Rewarding Learning

GCE PHYSICS
(SUMMER SERIES) 2010

Chief Examiner's Report

GCE PHYSICS

Chief Examiner's Report

Grade Boundaries

Grade	Uniform Mark
AS Maximum Mark is 300	
A	240
B	210
C	180
D	150
E	120

Grade	Uniform Mark
A2 Maximum Mark is 600	
A	480
B	420
C	360
D	300
E	240

ASSESSMENT UNIT AS 1 FORCES, ENERGY AND ELECTRICITY

AREAS OF WEAKNESS

- Definitions of quantities, laws, units etc tend to lack precision.
- Finding the base units of relatively complex quantities.
- Current, p.d. and resistance within resistor networks.

Q1 This question was generally well answered.

(a) Most candidates demonstrated a sound knowledge of the S.I. base units and received full marks. The most common candidate mistakes were to name "Celsius" as the S.I. unit for temperature and not knowing the unit of the amount of substance.

(b) Very few candidates successfully expressed all the derived units in terms of base units. The watt and the ohm were particularly poorly addressed.

Q2 Most candidates performed well in this standard projectile motion question.

(a) Some candidates were unable to, or did not, calculate the initial vertical component of the velocity.

(b) Most candidates successfully completed this part of the question.

(c) There were a number of candidates who did not use the horizontal component of the velocity.

Q3 Some candidates experienced considerable difficulty with parts of this question.

(a) The vast majority of candidates were awarded full marks for this part of the question. However, a significant number gave poor statements of the first law, failing to include a reference to an unbalanced force. Many responded to Newton's 3^{rd} Law with an 'action and reaction' answer and failed to achieve the mark.

(b) Part (i) of this question was well done by the majority of candidates although identification of the forces on the brick was often missed out. Part (ii) was addressed in a satisfactory manner by candidates in a small number of centres. Most scripts indicated only a very basic understanding of Newton's third law.

Q4 This question was well answered by most candidates.

(a)-(b) Statements defining the moment and the principle of moments were generously awarded by the mark scheme. Many candidates lacked rigour in their responses and often omitted any reference to the perpendicular nature of distance.

(c) This question challenged many candidates. Part (i) was generally well answered. However, in part (ii), whilst most candidates recognised that the plank would rise off the riverbank, few were able to explain why well enough to attain the final mark.

Q5 Most candidates produced quality work in this question.

(a) The conservation of energy is well understood and explained by candidates but again a lack of detail was penalised. A statement of the conservation principle was often offered without any attempt to relate it to the falling apple.

(b) Some candidates sketched incorrect curves. A significant number failed to take due care in drawing these sketches.

(c) This question was well answered and indicates the skill and confidence of most candidates for numerical questions on energy conservation. There were some candidates who confused mass and weight.

Q6 Most candidates were able to respond positively to this question.

(a) The vast majority of candidates obtained the correct expression for the Young modulus. Some candidates failed to correctly manipulate the equations for stress and strain.

(b) In general, diagrams in part (i) of the experimental arrangement, were poor. In part (ii), most candidates obtained full marks for the description. Candidates describing the vertical suspension arrangement tended to achieve fewer marks. It was quite common for a candidate to state the quantities to be measured but not the instrumentation. A small number of candidates failed to demonstrate any knowledge of this experiment.

Q7 This question was fairly well answered.

(a) The majority of candidates responded correctly to part (i) and part (ii) of this question. There were a variety of incorrect responses to part (i) with a significant number offering "coulombs" as the charge carriers!

(b) Many candidates had difficulty in expressing current as the rate of flow of charge.

(c) Many candidates found this calculation difficult.

(d) This question was very challenging, with only a few scripts indicating a deep understanding of the nature of electricity.

Q8 Responses to this question were varied.

(a) Resistivity was well defined by most candidates. Incorrect answers often failed to mention 'unit' length and/or 'unit' cross-sectional area.

(b) Part (i) of this question tended to be well answered. There were some candidates who confused R and ρ. In part (ii), most candidates realised the resistance would increase in proportion to the resistivity.

(c) Most candidates correctly identified the coils in part (i) but, in part (ii), failed to discuss the heating effect of a current through a resistance in order to explain their choice.

Q9 This question was generally well done. However, a small number of candidates made no attempt to answer any part of the question.

(a) Most candidates described the effect of internal resistance on terminal p.d. when a current flows.

(b) The majority of candidates correctly identified internal resistance as the gradient in part (i) and e.m.f as the intercept in part (ii).

(c) This calculation was well executed.

Q10 Some candidates found this question very difficult and were able to attempt only some parts.

(a) This part of the question was generally well answered. Most candidates correctly calculated the resistance in part (i) and correctly quoted an equation for the conservation of charge in part (ii). Fewer candidates were able to determine current I_3 in part (iii).

(b) This question was poorly answered by the vast majority of candidates.

(c) Most candidates found the resistor networks difficult to decipher. Consequently, there were not many correct answers to part (i) and even fewer correct responses to part (ii).

ASSESSMENT UNIT AS 2 WAVES, PHOTONS AND MEDICAL PHYSICS

AREAS OF WEAKNESS

- Quality of diagrams, particularly the care taken in their production.
- Emission spectra as evidence of electron energy levels.

Q1 This question was quite well answered.

(a) Polarisation was a problem for some candidates but others answered well. In parts (i) and (ii) the terminology used in the descriptions and explanations was not always good. For example, 'polarised' instead of 'polarising' was often used when referring to glass, lenses and filters. Many candidates had the correct idea(s) but were not always able to respond in a manner to attract all the marks. In part (iii) of this question, candidates should understand that waves do not oscillate, it is some property belonging to a wave which oscillates/vibrates.

(b) This calculation was very well answered and most candidates scored full marks.

Q2 Responses to this question were generally good.

(a) Many candidates did not make clear that it was necessary to evaluate the sine of the angles of incidence and refraction, while others described an experiment to obtain these angles.

(b) The calculation was answered correctly by some candidates but many answers scored only part marks. A common error was to neglect to indicate that the refractive index value depended on the direction of light travel into or out of the transparent material. Thus an incorrect angle for the light ray inside the block was obtained. Another error was to take 43^{o} as the incident angle inside the block of material. Most candidates could correctly obtain the critical angle and thus obtained some credit.

Q3 This question was quite well answered.

(a) In part (i) many candidates obtained the correct ray diagram. Some confused virtual and real images and drew a diagram for a virtual magnified image. Others could not position the object in a suitable position to obtain a magnified real image. Marks were lost here but error carried forward (ECF) allowed candidates to proceed and score marks in part (ii). As usual some ray diagrams were missing direction arrows on the rays. In part (ii) quite a number of candidates thought it was sufficient to measure u and v distances and then to state that their v/u value verified the magnification formula, without any consideration or measurement of the image and object sizes.

Q4 This question elicited mixed responses.

(a) In part (i), many candidates omitted items of apparatus to conduct a Young's slits experiment and often the labelling of the diagram was poor. Some candidates included much unnecessary detail of waves and rays when only the apparatus was required. In part (ii) candidates were asked to carefully sketch the interference pattern obtained. Many diagrams were very poor and did not display the details required of fringes and their spacing. Although no penalty was applied it was obvious that many candidates indicating a laser in their apparatus sketch were inconsistent in the type of interference pattern that would be obtained.

(b) In part (i), more able candidates calculated correctly. Others could not identify the terms to substitute correctly into the appropriate formula given on the Data and Formulae sheet. In part (ii), most candidates correctly suggested red light but many candidates thought the opposite and stated blue/violet. In (b)(iii) few were able to give the required response of 'dark conditions'. Most candidates gave very particular complex answers involving coherent sources, slit widths and distances to change the pattern instead of considering the general simple OBSERVATION of an already produced interference pattern. Strangely, it was often the candidates of lower ability who more frequently opted for dark or subdued light conditions to provide the best observation of the pattern produced.

Q5 This question obtained reasonable answers.

(a) Most candidates ticked the only correct box but some candidates applied single and multiple ticks to other boxes.

(b) Many candidates lost marks by failing to consider the wavelength of light or its comparison to the door width as characteristics of importance in deciding whether or not diffraction was observable.

(c) A mixture of good and poor diagrams was obtained; some of the diagrams were very carelessly drawn. The appropriate shape, spacing and number of wavefronts was sometimes incorrect and in some instances the patterns drawn for the short wavelength and the longer wavelength were incorrectly interchanged.

Q6 This question was not well answered by many candidates.

(a) In part (i) resonance tubes, signal generators and a battery pack were some of the answers offered in place of the required microphone. In part (ii), the better candidates could easily calculate the frequency of the tuning fork by the traditional method.

(b) In part (i) the answer could be deduced from the graph of Fig 6.2 and many candidates gave a response within the acceptable range. However, in part (ii) the answer was not obvious from the graph and recall was necessary to indicate 0 dB. Some unfortunate candidates correctly stated the intensity for the highest sensitivity instead of the intensity LEVEL. Others indicated 120 dB. In part (iii) the correct region was usually shaded for undetected sound but some candidates shaded only part of the region.

Q7 This question was very accessible to all candidates and especially to candidates of limited mathematical ability. It also lent itself readily to Quality of Written Communication assessment.

(a) Some candidates could not think of optical/glass fibres as the response for the first blank space. Most candidates correctly suggested images for their second response. The additional function required was sometimes stated very briefly eg electrodes or wires without any real explanation.

(b) This question evinced some excellent answers but also many which were completely inaccurate and irrelevant. The functions of coherent and non-coherent bundles of fibres were sometimes confused in the descriptions given. The main mistake, however, was to give inappropriate descriptions of the phase relationships of coherent and non coherent light. This sometimes extended to statements concerning the necessity of such light to get good reflections and total internal reflections without any consideration of the structure of an endoscope using coherent and non-coherent optical fibre bundles. The question stem stated “in the context of a medical endoscope” but this was ignored by many candidates. Quality of written communication was mostly acceptable, but in some cases the vocabulary used was imprecise.

Q8 Responses to this question were generally sound.

(a) It was rare to obtain an answer which stated that the incident photons had to be absorbed by the electrons in the metal. The other conditions for energy and frequency were regularly obtained.

(b) The calculation was usually executed correctly. Candidates who could not solve the problem appeared to know the energy equation E = hf but then substituted the wavelength of the blue light photons into this equation as their frequency. Many candidates seemingly could not extend this equation to $E = hc/\lambda$.

Q9 This question generally prompted satisfactory answers.

(a) This question was not well answered. Most candidates simply wrote what they thought they knew about energy levels in atoms. Little attention was paid to the evidence provided by emission spectra, especially the observation of lines and the explanation of their origin.

(b) This calculation was quite often correct. Wrong answers were due to incorrect selection of the appropriate energy levels and the non conversion of electron-volts to joules.

Q10 Responses to this question were generally good.

(a) In part (i), it was clear that most of the candidates did not know or appreciate the meaning of a de Broglie wavelength. Many candidates quoted the formula for the wavelength as the answer without further explanation. In part (ii), although many candidates drew the correct shape for the graph, others who apparently knew the formula for the de Broglie wavelength could not translate this knowledge into the correct graphical form.

(b) This question was answered correctly by many candidates. Those who could not find the velocity appeared to be stuck with the formula E = h/p and could not extend it to E= h/mv. Others who knew the correct formula substituted the mass of an electron instead of the mass of a proton.

ASSESSMENT UNIT AS 3 PRACTICAL TECHNIQUES

AREAS OF WEAKNESS

- Drawing curved best fit lines.
- Inserting an ammeter within a circuit.
- Organising data into candidate designed tables of results (Q3(a)).

Q1 Candidates scored highly in this question.

(a) In part (i), some candidates measured L outside the acceptable range and other candidates measured in centimetre rather than millimetre. In parts (ii) and (iii), a significant number of candidates measured image distances rather than object distances for x_1 and x_2.

(b) The focal length was generally calculated accurately.

(c) Most candidates offered answers suggesting that it was the judgement of a truly focussed image that affected the accuracy of the focal length determination. Very few candidates suggested the limitations of the single data set as affecting the accuracy. However, some candidates incorrectly discussed parallax errors or measuring uncertainties.

Q2 Very few candidates scored maximum marks in this question.

(a) A significant number of candidates failed to quote ammeter readings correctly in milliamp.

(b) In part (i), a significant number of candidates seemed to have difficulty connecting the ammeter in the correct position. There was less difficulty in locating the ammeter for part (ii). The vast majority of candidates recognised the correct relationship between the currents in part (iii). However, many failed to explain this in such a way as to gain the mark. Answers were frequently given in very general terms without considering the key phrase "in this circuit".

Q3 Candidates generally scored highly in this question.

(a) Very few candidates failed to give results in a neat, tabulated manner. However, most candidates carried out at least two oscillations from which they processed the periodic time. The vast majority of periods for the two diameters were within 10% of each other. Some candidates confused frequency and periodic time.

(b) A significant number of candidates quoted an incorrect diameter for the smallest ball bearing.

(c) Many candidates correctly deduced the independence of the period from the diameter of the ball bearing.

Q4 Candidates scored highly in this question.

(a) Some candidates failed to measure the total length of the spring but were able to gain marks for the extended lengths.

(b) Only the better candidates processed the data to obtain the correct spring constant.

(c) Very few candidates explained the more accurate value in terms of percentage uncertainty.

Q5 In general this question was well answered.

(a) A very small number of centres failed to indicate on the front cover if their candidates were given help with the equations. The vast majority of candidates offered the correct equations.

(b) In part (i), many candidates were inconsistent with the number of significant figures to which they quoted processed data. Most candidates correctly calculated the quantities with the correct unit. In part (ii), very few candidates plotted a wrong graph; suitable scales, acceptable axes labelling and accurate plotting were generally observed. Many candidates failed to draw an acceptable smooth curve.

(c) Most candidates used their value for maximum power to obtain an acceptable value for the load resistance.

(d) In part (i) of this question, most candidates correctly identified that more values would be required but only a few indicated that these should be around the maximum. Part (ii) was generally well done and in part (iii) many candidates obtained a single mark for identifying that the efficiency was 50% but very few candidates provided an acceptable deduction. Part (iv) was correctly addressed by an extremely small number of candidates.

ASSESSMENT UNIT A2 1 MOMENTUM, THERMAL PHYSICS, CIRCULAR MOTION, OSCILLATIONS AND ATOMIC AND NUCLEAR PHYSICS

AREAS OF WEAKNESS

- AS course content (sound intensity and intensity level).
- Diagrams of apparatus.
- Use of the terms: nucleus, nuclei, nuclide.

Q1 This was a stretch and challenge question incorporating the physics involved in simple harmonic motion and momentum. Candidates were clearly familiar with all the concepts being tested although the context confused some. Many candidates scored very well in this question.

(a) Those candidates who identified the particle's displacement as the focus for this part were able to achieve both marks. A large proportion of the candidature described the particle's speed or acceleration during the 600 μs of the motion graphed.

(b) A number of candidates in this part did not identify that it was the rate of change in displacement with time that was required and consequently received no credit. Most candidates were able to correctly calculate the gradient of good tangents. It was not necessary to literally draw a tangent but to select values that indicated the method was used. There were a number of centres from which the candidates were familiar with the simple harmonic equation for velocity (or maximum velocity) and used it to obtain full credit.

(c) In part (i), all but a handful of candidates were able to correctly define momentum. Of those who didn't score the mark it was usually because they stated an equation but did not define the terms used in the equation. In part (ii), all but a very small minority successfully answered this straightforward question. Some candidates missed out on the unit mark ($N\ s^{-1}$ was common).

Q2 This question was reasonably well answered.

(a) The diagrams drawn in part (i) of this question were generally of poor quality (too small and/or carelessly drawn) although most contained the vital elements required for the marks. Some candidates included these elements within a system that had no chance of working and so full credit could not be given. The labelling of the diagrams tended to be good. There was a small number of candidates who confused this Boyle's law experiment with either

Charles's law or Gay-Lussac's law. Candidates were able to describe how the experiment is conducted but did not always make clear how a value for the gas volume was obtained.

(b) The majority of candidates handled the analysis of Boyle's law experiment very well. There were some who did not identify the gradient as being *nRT* and others that took P = 12200 Pa m^3 and assumed V = 1 m^3! Only a small number of candidates did not make the conversion from degree Celsius to kelvin. Almost all candidates were able to draw the graph for the same gas sample at a higher temperature.

Q3 This very straight forward question on circular motion was successfully completed by the majority of candidates.

(a) Almost all candidates obtained full credit for part (i) of this question. Some candidates lost credit for not showing clearly how the value for angular velocity is obtained. Again, most candidates went on to use the value for angular velocity to correctly compute Ganymede's linear speed.

(b) Most candidates obtained full credit in part (i) of this question. A large number of candidates used the relationship between centripetal force and linear speed rather than angular velocity and relied upon an error being carried forward for full credit. Almost every candidate knew that the force acted towards the centre of its circular path and so picked up the mark for part (ii).

Q4 This question of oscillations and resonance was generally well answered.

(a) Most candidates gained credit for identifying the components that were forced to vibrate in part (i) although some included additional components. Almost all candidates identified the rotating cam as providing the driving force in part (ii).

(b) In part (i) of this question, some candidates labelled the y axis of the graph incorrectly; displacement was a common incorrect response. The majority of candidates correctly sketched the shape of a typical resonance graph. In part (ii) most candidates were able to suggest sensible methods for increasing the damping experienced by the mass-spring system. Part (iii) proved to be a stern test for many. Scoring here was generally good although many candidates had to rely on 'benefit-of-the-doubt' to receive the mark for the peak of resonance displaced to a lower frequency.

(c) Surprisingly the majority of candidates failed to obtain this mark. The most common answer was 16 Hz!

Q5 This question elicited mixed responses.

(a) The majority of candidates correctly stated what A and r_o represent. It was pleasing to note that only a few candidates stated that r_o was the proportionality constant.

(b) Few candidates experienced any difficulty with either part of this question.

(c) In part (i) of this question it was crucial that the candidates showed all the correct substitutions into equation 5.1 to receive the credit. Part (ii) was a standard calculation that most candidates completed successfully. Part (iii) of this question evinced a general lack of understanding. Many candidates felt that nuclear density would mirror the metallic density.

Q6 Many candidates found this question challenging.

(a) Lots of candidates failed to appreciate the units in which charge was measured in the table and lost the marks for the alpha and beta particles. Most candidates achieved the mark for the gamma ray since zero is zero in any unit!

(b) Part (i) of this question sought to illicit responses about the interaction between the decay particle and the molecules in the atmosphere. Few candidates mentioned collisions and the subsequent loss of energy from the decay particle and its transfer to the molecule. Many candidates simply relied on 'ionisation' to gain them both marks and ignored the direction given to them in the question stem. In part (ii) most candidates did not respond to the precise terms of the question.

(c) Most candidates obtained full marks for this question.

Q7 Candidates performed well in this question.

(a) In the first part of this question most candidates were able to draw the basic shape of the binding energy per nucleon curve but fewer were able to add the necessary detail to pick up the second mark. In part (ii) of this question it was pleasing that most responded correctly in explaining binding energy per nucleon.

(b) In part (i) of this question most candidates responded correctly. Some candidates were imprecise using the term atom rather than nucleus and the terms large (or small) rather than heavy (or light). Candidates experienced difficulty in writing a response to part (ii) that achieved both marks. Part (iii) of this question was well answered.

Q8 This stretch and challenge question was generally well answered.

(a) The majority of candidates were able to correctly name the nuclide used in most fission reactors and those used in fusion reactors.

(b) Most candidates correctly identified the neutron as the particle whose kinetic energy has to be controlled but fewer addressed part 2 convincingly. In part (ii) of this question, candidates again were able to identify the particle and this time most candidates responded appropriately to what was a more standard part (ii)(2) of this question.

Q9 This question drew its stretch and challenge element by testing material from the AS part of the course and through the data analysis. The AS material was generally poorly known but the data analysis was well done.

(a) Almost all candidates correctly completed the logarithm equation 9.2.

(b) Most candidates scored full marks for completing Table 9.1. Common mistakes here were in using natural logarithms rather than logarithms to base ten and in labelling the columns in a non-standard fashion.

(c) The graph in part (i) of this question was very well drawn. Candidates generally used their graphs accurately to obtain values for the constants *n* and *k*. Many candidates were able to obtain the speed of sound from the data provided in part (iii).

(d) This question was very poorly done. Many candidates were unfamiliar with the use of the decibel equation. Some introduced a power of ten error by not converting milli-watt per square metre to watt per square metre and many did not double the intensity to take account of both speakers.

ASSESSMENT UNIT A2 2 FIELDS AND THEIR APPLICATIONS

AREAS OF WEAKNESS

- The basic structure and operation of the synchrotron.
- Quality of diagrams.

Q1 This question was generally well answered.

(a) Newton's law of universal gravitation was well known.

(b) Most candidates were able to apply the law to the situation described but there were some that omitted to add height h to the Earth's radius in part (i). The majority of candidates successfully calculated the gravitational field strength in part (ii). However, few candidates were able to provide an explanation in part (iii) that attracted more than one mark. Many candidates said the force of gravity was negligible despite getting a correct answer to part (ii).

Q2 Answers to this stretch and challenge question were usually good.

(a) Coulomb's law was stated well by most candidates.

(b) In part (i) of this question, most candidates correctly identified that the direction of the missing force was vertically down but fewer correctly named it as weight. Part (ii) was well answered and the majority of candidates correctly calculated the electrostatic force in part (iii). In part (iv) the trigonometric manipulations were well handled by most candidates.

Q3 Responses to this question were mixed.

(a) Most candidates sketched a graph of the correct shape but many omitted to label the final value 12 V and consequently lost a mark.

(b) This question was poorly answered. Few candidates concentrated their responses on how the movement of charge carriers explained the shape of the graph.

(c) The majority of candidates who successfully completed this question used the fact that voltage falls to 37% after a single time constant period and therefore two time constant periods were involved in this question. However, a large number of candidates used the equation $V = V_o e^{-t/CR}$ which is not required by the specification.

Q4 Responses to this practical question were good.

(a) Most candidates successfully stated Faraday's law in part (i) of this question. Diagrams in part (ii) tended to be carelessly drawn though many contained the necessary features. Descriptions of how the apparatus was used to demonstrate the law varied from excellent to poor.

(b) The calculation of current was well handled by the majority of candidates.

Q5 This standard question on transformers was very well answered.

(a) The candidature has a sound appreciation of how the transformer works.

(b) This calculation to find the current was well done.

(c) Most candidates realised that the current drawn from the supply must increase if the output current is to remain unchanged for a transformer of efficiency less than 100%.

(d) Candidates were very familiar with this question and answered it very well. A few candidates were imprecise when commenting on the source of energy loss and failed to gain that mark.

Q6 Candidates handled this stretch and challenge question well.

(a) Part (i) of this question was well answered and almost all candidates were able to explain why the ions followed a circular path. Part (ii) was equally well done and most candidates were able to equate the force due to the magnetic field with that for centripetal force to obtain the expression for the radius. Consequently, few candidates had any difficulty using the equation in part (iii) to obtain a value for the radius, although there were some who didn't convert their calculated answer to centimetre. In part (iv) there were very few responses that used the information in Fig 6.1 with the answer obtained in part (iii) to complete an accurate scale drawing. The majority of candidates had the helium ions being deflected in the correct direction.

(b) Most candidates, in part (i) of this question, received credit for their sketch of the new path. However, many candidates argued qualitatively rather than using the values for B and the equation for r to make a quantitative statement as was required in part (ii).

Q7 Some candidates found parts of this question difficult.

(a) Very few candidates answered this question correctly. Most explained the term anti-particle rather than stating that anti-matter was composed of anti-particles and then explaining that term.

(b) This question on the synchrotron particle accelerator was done very poorly by the majority of candidates. The diagrams produced in part (i) tended to be carelessly drawn and inaccurately or incorrectly labelled. In part (ii), many candidates talked in general terms about the operation of the synchrotron rather than explaining how the kinetic energy was increased.

(c) The matter-antimatter annihilation concept was familiar to most candidates. Responses to part (i) in most cases correctly identified momentum conservation and the calculations of gamma photon energy in part (ii) were usually correct.

Q8 This question was well answered by the majority of candidates.

(a) The definition of a fundamental particle is generally well known as responses to part (i) of this question demonstrated and most candidates were able to give an example of a fundamental particle as required in part (ii).

(b) Almost all candidates correctly named the boson (or bosons) associated with each force in part (ii). Part (i) proved to be of much greater difficulty. Very few responses conveyed the twin idea of the repulsion being experienced as a result of the boson being exchanged between the electrons.

(c) Most candidates correctly identified baryons and mesons as the two types of hadron in part (i) and went on in part (ii) to correctly assert that baryons are composed of three quarks and mesons of only two.

Q9 Candidate performance in this synoptic question was generally good.

(a) The calculation in part (i) of this question was correctly done by most candidates. Unfortunately, fewer were able to adequately explain the difference between the theoretical and practical values.

(b) The calculation of coefficient of restitution in part (i) was correctly done by almost all candidates and this time the explanations offered in part (ii) tended to be sensible and worthy of the mark.

(c) Explanations of natural vibration frequency tended to be poor.

(d) In part (i) of this question, the vast majority of candidates correctly identified Material C as that which would give the highest coefficient of restitution. In part (ii), candidate explanations for their choice of material were good.

(e) This projectile question was poorly done by many candidates.

ASSESSMENT UNIT A2 3 PRACTICAL TECHNIQUES

Generally candidates performed very well, in particular in questions one and two. Question three allowed more discrimination and more able candidates were able to score highly while weaker candidates struggled.

Q1 (a) Almost all candidates obtained the mark for part (i). Some candidates omitted to mention that the rule was horizontal only if the measured distances were equal. In part (ii), a handful of candidates measured from the wrong end of the metre rule and were penalised as were the few who recorded their distances in units other than metres.

(b) The majority of candidates obtained four marks here and very few candidates received fewer than three.

(c) In part (i), all but a few candidates knew that k was the gradient of their graph. In part (ii), while most candidates used the intercept method, some candidates substituted values from their graph (or results table) along with the gradient which they calculated, into the equation. The majority of candidates worked through their methods accurately and obtained full marks.

(d) In part (i) of this question, most candidates scored all three marks but there was some confusion as to how to complete Table 1.2. The majority of candidates identified that the smallest value would contribute the largest percentage uncertainty in part (ii) but did not explain why. Part (iii) was well done, although power-of-ten errors were common.

Q2 **(a)** The marking points for this part focussed on sound practical technique and most candidates scored well. In some cases there was no column for average time but the candidates had found the mean before scaling down to obtain the period.

(b) In part (i), almost all candidates correctly interpreted Equation 2.1 to identify quantities to plot. Completing the table, in part (ii), to compute T^2 (normally) was the most common cause of error in that many candidates didn't square the second, though the majority of the candidates did. The graphs produced in part (iii) were generally well done. Many candidates obtained full marks and of those who didn't, the majority scored four and often lost the mark for starting their y axis from zero. In part (iv), very few candidates lost the mark for using widely separated points for the gradient. It was frustrating to note that some used points from their table that were not on their best-fit lines. In general the gradient was well done and values for P consistent with their results (if not the Earth's acceleration of freefall!). Many candidates failed to pick up the quality mark for R.

Q3 **(a)** In part (i) it was difficult to award full marks for descriptions of the experiment. Candidates consistently did not specify the number of multiple readings, nor make clear that pd and current were measured at particular temperatures (distances in session two). In session two it was often unclear what the candidate was going to average. Diagrams tended to be of poor quality despite often containing salient information. In part (ii), many candidates correctly identified the experimental procedure but few adequately explained why it was beneficial.

(b) The best fit curves in part (i) were not always well drawn. Taking logarithms of the equation, in part (ii) was generally well done. There were only a few who used $\log_{10}$ in session one.

(c) In part (i), almost all candidates correctly identified the quantities to plot. Most candidates were able to explain how the gradient is to be used to obtain A (session one) or B (session two) as required in part (ii). Part (iii) of session two was well done by the majority of candidates.

(d) Session One: This part was well done by most candidates.

Session Two: The majority of candidates were able to work out the units in part (i) and to sketch the correct shape of curve in part (ii).

(e) Most candidates were aware of the correct procedure. Fewer were able to clearly describe it so that the final mark was lost due to an incorrect statement.