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Examiners' Report January 2008

GCE

GCE Salters Horners Physics (8552/9552)

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Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

January 2008

Publications Code UA019882

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6751 Unit Test PSA1

In a number of questions on this paper, some candidates have failed to achieve credit because they have not followed the instructions in the question, for example to 'explain' or 'compare'. 'Explain' requires more detail than 'describe' and would usually entail the description of a Physics phenomenon and its application to the given context. 'Compare' clearly requires a statement of similarities or differences between at least 2 given quantities, objects or phenomena.

Question 1

The majority of candidates were able to tackle part (a) successfully. Many of the poorer-performing candidates still gained two or three marks for recall of formulae and/or correct calculation of a resistance from an incorrect current.
Part (b) proved more challenging. The majority of candidates failed to use the total resistance for the circuit (cables plus pump in series) in the first part, getting an answer of 6 A. Most candidates, including many of those who calculated the current correctly, went on to apply the whole of the 12 V potential difference in the second part, using P = IV. Despite the circuit diagram, or through failing to read the question, they appeared to fail to think of the circuit components separately.
Most candidates came up with a reasonable suggestion for increasing the power available to the pump. Among answers not accepted there were bald comments such as 'increase the voltage'; a number thought of using additional light sources to shine on the panels and suggestions to equalise the resistance for the panel and the pump were not infrequent.

Question 2

In part (a), most candidates knew how to find the force from the mass displayed, although a good number did not give their answer to the required extra significant figure to the one given in the question. Many failed to address the second part of the explanation, viz. 'upwards', and did not mention the '-' at all. The examiners saw many mentions of upwards gravity.
At least one of the required forces was usually identified, but arrows were added to the diagram somewhat haphazardly by many, often not particularly near the balloon. The label gravity appeared frequently, sometimes with the other force labelled weight or mass! Although the question asked for forces acting on the balloon, tension was often shown in the wrong direction. Given the limited number of values on the page, many candidates arrived at the correct equation for calculating weight, although they did not always quote their answers to the required number of significant figures. Occasionally candidates did not complete the calculation in (a)(ii) but did it as part of their answer to (b) (iii).
Candidates usually identified the required forces on the diagram in part (b), although weight continued to be mislabelled sometimes and a number of candidates added an additional forwards force.
The vertical component for tension was correctly expressed using cosine fairly frequently, although sine was often seen, tension was sometimes divided by the cosine or 0.16 N was taken to be the tension or its vertical component.
A minority of candidates found the tension correctly. Those who did tended to be those who set out their working methodically, identifying the forces in a clear equation at the start.
Most candidates realised that air resistance increased, although they only vaguely related this to the change of angle in most cases.

Question 3

The calculations in this question were despatched efficiently by the great majority of candidates. Occasional errors were made in calculating the correct temperature difference.
The assumption was usually satisfactory, but sometimes too vague, such as a bald 'no heat lost'. '100% efficiency' was sometimes seen, but insufficiently contextualised. A significant number of candidates said that the heat lost by the water was the same as the heat lost by the teapot.
While many candidates scored both marks in (b) part (iii), a number wasted a mark by not making a simple comparative statement. A few candidates explained how a smaller value of heat transferred would lead to a smaller value of c, but many just gave a reversed form of their assumption, which was usually sufficient to gain the mark if given in sufficient detail. Again, references to efficiency tended to explain too little and leave too much to the examiner.

Question 4

Most candidates identified refraction and a reason for it. Some gave diffraction and some gave defraction, appearing to hedge their bets. One even had 'efraction' with choice of R and D in front, finally opting for D and some appeared to be attempting an ambiguous combination of r and d. Reflaction was also seen.

The highest score generally seen for part (b) was 5 out of 8 available marks. Most candidates showed a refracted ray going from the butterfly to the fish, although a fair minority reversed the direction of refraction.
'Critical angle' was very rarely explained satisfactorily. Most candidates defined it as an angle at which total internal reflection occurred, and only a few as the largest angle before this. Of the latter, very few explained which angle they actually meant – that is the angle of incidence in the denser medium - and their diagrams tended not to help with this through insufficient labelling.
Candidates often gained 3 marks for (b) (iii), drawing both a reflected path and a direct path and describing the path involving internal reflection from the surface. It was vary rare to see an explanation of why the other path was undeviated. Candidates sometimes lost a mark for not including arrows on the rays. The reflected paths drawn often didn't even approximate to the angle of reflection equalling the angle of incidence, but this was not penalised.

Question 5

The great majority gained two marks for the gravitational potential energy calculation, a minority losing a mark by not quoting 3 significant figures.
A majority of candidates appreciated the task they had to undertake in part (b) (i) and performed the calculation satisfactorily. Some, again, failed to quote to 3 significant figures. Others attempted kinetic energy calculations, often using the combined mass of projectile and counterweight.
Assumptions were often not specific enough. 'No energy lost' is quite general and could be used in many situations. A mechanism by which it might be lost needed to be included in the answer.
Most candidates picked up at least one mark for (b) (iii), and many identified it as the kinetic energy of the counterweight and quoted the formula to justify this.
In (c) a large number of candidates failed to appreciate fully the independence of vertical and horizontal motion and applied the given speed to the vertical motion. In many cases they assumed this was the vertical speed when the projectile reached

the ground. A number of others assumed motion from rest, but used a vertical fall of 20 m instead of 21 m.
In (c) (ii) most candidates correctly calculated a distance from a time calculated in (c) (i). A number still assumed accelerated motion and used g as the acceleration.

Question 6

Most candidates identified the wavelength as twice the length, although some appeared to be mislaid by 'state' into writing a sentence about a longer length giving a longer wavelength without sufficient detail.
Many gave at least 2 points from a standard explanation of standing waves, but a number either failed to identify where the second wave came from in this context or failed to be sufficiently explicit about which waves were superposing.
Candidates generally gave a formula for the speed calculation and calculated the missing values.
In (b) (iv) candidates were asked to comment on the values, but there tended to be few references to the numbers or patterns revealed in the table or broad statements not supported by the figures. A lot of candidates made imaginative efforts suggesting reasons for the differences, but this would have been asked for by a stem requesting them to 'explain' or 'suggest a reason'.

6752 Unit Test PSA2

This was a high scoring paper that appeared to have been accessible to candidates of all abilities. There was no evidence that time was short for the paper. The question using Stokes's law and upthrust and that on thermoluminescence proved to be the most difficult for candidates, whereas the questions on ultrasound and the Force-Compression graph were answered well, showing a good understanding of these principles.

Q1 The majority of candidates could correctly describe ultrasound although a few thought it was an electromagnetic wave or gave insufficient detail by simply stating 'a wave of high frequency'. Many candidates could also explain why pulses were necessary, explaining that the reflected wave would interfere with the transmitted wave. Some, however, found it difficult to express their ideas clearly here. The majority of candidates understood the need for a high rate of pulses although a significant minority confused a high rate of pulses with pulses of a high frequency. The calculations were well answered although in many cases the layout of working was confused. Common errors seen included not converting kHz to Hz, not doubling the distance in (d) or omitting the correct unit. A few candidates either used the wrong equations or could not manipulate them to get the right subject. The fact that frequency would decrease as the moth moved away was well understood but relatively few candidates related this change to the movement of the moth.

Q2 The majority of candidates were able to produce a diagram showing diffraction of wavefronts, but the diagrams were often not accurate enough for both marks. The diagrams need care and attention to detail to show the constant wavelength before and after the obstacle. A significant number of candidates attempted to answer the interference question in terms of wavefronts, where a simple sketch of two sine waves would suffice. Diagrams often appeared rushed and with no labelling, providing no explanation as was required. Many candidates had difficulty making sensible suggestions as to the information that could be deduced from the diagram, with answers vague and often not relevant to the question. A common error was to simply describe the shape of the diffraction pattern formed, stating that DNA must have the same shape structure. Most candidates could state that the electrons were behaving as waves.

Q3 It was rare for candidates to gain both marks for showing the forces acting on the balloon. The quality of the arrows drawn was often poor with many drawn distant from their line of action. Most candidates could draw and label the upthrust arrow, but few marked the tension in the string. Weight was often mislabelled gravity. Many candidates scored full marks on the upthrust calculation. A common error was to use the diameter rather than the radius of the balloon, although this was often recognised and changed when the 'show that' answer was not achieved. The majority of candidates could draw three streamlines round the balloon. A small number, however, drew horizontal lines and some had lines crossing or lines which did not extend above or below the balloon. Most correctly described the airflow as laminar or streamline. A surprisingly large number of candidates could not give the correct terms for the equation. The most common error seen was to write 'Stokes' Law' instead of drag. Many did not recognise upthrust and wrote out all the symbols in words. About half the candidates were able to calculate the terminal velocity of the balloon. A large proportion could not rearrange the equation correctly and some used the diameter of the balloon instead of the radius. Very few candidates could suggest a correct reason for why the balloon would be unlikely to reach this velocity. The most common answer seen was to state that air resistance had not been taken into account.

Q4 The responses to this question again showed of lack of care and attention to detail. Many candidates did not draw a normal and then measured the angles to the surface. Measuring the angles accurately caused some difficulty, with some candidates not having a protractor. A significant minority appeared to be confused by the fact that the ray was travelling from the glass to the air and so labelled i and r the wrong way round. Many able candidates could calculate the refractive index accurately. A large number, however, did not realise that the refractive index requested was from air to glass and gave the answer from glass to air. A surprisingly large number of candidates could not draw the reflected ray correctly. Many drew the ray along the boundary or at what appeared to be a random angle in either the air or the glass. The majority of candidates showed some understanding of critical angle and total internal reflection. Many answers, however, were too vague and did not give any more detail than was given in the stem of the question. The final question required the candidates to use their answer for refractive index. This caused some difficulty for those who had an answer of less than one. Many of these candidates used the reciprocal of the refractive index as the only way to get a sensible answer, however their workings out clearly showed that they did not understand why this was necessary.

Q5 Most candidates could explain the exposure to gamma radiation, however, many could not accurately describe background radiation either listing sources of it or stating it is radiation ‘from the atmosphere’. The majority could give a sensible source of the background radiation. Weaker candidates failed to give a sensible assumption often stating that the background radiation in the area was negligible or that it was made up only of gamma radiation. Although the majority understood that the powder must be heated and that the intensity of light must be measured, the understanding of thermoluminescence was very mixed. Many excellent answers with good use of physics terms were seen from able candidates. Weaker candidates often showed a poor understanding and confused thermoluminescence with the photoelectric effect. A diagram was required to gain full marks. Many confused the diagram for energy levels in an isolated atom with the one required of energy in an insulator, although many good well labelled diagrams were seen.

Q6 The vast majority of candidates correctly stated that the spring must undergo elastic deformation with a clear explanation to justify their answer. The graph was generally very well plotted. Only the most able candidates calculated the stiffness of the spring correctly. Most simply gave the gradient of the graph. Those who did find F/x often failed to give a unit and so lost the second mark. Most gave a correct value for the force by reading from the graph. Some also used the equation to gain this mark. Most candidates scored two of the three marks for the energy calculation. The most common error seen was to not convert 6 mm into metres but then give the answer in J. A few converted mm to m incorrectly and some gave no unit at all. Answers to the final question were divided between double, the same and half the force. The most common answer seen was that double the force would be required.

6753 Unit Test PSA3 - Coursework

As last January there was a very small entry in this module: only 176 entries were eventually received.

The moderators were very grateful once again for the full documentation and annotation provided by most centres, although some centres had to be contacted for further information. 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 had read and followed Edexcel's instructions.

In such a small entry only a limited number of experiments were seen, the majority were appropriate. However, as noted in previous years, those titles which do not lead to numerical results limit the mark which can be obtained for the evaluation of results. Sometimes all that is required is a change in title rather than content: for example 'find the resistivity of a given material' rather than 'prove that $R = \rho l/A$ is true'. Centres are reminded once again that candidates should only be awarded marks for Skill A in the part of their work which is written before the experiment is carried out. The plan should be written in the future tense and should be distinguishable from the rest of the report, so that it is clear that safety, accuracy and sensitivity have been considered during planning rather than evaluation. Circuit diagrams should generally be included in the plan for an electrical experiment.

One centre had visited a materials testing facility at an aeronautical engineering firm. This allowed a range of aspects on which to base the visit report, and some useful numerical data.

Centres are encouraged to use the free coursework consultancy service for advice about suitable experiments, visits, projects and marking. If in doubt about the procedure for resubmission of coursework, centre should consult the circulated FAQs or the Subject Leader within the coursework team at Edexcel.

6754 Unit Test PSA4

Question 1

The majority of this question was generally well answered by candidates. The first part was the main stumbling block with a large number being unable to explain adequately how a transformer works. Several answers referred only to either the structure of a transformer or the effect of the 'turns ratio' on the output voltage. Marks were often gained for recognising the need for an alternating current and/or a changing magnetic field to induce an e.m.f. (not a voltage or current) across the secondary coil, although only good candidates were able to link all the stages together and achieve full marks.
Most candidates calculated the correct number of turns on the secondary coil. An appreciation of the step-down format of this transformer helped some candidates to correct initial errors made in the recall of the required equation.
The second calculation proved more difficult with several blank, deleted or confused responses. However, the majority of candidates used the input data from the stem of part (a) to find the primary current. Most then used the table to obtain the correct minimum diameter although a significant number rounded their current *down* to the nearest value in the table. Occasionally, despite a correct calculation of 0.026 A, candidates would use the table to find the minimum diameter for a current of 0.26 A.
The last part was generally well answered with most candidates stating at least one of the two required points. However, as is the case with most explanations, not all answers were clear and concise.

Question 2

Although most candidates found the correct total momentum, full marks were not always obtained because of an incorrect or missing unit. The fact that there were two balls moving was also sometimes missed.
The 'show that' format of the second calculation meant that errors were less likely although some candidates still only thought that one ball was moving.
The condition required for conservation of momentum was not very well known. A common response was that momentum before had to equal momentum after.
Most candidates found the value of cell C8 by working backwards from the kinetic energy in cell D8. This was unacceptable, particularly as the stem to part (c) stated that the speeds were found by applying the principle of conservation of momentum.
Candidates did better at providing a formula for cell C9 although far too many simply gave the general kinetic energy formula rather than a suitable spreadsheet version.
Answers to (c)(iv) often attempted to explain this in terms of momentum conservation. It was obvious that these candidates had failed to grasp that all the tabulated velocities conserved momentum. Many vague and rambling answers were seen both here and in (d) where the break down was often attributed to momentum not being conserved. In both parts, any references to the spreadsheet were often vague.

Question 3

Many candidates calculated the correct energy stored and gave its unit. Some used the potential difference of 8.0 V in the stem rather than the 2.0 V in the question. There was some confusion between charge Q and capacitance C.
The table was completed with only a few candidates making errors. These candidates should have used the two given ln values as a check of their method.

Having been instructed to determine ln values, it was surprising how many candidates ignored these and plotted a graph of *V* against *t*. Some others plotted ln *V* against *V*. Both plotting and line drawing were usually of an acceptable standard. However, candidates should be advised to use pencil so that changes can be easily made. A mark was often lost for incorrectly labelling the ln *V* axis; this was particularly disappointing as the correct format was shown in the table. Candidates used a large number of methods in their attempts to find the resistance. However, the complexity of some of the algebra used was beyond the ability of a significant number of candidates. There was often confusion between *V* and ln *V* values. Some candidates used (ln V_o)/e rather than ln (V_o/e) to find what they thought was the time constant. A common error in all methods was the failure to convert hours to seconds.

Question 4

A common error in part (a) was to state that 7 TeV was greater than 251 GeV/c^2. Many candidates failed to make the comparison required to achieve the second mark in (b)(i).
The more direct 'show that' format of (b)(ii) meant that this was generally well answered. However, some candidates failed to appreciate that the equation was given in the common stem for part (b).
Most candidates realised that they should make use of the dimension of the accelerator given at the start of the question. However, many used the 27 km as the radius while others failed with their attempted conversions from circumference to radius. Many candidates produced a correctly rearranged equation although some failed to appreciate that they should be using $r = p/Bq$ from the formulae sheet as their starting point, possibly because they did not recognise *p* as momentum.
Most candidates did well on the last part although those who only made a vague reference to FLHR were not rewarded.

Question 5

Many candidates had obviously learnt most of the stages involved in analogue to digital conversion and did well in part (a). Common errors included 'sampling the amplitude' and 'sampling at 2x the signal frequency'.
Part (b) was not answered well as most candidates gave general reasons for digital being superior to analogue without directing their answers specifically towards the benefits of remastering the analogue, magnetic tape signal.

Question 6

Many candidates were unable to make much progress with this question. Some just calculated the weight of the rider while others appreciated that circular motion was involved and recalled an equation for centripetal force. Finding the correct velocity at the bottom of the swing by the correct method proved to be beyond the majority of candidates. Some fully correct answers were seen although the majority of good responses failed to appreciate that the seat not only had to provide the force required for circular motion but also had to support the rider's weight.
The final mark was really only available to those candidates who could refer back to a reasonable attempt at the calculation. Even then, only a few well-explained answers were seen.

Grade boundaries

The raw mark obtained in each module is converted into a standardised mark on a uniform mark scale, and the uniform marks are then aggregated into a total for the subject.

The table below shows the boundaries at which the raw marks are converted into uniform marks. Raw marks within each grade are scaled appropriately within the equivalent range of uniform marks.

Units converted to 100 uniform marks

Unit	**Maximum mark**	**Grade**				
		A	**B**	**C**	**D**	**E**
	Uniform marks 100	80	70	60	50	40
	Raw marks					
PSA1	60	41	36	32	28	24
PSA2	60	47	43	39	35	31
PSA3	60	50	45	40	36	32

Units converted to 90 uniform marks

Unit	**Maximum mark**	**Grade**				
		A	**B**	**C**	**D**	**E**
	Uniform marks 90	72	63	54	45	36
	Raw marks					
PSA4	60	41	37	33	29	26

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