OCR
Oxford Cambridge and RSA

GCSE

Physics B

Gateway Science Suite

General Certificate of Secondary Education **J265**

OCR Report to Centres June 2016

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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

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B751/01 Unit 1 – Foundation Tier

General Comments:

This paper had a small entry of Foundation candidates. All questions were accessible. The paper had 75 marks and the range of marks achieved by candidates was between 0 and 65. The mean mark was 36.9 with a standard deviation of 11.8. The provision of additional space for answers at the back of the paper proved successful, but some centres provided candidates with extra sheets and left the sheets at the back of the paper unused. Some candidates used the back sheets for single words which would have easily fitted into the space provided with the questions.

Numerical questions were answered well, but longer written answers were often confused and contradictory.

Centres should again be congratulated on their entry policy, with few candidates being entered for the wrong 'tier'.

Comments on Individual Questions:

Section A

Q1 This question was about ultra violet radiation.

1a There were 3 marks for this question and examiners were looking for 3 separate answers. Most candidates gave skin cancer and some form of sunburn as correct answers, but few realised that it also caused eye damage or cataracts.

1b Asked about how people could protect themselves from UV rays. Sunblock, shade and clothing/hats/sunglasses were all popular answers, but many candidates only gave one answer despite there being 2 marks for the question.

1c(i) In this question most candidates were able to state that there was a hole or thinning of the ozone layer, but few were able to link this to CFC's.

(ii & iii) Candidates were familiar with the type of question, and well able to explain how scientists verified results and why they were confident with their conclusion.

Q2 This question was about insulation.

2a Most candidates were able to calculate the saving for the insulation in part (i) and successfully perform the calculation for fitting insulation in part (ii). In part (iii) candidates were asked to perform a calculation; many candidates just quoted data from the table and so were unable to score the full marks.

2b This was a 6 mark question about a thermogram. Most candidates scored some marks by linking the yellow and red to areas that were hot and lost most heat, but few were able to explain why a cold day gave better results. Examiners were looking for the ideal that there was a larger temperature difference between the inside and the outside of the house on a cold day and so a greater amount of heat lost.

Q3 This question was about different types of oven.

3a The majority of candidates gave a general list of how to make experiments fair rather than relating it to the question. An example is the same material for the beaker, when the question had told them that it was made of glass. Some candidates did not give enough detail such as 'same temperature' when the accepted answer was 'same **starting** temperature.

3b The accepted answer was by being absorbed by the milk or fat (molecules). The incorrect answer "from the inside out" was quite common. The majority of candidates failed to score marks on this question.

3c This proved a difficult question for candidates. Few were able to state that microwaves could penetrate glass or were not absorbed by glass.

3d In this question, examiners were looking for a comparative answer. Whilst the majority of candidates stated that black absorbed IR radiation and white reflected IR radiation, few said that black absorbs more IR radiation than white and white reflects more IR radiation than black.

Section B

Q4

4a Most candidates stated that photocells absorbed sunlight and changed it into electricity. Candidates could also say "to charge a battery" as a marking point. A significant number of candidates thought that photocells stored energy to use at night.

4b Examiners were looking for the idea that the battery provides power at night, or the battery had stored energy (from the daytime).

4c Approximately a third of the candidates were able to give a valid advantage. Several candidates stated that it was free, but that was only accepted if it related to the energy. The most suitable answer involved the idea that they could be used where there was no mains power supply.

Q5 This question was about greenhouse gases and global warming.

5a Most candidates successfully identified sources for the 3 gases named.

5b The majority of candidates did not realise that the atmosphere absorbed IR radiation. Credit was given to candidates who said that it stopped or trapped the radiation.

5c In this part candidates were asked for an opinion on global warming. It proved to be poorly answered. Marks were given for ideas that local conditions did not apply worldwide or "one off" situations do not undermine a trend.

5d Candidates had difficulty in understanding the term natural. Whilst most candidates were able to write about a cause of global warming, less than half gave a natural cause such as volcanoes, decay of organic material, forest fires etc. Common incorrect answers included power stations, motor vehicles and breathing.

Q6 This question was about electrical appliances.

6a Most candidates were able to calculate the power of the slow cooker as 460W.

6b The majority of candidates correctly identified the oven as the appliance which costs the most to use and gave a correct explanation.

6c Only about 25% of candidates correctly identified the device that reduces mains voltage as a transformer.

Q7

Approximately half of the candidates knew that asteroids were made of rock and caused craters when they hit the earth. Other correct effects were fires and species extinction.

Q8 This was a six mark question about using radioactive sources.

About 10% of candidates did not attempt the question.
There were some excellent responses to this question. The majority of candidates correctly identified the three types of radiation. In terms of safety precautions the most common was protective clothing. Candidates wrote at length about gloves, goggles, aprons etc., but this was only one point. Other precautions were safe handling and safe storage.

Section C

Q9 This question is about motion and was answered well by the majority of candidates.

9a Most candidate calculated average speed correctly to two significant figures. Very few candidates did not follow the instruction and used more than two figures.

9b (i) Whilst the majority of candidates correctly calculated the acceleration as 2.5 few gave the correct units of ms^{-2}.

9b (ii) Candidates had no problem with calculating the force as 150N.

Q10 This question was on the effect of force on the motion of cars.

10a Most candidates completed the table correctly.

10b Candidates were asked to suggest how air resistance could be reduced for cars.
The majority of candidates gave an answer of streamlining (or a description) for one mark, but hardly any candidates stated that reducing the speed reduced air resistance.

Q11 This was a six mark question concerning a speed time graph.
Most candidates were able to score marks on this question by giving a simple description in terms of speeding up and slowing down. More able candidates used the figures on the graph to give a more detailed description. The most able candidates calculated the acceleration and deceleration and some attempted to calculate the distance travelled and the average speed.

Q12 This question was about potential and kinetic energy.

12a Only about one third of the candidates identified Nick as having the greatest kinetic energy. There was evidence that candidates were in some way confusing this with potential energy and multiplied the person's height by their mass.

12b In this question candidates again confused kinetic and potential energy, with a significant number giving the answers to maximum KE and maximum PE the wrong way round.

Q13 This question was about science at work and concerned seat belts. Candidates are getting more accustomed to this type of question and about half the candidates answered it successfully.

13a Most candidates correctly suggested dummies being used in crashes with different types of seat belts, which scored full marks.

13b There were 2 marks for this question, but a large proportion of candidates were happy to give only one answer. To score full marks any two from crumple zones (often described as crumble zones – which was accepted), air bags or collapsible steering columns were needed.

13c Tested the idea of force = rate of change in momentum. About half the candidates answered the question successfully.

B751/02 Unit 1 – Higher Tier

General Comments:

This 75-mark higher paper gave a good range of marks up to 74 and a healthy mean mark of 47.4. This was a few marks higher than that of that in June 2015 (39). The answers showed that candidates generally were well prepared and appropriately entered for this tier. The paper gave a range of reliable marks that allowed clear grading decisions to be made.

The paper was of appropriate length and there were very few examples of candidates running out of time. Candidates used, when needed the additional space in the answer booklet although a few candidates left some answers blank, these 'no responses' tended again to be scattered throughout the paper rather than concentrated at the end. This year, however it was clear again that there were more attempted answers.

It was evident that there was largely a full participation in the paper this time and candidates were showing more success on tackling the 6 mark questions than in previous sessions. In June 2015 it was still evident that candidates were still coming to grips with some of the new approaches to questioning. For example, the developed calculations, How Science Works and data handling. In all these areas candidates tackled the questions better than in the past. The increasingly problem-solving approach to questioning generally tends to make questions more demanding and this again has made this paper a little more challenging. However, most candidates coped well with this and were still able to demonstrate what they knew and confidently applied this knowledge to the various contexts. Some answers though illustrated misconceptions of some Physics ideas and these are highlighted in the next section which covers individual questions.

Comments on Individual Questions:

1 This was generally well answered. Many understood about CFC and ozone. There were some misconceptions as candidates became confused with global warming and producing CO_2. Generally, though about a third of candidates gained 4 marks over the whole question.

ai. Markers were seeking to award marks for the advice given to industry. Most answers referred to reducing the use of CFCs in fridges or aerosols.

aii. This question was about the advice given to people in general. Many answers were concise with 'reduce the use of aerosols' [1] commonly seen. Some suggested throwing away old fridges [0] rather than disposing of them properly. Some gave answers in terms of the UV – using more sunblock / less sunbathing, etc. [1]

bi. This and part bii. were 'How Science Works' (HSW) questions. They were common with the foundation paper (B751-01). Candidates were asked how scientists could verify their measurements. Most gained marks with answers such as repeating measurements or experiments. Some referred to the use of more modern technology or collecting evidence from other scientists.

bii. This question was about increased confidence in explanations. Many answers simply repeated the answer from part bi. Markers were looking for the idea of more evidence / measurements to **confirm** their findings. Some explained the idea that after the CFC ban the ozone hole filled up [1].

2 This question about energy use in the home was well answered. Many were able to sensibly interpret the Sankey diagrams and use the concept of efficiency. This enabled them to use processed information in their answers.

a Most used the Sankey diagrams correctly to give the right answer of 1800J.

b Many gave the correct efficiency calculation but it was common to see answers that failed to write '%' so limiting them to [1] mark.

c Most calculated the efficiency of the slow cooker as 80% and went on to say it had the lowest energy input for 3 marks. Those that did use calculations could still get [2] marks from the alternatives given in the mark scheme –e.g. It's the most efficient [1] and only wastes 40 [1].

3 This question on payback time and house insulation discriminated well.

a This was very well answered with 25-years calculated for the payback time being commonplace. It was a common question with the foundation paper (B751-01).

b Many knew that the colour of the thermogram was important but failed to explain the correct link clearly enough. Many wrote about where insulation was required and some went on to relate it correctly to the colours and the heat loss e.g. Red and yellow show were most heat is lost so these need more insulation [2]. One common misunderstanding was that blue showed cold areas so these must be losing most heat. Others referred to heat loss but failed to relate it to the colours at all.

c This was a challenging level of response question on double glazing. Very few scored all 6 marks. There were marks for identifying the conduction in the glass, convection in the air gap and explanations in terms of particles. One common misunderstanding was that the gap contained a vacuum. Others thought that the vacuum had air in it. Many said 'air is an insulator/bad conductor' but the 'convection mark' was often not awarded as candidates discussed convection in the room rather than the air gap in the window. The 'particles mark' was less frequently awarded. Often seen were hot air particles passing through the glass to the outside. There were a large number of responses that were based on prevention of air movement rather than prevention of heat loss. There were a few good answers that explained how the small air gap prevents convection currents and that still (trapped) air is a poor conductor. Some also explained the passing on of vibrations between particles in conduction. It was common to see, however that many thought the air in the room had particles that vibrated and passed on this vibration to other particles.

4 This 5-mark question on heating water was quite well answered. Most scored 3 or 4 marks here.

a. Many scored 1 for warm water / particles rise. It was common to see particles 'expanding' or particles 'becoming less dense'. Some explained clearly about the particles spreading out and occupying more space [1] and rising [1]. 'Heat rising' was also common to see.

bi. This was a well answered question about calculating temperature rises.

bii. The candidates needed to say that the microwaves are absorbed by the water (rather than the plastic beaker). Some just said that the microwaves penetrated the beaker but failed to say that none were absorbed. Many referred to plastic being a poor conductor to explain their answer. Also the 'low SHC of plastic' was referred to unsuccessfully in many answers. It was rare to see explanations in terms of plastic not absorbing microwaves [1].

5 This 5-mark question was about using photocells to power a road sign. Most scored 3 or 4

marks overall. In parts a. and c. many candidates lost marks because their answers were not written with technically correct language. 'Generating electricity' or 'catching the light' were common phrases that did not gain any credit.

a. Candidates needed to give two advantages for the mark. Some answers were too vague with 'less / no pollution'. Better answers referred to no CO_2 produced / renewable / low maintenance / robust / long-lasting, etc. Often candidates failed to score a mark as they only had one correct answer – e.g. Renewable and less pollution [0].

b. This was quite well answered most scored at least one mark for the idea of light being absorbed by the photocell or silicon. Some explained about the electrons being knocked from the silicon atoms [1] and some referred to the electrons moving around the circuit [1]. Some vague answers had 'sunlight hits or touches the photocell' [0] and light is generated [0]. Some answered in terms of p-n but often gained the marks of electrons knocked [1] and electrons flowing [1] around the circuit.

c. This was a difficult question about collecting enough sunlight to power the road sign. It was about applying the Physics they knew rather than simply stating it. Many could relate the larger area to collecting more light or producing more energy or electricity [1]. Explaining how enough light could be absorbed from low angles was less well demonstrated. Few could explain the angle of the Sun or explain that more energy could be absorbed by the large area of photocells so there was enough energy to power the sign in low (angled) light. Only a few realised that the Sun moves across the sky. Generally, it was common for only [1] mark to be scored here.

6 This 7-mark question on the greenhouse effect was quite well answered with many candidates getting 4 or 5 marks. It was also common with the foundation paper (B751-01).

a. This question on water vapour, carbon dioxide and methane was well answered.

b. 'IR absorbed by the atmosphere' [1] was not as common as you would like. Quite a few got mixed up with UV and ozone from question 1.

c. This HSW question always attracted responses. Most scored [1] here by noting that she was only discussing the UK or that extreme weather events were taking place elsewhere. Others referred to extreme weather of climate events happening elsewhere. Others made sensible references to the importance of average temperature rather than the weather in just the UK. A few referred to Anita basing her findings on opinion rather than scientific data.

d. A common answer was about volcanoes. Natural forest fires [1] did not feature much although 'deforestation' was relatively common [0]. Cows excreting (and various types of biomass rotting) were both common and could be commonly explained too [1].

7 This was a 7-mark question on using and providing electricity in the home. It was common to see 3 to 5 marks scored overall.

a. This was well answered with 3 marks being frequently seen for the oven identified and the calculation correct. Often though [2] would be scored for failing to round the answer correctly to 2 decimal places (a common answer that falls into this category was 7.82 rather than 7.83).

b. This was poorly answered with only about a quarter calculating 540 pence or £5.40 [2]. A common answer was 1080. Many scored zero as candidates struggled to convert units and many doubled the power or time etc. Presumably they thought this was necessary as the time given for the grill was 0.5 hours.

c. About a third stated that the current was lower (at high voltages) [1] so that less heat was wasted [1]. Some answered well using I^2R to illustrate the marking points [2].

8 This was a level of response 6-mark data handling question on absorbing radiation. It was generally well understood and gave a range of marks from 0 to 6. Just over half of candidates scored 5 or 6 marks here. Candidates could generally identify the nature of the sources. Usually they could justify them too. Beta was the one most likely to be incorrect. Also some candidates failed to recognise that some sources had two types of radiation but this was still not essential to gain full marks.

9. This question from module P3 was about speed and force.

a. This part of the question was common with the foundation paper (B751-01). Most scored 2 marks with a correct table.

bi. They generally could describe the relationship but often expressed it unclearly e.g. As acceleration increases the speed decreases.

bii. – Many did not realise that drag or air resistance was involved. Better answers stated that the drag increased with speed and the (driving) force and drag force would balance. It was unusual however, for answers to get full marks here.

10 This question was about car safety features.

a. This question was common with the foundation paper (B751-01). Poor communication and use of English prevented many from scoring 2. Many said 'look at' accidents/tests but did not say what to do. Also common was 'with and without' seatbelts rather than different types of belt – e.g. Shoulder belt v lap belt or different materials for belts [1].

b. Only more able candidates tended to score [2] marks here. Many failed to say that seatbelts stretch. Common to see though was the belt preventing passengers hitting part of car – e.g. Windscreen or dashboard [1]. Often higher level answers such as seatbelts stretch giving a longer time or distance to stop [1] and a reduced acceleration and force [1] were also seen quite often.

c. Many correct, but ABS was also seen many times. Crumple zone / air-bag / collapsible steering wheel were the most common correct responses. Bumpers, safety cages, seatbelts and good tyres were often given as answers [0].

di. In this question candidates had to use the data in the chart to comment. It was quite well answered and the 'quadrupling' of breaking distance was often seen and understood. Most realised at least that the braking distance would increase [1]. Most however went on the gain the second mark also for more than doubling.

dii. In this question many failed to score because they did not specify the condition clearly. Commonly seen was 'the road condition' or 'the tyre condition' but did not say for example 'wet road' or 'bald tyres'. Often answers did not achieve the mark for this as they did not answer the question correctly by referring to things that *affected* the braking distance rather than things that *increased* it. As both answers were needed for the single mark this tended to reduce success on this simple recall question.

11 This was a 6-mark level of response question using a distance – time graph. Many scored well but the quality of communication was often poor. Many were confused by the graph and often answers clearly showed that candidates were answering as if it was a velocity / time graph. Common was 'accelerating at a steady speed'. For a simple graph, this was not answered as carefully as it should. Many candidates had the wrong descriptions for each section, or and a large number kept attempting to calculate the acceleration for each section. Basically greater initial thought from candidates about the axes would have clarified subsequent answers. This

question however, was a very good discriminator at grade C and grade A. Good answers described A as accelerating, B as steady speed, C as decelerating and D as stationary. This alone gained level 2 with [4] marks. Often in addition, the average speeds for at least one of the sections was calculated correctly to gain all [6] marks. Even at this level there were some uncertainties in the communication such as 'part B – accelerating at a steady speed'.

12. This motion, acceleration and power question gave the opportunity for candidates to give some good answers.

a. Most correctly calculated the acceleration from the graph.

b. This was generally poorly done as many did not obtain the correct distance from graph and simply read off a speed. Most candidates identified the correct formula (work done = force x distance) to use but were unable to calculate an appropriate distance to gain one mark for a reasonable substitution into the correct formula.

c. The power was correctly calculated by many.

B752/01 Unit 1 − Foundation Tier

General Comments:

This 85 mark foundation paper gave a good range of marks (1 to 68) and a similar mean to June 2015. As in previous years the answers showed that candidates generally were well prepared and appropriately entered for this tier. Few of the candidates would have been better suited to the higher paper.

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- Section D was answered very well by many candidates.

There was some evidence that some areas of the Specification have been covered less well by many candidates, most notably the three pin plug, kinetic theory as applied to air bags, interference, describing projectile motion, resistance of a filament lamp and half wave rectification. These areas were not unfamiliar but they did provide a significant challenge for many candidates who struggled to express their ideas coherently.

As in 2015 it was good to see candidates attempt calculations throughout the whole paper and in general there was an improvement in using developed calculations. The interpretation of evidence presented as graphs was done particularly well in a variety of contexts.

The 6 mark questions proved to be very challenging for all but the higher ability candidates. In particular, Question 10 describing projectiles and Question 14 describing and explaining resistance in a filament lamp were particularly inaccessible to most.

The 10 mark data section at the end of this paper was in a context new to candidates. Most candidates achieved very well in this section and were able to interpret and process data accurately. It was pleasing to see that this section was accessible to the full range of candidates.

Comments on Individual Questions:

Question No 1.
This question was focussed on the use of radiation in hospitals.
a Although many knew of another use beyond tracers candidates frequently incorrectly stated that X rays used radiation

b. Around half knew that beta and gamma could penetrate skin. It was surprising that many identified ultrasound as a form of radiation.

c. Most candidates correctly described one way to reduce exposure of the radiographer to ionising radiation. This was most frequently using protective clothing. Many candidates described in detail appropriate ways to reduce exposure.

Question No 2.
This 6 mark level of response question describing how to wire a plug for a double insulated hairdryer and to describe the importance of a fuse was not well answered. The question was targeted up to grade C. Many could recall colour coding to reach Level 1, some recognised that the earth wire was not needed and only the highest ability candidates could accurately describe the need for a 13 Amp fuse. This question was surprisingly challenging as the material is very familiar but the move to a less structured question proved to be challenging this year.

Question No 3.
This question was about electrostatics.

a Most scored at least one mark (usually for attraction) but very few, even amongst higher ability candidates scored 3 marks

b. It was pleasing that so many knew about the dangers of charge build up during refuelling. Many did not score the more straightforward mark about the advantage of faster refuelling.

Question No 4.
This question on electricity generation was quite well answered across the full range of candidates. Most scored at least 2 out of 4 marks.

a i. Most could identify a similarity between coal fired and nuclear power station.

a ii Only higher ability candidates tended to describe differences between the two types

b Almost all knew about nuclear fission. There was far less confusion with fusion this year.

Question No 5.
This question on voltage and its importance in power output was well answered by most candidates

a. The calculation of output power was well done by most candidates. Some able candidates (incorrectly) calculated the input power to score 1 mark

b i. Almost all understood the link between voltage and power.

b ii Most scored at least 1 in applying the ideas of too little power for the use in an iron but fewer recognised that it was the low voltage in Japan that led to this.

Question No 6.
This about the action of safety features in a car was not well answered across the ability range

a. Very few recognised that the force applied by the seat belt or air bag slowed he passenger down. Many answers were poorly described in terms of the dummy jolting forwards.

b. Most candidates had little idea about the kinetic theory of gases when applied to an air bag. This area was very unfamiliar to almost all candidates.

Question No 7.
As in 2015 this question on electromagnetic waves used for communications was not answered well. Candidates were unfamiliar with how different waves were reflected or scattered by the ionosphere and atmosphere and very few were able to apply ideas of interference to the question.

a. Around half could choose that electromagnetic waves were transverse

b i. Just under half could use the table to choose a long wavelength for reflection

b ii. Very few could explain why a long radio wave is be useful for long distance communications

c. Only half of higher ability candidates could explain that short wavelength waves pass through the atmosphere.

d. Very few (even amongst higher ability) could apply the principle of interference to explain why signals may vary in strength. This was a new and unfamiliar context and different from the previously covered focus on two source interference.

Question No 8.
This question on the behaviour of light was not well answered

a. Surprisingly few could describe any evidence for light travelling in straight lines. The most frequent responses referred to torches and lasers. There was far less recall of shadows than was expected. It was clear that this relatively simple area has not been well covered.

b. Most scored at least 1 mark (usually for refraction) but few scored 2 marks (frequently not recognising that violet light has the greatest change in direction).

Question No 9.
This question was describing and interpreting uniform motion in two different contexts

a i Few candidates knew the difference between velocity and speed

a ii Unsurprisingly this question on interpreting the addition of velocities of a boat and river from the perspective of the bank proved to be challenge across the full range.

b This question calculating distance travelled for an object increasing speed uniformly discriminated very well and higher ability candidates on the whole successfully chose used the equation accurately

Question No 10
This 6 mark level of response question trajectories was targeted at grade C. This question gave a good range of marks and discriminated well across the candidature. Most could compare the different speeds of the object in each trajectory. Higher ability candidates often achieved a Level 2 by describing that the faster object travelled further or by describing the parabolic shape. Responses that could describe accurately the horizontal and vertical accelerations of the projectile were very rare.

Question No 11
This question was about logic gates and light emitting output devices.
a i. It was surprising that few candidates could recall the symbol for a Not gate
a ii Just over half could complete the Truth table for a Not gate
b i. This question on the need for a relay for a filament lamp but not an LED was not well understood across the full range of candidature.
b ii It was pleasing to see that most candidates could evaluate the advantage and disadvantages of using LEDs as warning devices

Question No 12
This question on resistance in circuits was answered very well across the full ability range.
a. Almost all could work out total resistance of two resistors in series
b It was particularly pleasing that most candidates could interpret a potential divider to decide on the appropriate pair of resistors in series.
c Most could calculate the resistance using current and voltage and use this to consider whether it is suitable for an application.

Question No 13.
This question on circuit symbols was answered very well across the whole ability range.

Question No 14.
This 6 mark level of response question on explaining resistance in a filament bulb gates was targeted at grade C. Most candidates seemed unfamiliar in explaining resistance in terms of collisions between moving electrons and atoms or ions. Because this basic model was lacking very few could reach Level 3. Candidates usually scored Level 1 for describing that the bulb heated up or that the resistance went up when current flows.

Question No 15
This question on ac and half wave rectification produced the best and worst responses to questions in the whole paper.
a Most could recall that UK mains is 50Hz.
b i. Almost all could interpret a graph of ac voltage to correctly state the maximum voltage.
b ii. Explaining how a diode can be used to produce half wave rectification proved to be too challenging for almost all candidates. The fact that the graph was of alternating voltage meant that barely any candidates could talk about the action of a diode in only allowing current to flow in one direction and hence leading to a half wave rectified output.

Question No 16
Most candidates could identify errors in a table of step up and step down transformers. Only the lowest ability candidates found this question challenging.

Question No 17.
This data question on electrical energy usage across Europe was answered well across the full range of candidates.

a i. Almost all calculated energy usage in kWh
a ii. Almost all correctly selected Austria and Germany. A very small number gave more than 2 countries and so were penalised for doing so.
a iii. Most could not explain that there will be some users above as well as below the mean.
a iv. Most scored 1 for the idea that Belgium had a lower population
b i. This calculation in an unfamiliar context involved the multiplication of several factors that influenced energy loss. Most candidates struggled with this challenge but a large number of higher ability candidates could recall the joule as the unit of energy.
b ii. Almost all correctly stated that energy loss will increase in a cold winter..

B752/02 Unit 2 – Higher Tier

General Comments:

This 85-mark higher paper gave a good range of marks up to 84 and a higher mean (43.4) than June 2013 (41). The answers showed that candidates generally were well prepared and appropriately entered for this tier. As always though, a few candidates would have been better suited to the foundation paper as they had very limited access to these challenging questions. The paper was of appropriate length and there were only a few examples of candidates running out of time. Although a small number of 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 largely a full participation in the paper this time and candidates were showing more success on tackling the 6 mark questions than in previous sessions. In June 2015 it was evident that candidates were starting to come to grips with some of the new approaches to questioning. For example, the developed calculations, How Science Works and data handling. In all these areas candidates tackled the questions better than in the past. The increasingly problem-solving approach to questioning generally tends to make questions more demanding and this again has made this paper somewhat challenging. Most candidates coped well with this but were still able to demonstrate what they know and can confidently apply to contexts. Some answers though illustrated misconceptions of some Physics ideas and these are highlighted in the next section where individual questions are covered.

More candidates again 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 thus hitting more of the marking criteria.

The How Science Works questions were nearly always attempted but some candidates were again 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. Generally, however, these types of question again showed improved performance on last years.

The 10-mark data section at the end of this paper was in context giving a total of 85 marks. Most candidates carried their standards forward into this section and coped with the maths, data and written answers well. It was more successfully attempted than in 2015.

Comments on Individual Questions:

1. This 5-mark question on the use of radioactivity in medicine was well answered with most candidates achieving 3 or 4 of the marks.

a. This question asked why alpha was not used as a tracer. Some answers referred to high ionising power but failed to develop that and say they the alpha was absorbed by the body. Others stated that alpha is stopped by paper but failed to develop that further. Weaker answers did not refer to penetration but to the damage caused by alpha.

bi. This was quite well answered with more candidates mentioning damage or ionisation of **cells** than in previous years. Damage to tissues or organs was often seen and worthy of the mark.

bii. Over 60% of candidates answered correctly with 'half-life.' 'Rate of decay' was occasionally seen too [1]. Weaker answers included 'its radioactivity' or 'how old it is'.

c. Many referred rather vaguely to gamma hitting the 'right place' or the 'wrong place'. Better answers explained that gamma is meant to be focussed on the tumour [1] but (if the head moved) it may damage (surrounding) healthy cells [1].

2. This level of response 6-mark question on household plugs and fuses was quite well answered. It was targeted at grades D up to B. It gave a full spread of marks with just over half of answers scoring 4 or more marks. Weaker answers that the two wires required were earth and live. Other weak answers often only said that the earth wire was not needed but failed to develop the answer further. There were some good answers in terms of double insulation and the plastic insulating case being unable to become live. There were some misconceptions such as the wire is double insulated. Also some poorly communicated phrases such as the fuse breaks or goes (rather than melts or blows) were commonplace. Also fuses blowing with too much voltage was quite common. Only a few mentioned fire risk. Candidates often said that the current was below 13A but did not clearly say that current was (or needed to be) above 3A. Voltage, current and power were used interchangeably and some candidates were confused over a fuse heating up (and melting) and the hairdryer itself heating up. However, the question attracted many answers which were worthy and contained good physics.

3. This was a 5-mark structured question on electrostatics.

ai. Mostly correct with the seat becoming positively charged because it loses electrons. Occasionally one of neutrons, protons or charges was substituted instead of electrons.

aii. Few candidates mentioned conduction. Most thought that the spray stopped the flow of electrons or reduced friction forces, etc. Others thought it neutralised change. Good answers referred to it providing a conducting layer' [1].

aiii. About a third of answers correctly referred to the strip losing contact with the ground (because of uneven ground or the wind lifting it up). Some just thought it would break or it was not thick enough to carry electrons away.

b. This question was common with the foundation paper (B752-01). Weaker answers often repeated the question with the idea that the 'petrol left the pump quickly'. The idea that spending less time at the pumps [1] was seen in about a third of answers. Many though (about 40%) went on to write about the risks of sparks or explosions and gained the second mark. Some just mentioned the risk of (minor) shocks here.

4. This 4-mark question was about nuclear fission. Most candidates scored between 1 and 3 marks here.

a. About a half could correctly put stage B before F [1]. A third got the complete order correct with B E F A [2].

b. This question on the use of control rods in a reactor illustrated a few misconceptions about fission. Weaker answers referred to electrons rather than neutrons. Those that mentioned neutrons however usually gained the first mark with stopping or absorbing neutrons but all the answers in the scheme were given by the range of candidates. Some were too vague with answers like 'the rods control or help the neutrons'. Others thought that leaving the control rods inside the reactor would cause nuclear (or thermal) explosions. It was generally a well attempted question but about 40% fell short of both marking points.

5. This 5-mark question from unit P4 saw candidates answering well with most getting 3 to 5 marks in total.

a. This part of the question was common with the foundation paper (B752-01). A mark was often given for 1081. Most however scored [2] with 94 (W).

bi. This part of the question was common with the foundation paper (B752-01). Mostly it was correct with 'Kenya because it has the highest voltage'. UK was a common wrong answer.

bii. Weaker answers failed to link the change in resistance to a higher current. Fewer candidates attempted to gain the last mark. Those that did however often answered correctly. Many gave good answers such as low resistance increases the current to give more power for better ironing [2].

6. This 5-mark question, from unit P5 was about velocities and speed. It was well answered with most candidates gaining 3 to 5 marks in total.

ai. This part of the question was common with the foundation paper (B752-01). It asked candidates to describe the difference between velocity and speed. Three quarters of candidates could correctly describe velocity as being a vector quantity or having direction [1]. Weaker answers thought that speed was on land and velocity was in water. Other confusions were about 'speed is speed but velocity has force too'.

aii. This part of the question was also common with the foundation paper (B752-01). About two thirds of answers gained both marks for 'Y' and '6m/s'. X was often given incorrectly. Other answers were fewer and often missed the idea of the same direction (so velocities are added).

b. About two thirds of candidates calculated this correctly to get 7 [2].

7. This challenging two-part question was about momentum. It discriminated well with high attaining candidates.

a. This answer relied on a qualitative understanding of how particles create pressure on the walls of an air bag. Most candidates did not refer to collisions with the bag and very few gave the idea of increased collisions. Momentum changes were rarely mentioned with clarity. Weaker answers mixed up the collision of the car with the particles in the bag. They often thought that the momentum from the car crash directly filled the air bag with gas. Good answers described the particles as colliding with the walls of the bag and this change in momentum provided a force which pushes the bag out. Some used the formula force = rate of change of momentum and structured their answers around it.

b. About a third of candidates got the full calculation correct – '6.5 m/s and no'. A few got the idea that momentum was conserved (often by stating the equation). Others misused the equations of motion to gain various answers. Sometimes the equation would be populated with the correct substitution (1000 x V + 8000 x 2 = 9000 x 2.5) without the final calculation of V. This scored [2] marks.

8. This question was about the behaviour of waves. It was challenging in places, particularly part bii. However it did discriminate well between the grade ranges.

a. The 'reflection from the atmosphere' mark was often gained rather than that for 'diffraction around obstacles'. Some thought diffraction happened through obstacles whilst others explained in terms of satellites in space. Often just 'reflection' or 'diffraction' was given on its own without being related to the atmosphere or obstacles. Diffraction around the curvature of the Earth was a common correct answer.

bi. Hardly any candidates mentioned coherent [2] on this question about interference. The same wavelength or frequency was a common answer. Some were imprecise and mentioned 'similar' rather than the same. The phase mark was occasionally gained but amplitude was rarely mentioned at all. Both constructive or destructive interference were explained and both qualified for full marks if the marking points were covered.

bii. This was an intentionally challenging question about partial interference. Amplitude was not often referred to at all. Few gained the second or third marking points either.

9. This 4-mark question about refraction through a prism discriminated well at the higher grades.

a. Weaker answers only referred to refraction with respect to the normal. Often there was reference to the speed change but it was the wrong way around [1]. Many did say however that the speed increased [2] although fewer mentioned refractive index. Density differences were referred to quite rarely but when correct gained [1] mark.

b. Weaker answers did not refer to the change of speed of the violet light. They sometimes picked up a mark for shorter wavelength though. 'Speeds up more' and larger refractive index was stated equally by higher grade candidates [2]. Many thought incorrectly that violet had a longer wavelength than red light. Some contradicted themselves by writing that violet had a shorter wavelength and lower frequency.

10. This 6-mark level of response question on projectiles was challenging for many as it was targeted at up to grade A*. It did discriminate clearly at these higher grades. Candidates were asked to explain the horizontal and vertical accelerations and do a calculation of time.
Often candidates interchanged or confused speed or velocity with acceleration. They said constant horizontal acceleration when they perhaps really meant velocity. Vertical acceleration was more often given credit. Higher grade answers referred to the force of gravity. Some candidates did not appreciate that the vertical acceleration was constant. Many thought that acceleration increased (or did they mean speed increased) the nearer you got to the ground. Four marks for calculating t was the saving grace for a large number. (Calculations were generally good all through this paper). Weaker candidates on this challenging question went for speed = distance / time, often using the value of *g* as speed. About a fifth of candidates could explain it well enough with a correct calculation to get 5 or 6 marks.

11. This question from unit P6 was about logic gates.

a. The truth table was quite well answered with about a third of candidates getting all three columns correct. Most though gained [1] or [2] marks. The NOR gate was generally not understood by these.

b. In this question about a relay, few referred to a low voltage logic gate. Hardly any candidates got the idea of switching a large voltage with a small one. Many confused relays with transformers and others thought the relay simply carried on ringing the bell.

12. This was a 6-mark question on power transmission and transformers. Most candidates scored 3 or 4 marks on the whole question.

a. Most candidates substituted into the correct formula and gained a mark. Surprisingly few converted correctly to MW though. Mega was imperfectly known. Some realised that there should be a power of 10-conversion but went for kilo by mistake. Many failed to attempt a conversion at all.

b. Most answers referred to less energy wasted or more efficient for [1] mark. Others also added the increased risk of electrocution [1]. Some were vague by saying high voltage was dangerous or too high a voltage for the home.

c. The candidates were asked to look at the data in the table and identify and explain the incorrect rows. Few clearly referred to the incorrect ratios for 2 marks. A mark however, was often gained for stating that the D output should be 200. A compensation mark was sometimes

gained for 'C is a step-down' or the identification of C and D being incorrect [1]. B was often incorrectly identified as being incorrect.

13. Four marks were available for this question on solenoids and motors. Most candidates only scored 1 or 2 marks in total.

ai. Drawing the magnetic field around a solenoid is something that has not been asked in this way previously. About a sixth of candidates omitted the question or failed to notice it was a question at all. The quality of the drawing was often unclear and marks were difficult to award for many answers due to this. Marks were available for a uniform field within the solenoid (two straight parallel lines) [1] and the correct outer shape (diverging field lines or a looped line outside the solenoid) [1]. The diagrams in the guidance in the mark scheme whilst not exhaustive, illustrates what was acceptable.

aii. This question asked what would happen if the current was reversed. Many wrote that this would increase the voltage rather than reverse it.

b. As a suggestion of how to increase the speed of the motor most candidates gave a correct answer. Using 'more coils' or a 'stronger magnetic field' was mentioned in approximately equal numbers [1]. Using a soft iron core [1] was also seen from time to time.

14. This quantitative question on resistance was well answered.

a. Most calculated the resistance correctly with 20.

b. This part of the question involved the slope of a graph. Surprisingly large numbers of candidates said less steep. Most candidates said steeper [1] without further qualification. Better answers however stated it would be 3 x steeper [2]. Some answered fully and correctly by drawing on the graph.

15. This was an intentionally challenging 6-mark level of response question on the operation of a LDR. It discriminated very well at the higher grades of A and A*. Many weaker answers showed a misunderstanding of the operation of a LDR. Some referred to the effect of heat whilst others treated it as a photocell which charged-up during the day so it could release its light in the dark. Candidates were confused with the operation of the potential divider. Weaker answers did not mention the LDR and referred only to the potential divider. Very few correctly related the higher resistance of the LDR with a high output voltage across the potential divider and a low voltage across R. Candidates often made vague comments about currents through the divider. Many weaker answers said that resistance reduced in the dark. However, these answers generally gained level 1 marks if they related this (incorrect change in resistance) to turning on the light. Many got the dark and resistance change correct but did not relate it to voltages so gained [3] marks.

16. This section D (data section) 10-mark question was well answered by candidates. There was an even spread of marks from 4 to 10.

ai. Most calculated the family size to be 4 [1]. A few candidates however, gave wrong (and unreasonable answers) of family sizes into the many thousands. If these had re-read the question and judged if their answers were reasonable (for the size of one family) then they may have re-checked there arithmetic and gained the marks.

aii. This part of the question was common with the foundation paper (B752-01). Most referred correctly to the lower population in Belgium [1].

bi. This part of the question was also common with the foundation paper (B752-01). Weaker answers often had complex units but J or (J/s) was acceptable (given the wording of the question). Many gained only the unit mark here.

bii. This part of the question was common with the foundation paper (B752-01). Most knew that the heat loss through the wall would increase [1].

c. Higher grade candidates generally calculated the area as 40. Many candidates only gained the compensation mark for 12^0C as the temperature change. A third got full marks with the correct calculation leading to 40 (m^3) [3].

B753 Controlled Assessment

General Comments:

Overall centres have shown a good understanding of the requirements of the controlled assessments in the science subjects. The marking criteria have been mostly applied appropriately and it is good to see a large number of centres putting annotations on the scripts in the appropriate places to show how and why they have awarded the marks. Work submitted for moderation was generally well organised with all of the required paperwork submitted by the centres for the moderators' consideration.

However, a minority of centres are still submitting work that does not meet the full requirements of the courses. In particular;

- It is very important that marks are carefully checked before they are submitted. Moderators have noted a number of clerical errors this year where the marks submitted are not the same as those on the scripts sent to the moderator. This not only causes delays in the process but, if not corrected can result in incorrect marks being awarded to candidates.

- It is important that centres send the marks to OCR and the work to the moderators within the time frame set by the board. Unfortunately some centres are failing to meet these deadlines.

- It is important that the cover sheet for the work is completed correctly and, in particular, that correct candidate numbers are shown on scripts.

- All controlled assessments are valid for one year only. This is clearly indicated on the tasks that can be downloaded from the OCR web site. Some centres have submitted tasks for the wrong year. Some have submitted work from a previous year and others from next year's tasks. It is important that all centres make sure that the tasks they are undertaking are for the current year. The only tasks that are valid for 2017 are available on the website and clearly marked.

- All centres need to provide a copy of the CCS 160 Centre Authentication form with the candidates' work. On this staff are declaring that they have conducted the tasks under the required conditions as laid down by the specification. Controlled assessments require candidates to research, plan, carry out and review the tasks set and, other than for the practical work itself, this needs to be done independently. Even if candidates work in groups for the practical task they must complete their written work on their own and not work collaboratively.

- The amount of support that can be offered to candidates by the centre is the same regardless of the specification, the type of centre or the ability level of the candidates. Writing frames of any kind are not permitted and there should be no opportunity for candidates to produce a draft for review followed by a final piece of work for submission.

Previous reports have given considerable guidance on the application of the marking criteria, how to avoid common errors and the requirements for the award of high marks. Centres are advised to consult previous reports in addition to the notes given below as many of the comments below repeat advice that has been given previously and which is still being overlooked by a few centres.

Comments on specific Skill qualities:

Researching: Candidates generally scored well on this Skill quality and the marking criteria were usually well applied. In the main candidates have used a wide range of sources in their research although, not surprisingly, the majority of these are from internet sources and few references are given from books. If web sources are used then full URLs need to be provided so that these sources can be checked. If books are used then page numbers should be given as well as title and author.

In previous coursework, before controlled assessments were introduced, there was a requirement for candidates to consider the validity of sources. This **is not** part of the current marking criteria. Candidates are required to select information from their sources that is correct and relevant to the specific bullet points in task one that they are addressing and do not need to spend time considering where the information has come from. They should not use wholesale cut and paste from the sites although they may quote specific points, if referenced appropriately in the text. The inclusion of irrelevant material will reduce the mark available. For high marks candidates are also required to show which sources are relevant to the different parts of their notes. The easiest way to show this is by numbering the sources and putting numbers in the appropriate places within the text.

Planning: This Skill quality often begins with a hypothesis, except in the science specification, together with supporting science to explain and justify the hypothesis. This is only one part of the marking criteria and centres need to bear in mind that the marking is best fit not hierarchical. However, for high marks it is expected that candidates will demonstrate a suitably high level of understanding of the underlying science behind the task. This year there was a significant amount of misunderstanding of the science associated with the cold packs task for additional science, further additional science and chemistry.

Candidates sometimes find it difficult to obtain high marks when they do not address the task set. For example in the aerobic exercise task candidates will clearly obtain lower marks if they plan a task involving anaerobic exercise.

The method's written by candidates are now often of a high quality and frequently contain diagrams to support them. However, an appreciation of possible sources of error and how to control variables is still a weak area for many candidates. This is particularly true in biology tasks where there are many variables to control, for example how to maintain a constant pace in an exercise task.

Many candidates also do not consider the resolution of the equipment they choose to use, as is required in the marking criteria for 5-6 marks.

Collecting Data:

This is often a high scoring Skill quality but some centres are still awarding high marks when there are errors in headings and units. In particular, for full marks, candidates should not put units next to each data point in the table but should include these in the headings. For the purpose of this Skill quality, the level of precision is taken to be an appropriate and consistent number of decimal places for the recorded data.

Occasionally there has still been evidence of centres penalising candidates for failing to present processed data correctly, for example, averages being shown to a varying number of decimal p-laces. Also some centres have awarded high marks when not all raw data has been included, for example, failure to record initial and final temperatures and only recording temperature change.

As mentioned above, writing frames must not be provided and, if provide, can result in only very low marks being available to candidates as they have not constructed their own data table.

Managing Risk:

Most candidates now appreciate what is involved in carrying out and recording a risk assessment for an experiment. The weakest aspect remains their ability to evaluate the risk associated with a task, as required in the 5-6 marking criteria. This is particularly the case when a task is very low risk. Candidates vary from writing virtually nothing to coming up with a range of highly unlikely risk scenarios. It was surprising to see a number of candidates referring to the risk of mercury from the use of a thermometer when most modern thermometers do not contain mercury.

In order to score highly need to identify some hazards that are specific to the task and not just generic, they then need to identify the risk associated with these hazards and suggest way to both avoid and deal with these if they occur. These suggestions need to be specific and appropriate for high marks and not just comments such as "tell the teacher". The likelihood and severity of these risks should also be identified and. If a numbering system is given to the risks, then some key to explain what the numbers mean should be given. An overall comment about the level of risk for the whole task is important particularly for a very low risk experiment.

The level of risk should be realistic for example, not all risks should be graded as high otherwise the experiment would be too dangerous to do in a school context.

Processing data

Most candidates obtain averages for their data and produce graphs of varying quality. For high marks candidates need to produce a line of best fit and show a quantitative consideration of uncertainty. Although not penalised by the marking criteria, centres are encouraged to talk about range bars rather than error bars as error bars require a much higher level of processing than simply looking at the range of repeat values.

As mentioned in previous reports the marking criteria relating to scale in the graphs includes choosing a scale that maximises the size of the graph paper. Plotted points should occupy at least 50% of the graph paper. Candidates should be taught that graphs do not have to go through (0, 0) if is not appropriate.

With regard to the use of complex mathematical techniques these are only part of the marking criteria "where appropriate". For example, calculation of an energy change is an appropriate complex mathematical technique in cold packs but calculating a gradient in the cheese making task is not.

Analysing and interpreting

Most candidates were able to identify trends effectively and to link these both to their own data and data from a secondary source. Anomalous points were usually identified if present although few candidates used levels of uncertainty to explain why they classified points as anomalous. For high marks candidates analyse the level of uncertainty and this should be linked to the trend, for example discussing whether the line of best fit (trend) goes through all range bars.

In some tasks the trend was not well linked to relevant scientific understanding, particularly in the cold packs task where there was often confusion between the temperature change and the energy change. The science needed to explain the trends must be of a high level to support the award of high marks.

Evaluation

Again this was well marked by most centres but overall tends to be a lower scoring Skill quality.

Candidates often need more space to answer question 4 of part 3 than is available on the standard part 3. Centres may provide candidates with a reworked version of part 3 with more space available for answers if they choose to, as long as the wording is identical to that provided in part 3. This can be easier for candidates than using additional paper.

The marking criteria require candidates to consider both the data and the method and for high marks these ideas should be linked. Suggested improvements to the method should be explained in terms of how they would provide better quality data.

Question 4 of the task requires candidates to evaluate their method, their data and to make comments about risk. Many candidates fill the space available but focus primarily on just one of these issues and consequently can only score low marks.

Although most candidates have learnt how to produce range bars from their data few understand what these range bars represent and how they relate to an evaluation of the data.

The marking criteria require candidates to consider both the data and the method and for high marks these ideas should be linked. Suggested improvements to the method should be explained in terms of how they would provide better quality data.

Comments about risk do not contribute significantly to the mark for evaluation but can be used to further support the mark awarded in the risk Skill quality but as a general rule it would be unlikely for a candidate to obtain more than two marks for the risk Skill quality if their only consideration of risk was in part 3.

Conclusion.

Question five of part 3 requires candidates to link their data to their hypothesis, or the hypothesis given in a science task. Few candidates complete the question by explaining their answer. For high marks this should also show appropriate scientific knowledge and understanding.

Question 6 provides the opportunity for candidates to link their experiment to their research and a demonstration of this is required for high marks in this Skill quality.

Evidence for this Skill quality can be obtained from any part of the task. Centres are encouraged to clearly annotate the text to show where evidence is used from other sections.

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