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Examiners' Report June 2007

GCE

GCE Physics (9552/8552)

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6751/01

The majority of candidates demonstrated progress from GCSE science, but there was variation, with a significant minority of responses showing little mastery even of the Physics element of double science, ranging up to excellent and well-considered responses.

As in previous series, candidates tended to be more confident in approaching questions involving calculations than in giving written explanations and descriptions, even though some must be very familiar from inspection of past papers. It would plainly be helpful for candidates to memorise some basic definitions and descriptions, for example in question 4 on this paper. Given this, when a question seems familiar, candidates should still make sure they are answering the question set and not just writing what they have learned about that topic. A proportion of candidates appear to have had some idea of the required answers but to have been unable to adequately demonstrate their underlying knowledge and understanding of the relevant Physics through poor expression. Appropriate vocabulary, such as that used in the specification, should be introduced into written answers, for example oscillation and propagation rather than just movement. Precise use of language aids the elimination of ambiguity in assessing responses.

Diagrams are often very useful to aid explanations, but they should be labelled clearly if they are to gain credit.

Candidates should remember that a quantity requires a magnitude and a correct unit to gain credit in the examination.

Question 1

About half of the entry got at least one mark for the first part, those gaining only a single mark usually doing so for mentioning compressions and rarefactions. Most candidates knew that their answer needed to include the idea of two things being in the same direction, but a significant number gave ambiguous responses through imprecise expression, for example saying that 'wave motion is in the same direction as the movement'. Quite a number picked up the term 'propagate' from the question, but appeared to confuse it with 'oscillate' in answers such as 'the wave travels in the direction of propagation'. Very few described transverse waves in error.

Very few candidates experienced difficulty in calculating wave speed, with only a small minority confusing the units. Most could also make a relevant calculation, usually the time taken for the p-waves to arrive, although a number failed to make a statement in conclusion.

Question 2

A good proportion of the entry was able to correctly arrive at the required resistance, although candidates could often have demonstrated their method more explicitly for this 'show that' question. A number arrived at a similar answer but without including the total length of wire in their calculations.

Most candidates showed some conception of a sensible reason for using the whole length of wire for measuring resistance, but the written explanations frequently lacked focus and applied a shotgun approach with several suggestions.

The calculation of the rate of generation of heat energy proved more problematic for many candidates and some did not attempt this part at all. A significant number of candidates used the resistance for the whole wire instead of the resistance of the fuse in their calculations.

The heat energy calculation was answered well, with a few failing to use a temperature change or making a unit error.

Candidates with answers for the previous parts could generally calculate the required time, although some divided the energy by 20 A or divided the temperature change by 20 A. A number of candidates who could not calculate the rate of heat generation in part b (i) were able to do it as part of their answer to b (iii). They usually started from power = I^2R, suggesting that they had problems with the term "rate" in b (i).

Answers to the final part usually suggested a basic understanding of the mechanism of resistance in metals, although often poorly expressed, and most candidates got at least one mark. Those who did not get the second mark usually failed to describe adequately the increased vibration of lattice ions, often stating that they started to vibrate or saying they moved about more. Some others failed to refer to electrons in their answers, not clarifying what was colliding more with what.

Question 3

Candidates were usually able to complete the calculation of acceleration on the moon correctly, giving their answers to 3 significant figures as required in this 'show that' question. A number of those using $s = ut + {}^1/_2at^2$ forgot to square time when substituting values. The minority who attempted to use height and time to calculate a speed went astray by treating this as final rather than average velocity.

While most candidates appreciated the relevance of the lack of atmosphere on the moon, quite a few failed to be explicit about the lack of air resistance or said it would be low and did not get the first mark. Few candidates got the second mark – many because they answered a different question to that asked. There were quite a lot of explanations of why the hammer and feather had the same acceleration as each other rather than why their acceleration didn't change as they fell.

Very few candidates couldn't successfully calculate weight, although unit errors were seen occasionally and a few candidates used g for Earth.

The responses to the range calculations and comparison were well done overall with a fair proportion of candidates completing the whole section correctly. Of those who did not, most could state $v = u + at$ and many knew how to resolve the velocity into components, although some reversed sine and cosine and others used the same component in parts (i) and (ii). In nearly all cases candidates who had a value for distance were able to make a reasonable comparison or the last part.

Question 4

Candidates rarely referred to the sum of displacements in their explanations of superposition. Those who described any addition were more likely to refer to amplitudes. A number attempted to use diagrams in their answers, but these did not tend to have labels made them a useful complement to the rest of the answer if they had labels at all.

Candidates tended to get at least 1 mark for their standing wave explanation and often 2, but they usually did not make it clear what the reflected wave was interacting with to get the full 3 marks.

About a third of the candidates found the wavelength of the electron wave correctly. Most others incorrectly counted the number of wavelengths, usually choosing 4.

The majority of candidates struggled with explanations of amplitude and antinode. There were many diagrams, but few with adequate labelling. For example, without a labelled y-axis the amplitude was highly unlikely to contribute to the marks. A lot of candidates described amplitude as if it was displacement without the idea of maximum. Many described antinode as the place of maximum displacement or of no displacement – and sometimes as both!

Question 5

The great majority completed the first two calculations with no difficulty at all.

Many candidates failed to understand the question on maximum power transfer and wrote an answer about efficiency instead. Those who recalled the required condition had no difficulty relating it correctly to their resistance values.

Candidates generally calculated stored charge with little difficulty, although sometimes for only one cell. Most of these went on to calculate the time correctly.

A surprising number expected efficiency to increase with increasing internal resistance, some of these relating this to the condition for maximum power transfer being better matched as internal resistance approached the value of load resistance – a mirror error to that in part (a) (iii). Explanations of decreased efficiency were often somewhat vague and did not often gain credit. Answers tended to refer to lost volts without relating this to efficiency or to heating in a non-specific way.

Question 6

Candidates had little difficulty with average speed and also came up with an imaginative range of correct formulae for the spreadsheet cell.

Most candidates found the acceleration from the graph, although a number lost a mark by not drawing the line across the whole 2 seconds of the graph or made errors taking values from the graph. There were occasional unit errors.

Very few who had a value of acceleration failed to calculate force correctly, although a few used *g* or missed the unit.

The statement of the origin of the force was often in insufficient detail, failing to mention the nature and location.

In the last section candidates usually got 2 marks for kinetic energy and little else. They rarely referred to change in kinetic energy in their explanations. Where work = force x distance was stated it was not often rearranged to make force the subject to relate it to the gradient.

6752/01

Question 1

Although candidates generally scored highly on this question the standard of scientific writing was often poor. Many did not give crisp physics definitions but relied on the use of everyday language. The definition of 'strong' proved the least well understood, with the majority of candidates making no reference to the material breaking. The definitions of 'brittle' and 'plastic' were better understood, although a significant minority still believe that a brittle material is one which can be broken when a small force is applied. The force calculation was generally well attempted although some candidates failed to use the correct powers of 10. A small number tried to calculate back from the given answer but candidates should be warned that full marks are unavailable if this method is employed. A disappointingly large number of candidates were unable to calculate the area of a circle. The extension calculation was again generally well attempted. The main problems were in rearranging the formula, and in calculating strain but not extension. Many candidates correctly gave the definition of a polymer although some tried to describe the material behaviour, rather than the basic structure.

Question 2

Although the majority of candidates correctly stated that the converging lens had the greatest power, many then made a general comment about the positive power of a converging lens without relating to the experiment described or discussing the effect of the lens combination. Some thought that the converging lens was the strongest as this was the one that the light reached first. The most common answer given for the equation of the line was $y = -x + 10$ with only a minority of candidates then going on to substitute $1/v$ and $1/x$ into this equation. A common error made was to calculate the gradient to be +1. The calculations were generally well done although a number of candidates either failed to correctly read points or intercepts from the graph, or did not correctly handle the units, confusing m and cm. The ray diagram was often not well answered. The question required the use of the value of F from the previous section, and many candidates failed to do this. Many did not mark the position of F on their diagram and a surprisingly large number used the value F = 10 cm or misread the scale to put F at 10 cm instead of 5 cm.

Question 3

The definition of work function was generally well understood. However, a number of candidates seem to think that work function is to do with the movement of electrons between energy levels or from valence to conduction band. Many candidates had a poor grasp of the photoelectric effect and some gained no marks at all in part (b). Answers seen included explanations of how the photons became photoelectrons, how photons were emitted from the surface and how photoelectrons changed into photons. The marks gained were most often for stating that the photoelectrons were liberated from the surface of the metal and that by moving they produced a current. Both marks were awarded to the majority of candidates for the first calculation. However, a number of candidates were unable to turn the given wavelength into a frequency with some simply substituting λ for f in $E = hf$. The second calculation was generally less successful. Although many candidates realised that they had to subtract 2.7 eV from the photon energy, the conversion between eV and J confused a large number. The final part of the question proved to be very difficult with very few being able to explain the current reduction in terms of the energy of the electrons. The candidates were unable to relate the energy of the electrons emitted in eV to the stopping potential in V.

Question 4

Although the majority of candidates had the idea of a single plane when describing polarised light, far fewer mentioned vibrations / oscillations, instead talking in more general terms about the light 'moving' in one plane. Part (b) proved difficult for many candidates who showed a lack of understanding of polarised light. Many did not answer the question and talked about the use of two polarising filters rather than the effect of a single polarising filter in front of a beam of polarised light. Those who used diagrams often scored more highly than they would have otherwise as the diagrams did help augment weak explanations. A large number of candidates realised that the beetle would find navigation difficult without moonlight but fewer correctly stated that the beetle would make a 90^{o} change in direction when the plane of polarisation changed by this amount. It was common for candidates to think that this would also cause the beetle to become lost. Some also realised that the beetle would change direction but did not suggest a new direction.

Question 5

A minority of candidates successfully recognized the circuit as a potential divider. A larger number could correctly calculate the potential difference across the relay. The majority of candidates could correctly recall the equation for resistance. A number were then confused as to which dimensions to use as the area and length. A surprising number of candidates could not combine resistors in parallel and even those who used the correct equation for combining the resistances sometimes struggled to take the reciprocal. Only the better candidates realised that the p.d. falls to zero/near zero in a short circuit. The most common response was that the p.d. will 'decrease'. There were some excellent and well argued responses for part (v). Many candidates scored one out of two for appreciating that the signal would stay red or that the voltage across the ballast and relay was low. Unfortunately an almost equal number suggested that the lights would stay green and proposed a crash would result. A significant number thought that if the combined resistance fell, the p.d. would rise.

Question 6

Candidates generally scored very highly on this question showing a good understanding of viscosity and flow. The majority knew that high viscosity lava would flow slower than low viscosity lava. Most candidates also made a sensible suggestion as to how to compare the viscosities of the two lava flows, although a number did discuss dropping objects such as ball bearings through the lava and timing the descent. Many of the diagrams were drawn clearly and correctly showed the difference between laminar and turbulent flow. However, there were a number of poorly drawn diagrams, particularly for turbulent flow. Weaker candidates tried to draw lava flow rather than general diagrams. This often resulted in no marks being awarded. Almost all candidates suggested the use of a log scale in part (e).

6753/01

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.

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.

The majority of centres, as in previous years, sent clearly annotated scripts, with the correct accompanying paperwork including details of internal standardisation and a report of any briefing given to candidates. This year a centre included a handout of the PowerPoint presentation given to candidates on their hospital visit: this was very helpful. Only a few centres submitted samples without any annotation: these scripts were returned to centres for annotation. There seemed to be an increase in numerical errors this year. 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.

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.

Experimental Skills

The best experiments are simple ones which allow candidates a choice of method and which point to a clear numerical conclusion, and as noted above the best reports are concise. Good centres have followed this advice given in previous reports but some persist in using experiments from the course handbook such as the ski jumper which is a good classroom experiment but not a good coursework one.

In Skill A (Planning) it is not always easy for moderators to see a clear demarcation between the plan (written in advance) and the subsequent implementation. Any amendments to the plan during implementation should be reported but not awarded Skill A marks. Clear plans (A6a) were more evident this year, however, a statement that a graph will be drawn without any indication of variables to be plotted is not sufficient to meet this criterion. The plan should also 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. The best candidates checked for uncertainties in the stated value of masses and did not unthinkingly multiply by 9.81 N/kg to find the related force. Where appropriate, repeated results should be averaged rather than being plotted as separate graphs.

In Skill D (Interpreting and evaluating) the best computer drawn graphs were of a high standard, comparable with good hand-drawn graphs and including grid lines. However, for both types of graph, lines of best fit were again often drawn straight when curves would have been more appropriate. Only the best candidates can link their stated uncertainties to sensible quantitative uncertainties in their conclusion.

The visit

Two interesting new visits this year were to the ophthalmology department of a hospital and the sports science department of a university. Both of these locations allowed candidates choice in the aspects they explored. Several centres had sent candidates on individual visits, some of these were excellent, showing a good appreciation of physics in a variety of situations but in other cases it was not clear whether a visit had in fact been made.

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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. Centres are also referred to the

Frequently Asked Questions which are updated each year and to the JCQ leaflets for candidates.

Centres are encouraged to use Edexcel's free coursework consultancy service for advice about suitable experiments, visits and marking.

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6754/01

Candidates appeared to find this paper among the harder PSA4 papers to have been set recently. The mean mark was lower than for some time. There seemed more candidates than in previous series who had very little idea about the physics involved at all – and therefore scored a very low total on the paper. This of course would have contributed to bringing the mean score down.

That said, all the questions successfully attracted some full-marks scores.

The paper was marked by the "epen" computerised marking system. In this, all scripts are scanned, and markers see only the scanned versions on their computer screens. This makes it more important than ever that candidates present their work well. They should write clearly, legibly, in dark ink. Annotations and drawings should also be in dark ink – not colours or high-lighter inks, which do not show up at all. They should as far as possible write only within the spaces provided. If there is work carried over to other pages or to an inserted page, they should refer to it in the space for the answer.

Question 1

* (i-iv) Most candidates gained the marks on parts (i) and (ii). Not so many were able to ascribe attenuation to energy loss; and very few referred to the exponential relationship between intensity and distance.
* (v-vii) There were some good answers here. Even weak candidates who had done some decent revision were able to score well. In (vi) quite a number did not attempt to “explain” in any way – at A2 you are not going to get a mark for simply saying that more length leads to more dispersion.

Question 2

* (a) There was some good knowledge on display here. Most candidates were able to bank some marks. A mistake seen sometimes was to ignore the instruction “In the context of antimatter …”
* (b) Most stated that a particle and its antiparticle have opposite charge. Fewer went on to discuss the force on a moving charged particle in a magnetic field.
* (c) This calculation was quite discriminating, with only about 30% able both to navigate their way between nano and kilo, and to use the right mass.
* (d) Quite a number managed a good stab at this calculation. Popular wrong physics (which actually yields the right numerical result) was to say “wavelength = h/p”. There was also some confusion over factors of two: two particles annihilate to produce two photons. Most realised that their calculated wavelength would not be visible. There were occasional unfortunate contradictions, like “It’s an X-ray, so it is very bright.”

Question 3

* (a) (i) Disappointingly, only about 50% were able to draw correctly the direction of the force at P.
* (a) (ii-v) These parts together were very discriminating. Most were able to start well using F=Bqv. Significant numbers however used q=1 (what?). Many made good attempts at the later parts, though few were able to complete them all successfully. There were some encouraging answers to part (v), including several who achieved correct physics using F=ma.

* (b) Many could quote a formula for the force between point charges (though there were also significant numbers of E=V/d). Rather fewer could go on and complete the calculation correctly.

Question 4

* (i) Many had some idea about cutting field lines. However only a small number realised that a.c. meant that the probe need not be moving for there to be changing flux. A disappointing number still use voltage and current interchangeably.
* (ii) Many have some vague idea about Lenz – though it is of course really hard to put it into meaningful words!

Question 5

* (a) (i-iii) The majority of candidates were able to work out correct answers to parts (i) and (iii) – capacitor value and energy stored in it. A common mistake in (iii) was to read off the graph at V=4.8 V, not 4.0 V – i.e. reversing the axes. In (ii), very few indeed were able to derive properly the expression for energy stored, even though it is a stated specification item. Most just stated that energy stored equalled area under graph.
* (b) This was quite a discriminating item. Better candidates scored well on both parts. Weaker ones waffled about the power, and floundered over the time constant – quite a few giving the half-life, and others giving unlikely answers in milliseconds.

Question 6

This question was disappointing, especially given that it is a specification item. Many confused magnetic and electric fields, and described linear accelerators or electron guns in detail. Thus the detail that was invited concerning cyclotrons and synchrotrons was often expended on linear accelerators, with cyclotrons appearing as an afterthought. Magnets with + and - poles attracting/repelling particles were common, whether or not linked with linacs. There were many hazy ideas about detection, with some hopefully but vainly borrowing the ideas from question 4! Mixed in of course were some good knowledgeable answers – but they were rare.

Question 7

This question, as one would expect, was highly discriminating. The clear marking of the forces onto the picture was an important start – about 30% scored this mark. Most of that proportion went on to complete the question well. Others tended to write v=rw, and not consider forces at all. Candidates could score one mark by stating $F=mv^2/r$, and subbing in 30 m/s – but not that many took advantage of this possibility.

6755/01

This year it was pleasing to see that more candidates were being encouraged to carry out a genuine investigation based on their own interests and using novel material. Most projects were interesting to read. There was a good level of commitment from candidates resulting in reports that contained A2 level physics that the candidate had researched using a full range of sources and developed to be appropriate for their project. They had a real purpose. They chose and modified apparatus to enable them to carry out the experimental stage and analysed 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 include:

- the moderator receiving the sample after the deadline;
- 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;
- not making clear where errors of physics occurred and where appropriate marks had been deducted.

Centres are required to enclose, with their sample, a brief report on how internal standardisation was organised in their centre. It was clear in some cases this year that this had not been carried out and different teachers had applied different standards. This can lead to wide variation between the moderator and the centre.

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

Centres are to be congratulated on the increasing number of reports that were genuinely interesting. Sometimes this was because the topic itself was novel, e.g. a forensic application of Newton's law of cooling, but more often because the candidate had personalised the topic in some way.

It is possible to obtain a reasonable number of marks from standard experiments but it is still disappointing to see AS experiments being carried out for the A2 project. These included changing the polarizing angle, the ski jumper, and many viscosity experiments.

Several projects started with a promising title but become standard experiments with meaningless or vague conclusions, a minority even being at GCSE level. Experiments on the bounce of a ball could contain some interesting physics on collisions, momentum, energy transfers and gas laws but generally variables are poorly controlled and the physics not developed.

Research and rationale

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. It was good to see that more candidates had put references in the main body of the text or had annotated the bibliography to show what had been gathered from a source and where it had been used.

Centres still need to be vigilant for situations where candidates have copied and pasted information with no acknowledgment of source. 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.

For the highest marks, physics theory needs to be developed so that it is appropriate and meaningful for the project proposed. From it should lead the variables to be measured and some idea for analysing results. On many occasions centres awarded the highest marks for an equation that had just been quoted.

Planning

In most cases variables were considered within a coherent plan and apparatus was chosen well. Often a lack of structure in the report resulted in a lack of clarity and the reader was left unsure about what was going to happen in the experiment.

Moderators were concerned that in some centres the pilot took place within the two weeks of lab time. It should be completed before this time allowing candidates to then develop their investigation across a two week period and it not to degenerate into one standard experiment.

Risk assessments for the projects now seem to be the norm. That is very pleasing.
It is worrying that candidates seem to believe that digital readings are 100% accurate.

Observing

Tables of results were almost universally presented well with headings and units.
Most students reported the existence of anomalous results but few investigated them. Where a graph had a turning point, such as the stalling angle for an aerofoil, candidates should ensure that they take enough readings around this point to identify it correctly.

Analysis

The poor quality of many graphs was 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. Many candidates still seem to think that all curves are exponential.
It is still disappointing to see so few good attempts at relevant error analysis. This was a section in which centres awarded marks for the attempt but had not considered the suitability of the method used for error analysis.

Communication

As in previous years the vast majority of reports were well planned and readable. Diagrams and photographs often added to the clarity especially when considering the experimental set-up. Some diagrams were not helpful but the centre marker had not reflected this in their marking.

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. Bibliographies are improving but it is still rare to see a good bibliography that should include a range of sources from standard textbooks, other books, magazines and journals, expert and websites. Editions and page numbers should be given and the dates on which web sites were accessed.

Some candidates confuse length with clarity. 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 there was a more genuine attempt this year to reflect the investigatory nature of this section that this made the reports more interesting to read. Also they felt that administration was carried out well by most centres.

6755/02

Question 1

This was an accessible question, and most candidates were able to score at least half marks. Most candidates scored full marks in part (a), but occasionally the square root was omitted when calculating the speed of sound in steel, or units were given for the ratio. In part (b) candidates were able to give good descriptions of how vibrations are passed on from atom to atom, but they did not always make it clear that the process was more effective in steel because of the closeness of the atoms. References to the higher density of steel needed to be linked to the arrangement of atoms for the mark to be awarded. In part (c) many candidates stated that the expression quoted could not be suitable because sound does not have a luminosity, ignoring the fact that they had been told that it was a suitable expression for sound in air. The best responses recognised the equation as an example of an inverse square law and realised that this would only be appropriate if the sound was able to spread out in all directions. Some answers referred to the attenuation equation, but did not qualify this as being appropriate when energy is directed along a given direction, as in a rail or a fibre.

Question 2

On the whole this question did not produce good responses. In part (a) students often started by referring to specific materials rather than the properties of the materials. Nonetheless many candidates were able to discuss the use of fibrous or porous materials in the choice of suitable building materials for sound insulation. In some answers “elastic” and “plastic” deformation were confused. Some candidates thought that this part of the question was about resonance, and so did not score any marks. Occasionally active noise control was thrown in for good measure. Part (b) was generally well answered, and it is clear that candidates had learned definitions of resonance. However, some candidates lost credit because it was not clear from their answer that the building was being forced to vibrate at its natural frequency. Accurate use of terminology was insisted upon; vague descriptions of “vibrations getting bigger”, and use of terms such as “resonant frequency” did not gain credit. Full marks for part (c) was rare. Most candidates were able to gain credit for the idea that the springs absorb energy from the forcing vibrations, but they did not expand upon this statement by saying that the springs must deform for this to happen. In commenting upon damage to such buildings during an earthquake, many candidates were distracted by considerations of S-waves and P-waves; the crucial point that the amplitude of vibration of the building would be reduced was often lost.

Question 3

The first few parts of this question allowed candidates to demonstrate what they knew about gravitation and circular orbits. Virtually all candidates recalled the expression correctly in part (a), and most were able to derive the expression correctly in part (b). However, a significant number of candidates simply stated the expression for g; possibly because they had only skim read the question. Students who remembered the expression for centripetal acceleration were generally able to link this with the expression from part (b) and successfully derive the formula. Some candidates tried to use the expression given in the data section for two masses in mutual orbit; some gave a random scattering of formula snippets in the space provided. The calculation in part (d) should have been a straight forward substitution, but common errors included incorrect conversion of 24 hours to seconds, the use of 365 days for a geostationary orbit time, and simply forgetting to square the time period in the expression. The most demanding parts to the question were (e) and (f), and many candidates struggled to gain marks here. In part (e) many candidates were unable to explain their arguments. It was common to see answers suggesting that the satellite could remain in a geostationary orbit, but only if the radius of orbit increased / decreased. In part (f) diagrams rarely added value to the candidates written explanations, being poorly drawn and lacking clear labelling. A surprising number of candidates thought that the shape of the Earth, or even the Earth's magnetic field had some bearing on the answer. Many candidates were unaware that all satellites must have an orbit that describes a great circle; answers often indicated orbits parallel to the equator.

Question 4

The topic examined by this question was well understood by most candidates, but there was evidence that candidates had not read the question through before starting their answer. Hence there was much repetition in the answers to the three parts to the question. In part (a) some candidates used technical vocabulary incorrectly e.g. they referred to "bonding" instead of combining, "atoms" instead of nuclei. In part (b) the conditions for fusion were well known, but understanding of the nature of the containment problems varied enormously. Most candidates were able to relate the change in mass to the release of energy correctly, but some answers indicated confusion about the role of binding energy in the process.

Question 5

This was an accessible question that allowed most candidates to make progress. In part (a) candidates were able to score 3 marks easily for correctly estimating the sea temperature, converting temperature to kelvin and recalling the general gas equation. In calculating the volume, common mistakes included using the diameter instead of the radius, or squaring instead of cubing. The substitution of data into the gas equation was a problem for some candidates in terms of the pressure changes. For those candidates whose final answer was within the range required, the majority lost the final mark by giving too many significant figures in their final answer. Part (b) demonstrated once again that candidates do not read information given in the question carefully enough. Many candidates whose answer confirmed that the temperature would be higher at sea level and so the average kinetic energy of the molecules would be greater nonetheless selected the curve with the higher peak. Most candidates did not use the word "average", but explained the concept correctly using equivalent words.

6756/01

The overall demand of the examination questions was judged to be a little more accessible compared to the previous year by the examining team. The average mark was slightly lower than June 06 suggesting that candidates found this paper slightly more demanding.
In general many candidates scored well on question one and badly on question two. Questions three and four differentiated across the ability range.

Question 1

Candidates were able to access all of the marks in this question. Points to particularly note:

Candidates showed a good ability to use standard equations and, as long as only a few steps were involved, could confidently produce correct answers with appropriate recall of units.

In part (d) candidates often muddled the words continuous and constantly. Many candidates referred to a binary system being on or off which is a more specific example of a system with a signal that is in one of two states.

In part (f) candidates did not always make the link between direction of force and direction of acceleration.

A number of candidates were unsure of the question in part (h) (ii) and often tried to work out a percentage error. This would then be so small that a calculator display would not show any difference to zero.

Question 2

Candidates generally found this very demanding.

In part (a) no credit was given to answers referring to light gates or computers – however many candidates made the sensible suggestion to count several oscillations.

In part (b) many interpreted the increase between values as sensitivity or made general statements such as “the sensitivity seems about right”.

The graph defeated a very high proportion of candidates. The obvious method of using
T^2 or $l^{0.5}$ as one of the axes was used by about half the candidates. The log - log method also works but is cumbersome in these situations. Many candidates became muddled with just one log axis, plotting T against l, or including g within their calculated values.

Even when a correct graph had been employed many straight lines went through the origin. Where they didn’t, candidates often didn’t recognise the significance of this. Part (d) was attempting to draw their attention to this aspect but few picked up on the clue.

Very few candidates were able to use the gradient and produce a sensible value for g.

Question 3

Many candidates were able to access the first and last part of this question but struggled with both calculations particularly the part concerning vector forces.

In general candidates were not able (or willing) to draw vector diagrams. They also found it difficult to resolve components and frequently muddled their use of sine and cosine.

In part (b) many candidates managed to gain some credit but found a “several stage” calculation too demanding. Common errors included using the diameter rather than a cross sectional area, unit difficulties, muddling stress, strain and Young modulus and not being a aware of an equation to find energy stored.

Question 4

Some candidates who had, up till now, scored well did not always gain high marks for this question. However a number of candidates did gain full marks.

A number of candidates saw mention of two coils and, ignoring the string, launched into a standard description of a transformer. Another common misconception seemed to stem from when to apply Faradays law and when to think about the consequence of a current carrying wire within a magnetic field. A number of candidates seemed to think the second coil generated a magnetic field all the time. A number of candidates interchanged the words *electric* with *magnetic* field and produced confusing answers.
Many candidates simply failed to comprehend the situation as described by the question. Some candidates merely repeated parts of the question without explaining any of the physics principles.

Candidates who broke down the different stages of the argument and then explained some of the physics gained high marks.

Grade boundaries

6751

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	60	44	39	34	30	26
Uniform boundary mark	100	80	70	60	50	40

6752

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	60	44	39	34	29	24
Uniform boundary mark	100	80	70	60	50	40

6753

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

6754

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	60	36	31	27	23	19
Uniform boundary mark	90	72	63	54	45	36

6755 Option 01

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	80	58	53	48	43	39
Uniform boundary mark	120	96	84	72	60	48

6755 Option 02

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	80	58	53	48	43	39
Uniform boundary mark	120	96	84	72	60	48

6756

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	60	36	32	29	26	23
Uniform boundary mark	90	72	63	54	45	36

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