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General Certificate of Education

Physics 5451/6451

Specification A

PHA3/W Current Electricity and Elastic Properties of Solids

Report on the Examination

2007 examination - January series

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General Comments

All five questions on the paper proved to be very accessible to candidates and all marking points were awarded. Many candidates scored more than 40 marks, with some attaining the maximum of 50. At the other end of the scale, very few candidates scored less than 10 marks. Once again, examiners expressed concern over the large number of candidates incurring a significant error penalty. Additionally, this year there appeared to be a large increase in the number of unit errors, the nature of the paper making it possible for candidates to lose a mark in each question; marks which many of them could ill afford to lose. As usual, the Quality of Written Communication marks varied between awarding maximum marks for exemplary accounts to not awarding any marks for very poor, badly written accounts containing hardly any punctuation and numerous miss spelt words.

Question 1

Candidates seem to be comfortable with an analysis of resistor networks, and although the answer was not given in the stem this year, a very large majority of candidates correctly analysed the circuit in part (a) and obtained the correct value for the equivalent resistance. However, a significant number, still persist in attempting the calculation of the equivalent value from one involved equation, and although the equation itself is correct the calculation, invariably contains an error.

The calculations in part (b) were, in general, done quite well. The usual error in part (i) was writing 50 mA as 50×10^{-6} A. In part (ii), there was a high incidence of the use of the expression $^1/_2QV$ as the energy in the system. Candidates who used this equation lost both marks allocated to that calculation. Part (iv) also gave rise to the use of a wrong equation, namely $\epsilon = I(R+r)$. If it was not obvious that r = 0, then the mark was not given.

Question 2

Calculations on the potentiometer circuit in part (a) were invariably correct and candidates showed that they were very familiar with this type of analysis. The majority of candidates also gave the correct assumption, namely that there was no current in the voltmeter or that the resistance of the voltmeter was either very high or infinitely high.

Part (b) produced disappointing accounts. This type of question, where candidates have to deduce logically what occurs in a circuit, has been set for several years and there is really no excuse for the poor answers obtained. Far too many candidates merely reiterated what was given in the stem concerning the resistance of the thermistor, and then stated that the current increased, without any mention of the parallel section of the circuit and the effect on the resistance of the whole circuit, or that the emf remained constant.

Question 3

Descriptive answers to the required experiment in part (a) were most often an inconsistent list of facts which the candidate carried around their head, and which were given with no attempt to marshal the facts according to the requirements of parts (i) and (ii). In part (a), almost invariably it was stated that the diameter of the wire had to be measured, although the question stated quite clearly that the cross-sectional area of the wire was known. The majority of candidates did realise that the length of wire across which V was measured had to vary. In part (ii), although most candidates worked with a graph of R vs. l, there were far too many candidates who required a graph of V vs. I, having missed the point that the current remained constant, irrespective of the length of wire.

Visualising the carbon-reinforced plastic in part (b) caused great difficulty to a very large number of candidates, and the common error was not recognising that the length of the sample through which the current passed was 1.1 mm; a very large number had it as 90 mm. Units of resistivity were generally known well.

Question 4

Part (a) produced some very good answers and most candidates were able to score quite well on this section. The usual error came in part (ii) where candidates were unable to explain why the voltage across the oscilloscope dropped. Most were aware that it had something to do with internal resistance, but omitted the fact that a current now passed through the circuit, thereby producing a pd across the internal resistance.

Answers to part (b) were also thought out well and all three marks were usually awarded. A significant number of candidates however had obviously never seen an oscilloscope trace with the time base switched off and consequently drew an ac wave on the screen.

Question 5

Drawing the graph in part (a) produced good marks but it was surprising how infrequently the full five marks were awarded. Loss of marks was due to poor scales, not including the zero point in the graph (often the only error), poorly drawn straight lines (a ruler should have been used for the unloading graph at least), and not drawing a straight line through the first five points of the loading curve, but including the next point in a best fit straight line. It always surprises the examiners that when it was fairly obvious that the graph was a straight line, that candidates did not check a point which had been incorrectly plotted, but instead assumed that the point was way off the line.

Describing, in part (b), the behaviour of the wire was something that candidates were competent at, and it was unusual for the three marks not to be awarded. There was some slackness regarding terms such as limit of proportionality and elastic limit; yield point also appeared regularly. The downloading graph was competently described and almost all candidates realised that the wire had extended permanently by the end of the experiment.

The calculations in part (c) were, on the whole, disappointing. Apart from some alarming errors in the expressions given for tensile stress, and tensile strain, units were a constant source of error. It is a concern that many candidates have great difficulty with significant figure values for the tensile stress and the tensile strain. It was not unusual for these quantities to have as many as eight significant figures. The unit of the Young modulus continues to be a source of worry to candidates and many gave no unit at all; some had even written ‘it has no unit’ on the script.

Mark Ranges and Award of Grades

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