in one of its correct forms. Credit was also given for writing the equation with the correct symbols. Students should be made aware that writing the ‘equation triangle’ will not gain them credit.

08.6 Most of the students who knew the equation were able to rearrange it correctly for time and calculate the correct answer of 814 seconds. Around half of students scored all four marks. In this calculation, students also had to provide the unit. Despite an answer in terms of time being asked for, J, W, J / W, m / s and others were seen.

Question 9 (low and standard demand)

09.1 Around 90% of students were able to calculate the power output of the motor correctly. Some students did not use the equation and simply multiplied the two numbers together.

09.2 Around 40% of students scored both marks, with a further 46% scoring one mark. A number of students ticked only one box, despite the clear instruction to tick two.

09.3 Some students struggled to express coherently that closing either of the switches would complete the circuit and allow the motor to work. Very few stated that the switches were in parallel and only 7% of students scored both marks. A number of students stated that one switch would make the lift go up and the other would make it go down, or that one switch was for outside the lift and one for inside; such answers were insufficient.

09.4 This equation was not as well known as the others which had been asked for in this paper, with nearly 60% of students scoring the mark. Quantities are listed in alphabetical order but it is not necessary to write the equation starting with the first quantity given - any correct rearrangement is sufficient to score the mark. In fact, many students began the equation with ‘gravitational field strength = ‘. Of these, many proceeded to multiply the other three quantities together. Those who started with ‘gravitational potential energy = ‘, the more familiar form of the equation, usually got the rest of the equation correct, scoring the mark.

09.5 Scoring marks on this question was dependent on the student knowing the equation for gravitational potential energy, asked for in the previous question. Of those who knew the equation in the correct form, many were able to correctly calculate an energy value of 38416 J. This answer was awarded two marks. Many students did not give the answer to two significant figures as requested, so did not score the third mark. Less than one quarter of students scored all three marks, with a further 36% scoring two marks. Of those who went on to the two significant figure stage, some wrote an answer of 38 instead of 38000.

Question 10 (standard demand)

10.1 This was the first of the questions that were common to the Higher tier paper. Although some good clear explanations were seen only 14% of students scored both marks. A common misconception was to think that positive charge, or protons, were being rubbed off the student's socks. A few students seemed to think that friction between the carpet and socks would produce 'heat', which would make the socks negatively charged.

10.2 This is a new topic to GCSE Physics, drawing the electric field pattern around a charged sphere. Nearly half of students scored a mark for drawing three additional arrows pointing inwards. From an accuracy point of view, if the three arrows were pointing towards the words in the centre of the sphere, the arrows were considered to be perpendicular to the surface. Some students only drew two arrows. A number of students answered incorrectly in terms of other electric or magnetic field patterns, with lines curving round from the top position to the bottom. 11% of students did not attempt this question.

10.3 Approximately 15% of students scored a mark on this question, with very few scoring more than one mark. A common misconception was that the tap was positively charged, so the positive tap and the negatively charged student would attract each other. Then 'electricity' or 'an electric shock' would pass between them. Very few answers referred to the charge or the electrons moving; when this was stated, the direction of transfer was either not mentioned or was thought to be going from the tap to the student. A small minority of answers referred to there being a potential difference, for instance 'the student has a potential difference'. However, they did not state that this was between the student and the tap, so did not gain credit.

010.4 Around one quarter of students scored a mark, usually for stating that copper was a good conductor of electricity. Some stated that the copper would absorb the electrons; this did not gain the mark. When students had the correct idea of the copper conducting the charge, few went on to state that therefore there would be less charge on the student.

Question 11 (standard demand)

011.1 Around 9% of students did not attempt this question. Others randomly multiplied or divided the figures given, with no logic to their method.
Many students did not know how to deal with the background count rate; some ignored it altogether, others added it to the measured count rate, some divided the measure count rate by the background count rate. However, around 13% were able to subtract it to score all three marks.
Some students did the calculation as a rate of per minute, scoring two marks for an answer of 801, but failing to change the answer line unit to 'per minute'.

011.2 Nearly three quarters of students answered correctly, scoring two marks. Some scored one mark for showing that they were multiplying the two numbers together, but then making a mistake in the calculation. Of the few who did not gain any credit, the common errors were dividing the two given numbers or converting the mass into grams. Around 8% of students did not attempt this question. Students should be reassured that marks are not deducted for incorrect answers, so it is worth them attempting a simple calculation such as multiplying the two values given.

011.3 Around three quarters of students calculated the yearly dose from the granite worktop correctly, thus scoring one mark. Some ignored the values of dose per day and the number of days in a year which were given.
Around one quarter of students went on to compare their value to the lowest dose with evidence of causing cancer to explain why the householder need not be concerned, scoring the second mark. Some students failed to score this mark because they did not use information from the table.
Some related their calculated value to the average yearly radiation dose, which was insufficient, or calculated how many years they would need to be exposed to the worktop to suffer harm, which was also insufficient.
A few answers were seen where the yearly dose was calculated as 1 095 mSv (instead of 1.095 mSv). Students then went on to say that this would only cause radiation sickness, so the householder did not need to be concerned as it was unlikely to cause death.

011.4 Around 8% of students scored the mark for this question.
Answers generally fell into one of several categories. One category involved an answer along the lines of the public needing to limit their intake of bananas because of the radiation which bananas emit.
Another category gave the idea that the public would become aware that radiation was given off by everyday objects such as bananas.
Another category included answers which stated that everyone knows what a banana is.
The mark was awarded for answers indicating that it would be more meaningful to compare a certain dose of radiation with the number of bananas which would give the same dose.
Unfortunately, some students who had the correct idea were often unable to express this idea clearly enough to gain credit.

Question 12 (standard demand)

12.1 Many students re-drew the circuit with the addition of the voltmeter and ammeter in the space below the question. Normally, ammeter and voltmeter symbols should not have a line drawn through the centre but this was ignored if students had added them to the existing diagram.
Nearly three quarters of students were able to score two or three marks. Almost all of the answers showed the correct circuit symbols for the ammeter and voltmeter, although a few had the letters A and V within square boxes. The vast majority were able to position the ammeter correctly in the series circuit. The most common error was to show the voltmeter in series.

12.2 Most students had some idea of how to perform this investigation, but generally did not include the details which would lead to a valid outcome. The three quantities that needed to be measured to ensure a valid outcome were length, potential difference and current. In addition to this, to reach Level 3, students needed to state how the resistance would be calculated and include an appropriate hazard. Just over 2% of students matched these criteria to score five or six marks.
The criteria for Level 2 still required the method to lead to a valid outcome, so measurement of length, potential difference and current were still needed. A further 18% of students fell into this category, scoring three or four marks.
Students who did not meet these criteria were able to score one or two marks for making some relevant points. A common response was ‘measure its resistance’ without giving details of how this would be done. Other students described taking ammeter and voltmeter readings, without referring to current and potential difference, but did not mention changing the length.
Many realised that the wire could get hot, which would be a hazard, but there were a number of responses which referred to ‘electrocution’ and ‘electric shock’; this was judged to be insufficient for a hazard as low voltage supplies are likely to be used.

12.3 Nearly 40% of students gave the correct answer that the temperature of the wire would not change.

12.4 Around one third of students scored both marks, with a further 45% scoring one mark.

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.