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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

PHYSICS

GCE Ordinary Level

Paper 5054/01
Multiple Choice

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

General comments

The mean score in this examination was 28 out of 40 (70%) and the standard deviation was 19%.

The mean score was higher than usual and candidates scored well on all parts of the syllabus.

Questions 3, **8**, **10** and **21** were found to be very easy.

Comments on specific questions

Question 16

Half of the candidates opted for **B** or **C**, suggesting that they did not realise that it is the expansion difference between the surfaces which leads to the cracking of the glass. Many of the lower-scoring candidates chose **B**, thinking that thick glass would be less fragile, while some of the higher-scoring ones chose **C**.

Question 23

Some of the higher-scoring candidates chose **A**, opting for all components to be made from iron.

Paper 5054/02

Structured and Free Response

General comments

The general standard of answers seen was encouraging. There was a range of difficulty within many questions which produced a challenge to the most able but allowed the weaker candidates to display some of their knowledge of the subject.

A number of candidates failed to give enough detail in their answers, usually in ***Section B***. There is sufficient time to answer the questions and for all candidates to make their meaning clear. Candidates should be encouraged to plan their answers and to make sure that their knowledge of Physics is apparent in their writing; for example, it is always advisable to quote formulae when answering numerical questions.

Candidates were able to choose two questions from the three in ***Section B***. The least popular question was **Question 11**; the marks obtained in that question, from the small number of answers, were broadly similar to those obtained in the other question answered.

Candidates should be encouraged to use the lined pages on the Question Paper for their written answers and only ask for additional sheets when the lined pages are full. It continues to be the case that some Centres supply each candidate with a large answer booklet before the examination starts. In many cases this booklet is not used at all and it does not then need to be attached to the Question Paper.

The time available for the examination appeared to be more than adequate. The vast majority of candidates attempted three questions in ***Section B*** and made full attempts at all the questions in ***Section A***.

Although inappropriate numbers of significant figures were not penalised in this Paper it is advisable that answers should be quoted to the same number of figures as was provided in the question. In most cases this leads to answers given to two significant figures. In the following answers more figures are quoted and these were accepted.

Comments on specific questions

Section A

Question 1

(a) Although most candidates were able to make at least one sensible comment about the speed and acceleration of the lorry, it was common for at least one error to be made. The lorry increases in speed uniformly from rest, eventually reaching a constant speed. The acceleration is uniform at first and then decreases to zero. Many candidates made an error by suggesting that the speed increases and then decreases or by suggesting that the car accelerates and then decelerates.

(b) The maximum speed may be read from the graph. It was pleasing to find many candidates who could convert a speed in m/s into km/h with a simple calculation.

Answers: **(b)** 25m/s, 90km/h.

Question 2

(a) Although many candidates used the difference in the levels on either side of the manometer to find the pressure, they failed to use the conversion factor to convert this pressure to Pa.

(b) The pressure difference to be measured is unchanged. The distance h is the same when the tube is narrower and decreases when a denser liquid is used.

(c) It was encouraging to find that the formula for pressure was almost always quoted correctly. The question states that the weight is the force that provides the pressure difference; this force can be found simply from the pressure difference and area. A few candidates attempted to use the formula Weight = mg and lost credit.

Question 3

(b) It was pleasing to find many candidates who gave full answers to this question. The requires that a comment be made about the force between the molecules and the separation molecules in order to explain why gases are easier to compress and why latent heat is needed. A few candidates failed to give both comments but the majority of candidates gave sensible and well-argued comments.

(c) The definition of specific latent heat of fusion was often disappointing, with confusion about the actual change of state, which should be from solid to liquid, and a failure to mention that unit mass or 1 kg is involved. Weaker candidates incorrectly mentioned a change in temperature or gave a definition for specific heat capacity, or even mentioned nuclear fusion.

Question 4

(a) Two marks were awarded for the correct order of the parts of the electromagnetic spectrum, with one mark awarded if there was one mistake in the order. Where a single mark was awarded it was often because infra-red and ultraviolet were each on the wrong side of the visible part of the spectrum. Putting the wavelengths in the correct order was successfully achieved by almost all candidates.

(c) The syllabus specifies a few uses of infra-red radiation. Many other uses were also accepted, including night vision, detection of hot bodies, measurement of distance, burglar alarms that rely on the infra-red radiation emitted from a person and the use of the infra-red emitted from the Sun in solar panels. Confusion was often evident, and uses specific to ultra-violet radiation were sometimes given as answers.

Answer: **(b)** 3.0×10^8 m/s.

Question 5

(b) Although most answers indicated that positive and negative charges attract one another, relatively few answers explained that the charges might recombine, creating a current or spark which might ignite the petrol. To avoid the building up of the electrostatic, the tank and pipe need to be earthed or connected together. A large number of correct answers were seen but suggestions that the tank should be made of an insulating material were not accepted.

Question 6

(a) It was expected that three lamps should be drawn in parallel between the live and neutral rails given on the Question Paper, with a switch placed in the live connection to each lamp. Only strong candidates were confident enough to draw the correct circuit and many incorrect lamp symbols were seen as well as additional wires that provided a short-circuit between Live and Neutral. The new lamp symbol is a large X placed within a circle, but the older symbol was also accepted.

(b) It was encouraging to see the correct equation given to enable current to be calculated from power and voltage.

Answers: **(b)** 0.125A; **(c)** 0.375A.

Question 7

(a) It was apparent that some candidates were not able to use the resistor colour code.

(b) This was the first examination in which the topic Electronic Systems was tested in ***Section A*** of the examination. It was included as an alternative to a question that required potential differences across series resistors to be calculated. The marks awarded for the two alternatives were broadly similar, as was shown by those candidates who answered both alternatives. Many candidates answered the Electronic Systems question and were successful in drawing a simple version of the OR gate and completing the truth table. A few candidates attempted to draw an OR gate circuit with switches or the gate had only one input. The American ANSI Y 32.14 symbol was accepted.

Answers: **(b)(i)** 6V, **(ii)** 3V.

Question 8

(a) Most candidates displayed a sound knowledge of nuclide structure and gave the correct nu protons and neutrons in the two nuclides of hydrogen.

(b) The answers to this section were poor, with few candidates earning all four marks. Those candidates who realised that the charge on the nucleus was positive usually recognised that the nuclei repel each other. The high temperatures and pressure inside the Sun allow the nuclei to have sufficient kinetic energy to overcome the repulsion. Many candidates merely referred to high energy at the centre of the Sun.

Section B

Question 9

(a) The standard description of the law of conservation of energy was produced by most candidates and few failed to produce a good account of the energy transformation that occurs as the hammer falls. Candidates should aim to produce a sensible list in which energy clearly moves from one form to another. Thus as the hammer hits the baseplate kinetic energy may be transferred to heat (internal energy) and sound but not from sound to heat.

(b) The equations for kinetic and potential energy were well known and many fully correct answers were produced.

(c) In the first section candidates were asked to suggest why a motor requires more energy than was given to the hammer in lifting it up. Few candidates gave enough detail or were able to indicate sensible places where energy was lost from the system. Possible causes were friction in the moving parts of the motor, current in the resistance of the wires, the need to lift the rope itself and the kinetic energy given to the weight or the moving parts of the motor. Candidates should be able to explain the effects of friction on a body. The last section gave many correct answers with possible answers including a greater mass for the hammer, a greater height or a shaped baseplate.

Answers: **(b)(i)** 48 000J, **(ii)** 48 000J, **(iii)** 3.2m.

Question 10

(a) It was pleasing to find a large number of good accounts of conduction and convection. A reasonable number of candidates were able to express themselves well, and communicate the essential facts, that energy is passed on from molecule to molecule as the molecules vibrate in conduction and, in convection, that the hot air rises since the molecules are further apart and the density decreases.

(b) Candidates who answered this section logically by considering conduction, convection and radiation separately were the most successful. Those who were not clear, confused conduction and convection. The simplest approach was to explain that the insulation was a bad conductor of heat and that the outside surface of the heater was cooler and so less convection occurred. Heat loss by radiation was reduced since the white surface was a poor emitter of radiant heat. Many candidates suggested that radiation was reflected backwards from the hot water by the white surface. This argument was not penalised but was not credited. The advantages of having an efficient heater were ingenious and usually correct, although a few candidates could have given fuller answers. Merely writing that it “saves time” is not as good an answer as suggesting that “the water will be heated in a shorter time”.

(c) The equations tested in this section were well known. Few mistakes were made, although a significant minority of candidates did not convert the time in minutes into seconds and some calculated the electrical energy input to the water and stated that this was the increase in internal energy of the water. When calculating the efficiency it is advisable to quote the full formula for efficiency as the ratio of (useful) energy output to energy input, rather than just output/input.

Answers: **(c)(i)** 2 270 000J, **(ii)** 3 000 000J, **(iii)** 76%.

Question 11

This question was the least popular in ***Section B*** and was often chosen by weaker candidates, but they achieved was similar to that obtained in the other question answered from this section.

(a) Only a small number of candidates were able to explain that ultrasound has a frequency above 20 kHz that is inaudible to the human ear. Where a frequency was mentioned the value of 20 kHz was most often quoted.

(b) The numerical answers to this section were very encouraging. There was evidence of a sound knowledge of the formula that relates velocity, frequency and wavelength. In **(ii)**, a number of candidates attempted to use f = 1/T to calculate a time, rather than realising that a time should be read directly from the cathode-ray oscilloscope trace.

(c) This whole section was poorly answered. Many candidates realised that the reflected pulse was delayed and drew a correct trace but failed to earn a simple mark by not explaining that this was because the sound had travelled further. The other change, that the reflected pulse is smaller in amplitude, was suggested by a few candidates but rarely was there an explanation that the sound may have been absorbed by the water or have spread out or been reflected in different directions. The better candidates understood the meaning of the last section and were able to explain that the pulses must be sent les frequently or else a new pulse would be sent before the reflected pulse has arrived.

Answers: **(b)(i)** 50 000Hz, **(ii)** 0.1s, **(iii)** 150m.

Paper 5054/03

Practical Test

General comments

Generally the Paper was a similar standard to June 2002. The candidates possibly found the shorter questions marginally easier than last year and the long question marginally more difficult. In the long question candidates had to cope with a graph which involved plotting *F*/N against 1/*d*/(1/cm) and candidates had difficulty coping with the 1/*d* scale.

Comments on specific questions

Section A

Question 1

(a)(b) It was intended that T would be the more difficult measurement. Because the measurement was only of the order of 1.0 cm, Examiners expected candidates to repeat the measurement and take an average. Many candidates repeated the measurements of the width and length of the three samples but did not repeat their measurement of T.

(c)(d) Generally the mass of the 10 sheets was recorded correctly but some candidates were confused by T. A number divided the mass by 10 in order to gain the mass of one sheet but they then used the total volume of all the cards in order to find the density. This obviously gave the incorrect answer. Those candidates who divided T by 10 to get the thickness of one sheet and then used the mass of one sheet usually obtained the correct density value and were given credit for this.

(e) This was a wasted mark for many candidates. It was hoped that candidates would realise that T was the most inaccurate measurement because the uncertainty in its measurement was so large, e.g. an error of 1 mm in 10 mm would be equivalent to an error of 10%, but this point was virtually never picked up by candidates. A few did refer to T being the most inaccurate measurement but often this was related to air trapped between the sheets. This was an acceptable alternative response.

Question 2

(b) The majority of candidates did record measurements of the height of the object, height of the image and image distance to the nearest mm. However, a large number of candidates were confused by the term height of the object. A number clearly measured the height of the centre of the illuminated object above the bench rather than the height of the illuminated object. The same is true for the height of the image.

(c) The major problem here related to the use of units. A number of candidates gave units to the linear magnification, which does not have units and equally omitted units from the value of the focal length, which does have units. Good candidates obtained a value for the focal length in the expected range.

(d) Examiners required an immediate practical solution to test whether the image was inverted. An obvious test would be to cover the lower half of the object and to observe that it was the upper half of the image that was covered. A number of candidates wanted to replace the object with, say, a triangular one. It was felt that this was over complicated and not an immediate practical solution so this was not given any credit.

Question 3

(a) Generally the circuit diagram was drawn correctly. Notable exceptions included the use of a voltmeter in series with the heater circuit, when a voltmeter had not been included in the list of apparatus and the lack of a power supply in some circuit diagrams.

(b)(c) It was pleasing to see that the majority of candidates recorded the correct temperature. On some occasions it was disappointing to see the unit of angle (°) rather than the unit of temperature (°C). Good candidates attempted to interpolate between the divisions on their thermometer. The majority of current and voltage readings were recorded correctly although there were a number of power of 10 errors, e.g. 19 A instead of 1.9 A. Weaker candidates also tended to omit units.

(d) There was only one mark for the calculation of specific heat capacity and it was a difficult mark to score because there were a number of mistakes which candidates could make:

- The time in minutes had to be converted to seconds.
- A temperature difference in °C is the same as a temperature difference in K but a number of candidates tried to add 273 K to their answer in °C.
- Units were often omitted from the value of the specific heat capacity or incorrect units such as J/g were used.
- An answer in J/(g °C) was perfectly acceptable but a number of candidates converted the mass to kg and made a mistake in the conversion.

Section B

(a)-(c) Examiners were expecting both *l* and *d* to be recorded to the nearest mm. In the event many candidates wrote 79 cm for *d* and the mark scheme was eased and 79 cm was accepted. Most candidates suggested measuring the height of the metre rule above the bench at each end to test that it was horizontal but detailed descriptions were poor. The use of a set-square to check that the rule recording the height was vertical was rarely mentioned. Candidates should appreciate that a fully labelled diagram can score all the marks for description. The value of *F* should have been in the region of 0.8 N. Candidates obtained answers that were a factor of 10 different to this, e.g. 8 N presumably because the scale of the newton-meter was misread. There were some candidates who were clearly using a meter that was calibrated in grams. It would have been helpful, if in such circumstances, Supervisors could have covered up the grams scale and replaced it with a scale calibrated in newtons. This is easily done by covering up the numbers on the scale with sticky paper and writing correct values in newtons on the paper.

(d) Values of 1/*d* posed a number of difficulties for candidates:

- When the results were tabulated, units were frequently omitted from the 1/*d* values.
- Values of 1/*d* were frequently over rounded to 2 significant figures. For example values typically ranged from 60.0 cm to 95.0 cm. If values of 1/*d* were rounded to 2 s.f. then th would give extreme values of 0.017 and 0.011 cm^{-1}. This lead to the inaccurate plotting of data on the graph. Because *d* values were measured to 3 significant figures, the values of 1/*d* should also have been quoted to 3 significant figures, e.g. 0.0167 and 0105 cm^{-1} respectively.

Generally, the results for *F* and *d* were quite good but the poor processing of them lead to inaccurate work at the graph plotting stage.

(e) The best graphs did not start at the origin. Using the above example a 1/*d* scale that started at 0.010 and ended at 0.017 would have been adequate, a scale of 2 cm equals 0.001 cm^{-1} could then have been used. Equally *F* values ranged from 0.6 N to 1.0 N so that a scale that started at 0.6 N would have been better than one that started at 0.0 N. Generally, data was plotted correctly and the lines drawn by the candidates were acceptable.

(f)(g) It was pleasing to see that most candidates used a large triangle to determine the gradient of their graph. In the calculation of *G* a number of candidates used experimental data points that were not on the best-fit straight line and so did not get credit for the calculation. Also the calculation mark included the calculation of both *G* and *W*. Whilst the calculation of *G* was generally correct a significant number of candidates thought that *G* was multiplied by l to obtain *W* rather than *W* being *G* divided by *l*. The result was that only the very best candidates obtained a sensible value for *W*.

Paper 5054/04

Alternative to Practical

General comments

This Paper is designed to be a test of the candidates' understanding of the practical techniques related to the 5054 Syllabus. The best preparation for the component is a well designed practical course giving the candidates a wide experience of hands-on experimental work. The Paper was comparable to those of previous years. A full range of marks (0 to 30) was scored.

There were many excellent candidates whose answers were written in very good English. An impressive number of candidates were able to use good physics principles in their responses.

The general presentation of the answers was very good. However, some graphical work was untidy and carelessly prepared.

Comments on specific questions

Question 1

(a)(i) Many candidates did not draw the three rays, some had obviously used a short rule, others thick blunt pencils. Lines representing ray should be thin, neat and accurately drawn using a sharpened pencil.

There was a sizeable minority of candidates who drew rays in unexpected positions, e.g., to the left of the line OS_4.

(ii) Many of the sets of values for *y*, given in the candidates' table, were inaccurate. Some candidates had not read to the centre of the S dots given on the base line. Others gave unconnected sets for the values of *y*, some of these were greater than 108 mm.

(iii) Using the candidates' values for *x* and for *y*, the *xy* values were always correct. S… leaving too many significant figures in the answer, most of the candidates, who com… table, scored this third mark.

(b) When the *lamp/object/image*, the *mirror/line on the mirror* can be seen, at the same time, thro… the *viewing slot* then the reflected ray passes through the slot. Answers connecting the three points in italics were awarded the mark. The card with the slot also prevents rays other than the *reflected ray from the line* reaching the eye, answers expressing this point were accepted. There were some excellent answers to this section.

(c) Very well answered, apart from too many significant figures.

(d) Some very good answers that went beyond xy = k, to give y = k/x.

Question 2

(a) Many of the answers lacked clarity in the sequence of the operations. The sequence required was (1) the initial setting the compass, (2) marking, on the paper, the position of the *north pole of the compass*, (3) moving the compass to the next (correct) position, (4) repeating from step (2) until the *S-pole of the bar magnet* is reached.

In the account of field plotting, the candidates should be careful to distinguish between (bar) magnet and compass.

(b)(i) There were some unclear answers, e.g., "The field would pass through the steel". This answer does not get to the point of why the steel would be unsuitable.

(ii) There many sensible answers, especially related to part **(a)**, e.g., "this would give more points along the field line".

(iii) There were many vague suggestions. However, an encouraging number of the candidates related their answers to the balance of the pivot.

Question 3

(a) The answers covered the complete range from very good to very poor. In general, accepted symbols were used. Some circuit diagrams were very poor and untidy. Frequent errors were:

- the voltmeter was in series and not in parallel
- the voltmeter was shorted by a wire
- additional components were added
- the components were represented by three dimensional diagrams
- the positive terminal of the voltmeter was omitted
- the short line of the symbol for a cell was labelled +ve.

(b)(i) Most of the candidates gave the correct answer of 5 V or 5.0 V. However, there were candidates who gave 4.7 V. The unit was required.

(ii) Most candidates gave the correct answer of 0.1. The answer 4.1,…….4.9,5.0, was accepted. A frequent error was 1 mV.

(iii) Some very good answers were given by candidates who understood how small the deflection of 0.2 V would be, compared with the full-scale-deflection of 5 V. Many went on to explain how this would lead to a reading error.

Question 4

(a) Most candidates were aware that the question was to do with the line of sight of the obse
the diagram a straight line from the eye to the top of the mensicus, in the enlarged inset,
cuts the scale below 38.5°C. Diagrams do help candidates to explain difficult ideas, they should
encouraged to draw neat diagrams.

(b) The concept of parallax error and the meaning of 'perpendicular' is understood.

(c) The advice in the question to "refer to the steam that condenses as water on the thermometer", was intended to help the candidates concentrate on that relevant point in their answers. Some ignored this advice and wrote about: (i) the thermometer could not read above 100°C and (ii) the steam that condensed was involved in cooling the thermometer. However, there were many good answers. These explained that the temperature of the steam and of the water condensing were both 100°C.

Question 5

(a) There were many good answers most of which were based on $T = t/N$, where N = 20 or more.

(b) In general the candidates' graphical work was disappointing. Common errors were:

- reversed axes, i.e., x/mm plotted against T/s
- poor scales, e.g., non-linear or awkward scales; scales should be chosen so that the graph fills most of the graph paper, without using an award scale
- using the given grid, the point plotting should be as accurate as possible, the pencil work for plotting should be neat
- the graph line should be a continuous smooth line of best fit through the plotted points and should be a neat line drawn with a sharp pencil.

(c) To obtain the required value of T for x/mm = 0, the graph line has to be extrapolated to the T-axis. This required a neat extension to the graph line. This extrapolation was generally very poorly drawn or often omitted. There was some confusion with the instruction "start the T-scale at the value T/s = 0.9".