Examiners' Report January 2008

GCE

GCE O Level Physics (7540)

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Paper 1

General points and observations
Some very good work was seen and, as usual, calculations were well done although unit errors were common. Descriptive work that was not routine such as that required in Questions 3(c), 6(b) and 8(a)(ii) was poorly answered. By contrast candidates performed very well in Question 4 where boxes of text had to linked by drawn lines and in Question 5 where spaces had to filled with words respectively.

Question 1
In (a) candidates had to indicate with a cross whether given quantities were vector or scalar. A mark was deducted up to a maximum of two for each wrong answer. Many candidates scored only one mark because they thought that kinetic energy was a vector quantity.

In (b) candidates had to write down a formula that contained both vector and scalar quantities and identify these quantities. This was well answered with many choosing the formula $F = m \times a$. Other popular choices were the formulae for momentum and kinetic energy. In the case of the latter, identification of v as velocity was allowed.

In (c) candidates were shown an arrow drawn on a grid representing a force of 5 N acting at a point. They were asked to add another force drawn to scale acting at the point to show a combined force of 3 N. This required a force of 2 N drawn at the point in the correct direction. Many of the strongest candidates managed this but a very common error was to draw a vector of 3 N.

Question 2
In (a) the calculation of the momentum of a trolley, given values of mass and velocity, was very well done. An occasional error seen here and in previous sessions was the unit kg/m/s.

In (b) candidates were shown a velocity-time graph before and after a collision between the moving trolley and a stationary trolley on a horizontal frictionless surface. Given the mass of the latter, candidates were asked to show that momentum had been conserved. Candidates mostly scored three marks or zero. The combined mass after collision was 6 kg. This value combined with the velocity 2 m/s from the graph gave the same momentum (12 kgm/s) as before collision. Many calculations arrived at a velocity of 6 m/s.

In (c)(i) a line had to be added to the axes to show the velocity after collision on a frictional surface. There was a great deal of misunderstanding among candidates of all abilities who drew their lines from the point (4,3) instead of (4,2) and consistently added to the part of the graph before collision.

In (c)(ii) the energy change taking place after collision was kinetic to heat but under half the candidates scored this mark with many stating that the change was from potential to another form.

Question 3
In (a) the description of the convection process in the context of semi-molten rock between the crust and core of the Earth was well answered although errors seen in the past such as molecules becoming less dense and the rock becoming lighter were in evidence.

In (b) a calculation of gravitational potential energy used the correct formula but only a minority of candidates converted 2500 km to 2 500 000.

In (c) a very common explanation for why the value calculated in (b) might be too large was based on energy loss. The idea that it could be due to reduction in the value of *g* was rarely seen. Variation in *g* seems not be known by the vast majority of candidates.

Question 4
Candidates were given four horizontal boxes containing text relating to actions taken on a gas such as 'reduce its temperature'. Also given were five boxes containing text on the outcomes of the actions such as 'increases gas pressure'.
Candidates were asked to draw lines linking actions to the outcomes. This question scored well with a few linking 'reduce the pressure with temperature at constant volume' to 'changes a gas to a liquid'.

Question 5
Candidates had to fill in six spaces with words in a passage describing the movement of electric charges in a conductor. In a very well-answered question, many candidates did not know that one volt is the potential difference between two points when one joule of energy is needed to move one coulomb of charge between the two points.
The two middle answers of 'electron' and 'negatively' scored very well. Some confused meter with unit; ammeter for ampere and the spelling of 'coulomb' suggested that some candidates may not be fully familiar with this term.

Question 6
In (a) the calculation of a clockwise moment requiring the product of 6.0 N and 2.0 m was usually well done except where a distance of 1.5 m or 0.5 m was used instead. The uncertainty was caused by the presence of another force on the same side of the pivot, at a distance of 0.5 m from the pivot.
This error was often carried through the next two parts of the question and full credit was given there. There is some uncertainty with this topic. To state the value of a clockwise moment that would balance the previously calculated anticlockwise moment, some candidates started from scratch or failed to give an answer.

In (b) a situation where the size of the anticlockwise moment was reduced was not recognised and only a small minority of candidates gave a logical response here.

Question 7
In (a) the assumption that the resistance of an ammeter is negligible was well known.

In (b) the calculation of potential difference *V* given values of *I* and *R* was well done. The value of *I* was given as both 0.0020 A and 2.0 mA and a minority of candidates chose the latter. As in previous sessions a small minority of candidates used 0.02 or 0.0002. Very few unit errors were seen here.

In (c) a circuit in which a current of 2.0 mA was equally divided between two 6000 Ω resistors in parallel was not as well answered as expected. The main cause of uncertainty was the use of 12 V, calculated in part (b), carried through to this new situation.

Question 8

In (a)(i) the determination of the direction of induced current in a wire using the Right Hand Rule was correct for about half of the candidates but in (ii) this was also given as the reason why the current flowed in the opposite direction when the wire was moving in the opposite direction. Often the Left Hand Rule was quoted and answers to (ii) showed a good deal of confusion between motors and generators.
The feeling is that most candidates misinterpreted the diagram and guessed the answer to (i) which had a 50% chance of success.

In (b) the determination of frequency of a.c. from its voltage–time graph was frequently out by a factor of two. Two cycles were shown which most candidates were aware of but the time for these two cycles was incorrectly often used to find the frequency.

In (c) the coil of the generator was rotated twice as fast and though many knew that the frequency of the output would be doubled, they also thought that the peak voltage would be unchanged.

Question 9

In (a) most candidates knew what the composition of the alpha particle was.

In (b) candidates showed a good knowledge of the properties and detrimental effects of alpha particles in particular their short range in air and their ionising ability.

In (c) most students recognised a situation in which a source of gamma rays was being used.

Question 10

In (a)(i) candidates were asked how to send a 2.0 Hz longitudinal wave along a spring supported horizontally by several long, vertical supporting threads. Although some candidates had the correct idea of moving one end of the spring backwards and forwards in the direction of the spring twice every second, most of the descriptions were very badly put down on paper. Frequent references to springs and strings and loose statements about the direction of movement meant that many accounts scored nothing.

In (a)(ii) candidates were asked how they would find the wavelength of the longitudinal wave produced. Apart from those who described a calculation using speed and frequency, many had the correct idea that a measurement had to be taken. However only a minority of candidates referred to compressions or rarefactions. The best answers included mention of the phase of the waves but mention of crests and troughs was more common.

In (b) the calculation using $v = f \times \lambda$ was competently performed by the great majority of candidates.

Question 11

In (a) the calculation of refractive index using real and apparent depth was well done. Common errors were to work out the reciprocal of the correct value and assign a unit to the answer. A more infrequent error was to use the difference between the two data given rather than the quotient.

In (b)(i) the answer 'total internal reflection' was sometimes incomplete and in (ii) more errors than usual were seen in a question of this type with candidates referring to the angle of the ray 'entering' the block instead of the angle of the ray 'inside' the block being greater than the critical angle.

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Paper 2

General Points and Observations

In this paper candidates answered questions on the spaces provided on the question paper, a layout first introduced in January 2007. As in the last two sessions this has led to a majority of candidates addressing the question being asked and providing relevant answers which scored well. However many candidates still repeat parts of the question before starting their answers and then found it difficult to fit their answers in the remaining space. Candidates attempted all parts of the paper in the time allocated and individual candidates scored equally well across all five questions. Calculations were usually answered very well, although many failed to show all steps in their working, and marks were lost through missing or incorrect units.

Question 1

This part was answered very well. Most candidates calculated the weight correctly and a large majority knew that mass is constant but weight can vary as the gravitational field strength varies in different parts of the world.

A surprising number of candidates were not able to state that the gradient or slope of a displacement-time graph represents velocity. Similarly many failed to obtain correct values of time and displacement from the graph but a majority could gain both marks by calculating the velocity correctly using their values of displacement and time. Too many gave the wrong unit for velocity, most commonly writing m/s when the displacement had been written in cm/s. Candidates should avoid converting the unit in their final answer unless asked to do so in the question. Only a minority understood that the graph showed constant velocity or zero acceleration and that as a result the unbalanced force acting on the pen was zero; most gave a definition of an unbalanced force

The response to this part was very variable. Too many candidates gave answers comparing the arrangement and motion of air or water molecules and failed to score. The answers for air were more likely to be correct (molecules far apart and moving randomly). Those for water were frequently wrong with many candidates stating that molecules were not close packed or in contact. It is clear that many candidates think (and say) that liquid molecules are further apart than solid ones but closer than gas molecules and that they ignore the fact that liquids are incompressible in most situations. Explanation of the motion of water molecules was often vague with some repeating the answer given for gas molecules.

Few were able to give a sensible answer for the effect of making the disc larger. Most realised that water freezes at 0C but many of them failed to explain that the disc would not move. Although many realised that the disc would be subject to air or atmospheric pressure only the highest scoring candidates extended the answer in terms of collisions by air molecules.

Question 2

Those candidates that realised that when a current flows a wire it will heat up went on to also gain the mark for expansion. However many tried incorrectly to explain the extension stated in the question in terms of force; a number left this answer blank.

A majority of candidates misread the question and assumed that the spring would stretch when there was a current and so stated that the tension would increase and so fail to score. Those that did say the tension would decrease sometimes gave unclear or ambiguous explanations.

Answers explaining why the spring needed to behave elastically were also often vague. Many failed to address their answer to the behaviour of the spring, referring instead to the spindle or the pointer. Many tried to involve the need to not exceed the elastic limit rather that the need for the spring to return to its original length once the current was switched off.

Very few gave the full, correct response for temperature reaching a maximum, often trying to refer to latent heat or the wire reaching the same temperature as its surroundings. A fair number realised that it was something to do with energy transferred to the surroundings.

Calculations of energy and power were usually made correctly but many candidates gave the incorrect unit for power.

The graph usually scored full marks. Despite the check marks on the axes some candidates still chose an incorrect scale or failed to label the axes giving the correct unit. Points were usually plotted correctly and acceptable curves taking account of their plotted points. Some candidates still draw straight lines joining the plotted points and fail to score the curve mark. A handful of candidates plotted the point for current of 0.20 A at 0.7 cm instead of 0.07 cm and then proceeded to draw and S-shaped curve rather than checking their plotting. This made it impossible to obtain a sensible value for the current in part (ii).

Candidates who had drawn a suitable curve were usually able to obtain a correct value for the current causing a change of length of 0.50 mm but some did not show a line across and down on the graph or did not give the required unit. Candidates must be instructed to show the lines on the graph clearly. Where lines are drawn faintly they may not be visible on the scanned image that examiners will see on their computer screens.

Question 3

(i) Candidates often drew acceptable circuit diagrams, using the correct circuit symbols for voltmeter, ammeter and lamp. Many only included an ammeter, a few drew a resistor instead of a lamp and too many of those who included a voltmeter showed it connected in series with the lamp or connected in parallel with some other unnecessary component. Unnecessary components were ignored where they did not affect a correct measurement of power.

(ii) Most candidates could obtain a correct value for the power rating but a number again gave an incorrect unit.

(iii) Very few realised that 230 V is a high voltage or that as a result there was a danger of electric shock preferring to say that only a qualified electrician could wire the circuit correctly.

(i) Most knew that this was a parallel circuit.

(ii) A majority of candidates could give a reasonable account of how a fuse worked but many did not realise that its purpose was to protect the wiring or the circuit from excessive current. Many use the term “blow” rather than saying it would melt.

(iii) Too many said that a 1-A fuse was appropriate as it was less than 0.44 A of a single lamp. Those that correctly stated it was inappropriate either failed to state that the current would be more that 1 A when all the lamps were switched on or said the fuse would be too large as it would allow a current of more than 0.44 A to flow through the lamp which would then “burst”. Only a minority stated that the fuse would blow even if there was no fault.

(iv) A majority of candidates realised that A would be brighter than E and gave a correct explanation. Some candidates stated incorrectly that the current was shared between lamps D and E. Some just tried to explain the difference in terms of series and parallel connections or connection to switches.

(i) Many knew that the third wire was an earth wire although some called it a live or neutral wire.

(ii) The purpose of the earth wire was often confused with the purpose of the fuse but candidates could gain this mark if electric shock was mentioned in part (iii)

(iii) Many of those who knew that it was an earth wire could score both marks. Some confused this use of an earth wire with that seen in electrostatics experiments and talked about the metal parts becoming charged up rather than connected to live wire. Credit was given for charges or electrons passing to earth.

Question 4

(i) Most candidates measured just one gap scoring one mark. Only rarely did candidates show that they had measured the total distance between the first and last wavefront and then divided this by the number of spacings. A few missed the point, measured all eight individual gaps and then averaged them, again scoring only one mark.

(ii) Most of those who obtained a value for the spacing multiplied it by five.

(iii) Many gave the frequency as 8 Hz but some penalised themselves by dividing this by 2. A common incorrect answer was 1 Hz showing that they had read this as one wave per second.

(iv) The mark for speed of the waves was gained for using the values obtained in parts (a)(ii) and (a)(iii) correctly. Again marks were lost for using incorrect units.

(v) Most candidates knew how wavelength, frequency and speed were affected although some thought that frequency would change.

(i) Too many candidates just stated that light travelled faster than light rather than saying it was much faster. Credit was given for numeric answers which gave reasonable values for the respective speed. A few candidates picked up on the 6 seconds in the question to state incorrectly that light was six times faster than sound.

(ii) The calculation for distance was usually correct. Incorrect conversions to kilometres were ignored provided that 2040 m was seen.

(iii) Many candidates gave two acceptable reasons for the difference from that given in the data book.

(i) Most candidates gave at least two acceptable pieces of apparatus.

(ii) Again most candidates knew that they had to measure time. Many assumed that the distance would be 350 m and did not state they would measure it. Very few stated they would need to repeat the experiments even after having said in (b)(iii) that wind or air movement could affect the speed of sound.

Question 5

(i) Most candidates could name a suitable material for the core.

(ii) Most candidates gave a suitable reason for the choice of material although some stated that it was a good conductor indicating that they had not fully understood the action of a transformer and thought that current was conducted between the coils through the core.

(iii) The calculation was usually well done with most candidates giving the correct answer.

(i) Many candidates who had successfully calculated the secondary voltage then did not express themselves clearly or confused primary and secondary circuits. There were two coils and they could measure two voltages and frequently they did not specify which ones they were talking about. To gain the two marks they had to keep the primary voltage, primary turns or core material constant. Some referred to currents instead of voltage.

(ii) Many candidates did not know the circuit symbol for a transformer despite having been given a diagram of a simple transformer on the previous page. Even those knowing the symbol sometimes had no idea how to connect it correctly. Too many failed to include even one voltmeter and some of those that did connected it incorrectly. Additional ammeters, resistors, diodes and lamps were ignored if they did not affect the experiment.

(iii) The same problem seen in (b)(i) was seen here. The required measurements were of secondary voltage and number of secondary turns. Candidates frequently just said voltage and turns on the coil; provided that the term secondary was used correctly once then credit was given assuming that both answers referred to the secondary.

(iv) Too many candidates started by describing how they would set up the apparatus when they had already done this with their circuit diagram. Again they often failed to be explicit as to whether they were referring to the primary or secondary coils. Few stated that they would need to switch on the circuit and some described the action of a transformer rather than describing an experimental procedure. This was disappointing as this type of question has been set for many years. Many failed to state that they would repeat the readings for each different number of turns on the secondary coil.

(v) Most of those who sketched the graph gained both marks but those who failed to label the axes or who labelled them with anything other than secondary voltage and turns on the secondary coil failed to score either mark.

This question tested the higher scoring candidates. Vague answers such as “because energy was lost” or “because there were different turns on the secondary” gained no credit. Candidates were expected to state that energy was transferred to the surroundings or converted to heat or that there was incomplete flux linkage for one mark. For the other mark they could have stated that the transformer was not ideal or not 100% efficient.

PHYSICS 7540, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	72	61	51	46	28

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.

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