PHYSICS

Paper 5054/01
Multiple Choice

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

General Comments

All of the questions on this paper were answered well, showing that the syllabus had been fully covered. The mean score was 27.1 out of 40 (68%) and the standard deviation was 19%. Most candidates found questions 7, 24 and 40 easy to answer.

Comments on Individual Questions

One question was found to be particularly difficult: for **Question 8**, many candidates incorrectly chose options A or C. However, regardless of their size, the two blocks must have the same weight, because the beam balances on a pivot at its centre.

PHYSICS

Paper 5054/02
Theory

General comments

The examination produced some very encouraging answers with a large number of candidates showing depth to their knowledge and the ability to use that knowledge to explain technical concepts.

Answers were almost always legible and clearly presented. Even when wrong, calculations were usually explained with working clearly shown and with the correct unit included. Where diagrams were included they often added to the answer, particularly where they were labelled. The quality of writing, including the standard of basic English and the use of technical language, was usually more than adequate but was variable.

Many Centres showed very good mathematical skills, with candidates often gaining full marks on calculations. Others found the mathematical questions difficult, often because the correct equations were not known, or, if they were quoted correctly, then errors arose in the rearrangement of the equation or in the use of very large or very small values, as in **Question 6(b)**.

There were few significant figure errors, although these still did occur in two ways. Either a candidate gave an answer to only one significant figure when there were other non-zero numbers that followed, or when a candidate wrote down an answer and ignored any further numbers, thus rounding incorrectly. For example, in **Question 9(b)(ii)** where some candidates obtained an answer of 126.6 Ω recurring and then merely wrote down 126 Ω, whereas they should have written 127 Ω. The advice is that candidates should give their answer to more significant figures than necessary and then, at the final stage, if appropriate and if they understand the process, to round their answer to two or three significant figures.

In ***Section B***, the vast majority of candidates chose to answer **Question 9** and **Question 10**. **Question 11** was based on the cathode ray oscilloscope and was often poorly answered by those who attempted it, suggesting that few candidates had practical experience of using a CRO. There are a number of excellent simulations of the CRO available on the Internet that can give candidates knowledge of the controls, even if the actual apparatus is not available in centres. Some candidates did produce answers to **Question 11** that matched their performance on the other question in ***Section B*** but most able candidates did not answer this question. The other questions were all accessible to the candidates and all marks were awarded throughout the paper.

Comments on specific questions

Section A

Question 1

(a) This question proved difficult for most candidates, although they may not have been aware of the difficulty. The question was often answered superficially, using learnt answers which did not apply to the situation. Many candidates did not appear to read the question carefully enough to appreciate that the vertical axis of the graph represents height, and gave answers for a velocity/time graph, suggesting that the speed decreases. Technical terms were sometimes wrongly used, for example "the paper accelerates at constant speed".

(b) Very few candidates scored two marks in this section by finding the gradient of the line at t = 1.5s. The commonest mistake was to read the value of h at t = 1.5 s from the graph and find h/t. However h is just an arbitrary height and not even the distance travelled. Some candidates realised the need to obtain the distance travelled in a certain time, but used the curved part or all of the graph rather than the straight line section.

(c) Even though the question clearly states that the graph shows the height of a piece of paper and that the paper is falling, a significant number of candidates suggested that kinetic energy was turning into potential energy. The best answers suggested that P.E. was decreasing and that, as K.E. was constant, the decrease in P.E. becomes heat, thermal energy or internal energy. Some candidates did not give a clear change of energy from one form to another, thereby scoring no marks, for example by merely stating 'at the start, the paper has potential energy'.

Question 2

Most candidates scored well in this question with clear answers using technical terms correctly.

(a) The vast majority of answers gave the correct mechanism, conduction. Where convection was mentioned and explained, the process in **(ii)** was usually correctly described again in **(b)** where marks were awarded. Part **(ii)** was the least well answered part of the question. Candidates did not give a clear explanation of molecular vibrations being passed from molecule to molecule. Often answers referred to how the energy was passed from the hotplate to the pan or from the pan to the water or were merely statements such as 'molecules start to vibrate'.

(b) Many candidates gave arrows pointing vertically up rather than down. This may be due to learning a diagram where only the water over the heat source is labelled. The descriptions of convection in **(ii)** were often excellent, with a clear explanation of the cyclical nature. Some candidates omitted the reference to the change in density of the water, thereby scoring only two out of the three marks. Weak candidates usually gained one mark for answers referring to the hot water rising but, on occasions, gave descriptions of evaporation and boiling rather than of convection.

Question 3

Mathematically able candidates did well in this question. There was some confusion over which equations to use and weaker candidates often did not convert the time units to seconds or tried to use specific heat capacity equations.

(a) Many perfect answers were seen with well laid out calculations. Weaker candidates tended not to include the equation in their answer and often used 2 minutes instead of 120 seconds for the time. The unit was also often incorrect with watts or J/s being common incorrect answers.

(b) Many candidates showed confusion over latent heat and specific latent heat and effectively found $Q \times m$ instead of Q/m. It is perhaps not helpful to use an equation such as L=ml, as candidates confuse the meaning of the letters. The unit again caused some difficulty with °C or K appearing in the final unit. The conversion from g to kg was usually completed correctly although either J/g or J/kg was accepted in the final answer for the specific latent heat.

(c) This part of the question challenged candidates' understanding of melting. Many able candidates were able to appreciate that the ice below 0°C needed to raise its temperature to 0°C before it started to melt. However, many answers were unclear and poorly worded, often implying that the ice would start to melt below 0°C or that the temperature of the ice was above 0°C.

Question 4

(a) The majority of candidates were able to suggest that a solid has a more regular or ordered structure or that there is less space between the molecules in a solid.

(b) In **(i)** the stronger force between the molecules was usually cited as providing the reason for the smaller distance between molecules in a solid. In **(ii)** it was common for candidates to suggest that the more energetic molecules escape in evaporation but less common for candidates to follow through their argument to suggest that the molecules that were left had less kinetic energy and were thus cooler. Part **(iii)** produced the poorest arguments and most candidates only scored one mark for suggesting that the molecules, when hotter, had more kinetic energy. Few candidates suggested that more molecules would then have sufficient energy to overcome the forces between the molecules and escape.

Question 5

(a) Candidates found difficulty in deciding where the ray should strike the mirror. Many candidates placed the ray too high on the mirror and the ray drawn clearly had a different angle of incidence and angle of reflection. It was disappointing to find many candidates labelling the angle of incidence either between the ray and the surface or between the reflected ray and the normal. Strong candidates had no difficulty in explaining what is meant by the angle of incidence in **(iii)** but weaker candidates could not explain that this angle is between the incident ray and the normal.

(b) Many candidates incorrectly drew the ray from the hat horizontally to strike the mirror. The minimum size of mirror required is half the size of the object. Able candidates were able to use the diagram and the scale given effectively. Candidates produced a wide range of values for *h* and it was not clear how these values were obtained.

Question 6

(a) Many candidates suggested that ultrasound was a technique for viewing inside a patient rather than giving a definition of ultrasound as having a frequency above the audible limit, for example above 20 kHz. Often candidates did not make any reference to frequency, for example by stating that 'ultrasound is a wave outside the range of human hearing'.

(b) The formula $v = f\lambda$ was well known but a large number of candidates were unable to deal with the power of ten involved in the calculation. It is preferable for candidates to state the formula as $v = f\lambda$, rather than $s = wf$.

(c) Many candidates did not explain what happens to the particles as ultrasound passes, referring to compression and rarefactions. The question asks for a description of the motion of the particles and all that was required was a vibration in the direction of the waves. Fortunately many candidates when describing a compression and rarefaction did suggest that particles move together and apart and scored at least one mark.

(d) Most candidates suggested that compressions and rarefactions were responsible for the contraction and expansion of gas bubbles as the ultrasound passes through the body. A number of candidates confused rarefaction with refraction.

Question 7

This question produced mixed responses. The syllabus clearly mentions the action of a reed switch but the topic appears not to be generally understood in some Centres.

(a) The labelling of the N and S poles at either end of each reed was generally correct, though occasionally the poles on the overlapping section of the reeds were missing.

(b) Most candidates realised that the reed switch would close and possibly complete a circuit, however the full explanation involving the attraction of the unlike poles at the ends of the overlapping reeds was not always given. A few candidates incorrectly suggested that the glass stops the magnetism getting through.

(c) Most candidates stated that the resistance of a thermistor decreases with a rise in temperature. However, a common misconception was that this decrease in resistance causes the current to start to flow, rather than to increase the size of the current already flowing in the thermistor circuit. It was usually appreciated that the increased current produces a sufficient magnetic effect in the coil to close the reed switch and so cause current to flow in the circuit containing the warning lamp. Weaker candidates failed to appreciate that there were two separate circuits linked by the magnetic effect of the coil and stated, for example, that 'the current in the thermistor lights the lamp'.

Question 8

This question produced some very good answers from able candidates.

(a) Most candidates realised that nucleon number is the sum of protons and neutrons, but full credit could only be gained if it was made clear that these particles were in the nucleus of the atom. There were only occasional incorrect references to electrons. Mass number was sometimes mentioned as an alternative name for nucleon number, but there were no marks available for this observation alone.

(b) The proton number and nucleon number of an alpha particle were well known, though occasionally these were preceded by a minus sign. As **(iii)** and **(iv)** require subtractions from 92 and 238 respectively, this may explain why the minus answers appeared in **(i)** and **(ii)**.

Section B

Question 9

This was answered by nearly all candidates. The quality of answer varied considerably but many able candidates scored full, or very nearly full, marks.

(a) Most candidates were able to score three out of the four marks. They drew a circuit diagram showing a lamp, ammeter, voltmeter and power supply connected correctly. It is helpful if the symbols for ammeter and voltmeter are not drawn over the connecting wires. Weaker candidates often omitted the ammeter or voltmeter and some even omitted the lamp. Only a small number of candidates explained how to ensure that the voltage was 24 V. Just stating that the voltage is 24 V in the description was insufficient. However using a battery of e.m.f. 24 V was acceptable but often candidates also included a series resistor; even then a mark was awarded as long as this resistor was adjusted until the voltmeter reads 24 V. The equation $P = VI$ was well known.

(b) It was pleasing to see so many good answers for the calculations in this section. However, some candidates confused P, Q and R and in **(i)** many candidates did not appreciate that the current at R could be found by adding the values of the currents at P and Q. The effective resistance was often calculated in **(i)** and again in **(ii)**. The calculation in **(ii)** was well done by many candidates, but some struggled with reciprocals and used $R = 1/R_1 + 1/R_2$. Units were generally included and correct.

(c) Again the calculations were often excellent. Weaker candidates found them difficult, often using incorrect equations or transposing the equations wrongly.

(d) The explanation here challenged candidates' ability to write a clear, logical explanation using scientific terms correctly. Most scored one mark by explaining that in parallel the lamps can be operated independently. Poor explanations often stated that in series 'if one lamp blows then they all blow' rather than all the lamps go out. Many candidates also scored another mark with a comment such as 'the lamps are brighter in a parallel circuit'. Weaker candidates tried to explain that it was cheaper to use a parallel circuit but were unable to give a clear explanation as to why this was so.

Question 10

This was another popular question which produced high marks.

(a) The two marks in **(i)** were awarded for suggesting that air resistance increases as the bicycle goes faster and eventually becomes equal to the driving force. A large minority of candidates suggested that the air resistance decreases until it becomes constant or suggested that the driving force increases to cause acceleration. In **(ii)** candidates merely had to suggest that the driving force was larger than the air resistance. Weaker candidates suggested that the forward force increases whilst the air resistance decreases.

(b) It was encouraging to find many correct answers to this question. A few candidates did not square the value of velocity to be used in the calculation of kinetic energy or decided to change the mass into grammes for the calculation and lost marks as a consequence. In **(ii)**, candidates who used the formula $F = ma$ were generally successful and it was again encouraging to find most candidates use the resultant force as 10 N. A minority of candidates tried to use the formula $a = (v\text{-}u)/t$ and were unsuccessful.

(c) The loss in energy was between the pedal and the back wheel. Friction is likely to occur in the chain or at some point between the pedal and the back wheel and causes energy loss as heat. The marking scheme only penalised candidates who insisted that friction was occurring between the back wheel and the road but few candidates gave a sensible location for the friction. The vast majority of candidates obtained the correct answer in **(ii)** with very few candidates using the wrong energy to calculate the efficiency.

(d) The explanation here again challenged candidates' ability to write a clear, logical explanation using scientific terms correctly. There were many possible advantages that could be mentioned but to score full marks the description had to take one advantage and explain the Physics behind the advantage. Most candidates realised that the bicycle is likely to have a lower mass or weight. They then, for example, might have suggested that this would mean a greater efficiency or less energy wasted but only the more able explained that this was because there is likely to be less friction. Another popular alternative was to suggest that a lighter bicycle would have greater acceleration for the same driving force and the more able candidates quoted the formula $F = ma$ to support their explanation.

Question 11

Only a very small proportion of candidates attempted this question.

(a) (i) Diagrams frequently failed to show slip rings or brushes adequately, with candidates often drawing or labelling a split ring rather than a slip ring. Where slip rings were drawn, they were often not connected correctly to the ends of the coil and the alignment along the axis was often incorrect.

(ii) Candidates who had a basic understanding usually appreciated that the changing flux produced by the coil induces an e.m.f. in the coil as it is rotated. There were some descriptions of motors rather than generators and such answers often included a power source in the diagram in **(i)**.

(b) These sections were very poorly answered, indicating a lack of practical experience of using an oscilloscope. Applying a known voltage to the Y plates to observe a measured movement of the trace on the screen seemed an unfamiliar concept, as was the effect of the time base to adjust the horizontal component of the display. Even more unfamiliar was the use of the Y shift to move the complete trace up or down the screen. Those good candidates who attempted this question did show how easy it was to earn marks in **(i)** with just the attachment of a voltmeter and the measurement of a voltage by the voltmeter and the vertical height of the trace.

(c) This section was the best answered part of the question. Most candidates knew the basic details of thermionic emission and the acceleration of electrons by the anode. However, a few referred to an electron gun but failed to appreciate the component parts.

PHYSICS

Paper 5054/03
Practical Test

General comments

The performance of candidates was generally quite pleasing this year. The experimental results and graph work produced by candidates in **Question 4** were particularly good. **Questions 1**, **2** and **3** elicited the full range of marks. **Parts (d)** and **(h)** of **Question 4** proved to be difficult for candidates and the result was that the maximum mark for this question was 13 marks.

Comments on specific questions

Section A

Question 1

(a) It was pleasing to see that the majority of candidates quoted the position of the centre of mass of the rule to the nearest millimetre. There were very few answers such as 50 cm, which would not have got the mark.

(b) If candidates had measured to the centre of mass of the 100 g mass, then $x + y$ should have been about 2 cm less than the distance corresponding to the centre of mass of the rule. Good candidates obtained such values, however weaker candidates obtained a value for $x + y$ that was exactly equal to the distance of the centre of mass of the rule from the 0.0 cm end and did not get the mark.

(c) Those candidates who scored the mark either measured the diameter and halved it to find the radius, or used the hole in the mass as a guide to the position of its centre of mass. Weaker candidates did not answer the question because they explained how the rule was balanced rather than how the centre of the mass was located.

(d) Despite the fact that the question required candidates to determine *average* values for w and t, the majority of candidates measured only single values.

(e) Based on the candidates' data, the majority of calculations were correct. The large range of allowed density values also ensured that small measurement errors could still lead to an acceptable value for the density. The main problem for the weaker candidates was incorrect or missing units for the density.

Question 2

(a) Examiners were quite generous with the circuit diagram. The diode or LED symbol was allowed for the LED and it was not necessary for it to have the correct polarity. The mark was therefore accessible to the majority of candidates. However the two main sources of error were the use of the LDR symbol rather than the LED (or even a combination of both symbols), and weaker candidates showing voltmeters connected in series with the circuit rather than in parallel.

(b) The most common error in the measurements of I and V was the use of amps rather than milliamps for the unit of current. The other errors tended to be power of ten errors, so that a current may be quoted as 0.8 mA rather than 8.0 mA.

(c) Because the errors from **(b)** were carried forward, most candidates achieved the 1 mark for this section.

(d) Good candidates calculated the resistance of the LED in **(b)** and **(c)** in order to answer this question. Since unit errors were ignored, candidates who took this approach normally gained the mark. A simple statement that the current decreased and therefore that the resistance decreased was not sufficient for the mark because the voltage decreased as well. Candidates adopting this approach should have said that there was a large decrease in the current but only a small decrease in the voltage, hence the resistance must have increased. A small number of candidates said this.

Question 3

(a) Whilst most candidates achieved the mark in this section, there were two common errors:

- Missing, mixed or wrong unit. A common mistake was the confusion between ° (angle) and °C (temperature).
- A final temperature that was above 15°C.

(b) To give a reasonable answer, no more than 20 g of ice should have been added. A number of candidates obtained mass values in excess of 20 g and so did not get the mark. A small number of candidates tried to work the density into **part (iii)** and usually obtained the wrong answer for the mass.

(c) The majority of calculations of thermal energy changes were correct. The very small number of candidates who wrote answers that were incorrect had usually confused the values of the masses.

(d) This was a good discriminating part of the question. To receive any credit in this section, candidates had to obtain a value that was within at least 20% of the correct value. To get full credit the answer had to be within 10%, and with the correct unit. A number of candidates obtained answers that were 30% or 40% below the true value. The most likely reason for this was the transfer of water at 0°C, as well as ice at 0°C, to the plastic cup, despite the fact that the candidates were instructed to dry the ice before transferring it.

Section B

Question 4

(c) The majority of candidates gained the 2 marks by taking two scale readings to obtain the value of *x* to the nearest millimetre.

(d) This section was quite discriminating. A number of unclear statements **did not** get the mark, examples might include:

- Ensure there is no parallax.
- Put your eye level with the vertical rule.
- Put your eye vertically above the reading (when the reading was being taken on a vertical rule).
- Repeat your measurements, when there is no evidence of repeat measurements in **(c)**.

Good examples that gained credit included;

- Put your eye at the same level as the reading on the vertical rule.
- Put your eye at the same level as the intersection between the horizontal and vertical rules.

Candidates had to be quite precise with their language to get a mark in **part (d)**. A good labelled diagram can often replace many words but was not seen in answer to this question.

(e) Candidates often scored 3 or 4 out of the 4 available marks in this section. The only mistakes were:

- Omitting units from the heading of the table.
- Not including the result for a mass of 0.500 kg that was taken in **part (c)**.
- A systematic error in the readings, such that there was a significant intercept on the vertical displacement axis of the graph.

(f) Graph plotting was good, and many candidates obtained the full 4 marks for this section. Weaker candidates made the following mistakes:

- Chose a scale in which the data occupied less than half the page in the vertical direction.
- Did not plot a point correctly or failed to plot a point.
- Drew a line that was "dot-to-dot" rather than the line of best fit for the data.

(g) Good candidates drew a large triangle in order to determine the gradient, but some gave the gradient value to just 1 significant figure, rather than the 2 or 3 expected.

(h) A small number of candidates, who had a straight line through the origin, said that their data showed that *x* was directly proportional to *M* and got the mark. However most candidates simply said that as *M* increases, *x* increases, and did not get the mark.

PHYSICS

Paper 5054/04

Alternative to Practical

General comments

The paper achieved good discrimination and the full range of marks (0 to 30) was awarded.

The majority of candidates demonstrated good practical skills and understanding, and were able to use their practical expertise in answering questions about practical situations.

There was some evidence of candidates not having the correct equipment with them in the examination. A significant number did not attempt to measure the angle in **Question 2(b)** and a few did the calculations in **Question 1** and **Question 2** long-hand in the margins.

Graph work was generally good, with candidates completing the graph accurately. The graphs were clear and completed with sharp pencils. One point to note was that a significantly large number of candidates used a scale of 2 cm representing 15 g. This is not a suitable scale and the candidate will automatically lose both the scale and plotting marks. Scales should not increment by factors of 3, 7 etc., as these make plotting points difficult.

Many candidates found quoting values of volume to the nearest cm^3 difficult. They often failed to register this instruction in the question and gave the answers to 2 decimal places as they appeared on the calculator. Quoting values to an appropriate number of significant figures is an important part of all practical work. Candidates should be encouraged to consider this every time they take a reading.

There were many instances of candidates changing their minds and overwriting their first answers. This often makes it very difficult for Examiners to read and in this case they may not gain the mark. Candidates should be encouraged to cross out completely and then re-write their answers.

Comments on specific questions

Section A

Question 1

This question required the candidates to extract relevant data from a table, calculate the loss in mass and then plot two graphs on the same axes. The effects of different variables on the outcome of the experiment were considered.

(a) The majority of candidates scored two marks here for calculating the loss in mass for containers P and Q correctly. A few lost one mark due to a simple arithmetical mistake. Candidates who calculated the increase in loss of mass each day scored no marks. There was considerable evidence here of candidates changing their mind and many went on to answer correctly.

(b) The majority of candidates produced clear and accurate graphs of both containers. Marks were lost by failing to label the axes correctly, using large dots for the points (the use of small neat crosses is preferred) and by not drawing a best fit line with points equally distributed above and below. Those who used an unsuitable scale lost three marks. Several candidates lost a mark by not plotting all the points accurately – to within ½ small square. This often occurred if they had only a few values marked on the *y*-axis, e.g. 50, 100, 150, 200. If more values are added on the axes it makes plotting the points much easier and candidates are less likely to make a mistake.

A very small number of candidates gained no marks for what appeared initially to be good graphs. This was because they had labelled the *x*-axis *t* / s, used an unsuitable scale and had not drawn a good best-fit line. To gain marks, care and attention to detail are required in graph plotting.

(c) The majority of candidates were able to state that *m* and *t* are directly proportional. Many stated that 'since *m* increases as *t* increases, they must be directly proportional' which is not necessarily true. Some weaker candidates appeared to be confused by the fact that *m* was the 'loss in mass' and therefore stated that they were inversely proportional.

(d) (i) The majority of candidates were able to calculate the area of the containers accurately. Unfortunately many simply wrote the value from their calculator to 2 decimal places, gaining one of the two marks available. The stem of the question asks for the value to the nearest cm^2. Those who realised this often rounded incorrectly by just dropping the last two digits, making 86.64 into 86. Another error seen was to round 369.36 to 370 which is not to the nearest cm^2.

(ii) This was generally well answered with candidates referring to the curvature of the corners or the measurements given including the thickness of the container sides.

A surprising incorrect response here referred to the fact that it was an estimate as the height of the container/water was not known. Others thought that the surface area would change as the water evaporated.

(iii) In this question, candidates were asked to refer to their graph in their answer. There were many excellent responses commenting on the steepness of the graph or quoting values of the mass of water lost over the six days. Weaker candidates tended merely to restate the question in their own words. Some candidates forgot this was a practical paper and gave theory about evaporating molecules from the surface.

(e) (i) The responses given here were many and varied. They needed to refer to some external factor that would change the temperature on consecutive days, so answers such as 'a window was opened' or 'the weather may change' were acceptable. Many candidates incorrectly thought that the evaporating water from the containers would change the temperature in the room.

(ii) Able candidates produced some excellent answers here by clearly explaining that the change in temperature would affect all the containers equally so it would not affect the conclusion. Most candidates simply said that temperature would change the amount of water evaporated or that the effect was only on one day, so it could be ignored.

Question 2

This question required the candidates to take measurements from the paper. Most candidates were able to complete some of them.

(a) This part of the question was generally not well answered. Many candidates simply attempted to explain what parallax error was rather than answer the question. There were many good answers where candidates realised that there would be parallax error due to the distance between the paper and the string. Common misapprehensions were that it was due to the string being thin, that we were reading the newton meter and that it was necessary to make the line of sight perpendicular to the string rather than the paper.

(b) Although the majority of candidates were able to measure the angle accurately, a large number either measured the wrong angle or gave an answer of less than 90°, usually the complementary angle. A noticeable few left the answer blank.

(c) Again the majority were able to read the scale on the newton meter correctly, but many lost the mark by omitting or giving the incorrect unit (giving 5.8 N m), by reading the small increments on the scale incorrectly (giving 5.9 N) or by reading the scale in the other direction (giving 6.2 N).

(d) To gain this mark, the candidate was required to measure the length of the resultant and use the given scale to find the value of the force. Working was required to be shown. Many candidates made the question too difficult by measuring vectors B and C and then calculating the value of the resultant. This was a possible method and a few did it correctly, although the majority who tried this method used Pythagoras Theorem or simply added or subtracted the two force values obtained.

Question 3

This question required the candidates to mark the path of a light ray accurately on a diagram and describe a simple pin method to trace a ray through the prism.

(a) (i) The majority of candidates were able to trace the path of the ray correctly through the prism. Common errors were to start their ray at M_1 rather than 'continue the ray' or to draw the path incorrectly inside the prism.

(ii) Although a selection of responses here were acceptable, only about half the candidates gained this mark. Common errors were simply to state the light was refracted or reflected.

(b) Candidates generally find questions requiring a description of experimental techniques difficult to answer. Over half the candidates scored no marks here. They often chose to use a different means of producing a ray of light rather than using pins to trace a ray. Those who did use the pins often described a different experiment such as tracing a ray through a rectangular block or verifying the laws of reflection. Those who did answer the question asked, struggled to give a clear explanation of how the pins are used to locate a ray.

Question 4

In this question, the candidates were required to add pointers to two scales, given the value. They were also required to show an appreciation of the practical problems encountered during an experiment to find the specific heat capacity of aluminium.

(a) This part was well answered with most candidates able to position accurately the pointers on the dials given. The most common error was to assume the scale increments were the same on both voltmeter and ammeter, and therefore mark the ammeter scale at 4.35 A rather than 4.7 A. A few candidates lost the mark by stopping the pointer short of the scale.

(b) The majority of candidates scored one of the two marks here for placing insulation or lagging around the block. Those gaining the second mark described a variety of methods such as shielding from draughts or having a light or shiny surface.

Many candidates thought that doing the experiment in a warmer room would reduce the heat loss during the experiment. Others simply stated the processes of heat loss such as conduction or convection rather than how it was reduced.

(b) Most candidates appreciated the need to allow the temperature of the block to become uniform before taking the temperature.

(c) Most candidates missed the simple explanation here that the block would become a hazard as it would be too hot to touch. Most gaining the mark here correctly stated that this would increase the heat loss to the surroundings.