GCSE
COMBINED SCIENCE: TRILOGY

8464/P/1H: Paper 1 Physics (Higher)
Report on the Examination

8464
June 2022

Version: 1.0

General

Overall, the vast majority of students were able to make an attempt at every question on the paper, with almost all students showing some attempt at even the most demanding question parts.

In calculations there seemed to be far fewer students this year who were doing calculations without a calculator.

The handwriting of numbers was far more ambiguous than in previous years, with fours that look like sevens, sevens that look like fours or like nines, ones that look like sevens, threes that look like fives, zeros that look like sixes and many other variations. In most cases it was possible to work out what number was intended by looking at handwriting elsewhere in the exam paper.

Levels of demand

Questions were set at three levels of demand on this paper:

- **standard demand** questions were targeted at students working at grades 4-5
- **standard/high demand** questions were targeted at students working at grades 6-7
- **high demand questions** were targeted at students working at grades 8-9.

A student's final grade 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 01 (Standard demand)

01.1 Just under half the students gained all three marks on this question, with just over 40% failing to score any marks.

Errors were made reading the graph, with a fair number of students misreading the scale to obtain an incorrect peak value for gas, leading to a maximum mark of 2 on this question. It was common for students to think that the peak value of demand was the maximum value on the y-axis, which prevented any marks from being scored. Some students tried to determine the peak demand by adding the total supply and demand at 6 pm, which resulted in no marks being awarded. A small proportion of students gave an answer greater than 100%.

01.2 Nearly 70% of the students chose the correct energy resources.

01.3 Just over six in ten students recalled the name of the national grid.

Many students thought that the question was referring to a Wi-Fi signal, a mobile phone signal, or the internet. In many cases this led them to try to answer question **01.4** by also writing about mobile phone networks or Wi-Fi signals, which they were unable to do successfully. Some students gave answers such as national power grid, or national electricity grid, which did gain the mark.

01.4 About 10% of students gained all three marks on this question, with approximately 15% gaining two marks, and around a fifth of students gaining just one mark.

The most commonly awarded mark was for identifying that the potential difference is increased by a step-up transformer. However, there was a clear misconception among many students that greater efficiency referred to increased rate of delivery of electricity. It was not uncommon for students to suggest that a step-up transformer increases the speed of the current so that electricity can get to consumers more quickly, for example. Some students thought that a step-up transformer physically lifted the cables up above the ground. It was reasonably common for students to suggest that step-up transformers were positioned high above the ground to ensure better network coverage, or that they give a better signal with fewer connection issues, which seemed to correspond with responses to question **01.3** about mobile phone networks or Wi-Fi networks.

Question 02 (Standard demand)

02.1 Almost all students gained some marks on this question, with about half of students accessing level 2 of the mark scheme and gaining 3 or 4 marks. Just over 15% of students gave answers which scored in level 3.

It was clear that a lot of students were not aware of what a top pan balance is, with many thinking that it is a device to help prevent things from falling over, or that the pan of the top pan balance was to be used for heating the oil. As a consequence of this misunderstanding, many students placed the top pan balance on the heater. Of the students who did know what a top pan balance is, a sizeable minority thought that it is used to find the weight of oil, rather than the mass of oil.

While most students realised that the thermometer should be used to measure temperature, some students measured the heat with the thermometer, which was worth no credit.

The joulemeter was often confused with a voltmeter, or students did not appreciate the function of a joulemeter. Common suggestions included setting the joulemeter to 10 and leaving it for a fixed time, for example.

A lot of students did not mention the measuring equipment at all, and simply stated that they would weigh the oil and measure its temperature. Students who did this were unable to access level 3 on the mark scheme, but could gain some credit for these statements.

Some students described the use of a voltmeter, ammeter, and stopclock to determine the energy supplied to the heater. Although a method determining specific heat capacity of oil using this equipment would lead to a valid outcome, this did not use the equipment given in the question, so would not be able to score all 6 marks.

Many students described the wrong experiment, either finding the boiling point of the oil, carrying out a cooling-curve experiment, or describing how to use an immersion heater to find the specific heat capacity of a block of metal. These responses could still gain some credit, for example by correctly stating how to use the thermometer.

02.2 Approximately 60% of students could identify the risk when using the given equipment.

It was clear that many students were unable to distinguish between risks, hazards, and precautions. Some students did not talk about safety at all, instead suggesting that a risk might be inaccurate results, for example.

02.3 As students were given an equation sheet for this exam, almost 100% of students gave the correct equation.

02.4 Nearly 90% of students gained full marks on this question, with just over 5% of students scoring 0 marks.

02.5 Only about a fifth of students recognised that the electrical component whose resistance decreases as temperature increases is a thermistor.

02.6 Just over 40% of students gained both marks, with around a quarter gaining one mark on this question.

Some students misread the temperature scale, deciding that the maximum temperature reached was 152 °C or 170 °C, for example. Some students thought that the relevant temperature was the change in temperature of 140 °C. Of those students who correctly read 160 °C from figure 4, but did not then use figure 3, many decided to divide the temperature by a time read from the graph, or tried to use the equation $R = V / I$ or $P = I^2 R$. Some students used their temperature with the maximum resistance of 1000 Ω shown on figure 3.

Students who read 160 °C on figure 3 and decided that this was the resistance of the resistor by writing 160 on the answer line gained no marks.

02.7 Just under 40% of students chose the correct answer to why this was a physical change.

Question 03 (Standard and standard/high demand)

03.1 Many students struggled with this question, which revealed a number of misconceptions held by students. Around 70% of students gained at least one mark, but very few managed to score all 4 marks.

Many students began by describing energy changes as the child moved from the trampoline to the maximum height. This was ignored, and most of these responses went on to describe what happened as the child then fell downwards.

A lot of students described the forces acting on the child, which did not answer the question, and it was reasonably common to see descriptions of gravitational potential energy being a force which acts on the child. The concept of energy stores continues to be widely misunderstood by students, with some students making statements suggesting that there is a gravitational potential energy store when the child is in the air, for example. Lots of responses to the question described a transfer of gravitational potential energy to kinetic energy as the child descended, which gained the first marking point. Very few students realised that the kinetic energy of the child would decrease after landing on the trampoline.

For the springs, it was common to read descriptions of the springs stretching, rather than descriptions of changes to energy stores. Some students identified that the elastic potential energy of the springs would increase, but added that the chemical energy of the springs would decrease, and therefore did not gain the mark. A fair number of students made statements that elastic energy was used to stretch the springs, which was not credit-worthy.

For the surroundings, a lot of students stated that there was no change to the energy stores, and a lot of students described an increase in sound energy. This is not a store of energy, and was ignored. A fair proportion of students did identify that energy would be dissipated to the surroundings, thus gaining the mark.

03.2 This calculation proved to be very challenging, with nearly three quarters of all students failing to gain any marks.

A lot of students calculated the difference between the energies at positions A and B, which is incorrect physics so was unable to gain credit. A lot of students substituted 0.056 m in for the spring constant in position A, and some students forgot to square the extension when using the elastic energy equation.

Students who realised that they needed to use the value of elastic potential energy at position A to calculate the spring constant, tended to do very well in this question, with nearly two thirds of those who gained any credit scoring all 5 marks. A few students arrived at the correct final answer, but then subtracted the original extension to find the change in extension, an approach which scored a maximum of 4 marks.

03.3 Over 60% of students selected the correct definition of work done.

Question 04 (Standard, standard/high and high demand)

04.1 Just over half the students could convert this correctly.

04.2 Very few students were able to calculate the uncertainty, with just over 15% gaining both marks.

Many students simply calculated the mean, but if they then demonstrated that they thought the mean is the same as the uncertainty by writing this value on the answer line, they gained no credit. Some students gave the uncertainty as 3, rather than 0.003, but could still gain 1 mark if relevant working had been shown. Some students mixed up the two possible methods and calculated mean divided by two, rather than range divided by two.

04.3 Almost no students were able to identify that the graph shows a linear relationship. A lot of answers described the trend as directly proportional, and there were also many qualitative descriptions such as pressure increases evenly with temperature, which were insufficient to gain the mark. Some students gave an explanation of the relationship, which did not answer the question.

04.4 Slightly more than 55% of students gained some credit on this question, but it was uncommon for students to gain 4 or 5 marks.

A lot of answers did not refer to particles at all, and therefore gained no marks, but students who referred to atoms or molecules instead of particles could still gain full marks. Many answers wrote about successful collisions, which did not prevent them from gaining marks, but demonstrated a misunderstanding of the cause of pressure in gases. A large number of students did not state what collisions were between, or stated that the collisions were between particles in the steam.

Some students referred to an increased number of collisions, but did not indicate that this was in a fixed time period, or did not mention frequency of collisions, so did not gain marking point 4.

Few students identified that collisions at higher temperatures would cause a greater force, or that the number of particles in the steam would increase as the water boiled.

04.5 Only about a third of students gained any marks on this question, with most of these only gaining one mark.

The most commonly awarded mark was for the idea of particles spreading out. Most students gave vague descriptions of particles moving into a larger space or larger area, where they needed to be describing a volume to give an explanation of the density change. Some students stated that the steam would cool and condense, so the particles would move closer together, but the question clearly stated that the steam would expand as it moved into the atmosphere so this gained no credit. A few students stated that particles were less likely to collide, demonstrating a confusion between density and pressure.

Some students described a change in density of the gas remaining in the pressure cooker. This did give the opportunity to describe the correct physics involved, and could lead to full credit being awarded.

Question 05 (Standard/high and high demand)

05.1 Most students were unable to answer this question correctly, with only about 10% of students gaining any marks, and less than 5% gaining both marks.

Common suggestions which would not work included moving the LED closer to the battery, swapping the voltmeter and ammeter, moving the resistor, removing the resistor, reducing the resistance of the resistor, or placing the resistor after the LED.

05.2 Around a fifth of students gained full marks on this question, with a third of students gaining 4 marks.

Although the simplest way to calculate the answer was to use $P = VI$, a significant minority of students decided that a 5-mark calculation needed two equations to arrive at the correct answer. This was possible, by using $P = I^2R$ and then $V = IR$, an approach which could gain full marks. However, most students who attempted this alternative route neglected to convert mA to A.

05.3 Around 15% of students chose the correct description.

05.4 This extended calculation was answered well, with around 45% of students gaining all 6 marks. Just under 10% of students gained 3 marks, and about 35% gaining no marks.

Question 06 (Standard/high and high demand)

06.1 Nearly two thirds of students gained some credit on this question, but only about one in ten students scored both marks.

Most students correctly contrasted the penetrating ability of alpha and beta radiation. There was some confusion evident between contamination and radiation in many answers. Some students suggested that beta radiation would have a chemical reaction with smoke, causing the smoke detector not to work.

06.2 Just over 40% of students gained both marks for determining the nucleon and proton numbers.

06.3 Approximately 50% of students gained some marks on this question, with most of them gaining 2 marks. Very few students gained 3 or 4 marks.

The concept of there being two different types of radiation being emitted by the same source proved to be very difficult for students. Most answers which gained two marks identified that some of the radiation passed through paper, and it was all stopped by aluminium, and therefore beta radiation must be present. It was far less common for students to recognise that most of the radiation was stopped by paper, and to then suggest that alpha radiation must be present.

A fair number of students suggested that the radiation that was transmitted through the paper and stopped by aluminium would be alpha radiation. These students still gained marking point 3, despite drawing an incorrect conclusion from the data.

Many student responses recited facts that students had learned about the different types of nuclear radiation, but failed to apply it to this situation. Stating that alpha radiation is stopped by paper, beta by aluminium, and gamma stopped by lead, for example, was not sufficient to gain any marks.

Some students demonstrated confusion about nuclear radiation, with statements that paper was emitted by alpha radiation, or that alpha radiation was emitted by paper, being suggested by a small proportion of students.

06.4 Just under 10% of students gained some credit on this question, with about half of these gaining more than one mark.

Most students did not attempt to determine the half lives of the four isotopes, and answers based on gradients of each line, the change in activity of each isotope or comparisons of the initial activity of each sample led to incorrect orders of stability, so gained no marks.

Mark Ranges and Award of Grades

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