# Examiners' Report/ Principal Examiner Feedback

June 2010

GCSE

360Science

GCSE Additional Science
Structured Paper P2 (5020H/1H)

GCSE Physics
Structured Paper P2 (5048H/1H)

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**5020H Additional Science/ 5048H Physics Examiners' Report**
**Structured paper P2**
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## General Comments

There was noticeable variation in the achievement of candidates entering for the two different examinations. In general, candidates entering for 5020 performed less well (by an average of 5 to 10%) than candidates entering 5048. Where statistics are quoted below, unless stated otherwise, the data given is for candidates entering for 5020 paper as this was the highest entry.

There was some evidence that candidates were a little more familiar with standard definitions and vocabulary although this is still a weak area. Candidates can gain relatively straightforward marks relating directly to statements in the learning outcomes and glossary in the specification.

Some candidates failed to write legibly. There was no evidence that candidates had insufficient time for the paper. When candidates wrote at length the quality of their English deteriorated. Candidates should be guided by the marks available and the space given when considering how much to write. Candidates would be well advised to re-read their answer for sense. There were fewer examples of scripts written in pencil. However, some candidates wrote in such a heavy pen that their answers 'leaked' through to the reverse side of the paper. If the writing is illegible and crucial words (e.g. fission and fusion) cannot be determined then no marks can be awarded.

The standard of calculation seen was improved as there were fewer 'bald' answers without working-out shown. This enabled some candidates to gain valuable partial marks e.g. by substitution into the correct equation. Candidates could, on the whole, select the correct equation and substitute in a dimensionally correct value. However transposition is still a major problem area for many candidates. There was no evidence of problems with units apart from omitting them.

## 1. Alpha, Beta and Gamma properties

Part (a) of this question required candidates to complete 'revision cards' with the properties of the three radioactive emissions. The modal mark for this was two out of the possible three marks; 72% of candidates gained two or more marks. Candidates were, in general, quite insecure about the charge on alpha particles with quite a few thinking that the charge was '+1' or worse '-4'. Most knew about the comparative ranges but many lacked sufficient precision and gave vague answers e.g. 'far' for beta and 'very far' for gamma which did not gain credit. Some candidates gave answers in terms of penetration of various metals e.g. 'it can be stopped by thick lead' for gamma.

Part (b) was an application question on the range and ionisation of alpha particles. Most candidates (over 70%) deal with range correctly and were able to link this with the diameter of the cloud chamber although some clearly assumed that the (10 cm) diameter related to the size of the particle itself. A large proportion of candidates identified the strong ionising ability of alpha but found difficulty in relating the ionising ability to track thickness, track clarity or amount of condensation and so were not able to score the second mark. A tiny proportion made reference to alpha being a heavy particle but once again did not link this to straight tracks. In many cases candidates repeated chunks of the stem of the question in an attempt to provide an answer. Worryingly, there were a significant number of candidates who thought the tracks were clear because an alpha particle is 'big enough to see'.

**2. Force, acceleration and kinetic energy of a racing car**

The calculations in this question were accessible for most of the candidates. In part (a) 50% of the candidates gained all three marks for the calculation of force, and a further 40% gained two marks. These candidates usually gave an incorrect unit or omitted the unit. It was quite common to see derived units e.g. kg $m/s^2$ rather than N.

In part (b), the explanation of why the force produced by the engine was greater than the calculated force was poorly done with less than 20% gaining this mark. Often mistakes were made due to the candidates not reading the question which was clearly about forces. There was considerable confusion of force and energy ideas e.g. 'it needs to produce more force as some will turn into heat/sound'. Many candidates tried to use an energy argument e.g. wastage of energy as heat/sound/friction. Some candidates mentioned friction between the tyre and the road, some made reference to friction but gave no explanation as to where the friction was produced, but the concept of friction inside the engine was rarely seen.

The calculation in part (c) was a little more complex as it involved a transposition of the equation. Over 55% of the candidates gained all three marks. The most common mistake was to multiply the velocity by the acceleration. A few candidates were able to gain partial marks for a correct substitution seen before the incorrect transposition. As usual bald incorrect answers gained no marks.

Transposition errors also occurred in part (d)(i), but often candidates self-corrected as they were 'given' the answer. Difficulties arose with the factor of '1/2' and 54 (rather than $54^2$). Over half of the candidates were able to gain at least one of the available marks. Both methods of doing the calculation were equally popular. Those candidates who went down the route of calculating the kinetic energy for a mass of 600 kg often failed to compare their answer of 874 800 J with the given kinetic energy of 860 000 J. This meant they only gained 1 of the 2 available marks. There was evidence that a minority of candidates were unfamiliar with the equation for kinetic energy, despite it being given on page two.

The reasons given for the reduced mass of the car in part (d)(ii) were varied and inventive. The simplicity of the answer required defeated most candidates and some candidates wandered off into discussions about equivalence between mass and energy and relativistic effects. Very many cars suffered because seats, wing mirrors, luggage, and even drivers were ejected. Loss of fuel appeared to be an after-thought.  Less than 30% were able to gain this mark.

**3. Half-life using a simulation**

In part (a) many candidates incorrectly gave variations on 'validity' or 'reliability' as the reason for preferring a simulation to a demonstration. Just over half of the candidates gained this mark, mostly for 'safety'. More able candidates gave more considered correct responses such as the ability of the simulation to operate outside real time.

Part (b)(i) was poorly answered. A large range of misconceptions was demonstrated in the responses e.g. half life is the time it takes an **atom** to break down/decay, it is the time taken for half of the **radioactivity** to decay, the time taken for half of the **electrons** to decay, half life is the activity halfway through, time it takes the **radiation** to decay by half, the half-life is half the life of the source, and a single atom (or nucleus) halving, decomposing, dying, deteriorating or rotting. Answers in terms of activity or count rate produced better answers that were generally correct compared to those who took the decay route.

Part (b)(ii) produced mainly a correct answer, even in situations where there was no answer in part (i). Those candidates who failed to gain the mark usually put either the maximum time displayed on the graph, or halved it, or put the time interval at which the experiment was taking readings, 25s.

**4. Fission products of uranium 235**

The first part of this question was relatively straightforward and nearly 70% were able to gain the first mark for calculation of the number of neutrons in a uranium 235 nucleus. However explanations of why two xenon137 cannot be produced were often too imprecise. Many candidates were on the right line but mentioned only neutrons or only protons. Some candidates had been taught the term nucleons and these candidates were generally more successful. Only the more able candidates were able to find the number of neutrons produced from the fission (with or without the impacting neutron). There were approximately 25% of candidates who gained either of these two marks.

Many candidates interpreted part (b) as "write everything you know about". Weaker responses ignored the instruction 'use the information in the tables…' and wrote about generic nuclear waste "issues" or regurgitated project work. Approximately 35% of candidates were able to gain one or more marks for this part. Many candidates made promising starts to the question but failed to gain marks because of the imprecision of their answers. Frequently answers were very general and did not mention any isotopes by name, or made points about safety that were very vague. Much of the vagueness came from the use of basic terms like carefully, safely, difficult, easy, hard, dangerous, problem.

Marking Point 1 was probably the most popular; however many candidates started with 'it' being 'harmful' but then didn't mention shielding or security or even what 'it' was. Successful answers related emission of beta particles to the need for shielding by lead or aluminium.

MP2 was also popular, identifying an isotope and linking its half life to the time of storage required but many mistakes were made. The most common errors showed fundamental misunderstandings of half life – there were assumptions that either 2x half life means no activity remains or 1x half life means that the activity is at a "safe" level. Some candidates even considered it desirable to use isotopes such as xenon as they had short half lives as fuel rods!
A significant proportion gained the mark for MP5, although it was obvious that the vast majority of candidates did not realise that uranium would remain in the rods, essentially forever.
There were very few responses that scored MP4, the heat generated by the fuel rods. A tiny proportion attempted to link activity to half life thus scoring MP3.
These are examples of some of the strange ideas seen:

- Xe has a half life of 30 years and 38 minutes
- put them in a lead box for 0.2 s as they are hard to keep
- Kr is no good because it does not last long

### 5. Velocity, acceleration and work done by a satellite

Part (a) was well answered with 65% of the candidates gaining both marks and a further 20% gaining one mark. The most common mistake was to draw both the velocity and gravitational force at either or both positions B and C.

In part (b) nearly 40% gained at least one of the two available marks. It is pleasing to note the improvement of attainment from previous occasions when the concept was examined. Many candidates answered that either the velocity was changing or that the direction was changing, but often they did not put both of these statements together. Responses that did not score included those where candidates talked about gravity/centripetal force accelerating the satellite. However the most common incorrect answer was that time is increasing so there must be acceleration.

Candidates found part (c) the most difficult of the entire paper with many failing to gain any mark. The concept was not well understood but this was centre dependant; explanations were poor and were not always coherent. It is worrying that a number of candidates consider that there is no gravity in space, or rely on magnetic or other planetary effects to explain the behaviour of the satellite. Some candidates gained a mark for mentioning lack of air resistance. Some candidates wrote the equation for work done (often without a statement that work done equals zero) but made no reference to the distance in the direction of the force being constant. Common incorrect responses included; 'the satellite does not need fuel to stay in orbit because the gravitational force is keeping it in orbit', 'gravity provides the fuel so no fuel is needed', 'the satellites velocity & the earth's gravitational force keeps the satellite moving'.

**Suggestions for improvement**

1. Ensure that the vocabulary of physics is well known. There is a glossary of terms in the specification that can be helpful. Many starter or plenary activities can be devised along these lines. There will always be some of these 'recall' type questions on each paper. However it is important that centres are very specific with definitions

and do not teach their candidates alternative ‘almost correct’ definitions especially for half life as these invariably score zero marks.

2. Practice transformations of equations. On the higher tier paper the equations are only given in their fundamental form.

3. Candidates need to know which sections are in bold in the specification. There are not many of them but the last part of the paper usually covers at least some of them.

4. As always, get students to check that they have answered every section. Some candidates are helped by using a highlight pen to focus in on the detail of the question. The specific meanings of the instruction words could be included in vocabulary revision.

5. Ensure candidates write legibly and show working in calculations.  Also give unit penalties on homework or classwork if your candidates omit units or give incorrect units. You can be harsh with your class marking and/or mock exam to ensure that good practice and exam techniques are well drilled. In a GCSE exam, incorrect bald calculations get no marks whereas calculations with working shown usually can gain at least some of the marks.

6. Practice data analysis/application questions such as Q4b. This can often be done with techniques such as snowballing. Able students may benefit from a discussion of the mark scheme. Class analysis of (anonymous) students’ answers can also be helpful. Concentrate on elimination or expansion of vague terms such as ‘easy’, ‘difficult’, ‘powerful’ etc. Sequencing is a technique that can help weaker students.

# Grade Boundaries – June 2010

## Multiple Choice Papers – GCSE Additional Science

### Raw Mark Grade Boundaries

| 5015/5027 | Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 24 | 21 | 19 | 17 | 16 | 13 | 11 | | |
| F | 24 | | | | 17 | 14 | 11 | 9 | 7 |

| 5017/5037 | Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 24 | 19 | 17 | 13 | 10 | 7 | 5 | | |
| F | 24 | | | | 16 | 13 | 11 | 9 | 7 |

| 5019/5047 | Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 24 | 19 | 16 | 14 | 12 | 8 | 6 | | |
| F | 24 | | | | 16 | 13 | 10 | 8 | 6 |

### Uniform Mark Grade Boundaries for these units

| | Max UMS | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 40 | 36 | 32 | 28 | 24 | 20 | 18 | | |
| F | 27 | | | | 24 | 20 | 16 | 12 | 8 |

Note: On higher tier papers, the "allowed" grade E is calculated as half a grade width

## Structured Papers - GCSE Additional Science

### Raw Mark Grade Boundaries

| 5016/5028 | Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 30 | 20 | 16 | 12 | 9 | 6 | 4 | | |
| F | 30 | | | | 18 | 15 | 12 | 10 | 8 |

| 5018/5038 | Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 30 | 20 | 15 | 11 | 7 | 5 | 4 | | |
| F | 30 | | | | 18 | 15 | 12 | 10 | 8 |

| 5020/5048 | Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 30 | 20 | 18 | 14 | 11 | 8 | 6 | | |
| F | 30 | | | | 19 | 16 | 14 | 12 | 10 |

### Uniform Mark Grade Boundaries for these units

| | Max UMS | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| H | 40 | 36 | 32 | 28 | 24 | 20 | 18 | | |
| F | 27 | | | | 24 | 20 | 16 | 12 | 8 |

Note: On higher tier papers, the "allowed" grade E is calculated as half a grade width

## Biology, Chemistry and Physics Extension Papers

### Raw Mark Grade Boundaries

**5029**

| Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 60 | 48 | 43 | 38 | 34 | 29 | 24 | 20 | 16 |

**5039**

| Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 60 | 55 | 49 | 42 | 36 | 30 | 25 | 20 | 15 |

**5049**

| Max mark | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 60 | 50 | 44 | 38 | 32 | 26 | 20 | 15 | 10 |

### Uniform Mark Grade Boundaries for these units

| Max UMS | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 120 | 108 | 96 | 84 | 72 | 60 | 48 | 36 | 24 |

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