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

General comments

The mean score this year was 23.9 out of 40 (60%) and the standard deviation was 18%. The general standard of performance across the Paper was uniform, showing that all sections of the syllabus had been well prepared. **Questions 4** and **5** were found to be easy to answer correctly.

Comments on specific questions

Question 1

As usual this was intended as a simple, introductory question to help settle the candidates. So it proved, with 75% of the candidates answering correctly. Response **B** attracted some attention, presumably from candidates who did not notice the 0.5 mm marking.

Question 2

Very few candidates felt that the mass of a body would change during acceleration, but all other re[sponses] attracted a sizeable number of candidates.

Question 5

Candidates found this very easy with only one in ten not being able to calculate the density.

Question 7

Several of the better candidates chose option **B**. Perhaps they thought that to have the same magnitude as one of the components, the resultant must be that component, and so was not possible.

Question 9

The key (**A**) was selected by a slight majority, but response **D** proved almost as attractive and was selected by almost as many candidates.

Question 13

Surprisingly candidates found this difficult with some evidence of "guessing". Perhaps this was because the graph showed a "cooling" situation rather than the more usual case of heating a solid.

Question 14

Response **C** proved even more attractive than the key **B**.

Question 20

Another question where the statistics seem to suggest guessing was taking place. Responses **B**, **C** and **D** being popular answers with **C** (slightly) more popular than the key **D**.

Questions 22 and 28

Both these questions proved rather easy, with most candidates selecting the key, other responses each attracting only a few candidates.

Question 29

A lot of candidates chose options **A** and **C**, suggesting that they think that there is no current in the neutral lead.

Question 32

Nearly everyone decided that the commutator would reverse the current only once or twice per revolution, with only one third of these making the wrong selection.

Question 37

This proved an easy question with nearly 80% selecting the correct answer. A pleasing response for a question on radioactive emissions.

Questions 39 and 40

Again a good and pleasing response to questions on this area of study.

Paper 5054/02

Structured and Free Response

General comments

This was the first November examination where the subject content of the syllabus contained learning outcomes. Only a few parts of some questions were entirely new, and even then it was intended that candidates who had studied the main ideas of Physics would be able to see the relevance of those ideas to the question that had been set. For example, in **Question 1** which tested the effect of friction on the motion of a vehicle and in **Question 5 (b)** where candidates could apply simple ideas about like and unlike charges to explain the working of an electrostatic precipitator.

There were some excellent performances where candidates had clearly learnt the relevant areas of Physics well, but there were also a much larger number of poor performances where candidates had clearly not had enough practice in the application of physical concepts and principles. It is the intention of the syllabus to promote the understanding and application of physical concepts and principles. Candidates need to learn how to apply the simple principles to new applications. The Examiners were disappointed by the performance in the first part of each question in ***Section B***. Each of these questions had an element of 'free response' where candidates had to explain energy changes, explain how pressure is transferred through a hydraulic system or how sound travels through the air. There were many possible approaches to each of these questions, but too often candidates did not write any sensible Physics in their answers.

The Examiners reported that the general standard of the written English was good and that most scripts were completely understandable.

Answers should be quoted to the same number of significant figures as given in the question. It is not the intention to penalise the wrong use of significant figures to any great extent; only in **Question 2 (b)** was there a possible mark lost for quoting too many figures and in **Question 11 (b)** where some candidates quoted answers to a very large number of significant figures. It is very important that units are given, where appropriate, to every numerical answer and it is advisable that candidates should give formulae when answering numerical questions.

It has been stated in previous reports that some candidates are not using the lined pages at the end of the Question Paper for their answers to ***Section B***. Some Centres are still supplying each candidate with a large answer booklet before the examination starts, which, even though unused, is still attached to the Question Paper. Candidates should be encouraged to use the lined pages and only ask for additional sheets when the lined pages are full.

The time available for the examination appeared to be adequate for most candidates. A few candidates attempted to answer three questions in ***Section B***, and, in general, their last answer appeared to be rushed and scored significantly lower marks. Some weaker candidates only attempted part answers in ***Section B***.

Comments on specific questions

Section A

Question 1

Candidates were usually able to produce sensible graphs, which showed that the car started at 18m/s, continued at that speed for 0.6s and then slowed uniformly to rest at 3.6s. In part **(b)** there are many factors that increase braking distance, e.g. poor tyres, a slippery or wet road, applying the brakes with a weak force. Many candidates failed to state factors that would increase the braking distance and merely gave factors that affected or even decreased the distance. These candidates were given credit if they gave two factors.

Answer: **(a)(ii)** 10.8m.

Question 2

Most candidates mentioned that total internal reflection occurs at Q, since the angle of incidence is than the critical angle. Some answers were unclear particularly when candidates compared 'an angle the critical angle. In **(a)(ii)** reference to the increased speed of light as it emerges from the glass fibre w the best explanation for the change in direction, but other answers were accepted in which simply the concept of refraction was mentioned as there was a change in medium from glass to air. Many candidates knew and applied the formula for refractive index and used the equation successfully, but other candidates were confused by the fact that light travels from glass to air and produced an answer of 9.9°. The answers to **(c)** were disappointing. It was hoped that candidates would mention that optical fibres are able to carry more telephone conversations than a copper wire, or that attenuation of the signal is lower or that optical fibres are more secure from interference or tapping. Many candidates suggested that the speed of the wave travelling along the fibre was faster and thus the signals arrive sooner. This was not accepted, although the Examiners did accept that data can be sent at a faster rate along an optical fibre.

Answer: **(b)** 23°.

Question 3

Most candidates correctly gave radio waves in **(a)(i)**. Full marks in **(ii)** were awarded either for using the formula $v=f\lambda$ and stating that speed is constant for all electromagnetic waves, or by realising that, with a constant speed, an increased wavelength must increase the time for one oscillation. Only good candidates stated the need for constant velocity in their answers to this question. In part **(b)** only simple answers were required, showing that candidates realised that high buildings reflect or obstruct waves and that radio waves decrease in strength or spread out or even that a booster station can increase the strength of the signal received. Some candidates produced confused ideas, which included microwaves experiencing interference from other types of waves, sound messages dying away, or a repeater station sending out a signal if the first one was lost.

Question 4

Parts **(a)**, **(b)** and **(c)** produced some good answers. Part **(d)**, in contrast, revealed many confused ideas. It was hoped that candidates would realise that there is a larger current in the wires to the heater and that thicker wires lose less heat or are less likely to melt. Answers sometimes mistakenly referred to the wires of the heater itself rather than those supplying it, or suggested that the thickness of the wire is due to an extra earth wire within the insulated cover of the cable; the explanation frequently referring to avoidance of electric shock. The fact that thicker wires become less heated was missed by weaker candidates though statements that the thicker wire has lower resistance or that there is a larger current in the heater, or the wires to it, gained one mark.

Answers: **(a)** 2.0 kWh, 0.2 kWh, 0.9 kWh, 1.2 kWh, 3.0 kWh; **(c)** 6357.8.

Question 5

Correct answers in **(a)(i)** were very common and included explanations that density decreases or explanations of the formation of a convection current. There were some weaker statements that the gas becomes lighter or that the molecules themselves expand, rather than there being an increased distance between them. In **(ii)** the Examiners were pleased to find many good explanations that clearly stated that energy is passed on from molecule to molecule as the particles vibrate. This was given full marks as were explanations that involved the movement of free electrons. Weaker answers tried to explain how conduction occurs within the gas or water and often failed to score. Sensible and reasoned explanations in **(b)** used the simple principles of electrostatics in a new situation. Most candidates realised that negatively charged dust particles were attracted to the positive plates. Many answers correctly suggested that the particles became charged negatively as they passed through the fine wires, and this was sufficient.

Question 6

Most candidates in **(a)** recognised that nitrogen is liquid at the temperature stated. Definitions in **(b)** were usually adequate. Answers to the unusual question in **(c)** showed good sense by using the equations for specific latent heat and specific heat capacity and either leaving a term for *m* in the equations or by merely making the calculation for 1g. The Examiners were generally pleased with the quality of the argument produced in the space available.

Question 7

The majority of candidates realised that the average speed of the molecules is greater at a temperature. The question explains that the gas in the syringe occupies a greater volume at t temperature and so many candidates correctly stated that the distance between molecules has a increased. However it was rare for candidates to score full marks in this question as they did not realise that the pressure of the gas is the same at the higher temperature (since the piston moves without friction and the pressure inside and outside must be atmospheric pressure). The last part produced, understandably, the fewest correct answers. Since the pressure is the same at the higher temperature and the molecules are hitting the sides with a greater speed there must be fewer collisions per second to produce the same pressure.

Question 8

Most candidates plotted the correct points in **(a)(i)**, but a considerable number then drew a straight line and failed to earn full marks in this part. Candidates should realise that the instruction in the question to draw a line may require that a straight line or a curved line is to be drawn. The line drawn in **(ii)** needed to drop from x, the given point, to somewhere between 12 and 18 small squares. It was not intended that candidates calculate the number of atoms after less than a half life. Almost all candidates gave the correct answer for **(b)(i)**. However correct answers to **(ii)** were far less common. Candidates who showed working were often awarded one mark because it was clear that they had calculated two half lives, even though it was not converted to an actual time interval. Calculation of the time taken for a reduction from 4000 counts per minute to 10 counts per minute was rare but was also awarded some credit.

Answers: **(b)(i)** 40, **(ii)** 10 years.

Section B

Question 9

The answers to **(a)** were disappointing. Candidates were able to score almost full marks either by describing what happens inside the Sun or the processes by which winds are created on the Earth. The fusion of hydrogen nuclei in the Sun to create helium and energy with the emission of light or infra-red or radiation and its subsequent absorption would have been sufficient for full marks, as would have been the absorption of light from the Sun and a detailed explanation of convection currents being formed since some areas of the Earth absorb more radiation than others. The calculations in **(b)(i)** produced better answers and it was encouraging to see the correct formulae given at the start of an answer. **(b)(ii)** required a simple statement that potential energy changes to kinetic energy. Many candidates added extra energy changes. These were accepted as long as they were reasonable, but often the kinetic energy was changed into potential energy again or was changed to heat and then to sound. In these cases candidates did not earn full marks.

Answers: **(b)** 16J, 167J, 9.6%.

Question 10

The Examiners were disappointed by the level of understanding shown regarding hydraulic systems. In **(a)** only simple explanations were required, such that piston P causes a pressure in the oil which acts on piston Q and creates a force on that piston. In the process oil moves to the slave cylinder, keeping valve B open and valve A shut. Part **(b)** allowed candidates to apply the formula for pressure and in **(ii)** to state that the pressure in the slave cylinder is the same as in the master cylinder. The formula for pressure was generally well known. Candidates were able to use even an incorrect value for the pressure in **(ii)** to earn full marks in **(iii)**. Calculation of the volume of oil in **(c)(i)** was a simple task of multiplying an area by a distance but it was not always answered correctly.

Most candidates realised that valve A opens in **(d)** and valve B shuts but it was a common misconception that piston Q returns to its original position, even though candidates realised that valve B was closed. Many candidates appreciated the need for the fluid to be incompressible in **(e)**, although incorrect attempts frequently were related to density references.

Answers: **(b)(i)** 15 (N/cm^2), **(ii)** 15 (N/cm^2), **(iii)** 6000N; **(c)(i)** 100 cm^3, **(ii)** 0.25 cm.

Question 11

In **(a)** many candidates recognised that a vibration was involved in the transmission of sound but ofte wrongly that 'sound particles' rather than the correct statement that air or, even better, air molecules vi passing their energy or vibration on from one molecule to the next. Many answers stated that sound i longitudinal wave and that compressions and rarefactions are involved, and these ideas were credited. In **(a)(ii)** most candidates stated that the sound is quieter at microphone 2 because the sound has further to travel but answers which explained that the air absorbs the sound or that the sound spreads out were far fewer.

The points plotted for the graph in **(b)** were sometimes incorrect, with candidates often failing to draw the time axis correctly or using extremely awkward scales which caused candidates to plot their points inaccurately. In general candidates should be taught to draw graphs using the recommendations given in the Practical Assessment section of the syllabus, and 2 cm on the graph paper representing 1, 2 or 5 units of the variable (or 10, 20, 50 etc.). Most candidates knew the formula that allowed them to calculate speed from distance and time but sometimes failed to use the graph (as the question required), and merely used two points from the table. This was accepted where the points were on or very close to the line, but is preferable to draw a reasonable sized triangle on the graph to show how the gradient is calculated. The time delay in **(c)** was sometimes given as 8.0ms, but whatever value was given, full marks were awarded in **(ii)** if the candidate successfully used the speed calculated from the graph. The major cause of error was a failure to convert the time interval into seconds before calculating the distance. Candidates were usually able to make at least one sensible comment in **(d)**, for example that multiple reflections from the walls cause confusion, that the time taken is too short to measure accurately or that the reaction time of the observer will cause a large error. In **(e)**, candidates needed to know that sound travels faster in water than in air. Many candidates failed to answer the question fully by not specifying that the time taken would be shorter as a consequence.

Answer: **(c)(i)** 5.0ms.

Paper 5054/03

Practical Test

General comments

The Paper was of a comparable standard to previous years and there was no real evidence that candidates had either significantly improved or significantly declined in standard.

Comments on specific questions

Question 1

The majority of candidates recorded, to the nearest mm, the position of the centre of mass of the rule and the scale readings on the rule. Better candidates recorded how they had made measurements to the centre of the 100 g mass. In these cases the position of the centre of the 100 g mass was recorded and this was subtracted from the position of the knife-edge in order to find the distance *x*.

Examiners allowed error carried forward to the calculation of the mass of the rule; provided candidates obtained a reasonably sensible value for *M* and quoted an appropriate unit, the calculation mark was awarded.

Values of *l*, *w* and *t* were generally recorded correctly, although Examiners did not allow *l* = 1 m because this was only quoting the length to one significant figure. Perhaps rather generously *l* = 100 cm was allowed.

Most candidates obtained a reasonable value for the density of the material of the rule.

Question 2

Temperatures and volumes were generally recorded correctly. Better candidates interpolated bet divisions on the thermometer in order to record the temperatures to better than 1°C.

Most candidates determined a correct mass of 80 g for the water and a mass of about 15 g for the melte ice. Significant errors included a water mass of 95 g (final mass of water rather than initial) or an ice mass of 95 g (initial mass of water not subtracted from final mass).

Since the correct calculation of *L* included a unit, a number of candidates lost the mark immediately because they quoted the unit for specific heat capacity rather than specific latent heat.

The majority of candidates scored a mark for precautions because of the large number of possible alternatives.

Question 3

A number of candidates did not know the correct circuit symbol for a light dependent resistor. Popular alternatives included the symbol for a variable resistor, the symbol for a thermistor, or an LDR symbol either with arrows pointing away from the resistor or more than two arrows pointing towards the resistor.

When the LDR was open to light, Examiners expected the potential difference across the resistor to be greater than the potential difference across the LDR and the sum of the p.d.s to be equal to the supply p.d. Most candidates obtained results such as described above. In some cases Supervisors reported that different LDRs were used and the Supervisors reported that different results were obtained. When this was done Examiners were able to take account of the unexpected results. When the LDR was covered it was expected that the p.d. across the LDR would be greater than the p.d. across the resistor and that the sum of the p.d.s would be equal to the supply p.d. Good candidates obtained this result and where Supervisors reported difficulties, this was taken account of in the marking.

In the last part of the question, there were two possible answers that candidates could use;

Either; The p.d. across the resistor had decreased indicating that the current in the circuit had decreased which indicates that the LDR resistance had increased.

Or; The p.d. across the LDR had increased indicating that it had a greater share of the voltage and therefore a greater resistance.

These points were only made by the top grade candidates.

Question 4

The majority of candidates had the glass block in the correct position, drew a normal at the point of incidence and marked the correct angle of incidence. A small number of candidates measured the angle of incidence from the surface of the block rather than the normal. Most candidates had correct incident and emergent rays but only the better candidates used the widest possible spacing for the optical pins in order to gain the most accurate result possible.

Most candidates obtained an angle of refraction of between 23° and 27° when the angle of incidence was 40°. A correct value for the sine of 40° was also determined, although the weaker candidates gave values such as 0.642, which has been incorrectly rounded and 0.6428, which is an inappropriate number of significant figures. Only the best candidates used a range of values for the angle of incidence that was greater than or equal to 50°. The last mark for the quality of all 5 results was scored by about half the candidates. A common mistake amongst weaker candidates was to measure the angle of emergence rather than the angle of refraction.

Graph work produced the usual spread of marks with the best candidates scoring the maximum 4 marks and weaker candidates scoring zero. Mistakes included, plotting the graph the wrong way round (sin *r* against sin *i*), choosing a scale which was difficult to follow, misplotting points and drawing a line which was either too thick or not the best fit line to the points.

The gradient calculation also produced the usual spread of marks. Good candidates correctly read the sides of a large triangle in order to produce a value for the gradient that was in the range 1.45 to 1.55. Mistakes included using a small triangle, misreading the sides of the triangle, and not producing a gradient in the correct range either because of poor results or because the line drawn on the grid was a poor fit to the experimental data.

Paper 5054/04

Alternative to Practical

General comments

This Paper was designed to examine the candidates' understanding of the practice and techniques of experimental work associated with the Physics syllabus. The preparation for this Paper should be a well designed laboratory course covering most of the topics within the syllabus. Candidates should have hands-on experience with appropriate equipment.

Most candidates gave an answer to each section of each question, there was no evidence that there was any shortage of time. The answers were written in very clear English and well presented. The standard of the material in the answers was very variable. The comments in the next section will give specific examples on common weak responses.

An important general point is that the candidates should follow the instructions contained in the question. For example in **Question 1 (b)** candidates were asked to "Draw on Fig 1.2" and to "Show your arithmetical working". In **Question 5** there were instructions about the "best straight line" and marking "the graph" for the gradient calculation. Such instructions are designed to help the candidates carry out their tasks and present them so that they can be understood and followed by another person. Many candidates failed to take note of such instructions.

Comments on specific questions

Question 1

In some situations, when only a rule is used as the measuring apparatus to determine a length, the measurement is unreliable. This question was about using a set-square and the rule MR to obtain accurate measurements, of object distance *u* and image distance *v,* avoiding parallax errors.

(a)(i) The Examiners expected an answer in words or on a diagram that positioned the set-square correctly and used two settings for *u* or *v.*

A large number of candidates correctly drew a diagram showing one side of the right angle of the set-square alongside the rule with the other side alongside one item of the optical apparatus. Some diagrams had carelessly drawn set-squares having a wrong orientation, for example showing the hypotenuse along the side of the rule. In some, the set-squares were shown being used as though the vertical setting of the optical items were being checked.

(ii) Most candidates correctly gave the answer "parallax error", but there were a considerable number of wrong answers, for example, one of these was "zero error".

(b) Many candidates did not appear to have a set-square, some of these candidates improvised using a rule. The advice to "Draw on Fig. 1.2" and to "Show your arithmetical working" was ignored by a large number of candidates. Some diagrams showed the hypotenuse of a set used as a rule; this was placed alongside the scale MR. Using the scale MR and a set-square, the Examiners expected to see a mark on MR at the points 20 mm and 134 mm. By subtraction the distance AB = 114 mm. (The calibration of the scale on MR is smaller than on a mm rule, measured directly with a rule the distance AB = 115 mm.) Common errors were: writing 130.4 mm for 134 mm and 10.9 mm for 19 mm; wrong or no unit for the distance. Marks were awarded for: - two points on the scale MR or two lines perpendicular to the scale MR; - a correct record of the MR scale for these two points or where the lines meet the scale: - and a correct subtraction with unit.

Question 2

(a) It is interesting to note that many candidates expected all the ice to remain frozen for the of the experiment, that is 100 minutes. Very few drew attention to this length of time, ho most responded to the advice about temperatures and mass of ice melted. Correct informa was extracted from the table and this information was sensibly applied. A large number used the numerical information about the amount of ice melted i.e., 70 g and 81 g, respectively in A and B. Some gave this information in the form of "more ice melted in B". A very common misconception was that the ice inside a container melted because heat had been transferred from the ice to the laboratory surrounding the containers.

(b) The idea that the initial mass of ice was a possible variable in the experiment was well understood. Most candidates were able to explain that the amount of ice melted would depend upon how much ice was present at the beginning of the experiment.

(c) "Deep-freeze" was often confused with "physical depth". Very few candidates realised that a deep-freeze had a "device" (the refrigeration unit) to maintain the very low temperature. "The lagging stops the cold escaping" was a very common theme given in wrong answers.

Question 3

(a) "If *N* oscillations take a total time *t* then each oscillation has a time period of $T = t/N$." Those candidates who were familiar with this statement about oscillations were able to give an answer applicable to the oscillating rule. There were however many candidates who were careless about their terminology for example, confusing oscillation with oscillations, confusing *t* with *T* and confusing $(t_1 + t_2 + t_3)/3$ with t/N. The three marks for this section were awarded for the three points contained in the statement about *N, t and T* above. (Candidates who only discussed determining the time for one oscillation did not lose 3 marks.) This part was about the periodic time *T.* Many candidates spent time considering *L,* this was wasted effort. Many candidates tried to determine *T* = 0.61sec from one oscillation. The Examiners had hoped that by giving *T* = 0.61sec, the candidates would not have made this suggestion. (Trying to stop and start a stopwatch in such a short interval of time would be a good introductory practical exercise to the procedure of measuring the periodic time of an oscillation.)

(b) There are many good reasons why the fiducial mark was in the position shown in Fig. 3.1. Some of these are: the position marks the start and end of one oscillation, it is the equilibrium position for the rule, the rule is moving with maximum speed as it passes the position, when oscillating the rule always passes this position. When given by a candidate any of the above reasons was awarded the mark for this section. To support the rule was a common wrong answer.

(c) The Examiners expected answers, which proposed determining *t* by: using at least *N* = 20; repeating the experiment and then calculating the average of the two values for *t* (or *t/N*). Similar procedures were, in fact, suggested by a large number of the candidates. However there were many candidates who were not clear about what they were averaging (see above at **(a)**).

Question 4

(a)(i) Despite the reference to a "series circuit", in part **(i)** of the question, a large number of the candidates use the formula for the resultant of parallel resistors to determine the combined resistance of the resistor R and the wire AB. The value of the required resistance was 12Ω.

(ii) The required graph line lies above the line drawn already shown on Fig. 4.2. Because the resistance of the wire is proportional to it's length *x,* the voltmeter reading *V,* increases as the resistance of the wire between A and J increases. The graph shows that the larger the value of *x* the larger is the value of *V.* The contact resistance between the jockey and the wire effectively increases the length of wire in the circuit. Hence, compared with a clean jockey, when a dirty jockey is used, all values of *V* are larger for each value of *x*. Although a sizeable minority drew lines above that already shown most candidates drew a line below the line shown.

(iii) A wide variety of ideas were suggested, these even included using ultrasound. Not many of the candidates suggested the more realistic use of some form of abrasive paper.

(b) Very well answered with K the correct and very popular choice. However many st… over their reason when they clearly knew which one to choose. A reasonable number … significance of the largest experimental value for *V* (= 1.02 V) in relation to the full scale … of each meter. The Examiners are pleased to report that some candidates discussed *ideas* … to the deflection per volt (FSD/60 mm/V). For K the deflection per volt 40 mm/V; for M the va… was 4 mm/V; so K is 10 times more sensitive than M. Indeed sensitivity was a well used word.

There is much to learn about this topic with much to clarify; e.g. full scale deflection, range and scale. There were some strange answers relating the 60 mm length of each scale to a length of wire on the graph. Another was to choose meter M (15 V FSD) because the total resistance from part **(a)** was 12 Ω. These answers were widely used.

Question 5

(a) Most candidates scored well on this part of the question. The graph axes were well prepared with axes: that used the advised origin; that were of the correct orientation (i.e. *y* against *x*); labelled by name or symbol and with unit; that used a scale which could not be doubled. Apart from the point (56,390) the graph point plotting was very accurate, better than to the nearest half small square of the graph grid in most cases. The quality of graph line drawing was very variable. Far too many candidates ignored the instruction to draw the best straight line through the points. Point-to-point line drawing was not accepted. Where there is scatter of the points the straight line should be drawn so that some of the points are on either side of the line. Some lines were not drawn so as to cover the full range of the plotted points. Ideally the straight line should be extended to occupy the *whole* graph page (see the comments at **(b)**).

(b) Most candidates used gradient triangles that were larger than half of the line. The size of the triangle should be made as large as possible. The accuracy of the measurements of the "lengths" (in units of the scale) of the sides of the triangle is increased by using a large triangle. Two points of the gradient triangle *must* lie on the graph line. The co-ordinates of the three points of the triangle should be recorded somewhere on the graph. Some candidates ignored the scale of the graph and counted graph grid squares when trying to calculate the gradient. A large number of the candidates chose very good gradient triangles but incorrectly gave the gradient as $\Delta x/\Delta y$.