PHYSICS

Paper 9792/01
Part A Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**C**	21	**A**
2	**B**	22	**C**
3	**C**	23	**C**
4	**B**	24	**D**
5	**D**	25	**B**
6	**A**	26	**B**
7	**C**	27	**D**
8	**C**	28	**B**
9	**D**	29	**C**
10	**A**	30	**B**
11	**C**	31	**C**
12	**D**	32	**B**
13	**B**	33	**B**
14	**C**	34	**D**
15	**B**	35	**C**
16	**D**	36	**D**
17	**B**	37	**C**
18	**D**	38	**B**
19	**C**	39	**B**
20	**B**	40	**D**

With forty questions to answer, over 40 % of the candidates scored over 30 marks, showing the high quality of candidates taking this paper. There was a good spread of marks with a mean of 27.4 and a standard deviation of 6.4. All of the questions showed a positive discrimination, and the less able candidates were able to access the easier questions.

Questions 3, 7, 8, 19, 20 and **36** proved particularly straightforward, allowing the great majority of candidates to demonstrate their knowledge, perhaps predictably so, as these questions mostly involved one stage substitution of numbers into formulae. The one question out of this set that did not involve substitution into formula used a graphical representation to test an understanding of resistance; a concept first met at GCSE and built upon in the Pre-U syllabus.

At the other end of the scale, **Questions 2, 9, 13,** and **24** were found more challenging.

Question 2 gave a diagram where the vectors needed to be rearranged before addition.

Question 9 was found to be the most difficult question in the paper, with good discrimination. Candidates were required to combine two sources of energy (KE and GPE) while considering the answer – most candidates seemed to forget that some gravitational potential energy would also be lost as the spring compressed. Nonetheless, about 20 % of the candidates worked through the problem to the correct answer.

Incorrect answers were evenly distributed amongst the three distracters in **Question 13**.

Question 24 concerned the correct explanation for the varying amount of refraction amongst the spectrum of light; the most commonly selected distracter was a correct statement, but not one that answered the question. This is further evidence to support the perception that candidates need to consider more carefully what a question is asking before selecting or constructing an answer, in line with patterns seen in paper 2 and 3.

The question with the best discrimination was **Question 37**, with the top quartile of the candidates selecting the right answer while the lowest quartile of candidates opted for all of the four options in roughly equal numbers. This was a straightforward two stage problem, where the candidates had to convert energy in electron volts to joules and then combine the de Broglie equation with the wave equation to give the wavelength of a photon having that energy in joules. That this question had the highest discrimination suggests that the lower quartile of candidates may benefit from practice on similar two stage problems during the course of the teaching.

Another question with a high discrimination was **Question 25**, where a surprisingly high proportion of the lowest quartile of candidates felt that *all* transverse waves are electromagnetic and able to travel through a vacuum.

Question 17 and **Question 2** also demonstrated high discrimination. **Question 17**, a seemingly straightforward energy transformation question was not read carefully enough by the lowest quartile who failed to take account of the phrase ‘at terminal velocity’ in the stem, and **Question 2**, as described above, required the candidates to realise that the vectors needed to be rearranged in order for addition to take place.

These questions are worthy of note in that they reinforce the perception that the lowest quartile were less attentive to the detail in question stems and experienced more difficulty in visualising the route to an answer if more than one step was involved.

The overall impression of the paper, from an Examiner’s point of view, is that the paper proved to be set at the correct level for the candidates, with a good mixture of easily accessible questions and more testing questions.

PHYSICS

Paper 9792/02

Part A Written

General comments

The general standard of the answers offered by candidates to this paper matched that which had been anticipated by the Examiners. Some candidates produced scripts of an extremely high standard where numerical answers were almost invariably well set-out, accurate and given to an appropriate number of significant figures, where more descriptive answers were logically presented and clear and where diagrams were neat, labelled and relevant. Other candidates did not produce such excellent work but in all cases, it was clear that the candidate had scored a mark that would enable an accurate assessment of the quality of the work submitted to be made.

In calculations, a few candidates rounded off answers to 2 sig. figs at each line in the working and sometimes ended up with answers that were noticeably different from those in the mark scheme. In general, it is best to work through to the final answer preserving all sig. figs and only to round off when giving the final answer.

Where a question demands a more descriptive answer, candidates should be encouraged to write simply and clearly and, where appropriate, to use bullet points rather than more convoluted descriptions which are frequently less clear and sometimes ambiguous.

Some candidates tended to offer descriptive answers which were too general or which did not answer the question set. This was clearly seen in **Question 7**. In **Question 7(e)**, candidates were asked to show the effect of reducing the intensity of the ultra-violet radiation. **Question 7(f)** related specifically to why this result was unexpected. Many candidates described other features of the photoelectric effect that were unexpected, such as the effect of varying the frequency of the incident radiation. Although some of these answers were accurate and carefully described, they did not answer the question and could not be credited.

There was no hint in the scripts that candidates were short of time. Those who left gaps in the final question tended to do so elsewhere as well.

Comments on specific questions

Section A

Question 1

(a) (i)(ii) The answers here were almost invariably correct; candidates know how to obtain the distance travelled from a velocity-time graph.

Answer: 64 (m); 35 (m)

(b) This answer was very commonly correct but a few candidates divided the irregularly shaped area into several sections and then forgot to include these sections when estimating the final answer.

Answer: 440 – 460 (m)

(c) (i) Many candidates correctly identified the significance of the 23 s point and drew a graph with the appropriate gradients. It was surprising how many of the graphs, however, were poorly drawn with thick or multiple lines and sudden changes of gradient.

(ii) This graph was more testing with only the highest-scoring candidates obtaining full marks here. Many candidates did not notice the decreasing magnitude of the negative acceleration between 23 and 28 s.

(d) Although most candidates answered the question well, very few produced an instruction sheet as requested in the stem of the question. Most candidates merely described what the candidates should do. Some even forgot about the bus altogether and described how to plot the distance-time graph for a candidate running along a track. Such candidates were unlikely to score the mark which was awarded for stating that timings should be made when a particular part of the bus reached the timer.

Question 2

(a) (i)(ii) These two calculations were almost invariably carried out accurately and most candidates scored full marks. Some candidates took the width of the hotel as 35 m rather than the 32 m in the question. Many candidates gave answers as long strings of figures rather than use the power of ten notation that is expected at this level.

Answer: 5.3×10^6 (kg); 5.2×10^7 (N)

(iii) The pressure given was also very commonly correct.

Answer: 3.1×10^4 (Nm^{-2})

(b) This answer was frequently correct but there were two common errors. Some candidates forgot to subtract the mass of the foundations before giving the final answer whilst others did not divide by 9.81 (Nkg^{-1}) and so obtained the weight of the building and contents.

Answer: 6.8×10^6 (kg)

Question 3

(a) Although some candidates found this part difficult, many candidates scored full marks here either by using standard equations or by using integration. Some candidates lost a mark by not making it clear that the *work done* is equal to the *kinetic energy.* Those candidates who did not know how to proceed, tried a variety of approaches including some based on *the principle of the conservation of momentum.*

(b) (i) The answer here was almost invariably correct although some candidates who wrote down $½mv^2$ went on to substitute 8500 rather than 8500^2.

Answer: 6.5×10^{10} (J)

(ii) Many candidates obtained the correct answer here although a few carried out the correct calculation carelessly and obtained a wrong answer.

Answer: 6800 (K)

(iii) The correct answer *gravitational potential energy* was very commonly given.

(iv) Few candidates scored full marks in this part. Many candidates stated that thermal energy would be transferred only slowly through insulating tiles and that as a result, the rise in temperature of the whole spacecraft would be lower than that calculated. Others stated or implied that in the absence of air, potential and kinetic energy could not be transformed into thermal energy and that for the section of the journey above the atmosphere, the thermal energy that would have been generated was simply lost for ever.

Question 4

(a) The table was completed accurately by the overwhelming majority of candidates.

(b) (i) Some candidates drew a graph that peaked at (2.0, 5.0) rather than (2.0, 4.5) and lost the mark. Other candidates who lost the mark were not sufficiently careful when drawing the curve. Sudden changes of gradient, unacceptably thick lines and multiple lines were very commonly presented.

(ii) Nearly all candidates gave an acceptable answer here.

Answer: 1.8 – 2.0 (Ω)

(iii) Candidates were expected to state that all the power was used by the internal resistance of the battery and to explain this by stating that no power was delivered to the external resistor. Few candidates made both points.

(iv) Not all candidates realised that the total power supplied by the battery was 9.0 W and those who used other values such as 4.5 W were unlikely to calculate the efficiency of the circuit correctly. It was, however, encouraging to notice that a very large number of candidates realised that the circuit was at its most efficient when the value of *R* was as large as possible.

Answer: 0.50 / 50 %; 10 (Ω)

Question 5

(a) Few candidates scored 2 marks on this part and there were some candidates who were unable to explain what is meant by a *standing wave* at all. It was disappointing that very few candidates stated that *standing waves* do not transmit energy but store it.

(b) There were some good answers here but many candidates gave incomplete descriptions and a badly drawn diagram which was difficult to interpret.

(c) (i) Nearly all candidates realised that the distance OP represented the wavelength.

(ii) There were some good answers here but many candidates sketched waves with wavelengths that were typically one half or one quarter of the wavelength of the wave given in the question and so indicated that the question had been misunderstood.

Question 6

(a) Most candidates were able to give the correct symbols for the three stable isotopes of silicon. A few candidates placed both the superscripts and the subscripts to the right of the symbol throughout this question.

(b) (c) Only a small fraction of the total entry was able to score highly on these parts of the question; errors were very common and varied. Many candidates did not know the appropriate superscripts and subscripts for either β^- decay or β^+ decay. Many candidates presented equations that did not balance and few candidates used the table **Fig. 6.1** to deduce the correct atomic symbol for the products of the decays. In **Question 6(b)(ii)**, very few candidates either knew or were able to deduce the change that had taken place before the β^- decay

(d) This part was generally better answered than the rest of the question and those who realised that 33 min is an integral multiple of the half-life 6.6 min found it comparatively straightforward. Some candidates used the equation $A(t) = A_0 e^{-\lambda t}$. This was a more difficult method and not all such candidates battled through to the correct answer.

Answer: 1.5×10^4 (Bq)

Question 7

(a) This was very frequently correct.

(b) (i) This answer was often correct but there were candidates who tried to use the formula $E = hf$ but did not obtain the correct value for the frequency. Some just used the wavelength (250 nm) instead.

Answer: 8.0×10^{-19} (J)

(ii) Those who correctly calculated the answer to **Question 7(b)(i)** very often, but not without exception, correctly went on to convert the value to electron-volts.

Answer: 5.0 (eV)

(c) This answer was often either correct itself or scored full marks when the candidate had correctly used an erroneous answer from **Question 7(b)(ii)**.

Answer: 1.3 (eV)

(d) There were many different attempts at this graph and only a minority of candidates scored full marks here. Some candidates sketched straight lines, others hyperbolas and others just left the axes blank. Those candidates who had some idea as to the correct shape frequently lost a mark for not including the value of the stopping voltage.

(e) Most candidates realised that the correct graph was similar in shape to that in **Question 7(d)** but with lower I values for a given voltage. Consequently more marks were scored on this part of the question than on the previous one.

(f) A large majority of candidates, in answering this part, failed to restrict their answers to the unexpected result that was obtained when reducing the intensity of the incident radiation. Consequently some good physics and carefully argued explanations scored few or no marks because the question set was not addressed.

Question 8

(a) (i) The two sub-sections of this part of the question were well answered by the candidates with most candidates scoring both marks.

Answer: 2:49 (ms^{-2} to) 200 (ms^{-2})

(ii) The majority of candidates sketched the graph between time = 0 and time = 0.020 s with an increasing gradient. Many candidates also attempted to start the graph at time = 0 with zero gradient but very few candidates attempted to sketch a gradient at time = 0.020 s corresponding to an acceleration of 16*g*; most graphs finished with a gradient that was not sufficiently steep.

(b) (i) Nearly all candidates obtained the correct value for the distance travelled and included the correct unit.

Answer: 54 m

(ii) Most candidates stated that a large acceleration was required to prevent the pilot hitting the tailplane but few explained that this, in turn, was because of the extremely high speed of the aeroplane.

(c) Although some candidates attempted to use *Newton's Third law of Motion*, many candidates could not apply it correctly. A common misunderstanding was that the rocket jets exerted a downward force on the floor of the aeroplane and that it was the reaction to this force that accelerated the ejector seat upwards. Only a very few candidates stated that the upward force had to exceed the weight of the seat and pilot.

(d) (i)(ii) Most candidates were able to answer these two parts of the question but did not always give an explanation in **Question (d)(ii)** as was asked for.

(e) (i) Many candidates produced a good answer in this part of the question and scored full marks. Answers which attempted to take account of the combined weight of the seat and pilot and those that did not were accepted.

Answer: 0.048 s / 0.044 s

(ii) This part was well answered by the majority of candidates.

(f) This was a very open ended question and there were many different ways in which the seven marks available for this part of the question could be scored. Consequently, many candidates scored full marks here.

By and large, the answers of the candidates, who did not score full marks, either did not suggest enough separate points or did not produce explanations that were sufficiently detailed. It is unlikely, for example, that an answer which concentrated solely on the financial consequences of installing ejector seats in commercial airliners could make seven separate points. Neither could an answer which restricted itself to generalities score as highly as one which homed in on very specific consequences. An answer which merely stated that *multiple, simultaneous ejections would lead to chaos* was not considered as good as one that detailed the consequences of such ejections. A candidate might have alluded to the inevitable collisions, the burns caused by the rocket motors and the injuries due to flailing limbs and personal possessions.

PHYSICS

Paper 9792/03

Part B Written

General comments

This paper proved to be accessible to a very large percentage of the candidates. A three hour paper is challenging, but the majority of the candidates adjusted to the demands of the paper and utilised their time well. Only the very lowest scoring of the candidates failed to attempt to answer all the questions required and the blank spaces in these scripts were scattered through the scripts, indicating that questions were left unanswered due to a lack of knowledge rather than a lack of time. The overall standard achieved by the candidates was remarkably good, with a large proportion of candidates scoring over 125 out of 140.

Part **B** presented the candidates with a choice of three mathematical questions and three more discursive philosophical questions. All questions proved to be of roughly equal difficulty. Many alternative but correct answers were credited in the philosophical questions. In practice, about 50% of candidates answered all three mathematical questions, with a further 20% choosing to answer two mathematical questions and one philosophical question. The number of candidates choosing to answer all three philosophical questions was around 10%.

In general, candidates need to think more carefully about the numerical values they give as answers. Working with a calculator can induce a mechanical processing of data, where candidates fail to make the necessary review of the size of their calculated answer at the end of a calculation. Ridiculously large or small answers can indicate to candidates that they have performed a division where a multiplication is warranted, or vice versa, for example.

Another general point concerns the overly enthusiastic application of the guidelines concerning significant figures. Candidates should be instructed not to round down their calculations until the end of a question. Repeatedly rounding the working to the same number of significant figures as the data given in the question can result in misleading answers in a multistep calculation. Furthermore, if a question gives data using numbers such as 88 and 93, that data will have an uncertainty of just over 1%; if the answer to that question consists of numbers such as 10 and 12, the answer will have an uncertainty of 10%. No candidate will be penalised for giving an answer to one significant figure more than strictly required except, perhaps, on a question that is specifically about uncertainties.

Comments on individual questions

Section A

1. This question was answered well. Many candidates scored 13 - 15 marks though few candidates registered that the satellite is in an unstable equilibrium. A small displacement of the satellite in either direction will result in a fall towards the Earth or the Sun if not corrected.

(a)(i) 29.5 km s^{-1} **(ii)** 5.87 x 10-3 m s^{-2}
(b)(i) 3.499 x 10^{-2} N **(ii)** 1.210 N **(iii)** 1.175 N
(c) 5.875 x 10-3 m s-^{2}

2. A surprising number of candidates were unable to see that an ellipse must be their answer to **(b)(ii)**. Many tried to show a sine wave pattern. Candidates needed to understand that the velocity has a positive and negative maximum value when *x* is zero and is zero at a positive and negative value of *x*. Part **(c)** was answered well, along with most of **(d)**. Once candidates realised that the total energy had a constant value of 2.47 J they were able to proceed. Many candidates came unstuck, however, in that they gave the elastic potential energy at the bottom as + 3.85 J instead of 8.79 J. A few candidates tried to alter the –3.85 J given as being the elastic potential energy at the top of the oscillation; they were ignoring the fact that the question stem did not state whether or not the spring is stretched at this point.

(c)(i) 5.23 rad s^{-1} **(ii)** 2.47 J **(iii)** 1.47 m s^{-1}
(d) 0, 6.32, 2.47, 2.47, 2.47, 0, -6.32, 8.79, 2.47

3. Several parts of this question caused problems. Part **(b)** was answered poorly as many candidates assumed that $E = V / x$ is a definition of electric field rather than showing that the potential gradient equates to force per unit charge. In part **(c)** many candidates showed the force on an electron at E to be directly towards the positive charge and not along the field line. The use of potential difference was missing in many responses to part **(c)(iii)** (Work = QV = 3.0 C x (400 – 200) V = 0.60 J).

4. Answers were mixed for this question. There was the usual confusion about *n, N* and N_A and between *m* and *M*. Candidates need to ensure that they distinguish clearly between physical quantities in questions such as this. Some answers gave the internal energy of this small quantity of gas as millions of terajoules; this is a good example of a question where a moment taken to assess the size of a given answer would have indicated to candidates that they had made an error in their calculation.

(c) 2800 J

5. This was another well answered question. Parts **(a)** to **(d)** caused candidates no undue problems, but there were some interesting answers given to part **(e)**. The expected answer was that the penetration of the alpha radiation is minimal so there is a reduced risk of increased radiation outside the container. Many candidates missed the point of part **(f)**. The power requirement of the spaceship will still be the same, so the mass of the polonium-209 power source needs to be much larger. The short half-life of the 210 isotope will cause a significant fall off in power in a long mission. With a constant power there is no difference in immediate safety.

(b) 8.32×10^{-13} J
(c) 3.00×10^{15} s^{-1}
(d)(i) 5.81×10^{-8} s^{-1} **(ii)** 18 g

6. This routine question caused no problem to most candidates. Where marks were lost it was usually in one of the following ways: in **(a)** λ was often taken as 623.7 nm, in **(b)** candidates frequently did not know Hubble's law by name, and in **(c)** they did not give enough detail.

(a) 8.49×10^{7} m s^{-1}
(d) 4.35×10^{17} s

Section B

Mathematical questions

7. This was a popular question but a surprising number of candidates did not answer parts **(a)** and **(b)** correctly. Part **(b)(ii)** was particularly badly done. Answers to **(d)** were often sloppy. Force needed to be replaced by torque and displacement by angular displacement, then momentum by angular momentum, mass by moment of inertia and velocity by angular velocity. The integration needed to be done carefully with all the limits given. The values of the rotational kinetic energy of this small disc given by candidates were sometimes astronomical; this was another question where some candidates would have benefitted from taking a moment to evaluate the reasonableness of the size of their answer.

(a) 2.46
(b)(i) 53.2
(c) (i) 419
(e)(ii) 8.0×10^{-2} m   **(ii)** 9.9 J

8. This was the least popular of the mathematical questions. The Examiners gave allowance to alternative methods of demonstrating that the graph is an exponential decay curve, but the scale on the graph was often misread by candidates. For example, the value of the activity at 10.0×10^{6} s was often given as 0.7×10^{14} Bq. Parts **(d)**, **(e)** and **(f)** were usually done well though the drawing of the electric field lines asked for in **(d)(ii)** left much to be desired in many cases.

(c)(ii) 0.425×10^{14} Bq
(e)(i) 1.79×10^{-14} N   **(ii)** 4.8×10^{-19} C

9. Most candidates could answer parts **(a) (b) (c)** and **(d)(i)** well, but many had problems with the calculation required by **(d)(ii)**. It appeared that candidates choosing to work in radians failed to reprogram their calculators to work in the appropriate units, using the degree setting and inserting π as 3.1416°, for example. Units and powers of 10 caused unnecessary mistakes in part **(e)**. Many candidates found part **(f)** very difficult, failing to apply Faraday's and Lenz's laws appropriately.

(a)(ii) 1.47 s
(c) 9.73 m s^{-2}
(d)(ii) 1.61 cm
(f)(i) 1.25×10^{-4} Wb s^{-1}

Philosophical questions

10. The bookwork associated with parts **(a)** and **(b)** was known well but parts **(c)** and **(d)** were less well answered. There was considerable confusion in separating uncertainty in position and uncertainty in momentum and answers to later parts of the question had often been given by the time the candidate reached the later parts. Only a handful of candidates realised how a vector diagram could be helpful in conveying their understanding of this application of the uncertainty principle.

11. This was the best answered question of these three philosophical questions. Part **(a)** was answered well with many diagrams showing isosceles triangles and many working out the time dilation equation. Part **(b)** was done well but the key concept of 'different times' was missed by many candidates. Part **(d)** was well answered and most candidates scored at least 3 marks from part **(e)**.

(b)(i) 6.8×10^{-11} s   **(ii)** 4.1×10^{-9} s ~ 4 ns
(d)(i) 260 ns   **(ii)** 78 m

12. This question was generally not answered well. Many of the problems stemmed from not knowing which law was being referred to. Newton's first law was often quoted as 'action and reaction.......' and not many differentiated between the first and second laws of thermodynamics correctly. Ideas on entropy and the link with disorder in part **(c)** and parts **(d)** and **(e)** were better explained and enabled most candidates choosing this question to score a reasonable mark from those parts.

PHYSICS

Paper 9792/04

Coursework

General comments

Any assessment of practical skills relies very much on the care and attention to detail that the individual Centres put into the process. It would appear that the majority of Centres approached the Personal Investigations well and candidates appear to have been suitably prepared. Centres are thanked for the valuable contribution that they have made in making this assessment successful. It was pleasing to see the award of full marks as well as Centres applying the criteria sensibly to weaker candidates.

One of the purposes of the moderation process is to confirm the marks awarded by a Centre. It is thus very helpful where a Centre has annotated the script either to justify the award of a mark or to indicate why a mark has not been awarded. It was clear from the moderation process that the majority of Centres marked the tasks carefully and it was pleasing to see many helpful annotations. A number of Centres enclosed annotated copies of the marking criteria whilst one Centre produced a small comment on each of the criteria areas justifying the mark. It is obviously helpful that both good physics and wrong physics in the reports are highlighted so as to judge the award of the appropriate mark.

It was clear that the majority of larger Centres had carried out a ‘cross-moderation’ process. An occasional difficulty occurred where a report had been marked several times in a Centre as part of an internal moderation process and it was not clear as to which mark had been awarded; Centres must ensure that the marks awarded are clearly indicated on the scripts.

Another purpose of the moderation process is to ensure consistency between Centres and thus it is essential that the criteria for awarding marks provided are followed. Both teachers and candidates should read the syllabus carefully. A ‘best-fit’ approach should be used when applying the criteria to an individual candidate’s plan and report. It was pleasing to see that the ‘0’ mark was being awarded appropriately in some cases.

The majority of Centres met the relevant deadlines although one or two Centres were very late. It is essential that Centres include appropriate paperwork with their sample. In particular, there should be a copy of the MS1 (or equivalent) and the Coursework Assessment Summary Form (or equivalent Centre generated form) as shown in the syllabus.

Comments on applying the criteria

Initial Planning

Centres generally applied the criteria appropriately. It was useful when candidates clearly indicated where the plan ended and the report and their investigation started. Four marks should be awarded for appropriately detailed work.

Organisation during the two weeks of practical work

Centre’s comments were very helpful in justifying the award of the marks. Some Centres included candidates’ lab. books which indicated candidates’ progression in their investigation. Candidates should be encouraged to date their records. For the award of two marks, Centres should be satisfied that candidates are analysing and interpreting each experiment as it is completed.

Quality of Physics

A number of weaker candidates tended to copy sections of the reference material. Good candidates explained how the Physics used was related to their investigation. For the highest possible marks to be awarded, candidates should be explaining Physics which goes beyond the taught course and their explanations should be without error and detailed.

Use of Measuring Instruments

If a candidate has help in the setting up or manipulation of apparatus then the mark for this criterion is zero. For the award of two or three marks, two experiments must have been undertaken and some further attention is needed to the measuring instruments used. Where data logging equipment is used, there should be some explanation in the report as to how the equipment is being used.

Practical Techniques

For the award of the higher marks, it would be helpful if candidates could include an explanation in their reports of how they are considering precision and sensitivity. Candidates should be analysing their results as the investigation proceeds and as a result it may be necessary to repeat readings or take additional measurements near any turning points.

Data Processing

This area was a little generously awarded. Some candidates produced many ‘Excel’ graphs without much thought to scales, plots, lines of best-fit and the analysis of the data. For the data processing to be successful there must be clear explanation of how the experiments are being analysed. It was pleasing to see that a large number of candidates added error bars to their data points; however, it was not always clear as to their reasoning and thus the treatment of uncertainties was in some cases generously allowed. A good number of the more able candidates successfully plotted log-log graphs to test for power laws. Often their work was supported by detailed reasoning.

Communication

The marks for this section were a little generous in places. It was pleasing to see a number of stronger candidates include glossaries which were detailed. Candidates should be encouraged to include detailed references which include page numbers. Some of the reports were excessively long and thus were not well organised and did not have a clear structure; verbose reports should not be given six marks. It is also expected that candidates who are achieving the highest marks in this area include aims and conclusions for each practical and for any mathematical analysis. This particularly applies to the treatment of uncertainties. References used should enhance the report.