RECOGNISING ACHIEVEMENT

GCSE

Physics B

Gateway Science Suite

General Certificate of Secondary Education **J265**

OCR Report to Centres

January 2012

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Oxford Cambridge and RSA Examinations

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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 specification 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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Overview

Centres have been exposed to the Sample Assessment materials for this new GCSE. In this sitting, only the unit 1 assessments were available (B751-01 foundation and B751-02 higher). There has been a noticeable shift in questioning techniques as required by the regulator, and these were evident for centres to see in these papers. As a result of this new approach, the mean marks on the papers were lower than in the past but candidates gave good answers despite the challenges they faced.

On these papers, candidates were expected to apply more in terms of **data handling** skills and the **application** of physics knowledge and understanding. **H**ow **S**cience **W**orks questions were more in evidence and these left many candidates wondering what to do. Candidates are well advised to refer to the HSW statements at the front of the specification, as familiarity with the language may help them. The reports on the individual papers, along with their mark schemes will help guide candidates and centres toward the desired expectations for success. Also, prompting in longer questions with bullet points, which has proved very successful in the past, was largely absent on these papers. This led to answers that were often less focussed than in the past.

Calculation questions as a rule are being completed increasingly well. This is partly due to the formula being present on the paper. However they do have to choose the correct formula and substitute the correct figures into it for 1 mark. The other mark is available for the correct answer. At higher level they may be asked to rearrange formulae too. The usual errors are missing decimal points from one of the input values (eg 15V rather than 1.5V).

Not using, or forgetting to bring a calculator.

Dividing the numbers the wrong way. Irrespective of the division it is tempting for candidates to put the smaller number ‘underneath the line’. So, for example, if the correct division is 3 / 6 which = 0.5 [2 marks], many will incorrectly divide 6 / 3 to get 2 [0 marks].

Calculations are increasingly being asked where candidates choose numbers from a range of values. These questions may contain distracters in addition to what is really needed to answer the question. For example a question to calculate acceleration given mass and force may also contain the distracters: speed or energy. This makes the selection of correct formulae more demanding.

Calculations are also increasingly being presented in developed form. In these cases candidates are asked to do a calculation to prove an answer, or to comment on a response, or decide who is right. Often the maximum marks are only obtained when candidates refer to this developed aspect in the answer.

Centres should remind candidates that scripts are scanned as black and white images, so the use of coloured pens or faint pencil is not recommended. Also often candidates’ answers will not fit in the designated area. A sensible approach used by many candidates is to indicate part of the answer is elsewhere on the page. An arrow is often all that is needed to highlight this. This will then direct the marker to open up the whole page and mark accordingly. If no such indication is there then the answer may be missed.

The Principal Examiners’ reports which follow indicate good advice for teachers and candidates alike. Heads of Science are advised to use them with their colleagues so that in classroom situations, they can routinely and purposefully advise their students.

B751/01 Unit 1 – Modules P1, P2, P3 (Foundation Tier)

General Comments

This was the first paper of the new Gateway physics GCSE. Centres had been aware of the changes to the specification and the sample assessment materials had been available for some time. As a result centres will not have been surprised at the changes in emphasis in some parts of this paper. There was a more rigorous expectation in terms of data handling, extended answers and applying knowledge and understanding. Also questions contained less scaffolding than those in the legacy assessment. Despite the changes and the different look and feel of this paper candidates generally responded well. For instance there was a high attempt rate and very few answers were left blank. The paper seemed to fit in with the time allocated and there was no significant evidence of answers being rushed or papers left unfinished. The mean on this 75 mark paper was 31 and the marks ranged from 7 up to 64.

Comments on Individual Questions

1 In part (a), good answers referred to black being the better absorber of heat [1] or white reflecting heat (and black not reflecting heat) [1]. The answer needed a correct comparison to secure the mark. Many answers fell short of this comparison however with 'black absorbs heat' [0] being a common response. There were quite a number of references to black being a good conductor.

In part (b), about a third of candidates correctly stated that the colours in thermo-grams are indicative of temperature. Many candidates attempted to describe the liquid thermometer instead. In choosing the quickest cooling cup many were caught out by the problem solving aspect, handling the data and applying and explaining the science. Most thought C would cool quickest as it had a low temperature. Marks were available for A [1] (black cup at $90^{O}C$) because it is hottest [1] and black emits most heat [1]. Very few candidates gained all three marks here. The explanations were marked independently so for example candidates who chose cup B [0] because 'it was the hottest [1] gained a single mark. Many candidates though were preoccupied by the heat gained by the cups rather that heat radiated from the cups. Few clearly applied how temperature difference can affect the rate of cooling.

Part (c) was about graphical interpretation of melting and boiling. Successful answers indicated parts B and D [1] of the graph and explained that the temperatures here 'stayed the same' [1]. Some merely described the shape of the graph and called them 'the straight bits' [0].

2 This question was about seismic waves. In part (a) two thirds of candidates knew that the seismometer was used to detect shock waves [1]. Common incorrect answers were ammeter and voltmeter. Part (b) looked at p and s-waves. More than half the candidates could not complete the table correctly although about a quarter described p and s-waves perfectly. In part (bii), nearly a half chose the correct answer about the relative speeds, A [1].

In part (c) candidates were asked to calculate a speed and make a judgement. Most calculated the speed correctly and related this to Jill [2]. A few gave the correct calculated number but failed to make reference to Jill [1].

3 This question was a 6 mark extended prose question about house insulation targeted up to grade E demand. It not only required some scientific knowledge but also some data handling skills too. It was also the question on this section which assessed the 'Quality of Written Communication'. Generally it was answered quite well given that candidates will have had little experience of these before. There were three levels of answer. Level 1 answers (1 or 2 marks) confined themselves to a simple solution (eg loft insulation and cavity wall insulation). Level 2 answers (3 or 4 marks) typically had either the economics (clear references to payback time/money saved) OR heat transfer (eg an explanation of conduction or convection being reduced). Level 3 answers (5 or 6 marks) involved both the economics AND heat transfer. Over half the candidates scored 4 marks on this question. Very few scored zero and about a quarter gave level 3 answers.

4 This 4 mark question was about mobile phone masts and signals. It also assessed the 'how science works' aspect of the specification. Only about half of the candidates gained any marks on the whole question. In part (a) many candidates mistakenly referred to the mast being dangerous because it may 'fall over', be 'struck by lightning' or be a 'climbing hazard' for children [0]. Also there were many references to the signals from the mast 'interfering with other equipment in the house', which did not score, and a significant number of candidates wrote that people would be better off (or happier) because they would get a better signal.

Examiners were seeking to award marks in the following areas:

In support of danger the options were possible health risks from radiation such as heating the brain, causing cancer or tumours [1]. Also acceptable (but rarely seen) was the idea of concentrated microwaves [1]. Few also referred to lots of time spent in the house so high dose/continuous exposure [1].

In support of little danger the options were the mast is well above the house [1] or the idea of fabric of the house absorbing some microwaves [1]. The idea that microwave power output is low [1] was rarely seen.

In part (b) 'how science works' was assessed in the context of the difficulties of making conclusions about the dangers of microwaves. Few could get to grips with this question. About a third of answers referred to the evidence lacking data or being in conflict [1]. Rather fewer answers explored the ideas of the difficulties of having a control group [1] or long term effects being immeasurable at this stage [1].

5 This 2 mark question was about the difference between analogue and digital signals. It was answered well with over half of candidates gaining full marks. Common errors were to get digital and analogue mixed up [0], give good diagrams but fail to show which was which [1] and to confine the answer to digital devices [0], eg clock displays.

6 This question about harnessing the Sun's energy was answered quite well. In part (a), only about a quarter of candidates failed to score at all. Many knew that photocells transfer light energy into 'energy' [0] but fewer could name the energy as electrical [1] energy. Most however, knew the photocell power relies on the surface 'area' [1] exposed to the Sun. In part (b) about a half of candidates gained 1 mark with just a few gaining 2. Most referred again to solar panels/cells producing electricity [0]. Others however, answered with solar panels [1] heating water [1] for example. Other good answers were to do with passive solar heating such as 'radiation passing through windows' [1] and 'heating the things inside the house' [1].

7 In part (a) most knew one greenhouse gas (CO_2) but were unable to give another one (either methane or water vapour was acceptable). Therefore, most answers gained zero marks because one gas was either not named or was named incorrectly. Common wrong answers were CO_2 and CO, hydrogen, nitrogen, oxygen and acid rain. About a third of answers gained the one mark here. In part (b), most answered well with more cars (power stations or factories) [1] producing more CO_2 [1]. Also acceptable, was deforestation [1] and more intensive farming producing methane [1]. Some, referred merely to 'litter' [0] but better answers on this theme involved litter decomposition – eg 'more landfill producing methane' [1].

Part (c) was again a 'how science works' question and the majority of answers gained 1 of the 2 marks available. Marks were available for measuring difficulties [1] and reasons for sharing data [1]. Candidates found the sharing data area more fruitful than the difficulty in measuring global warming. Few could articulate the difficulties in collecting 'average' temperatures [1]. Some explained in terms of temperatures/weather fluctuating [1]. Also acceptable was the idea of temperatures being slow to change [1], that data only covers recent years or that other factors may be responsible [1]. Most candidates gained marks for the reasons to share data with other scientists. For example, they can check/re-test/analyse/compare data [1] or that more data would then be available (to scientists to increase confidence in findings) [1].

Part (d) was again a 6 mark extended prose question about natural causes of global warming. It was targeted up to grade C demand and was also the question on this section which assessed the 'Quality of Written Communication'. Generally it was answered quite well given that candidates will have had little experience of these before. There were three levels of answer. Level 1 answers (1 or 2 marks) confined themselves to a simple dust or gas source namely (eg volcano erupting, forest fires, asteroid impact). Level 2 answers (3 or 4 marks) typically had the source and what was put into the air (eg volcano erupting and throwing dust into the atmosphere). Level 3 answers (5 or 6 marks) involved the source, the process and how it affects the temperature on Earth (eg volcano erupts throwing dust into the atmosphere. The cloud reflects radiation away from the planet and the atmosphere cools and has less light). Nearly half the candidates scored zero marks on this question, mostly by writing about man-made causes of global warming rather than natural causes. About a quarter gave level 2 answers here.

8 This question was about paying for and using electricity in the home. Most knew the heater would cost most to use because it had the highest power [1]. In part (b) most could calculate the 0.75 kWh [2] (or at least gain some merit in the calculation [1]). Only a few successfully calculated the cost 13.5 pence.

In part (c) most candidates could **not** name the 'device that decreases voltage' as a **transformer**. But about half of answers stated that the radio was (probably) on for a longer time [1]. It was very rare to see any **application** of understanding in answers though, such as any reference to the inefficiency of charging [1] or that batteries are expensive [1].

9 This question was about nuclear waste and its safe disposal. Just over half the candidates failed to gain any marks here. In part (a) the idea of the radiation (alpha and gamma) having the smallest range in soil was given by about a quarter of candidates. In part (b) some answers gained [1] mark for the idea of contamination, radioactive material moving or being dug up. Common was water supply being contaminated [1] or radioactivity getting into the food chain [1]. Very few answers wrote of glass containment, eg in glass radioactive material cannot move [1], the idea that glass cannot decompose [1] or that beta has shortest range in glass [1]. A few gained full marks here.

10 This question on speed and forces was generally well answered. Most selected correctly the stationary portion of the graph [1] and the steady speeds also [2]. In part (b) most could calculate a speed [1] but perhaps not the correct average speed for [2]. Also many failed to act on the '2 significant figures' advice. This is now something that is expected on GCSE papers. Common errors were to ignore the advice or round the figure down rather than up.

Candidates had some difficulties wording their answers about average speed v instantaneous speed in part (bii). But ideas expressing the idea of changing speed (eg 'sometimes faster and sometimes slower than average') gained [1] mark here.

11 This question on fuel efficiency and drag resulted in many candidates scoring between 2 and 6 marks out of 8. Only a few failed to score at all. In part (a) the majority could calculate the correct mean (again another mathematical requirement expected to be assessed in this new GCSE) from the data. In explaining D's poor fuel consumption most scored 2 of the three marks available. Two marks were available for the ideas of open car windows [1], roof box [1] or more weight/load [1]. Also credited was the 'increase in drag' or 'less streamlined' [1].

In part (c) C was the answer, which many got but fewer offered the idea of highest CO_2 emissions [1]. Part (d) was about 'work done' and most correctly calculated the value asked. Some made errors due to lack of calculator, others had one too many or too few zeros in the answer. Some used 15 000N rather than 1500N [1] in their calculation. In the last part the question was aiming at more force was needed to overcome the higher drag forces [1]; allowed also was 'more driving force required' [1].

12 This was again a 6 mark extended prose question about crumple zones. It was targeted at grade C demand and was also the question on this section which assessed the 'Quality of Written Communication'. The question was common with the higher tier paper. Generally it was answered quite well given that candidates will have had little experience of these before. There were three levels of answer. Level 1 answers (1 or 2 marks) confined themselves to a simple description of the crumple zone (eg changes shape, protects passengers and absorbs energy) or simple testing procedure. Many candidates were able to write about absorption of energy by the crumple zones which helped them access the L1 and L2 criteria. Some were less precise in communicating and wrote of 'absorbing impact', 'absorbing force' or 'absorbing speed'. Level 2 answers (3 or 4 marks) typically referred to more detail of testing and using the data to improve future designs. Also more secure understanding of collisions (eg longer collision time or distance/less rapid deceleration). Level 3 answers (5 or 6 marks) involved the idea of spreading the momentum change over a longer time. Only a few candidates scored zero marks on this question. Most gave partial level 2 answers here scoring 3 marks. But it was extremely rare to see momentum mentioned at all. This is a new requirement of unit P3 and candidates are well advised to take this on board in the future.

13 This 3 mark question on electric cars and the environment resulted in most scoring 1 or 2 of the 3 marks available. Most mentioned the need for charging [1] or the short range [1] or low speed [1] of electric cars. Similarly it was common to see answers appreciating that fossil fuels were not needed in the car [1] and that CO_2 emissions were reduced [1]. A few wrote of the cars being quieter [1].

14 This question was about surface area, drag and terminal speed. About a half of candidates were able to refer to the increased surface area of A [1]. Fewer (about a third) then went on to relate this to greater drag [1]. There were some good concise answers such as drag increases with surface area [2]. The question did however illustrate some of the common misconceptions found in the classroom (eg 'if its crumpled up it will be heavier').

B751/02 Unit 1 – Modules P1, P2, P3 (Higher Tier)

General Comments

This was the first paper on the new syllabus and the questions stretched the candidates. They often struggled to apply their knowledge and understanding to styles of question that were new to the Gateway suite:

- six mark level of response (LoR) questions
- how science works (HSW)
- new mathematical requirements such as expressing answers to a number of significant figures
- graphical and data analysis
- more questions where extended writing was required and by implication less objective (ie 1 mark) questions.

Bearing these points in mind, the mean mark was lower than anticipated, However many candidates rose to the challenge and produced excellent answers to even the most challenging of questions.

SECTION A

1 This question was about the potential dangers arising from the microwaves associated with a phone mast close to people's homes and the difficulty of drawing conclusions about the potential dangers. The second part of the question was set within the framework of the '*how science works'* section of the syllabus. In reality both parts were often answered in this way, as they often failed to relate their responses to the dangers arising from the actual properties of the microwave radiation.

(a) Many candidates merely referred to the danger of the mast falling over, lightning strikes or interference with electrical items in the house or thought that a benefit would be a strong signal for phone use.

Most candidates did gain credit for a health risk explanation.

(b) Often candidates repeated the question (difficult to make conclusions) but again more than half gained some credit, often for describing an example of the difficulty of a control group or little evidence that microwave radiation causes cancer. A large number of candidates referred to there being no evidence rather than evidence being insufficient to support a conclusion.

2 **(a)** This was the first level of response question in the paper. Candidates have traditionally struggled to use kinetic theory to explain the mechanism of conduction and the nature of this six mark question served to magnify the problems. Good, general, answers about particles passing on energy on to other particles were not always related to particles of glass in the window. The passing on of heat energy from particles in the room to the glass and/or passing on from the glass particles to the outside air particles, was often overlooked.In many cases the reference to transfer of vibrations or kinetic energy was not set within the context of a solid. Too many candidates attempted to describe how the process was different from that when double glazing is present.

Many answers were about air/heat/particles escaping **through** the window, or gaps around it.

However it should be noted this question was aimed at a high level of response and almost 20% reached Level 2 or 3 (in the range of 3–6 marks).

(b) **(i)** The calculation caused problems for most candidates, sometimes at the start when they could not rearrange the S.H.C. formula. Frequently the formula was rearranged correctly but candidates could not then carry out the calculation using a calculator. The best candidates processed the figures accurately and added 20^0C to gain all 3 marks. Usually, candidates with an incorrect answer appreciated the need to add the starting temperature to the temperature rise to determine the final temperature. Incorrect rounding often reduced the mark.

(ii) Very few appreciated conduction by the steel with poor answers constructed around the water evaporating or boiling before it reached 61.7^0C.

(c) The good answers worked logically through the correct explanation; water heats up more slowly/due to higher S.H.C./gives out more heat. Weaker candidates only gained the first mark.

3 There were some excellent answers in this question; the best went beyond 3 points to give a full explanation of one method of cooking and comparison to the other one. The question structure was familiar and the majority of answers scored 2 or 3 marks. Weaker answers contained reference to reflection, microwaves cooking from the inside to outside, microwaves travelling to the centre of the potato or failing to refer to infrared radiation in cooking.

4 For a relatively easy question this posed more problems than envisaged.

(a) Candidates often tried to describe reflection from the sides of the fibre or failed to state **total internal** reflection.

(b) Whilst picking up a mark for the idea of higher or rapid data transmission rate most failed to mention the idea of less interference or the ability to remove interference.

(c) Answers often focused on the light from a torch spreading out without mentioning '**low divergence**' for laser light and went on to compare brightness. However there were many excellent answers that often explained coherence as well as using the term correctly.

SECTION B

5 **(a)** This type of question has historically been poorly answered and it proved to be the case this session.

1500 W x 0.5 was often the correct start but the majority then failed to go on to convert this to 0.75 kW, some credit was usually gained.

(b) Reinforces the comment above, using a formula without stages in the calculation, even with a rearrangement proved to be well within the capabilities of the vast majority of candidates.

(c) **(i)** Very few failed to give an acceptable advantage but disadvantages were often vague and did not specify 'at night' or answers were unqualified (eg fire risk with out mentioning 'unattended').

(ii) Often the increasing profit in the question was repeated as the answer, the idea of balancing supply with demand or avoiding spikes in demand was is not widely appreciated.

6 **(a)** A HSW question where candidates often failed to give a response which reflected the methodology of science. Answers were often limited to the idea that scientists do not think that it is just human activity that is responsible for global warming without going on to say why not. Candidates confused natural causes of greenhouse gas production with natural cycles of the Earth. Data, data collection and data interpretation rarely featured in answers, far too often the response centred on scientists having different views, opinions or even feelings.

(b) The second LoR question in the paper. To answer the question fully candidates had to organise some difficult concepts to attain Level 3 marks. Nevertheless, some candidates did manage just that, very satisfying in the light of the high end grade target. Able students could show their grasp of some difficult ideas and the question differentiated well at the top of the mark range. Answers that gained lower marks, either failed to appreciate the significance of short and long wavelengths (or reversed their role in the answer) or failed to mention wave length or infrared at all, confining their answer to the atmosphere trapping heat in or below it, thus causing the Earth to 'warm'. Common misconceptions referred to trapping of gases rather than radiation and the role of the ozone layer and ultraviolet radiation which many candidates think plays an important part in global warming.

7 **(a)** This calculation was very well done; see comments about calculations in 5(a) & (b). Incorrect answers calculated 180 ÷ 320 or 320 ÷ 500, whilst some lost a mark by adding a unit (eg 0.36J), adding a percentage sign (eg 0.36%) or failing to show their working and giving an answer of 36.

(b) Despite this being aimed at Standard demand, candidates struggled to gain credit (approximately half did not gain any mark) and the question showed good differentiation. Candidates often wrote about insulation, transformer design, electrical efficiency or generating more electricity rather than indicating how the wasted heat in the Sankey-type diagram could be **used** or **reused**.

8 **(a)** A good level of success in this question although there was a measure of differentiation (1/4 of the entry scored zero). Common errors were:

- alpha use: fire alarms
- beta use: non-medical tracer (tracker often seen)
- beta stopped by: paper or just 'aluminium'.

(b) The number of 2 mark answers was low. Contamination of drinking water or water supply was the most common answer but entering the food chain, risk of cancer or remaining radioactive for a long time, were rarely seen as second point. Vague references to 'harmful' or remaining dangerous, without mention of radioactive or long time, weakened potentially good answers. Weaker responses included terrorist risk or spoiling the land.

SECTION C

9 **(a)** Some answers only repeated the acceleration statements in the question without using the data about speed change or the magnitude and direction of the gradients for A, C and D from the graph. Other answers simply described the speed increasing in A, steady speed in B, slowing down in C, without mentioning the more rapid speed reduction in D, and were awarded 1 mark. More than half did gain 1 or 2 marks.

(b) **(i)** A good differentiator. The popular error was to omit the '1/2' in the distance calculation and ring '100m'.

(ii) Almost half of the entry gained one mark; often candidates calculated correctly but could not then express the answer to 3 significant figures. This is a new skill that candidates require and centres should stress this to their candidates.

10 **(a)** Another required mathematical skill but a much better level of performance.

(b) Most candidates gained the mark for recognising the cause of the drag in terms of open windows or a roof box fitted but failed to go on and answer the question fully. Very few candidates could explain how these features and other factors affected work done against drag. They did not address all of the points that arose from the data in the table and the set question. Different driving style or an example was included in better answers but rarely did that go on to gain the third mark for relating this or the drag to kinetic energy or work.

Again, this is new style of question on Gateway papers and centres should make candidates fully aware of the need to use and analyse data in their answers.

11 The final LoR question and it performed very well in the targeted standard response area of P3.

Very few candidates failed to reach Level 1 whilst a significant number who gave excellent answers in terms of increased collision time linked to reduced acceleration and hence force made it into Level 3.

Weaker answers only described the crumple zones changing shape or absorbing energy or gave a brief account of testing. Level 2 answers usually mentioned longer collision time with the idea of the transfer of energy or what caused the injury in a crash (ie rapid deceleration of body). When 3 or 5 marks were awarded the 'lost' mark was usually due to a poor description of the testing regime at that level.

12 **(a)** This was very similar to 10(b) in the sense that candidates often gave a partial answer.

Candidates were not able to fully analyse the data and tailor it to their response. The most common error was to do as 'Trevor' did in the question; ie think that the lowest number (X) gave the best fuel consumption or best fuel economy. Often answers were half-way there when stating that Y had low noise or CO_2 emissions but neglected to include **both**. Very few recognised that car Z had the best fuel economy.

(b) **(i)** Again a standard calculation with the extra requirements of rounding and conversion to kilowatts.

Correct arithmetic followed by poor mathematical skills often resulted in one mark.

(ii) A low rate of success, V was often correctly chosen but unqualified. Another change to what is expected of candidates, that centres need to take on board.

(c) Generally there were well constructed answers addressing both driver and pedestrian as the question asked, answers that did not gain both marks often failed to include both. Unspecific references to pollution marred some responses together with an unnamed vehicle causing problems on the pavement for pedestrians.

13 One mark was regularly awarded but few gained both. Candidates were clearly thrown by the number of correct statements not being specified.

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