OCR
RECOGNISING ACHIEVEMENT

GCE

# Physics A

Advanced GCE **H558**

Advanced Subsidiary GCE **H158**

# Report on the Units

# January 2009

**H158/H558/MS/R/09J**

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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## REPORTS ON THE UNITS

# Principal Examiner's Report

**G481: Mechanics January 2009**

**General comments**

This new unit exam produced a good spread of marks. It was clear that most Centres had effectively delivered the content of the new specification. However, a very small number of Centres were clearly teaching the legacy specification because their students failed to answer the questions addressing the additional learning outcomes (e.g: GPS). A small number of candidates seemed to be inadequately prepared, attempting less than one fifth of the questions. It was good to see that many Centres had made an excellent use of the 2821 legacy papers in preparing their students for this unit paper.

It is worth reminding candidates that their scripts are now scanned and then electronically marked by examiners. It is therefore imperative that they do not write beyond the scanned zones on the paper. The legibility of candidates' work remains a serious concern with too many key words spelled phonetically. It was not uncommon to see words like '*satalights'*, '*coz'* etc. In some cases, the candidates' scripts were almost illegible, with letters and numbers merging into random doodles. At times, examiners had no alternative but to make an intelligent guess as to the intended words used.

Candidates are reminded that there are two marks available for including two technical words and spelling them correctly. Candidates must not use abbreviations when answering questions signposted by the pencil icon. On this paper, one of the expected words was 'gravitational'; too many candidates wrote down 'GPE' and lost the mark. The availability of the Data, Formulae and Relationships booklet does imply that candidates do not have to recall equations and marks awarded in the paper will be for correctly using the equations. A disappointing number of candidates failed to take advantage of this booklet. Too many candidates were overwhelmed when rearranging equations. A small number of candidates tried using the mnemonic triangles to rearrange equations and displayed poor analytical skills. Many answers lacked the robustness expected at AS level.

Most candidates finished the paper in the scheduled time. However, a small number of candidates were rushing at the end of paper. Candidates are reminded that on average it should take about one minute per mark. It is not sensible to spend a disproportionate amount of time on a particular question. The advice from examiners is to leave a part question that they cannot do and to move on to the subsequent questions. Candidates must also endeavour to scrutinise questions with care before answering. Sadly, too many candidates lost vital marks because their answers had little to do with the questions asked. Candidates must also have a decent grasp of all command terms such as state, describe, define etc.

## Comments on Individual Questions

### Question One

Most candidates scored three or more marks for this opening question.

Most candidates made a good a start by defining a vector correctly in (a). A very small number of candidates described the vector as '*a force with direction*'.

At AS level, candidates are expected to recognise vector quantities. About half the candidates correctly identified the three vectors in the list of five in **(b)**. A small minority thought speed was a vector and a similar number of candidates omitted weight.

Candidates generally struggled with **(c)**. The lack of precision in their answers in **(c)(i)** meant that many candidates scored one rather than two marks for describing the motion of the Car A. Many candidates failed to mention that the acceleration of the car up to 4.0 s was constant. There were too many scripts with answers such as '*initially the car accelerates at a constant rate'* or '*the car accelerated with constant speed'*. For some candidates velocity and acceleration were identical. In **(c)(ii)**, most candidates recognised that the area under the graph was equal to the distance travelled by the car. About half of the candidates managed to get the correct answer of 68 m. The most popular incorrect answer was 'distance = $\frac{1}{2}\times 14\times 4.0 = 28$ m'; candidates simply ignored the initial velocity of 10 m $s^{-1}$. Some candidates wasted unnecessary time by first determining the acceleration of the car from the gradient and then using the equation '$s = ut + \frac{1}{2}at^2$' to determine the distance travelled by the car. Candidates are reminded that sloppy work can prevent them from getting compensatory marks for showing working. The majority of the candidates secured one mark for **(c)(iii)1**. Sadly, most candidates struggled to see the connection between this answer and the answer to **(c)(iii)2** and this either resulted in convoluted analysis involving equations of motion or a no response. Too many candidates should have cut their losses and ploughed through the rest of the paper.

### Question two

This was a low-scoring question, with about a quarter of the candidates scoring more than four marks.

The topic of projectiles can be quite daunting, but most candidates found **(a)** accessible. A small number of candidates thought that the acceleration of the water at P was either a tangent to the path or in the same direction as the initial velocity of the water.

In **(b)**, candidates had to include the word 'gravitational' and spell it correctly. Sadly, instead of picking up some easy marks here, some candidates did jumble up their physics. Some candidates thought that the water has no gravitational potential energy (GPE) at the start and that the energy transformation was from kinetic energy to GPE.

Most candidates found **(c**) tough. The idea that the weight or the acceleration has no component in the horizontal direction was too challenging. However, about a quarter of the candidates managed succinct answers. Low-scoring candidates either gave no answer or paraphrased the wording in the stem of the question.

Once again, too many candidates in **(d)** wasted considerable time using equations of motion to show that the water took about 0.5 s to reach the ground. The answer was much simpler; divide the range 3.6 m by the horizontal speed 7.0 m $s^{-1}$. A significant number of candidates analysed the vertical motion of the water and used '$1.3 = \frac{1}{2} \times 9.81 \times t^2$'.

Less than a quarter of the candidates managed to gain more than one mark for **(e)**. A pleasing number of candidates correctly used an equation of motion to determine the vertical component of the velocity of 5.0 m $s^{-1}$ and this was correctly added vectorally to the horizontal component of 7.0 m $s^{-1}$. There were a few blatant fiddles in this 'show' question. Candidates are reminded that at AS level such manipulation of figures is most unlikely to escape severe penalty. A significant minority of candidates determined the final displacement of the water from the end of the pipe (3.83 m) and then used the equation '$v^2 = 7.0^2 + 2 \times 9.81 \times 3.83$'; this was clearly wrong.

**Question three**

The majority of candidates scored four or more marks for this question.

Candidates must not ignore learning key definitions. About a third of the candidates could not define the newton in **(a)**. Some of the answers lacked rigour and showed the naivety on part of the candidates. It is impossible to secure a mark for definitions such as '*coz it is named after Isaac'*, '*it is the unit of force*', *'100 grams is equal to 1N*' or *'it is when 1 kg moves through a distance of 1 m*'.

The answers to **(b)** were generally very poor with about a third of the candidates secured a mark. The question was almost identical to one of the learning outcomes of this new specification. Many candidates had no concept of a particle. To them particles '*were too small and hence had no mass'*. Candidates were expected to know that the mass of particles increases at very high speeds.

Most candidates gained two marks for **(c)(i)**. A few candidates found rearranging the equation $F = ma$ difficult, however, most of them did appreciate that they had to use the net force of 120 N. The modal mark for **(c)(ii)** was zero, with a fifth of the candidates gaining a mark. The question did not trigger the response expected, namely that the acceleration of the car was not constant because of changing magnitude of the drag.

Most candidates scored either one or three marks for **(b)**. Many candidates were content to quote an answer of either 706 N or, more frequently, 108 N. Some of the most popular incorrect answers were '$72 \times 9.81 \times 1.4$' or '$mg / a = 72 \times 9.81 / 1.4$'.

**Question four**

Most of the candidates scored more than half of the available marks in this question.

In **(a)**, a disappointing number of candidates either defined a 'couple' instead of a 'torque of a couple' or omitted 'perpendicular' distance in their definition. Sadly, only a third of the candidates gained a mark here.

In **(b)**, the majority of candidates realised that the units were identical because both quantities were a product of force and a distance. A small number of candidates wrote '*Fd*' without defining the terms and hence lost the mark.

Amazingly, only half of the candidates managed to pick up a mark for the magnitude of the clockwise moment in **(c)(i)**. A range of answers were seen, with '6.0 × 0.30' and '6.0 × 5.0' being

the most common errors. In **(c)(ii)** the answers were not sufficiently precise to score the mark, with only a small number of candidates referring to the perpendicular distance between the pivot and the weight.

The question in **(d)** was straight from one of the learning outcomes of the specification. About a quarter of the candidates scored zero. However, the majority of the candidates gave adequate description of the experiment and picked up three valuable marks. Some candidates would be advised to write their answers in bullet points rather than in continuous prose. As mentioned at the start of this report, candidates struggle with presentation with poor spellings, ungrammatical sentences and illegible words. The examiners were amazed with the variations to the word 'plumb line'.

It was good to see some excellent answers to **(e)**. Some candidates did struggle with working consistently in either centimetres or metres.

**Question five**

More than half of the candidates scored six or more marks for this question.

The majority of candidates made good use of the Data, Formulae and Relationships booklet and secured full marks in **(a)**. A very small number of candidates either swapped their answers for the horizontal and vertical components of the force or misread the information by writing '*horizontal component* = 38 × cos20'.

The answers to **(b)(i)** were generally good with the majority of the candidates doubling the vertical component of the force from **(a)**. A few candidates did a scale drawing. About a third of the candidates scored zero in **(b)(ii)** but more than half of the candidates scored full marks. The most common errors were using:

- 25 for the mass
- 25 × 9.81 for the mass
- density = mass × volume

**Question six**

The majority of the candidates scored more than three marks for this question.

Most of the candidates gave clear definition of the stopping distance in **(a)**. A small number of candidates gave the definition for braking distance instead.

The answers to **(b)** were generally good. A small number of candidates effectively gave several cases of one factor that affected braking distance - for example, icy road and wet road. Examiners were a bit generous with their marking and allowed the use of 'stopping distance' instead of 'braking distance'.

The study of GPS is new to the specification and Centres could almost have guessed that there would have been a question on this topic. Sadly, the answers to **(c)** showed the total lack of understanding of how GPS works. Only a very small number of candidates could correctly spell 'satellites'. Candidates had satellites roaming a few miles away from the cars. Most candidates drew intersecting circles but the interpretation of these circles mystified virtually all the candidates. For most candidates the satellites were magical and computed the position of the cars by beaming coded messages. A response such as '*the satellite knows where the car is'* was quite common. There was not much physics visible in most responses from the candidates.

**Question seven**

The majority of candidates scored four or more marks for this question.

Most candidates made a good start in **(a)**. A small number of candidates gave kinetic energy and potential energy as their answers.

Only about half of the candidates managed to work consistently in the right units to calculate the value of the strain in **(b)(i)**. There were too many candidates with an answer of 0.29 instead of $2.9 \times 10^{-4}$. In **(b)(ii)** many candidates used the $E = \frac{Fl}{Ax}$ approach and for some the rearranging of the equation to make *F* the subject proved too difficult.

There was evidence that some low-scoring candidates were rushing through **(c)**. A surprising number of candidates in **(c)(i)** were not aware of the size of a nanometre; values ranged from $10^{-12}$ to $10^{15}$. Knowledge of prefixes is clearly stipulated in the specification. Candidates also demonstrated a poor understanding of plastic deformation. Too many candidates gave answers such as '*the material extends beyond elastic limit*' with making clear reference to permanent deformation when the stress or force was removed. Most candidates gave 50 as the answer to **(c)(ii)**. A small number of candidates gave 50 GPa or 58.8 GPa as their answer. The majority of the candidates in **(c)(iii)** realised that a bicycle with CNT technology would be both lighter and stronger.

# Grade Thresholds

**Advanced GCE Physics A (H158/H558)**
**January 2009 Examination Series**

**Unit Threshold Marks**

| Unit | | Maximum Mark | A | B | C | D | E | U |
|---|---|---|---|---|---|---|---|---|
| **G481** | Raw | 60 | 42 | 37 | 32 | 27 | 23 | 0 |
| | UMS | 90 | 72 | 63 | 54 | 45 | 36 | 0 |

**Specification Aggregation Results**

**No aggregation was available in this session.**

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

Statistics are correct at the time of publication.

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