GCE

Physics B (Advancing Physics)

Advanced GCE **A2 H559**

Advanced Subsidiary GCE **AS H159**

Report on the Units

January 2010

HX59/MS/R/10J

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REPORT ON THE UNITS

Chief Examiner’s Report

The three papers taken in January 2010 showed a range of responses from the very encouraging to the rather disappointing. Although it is normal to find this, the mean mark on the two 60 mark papers was lower than expected. There are a number of possible reasons for this. The change in style of G494 from the legacy 2863 may well be a factor, along with the reduction of time for the examination. A paper of 60 marks in 60 minutes may be a tougher proposition than 70 marks in 70 minutes.

The responses to G491 showed that the jump from GCSE to AS level is as wide as ever, and the examiner’s comments on individual questions are illuminating. As ever, the principal examiners consider the candidates’ performance very carefully and this informs future paper development.

G492, the second AS paper (taken by re-sit candidates) performed well. It seems clear that some candidates are choosing to tackle the advance notice section of the paper before trying section B and in doing so making the best use of the time available.

The report for each unit of the January 2010 examination is given below.

G491 Physics in Action

Once again on G491 there were too many minimalist answers, lacking explanation or sufficient detail, giving particularly disappointing scores on the two Quality of Written Communication marks. This session there was also evidence of weaker numeracy skills and of the inability to get calculations out,; this included many more powers of ten errors and the inability of many to handle strain expressed as a percentage. There was also evidence again of candidates running out of time as many had no responses to parts of questions 10 and 11 in particular. There were also noticeable earlier gaps on the composite materials question 6 and bandwidth 10 (b). These factors lead to a disappointingly low mean of 23.3/60, with too many candidates scoring 15/60 or under. The questions showed good differentiation and the paper overall showed a standard deviation of ± 9.5.

Section A

1 This simple starter question on units was in a different format to usual, candidates were given equations for resistivity and conductivity and asked to write down the units, rather than selecting correct units from a list. This was a surprisingly a higher order of difficulty and the facility was about half its normal value on this type of question.

(a) Most correct answers were for Ωm, a few said VA^{-1}m.
Common wrong answers were Ω or ρ or a repeat of the given formula.

(b) Most correct answers were for Sm^{-1}.
Common wrong answers were S or G or σ or again a repeat of the given formula.

2 This question about an image improved by processing had a higher facility.

Most correct answers were for increase contrast or increase range of pixel values. Only a few said increase brightness, which was good enough for the two marks. Many wrong answers were about sharpening, edge detection or noise removal and scored zero.

3 This question was about brittle and plastic fracture illustrated by images of fractured steel.

(a) Most correct answers were for straight or sharp edges. Quite a number didn't get the mark because they just said jagged edges, which was not deemed a good enough description of brittle fracture features.
Many wrong answers referred to crack propagation, which were not rewarded.

(b) An easy mark for linking the brittleness to the low temperatures that might be met in space, weaker candidates didn't make the link to low temperature and lost the mark.

4 This was a graphical interpretation question on an analogue signal with some random noise. This is a new topic on the specification and many candidates were not familiar with the term peak to peak voltage (twice the amplitude).

(a) Many wrong answers gave the analogue signal amplitude rather than the peak to peak voltage. Many of those that did know the term chose 4.6 mV, but this included the noise and so they also lost the mark.

(b) This asked for the peak to peak variation of the noise in the signal. The facility rose to 0.49, a common wrong answer was 4.5 or 4.6 mV again. Weak candidates often gave 4.6mV as the answer to both a) and b), not distinguishing between the signal and noise components.

(c) Most candidates knew that the number of alternative sampling levels with 8 bits is $2^8 = 256$.
Wrong answers included calculations of $8^2 = 64$ or the ratio V_{total}/V_{noise} which was not relevant until d).

(d) This asked why 4 bits per sample was more appropriate with this level of noise. Many candidates got a first mark for noting that there would be 16 sampling levels ($2^4 = 16$).
Better candidates calculated $\log_2 (V_{total}/V_{noise}) \approx 4$ and could get full marks for their incorrect values by ecf.
Other good answers worked out the resolution of the levels with 4 or 8 bits and compared it to the noise signal for both marks. Candidates who did not include any numbers/calculations in their answer and wrote incorrectly about removing noise by sampling or sampling at a different frequency scored zero.

5 This question gave the voltage and power rating for a mains kettle and asked for the resistance of the heating element, and was well answered by many. There were many errors due to incorrect manipulation of equations leading to a calculation involving $R = V^2/P$. Many weaker candidates worked out P/V which is the current, (which could have gained a first mark if it was clearly labelled in Amps), but then quoted this in the answer line as the resistance scoring zero by contradiction.

6 Surprisingly many candidates left out this question or did not know what is meant by a composite material, many chose an alloy. This scored zero, but they were still allowed to gain credit by naming useful properties of the component metals in the alloy – many could not do this.

Most common composite named was reinforced concrete. A few got marks for concrete, bone and GRP or other fibre reinforced composites. Many missed the mark by writing about carbon and fibre making carbon fibre, but the vast majority of errors were about alloys .

7 Here candidates had to complete a diagram of focussing wavefronts and most made a reasonable attempt scoring either the mark for completion of focussing, or for keeping the wavelength sensibly constant. About a third of the candidates were able to score both marks,. There was some careless drawing, candidates most often drawing too many or unevenly spaced wavefronts; some drew rays only and lost both marks.

Section B

8 This question was based on a stress against strain graph for mild steel. Success in this fairly straightforward question, was somewhat lower than it has been in the past for questions on this topic.

(a) (i) Most candidates could describe the graph up to 0.1% strain; the mark was awarded for proportional or elastic or obeying Hooke's Law. Common errors included plastic behaviour and just writing linear.

(ii) To calculate the Young modulus, the majority of candidates had the method right, but a small percentage got the correct value and scored 3/3. There were many arithmetic errors, omitting the M prefix or not accounting for strain in % were most common, each was penalised a mark out of 3. The weakest candidates were not on the proportional part of the graph and calculated eg 300/0.5 which scored zero.

(b) (i) This question was surprisingly poorly answered by many candidates for the simple calculation of extension = length x strain and a significant minority candidates did not attempt this part. Candidates who missed the conversion of strain from % to decimal fraction in b) usually repeated the error here, so a common wrong answer was 0.1 m.

(ii) Here candidates had to calculate the force = stress x cross-sectional area. The first mark was available for getting the correct cross-sectional area, and the other two could be gained for method by ecf. Many found an incorrect area forgetting to half the diameter or by multiplying diameter by length. Power of ten errors were also very common for missing out M Pa or for ignoring 10^{-6} m^2 in 1 mm^2.

(c) This question asking for an explanation of plastic slip in metals was answered very poorly, with very few candidates gaining the QoWC mark and scoring 3/3. Despite the advice to make clear the changes in arrangement of atoms, some candidates referred back to the graph and argued about the shape of it. Many got 1 mark for the *not all planes slip at once* idea, but very few went on to write about stress concentration. Some mentioned dislocations, which gained credit but explanations to gain the 3rd mark were very poor. Mostly attempts at diagrams were rushed and added little to the answers.

9 This question was about planning the practical measurement of the electrical conductivity of a semiconductor.

(a) Many candidates could draw a reasonable circuit diagram for the experiment. Common errors were voltmeters connected in series, and some ammeters in parallel. Zero was awarded for non-functioning circuits, but some gained 1/2 marks if one essential element was missing. Use of an Ohm-meter was allowed, provided the semiconductor was not shown connected to a battery as well.

(b) This asked for the measurements needed to determine the conductivity. Most marks awarded for measure V and I and $G = I/V$ or $G = 1/R$. The approximate measurements given on the diagram (to help students think about suitable measuring instruments) may have led them to believe these were given values, and did not need to be measured. Hence not many candidates scored the easy mark for stating measure the length. It was rare for them to make clear that the area was a cross-section = width x height.

(c) Candidates had to make clear how the measurements were used to calculate the conductivity. Most got one mark for the transposed equation $\sigma = G\,L/A$ but lost the area mark because they just said *measure the chip to find the area*, or *we know the area from the measurements given*. Weak students mixed up conductance G and conductivity σ.

(d) Candidates were invited to suggest a way in which the measurement of conductivity could be improved. Many candidates did not attempt this question and again few candidates scored 3/3 including the QoWC mark. Many got 1 mark for mentioning some valid point eg temperature effects or meter resistance, but they didn't develop it. Many just wrote lists of different sources of uncertainty without suggesting any improvement, or just mentioned repeat readings without explaining the purpose (to find a mean or eliminate outliers). Many candidates are not yet used to looking for the measurement with the greatest % uncertainty (here probably the thickness of the semi-conducting chip) and thinking about how to improve it eg by using a measuring device with smaller resolution such as a micrometer screw gauge.

10 This question was about information transfers to run a HDTV system with a digital recorder.

(a) (i) Most candidates could multiply the number of pixels x bits per pixel x frames per second to obtain the bit rate. A common error was to include a factor of 2^{24} (the number of possible colour shades per pixel).

(ii) To find the maximum amount of information for transmission of 1 hour of HDTV, candidates needed to multiply their bit rate x 3600 secs/hour and then divide by 8 to convert bits to bytes. Some got one mark for getting as far as 3.98×10^{12} bits total information; others only multiplied by 60, but still scored 1/2 marks for a correct bits to bytes conversion.

(iii) This was very easy, although many candidates did not attempt the calculation of 200 Gbytes/80 hours. ORA reverse argument was perfectly acceptable ie about 3 Gbyte/hour x 80 hours = 240 Gbyte. The facility was high at 0.76. Some candidates who got parts (i) and (ii) correct and then omitted this part, must have been under severe time pressure.

(b) (i) Answers explaining why data compression must be used were not well expressed. Many just said *too much data*, without referring to the numbers they had just calculated or been given or making clear what data they were referring to. To state that even a 1 hour recording of 500 Gbytes would not fit on 200 Gbytes recorder memory designed for 80 hours was sufficient to get the mark. Better students did further calculations to show that the compression ratio was about 200:1, but this was not essential.

(ii) This question was also about evidence of compression from the viewpoint of bandwidth and on this new specification topic there were a comparatively large number of candidates who omitted this question. Candidates often repeated what they had said in b(i), and did not show an awareness that bit rate $\approx$ bandwidth or a bit less (factors of 2 were not expected and were ignored if included).

(c) The explanation of the term vertically polarised carrier wave was weak. There were many poor diagrams of wobbling ropes going through fences, but if they illustrated a transverse wave, the first easy mark was awarded. Many wrote about waves travelling or moving, rather than oscillating vertically, and so missed the second mark.

11 The final question was about a pressure sensor, it was complex and was targeted at the more able candidates. It was apparent that many otherwise good candidates were running out of time to read the detail of the question and think and write about it.

(a) (i) This asked for the current through two equal series resistances. Two thirds of candidates were successful in this $I = V/R$ calculation. The most common wrong answer was double the correct value because the two series resistances had not been added before the current calculation.

(ii) This asked for an explanation of the potential divider circuit and was poorly answered. Most marks were awarded for stating resistance B increases in resistance or F decreases or total resistance remains constant. Many students just attempted to explain the constant current and did not attempt to explain the p.d. increase across B. Only a couple got marks for the increased p.d. using resistance ratio reasoning and they forgot to explain constant current. So 2/3 was a common mark for good candidates. Weaker candidates missed this out or wrote irrelevant cover all statements eg *current is always the same in a series circuit.*

(b) (i) This showed a calibration graph for the pressure sensor and asked for the sensitivity, $\Delta y/\Delta x$ in this case.
The facility was 0.45. Common wrong answers were output/input at a point on the graph or $\Delta x/\Delta y$ which scored zero, but candidates who clearly attempted the gradient but made an arithmetic error gained a method mark.

(ii) This gave the voltage resolution of the meter 1 mV across the sensor and asked for the pressure resolution. Few candidates chose the easy method of reading directly from the graph the pressure variation that causes a 1 mV change in output p.d. There were many incorrect guesses with no working and some got the correct method but missed M prefix and scored 1/2.
Very few realised that they could calculate pressure resolution = voltage resolution/sensitivity.

(iii) This asked how temperature differences between the two resistors could cause a systematic error in the pressure measurement. Many scored 1/2 marks for stating that a change of temperature changes the resistance. Very few went on to develop the constant difference idea for the 2nd mark. Weaker candidates said pressure changes with temperature.

(c) (i) This introduced a the idea of a four resistor bridge circuit and asked for an explanation of the null output p.d. when all resistors were of equal value. The no response rate was quite high, but wrong answers included points like *voltmeter should be in parallel*, *or no current can get through here*, or talked about *voltage through* resistors. Not many were comfortable with the concept of a voltage at a point in the circuit and so did not have the language to explain that two equal voltages (3 V) at M and N have no p.d. between them.

(ii) The extra sensitivity of the bridge circuit with a 0.01 mV resolution meter was not apparent to many. Again there were many wild guesses; a common error was to multiply the original sensitivity by 100 instead of dividing. Sensitivity is an example where *bigger is not better* but very few candidates appreciated or remembered this under time pressure; others divided by 10 instead and also scored zero.

G492 Understanding Processes, Experimentation and Data Handling

General Comments

Following changes made to the examination time and also to the length of questions in this paper, there was no evidence of candidates running out of time. Also, statistical data on performance in the questions revealed that section C was more accessible, and in fact (unlike May 2009) proved easier than section B. As the contexts in section B are novel, while the contexts in section C were given in the advance notice material, this is very much as should be expected.

Comments on Individual Questions

Section A

Section A was an easy start to the paper, with A candidates getting 18+/20 and E candidates about 12.

In **Q1**, the expression Fv sometimes featured as an answer to both parts, suggesting not only a problem with the understanding of dimensions, but also lack of familiarity with $P = Fv$.

Q2 proved difficult for many, with the most popular answer being $\lambda/2$ rather than /4, presumably because (as in echo calculations) candidates neglected to allow for both wave paths.

Q3 had an error which is regrettable: the question read ‘velocity of 200 km h^{-1} relative to the ground’ rather than ‘relative to the air’ (it would have been better to have written ‘the aircraft flies at a speed of 200 km h^{-} through still air’). As a consequence, markers were instructed to mark as correct the three possible interpretations of the question. Most candidates read the question as meaning what the examiner had originally intended; most of the remainder chose to interpret it as reading that the resultant velocity was 200 km h^{-} due north, and found out the velocity relative to the air; a small number gained the one mark for v by stating it was 200 km h^{-1}. There was no evidence that candidates were put off by the wording, with at least three-quarters of the candidates being successful with this.

Q4 was well done by most, although confused candidates seemed to tick two boxes at random (clearly it makes no sense to tick two boxes for **X** and none for **Y**).

In **Q5**, most candidates either remembered the *Young’s slits* expression or else correctly deduced $\sin\theta = x/L$. There were quite a few ‘powers of 10’ errors in this question.

Q6 (a) and (b) were correctly done by nearly all, but 6(b) gave rise to a range of output powers (for an LED torch) ranging from 8.3×10^{-18} W to 6.4×10^{21} W without comment.

Q7 was well done, with few losing a mark for forgetting to convert from mm to m in part (b). Although almost all could find Usain Bolt’s reaction time in (a)(ii), few allowed for it in calculating the initial gradient of the graph in (b)(i), and many gradient measurements used very small values of Δv and Δt for their triangle.

Section B

Q8 In parts (a)(ii) and (c), candidates had to make estimates from the graph and justify their conclusions. In (a)(ii) they frequently lost a mark for not explaining themselves, although in part (c), prompted no doubt by the QWC icon, the explanations were frequently better, although many candidates fixed on the time $t \approx 6$ s, when Usain Bolt stopped accelerating, rather than $t \approx 8$ s, when he started to decelerate markedly, as the point when he relaxed his efforts.

Q9 Interpreting the spectrum shown in Fig. 9.1 proved surprisingly difficult. Many candidates chose the smallest intensity peak as having photons of the lowest energy, and about two thirds of the candidature correctly identified the two peaks in the ultraviolet range as being invisible to the human eye.

Part (b), identifying the spectral lines in a plan view of the diffraction of the light by a grating, proved hard. This was the question with the highest number of Nil Responses in the paper.

In part (c), calculation of the energy of the photon of light of wavelength 360 nm was done well, but few subtracted the kinetic energy of the emitted electron from that value to find the energy needed to escape the surface (the work function, although the term was not used in the question). Those who calculated the photon energy of the shortest wavelength spectral line which did not emit electrons gained full credit.

Q10 In (a)(i), many candidates had difficulty in explaining the formation of standing waves, and in (a)(ii) many correctly used the incorrect wavelength to get 2/3. The positioning of nodes and antinodes – most drew 'loops'; although these were not asked for – was frequently poor, with scrappy diagrams, lack of equal spacing of Ns and As, and not getting the ones at the ends (defined in the stem to (a)) correct.

An encouragingly high proportion of candidates applied the right test for proportionality in (b); a sizable minority correctly applied the wrong test (for linearity, not proportion), getting 1/3 if done correctly, Only the weakest candidates failed to realise this was a mathematical test on the data and suggested an experimental test instead.

Q11 As the facility indicates, this question on a computational model of changes of velocity in small discrete time steps was poorly understood by most, suggesting that this was a part of the specification (Understanding Processes 2.3 (viii)) which was unfamiliar.

In (a), candidates generally either explained why the horizontal displacement was constant, or else showed that it was 1.0 m, although both were required.

Part (b)(i) was difficult. About half the candidates got one mark for pointing out the straight-line sections joining points, but very few realised that these straight sections indicate constant velocity only if the horizontal axis were time; to justify this, the constant horizontal velocity component (from (a)) needed to be invoked. Most could show the time to fall (from the graph) was 0.7 s in (b)(i), and could also use $s = ½at^2$ to get 0.57 s in (b)(iii). In (b)(iv), few (13%) recognised that the lack of allowance for changes in v during the time intervals was responsible for the discrepancy in times to fall.

In (c), about a third of the candidates gained 1/2 for suggesting smaller time intervals (or a model which included velocity changes within the interval), but few could explain their suggestion to get 2/2.

Section C

Q12 Most could identify the appropriate resistors in (a), and a pleasing proportion could find the sensitivity, including the unit, in (b), with a mean facility there of 69% and 47% of the candidates earning all 4 marks.
The more difficult part (c) had different, equally valid approaches: either the number of 0.01 V 'steps' in the range of p.ds covered between 50 and 60 °C was calculated, and then the 10 °C range divided by this, while stronger candidates realised that temperature resolution = voltage resolution/sensitivity.

Q13 In part (a), most calculated the power correctly in (i); many failed to relate the last significant digit in a quoted value to any rounding uncertainty; and most made an attempt along the right lines, if not completely correct, to estimate the uncertainty in the value of P when u = 0.11 m. Only those who rounded to 1 s.f. gained the fourth mark. A common (and understandable) error was to pair u_{min} and v_{min}, and u_{max} and v_{max}, in calculating extreme values; if done consistently, this earned 3/4.

In part (b), nearly all completed the table corrected (3 s.f. were not penalised, even though 2 s.f. were appropriate), plotted the points correctly and drew an acceptable best-fit straight line. Only 25% were able to go on to use the graph to deduce the power, either by taking values from the line and substituting into the equation, or by realising that P = – (intercept on the horizontal axis); the commonest errors were omission of the minus sign, or reading the scale of the graph incorrectly.

Q14 The numerical answers (a)(i) & (ii) and (b)(i) & (ii) were well done, but the written discussions in (a)(iii) and (b)(iii) were often unclear and lacked the sophistication expected of a physics explanation. Relevant factors were often identified, but they were not adequately justified, so getting 1/2. For example, stating in (a)(iii) that the reason aircraft carry more fuel than the calculations above showed was necessary is 'It needs more fuel to take off than to cruise', gets the 'suggest' mark, but not the 'explain' mark. A fuller answer – and there were a number of possibilities, as is always the case when the command word 'suggest' is used – could have been 'It needs more fuel to take off than to cruise because greater force is needed to accelerate it to take-off speed than is needed just to overcome air resistance and provide lift'
In part (c), very, very few candidates referred to equilibrium between force and weight (and many seemed to think that mass and weight were synonyms, as in the world outside). The few who did often drew free-body diagrams with equal-sized arrows for *lift* upwards and *mg* downwards; alas, all too rare.

In (d) most (but by no means all) gained a mark for a best-fit line *excluding the outlier* (the Boeing 777, which was rather unsubtly labelled to draw attention to it), and also then a mark for the trend displayed and a mark for commenting that the Boeing was clearly of a different design from the others.

G494 Rise and fall of the Clockwork Universe

General Comments

This was the first A2 paper of the new specification. It should have provided no great surprises for any of the candidates, as both the specification content and paper construction were broadly similar to the previous series of Rise and Fall of the Clockwork Universe exams. This is not to claim that there was no change at all. The new version awards marks for Quality of Written Communication differently, and contains stretch-and-challenge questions to provide differentiation at the top end of the ability scale. The latter inevitably makes the paper feel a bit harder than its predecessor for able candidates, but did not appear to make any difference to weaker candidates.

Despite the high omission rate on parts of the last question, there was no evidence in the scripts that candidates were short of time in the exam. This is because that question was set on part of the course (applications of the Boltzmann factor) that candidates have always struggled with, and was inaccessible to candidates with poor mathematical skills. It was placed last so that any discouragement experienced by weak candidates would not affect their resolve to tackle the other questions.

Now that all of the formulae are provided on the data sheet, candidates should be less liable to attempt a calculation with the wrong formula. However, the need to join pairs of rules together to calculate quantities still defeats many weak candidates. Furthermore, their inability to articulate explanations using correct terminology is the same as ever – although their ability to pick out a correct statement from a number of incorrect ones is often very good.

Comments on Individual Questions

Section A

Although this still contains 20 marks, this is a larger proportion of the total mark (60) than on previous papers. This means that although it is still intended to be a straightforward and easy start to the paper, it can no longer contain just easy questions. However, it continued the tradition of testing understanding over a wide range of the specification.

Q1 Most candidates had little difficulty in correctly identifying the required units.

Q2 Although the vast majority of candidates were able to calculate a value for the decay constant, only a minority could write down a satisfactory definition of it.

Q3 Only a minority of candidates could use their calculated change of momentum of the astronaut to find her velocity after emitting a jet of gas. Many candidates were confused about the direction of the change, adding the velocities rather than subtracting them.

Q4 This was the debut question for the time dilation factor. It was good to find that calculating a value for it and applying it to find the half-life of particles moving in a beam was easy for most candidates.

Q5 Many candidates who were able to successfully calculate the gravitational energy, lost a mark by omitting the minus sign. Most were able to correctly identify the correct statement about the satellite in its orbit, showing a good understanding of the term equipotential.

Q6 Although the vast majority of candidates knew that the area under a voltage-charge graph represents energy, only a minority realised that charge is the area under a current-time graph.

Q7 Most candidates incorrectly made the amplitude tend to 5 mm at high frequencies, whereas it should tend to 0 mm.

Q8 This was correctly answered by the vast majority of candidates.

Section B

Q9 Most candidates found this question relatively easy. The majority were able to correctly calculate the number of particles in the gas and calculate its temperature after a rapid compression. Explaining the change in pressure of the gas when heated was not so easy, with many candidates not providing enough detail. In particular, few candidates stated that the force of each collision with the wall increased because the change of momentum of the particle was greater. Many candidates lost a mark in the third calculation by not stating their assumptions. The last part of the question was very poorly answered – very few candidates have any appreciation of the conservation of energy applied to the expansion of gases, with only a small minority stating that the work done by the expanding gas must be at the expense of the internal energy so that the total energy remains unchanged.

Q10 The calculations in this question performed as expected, with the last part providing the most discrimination – strong candidates found it easy and weak ones found it impossible. The first part required candidates to write about a method of distance measurement using electromagnetic waves. Many candidates lost marks by omitting important practical details (the waves needed to be pulsed) or being too vague about the assumptions required. "Constant speed" earned no marks, whereas "the same speed on the way there as on the way back" did. Although most candidates could correctly draw the force arrow on the Moon, only a few understood why it did not change its speed.

Q11 This question used a modelling context to test understanding of several different parts of the module's specification as well as some synoptic elements from AS. Although few candidates were able to relate the factor of d-cubed to the volume occupied by an atom, they were nearly all able to correctly calculate a value for d, and use it to find a value for the force constant. However, many weak candidates struggled with the units question, mainly because they couldn't remember the equivalent of Pa in N and m. Many candidates sketched good velocity curves, but only a minority could do the same for kinetic energy. The last calculation was intended as stretch-and-challenge. Only a minority of candidates were able to keep a clear head, decide on the path to follow and not get confused between the two different quantities denoted by k in the question.

Q12 As expected, this question proved to be the hardest one in Section B. The first calculation provided good discrimination, with weak candidates often showing insufficient working to earn any credit for a wrong answer. Even strong candidates struggled to apply the Boltzmann Factor to account for the rate of emission of electrons – it was the second stretch-and-challenge question on the paper. The last parts of the question required candidates to use logarithms to expand the Boltzmann Factor and use the gradient of a graph to calculate an energy. Many weak candidates were unable to do the maths, and also forgot about the powers of ten when reading values off the graph.

Grade Thresholds

Advanced GCE Physics B (H159/H559)
January 2010 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
G491	Raw	60	34	29	24	20	16	0
	UMS	90	72	63	54	45	36	0
G492	Raw	100	71	64	57	50	43	0
	UMS	150	120	105	90	75	60	0
G494	Raw	60	39	35	31	27	23	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
H159	300	240	210	180	150	120	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
H159	10.1	32.1	57.4	79.4	95.8	100	530

530 candidates aggregated this series

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums/index.html

Statistics are correct at the time of publication.

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