Rewarding Learning

GCE Physics
(January Series) 2011

Chief Examiner's Report

Foreword

This booklet contains the Chief Examiner's Report for CCEA's General Certificate of Education (GCE) in Physics from the January Series 2011.

CCEA's examining teams produce these detailed reports outlining the performance of candidates in all aspects of the qualification in this series. These reports allow the examining team an opportunity to promote best practice and offer helpful hints whilst also presenting a forum to highlight any areas for improvement.

CCEA hopes that the Chief Examiner Reports will be viewed as a helpful and constructive medium to further support teachers and the learning process.

This report forms part of the suite of support materials for the specification. Further materials are available from the specification's microsite on our website at www.ccea.org.uk

Contents

Subject Code	1210
QAN	500/2471/1
QAN	500/2438/3

GCE PHYSICS

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Grade boundaries

AS Units 1 and 2	
Weighting 18.5%	
Maximum Uniform Mark 111	
A	89
B	78
C	67
D	56
E	44

A2 Unit 1	
Weighting 18.5%	
Maximum Uniform Mark 111	
A*	100
A	89
B	78
C	67
D	56
E	44

Assessment Unit AS 1 Forces, Energy and Electricity

Q1 Candidates performed well in this question.

(a) This part was answered very well with almost all candidates obtaining full marks.

(b) While most candidates obtained full marks there were a number who incurred penalties as a result of ticking too many or too few boxes.

(c) Candidate ability to resolve a vector into its components, as required in part (i), was good however, fewer were able to correctly combine the vertical component from part (i) with the weight of the brick to obtain the answer to part (ii).

Q2 Candidates were familiar with the physics tested in this question and responses were good.

(a) Recall of the correct equations of uniform acceleration was excellent and almost all candidates used them accurately and obtained the correct answer to both parts of this question. Some candidates mistakenly quoted the time taken to reach the maximum height as the total flight time, in part (ii), and received half credit.

(b) In part (i), most candidates specified the motion as 'uniform' or 'constant' thereby securing the mark. In part (ii), some candidates did not specify the time interval between which the area under the curve to the time axis should be determined and consequently lost the second mark.

Q3 Candidates did not score well in this question.

(a) Owing to AS candidates not studying momentum, the statement of this law has been relaxed. Candidates who quoted F = ma only received credit if they also defined the terms. Many candidates omitted to specify that the acceleration took place in the same direction as the resultant force and forfeited the second mark. There was some confusion with the first and third laws.

(b) Candidate responses indicated general confusion as to how Newton's laws are applied in this context. Most candidates appreciated that gravity had to be considered and often got part (ii) correct. Many fewer candidates were able to combine the acceleration of the lift in parts (i) and (iii) with the person's weight to get the correct answer. In many cases the answer to part (iii) was given for part (i) and vice versa. Some centres had studied this particular application and the responses by their candidates were generally very good.

Q4 Candidate performance in this question was surprisingly poor.

(a) Candidate failure to obtain the reaction forces was due mainly to an inability to apply the principle of moments to the situation. Most candidates knew to interpret 'uniform plank' as the plank's centre of mass being at its geometrical centre.

(b) Many candidates omitted to calculate the increase in weight, having done the more difficult moments calculation, and lost a mark.

Q5 Many candidates found parts of this question challenging.

(a) Most candidates correctly calculated the kinetic energy of the car in part (i) and used that value to obtain the power output of the engine in part (ii). Part (iii) posed more of a challenge to many with some candidates failing to convert the percentage efficiency to a fraction while others made algebraic errors or confused power and energy.

(b) This was a difficult calculation for most candidates. Typically, candidates attempted a solution using equations of motion rather than energy conservation and often failed to calculate the component of the acceleration of free fall acting down the slope.

Q6 Most candidates scored heavily in this question.

(a) In part (i), the labelled diagrams produced by the candidates were generally very good and obtained full credit. In part (ii) candidates responded very well on the whole. There were some who listed the cross-sectional area as having to be measured and were duly penalised. Some lost credit for imprecision in response, such as those who did not indicate that the extension was determined by the movement of a marker along a millimetre scale.

(b) The calculation of extension in part (i) was successfully done by most candidates. Fewer candidates successfully calculated the cross-sectional area required in part (ii). There were a significant number of candidates who made power of ten errors in converting distances in millimetre to distances in metre.

Q7 Many candidates found the series of questions on superconduction difficult.

(a) Few candidates appreciated that metals only behave ohmically if they are at constant temperature and consequently lost credit. However, almost all were able to sketch an appropriate current-voltage characteristic.

(b) A large proportion of candidates were unable to fulfil all aspects of the three marks on offer for part (i) of this question. Specifically, some omitted an explanation of superconductivity and others omitted a label for the transition temperature. In part (ii) many candidates were careless in that they did not specify the magnetic aspect of their chosen application.

Q8 This question was generally very well done.

(a) In part (i) most candidates made the conversions to ampere and second correctly to gain the mark. However a significant minority could not. Most candidates were able to obtain the number of electrons passing, as required in part (ii).

(b) Few candidates had trouble calculating the potential difference required in part (i) and most went on to correctly determine the energy dissipated in the resistor in part (ii), although there was some confusion between the equations for electrical power and electrical energy.

Q9 Candidates performed well in this question.

(a) The circuit diagram was well known by this cohort with most using the correct circuit symbols. The most common error was to include a second load and measuring the wrong potential difference. The description of the experiment was usually accurate and the quality of written communication was generally good.

(b) Most candidates labelled the axes of the graph correctly and sketched an appropriate graph in part (i). In part (ii), lots of candidates lost credit as a result of their failure to explain the negative gradient.

(c) A number of candidates performed this question very well. Others found it more difficult.

Q10 This question had a good incline of difficulty and consequently the latter parts were poorly done by many candidates.

(i) Most candidates were able to determine the current flowing around the circuit but there were lots of errors converting to milliamps.

(ii) Only those candidates who were unable to obtain an answer in part (i) failed to score here.

(iii) This part proved slightly more troublesome but most successfully calculated the potential difference.

(iv) Many candidates omitted to consider the impact of the load resistance on the total resistance of the network.

Assessment Unit AS 2 Waves, Photons and Medical Physics

Q1 Many candidates experienced difficulty in responding to this question.

(a) A very common error here was to ignore the reference to the source and to simply describe transverse and longitudinal waves. Such candidates were penalised a mark.

(b) In this question many candidates lost marks as there was a lack of precision in their responses. In part (i), to explain unpolarised, a large number of candidates talked about the direction rather than the plane of the vibration. In part (ii) most candidates correctly gave an example of a wave that could not be polarised but often their explanation was marred by a similar lack of precision as commented upon in part (i).

Q2 This question was very well done. The overwhelming majority of candidates were very familiar with this experiment. The quality of the labelled diagrams was generally excellent and were usually accompanied by prose that contained all the information required by the second and third bullets. Some otherwise good diagrams were spoiled by the incorrect angles being identified.

The quality of written communication was generally good.

Q3 This question was poorly done.

(a) Most candidates correctly identified the eye defect as hypermetropia.

(b) The calculation of the image distance from the magnification equation, in part (i), was typically the only mark for calculation the candidate received. Few candidates substituted a virtual image distance into the lens equation and consequently lost the substitution and answer marks. The unit of power mark was awarded independently and most candidates achieved it. Only a small number of candidates got any marks for part (ii) with confusion between object and image distance being a common difficulty.

Q4 Candidate performance in this question was disappointing.

(a) Most candidates lost marks, in part (i), because they stated the general conditions for standing wave formation without reference to the specific situation described. In part (ii), most candidates correctly obtained the wavelength but few were able to sketch the fifth harmonic required in part (iii).

(b) This calculation was poorly done as many candidates were unable to correctly relate the tube length to the wavelength.

Q5 This question was well answered by the majority of the candidature.

(a) Almost all candidates explained monochromatic correctly.

(b) The interference pattern was well described in part (i). In part (ii), the calculation was generally well done although power of ten errors were very common in the substitution of values into the equation. In part (iii), only the better candidates were able to correctly state two ways of increasing the fringe separation.

Q6 Most candidates found this question accessible.

(a) Not all candidates were able to identify the logarithmic feature of the scale.

(b) Part (i) of the question was well answered as most candidates identified the lower frequency threshold as being the same but that the dog could hear to a higher frequency. Graphs drawn in part (ii) were generally correct. Candidates found it difficult to achieve the mark for explaining why the dog would perceive the sound as being louder in part (iii).

Q7 Candidates found this question challenging.

(a) Most candidates appreciated that the field gradient coils produce a magnetic field but few distinguished between the gradient coils and the scanner magnet and so gained no credit. In describing the function of the computer few candidates clearly identified its dual role of processing the data and producing the image.

(b) Whilst most candidates appreciated the application of superconductors to the process few were able to compose a response that picked up all three marks.

(c) Few candidates were able to outline three advantages of MRI compared to CT.

Q8 Many candidates found parts of this question challenging.

(a) Most candidates were able to recall the equation for photon energy and substituted accurately to confirm the value in part (i). Candidates experienced much greater difficulty in part (ii) with only the stronger candidates obtaining the correct answer.

(b) Many candidates were unfamiliar with the experimental observations from photoelectricity. In part (i), some candidates did appreciate that there would be more photoelectrons emitted but the same candidates were often unable to explain why convincingly. A number of candidates appreciated that radiation intensity has no effect on the kinetic energy of the photoelectrons and were awarded the mark in part (ii).

Q9 Candidates responded well to this question.

(a) Most candidates were able to state what 'quantised' means.

(b) The unusual context in which this question is set did not distract too many candidates. In part (i), most candidates appreciated that 'maximum absorption' referenced the minimum of the curve from which they obtained the frequency from which the photon energy can be calculated. In part (ii), the candidate had to use the photon energy to identify the electron energy transition and most were successful in doing so.

(c) The term population inversion was well explained by most candidates.

Q10 Candidate performance in this question was mixed.

(a) Explaining the term 'wave particle duality' was well done by only a few candidates. Most candidates correctly stated electron diffraction as evidence of the wave nature of matter and often candidates expanded their answer to pick up the third mark.

(b) Part (i) of this question was not done well. Few candidates clearly stated that wavelength (wave property) is inversely proportional to momentum (particle property). The calculation in part (ii) was perceived as difficult by the large number of candidates who only obtained the mark for calculating 8% of the speed of light.

Assessment Unit A2 1 Momentum, Thermal Physics, Circular Motion, Oscillations and Atomic and Nuclear Physics

Q1 Candidate performance in this question was very strong.

(a) Almost all candidates correctly defined momentum and of those who stated p = mv (or equivalent) the overwhelming majority correctly explained the symbols used and achieved full credit.

(b) Part (i) of this question was very straightforward and posed few problems. Part (ii) tested the candidate's ability to apply the conservation of linear momentum and most were successful in determining the unknown mass. Only a few candidates mistakenly thought that the collision was elastic as most went on to obtain full marks in part (iii).

Q2 Candidate performance varied in this question.

(a) A very generous mark scheme meant that most candidates scored well in part (i) of this question. Part (ii) was also very well answered. In part (iii), whilst most candidates performed very well, some candidates did not respond to both parts of this question and consequently lost marks. The quality of written communication was generally good.

(b) Many candidates found this calculation difficult. Too many candidates omitted to convert temperatures to kelvin, the new volume was poorly calculated and a large number of candidates incorrectly converted from millimetre to centimetre.

Q3 Most candidates coped very well with this question on circular motion.

(a) This section of the question tested the candidate's understanding of angular velocity. In part (i), most candidates correctly explained that the motorcyclist sweeps out an angle over time to receive credit. Many candidates were able to calculate the angular velocity from the linear velocity and radius although the conversion from kilometre per hour to metre per second did confuse some.

(b) This part of the question examined the candidate's understanding of the centripetal force. Part (i) of this question was not well done. Few candidates wrote convincing explanations often failing to state that the velocity changes because the direction of motion changes. Despite these problems, most candidates did appreciate that the friction between the tyre and the road provided the centripetal force.

(c) The calculation of centripetal force required in this section was well done by most candidates.

Q4 This question on simple harmonic motion stretched many candidates.

(a) Most candidates were able to correctly define simple harmonic motion. However, a large minority were not.

(b) This question caused many difficulties. The majority of candidates drew a sinusoidal curve but only some realised that it had to be a cosine curve. Fewer candidates matched the curve they drew to the time axis and, to a lesser extent, the displacement axis.

(c) Candidates who drew the curve in (b) correctly found this question relatively straightforward. Candidates were afforded an 'error carried forward' from (b).

Q5 This question was answered well by the majority of the candidature.

(a) Candidate responses to this part tended to be disappointing. Common were the answers indicating only partial understanding of the significance of the observations.

(b) In part (i) of this question most candidates had a sound appreciation of what they had to do. Despite this a large number of candidates did not obtain the correct answer; perhaps because they do not split calculations into easily manageable parts. Part (ii) of this question trapped the large number of candidates who did not appreciate that nuclear density is constant.

Q6 Many candidates found the calculations in this question difficult.

(a) Although this was a straightforward question, many candidates were unable to define half-life correctly.

(b) A good number of candidates calculated the decay constant but many fewer appreciated the necessity to convert it to its S.I unit before using it with the activity in bequerrel to obtain the initial number of nuclei.

(c) Lots of candidates quoted the equation $N = N_o e^{-\lambda t}$ and went on to obtain the correct answer. A greater number of candidates were successful with this calculation than that in part (b) partly because the time used was measured in days which is consistent with the decay constant most worked out in part (b).

Q7 Candidate responses indicated a familiarity with this theory but imprecision led to many lost marks.

(a) Many candidates experienced difficulties in explaining why the reaction could occur spontaneously. Most stated that the binding energy per nucleon of the daughter nuclei was greater than the parent nucleus but did not continue to say that this meant they were in a more stable state.

(b) In this part, a common error was to consider only a single neutron being produced and miscalculating the mass defect. A second common mistake was to omit the conversion from relative atomic mass unit to kilogram.

(c) In part (i), most candidates were able to name and describe the purpose of the moderator and the control rods in a fission reactor. Parts (ii) and (iii) tested the concept of critcal size. In part (ii) many candidates appreciated that a chain reaction was only possible if there was a super critical size. In part (iii) few candidates adequately expressed the idea that the fission reactions that occur in a single fuel rod cannot be controlled so having a super critical fuel rod would be highly dangerous.

Q8 Candidates coped very well with this question.

(a) Candidate responses indicated sound appreciation of the necessity to have a high plasma temperature.

(b) This part was less well done. Few candidates clearly explained that confinement was required to provide the conditions required to encourage fusion.

(c) The names of the three methods of confinement were known by almost all candidates and most were able to provide enough of an explanation to receive credit.

Q9 This relatively straightforward data analysis question was well done by most candidates.

(a) Most candidates received full credit for part (i). It was encumbent upon the candidate to rearrange equation 9.1 and map it clearly to y=mx+c; any lost marks tended to reflect poor answering technique rather than poor data analysis skills. In part (ii), the majority of candidates obtained full marks. There were candidates who were penalised for incorrect table headings and others for not maintaining two significant figures in the data they added to the table.

(b) Graphs were produced well and candidates scored heavily in part (i). In part (ii), almost all candidates read off their intercepts correctly and went on to determine a consistent value for the internal resistance. Part (iii) was generally well done with most candidates receiving the quality mark for their value of the cell's electromotive force.

(c) Candidates tended to appreciate that the gradient would decrease for the new cell but not all were able to explain that the intercept would have a higher negative value which would bring the best fit line closer to the origin.

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