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General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Report on the Examination

2011 Examination – June series

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Additional Science / Physics
Higher Tier PHY2H

General

Questions 1, 2 and 3 were standard demand, targeting grades C and D. Questions 4, 5, 6 and 7 were high demand, targeting grades A* to B.
Candidates were able to access all questions with very few items not attempted by all candidates. There was no evidence of candidates being unable to complete the paper in the time allocation. The vast majority of questions were well answered by the better candidates. Mathematical questions remain a strength for many candidates, although those equations requiring rearrangement posed more difficulty, perhaps where a candidate was less suitably entered for the higher tier. There was evidence of a significant proportion of candidates not having access to a calculator, and attempts at long division and long multiplication were often unsuccessful. Those candidates who show workings clearly were much more likely to score compensation marks in mathematical questions. Quite a sizeable number of candidates had an almost illegible writing style or failed to use a dark-inked pen.

Question 1 *(Standard Demand)*

(a) Only two thirds of candidates were able to answer this correctly.

(b) Fewer than half of the candidates explained that the casing was plastic or an electrical insulator. Some candidates narrowly missed the mark because they were imprecise: 'it is plastic' does not sufficiently identify the casing as the significant part. Those who scored zero often realised that safety was the issue but referred to another feature of the hairdryer, giving answers such as: 'it has switches to control it', 'the plug already has an earth', 'the fuse would blow' and 'the fan keeps it cool'. A smaller number of candidates had little understanding of the physics, offering suggestions such as 'the person's body earths it' and 'it is plastic so it is already earthed'.

(c) (i) Nearly all candidates correctly answered the first part and just under three quarters of candidates went on to score the second mark. Those who missed the second mark usually chose all three switches or just S_3 on its own. A small, but surprising number chose S_1 and S_2, perhaps because they did not look carefully enough at the diagram to see that S_3 is the switch next to heater 2.

(c) (ii) A third of candidates gave a clear explanation of how the circuit worked and gained both marks. Almost half of all candidates gained no credit. Often this was because they did not refer to the electrical circuit and instead only explained the purpose of the fan being on when the heaters are on, eg to prevent overheating. Those who did answer in terms of the circuit sometimes made incorrect statements such as 'the current goes through the fan and then to the heaters'. About a fifth of candidates showed some understanding of the electrical circuit but did not clearly identify S_1 as the key factor, or referred to S_1 in an ambiguous way.

(d) Over half the candidates completed the calculation successfully to gain two marks. Of these, half gave the right unit to gain full marks for the question, but the others stated an incorrect unit or gave no unit. There was a wide variety of incorrect units, with J and A being the favourites. A few candidates lost the unit mark because their symbol for watts was clearly a lower case w and not W. It was disappointing that a quarter of the candidates failed to score any mark, either for the calculation or for the unit.

This is surprising from a Higher Tier cohort, given that the equation was stated and no transformation was needed.

Question 2 *(Standard Demand)*

(a) Nearly four fifths of candidates answered this correctly. Most incorrect responses involved adding the two distances together and then multiplying by the force. Some candidates lost marks by changing the units for length from metres to cm/mm.

(b) (i) A large number of candidates used free hand straight lines rather than using a ruler; this led to candidates losing marks as their lines were made to go through too many of the points and looked like a wavy curve. The term, line of best fit, is still misunderstood and misapplied by some candidates, many of whom tried to include the origin in their line, apparently not considering the physics behind the graph. Even the straight lines were often poor, with far too many points on one side of the line, or a straight line connecting the first and last point.

(b) (ii) Nearly all candidates scored this mark, correctly writing a statement of the relationship between the two variables, as angle of slope increases, so does force. The candidates who did not score mentioned the phrase 'proportional' or 'directly proportional', which negated the answer. Candidates need to be instructed on the difference between positive correlation and direct proportion for future exams.

(b) (iii) Just over half of candidates scored both marks reasoning that the long plank meant a smaller angle, hence a smaller force. Some candidates negated the second mark by stating less work was done, when in fact more work is done with a longer ramp. Most candidates who scored one mark missed out the fact that the longer plank meant a smaller angle, jumping straight to the lower force idea. A significant minority didn't realise that a long plank gave a smaller angle to the ground and hence struggled to relate the experiment to the builder's task. A minority of candidates opted for short plank, some incorrectly using the justification for the longer plank. Most who successfully opted for the short plank correctly identified less work done by appreciating the smaller distance involved, but few also mentioned the larger force needed to lift the wheelbarrow.

Question 3 *(Standard Demand)*

(a) Nearly three quarters of candidates scored both marks and a further fifth of candidates scored one mark.

(b) Nearly two fifths of the candidates gained this mark, with 'amount' being an alternative to 'number'. Many of the incorrect answers were of the type 'electrons cancel out the protons', 'the negatives cancel out the positives', and neutrons were often mentioned instead of either protons or electrons.

(c) Over half of candidates gained this mark.

(d) Just under two thirds of candidates gained this mark by mentioning either the losing or gaining of electron(s). Many candidates made reference to the outside shell becoming complete as a result; some went too far and were confused with the sharing of electrons as in covalent bonding.

A few candidates made the mistake of 'electrons are lost so leaving a negative charge' and as in part (b), some candidates talked about neutrons or protons being lost/gained instead of electrons.

Question 4 *(High Demand)*

Just over a quarter of candidates gained full marks by either commenting on the mass number and atomic number or identifying the neutron decaying to a proton and electron. A number of candidates wrongly thought the proton number decreased and confused the atomic number with the mass number, although a further fifth of candidates were able to gain two marks. A further quarter of candidates scored one mark for correctly identifying beta, without being able to explain why. A number of candidates incorrectly identified the radiation but then went on to give a correct explanation for beta radiation.

Question 5 *(High Demand)*

(a) Nearly three quarters of candidates calculated the correct answer and scored both marks. The most common incorrect answers were where candidates had used distance = speed x time with incorrect figures, usually 8 x 10, or had arrived at an answer by dividing numbers, eg 8/6 or 10/8, showing failure to understand graphical representation of motion, including the idea of distance travelled being area under graph.

(b) Even those candidates who scored two marks in part (a) often lost marks here, with only two fifths of candidates gaining both marks. There were many incorrect permutations of graphs - some repeated the graph from part (a) either at the same or different values, some had a diagonal line up and then down, many had a correct shape but at incorrect values of time and distance (45 was a common wrong value) or just a diagonal line to t = 10 s. Just over a further tenth of candidates scored one mark, usually for the first half of the graph. Very few candidates failed to attempt this part question.

Question 6 *(High Demand)*

(a) (i) Only about a fifth of candidates scored full marks, with a further two fifths of candidates scoring one mark, usually losing the mark for the misplacing of the voltmeter. Scripts with higher marks usually had candidates drawing the circuits with the use of a ruler. Perhaps using a ruler indicated they would be careful when drawing the components. The most common error was joining both the ammeter and voltmeter in series suggesting a lack of practical experience. Others placed the voltmeter across the wrong component or even across a lead, and some lost marks for careless diagrams, notably lines drawn through meters and gaps in the circuit.

(a) (ii) Just over half the candidates scored this mark. Many candidates believe that it is the **value** of d.c. which does not change, and many responses appeared based on the appearance of a.c. and d.c. on an oscilloscope. Another common incorrect response referred to d.c. going straight to the component.

(b) (i) Approximately three quarters of candidates completed the calculation correctly. Weaker candidates struggled to transform the equation.

(b) (ii) The relationship between current and resistance is, generally, well understood and four fifths of candidates scored this mark. Weaker candidates often used inappropriate language; the use of 'stronger' resistance was one such example.

Candidates would benefit by using the stem to help their wording; if the word decrease is used in the stem it makes sense to respond with the word *increase* and not seek synonyms which are less appropriate.

(b) (iii) Many candidates realised that elastic energy is stored but under half of candidates gained the mark since many failed to include the word *potential* in their answer. The wrong answers often referred to kinetic energy.

Question 7 *(High Demand)*

(a) Many candidates obtained the correct answer having correctly calculated the resultant force as 1155 N. Correct calculation of the force 1155 N then multiplying by the mass of 275 kg was a common error gaining just one mark. The use of an incorrect force with the correct method, gained many candidates one compensatory mark.

(b) (i) Many candidates failed to understand that the question was referring to the validity of the data with many answers given in the form of a conclusion rather than answering the question about valid data. Those candidates who realised the question was about the data, answered mainly in terms of the reliability of police files (YES) or on the lack of information about ages (NO). Many candidates quoted the number of files in the source, but as they failed to express whether this was a large or a small sample, failed to score a mark for this. There was also evidence of much rewriting of answers, mostly to little or no advantage.

(b) (ii) Just over half of candidates gained one mark for describing how the smaller motorbikes had more accidents and a small minority of candidates went on to note how there were fewer smaller bikes than larger bikes, or calculated ratios.

(c) (i) Very few candidates gained full marks on this question, in spite of it being a well examined aspect of the course. A change in context does disguise what is needed to all but the highest scoring candidates, in spite of the stem referring to momentum. Over half of candidates scored zero. The quality of the explanation was often poor. There are still a large number of answers referring to cushioning the impact rather than reducing the force. The 'decreases rate of change of momentum' is the most frequently missed mark. A number of candidates confused their response with references to kinetic energy and stopping distances.

(c) (ii) Most candidates gave the answer that the new safety barriers would save lives, or reduce injuries, which gained the mark. Those who thought that 17 m/s was too slow to crash or cause serious injury had confused the unit with mph. 'Money could be better spent' was rarely a complete answer and so did not score a mark very often.

Mark Ranges and Award of Grades

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

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