Examiners' Report Summer 2008

GCE

GCE Salters Horners Physics (8552/9552)

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6751 Unit Test PSA1

Most parts of this paper were accessible to the majority of candidates and allowed them to demonstrate their understanding of the concepts studied in this unit.

Question 1

The majority of candidates appreciated the difference between weight and mass required for the first part, although a number did not express this explicitly.
The majority could use $s = ut + 1/2\ at^2$ successfully, but a significant minority attempted to apply other equations unsuccessfully. As previously, candidates who set out the known values from *s, u, v, a* and *t* and then selected their equation seldom went wrong.
The majority chose to complete the question by using speed to calculate kinetic energy rather than the somewhat simpler route of calculating the change in gravitational potential energy. Many completed this successfully, but a fair proportion, often those who had problems in part b, neglected acceleration and calculated the speed from 100 m / 5 s.

Question 2

In part (a), most candidates knew that parallel rays focused to a point and this tended to be shown in diagrams of varying, but sufficient, quality. Many candidates, however, identified this point as the focal length or just ignored the 'length' part altogether.

Most candidates knew the critical angle was important, although many of them thought the angle of incidence should be smaller and a fair proportion quoted 'greater than or equal to' incorrectly. References to the angle of incidence were often vague, e.g. 'the incident ray must be greater than …'
In part b ii there was often imprecise use of optical terms, with many references to 'bent' rays, despite 'reflection' and 'refraction' being in the stem. A substantial group thought diffraction was occurring and some resorted to the deliberately ambiguous 'defraction'. On the other hand there were excellently comprehensive answers from a good number of candidates.
In part c the impression was again given that many candidates could see what was wrong but were unable to express it well. Overall, they usually managed to describe two errors and get at least one refraction right on the diagram. It was surprising that so many did not follow the clues in the previous diagrams and get the emergent ray in the right direction.
Apart from occasional unit errors such as Watts, they nearly all managed power of the lens.

Question 3

A number of candidates overcomplicated the first part by showing how to calculate the component and some did that alone. The simplest answer is $v = u + at$, but relatively few chose this.
Many candidates simply answered b by reference to no acceleration, which is effectively given in the question, without giving an explanation in terms of forces. Examiners noted that candidates sometimes referred to 'it' without distinguishing between possible alternatives.

The great majority understood the significance of the negative values in c, but the most common error was that the ball was now below the starting height.

The diagram in d rarely caused difficulty, and the majority completed the magnitude part of the calculation straightforwardly. Some, however, attempted to use equations of motion using one of the given values as *u.* Some candidates missed the angle and a fair number used the wrong trigonometrical function, but many were successful.
The components were calculated remarkably well, although sometimes reversed. Suggestions for the difference in distances were generally vague, and some demonstrated a very clear misunderstanding of the concept independence of horizontal and vertical motion.

Question 4
Few candidates had much difficulty in parts a or b. Occasionally candidates used a temperature rather than a change in part b i or used the wrong energy in part b ii. In c i, ‘heat losses’ was given in the question and some candidates failed to give sufficient elaboration of this.
Candidates made some interesting suggestions, like the decrease in mass due to evaporation, in answering part c ii, and there were some quite ingenious explanations, such as the insulating effect of the skin on the milk.

Question 5
The great majority gained two marks for the input current.
Like question 1, most candidates appeared to know why VA is a unit of power, but they did not all ‘explain’ it satisfactorily. They could usually find the efficiency. Explanations for the efficiency being less than 100 % tended to be vague, with references to ‘heat loss’ but few suggestions as to why heat was generated, rarely even mentioning resistance. Some candidates went off track and referred to maximum power for matched internal and external resistance. There were other references which were clearly about the battery pack rather than the adapter. Candidates generally found the charge, although the time conversion confused a proportion. A number also used the wrong current. In the work calculation there were more opportunities to choose the wrong quantity, with alternative values of power and voltage being visible, and quite a few candidates made the wrong choices, demonstrating a failure to connect work done with output.

Question 6
Part a was answered straightforwardly by the great majority. Occasionally candidates labelled the anode or drew non-horizontal standing wave patterns and a few ended with antinodes.

Some candidates went for a wavelength of 2.8 m, but most could calculate the frequency for whatever wavelength they had used.

The straightforward answer required in part c i was often overlooked, although it was often mentioned (and credited) in part ii. There were quite a few references to human hearing being more sensitive at this frequency, or just to hearing range in general. Most candidates could suggest another frequency, but often they could not clearly say why. Candidates sometimes divided their fundamental frequency instead of multiplying it.

In part d, candidates who identified the longer wavelengths usually linked it to lower frequencies. A number of candidates didn’t make an explicit connection between the greater length in the room and a greater wavelength.

6752 Unit Test PSA2

Question 1

Most candidates correctly identified a suitable property even though some were confused as to the physics associated with the property. The frequency calculation proved difficult for many candidates with many unsure as to how to solve the problem especially with regards to converting eV to J. Lack of accuracy when drawing the arrow on the energy level diagram caused a surprising number of candidates to lose a mark with many showing arrows starting/ending between the energy levels rather than on them. Many candidates simply commented that the drop in resistivity would cause a reduction in resistance or an increase in current without stating any advantages of this. Comments on efficiency and energy loss were less common. Although the majority of candidates made a good attempt at the resistance calculation errors with powers of 10 or rearranging the equation were frequently seen.

Question 2

The overwhelming majority of candidates incorrectly circled 'tough' but many then went on to define it correctly. Those who chose plastic also tended to get the right definition, but the candidates who chose tough often talked in terms of 'withstanding large forces' instead of impacts or dynamic loads. The definition of brittle was well understood however many candidates could not give a correct definition of strong. Many candidates were confused by the expression of strain as a % value and it was common to see an error of a factor of 100. It was not uncommon to see incorrect/omitted units for the calculation in b(i). Many candidates managed to score at least 2 marks for the force calculation although a number used the diameter to calculate the area. Some candidates managed to correct their power error in the previous section from their answer to b(ii) although many simply forced a correct answer by juggling powers of 10. The vast majority understood that biosteel would be able to support a force 20 x that of steel and so gained a mark in part b(iii). A wide range of suggestions were seen to the final section including many who thought that the wires should have the same value for Young modulus or breaking stress. Many restated the question by answering that the wires should have the same dimensions.

Question 3

Most candidates successfully identified that the radiation would need to pass all the way through the food however many stated that alpha radiation should be used as this is the most ionising, without thinking through that this is unlikely to even reach the food let alone pass through it. Almost all candidates successfully stated that thermoluminescence is used to find the age of artefacts. Generally, candidates also recognised the need to check whether the food had been irradiated. Where candidates scored zero marks in b(ii) this was most commonly because they still referred to the age of the food rather than whether it had been irradiated. The diagrams seen in c(i) showed a wide range of standards with many poorly drawn and lacking labels. Most candidates talked about the electron dropping down energy levels, although some talked of photons, protons or atoms moving around the levels. A significant minority thought that the electrons would go up in energy level and give out a photon. Some talked accurately about the release of energy as photons. Many candidates though had confused this with the photoelectric effect, and some talked of the electron giving out light as it was heated up. Although the majority of candidates grasped the idea that background radiation could be responsible for the false result many did not realise that it must have been relatively higher in that particular area.

Question 4

Only a minority of candidates used the dot in the middle of the circle to draw their normal which resulted in the majority of normals being drawn incorrectly with many seen at a tangent to the circle. More candidates could successfully identify the two angles. The angle of refraction calculation was generally well answered. The majority of candidates had an understanding of critical angle however many described it as the point at which TIR occurs or starts. Although the critical angle was calculated correctly for the vast majority of the time there was a significant minority of candidates who did not quote μ = 1/sin C and quite a number seemed unable to take inverse sin. It was rare for candidates to gain full marks for (d). Very few showed a ray refracting out of the drop at the back as well as reflecting. Many were careless in getting the angle of incidence = angle of reflection at the back of the drop. Many did show the refraction away from the normal as the ray finally exited the drop. Most candidates measured the angle correctly. The majority of candidates correctly compared the refractive index of red and violet light.

Question 5

Most candidates drew a good best fit line, though a significant minority did not have it passing through the origin. Several did not extend the line back towards the origin. Although the calculation was generally well done many did not have correct units for stiffness. Several used dx/dy rather than dy/dx to calculate the gradient and some also used area under line to calculate the stiffness. The majority of candidates calculated the energy stored correctly, though a significant number forgot to include the ½ factor in the calculation. Part (c) was a problem for most candidates. Many thought that the child's contact with the trampoline bar made the difference. There were also a large number of references to the force being spread out through the rope, generally too vague to credit. The majority of candidates understood that the rope should be thicker however many went on to state it should also be longer, losing the mark by contradiction. Again, vagueness of answer lost many candidates the second mark as simply stating that the rope needs to be stronger was not sufficient.

Question 6

Although the vast majority of candidates used the correct formula many were unable to process the numbers correctly. Most candidates also did not make the connection between the object distance being greater than the calculated focal length which leads immediately to the conclusion of a real image. In part (b) many candidates drew two correct diverging rays, but failed to extend them backwards. A significant number did not draw rays originating from I_1. Some candidates forced their rays to create a real image, and a few clearly had no idea how to construct ray diagrams. When describing the image many candidates did not write down 3 separate properties even though 3 marks were available. It was not uncommon to see the terms 'imaginary' and 'unreal' used as an alternative to virtual.

6753 Coursework PSA3

The best work, as in previous years, was outstanding; written clearly and concisely, displaying high standards of physics and communication, in both the experiments and the visit.
The majority of centres sent clearly annotated scripts, with the correct accompanying paperwork including details of internal standardisation and a report of any briefing given to candidates. Only a few centres submitted samples without any annotation: these scripts were returned to centres for annotation. Some centres still persist, despite instructions to the contrary, in using plastic envelopes, rather than treasury tags, large paperclips or staples. The moderators were, as ever, very grateful to those teachers who read and followed Edexcel's instructions.

Experimental Skills

The best experiments are simple ones which allow candidates a choice of method and which point to a clear numerical conclusion using an equation in the form $y = mx + c$, and as noted above the best reports are concise.

In Skill A (Planning) some plans were obviously written as an afterthought. A weak plan usually yielded an ineffective evaluation. The plan should include any relevant equations and details of any planned calculations. Marks for A6d and A6e are still being awarded by some centres with sparse evidence in the plan.

In Skill C (Observing and recording) the majority of candidates scored highly.

In Skill D (Interpreting and evaluating), some computer drawn graphs were scaled to integrate neatly into the text. As a result they were usually too small to be useful. Several times, weaker candidates scored well with hand drawn graphs whilst stronger candidates from the same centre missed this point because they put presentation ahead of good science. Where appropriate, repeated results should be averaged rather than being plotted as separate graphs.

The visit

Two interesting new visits this year were to an oil testing laboratory and a climbing wall. Both of these locations allowed candidates choice in the aspects they explored.

Plagiarism or lack of acknowledgement of sources continues to be a concern. Centres are reminded that advice on this is given in a Joint Council for Qualifications leaflet which should be provided for all candidates.

Centres are again reminded that marks for Skill B (Account of physics) should come from one aspect only: it may help if candidates identify in their introductions which aspect is the one they will be explaining in detail. For Skill C (Communication), 4 marks should only be awarded if grammar and spelling are of a high standard and sources are acknowledged.

Administrative matters

Centres are reminded to use the most up-to-date paperwork, which includes record sheets to be signed by the candidate and teacher.

6754 Unit Test PSA4

Question 1

Part (a) This presented no problems for students.

Part (b)(ii) was no problem for candidates that had learned the particles. Common mistakes were to reverse the two answers, or to give boson for baryon, or lepton. The meson was better known.

(b)(ii) Some candidates lost marks for not being specific; 'one has three quarks and the other …'
Some candidates lost a mark for saying that the meson was made of 2 quarks.

1c) A number of students talked about high energy particles without saying that high speed particles had high energy.
Diffraction was mentioned by a number of students.
There were GCSE style answers about increased penetration and energy to smash particles.

1d) Well answered. The most common incorrect response was to say that a vacuum was required.

Question 2

A disappointing number of students used the formula for the area of a circle, or even volume of a sphere to calculate the circumference. However this was generally answered well; many calculated correctly and remembered the units. Other common mistakes were to confuse frequency and period (for those who chose the circular motion method) or to use time = 1s. Most candidates who got the correct answer recognised that this was greater than the speed of light – and even some of those who did not get the correct answer realised that the speed of light needed to be considered. It was a pity that some of these students did not go back to check their answer.

Question 3

3a) Many students remembered the basic field diagram for a bar magnet, but there were a large number of very poorly drawn diagrams, including some with crossing field lines. Many candidates thought that the field lines converge to a point at the centre of the pole face. A few forgot to show the direction of the field, and some thought the arrows should go towards N. Clearly some students did not know what the field would look like, and some of the resulting patterns were purely artistic, for example, with fields emanating from the poles of the cell, or entirely enclosed within the cell.

3bi) Generally well answered by students. The most common error was an incorrect calculation after a correct substitution.

3bii) The common answer to this was that the field was not at 90^o to the wire/direction of the current. It was generally well answered.

3bc) Few students realised that this could be a result of the reduction in field strength with distance from the magnet.

Students should realise that answers along the lines of ' The data I was given in the stem of the question is incorrect' are unlikely to score e.g. 'The current may have been less because the cell was used.' 'The length of wire may not have been 12mm' Similarly, answers where the procedure is under the control of the experimenter e.g. 'The wire may not have been parallel'. They should focus on parts of experiment not yet considered. GCSE style answers about the variation in a batch of magnets were inappropriate here, a variation of 200% across a batch would be excessive.

3d) Generally well answered, most candidates choosing to describe in terms of two changes cancelling rather than FLHR from scratch. A number did not realise that there had been two reversals, and there were some who did describe both changes but still thought the wire would move down. Some candidates thought the word levitate meant 'move itself' not 'move itself upwards', a few used inappropriate terminology e.g. 'float' and some thought the wire would rotate or go towards or away from the magnet.

Question 4

4a) Most students realised that this was because capacitors required d.c. and mains was a.c. although a minority believed that capacitors need a.c. and mains is d.c.
Some found difficulty in explaining why. Those describing the capacitor or plates charging generally found it easier than those trying to describe movement of electrons, or current changing direction.

4bi) Many students are not aware that the time constant is the time for the voltage to fall by 1/eth of its value. This value (37%) can be easily found on a calculator but some students use 1/3 or 30% which is not accurate enough. Others substitute values taken from the graph into the equation and often make errors during this process. Using the tangent to the line was quite rare. They should be aware that 'secs' is not a recognised symbol for seconds.

4bii) This was well answered, with some students scoring for ecf from bi). A surprising number did not know that 'n' = 10^{-9}

4ci) Well answered by most students. The common errors were to use the 100nF capacitor from the first part of the question, to think that μ was 10^{-3}, and, less often, to think that the symbol C in the equation Q=CV was for charge.

4cii) Well answered, including students who scored for ecf from ci)

Question 5

5a) A number of students lost marks for using the equation rather than finding the gradient of the graph. Some students did not find the gradient with sufficient accuracy, usually because they did not read off the graph to the level of accuracy required.

5bi) this was answered well, although some students forgot the 83%

5bii) Generally done well. Some students could not correctly rearrange the log equation. Some substituted incorrect values from their own calculations, although they had been told the actual values for I_o and μ.

5biii) Some students forgot to actually compare the two values. Answers about thickness/density of fog/density of water droplets were too vague and needed to be qualified by saying that the attenuation (coefficient) would vary.

5c) generally answered well, although some students stated that the attenuation coefficient was less for high frequencies.

Question 6

6a) This was challenging for most students. They found it easiest to describe the relationship between card capacity and number of photos, and most did this in terms of when one doubles so does the other. However some lost the mark by saying that the number of photos doubled as the card capacity increased. Many scored for the data marks, but very few chose to describe the proportional relationship. Many students don't understand the terms proportional and inversely proportional. Some students chose incorrect mathematical relationships – e.g. exponential. The doubling of the pixels and halving of the number of photos was spotted by fewer students. Some students focussed too much on the small discrepancies, rather than looking for the broad relationship.

6b) This part was straightforward to answer and mark. A surprising number of students thought that M (Mega) = 10^3. Most students chose the card with 127 photos for the calculation. Other choices were 1016 photos, or the 1st and last entries in the bottom row. Providing students could handle the M correctly, many completed a correct calculation. The methods were varied, from 'doing it in their head' to lengthy working. Some students were obviously confused, and divided pixels by bits, instead of bits by pixels.

Question 7

There was a clear progression from weak to strong candidates in the marks awarded.
Some students stated that momentum before the collision = momentum after collision, but then used a value for the final velocity of car and lorry = initial velocity of the lorry. Even when this gave two different values for the momentum before and after the collision they did not realise their mistake.
Many students who correctly calculated the final velocity did not go on to consider kinetic energy, although this instruction was given in the question.

6755/01 Coursework Unit Test PSA5

It is always good to read projects which show a good level of commitment from candidates resulting in reports that contained good research using a range of sources from which they identified and developed the physics relevant to their project. Some had real purpose and there were many examples where candidates had a big commitment to the development of their apparatus. Most candidates made a good attempt at analysing their results in a meaningful way.

Once again the majority of centres marked their coursework projects correctly according to the marking guidelines and dealt with the necessary administration efficiently.

Common faults included

- Sending all the OPTEMS sheets to the moderator
- Not including highest or lowest candidates in the sample,
- Absence of signatures on record sheets.
- Arithmetic errors. Centres need to be careful in the transfer of marks to the OPTEMS.
- Not using shaded marking grids which are available on the Edexcel website.
- Not making clear where errors of physics occurred and where appropriate marks had been deducted.

There was big variation is the quality of annotation. At the very least this should include the marking grid code at the place in the report where the marker awarded that mark.

Treasury tags or tied loops of string through a punched hole are still the best way to present a candidate's script. Staples are unsuitable if the wad of paper is too thick to allow a staple to close properly. Plastic wallets mean that the pages are not connected together when removed from the wallet for reading.

Choice of Projects

The quality of choice of topic varied from centre to centre. Some centres obviously encouraged candidates to choose a project arising from their own interests and hobbies and others relied on the standard experiment. It was disappointing to still see a few examples of GCSE level projects which would not be able to achieve the highest marks. Most of these were marked accordingly although there were still examples of standard experiments being given almost full marks.

When candidates do opt for an original investigation then the support of teachers is essential just to ensure that they do not end up with too few useful results. Occasionally one sees a project where a candidate has been left to struggle which is a pity.

Still quite a few projects started with a promising title but become standard experiments with meaningless or vague conclusions.

Good projects this year included holes in CDs, quantum tunnelling composite, creep in plastic and the comparison between energy saving light bulbs and incandescent light bulbs.

The higher mark for A2 physics theory was often inappropriately awarded by centres. Sometimes there was a lot of theory which was not relevant to the investigation and still there is wrong physics which has not been marked as incorrect by the centre.

Research and rational

Rationale is still an area of confusion with several centres giving the highest marks for a simple statement of physics theory. Rationale is not physics theory. It should reflect the interest the candidate has in the project and include a well-constructed argument for wanting to carry out the investigation.

Wikepedia is still, understandably, a popular research source quoted in almost all bibliographies. It is a good first stop but should not be the only source. Only a handful of candidates commented on its lack of reliability. This year more candidates have put references in the main body of the text although it is still a minority of candidates who showed what had been gathered from a source and where it had been used.

For the highest marks, physics theory needs to be developed and relevant to the project title and aims.

Planning

In most cases variables were considered within a coherent plan and apparatus was chosen well. Some candidates and centres think that length means clarity but often it is the reverse. Also diagrams seem to be a rarity this year with candidates opting to photograph their experiment. Whereas a clear photo is often helpful it does not replace a clear labelled diagram and, without this, it makes it more difficult to know exactly what the candidate is aiming to do.

Risk assessments for the projects continue to be the norm. That is very pleasing.

Observing

Tables of results were almost universally presented well with headings and units.

This year there were a couple of examples where results were not given at all although graphs were drawn. This mainly arose when data logging had been the means to collect data and a graph had been generated directly from the data. With no record of results it is impossible to assess repetition and precision and therefore to award skill D highly.

Analysis

The poor quality of many graphs continue to be a concern this year. Computer graphs continue to be the norm and can be an excellent way of analysing the results. However candidates need guidance to make their graphs an adequate size with vertical and horizontal gridlines and labelled axes. A significant number of graphs had the points plotted but there had been no attempt to draw a line.

Hand drawn graphs are still often the best and easiest way of dealing with graphs.

Best-fit straight lines are still being drawn through points that are obviously a curve. Too often candidates call any curve exponential and draw log graphs for no good reason.

In a lot of cases final conclusions were vague, unclear and did not relate well to the initial aims of the investigation.

Communication

The general standard of written work was good with a large number of well planned and well laid out reports.

Diagrams and photographs often added to the clarity especially when considering the experimental set-up. However candidates seemed to think that a photograph can take the place of a labelled diagram. Without this it was often difficult to understand what the candidate intended to do. This needs to be reflected when marking F6d.

The best reports had clear sections and I would advocate subheadings especially in the planning section that contains so many different aspects of the project to be considered.

Clarity was also improved with the use of abstracts, page numbering and the use of appendices

It is still rare to see a good bibliography that should include a range of sources from standard textbooks, other books, magazines and journals, experts and websites. Editions and page numbers should be given and the date on which web sites were accessed.

Some reports were overlong. This was often because a huge mass of data had been accumulated and many graphs drawn. However the final conclusion depended on only a few graphs and consideration should be given to the most appropriate presentation of this information.

Although this report suggests areas for improvement, moderators felt that the majority of reports showed genuine commitment from both candidates and teachers. Also they felt that administration was carried out well by most centres.

6755/02 Unit Test PSA5

Module 5 covers a wide range of physics topics, and the questions in the paper reflect this.

Although the overall demand of the questions on the paper was similar to last year, it was clear that some candidates were poorly prepared for some of the questions. Knowledge of basic ideas to do with kinetic theory and radioactivity was patchy, with many answers to questions on these topics revealing fundamental misconceptions.

It was pleasing to note that the general standard of written English was good, with the majority of candidates able to write a coherent well-structured answer to the open-ended question.

Question 1

In part (a) the vast majority of candidates correctly named resonance as the effect, and gave a clear statement of the condition for this to occur. There was occasional reference to the "resonant frequency" of the bridge, although most answers correctly identified that the step frequency needed to match the *natural* frequency of the bridge. Some answers referred to simple harmonic motion and the conditions for this, and so scored zero on this introduction to the question.

In (b)(i) many candidates simply re-phrased the question, but omitted reference to the wind. The calculation in (b)(ii) was not well done. Many candidates calculated the frequency and then used it as a time period in $\omega = 2\pi/T$; others thought that ω was the same as the frequency. In (b)(iii) many candidates understood that the condition for the car leaving contact with the bridge was that the acceleration of the bridge must exceed the acceleration due to gravity. Unfortunately, many answers did not make it clear whether this should be above or below the equilibrium position of the bridge. Pleasingly, a small number of candidates gave a full answer to the question, equating g to the maximum acceleration to give the exact displacement at which contact would be lost.

Question 2

In part (a) a large percentage of candidates correctly named the reaction as fusion. Of those who did not score this first mark, the vast majority gave fission as the answer. A small number of responses gave hybrid spellings; it is expected at this level that candidates will be able to spell technical words correctly.

Part (b) was high demand, and many candidates struggled to gain marks here. In (b)(i) most candidates were able to recognise that use of $F = L/4\pi d^2$ was required. However, it was common for symbols not to be defined, and many answers failed to make it clear that the luminosity would have to be known. Vague references to standard candles were insufficient for marks to be awarded. Either Doppler effect or red shift was an acceptable answer for one mark in (b)(ii), but the steps necessary to determine the star's velocity were rarely made clear. Typical answers stated the Doppler formula with little explanation of how it would be used.

Part (c) was generally well answered. Most candidates drew a good best-fit line and stated the relationship between velocity and distance. In (c)(ii) most were able to calculate the Hubble time within acceptable limits, although mistakes with the powers of 10 were the most likely way in which the final answer might be incorrect. Only the best answers made a convincing argument that H_0 was the gradient of the graph.

Question 3

This question was well answered by many candidates, although in the low demand introduction to the question many candidates were unable to state the meanings of the symbols clearly. It was common for m to be mistaken for the mass of the whole gas and T to be identified simply as the temperature. Less common was for $<c^2>$ to be referred to as the mean velocity squared; occasionally candidates called it the root mean square velocity. Astonishingly at this level, a sizeable number of candidates thought that c referred to the speed of light. In (a) (ii) it was common for answers to refer simply to energy. Some candidates paired kinetic energy with potential energy, which did not gain credit. The calculation in a(iii) was generally well done. Those candidates who did not obtain the correct answer mostly omitted to convert the temperature to kelvin, or used an incorrect conversion. A small number who substituted correct values into the formula forgot to take the square root to obtain the final answer.

In (b) (i) it was common for candidates to be able to perform the algebraic manipulation, but less common for them to make it clear that the total energy must be zero if the molecule is to escape. In (b)(ii) many candidates forgot to add 100 km to the radius of the Earth. Good answers to (b)(iii) were rare. A small number of candidates made it clear that it was the fraction (rather than the number) of molecules above the escape velocity that was important. The best answers made a quantitative comparison between the escape velocity and the r.m.s. velocity of the molecules. A minority of candidates misunderstood the information given in the graph and concluded that the oxygen molecules were likely to escape.

Question 4

This was a poorly answered question. In part (a) many candidates seemed unaware that electrons do not exist inside the nucleus. Some treated the decay as an atomic process, concluding that the nucleus remained unchanged as an electron was released from atomic shells. Some candidates confused beta decay with alpha decay, and only a minority of candidates stated the correct change in nuclear composition.

The calculation in part (b)(i) was well executed by a good proportion of candidates. Some candidates had difficulty in interpreting the proportion expressed as a percentage. A small number of candidates converted the half-life to seconds; on occasions this led to unnecessary arithmetic errors. In (b)(i) most candidates seemed to think that background radiation would be a problem. It was rare to see answers referring to the difficulty in measuring such small percentage compositions. Some candidates realised that the original composition in the old skulls might not have been the same as that for recent skulls. Most answers to (b)(iii) were too vague, simply re-stating the question, rather than relating the short half-life to the age of the recent bones.

Question 5

The open-ended nature of this question proved challenging for many candidates. Most answers began with a reference to stone walls reflecting rather than absorbing sound. Good answers then went on to consider superposition effects in detail, giving the conditions for constructive and/or destructive interference and the resulting loudness of sounds in different positions. Marks were awarded for good annotated diagrams to explain the superposition effects, although some were poorly drawn and failed to gain credit. Explanations of path difference causing a phase change were rare. Some candidates based their answer almost entirely on resonance and so gained little credit.

Those candidates who realised that sound absorption was necessary to reduce the effect mostly gave good answers to the second part of the question. Some vague references to “magic wallpaper” were seen, and a large number of answers referred to active noise control without realising that this would not be suitable in this case. Those candidates who went into active noise control in great detail at the expense of the rest of the question scored low marks overall in this question. It was pleasing to see that some candidates were sensitive to the aesthetic effect of changing the interior of St. Paul’s Cathedral to reduce reflection from the walls, although this was not specifically rewarded by the mark scheme.

6756 Unit Test PSA6

Question 1
Many candidates included a drag force in a(i) and ignored the 20 N for the calculation in a(ii). It was pleasing to note that many candidates remembered the equation to calculate upthrust.

Candidates found c (i) difficult and either included a "2" in the calculation or placed the ratio upside down.

In e (i) although many candidates recorded the equation for induced emf (= - $d\phi /dt$) they could not apply this to a graph and consider the significance of the gradient. The majority of candidates drew a graph for emf which was 180 degrees out of phase to the flux.

Many candidates scored well in Part f demonstrating a solid understanding of the laws of electromagnetic induction. A number of candidates simply thought that the body would absorb flux without considering the effect of the eddy currents.

Question 2
Part a was considerably better answered than a similar question on a previous paper.

The incorrect answer of '$1/I^2$ is directly proportional to $1/f^2$ 'appeared regularly but was otherwise sensibly answered in terms of a straight line graph or discussing aspects of y = mx +c.

Units caused difficulties. At a basic level there was little appreciation that when quantities are manipulated in a table (eg $1/f^2$) the new column will also have units and these will no longer be Hz.

Very few candidates appreciated that gradients (of graphs) also usually have units.

Some candidates did not appreciate that writing all values within a column of a table to the same power of 10 is helpful, particularly when deciding graph scales. Some errors with graph plotting can occur if values are left as x 10^{-8} and x 10^{-7} turning a linear scale into a log scale.

Most candidates recognised that the gradient was required for (c). Problems occurred when candidates had the axes of their graph reversed or were unclear whether to calculate k and R using mA or A and ended up a factor of 10^{-3} out.

Again candidates appreciated that the intercept should be located for (d). Many candidates did arrive at a correct answer, the occasional fault being to ignore the units of current. The value of resistance given in e was meant to alert candidates to an approximate figure for reference in d but few took advantage of this.

Part (e) was well answered by the majority of candidates.

Question 3

A surprising number of candidates did not know that a proton is represented as

$^{1}_{1}$p. A number of candidates knew this but didn't realise that the nuclear equation has to be balanced and failed to deduce that another particle was involved.

Part b was answered well in terms of descriptions of particle accelerators but many candidates failed to mention the required accelerating voltage. Some candidates were aware of this but managed to calculate an incorrect value for accelerating voltage using a spurious equation.

Part c was answered well by the vast majority of candidates. Of those that didn't get full credit the most common errors were to forget a factor of 2, use the charge of the electron rather than the mass and neglect to square the speed of light. A few candidates calculated the deBroglie wavelength for an electron with an energy of 19 MeV.

Most candidates scored well in part e with a good discussion of momentum conservation but a number of answers suggested that opposite charges repel.

Question 4

This was a relatively low scoring question for many candidates. A good approach taken by some was to split the paragraph up sentence by sentence and comment on each in turn.
It did reveal a number of common misconceptions:

- infrared radiation has a higher frequency compared with visible light
- frequency changes when waves refract
- optic fibres use frequency (or amplitude) modulation
- modulation - multiplexing are the same thing

Many students did not add any Physics within their answer but merely restated the paragraph in their own words. Finally many candidates avoided the use of technical terms such as frequency division multiplexing or total internal reflection.

Grade boundaries

6751

Grade	Max. Mark	A	B	C	D	E
Uniform boundary mark	100	80	70	60	50	40
Raw boundary mark	60	50	45	40	36	32

6752

Grade	Max. Mark	A	B	C	D	E
Uniform boundary mark	100	80	70	60	50	40
Raw boundary mark	60	43	39	35	31	27

6753

Grade	Max. Mark	A	B	C	D	E
Uniform boundary mark	100	80	70	60	50	40
Raw boundary mark	60	50	45	40	36	32

6754

Grade	Max. Mark	A	B	C	D	E
Uniform boundary mark	90	72	63	54	45	36
Raw boundary mark	60	43	39	35	31	28

6755 Option 01

Grade	Max. Mark	A	B	C	D	E
Uniform boundary mark	120	96	84	72	60	48
Raw boundary mark	80	57	52	47	43	39

6755 Option 02

Grade	Max. Mark	A	B	C	D	E
Uniform boundary mark	120	96	84	72	60	48
Raw boundary mark	80	57	52	47	43	39

6756

Grade	Max. Mark	A	B	C	D	E
Uniform boundary mark	90	72	63	54	45	36
Raw boundary mark	60	40	36	32	28	25

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