PHYSICS

GCE Advanced Subsidiary Level

Paper 8702/01
Multiple Choice

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

General comments

The candidates and their Teachers are to be commended on the generally high standard achieved in this the first paper of a new examination. It is always more difficult to prepare for a new examination than for an established one, so the mean mark of almost 25 out of 40 (62%) is very creditable. Out of all entries 7% of candidates obtained at least 35 correct answers. At the lower end 8% of candidates scored fewer than 15. The standard deviation for the test was 7.0. Most of the questions proved to be a good test for the candidates with very few questions being either too easy or too difficult.

Comments on specific questions

Question 8

A common wrong answer (26% of candidates) was **A**; this is a speed/time graph.

Questions 10 and 11

Both questions involved resultant forces and the responses showed that this is an area that needs some attention, particularly amongst the weaker candidates.

Question 14

The correct answer was selected by 54% of the candidates but 29% thought that the density of the block is what determines the upthrust.

Question 21

This is a question about nomenclature; it led 71% of the candidates to choose Brownian motion as the name for the random movement of molecules of a gas, but only 25% to attach it to the random movement of small particles suspended in a fluid.

Question 25

The definition of the Young modulus was well known (88% correct), and this was the easiest question.

Question 38

This question proved to be too difficult for candidates at this level, although it is clearly in the subject content for this paper. It was the most difficult (23% correct) and the answers were almost equally divided between the four options, suggesting a large amount of guesswork.

Paper 8702/02

Structured Questions

General comments

Candidates appeared to have sufficient time to complete their answers to the questions. However, in some of the weaker scripts, parts of questions had not been attempted. Candidates should always be encouraged to make an attempt at every part of a question, even if this amounts to merely writing down relevant formulae. They should be advised that, at worst, they will only lose the marks for that particular section. Extra marks are not deducted for incorrect or irrelevant physics.

Comments on specific questions

Question 1

Most answers included a reference to mass as a measure of resistance to change in velocity. Also, some reference was made to 'gravity' when discussing weight. Frequently it was not made clear that weight is a force. For four marks, (as indicated on the question paper), it was expected that some further detail would be given, e.g vector/scalar nature, constant/variable quantities.

Question 2

(a) Although the Paper included the instruction to explain the working, many answers contained only a calculation of the gradient and a statement that this is the value of g. Candidates who started by giving the relevant equation of motion usually recognised the gradient as being $\frac{1}{2}g$. It was pleasing to note that few candidates attempted to use a single point on the graph.

(b) In many scripts it was apparent that there is confusion between random and systematic errors. The stating of a systematic error was not given any credit.

Answer: **(a)** 9.8 m s^{-2}.

Question 3

(a) Most candidates did make a reference to both forces and moments. However, answers were frequently inadequate in that no reference was made to the direction of forces or to the point about which moments are taken.

(b) In most scripts there was an understanding that resolution of forces along the direction of S_3 is necessary. However, in many answers there was no mention of forces. Instead, the extensions were 'resolved'.

(c) Parts **(i)** and **(ii)** were completed successfully. However, very few were able to show correctly the force at the hinge. Generally, the force was shown as acting along the lid. Candidates should appreciate that, where three coplanar forces are in equilibrium, their lines of action will all pass through one point.

Answer: **(b)** *x*.

Question 4

(a) The vast majority of answers were correct.

(b) It was expected that candidates would make reference to the difference in hydrostatic pressure between the lower and upper surfaces , resulting in a force in the upward direction. Instead, many answers merely made reference to a displacement of liquid giving rise to an upthrust.

(c) Part **(i)***1* presented very few difficulties. In part **(i)***2*, many candidates lost some credit because they substituted speed into the equation $\Delta E_p = mg\Delta h$ without any justification. In part **(ii)**, the majority answered the question in terms of the constant speed, rather than discussing energy changes.

Answers: **(c)(i)** 3.6×10^{-6} J, **(ii)** 1.2×10^{-3} J s^{-1}.

Question 5

(a) The response here was very mixed. It was clear that some candidates used guesswork to try to identify the crystalline materials.

(b) In part **(i)**, once again guesswork was used in a significant number of scripts. In part **(ii)**, nearly all answers were based on the area bounded between the line and the *x*-axis. The most common errors were a failure to use the average force for extensions between 2 mm and 4 mm and also to fail to convert millimetres to metres.

Answer: **(b)(ii)** 9.2×10^{-3} J.

Question 6

(a) In part **(i)**, explanations were usually quite adequate. In part **(ii)**, very few appreciated that it is diffraction at the slits that enables superposition to take place. Consequently, the average mark in the section was very low.

(b) The algebraic form of the Young formula was quoted correctly in most scripts. However, from the substitutions it became apparent that a significant number of candidates did not know the meanings of the symbols in the formula.

(c) In most answers it was stated that the fringe separation would be unchanged. Reference was frequently made to the 'fringes becoming brighter'. What was really required was a statement that the bright fringes would be brighter and the dark fringes would remain dark. Some did state that the dark fringes would be darker.

Answer: **(b)** 1.1 mm.

Question 7

(a) In part **(i)**, nearly all candidates were able to arrive at the correct answer but in some, explanation was less than adequate. Relevant equations should be quoted before substitutions are made. In part **(ii)**, the equation was, in general, quoted correctly. However, there were many errors associated with the algebraic manipulation and the determination of the area of cross-section.

(b) Part **(i)** presented very few problems. In part **(ii)**, there were more correct responses for loop ABEFA than for loop ABCDEFA. The signs associated with the directions were the usual problem.

Answer: **(a)(ii)** 1.12 m.

Question 8

(a) With very few exceptions, this part was completed successfully.

(b) Very few diagrams of reasonable quality were seen. The majority showed a sharp change in direction or were not smooth curves. Furthermore, the change in direction was not shown in the correct position relative to the position of the nucleus.

(c) A significant number of candidates did not appear to understand the meaning of deviation. Frequently, mention was made of the position at which the deviation would occur.

Answer: **(a)** 118.

Paper 8702/03

Practical

General comments

The performance of candidates was similar to that in the summer. Candidates generally found the paper quite accessible, with the bulk of the marks ranging from about 10 - 23. It was pleasing to see a number of the most able candidates scoring full marks (25 marks).

Very little help was given to candidates from Supervisors. Virtually all candidates were able to obtain an appropriate number of readings in the allocated time, although the weaker candidates were unable to complete the analysis section at the end of the paper, which may have been due to a lack of time.

There appeared to be no problems for Centres in obtaining equipment for this examination.

Comments on specific questions

Question 1

Candidates were required to suspend a semicircular card by a pin at two different points on the card and determine the perpendicular distance *y* from the centre of gravity of the card to the straight edge as the angle α subtended at the centre of the card was reduced.

Candidates usually presented the results in tabular form, recording six observations with sensible intervals between readings. Most candidates were able to calculate values of $\frac{\sin\alpha}{\alpha}$ correctly. Common errors included using values of 2α instead of α; expressing α in radians instead of degrees or using an invalid subtraction method (i.e. sin (180-160)°/20° instead of sin 90°/90°). Sometimes the unit of *y* had been omitted in the column heading. Solidus notation is preferred in the column headings.

Values of *y* were often given to the nearest centimetre instead of the nearest millimetre. It is expected that candidates will record the raw readings of *y* to a degree of precision that is consistent with the apparatus used to take the measurement. Therefore candidates should be encouraged to record the readings of *y* to the nearest millimetre, since a rule is used to make the measurement. The uncertainty is 1 mm (as the uncertainty in placing the rule along the distance *y* is ½ mm at each end). The uncertainty in the first value for *r* (by direct measurement) is therefore about 0.68%. A number of candidates used ½ mm as the uncertainty (leading to a percentage uncertainty of 0.34%, which was considered to be too small).

Candidates were required to plot a graph of y against $\frac{\sin\alpha}{\alpha}$. Most candidates chose sensible scales and plotted the points correctly. The most common error was to see a non-linear scale on the x-axis (markings of 0, 0.010, 0.012 etc. on adjacent thick grid lines). This sometimes led to incorrect triangle read-offs in the determination of gradient (when an apex of the triangle was chosen to lie on the *y*-axis) resulting in a value for *r* that was well out of range. Some candidates acceptably showed 'squiggly' lines on the axis between 0 and 1.0 to show that there was an undesignated gap. It is recommended that all markings on an axis increase in equal increments from the left hand or bottom thick grid lines.

It is expected that the scales will be chosen so that the plots occupy at least half the graph grid in both the *x* and *y* directions, and that the scales will be easy to use (i.e. 2, 5 or 10 for each large square on the grid). Candidates should be discouraged from using awkward scales (e.g. 3:10) as this makes the plotting of points and determination of gradient difficult. As the given formula implied a '$y = mx$' format a large number of candidates plotted a graph which included the origin, thereby compacting the plots to a small region at the top end of the graph grid.

It is expected that the graph will be plotted with reasonable care. Very scruffy plots and poorly drawn lines (or very thick lines) were penalised. Candidates should be encouraged to use sharp pencils and clear plastic rules so that a single clear line of best fit can be drawn through the plots. There should be a reasonable balance of plots about this line. This can be done most easily by using a clear plastic rule (so that all the plots may be seen when the line is drawn). An opaque rule obscures the plots below the line making it more difficult for candidates to draw the line of best fit.

The calculation of the gradient of the line was usually quite good, although a number of weaker candidates tended to use small triangles when finding $\Delta y/\Delta x$. It is considered good practice to use triangles where the length of the hypotenuse is at least half of the length of the line that has been drawn. It is expected that the read-offs will be read to half a small square. If candidates had used awkward scales this often led to inaccurate read-offs and loss of the gradient mark.

Two marks were reserved for 'quality of results'. This was judged on the scatter of points about the line of best fit. Those candidates who had made the correct calculations, plotted the correct quantities and constructed a graph of six plots had mixed fortunes. Many graphs showed a good straight line trend, implying that reasonable care had been taken with the experiment. Quite a few candidates had five plots in a straight line with one plot adrift (usually the last one) possibly implying that time was beginning to run short. Several candidates had a shallow curved trend to the plots; probably due to a systematic error.

A few graphs showed an unacceptable level of scatter of points, and in these cases no credit was given for quality.

Candidates were instructed to use their value for the gradient of the line to find a value for *r*. It was pleasing to see most of the candidates equating $\frac{120r}{\pi}$ with the gradient and going on to find a value for *r*. There were few algebraic slips. One mark was reserved for the candidates who obtained a value for *r* in the range from 14.0 to 15.2 cm (although this range was adjusted for the Centres who had supplied their candidates with cards of different radii to that specified). It was disappointing to see many candidates who had provided units with the first value of *r* (and *y*) on pages two and three failing to give a unit for the final value of *r*.

Some of the weaker candidates substituted values from the table of results into the given equation, and did not use their gradient value. The very weak candidates did not attempt the analysis section at all.

In the last part of the paper candidates were expected to comment on the value of *r* that they had just obtained. Many vague responses were seen. 'My value is not the same as the one I had before because of the errors in the experiment' was common. Candidates who had not done the experiment carefully and obtained a value for *r* that was very different to the first one were usually not able to make any kind of sensible comment. 'My values aren't the same because the apparatus was too inaccurate' or 'I enjoyed this experiment but the answers aren't the same'. Sensible comments were expected, such as a meaningful comparison between the two values for *r* and some explanation of why the values were different (such as friction at the pin, or parallax errors in marking the card etc.).