GCSE

Physics B

Gateway Science Suite

General Certificate of Secondary Education **J265**

OCR Report to Centres

June 2013

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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.

OCR will not enter into any discussion or correspondence in connection with this report.

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General Certificate of Secondary Education

Gateway Physics B (J265)

OCR REPORT TO CENTRES

Overview

Centres have been exposed to not only the Sample Assessment materials for this new GCSE but also the papers sat in June 2012 and January 2013. In these sittings, again only the unit B751 assessments were available (P1, P2 and P3). This series has seen the controlled assessment and unit B752 (P4 P5 P6) completed by the candidates.

On these papers, candidates were expected to apply more in terms of **data handling** skills and the **application** of physics knowledge and understanding. Candidates and centres are well advised to refer to the **H**ow **S**cience **W**orks statements at the front of the specification as familiarity with the language alone may help them direct their answers better. The reports on the individual papers, along with their mark schemes will help guide candidates and centres towards the desired expectations for success. **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 formula too. The usual errors are

- Missing decimal points from answers or calculations.
- Not using or forgetting to bring a calculator.
- Dividing the numbers the wrong way (or is it the easy 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 formula more demanding.

Calculations are also increasingly being presented in developed form. In these 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. It was pleasing though to see this happened regularly on both tiers. This series showed candidates more willing to attempt the calculations. In a line of calculations the candidate may get the first part incorrect. However, full marks were still available if candidates carried their errors forward and used them correctly.

Six mark level of response questions are being answered by candidates more confidently. They are still a significant challenge and a hurdle to some. But this time it was noticeable that candidates' answers more often responded to more parts of the question than in previous sittings. Answers were generally more focussed this time and candidates seemed better prepared for them than in previous sittings.

Centres are advised to remind candidates that scripts are scanned as black and white images, so the use of coloured pens or faint pencil is not recommended. In some instances, partially rubbed-out pencil lines were still visible. Also candidates' answers will often 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 there is always the chance that the answer may be missed. Many candidates who could not fit in just two or three extra words onto the answer lines chose to put these onto additional sheets. These additional sheets are not needed if the answer can be placed within the borders of the page as indicated above.

This was the first year for the Controlled Assessment in Physics. Many centres had one year of experience with the criteria as they had completed Gateway science for a cohort in June 2012. The second year of using the science criteria showed that centres became more confident. There was an improvement in marks submitted and the raising of thresholds partly reflected this. The thresholds on the separate sciences and additional science were therefore set in line with the science.

The 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 candidates.

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

General Comments

The paper performed well with good discrimination across the candidature. This paper had a very small entry due to the change in examination requirements for all candidates starting the course from September 2012 which prevented candidates taking this paper half way through the course.

Section A

Question 1
This question was about energy loss from houses.

1(a) Most candidates knew that thermal imaging cameras produce photographs that show different colours and most of those candidates knew that the picture was called a thermograph or themogram. Thermal image was not allowed as this was given in the question.

1(b) Candidates were asked to describe energy saving methods and explain how air is important. Examiners did not accept simplistic answers such as ‘insulate the roof’ or ‘insulate the walls’. A more detailed description was needed, for example, insulate the roof with fibreglass or fill the cavity in the walls with foam. A maximum of 2 marks was awarded for method, and a maximum of 2 marks was awarded for describing how air was important. The question had a maximum of 3.

1(c) Most candidates correctly calculated the efficiency of Allan’s boiler and identified it as being in band F which was next to the bottom band.

Question 2
This question was about microwaves.

2(a) This was a six mark level of response question comparing microwave and conventional ovens. As in previous papers that have asked questions about microwave cooking, the candidates found it challenging. The most common misunderstanding was that microwaves cook from the inside outwards. It should be stressed to candidates that one reason that they cook quicker is that the waves penetrate 1 or 2 cm into the food so there is less distance for the energy to travel to the centre by conduction whereas in a conventional oven the energy is absorbed at the surface and has further to travel by conduction. For the requirements at each level full details are given in the mark scheme.

2(b) In this question few candidates failed to score. Often either Susie or Damien was mentioned, scoring 1 mark, but not both. An explanation was required for both statements in order to score full marks.

Question 3
This question was about a boiling liquid.

3(a) About half the candidates were able to explain how the graph showed that the liquid was boiling. Many different expressions were accepted to describe the temperature as steady for the last 200 seconds. Examiners, however, did not accept the word straight as a correct description as this does not suggest horizontal.

3(b) Most candidates gave the correct answer of 106^{o}C.

Question 4
This question was about waves.

4(a) About one quarter of candidates correctly answered this question. Examiners would ideally have liked to see ‘total internal reflection’ for 2 marks but were happy to credit ‘reflected from the sides’ as a correct answer. The word ‘bounces’ was often used by candidates and should be discouraged as, whilst not being penalised neither was it credited. Approximately half the candidates gave an alternative use for infrared radiation, the most common answer being remote controls.

4(b) Most candidates correctly gave an advantage of not needing a cable.

4(c) Candidates generally identified the signal as digital but struggled to explain why it was a digital signal or alternatively why it was not an analogue signal.

Question 5
This question was about nuclear radiation.

5(a) Most candidates were able to complete the diagram showing the penetrating power of alpha and beta radiation.

5(b) About half the candidates were unable to describe how to handle radioactive materials safely, of the other 50% about a quarter answered the question fully, providing two correct answers. Whilst examiners accepted the general term protective clothing, answers such as wear gloves, lab coat, goggles were not accepted. A specific example of protective clothing that was accepted was a lead apron. Other correct answers included limit exposure time, handle with tongs etc. A full list of acceptable answers can be found in the mark scheme.

5(c) Almost all the candidates scored at least one mark on this question by being able to identify the beneficial and harmful properties of radiation.

Question 6
This question was a six mark level of response question about an NEO.

6 Candidates were asked why scientists were making detailed observations of the NEO and about the effects on earth of a collision with a large asteroid. Over half the candidates scored level 1 mainly because they gave a brief description of why scientists were observing it, such as to check its path/speed etc, but failed to give any description of the effect of a collision on Earth. Answers such as climate change, dust clouds, craters etc were expected but were lacking in most responses.

Question 7
This question was about wind turbines.

7(a) The majority of candidates were able to describe the advantages of wind turbines over coal fired power stations. Whilst examiners credited advantages of wind generators it was good to see several true comparisons such as ‘wind is renewable but coal will eventually run out’.
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7(b) Very few candidates failed to score on this question and most gave the straight forward relationship ‘the faster the wind the louder the noise’.

7(b)ii Candidates tended to score 1 mark for the general statement that the background noise is more noisy than the turbines for most of the time. In order to score the second mark some statement about when it was above background noise was needed, for example 'even at high wind speeds the noise of the turbines is not much more than background'.

Question 8
This question was about electrical power and energy consumption.

8(a) About three quarters of candidates correctly calculated the power of the monitor as 115W.

8(b) Candidates were able to put the four parts of the computing system in order of operating cost. This question was the best answered question on the paper.

8(c) This question was another example of being part answered. A large proportion of candidates were able to identify one view and describe the long term effect on the environment but then went on to either describe a similar view or not describe the second view at all, leaving the question half answered and scoring half marks.

Question 9
This question was about generating electricity.

9(a) Candidates, in general correctly calculated the efficiency of the power station.

9(b) About half the candidates knew that a battery produces direct current (DC was also an acceptable answer). Few candidates were able to explain why all four graphs showed alternating current. Examiners were looking for an indication that the readings change from one side of the 0 line to the other or that the current kept changing direction.

Section C

Question 10
This question was about cars.

10(a) Most candidates correctly identified the Jaguar as the most powerful car but found it difficult to use the data to explain why it did not have the worst fuel consumption. Examiners were looking for the idea of low mass and low engine capacity. In part iii several candidates misunderstood best fuel consumption and thought that it meant the one that used the most fuel per km incorrectly giving the answer Rolls Royce which then made answering the rest of the question correctly very difficult.

10(b) Very few candidates gave the wrong answers for the two parts of this question.

10(c) Candidates knew why scientists share their findings but were unclear as to why safety ratings should change. Several thought that it applied to old cars and put the reason, incorrectly, due to wear and tear. Examiners were looking for ideas that the same model of car had been modified over time or improved, or evidence from accidents or use had come to light or that the tests had become more reliable.

10(d) Candidates answered this question well, the most common safety features being crumple zones, seat belts and air bags.

Question 11
This was a six mark level of response question on distance time graphs.

The majority of candidates scored level 1 for a general description of some part of the graph. This could be as simple as starts, stops and starts. In order to achieve level 2 examiners were looking for a reference to steady speeds at the start and end. Many candidates failed to reach this level by describing acceleration or increasing/decreasing speed during the first and last parts of the graph. For level 3 a detailed description was needed for the whole journey. An example for the first part is ‘moved with a steady speed for 2 seconds travelling a distance of 8m’. A significant number of high level answers were seen such as travels at 4m/s for 2 seconds covering 8m, stationary for 2 seconds then travels at 6m/s for 2 seconds covering 20m in all at an average speed of 3.3m/s.

Question 12
This question was about work.

About three quarters of candidates were able to calculate the weight of the bar as 2500N but only about one third of these were able to calculate the height that he lifted the bar as 2m. Many found difficulty in rearranging the equation to make distance the subject.

Question 13
This question was about the fuel consumption of cars.

13(a) Most candidates calculated the fuel consumption of Lindsey’s car correctly.

13(b) Candidates found difficulty in thinking of reasons for the difference in fuel consumption. Many incorrectly thought it was due to them travelling different distances. Examiners were looking for answers not provided by the data such as travelled at different speeds, different routes, different driving styles etc.

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

General comments

This year it seemed that the majority of the students attempting this paper had been entered for the correct tier. The paper was of appropriate length and there were very few examples of candidates running out of time. Although a few candidates left some answers blank, these 'no responses' tended to be scattered throughout the paper rather than concentrated at the end.
It was evident that there was fuller participation in the paper this time and candidates were showing more success on tackling the 6 mark questions than in the past. Some candidates however were often unable or unwilling to attempt the 6 mark questions and made no response at all. This is a pity as many 6 mark answers were given full marks for short and concise answers. But the incidences of no responses seemed to be less common than in previous papers.

Candidates generally showed more composure and direction in answering the longer prose questions. Calculations were generally done well by most candidates although developed calculations tended to discriminate within the higher grades. Also the use of indices and the use of appropriate decimal places tended to discriminate also.

The How Science Works questions were nearly always attempted but candidates were often unsure how to tackle the questions. Often long-winded answers gained credit only in the last few words. Some of these questions were answered confidently and concisely using some of the language from the learning outcomes in the AO section in the specification.

Comments on individual questions

Question 1

(a) Virtually all candidates were familiar with thermograms. The question was well attempted although many wrote at length that, 'a thermogram uses colours to show where heat energy is lost' and then omitted to give any colours or to relate them to areas of most or least heat loss. Also there were references to bright or dark, which did not really specify the colour.

(b) This data handling question on payback time was well answered by most. The calculations were usually correct along with the explanations.

(ci) Most candidates obtained 3 marks for calculating the efficiency correctly and giving 70%. Occasionally 7000/3000 was used, but candidates who wrote this usually got the useful energy mark. Also 30% was obtained on a few occasions.

(cii) This proved a challenge for some in that they had difficulties in communicating their idea. Some communicated the idea of conservation clearly or used numbers to illustrate it.
Eg. 10 000 input = 3 000 + 7 000 output [1].
Others were able to explain that the energy was not lost but wasted as heat [1].

Question 2

(a) In order to get 5 or 6 marks here candidates had to write answers in terms of gains in KE. There were some good answers at this high demand level. The mechanisms for microwave cooking were well understood by most but infrared was generally less well understood or communicated. Many mistakenly thought IR penetrated all the food to the centre. The conduction idea of energy transfer was better understood and many used this to partially explain how micro-waved food (it penetrating 1 or 2cm) has a shorter distance to heat to the centre.

Many candidates found difficulty in linking an explanation of the mechanisms of infrared and microwave cooking to the reasons for differences in energy needed or cooking times needed. Some relied heavily on the data given in the stem of the question with little or no reference either method.

(b) This two mark 'How Science Works' question was poorly answered by many. The majority of candidates either reiterated the data given in the question or talked about C being the most recent study and therefore the most reliable. A few referred to the consideration of balancing the risk against benefits [1]. Some recognised that there were two arguments for and one against [1]. Some candidates (perhaps familiar with the HSW wording in the specification) were able to give clear and concise two mark answers.

Question 3

Most candidates gave the correct values [1] but rather fewer could explain that intermolecular bonds were broken. Many said forces were broken [0] or that the energy was used to change state [0]. Also 'bonds were broken' failed to reach this marking point. Some candidates talked about the breaking of intermolecular bonds, but whilst the temperature was rising. Others mentioned change of state but did not talk about the breaking of intermolecular bonds.

Question 4

(ai) Few responded to the fact that the question asked for the answer to 2 significant figures. So many gained [1] for the correct calculation but became mixed up with the powers of 10.

(aii) This tick box question, on wave versus particle theories, proved to be challenging for many. Most candidates scored [1] for this two mark question.

(b) Most mark-worthy responses referred to multiplexing [1] although the second mark eluded them. Many confused noise on a signal with interference. Also often answers showed a lack of clarity in explaining that noise could be removed and that it was the end signal that could more easily be made clearer.

Question 5

(a) This question was well attempted with many candidates gaining full marks. Occasionally alpha and beta were the wrong way round. Occasionally also some candidates failed to attempt the question at all indicating that they had not read the paper with sufficient care. There were some careless diagrams with the arrows just stopping short of the barriers or just going beyond the barriers.

(b) The uses of gamma radiation were well known. Most candidates gave cancer treatment [1] and a medical or industrial example of a tracer [1].

(c) This was well answered. Most knew that radioactive waste lasts a long time [1] and that it needed to be encased in a material [1] or buried deep underground [1]. Some answers lacked detail however, e.g. stored underground, rather than stored deep underground.

Question 6

This 6 mark question on asteroid risks was well attempted by almost all candidates. The exploding of a threatening asteroid was often mentioned. Better answers wrote of a nearby explosion deflecting the asteroid (when it was far away) by a small degree and missing the Earth by a long way. Many recognised the dangers of deliberately exploding an asteroid when it was near to Earth. Many put their faith in evacuation to a different area as the only escape.

Question 7

(a) This question on wind turbines was generally well answered although quite a few gave the disadvantages of coal powered stations rather than the advantages of wind power. The ideas of renewable energy and no greenhouse gases were the usual scoring points.

(bi) The majority of candidates described the main trend in the graph correctly.

(bii) Most gained a mark here but many candidates did not differentiate between low and high wind speeds thereby avoiding the opportunity of a second mark.

Question 8

(a) Most got the first mark for this calculation but were unable to convert to kW or did not realise they had to.

(b) About half of the answers showed the correct calculation of the hours used. A popular distracter was the use of the power that had just been calculated i.e. 0.45/0.115 = 3.9 hours.

(c) Most arranged the components in the correct current order. The monitor and desktop were frequently interchanged. The mouse was virtually always seen as the one with lowest current.

(d) Candidates found it difficult to analyse the views and wrote at length about each view independently rather than, ‘both reduce global warming’ etc. Rather fewer gained the second marking point where they needed to make a point about the merits or impracticalities. Eg walking and using more energy efficient light bulbs reduce global warming but not all people can complete journeys without cars [2].

Question 9

(a) Most could calculate the energy input from the coal. Any errors were usually too many or too few zeros in the answer. Also common were:

- Those candidates who worked out 34% of the output energy and obtained an answer 57800 J.
- Those candidates who divided the output energy by 34 (instead of 34% = 0.34) and obtained an answer of 5000 J.

(b) This was quite well answered with most answers referring to positive and negative or different directions of supply. Vague answers described the signals as varying and some mistakenly explained in terms of having the same wavelength, frequency etc. Weaker answers described peaks and troughs or up and down and did not get the mark.

Question 10

This 6 mark question discriminated well and attracted good responses from most candidates. Many understood that the vehicle accelerated and then moved at constant speed followed by a greater acceleration. Some though did think that the vehicle had stopped. Higher level answers correctly calculated the accelerations and distances travelled in each stage (5 or 6 marks). Most had some difficulty in the calculation of the distances travelled thus restricting them to level 2 marks (3 or 4).

Question 11

In this common question targeted at C/D grades many candidates correctly calculated the weight but rather fewer could go further and calculate the height. These weaker candidates could usually get the weight mark but confused mass and weight in the formula for work or simply did not attempt that part.

Question 12

(a) Very few candidates attained the full 2 marks primarily because the answer was expected to 1 decimal place. Also many candidates mistakenly used time = speed/distance in this question obtaining an answer of 1.5 seconds. Those that obtained the correct numerical value often struggled with the correct significant figures.

(b) Many gave the reason, ie. doubling speed doubles thinking distance, without giving the numerical answer of 12(m).

(c) This was an intentionally challenging question and many omitted this part altogether. Very few got 54(m) or wrote about 'KE being absorbed in braking'. All the marking points were seen on scripts but very rarely were all three given for an answer.

(d) This was quite well answered with many scoring all 3 marks here. The most common errors were 'time' in place of 'distance' in the first sentence and in the third sentence 'poor or bad' after the word 'road'. More specific conditions were needed here such as wet road rather than a vague reference to 'poor weather'.

Question 13

(a) Most got the idea that the collision took a longer time [1]. Rather fewer realised the acceleration was reduced. Some good answers used the equation 'force = change in momentum/time' [1], referred to a longer time [1] and even mentioned that the momentum change was the same [1]. Many answers focussed on some lower demand points: crumple zones absorb the kinetic energy (or just the energy). A common misconception was that crumple zones absorb the force or impact of the collision.

(bi) Many did not realise that the question was about pedestrian collisions. Their answers were often preoccupied with dummies in the car. However it was still possible to gain some marks despite this oversight.

(bii) Most gave good answers here on the reasons why the results were published. There were three main answers given here all of which gained credit, other scientists checking the results, changing the design of the car, or informing customer choice.

B752/01 Modules P4, P5, P6 (Foundation Tier)

General comments

This is the first sitting of this paper of the Physics specification. Most students had been entered for the correct tier with only very few who would have benefited from being entered for the higher tier to reach Grade B. Running out of time was very rare. Many candidates successfully accessed the 6 mark questions. Most candidates handled the calculations very well and many continued to make further use of calculated values in developed questions.

Explanation making use of models was a challenge to most candidates. This was clear in many areas including: charging and earthing, describing nuclear fission, and most notably using atomic structure to explain resistance.

The How Science Works questions were usually attempted. Successful responses were concise and clear. Long winded answers tended to be confused and credit was often only gained from the last few words of the response.

There was full participation in most of the paper.

The 10 mark section D data section was new to candidates. Most candidates coped well with this section and many applied the skills of selecting and interpreting data very well to exceed their performance in the rest of the paper.

Comments on individual questions

Question 1

(ai) Less than half of the candidates identified wavelength correctly.

(aii) Rarefaction was not well known.

(bi) Most candidates gave a valid reason for using ultrasound in pre-clinical assessment and some correctly referred to ultrasound as a treatment. A small number did not score as they gave vague answers referring to seeing inside the body.

(bii) Most candidates gave another suitable use of ultrasound - mainly for neo-natal scans.

Question 2

This 6 mark question on tracers was attempted by nearly all candidates. Most responses were at Level 1 (1 or 2 marks) for a simple description of the graph. Many candidates described the graph in detail and showed an understanding of how the technique can identify a blockage or leak in the pipe. There were some misconceptions such as the idea that the water supply was radioactive rather than the addition of a radioactive tracer as a means to a solution of the problem.

Question 3

(ai) Most candidates estimated the resistance correctly. In many cases this was done without any calculation or extrapolation of the graph shown.

(aii) Most calculated the resistance correctly.

(aiii) Nearly all candidates attempted this question. Few achieved full marks and many ignored their calculated answers to parts (ai) and (aii). Successful candidates used their calculations and went on to correctly link lower resistance with higher current flowing. A small number attempted to link the thicker wire to the idea of having a greater number of atoms and therefore more resistance. Lack of clarity in communicated ideas was the key challenge faced by most candidates in this question which was aimed at the further use of calculated values.

(b) Over half of candidates did not achieve any marks in this question. Weaker descriptions often referred to the action of turning the switch or changing the current without any qualification of it decreasing. A few successful candidates went on to correctly link increasing resistance to reducing current (and hence reducing brightness).

Question 4

(a) Most candidates achieved at least 1 mark and about a third achieved 2 marks. Lack of knowledge of uranium as nuclear fuel and that nuclear waste was recycled (rather than radioactive) frequently prevented the gaining of 2 marks.

(b) Most candidates achieved at least 1 mark. Misconceptions in describing the model mainly related to the initial neutron (becoming the large nucleus) and the production of additional neutrons as a result of fission of the daughter nuclei.

Question 5

(a) Lack of precision and clarity in describing charging and discharging to earth hindered many candidates. Vague terms such as “becoming static”, “transferring electricity” and still too many “positive electrons” all added to the confusion.

Most scored at least 1 mark - usually for a description of how friction between insulators leads to charging.

(b) Most correctly selected moist air. However many candidates found this conclusion from the data difficult to accept. Very few could explain why moist air prevented the build-up of charge. Some thought that the dampness of the trampoline reduced friction.

Question 6

(a) About half of candidates scored on this question. Many candidates described the buildup of pressure inside the rocket and about collisions between energetic particles and the walls of the rocket. Candidates often scored from the description of the force acting on the rocket. One unexpected misconception from a significant minority was that the rocket was lifted due to the reduced density of the gas inside - as a hot air balloon.

(b) Most candidates scored on this question and focused on increased acceleration due to the increased pressure of hot gases but few went on to link this to an acceptable consequence e.g. more force. A significant number realised that the rocket would be heavier and therefore acceleration would be less. When candidates did not achieve any marks it was often due to disregarding the question and writing about the speed of the rocket.

(ci) Almost all stated gravity correctly.

(cii) Most candidates gained at least one mark – usually for identifying the Moon and/or that it was not man-made. A misconception by a minority of candidates was that a stationary satellite is an example of a natural satellite.

(di) Most correctly calculated the weight on Mars.

(dii) Most candidates wrote about the Rover being too heavy or heavier on Earth (often without any reference to the information given). A small number calculated its weight correctly. Many candidates did not use the information in the table to apply to the question but simply compared gravitational field strengths.

Question 7

(a) Most correctly calculated magnification.

(bi) Just over half the candidates completed the ray diagram correctly. A minority of candidates did not attempt the diagram.

(bii) About half of candidates correctly named the focal point.

(biii) Most candidates found this challenging. Many candidates knew that a thicker lens refracted light more but often went on to state that the focal length would therefore increase.

Question 8

Most candidates realised the significance of the cars travelling in opposite directions. Very few either wrote about or calculated the addition of the speeds. When candidates achieved full marks it was often by calculating the relative speeds in all three scenarios correctly.

Question 9

This six mark question on communication using electromagnetic waves was intended to focus on the comparison between long waves and microwaves. Almost a quarter of candidates made no response at all. Of those that attempted the question there were many level 1 answers. Most candidates were aware of the involvement of satellites but fewer were aware of the importance of the atmosphere or ionosphere. Some candidates described correctly the diffraction of long wave radio waves. The greatest barriers to achieving level 2 were often: a failure to identify the wavelength or wave type **or** to link the type of wave to the mode of transmission **or** a contradiction between high wavelengths and high frequencies.

Question 10

Just under half of candidates completed one column correctly (usually the interference). Very few gained both marks mainly due to a failure to tick that the wave model explains reflection.

Question 11

(a) Few candidates were able to identify the two components correctly.

(bi) Most candidates calculated the total resistance correctly.

(bii) It was good to see around half of candidates using their answer to calculate the unknown resistance in a series circuit. Several candidates who made a mistake in (bi) achieved a mark from the error carry forward into (bii).

Question 12

(a) About a third of candidates identified the two appliances that contained an electric motor. Many added extra appliances rather than omitting the correct ones.

(b) Very few candidates identified the diode or knew its purpose. Many thought that the diode was a NOT gate. Some misunderstood the symbol for a battery as providing a gap in the complete circuit.

(c) Almost no candidates had any understanding of the role of the diode in half wave rectification.

Question 13

This question was challenging to most candidates. About half managed to score. Many reached the basic level one for a description of the values in the table. Some found the idea of increasing resistance with increasing current confusing. A very small number made any attempt to explain current or resistance in terms flow of electrons or of collisions with atoms.

Question 14

(a) Few candidates completed the truth table correctly. Usually this was because of a lack of understanding of the role of the NOT gate on the signal from the light sensor. A minority of candidates used combinations of 0,1, 2, 3 in the truth table.

(b) Most scored one mark for hot or wet. Very few correctly identified the need for dark conditions.

(c) This 2 mark question on manufacturing small electronic components for space was challenging for many. About a third gained one mark here.

Question 15

(a) Most candidates showed a good grasp of the structure of different types of transformer to gain both marks.

(b) Most candidates had little knowledge or understanding of the transistor.

(bi) Very few identified the terminals correctly.

(bii) About half of candidates calculated the current leaving the emitter correctly.

(biii) Very few gave the expected answer of 'logic gates' – 'circuits' was a common incorrect response.

Question 16

This section is devoted entirely to the skills of data handling. The question was accessible to nearly all candidates and produced a good spread of marks.

(ai) & (aii) Nearly all candidates extracted the data correctly from the table.

(aiii) Most candidates calculated the average rating correctly and many gave a correct explanation.

(b) Most candidates interpreted the graph to make at least one correct conclusion. Candidates frequently did not achieve two marks as they asserted which surface was better without giving justification using the data presented in the graph.

(ci) About a quarter of the candidature correctly calculated the distance as 30,000km and so scored three marks.

(cii) Just under half of candidates gained a mark here - mainly for the increase in stopping distance.

B752/02 Modules P4, P5, P6 (Higher Tier)

General comments

This is the first sitting of this 85 mark paper for the new Physics specification. It seemed that the majority of the students attempting this paper had been entered for the correct tier. The paper was of appropriate length and there were very few examples of candidates running out of time. Although a few candidates left some answers blank, these ‘no responses’ tended to be scattered throughout the paper rather than concentrated at the end.

It was evident that candidates were showing more success on tackling the 6 mark questions than in the past. In the unit B751 paper in June 2012 it was evident that candidates found some of the new approaches particularly challenging. For example, developed calculations, How Science Works and data handling. Developed calculations were often left blank last year but this year this was uncommon and although the developed aspect still proved a challenge for some it was good to see candidates attempt calculations as far as they could take them. In this way they at least gained partial marks on the question. So calculations were generally done well by most candidates and developed calculations tended to discriminate within the higher grades. Also the use of indices and the use of appropriate decimal places also tended to discriminate at this level. Some candidates however were often unable or unwilling to attempt the 6 mark questions and made no response at all. This is a pity as many 6 mark answers were given full marks for short and concise answers. But this seems to be less common than in last year’s paper. The most common 6 mark question to be left blank was the transformer question. There also appeared to be an increase in candidates continuing answers on extra booklets. Much of this appeared unnecessary, with candidates repeating the question in their answers, writing at great length on ideas that were not asked for in the question and generally failing to answer in a succinct manner.

However more candidates showed more composure and direction in answering longer prose questions (6 markers). It was evident than many candidates had highlighted the key points in the question beforehand. These answers tended to be more focussed and structured.

The How Science Works questions were nearly always attempted but candidates were often unsure how to tackle the questions. Often long-winded answers gained credit only in the last few words. Some of these questions were answered confidently and concisely using some of the language from the learning outcomes in the AO section in the specification.

The 10 mark data section at the end of this paper was new to candidates giving a total of 85 marks. Most candidates carried their standards through into this section and coped with it well.

Comments on individual questions

Question 1

(a) One misconception here was that many candidates thought the lines were waves. So answers such as compressions are where the waves are close together scored [0]. Some good answers explained in terms of particles (or lines) being close together [1] for compressions. Others explained successful answers in terms of high or low pressures.

(bi) Most wrote of the waves causing vibrations or resonance in the kidney stone [1]. Some were less precise and wrote of the stone being broken into small pieces. Quite a few answers described gamma rays breaking kidney stones.

(bii) This was well answered in one of two ways: X-rays damage cells but ultrasound does not [1] or ultrasound shows up soft tissue but X-rays can't [1].

Question 2

(a) This 6 mark question on tracers was attempted by most candidates. There we many level 1 responses (1 or 2 marks) where the answer was limited to a simple description of the graph. Better answers related the peak to the likelihood of a leak or a blockage (3 or 4 marks). Others gave more detail indicating its whereabouts and the advantage of this in repairing the damage. There were some misconceptions such as some failed to appreciate that the radioactivity was from a tracer which was deliberately introduced. Some thought that the question was simply about radioactive pollution of a water supply.

(b) Most candidates had at least an appreciation of half life and identified X as having the longer of the two [1]. Better answers quantified this with X being 4 years and Y being 1 year [2]. There was a certain amount of confusion between half life and activity.

Question 3

(ai) This was an intentionally challenging calculation for many. A mark was available for those who used the graph to determine 5 ohms. Quite often though this was incorrect with 0.5 ohms being a common error. Higher ability candidates generally used the 5 ohms to calculate the current.

(aii) Most wrote correctly about the longer wire carrying less current [1]. Some though failed to mention current at all despite writing correctly about longer length and higher resistance.

(b) Just over half the candidature drew a straight line from the origin with higher gradient than the original [1]. Others either extended the existing line or gave a line with lower gradient [0]. Only rarely were curved lines given [0].

Question 4

(a) Most gave two or three correct answers in the crossword [1]. One common error was 'reactant' (instead of neutrons).

(b) In this How Science Works question most gained marks by explaining that the method or catalyst was secret [1]. Some focussed on how fusion usually occurs at high temperatures and pressures [1]. Others wrote of the unrepeatability of the experiment [1].

Question 5

(a) This question on electrostatics was better answered than previously. Most got the idea of electrons transferring from sock to trampoline or vice versa [1]. Less successfully explained was the charge moving to/from the ground [1]. Electrons and charge were needed for a full answer. Often rather than this, 'static moving' was a common vague attempt at an answer. Positive electrons were also relatively common.

(b) This proved challenging for many. It is a question where candidates need to apply knowledge to solve a problem or explain an application. Marks were available for the idea of a conducting surface [1] (rarely seen) and so charge could not build up [1] (more commonly seen).

Question 6

(a) Many mentioned collisions of gas particles but avoided the key idea of particles colliding with the rocket walls [1] thereby producing a force [1].

(b) Most gained the mark here by explaining in terms of more particles or energy [1].

(c) This was a 6 mark question on artificial satellites targeted up to grade A*. There were many level 2 answers (3 or 4 marks) that correctly compared the orbital periods, speeds and heights. Level 3 answers were obviously less common and this discriminated well at A and A*. For this they had to relate the orbits to the relative force of gravity.

(di) Most correctly calculated the weight on Mars as 703N [2].

(dii) Most wrote about the Rover being too heavy or above the recommended weight limit on the legs [1]. Others calculated its weight correctly as 1850N [1]. Some concise answers were seen such as ‘it is 50N above the weight limit’ [2].

Question 7

(a) About a third of candidates put momentum and velocity as vector with mass and speed as scalar [1]. Often though weight was mistakenly placed in the scalar column. About a fifth of candidates got all the quantities correctly placed.

(b) The acceleration question was done well with most giving the correct answer.

(c) This challenging calculation was correctly done by about a fifth of candidates. It discriminated well at A*.

Question 8

Just over half of candidates could get one column correct (usually the interference one) [1]. Less than a fifth gained both marks here.

Question 9

(a) It was encouraging to see most candidates able to calculate the speed of light correctly despite the indices in the data.

(b) About half could select the correct material which gave the smallest critical angle.

(c) This challenging question on dispersion was designed to discriminate at A and A* grades. Many described blue light as refracting the most [1]. Some mistakenly used diffracts, disperses or bends more [0]. Some of the higher ability candidates went on to explain that blue light slows down the most [1]. Another acceptable route was to describe blue light as having a shorter wavelength [1].

Question 10

(a) Most knew there was a link between resistance and current and gained [1] mark. Those that could correctly link this to the thermistor with answers like ‘the thermistor when hot has less resistance and so more current causing more brightness’ gained [2].

(bi) There was much confusion over this question. Many selected the correct formula but were unable to use it to make progress.

(bii) Most candidates used their incorrect answer from part (bi) here. Using ECF (error carried forward) examiners were able to award just over half the candidates with full marks.

(c) Most calculated the emitter current correctly [1].

Question 11

(a) Few candidates gave diode [1] here and even fewer could describe it as a one way current device or that it required a threshold voltage. A few explained it correctly in terms of forward and backward resistances.

(bi) About half of candidates completed the truth table correctly [1].

(bii) In identifying the conditions most knew that hotness and/or wetness was needed [1]. Rather fewer gave dark too [1]. Some said light [0] whilst others did not mention light intensity at all.

(biii) This question on relays was better answered than in previous years on the legacy specification though candidates were often mixed up over the relative currents or voltages. Also many think relays are there primarily to stop electrocution.

Question 12
This was a challenging 6 mark question on transformers targeted up to A* grade. About a third of candidates failed to score any marks here. Some made no attempt at all whilst others wrote of potential dividers or relays. Two thirds of candidates, however made valiant attempts at the question and produced a wide spread of marks enabling differentiation and discrimination to happen.

Most described the transformer correctly and this was often seen as a diagram. Better answers then described the relative turns and performed a simple calculation [4]. Higher grade answers also did this but in addition explained the induction process in clear detail to gain [6].

Question 13
(a) Again, as in previous years of legacy assessment many were unable to describe the action of the bridge rectifier. In many answers there was no reference made to the path through the resistor (or to T).

(b) About a third gave an explanation in terms of smoothing the output [1]. Many also did this convincingly in diagrammatic form.

Question 14
This two mark question on manufacturing small electronic circuits for space proved challenging for many. About a third of candidates gained [1] mark here with significantly fewer gaining full marks [2].

Question 15
This question is essentially focussed on data handling. Whilst there are questions involving data handling on sections A, B and C this section D is devoted entirely to those skills. The section in total is worth 10 marks on this 85 mark paper. This section also gave a wide spread of marks enabling judgements between grades to be made.

(ai) Most stated that the braking distances are longer on concrete [1].

(aii) Most got at least one of the points here. Same speed [1] was commonly given. Also acceptable was the idea of the same weather or road conditions [1].

(aiii) Generally, grade A* ability candidates managed to gain full marks here for ‘No’ and 45% [3].

(bi) Just over half of the candidature correctly calculated the distance as 30000km [3].

(bii) Again as in part (bi) just over half the candidature gained the mark here, mostly for the idea that the braking distance increases significantly [1].

B753 Controlled Assessment

This was the first full year of assessment for Controlled Assessment. The number of centres entering candidates for the separate sciences was higher than in previous years following the national trend. Many centres had entries for all five specifications and these were, as far as possible, dealt with by the same moderator.

Most centres followed the procedures for carrying out assessment, submission of samples and application of marking criteria with little problem but there were, as always, exceptions. Problems faced by some centres are described below and centres should take care to avoid them when entering candidates next year.

Carrying out the assessment:

The word 'Control' in Controlled Assessment refers to control of the candidates to ensure that the work completed is the candidate's own. Some centres gave candidates far too much guidance as to how plan, execute and write about the task. Centres should ensure that all of the work, not just the 'high control' part 3, is the candidate's unaided work.
For the same reason, writing frames are not permitted. This includes generic ones which do not refer directly to the task.
Candidates can work together in groups of no more than three but the plan produced by any candidate must be their own work not a copy of that of other members of the group. Plans within a group will, of course, be similar but examples were seen by moderators of plans which were identical. The same principle applies to tables of data and graphs.
Controlled Assessment tasks can only be used in the year printed on the front cover. They can be completed at any time but can only be submitted in that year. A 2012 task done in 2012 cannot be submitted in 2013 neither can a 2014 task done a year early. If a task is completed but not submitted in the appropriate year it cannot be used.
Some centres submitted tasks from 2012 and 2014 and some centres submitted a mixture of different years. Such mistakes are not without penalty.

Submission of samples:

Many centres organised their samples of work very well whereas others adopted a rather more random arrangement which varied according to which teaching group the candidate was in. It is helpful to moderators if the work is arranged in order with the front page of the part 3 booklet at the front.
This page is what the moderator needs to look at first as it contains all of the essential information; year, specification, task name, candidate name, centre number, candidate number and the marks for each Skill quality. It is disappointing when this page is incomplete. In too many cases centre number and/or candidate number were missing. Sometimes the marks were not completed or were wrongly totalled.
Centres are asked to ensure next year that in the sample sent for moderation this sheet is at the front of the candidates' work and is correctly and completely filled in.

Application of the marking criteria:

This is dealt with in detail below under the heading of the individual Skill qualities but a few general points follow:
The 'Additional guidance' given below the criteria in the Teacher Guidance for each task, should not be used as a mark scheme.
No other mark scheme, whether from the internet or generated by the centre should be used. The only valid mark scheme is the marking criteria provided by OCR.

There have been issues in some centres this year where candidates were disadvantaged by centres using mark schemes other than the official marking criteria.
Guidance follows on how to apply the Criteria when marking a candidate's work.

Researching:

It is the notes which the candidate makes on their original research which are assessed. The original research may not be the candidate's work as it may have been done at home or in a group. The original research need not and, indeed, should not be included in the sample nor may it be taken, by the candidate into the final (part 3) session.
To gain higher marks candidates must 'select' 'appropriate' information/sources. The only acceptable way to demonstrate this is to ensure that the information presented in the notes is relevant to the bullet points in Stimulus 2 and covers them thoroughly. In addition, there should be a reference in the text of the notes to show the information sources..
Moderators frequently saw the work of candidates who had wrongly been given high marks for extensive notes (often copied straight from sources) which were not focussed on or entirely pertinent to the questions posed in the Stimulus sheet.

Planning:

Take care when deciding if a plan is repeatable. As a science teacher you will know what the candidate intends but to score 4 or more the plan should have sufficient detail for it to be carried out by a non-scientist. This includes how apparatus should be set up, a range of values to be investigated and the number of replicates. For the higher marks a more detailed treatment of variables, ensuring accuracy and avoidance of errors is needed.
A significant number of candidates explained the control of variables in great detail and explained how accuracy would be ensured and errors avoided but then let themselves down by writing a very sketchy plan. This work was not worthy of the high marks given because of the lack of sufficient detail to allow it to be repeated.
It should also be noted that a plan should not be written in the past tense. This gives the impression (sometimes justified) that the plan was written after the investigation had been carried out. This is not what the Controlled Assessment task demands.
In Additional Science and the separate sciences this Skill quality also involves the writing of a hypothesis. For higher marks, the hypothesis should be justified with correct science which is clearly understood by the candidate.
However, the hypothesis is only part of this skill quality and an excellent hypothesis with justification cannot, alone, lead to a high mark. Equally a poor, unjustified hypothesis does not necessarily mean a very poor mark.

Collecting data:

This Skill quality should mean a high mark for most candidates if they have been properly instructed. It was sometimes under-marked in some centres. If data are tabulated with correct headings and units for columns and values are to an appropriate number of decimal places, there is no reason why a mark of 6 should not be given.
However, raw data should be recorded and this was not always the case. For example if a temperature change was being measured, the initial and final temperatures should be recorded not just the change. Mixed units e.g. minutes and seconds are also not appropriate. Time should be recorded as minutes or as seconds. Examples of both these types of error were seen this year.

Managing risk:

Evidence for this skill should be found in the plan and also in the answer to question 4 in part 3. However, the first part of the statement in the criteria is only really addressed by a risk assessment in the plan. Only this is an analysis of the risk before activity starts.

A simple statement of general safety rules can, as clearly shown in the criteria, only be awarded 2 marks. If risks specific to the task are identified and suitable responses suggested then 3 or 4 marks are available. To gain the higher marks 'significant risks must be evaluated'. There should be mention of how likely it is that that risk will occur and of the consequences if it does together with appropriate procedures to avoid/minimise it.
If an activity is 'low risk' then this should be stated. Little credit can be given for risks which have been 'invented' so that the candidate has something to write about.

Processing data:

Processing involves the use of 'mathematical techniques'; at least two for marks above 2. One of these may be a technique concerned with graphing (plotting or constructing an appropriate scale). It is, of course necessary for these techniques to be used accurately. Wrong averages, wrong plotting or scales which are too small or non-linear will not do.
There is no need for the candidate to undertake 'complex mathematical techniques' unless they form part of the task undertaken. However, for the highest marks some treatment of the uncertainty of data is essential (the easiest way to accomplish this is by the use of range bars).
A graph deserving of six marks should have axes labelled with quantities and units. Axes should be constructed so that the graph occupies at least half of the A4 sheet. A best fit straight line or curve as appropriate should complete the graph together if range bars if used.

Analysing and interpreting:

Candidates should be informed that it scientific explanation of the trends is necessary and explicit in the criteria. Credit can be given for an explanation given later in the conclusion section. Centres sometimes gave lower marks than necessary for this skill quality because they did not take into account explanations which the candidate later gave in answer to the final two questions.
Where comparison with secondary data is merely a statement that data from other groups was much the same, little credit can be given. What is expected for higher marks is a comparison between two sets of data; the candidate's and those of another candidate. The secondary data used should be included as part of the sample. This was rarely seen in the samples moderated.

Evaluating:

Evaluation is, perhaps, the most difficult Skill quality for candidates. Many candidates attempt this by explaining in some detail what they did and stating how successfully they followed their plan and how good their results were. This deserves very little credit especially when it is clear from their raw data and from their graph that their data was anything but good. The statement 'my data is good because it is primary data' was not uncommon.
Both the quality of the data in terms of accuracy and repeatability and the weaknesses in the method which led to any problems need to be addressed. Suggestions for improvement were often made but an explanation of why that would make the data better was seldom seen.
Candidates should be encouraged to start their evaluation by looking at their data to find any inconsistencies (there almost always are some) and then describe how the method could have led to these. Conclude by explaining how the method could be improved to get better data. Simply stating I would repeat it 5 times rather than 3 is worth little.

Justifying a conclusion:

This Skill quality was usually marked accurately by centres. Candidates should be advised that some science is needed in answer to questions 5 and 6. In question 5 the words 'explain your answer' should be taken to mean reference to their data and the scientific explanation of the trend observed. In question 6 the requirement for science is stated more clearly and reference needs to be made to their research notes also.

Good candidates often find the space allowed in the answer booklet rather too small. Candidates can use continuation sheets if necessary. These should be clearly labelled with candidate name and number together with an indication of the question number.
Another, perhaps better, solution is for centres to create their own answer booklet. As long as the first page is kept and the wording of the questions is not changed this does not count as a writing frame. It allows centres to provide more space for their candidates to give answers to the questions posed.

There are a number of documents available to assist centres with the application and administration of these tasks.

- **The specifications for the Gateway Science Suite**
- **Gateway Science Suite Guide to Controlled Assessment**
- **Exemplar tasks with marked candidate's work on the OCR website**
- **Candidate guidelines for controlled assessment** (section H of the guide to controlled assessment) also available separately from the website. These guidelines may be used by candidates in all parts of the controlled assessment.
- **The assessment criteria**. These may be given to candidates but the wording may **not** be simplified or changed in any way. Issuing the additional guidance to candidates is strictly forbidden.

Centres are thanked for the many hours of work put into running the assessments, marking the assessments and preparing the sample for submission. In the majority of centres this work resulted in a moderation process which was accomplished without too much trouble.

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