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General Certificate of Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Report on the Examination

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Additional Science / Physics
Higher Tier PHY2H

General

All questions on the paper were attempted by most candidates suggesting that there was sufficient time to complete the paper.

As in previous years many candidates did not realise that the correct answers to numerical questions are realistic. For example, candidates who obtained an answer to Q6(a)(i) in excess of one million amps should have realised that they had made a mistake and needed to go back and check both the method and the working out. Many candidates still seem happy to accept whatever number is displayed on a calculator without thinking about it. The instruction ‘show clearly how you work out your answer’ is intended to allow candidates that make a numerical error to gain credit for a correct method. Candidates that write ‘I did it in my head’, show no working out and arrive at a wrong answer need to understand that they will gain no marks.

Question 1 (Standard Demand)

(a) Most candidates scored both marks. However some candidates indicated they were not really understanding the question by putting ‘-1’ for relative mass.

(b) Few candidates scored both marks. Most scored one mark for suggesting that the charges cancelled but few mentioned that the numbers of electrons and protons was the same.

(c) (i) The majority of candidates did not know the correct answer and tended to state that there were ‘different numbers of protons or/and neutrons’

(ii) Almost half of the candidates scored this mark. Popular incorrect answers included ‘nucleus’ and ‘alpha particle’

(iii) Most candidates scored this mark. The candidates who did not, often cited chemical processes such as diffusion, electrolysis, cracking or the Haber process.

Question 2 (Standard Demand)

(a) (i) The majority of candidates knew that the ruler became negatively charged because it had 'gained electrons'.

(ii) Most candidates were able to describe a method of showing that the ruler was charged: either exerting a force on another ruler or the rubbing cloth, or observing the effect of holding it near paper, hair, water or an electroscope. Worryingly, a significant minority of candidates wrote about the effect on magnets, paper clips or iron filings. A number of candidates suggested marking the ruler in the diagram with ‘-‘ signs.

(b) (i) Most candidates gained at least one mark for either describing plastic as an insulator or explaining that the charge would remain on the person; many candidates gained both marks. Some candidates, however, failed to relate the use of the plastic sheet to the investigation in the question and wrote that the person would avoid getting a shock. A few candidates seemed confused about the meaning of 'earthing' and wrote about the plastic sheet absorbing the charge.

(ii) This was well understood with most candidates able to convey the idea that the type of clothing could affect the results of the investigation or that it was a factor that needed to be controlled.

(iii) Candidates usually gained this mark by explaining that the results were precise enough to see the pattern or to compare the materials; many simply pointed out that there was a wide range of values. A few candidates made the point that the results were further apart than 0.1kV from each other or from the shock line. However the majority of candidates scored no credit as they merely stated that the results were all much greater than 0.1kV.

(iv) Many candidates wrote responses that were lengthy but lacking clarity. Many candidates correctly described that the material most commonly used was most likely to shock but few went on to clearly describe how changing the material to one that reduced the p.d. would reduce the chance of being shocked. Instead, candidates wrote of how customers getting shocked would be dangerous (for example, sparks causing explosions) or uncomfortable and undesirable.

Question 3 (Standard Demand)

(a) This was well answered, the favourite wrong answers were: gravitational potential energy and mass.

(b) (i) In general physics terms the idea of balanced and unbalanced forces seemed to be quite well understood. However candidates often missed the first mark by talking about gravity / weight/ L accelerating the ball-bearing with no reference to Force M. The idea that Force M increases with the speed of the ball-bearing was understood. A few candidates said that L reduced with time. Too many candidates lost the last mark by stating "the forces **start** to balance / equal out / equal without stating that when the ball falls at constant speed, Force L = Force M. A reasonable number of better answers talked about zero resultant force. These better responses often included correct statements about the *resultant* force at the various stages in the fall, as well as higher level descriptions of how the acceleration starts off large and reduces to zero.

(ii) Surprisingly only just over half the candidates could give the correct answer. A frequent incorrect response was 'optimum speed'.

(iii) There were many well presented calculations using data correctly drawn from the graph. Most wrong answers were due to candidates not realising the need to use the straight line part of the graph. A smaller number of candidates obtained a wrong answer because they took values from a single point on the graph. Too few candidates (even when giving the correct answer) showed how they obtained the values used. Quite a number of candidates failed to read the scale on the graph correctly and subsequently calculated the wrong answer.

Question 4 (High Demand)

(a) (i) The calculation was well done with most candidates obtaining 210. However, only half of those obtaining this correct answer were also able to give the correct unit.

(ii) Most candidates who scored 2 or 3 marks for part (a)(i) obtained the correct answer. Those who did not tended to multiply 210 by 0.25 instead of dividing. A number of candidates subtracted 6 or 35 from 210 before dividing by 0.25 thereby losing both marks.

(b) This was either done very well or very poorly. It was not always clear that the rubber tile increased the time to stop and some candidates went straight to the second marking point i.e. increases the time for the change in momentum. Occasionally when a poor answer was written the candidate managed to salvage a mark by finishing with 'the force is reduced'. A lot of candidates mentioned 'air gaps' and 'bouncing/cushion effect,' gaining no credit.

(c) The answers were very variable. Many were very vague and referred to accuracy rather than reliability or human error rather than anomalies. The range of thicknesses being insufficient was seldom referred to.

(d) This was generally done well; a few candidates just mentioned recycling without explanation and gained no credit. The most popular answers concerned either burning or use of land-fills, a few candidates mentioned deforestation of rubber trees but these were not penalised!

Question 5 (High Demand)

(a) Most candidates were able to use the given equation but not always to obtain the correct answer. Common errors included: trying to calculate the change in kinetic energy by subtracting the velocities (18 -3) and using this value to calculate the KE, arriving at 33750 as their answer and gaining 1 mark. Many candidates simply used one or other of the velocity figures given and calculated a KE value from that, arriving at answers of 1350 and 4860 for the lower and higher velocities, respectively, again gaining 1 mark.

(b) (i) Few candidates were able to make the correct link between their answer for part (a) and the answer to part (b).

(ii) Most candidates stated that the energy is transformed into heat. However a number of candidates gave vague answers such as 'transformed into other types of energy' and gained no credit. Some candidates failed to make the distinction between energy and force, arriving at an answer of friction.

Question 6 (High Demand)

(a) (i) Many candidates were able to transform the given equation, substitute numbers and use their calculators, but very few spotted that they had to convert kΩ to ohms. Many candidates that attempted a conversion evidently did not know how to do it. A significant number of candidates multiplied the two numbers giving an unrealistically high value for their answer.

(ii) Most candidates failed to gain any credit because their answers were in terms of insulation and not resistance. Most did not appreciate that good insulators are not perfect insulators. Many of the candidates erroneously thought that being a good insulator meant that the electrician was earthed and the boots provided a safe path to earth. Some candidates referred to rubber gloves and not boots. Very few candidates recognised that a current would flow but that, as it was very small, the shock received might not even be felt.

A significant minority of candidates had not related the introduction to the whole question to this part and wrote about the danger of the electrician standing on the wires.

(b) (i) Surprisingly only half the candidates knew the answer to this question. The most common error was stating a voltage (230V) or a totally incorrect frequency, 100 Hz was a popular number.

(ii) This was very poorly answered as most candidates struggled to interpret the graph and those that did often contradicted their reason by choosing 'yes' instead of 'no'. This question required very clear thinking giving the potential A* students a chance to earn the mark.

(c) This question was very poorly answered. The function of the earth wire, and its link to a melting fuse, was poorly understood. Various misconceptions surfaced such as the fuse being connected to the earth wire and the kettle holding charge (as on a Van der Graaff generator). Many candidates regurgitated stock phrases from textbooks, revision books

and the specification about the earth wire and fuse, but did not relate this to the context of the question.

Mark Ranges and Award of Grades
Grade boundaries and cumulative percentage grades are available on the **Results statistics** page of the AQA Website.