PHYSICS

Paper 0625/11
Multiple Choice 11

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

General comments

The mean score on this paper was 27.3 and the standard deviation was 7.0.
The best answered items (with a facility of 90% or above) were **1**, **4, 12, 14, 15**, and **26**. The more taxing ones (with a facility of 60% or less) were items **6, 8, 10, 16, 17, 19, 21, 22, 25, 28, 31, 32**, **34, 35** and **37**.

Comments on individual questions

(Percentages in brackets after an item number show the proportion of candidates choosing the correct response)

With a facility of 94%, the straightforward measurement item **1** caused little difficulty, and similarly the timing item **2** (84%) was answered well. In item **3** (82%) only the distractor option D was popular, these candidates failing to check the *y*-axis label. The speed calculation was well understood in item **4** (92%) as were the concepts of mass, weight and volume in item **5** (87%).

The first widespread problem occurred in item **6** (49%), in which just over 4 in 10 candidates chose D, suggesting that they believed that weight would remain constant on a different planet, and not mass – this idea would appear to need some attention.

Item **7** (86%) was on density, and caused little trouble, but item **8** (40%) lead just over half of the candidates to opt for D; this demonstrates the widely-held misconception that any moving object requires a resultant force to be acting on it – again, another area of the syllabus worthy of attention. Choosing option C was the popular error in item **9** (80%), this being the value midway between the readings for loads of 1N and 3N, ignoring the extension values supplied.

In item **10** (37%) distractor B was slightly more popular than the key, candidates failing to consider the *stored* energy in matches, rather than the final energy supplied. Item **11** (73%) worked well; option C was chosen by just over one in five, work and energy being confused with each other.

The first pressure question item **12** (94%) caused little difficulty, but in the second, item **13** (68%), 22% were not clear about the effect of changing the liquid density, and chose B. The question on kinetic theory of gases (item **14** (93%)) was well answered, as was item **15** (94%) on evaporation. Item **16** (54%) concerned thermometer fixed points, and many believed that these simply referred to the lowest and highest temperatures shown on the scale (-10 and 110).

All distractors worked well in items **17** (59%) and **18** (67%), as they did in item **19** (44%), but in this item it was not surprising that B was the most popular error, these candidates failing to take into account the position of the candle.

The recall item **20** (79%) worked as intended, but in item **21** (38%) there seemed to be considerable confusion over how to calculate frequency, especially as the time was given in minutes. An understanding of total internal reflection was required to answer item **22** (51%), and options B and C proved popular with those who were unsure of this part of the syllabus. In item **23** (70%), 18% of candidates knew that the rays would cross, but failed to remember that this would happen inside the lens, so opted for A.

Item **24** (71%) was very straightforward recall, and the facility might have been expected to be higher. Distractor B was by far the most popular in item **25** (47%), presumably because the trace for sound Q was smaller than that for P, and this was associated with lower pitch.

Magnetic poles were well understood in item **26** (95%), but the concept of hard and soft magnetic materials was less secure in item **27** (61%). This was also the case for how length and thickness of a wire affects its resistance in item **28** (60%). Ohm's law was well known in item **29** (85%), but the circuit symbol for a variable resistor as used in a potential divider was less familiar in item **30** (67%). In item **31** (58%), approaching a third of candidates failed to appreciate that two identical resistors in parallel would have less resistance than a single resistor, and in item **32** (56%) a similar proportion thought that a switch should be connected in the neutral wire. Item **33** (66%) dealt with electrical safety, and just over a quarter of responses were A, showing confusion over the risks of fire and electric shock.

Although 43% of candidates answered correctly in item **34**, almost as many thought that reversing the current direction would also reverse the direction of the force on the iron bar. In the transformer question this year, item **35** (46%), the most common mistake was to fail to notice or appreciate that a transformer will only operate effectively using an a.c. supply, making option B incorrect.

Item **36** (89%) on the nature of cathode rays was well answered, whereas in item **37** (58%), on the production of cathode rays, a significant number of candidates did not realise that the cathode had to be hot to work. Item **38** (63%) showed confusion over the nature of α-particles, but there were better responses to items **39** (71%) and **40** (79%) on half life and nuclide notation.

PHYSICS

Paper 0625/12
Multiple Choice 12

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

General comments

The mean score on this paper was 28.6 with a standard deviation of 6.9.

There were several items found to be easy for the candidates (facility of 90% or higher), namely items **2, 3, 4**, **8, 11, 17, 18, 26** and **30**. Those with a facility of 60% or lower were items **6, 9, 13, 14**, **16, 21, 23, 25, 27, 28, 33, 35** and **40**.

Comments on individual questions

(Percentages in brackets after an item number show the proportion of candidates choosing the correct response)

The time measurement item **1** (85%) was answered well, and similarly the speed calculation item **2** (94%) and the volume measurement item **3** (96%) caused little difficulty. Few candidates found problems with the density item **4** (91%) or the distance/time and speed/time graph item **5** (86%), the most common error in this latter item being failure to check the quantity on the *y*-axis, leading to choice of option D.

It was item **6** (45%) which caused the first real challenge, with slightly more candidates opting for distractor D than the key; the concept that an object only requires a resultant force in order to accelerate is not well understood. Item **7** (84%) dealt with force and extension, and here it was option C which was the popular distractor, being a value half-way between those for loads of 1N and 3N; candidates failed to use all the available data. Item **8** (91%) was found easy, but many opted for D in item **9** (57%), suggesting a belief that weight rather than mass would remain constant when moving between planets. In item **10** (76%) distractor C attracted one in five responses, candidates probably confusing work done and power.

Pressure was covered by item **11** (95%) and item **12** (71%), and in this second item the popularity of option B implied some lack of clarity about the effect of changing the liquid density. Item **13** (53%) concerned thermometer fixed points, and 42% believed that these simply referred to the lowest and highest temperatures shown on the scale (-10 and 110). The worst answered question on the paper was item **14** (35%), with all distractors working effectively, although option B was particularly popular (candidates failing to consider the *stored* energy in matches, rather than the final energy supplied). Item **15** (70%) on heat transfer worked well, and item **16** (47%) on convection showed B as the most popular error, these candidates failing to take into account the position of the candle. Kinetic theory was well known in items **17** (93%) and **18** (92%), but the performance was not so strong in item **19** (66%) on cooling, all three incorrect options working well.

The recall item **20** (81%) on waves was generally answered well, but this was not the case for the second waves item **21** (54%), in which distractor B was by far the most popular, presumably because the trace for sound Q was smaller than that for P, and this was associated with lower pitch. The simple recall item **22** showed a satisfactory facility of 77%, but the final waves item **23** (50%) was found much more difficult, almost a quarter of candidates failing to convert the time of two minutes into seconds.

In item **24** (77%), 13% of candidates knew that the rays would cross, but failed to remember that this would happen inside the lens, so opted for A. An understanding of total internal reflection was required to answer item **25** (53%), and options B and C proved popular with those who were unsure of this part of the syllabus.

Magnetic poles were well understood in item **26** (96%), but in item **27** (47%) many thought that reversing the current direction would also reverse the direction of the force on the iron bar, and the concept of hard and soft magnetic materials was found to be not very secure in item **28** (58%).

In item **29** (67%), approaching a quarter of candidates failed to appreciate that two identical resistors in parallel would have less resistance than a single resistor. Ohm's law was well known in item **30** (91%), but fewer appreciated how length and thickness of a wire affects its resistance in item **31** (66%), or knew the circuit symbol for a variable resistor as used in a potential divider in item **32** (72%). In the transformer question item **33** (50%), the most common mistake was to fail to notice or appreciate that a transformer will only operate effectively using an a.c. supply, making option B incorrect. Item **34** (64%) dealt with electrical safety, and just over a quarter of responses were A, showing confusion over the risks of fire and electric shock, and in item **35** (56%) almost one in three thought that a switch should be connected in the neutral wire.

The most common error in item **36** (80%) was to opt for C, confusing neutrons and electrons. Item **37** (77%) on half life showed all distractors working well, and in item **38** (65%) option D was popular, candidates believing α-particles not to be very ionising. Item **39** (89%) on the nature of cathode rays was well answered, whereas in item **40** (58%), on the production of cathode rays, a significant number of candidates did not realise that the cathode had to be hot to work.

PHYSICS

Paper 0625/21

Core Theory 21

General comments

To be successful on this component, candidates need to be competent across the whole range of Core topics. Many candidates fulfilled this requirement. Such candidates and their teachers are to be complimented for this.

Most candidates were able to make some attempt at all parts of all questions, and most candidates left few, if any, sections unanswered. There was no evidence that candidates ran out of time before they had completed the paper.

In this particular paper, there was relatively little extended numerical work. Any problems with numerical questions seemed to be related to poor understanding of the underlying Physics, rather than lack of facility with numbers. Ability with units is only tested, on this paper, where no unit is printed on the answer line. Candidates in general seemed to have a competent ability with units.

It is worth recording that, as on occasions in the past, there was lack of care over the presentation of answers, on the part of at least some candidates. Candidates are not penalised for poor writing or for poor language skills, but marks cannot be awarded if an answer simply cannot be read unambiguously.

Comments on specific questions

Question 1

(a) It was common for candidates to score 3 out of 4 for this part, the missing mark usually being for an inability to identify an appropriate instrument for measuring the distance over which the vehicles were timed. On this occasion a metre rule was not thought to be appropriate.

(b) The equation was usually known. A general point may be made here – if a question asks for an **equation**, then an equals sign is expected in the answer.

(c) Few could give a convincing unambiguous reason for the average speed being less than the top speed, but most could carry out the calculation to find the distance. A significant proportion forgot to change the minutes to hours.

[22 km]

Question 2

(a) A high proportion, though by no means 100%, were able to calculate the extension of the spring.

(b) Responses to this part were often very pleasing, even to the extent of the provision of a correct unit. A common mistake was to insert the figures in the equation the wrong way round.

[33 cm, 0.167 N/cm]

Question 3

(a) Not all could answer this correctly, with answers like $U = I + W$ and $W = U/I$ being common.

(b) A good proportion knew the value of the tension force when moving steadily, but very few linked the increased value at the start with the initial acceleration. A lot thought it was because "gravity is bigger on the ground". Candidates seemed to be familiar with the quantities needed to calculate work and power, but frequently muddled them up in **(iii)** and **(iv)**.

(c) Likewise there was confusion about the answer to **(c)**, where a lot thought the energy supplied to the motor would be the same or even less than the increase in energy of the load.

Question 4

(a) Most used common sense and obtained at least some of the marks. Answers to **(i)** and **(ii)** usually corresponded.

(b) Echoes seemed to be well understood, although answers were often in rather ambiguous language.

Question 5

Like many answers requiring things to be put on a diagram, carelessness often cost marks. A reasonable proportion indicated X on the vertical through the pivot, though virtually none showing it below the pivot. A lot marked X with less than acceptable accuracy, and lost the mark. Others simply had no idea. Y was usually marked to the right of X and scored the mark. Few could give an explanation for **(b)(ii)** that was worth 2 marks, but a good proportion scored 1 mark.

Question 6

Answers to all parts of this question showed lack of understanding about heat transfer. Even attempts at the meaning of thermal capacity rarely scored any marks. Teachers need not be hesitant about requiring their candidates to memorise basic definitions and equations – they are the backbone of the subject and give even weak candidates the chance of scoring marks.

Question 7

(a) Hardly any could offer a sensible attempt at a reason for the coiled coil. A good proportion worked out that if the glass was still cool, then the heat must have reached the hand by radiation. A lot wrote convection, though.

(b) It was expected that this part would provide a relatively easy few marks for most candidates, but this did not seem to be the case. Lots did not know what the two figures on the lamp meant and far too many could not calculate the current, and were often even not able to score the mark for the correct unit.

[0.417 A]

Question 8

(a) Apart from the correct answer, 24 cm and 18 cm were very popular answers.

(b) Every imaginable thing would be happening to the image, if these candidates are to be believed! Only a small minority knew that it would get smaller and get closer to the lens. It would be good if candidates could be warned about the vagueness of answers such as "it gets closer" – to what does it get closer? and "it is small" – this does not describe a change.

(c) Not many knew the correct name for the focal points/principal foci, but it was pleasing to see how many were able to correctly draw the required ray on the diagram. However, once again, some candidates lost marks because of sloppy drawing. Some even failed to use a ruler, and offered a free-hand ray. This was penalised.

Question 9

(a) Most knew that a push-button switch would be likely to result in an electric shock, but virtually none attempted to explain this in terms of water conducting electricity. Very few could give a convincing reason why a pull-cord switch would be safe to use in a washroom, with many being convinced that the cord would stop water getting into the switch. Answers often seemed more to do with protecting the circuitry than protecting the user.

(b) The choice of fuse seemed to be almost random.

(c) The whole idea of the connecting cable being of a thickness to suit the current taken by the equipment was rarely understood. Most seemed to think that a thicker cable would **cause** more current to flow to the cooker and that a thin cable would result in the cooker not heating up properly.

Question 10

(a) This question was a slight variation on the usual transformer question, and many coped very well with it. There were various acceptable approaches, and all were given appropriate credit. Answers were rarely well set out or well explained, which meant that it was often difficult to give credit to answers which failed to give the correct answer.

(b) Not all realised that the voltage between W and Z would be the same as across the primary coil (because the number of turns was the same). The question required the candidate to **state** the voltage, but candidates who showed a calculation leading to the correct answer were awarded the mark.

(c) Surprisingly, there were a lot of candidates who were not familiar with the term **core**, although generally it was known that it was made of iron.

(d) The fact that copper is a good conductor was well known, although some tried to invent magnetic properties of copper as an explanation.

[Y and Z, 240 V]

Question 11

Questions like this have often been asked on this paper in the past, so it was disappointing that there were so few who scored full or nearly full marks.

(a) Most mentioned refraction or something equivalent to that; not so many could find an adequate way to deal with dispersion. “Gets split into two rays,” “Becomes coloured,” “Becomes red and blue” were typical of unacceptable attempts. Quite a few got dispersion muddled with diffusion or diffraction.

(b) Red and violet were well known, although often reversed. Blue and mauve and purple were not acceptable alternatives to violet.

(c) This part of the syllabus was not well understood, with X appearing in all sorts of positions, many not even on the screen. Similarly, only a few knew that IR/heat/thermal energy would cause the larger reading on the thermometer.

Question 12

(a) Candidates who stopped to think often scored both marks. Some simply rewrote the question using different words, thereby scoring no marks. The question is about the radiations escaping from the watch, so candidates who simply rehearsed the penetration properties of the different types of radiation were unlikely to be rewarded. Many realised the health hazards of wearing this watch, although considerable language interpretation was often required on the part of the marker.

(b) All options were chosen by different candidates, with the correct one being the most common. Most candidates had some idea of safety precautions, but a lot were more to do with safe handling (and were often impractical) than to do with safe storage of the radioactive material.

PHYSICS

Paper 0625/22

Core Theory 22

General comments

To be successful on this component, candidates need to be competent across the whole range of Core topics. On this occasion, such competence was lacking for most candidates. It is not considered that questions as a whole were significantly different in standard from previous years. What was noticeable however was that large numbers of candidates simply did not show knowledge of even some of the basic facts of Core material. It is appreciated that this paper is intended for candidates of lower ability, but when large numbers cannot name the device used to find the mass of a ball, or say that you measure it with a ruler or a measuring cylinder, when equally large numbers cannot identify angles of incidence and reflection, and when similar ignorance is demonstrated across the paper, then teachers really must take notice of how their candidates prepare for the examination.

That said, however, there were a few candidates who performed exceptionally well in all questions, showing that, with adequate preparation, good marks could be obtained.

Most candidates felt able to make some attempt at all parts of all questions, and most candidates left few, if any, sections unanswered. The sad thing was that so many attempts were incorrect, often even bearing little relationship to the question. There was no evidence that candidates ran out of time before they had completed the paper.

In this particular paper, there was relatively little extended numerical work. Any problems with numerical questions seemed to be related to poor understanding of the underlying Physics, rather than lack of facility with numbers. Ability with units is only tested, on this paper, where no unit is printed on the answer line. There was some evidence that use of correct units was poorer on this paper than previously.

It is worth recording that, as on occasions in the past, there was lack of care over the presentation of answers, on the part of at least some candidates. Candidates are not penalised for poor writing or for poor language skills, but marks cannot be awarded if an answer simply cannot be read unambiguously.

Comments on specific questions

Question 1

(a) Very few could use the diagram to find the diameter of one ball. Some tried to read off the diameter of a single ball from the scale, and got an answer that was nearly correct. Very few showed their working and there were many answers where it was impossible to see how the answer had been obtained.

(b) Few candidates knew what instrument is used to measure mass. Many claimed they would use a ruler or a measuring cylinder and water. Some said “mass measurer” or “weight measurer”. “Scales” was accepted as a correct answer, but not “scale”.

(c) It was pleasing to see how many, including some who had got the previous parts wrong, could do this calculation. Some used the formula upside-down, some gave incorrect units, but generally this was well done.

[2.4 cm, 8 g/cm^3]

Question 2

(a) A good proportion realised that a force would not be necessary.

(b) Many realised that the firing of the rocket motors would "make it go faster" (very few referred to acceleration), but most failed to score the second mark for indicating the direction of the acceleration.

(c) Answers to this part were usually vague and meaningless.

Question 3

Candidates generally made intelligent attempts at this question. In part **(b)** candidates were sometimes confused about which way the conversion was going e.g. answering loudspeaker in **(iii)**. A few lost marks they would otherwise have gained, by giving two or more options, one of which was wrong.

Question 4

(a) Most obtained the correct answer and gave a valid reason. A few did not read the question carefully and gave answers that were clearly related to the **most** likely to sink.

(b) Many candidates answered this incorrectly, and very few referred to the factor of 4 in **(ii)2**. It would appear that P=F/A is the limit of many candidates' understanding of pressure.

Question 5

(a) Rather a mixed bunch of responses to this part, but many answered the first three parts correctly. Many did not think about the logic of their answers – for instance, it was not uncommon to find that the contacts opened but the current rose (or even just "decreased").

(b) Not all could take the appropriate value from the graph, but a good number scored their only mark for this part of the question. Having obtained a value for the time, a small proportion then knew to use energy = power x time. Unfortunately, all but a handful failed to turn the minutes into seconds. More worrying was the fact that a large proportion of candidates tried to use energy = power/time.
[3.48 x 10^6 J]

Question 6

This whole question was very badly answered by virtually all candidates. The majority simply did not know about waves. A lot knew that the particles in the sound wave move along the direction of the wave travel, but virtually none indicated the forward **and** backward movement. A similar deficiency applied to the water wave. Hardly any gave a correct value for the wavelength of either of the two waves, most having measured the total length from left to right of the diagrams. There was a great deal of ambiguity between length of the waves and wavelength and height of the waves, which meant that very few scored the marks for the two parts **(iii)**. It is known that the waves section of the syllabus does cause many candidates some difficulty, but it is part of the syllabus and teachers would do well to allocate adequate time for their candidates to come to grips with it.

Question 7

(a) The reasons given for the lack of a deviation at A were frequently very poorly expressed, but many had recognised that this happened because the ray was perpendicular to the surface. A good proportion showed the ray being reflected at the second surface and then continuing straight on through the third surface. However, drawings were often poorly drawn, and consequently penalised.

(b) (i) and (ii) Few candidates could correctly mark *i* and *r* on the diagram. Virtually all possible angles at A were chosen, together with quite a few at B plus some things that were not even angles. Candidates really should be able to do this. Vast numbers did not know the equation linking *i* and *r*, with quite a proportion quoting the refractive index equation (or their version of it). A general point which comes out of this is that if a question asks for an **equation**, then an equals sign must appear in the answer.

(iii) This is a difficult diagram to draw under exam pressures, and some generosity was applied in the marking. If the candidate had the correct general idea about reflection at the back surface of the prisms, credit was given. Many had no idea at all, even insisting on using mirrors again in some cases.

Question 8

(a) and (b) Most candidates scored at least 2 out of the 3 marks available for these two parts. What caused the loss of the third mark was usually not realising that all 3 boxes could be ticked in **(b)**.

(c) A good number had some idea about why it would not be wise to close the switch, albeit often badly expressed.

(d) Very few spotted that R would have to be 10Ω in order for the p.d. across it to be 6V. Most attempted some sort of V=IR calculation. However, an incorrect value was not penalised again in the calculation if no further mistakes were made. A lot of candidates could not transpose V=IR to find the current.

[10Ω,0.6A]

Question 9

There was some uncertainty about what to write and where, particularly the second line, but many candidates scored at least 2 out of 3.

Question 10

(a) Not many could provide a convincing statement about an electromagnet. Many thought it created electricity – presumably confusing electromagnetism and electromagnetic induction. Some could identify a useful property of an electromagnet. Others gave a *use* for an electromagnet, which was not what was required.

(b) Many candidates had little or no understanding of electromagnetic induction. Admittedly, this is a difficult topic conceptually, but they should be able to do better than ideas such as “electricity flows though the bar and jumps across to the flat coil.” This is another topic that needs plenty of teaching time and persistence.

(c) Some candidates made a good attempt at this, but a minority treated it as a version of thermostat.

(d) Very few realised the significance of permanent/temporary magnetism. Many more thought the answer was something to do with conductivity of either electricity or heat or the strength of the material. A few even tried to invoke rusting,

Question 11

(a) A good number knew what thermionic emission is, even if some were uncertain about what was emitted. Some thought it is heat released when particles bombard.

(b) The nature of cathode rays was known by many. Probably the most common incorrect answer was alpha particles. Hardly any were able to show the path of the cathode rays correctly on the diagram. Some seemed to have the right idea, but drew lines so carelessly that they were not worth any marks. It is important to note that the path is curved from the instant the cathode rays enter the electric field, and straight from the instant they leave the field.

Question 12

(a) and (b) A large proportion chose the correct definition of half-life, but very few realised that it was the half-life that was the same for the two samples.

(c) Very few candidates scored well on this question. As with all numerical answers, candidates are well-advised to stop and think, “Is that a sensible answer?” Perhaps then, those who thought that 1000 or 2000 half-lives elapsed during the journey would stop and re-consider.

[4 hrs, 1, 13 hrs]

PHYSICS

Paper 0625/31
Extended Theory 31

General comments

The syllabus for this paper is wide and questions on the same topics vary greatly from session to session. For that reason candidates, to do justice to their ability, must have a thorough grasp of a large body of material. Practice using past papers is valuable but such work alone could not possibly have prepared candidates for the range of questions they had to face. The general quality of the answers seen on these scripts suggests that a great deal of concentrated study must have been carried out and candidates had responded well to sound and comprehensive teaching.

It is always the intention to set questions that sufficiently challenge those with the highest level of ability, and at the same time do not cause those with lower ability to become demoralised and decide that their study time was wasted. The trend of the marks obtained suggests that this objective largely succeeded in this paper. Some marks above 70 were achieved, but not so many as to suggest that the paper was too easy. At the lower end of the range, comparatively few candidates gained fewer than 30 marks, evidence that the more straightforward questions were accessible. However, it is pleasing to note that many of these candidates gained some of their marks in the more demanding parts of questions.

Very few candidates were unable to complete the paper. Questions to which there was no response were rare. In general the work of candidates shows an improving knowledge of units.

Candidates should be encouraged to write down any formula being used for a calculation. This could ensure a mark even if subsequent substitution of data is incorrect.

Comments on specific questions

The numerical answers given are the most common correct answers given by candidates.

Question 1

(a) Incorrect answers were a rare exception.

(b) A few candidates lost a mark for inaccuracy in reading a value from the graph.
[312 m]

(c) Some marks were lost for the same reason as in **(b)**. Unit errors occurred infrequently.
[1.5 m/s^2]

(d) Various wording was used to convey the idea of equal gradients, but most were successful.

Question 2

(a) Very few lost the mark for quoting the K.E. formula. An infrequent subsequent error was the failure to square the speed in the calculation.
[405 000 J]

(b) The wording of the question persuaded many that time had to be involved in the calculation, so few used the given force multiplied by the 30 m travelled in 1 second. Correct answers were rare.
[60 000 J]

(c) A mark was awarded for the previous answer with the unit changed to watts, but the need to use the equation P = W/t was not realised as frequently as expected. Surprisingly, a few candidates arrived at the correct numerical answer even with the wrong numerical answer to **(b)**.

[60 000 W]

(d) Chemical energy was the only acceptable answer, and stated by nearly all.

(e) Candidates had to realise that friction and air resistance were included in the 2000 N resistive force acting on the car, so those who quoted work done against resistive forces were unsuccessful. Heat or sound energy, energy used to operate devices within the car, and inefficiency were all acceptable ideas.

Question 3

(a) This question required some quite subtle reasoning, and needed a good grasp of the idea of inverse proportion. A commendable number however, not exclusively the highest scoring candidates, were able to write 'force' in the first gap and 'inversely proportional to mass' in the second.

(b) Failures to write down F = ma or another form of the formula were rare.

(c) Very few candidates were successful in more than one part of this question. The core syllabus requirement to describe the ways in which a force may change the motion of a body is effectively a requirement to apply Newton's 1^{st} law. This law can be stated in the form, 'If there is no resultant force, a body will continue in a state of rest or of uniform motion in a straight line'. The words in this which candidates failed to address were 'in a straight line'.

Thus in **(i)**, the common response 'keeps the same speed' was unacceptable. In **(ii)** references to stopping or reversing the direction of motion were not rewarded. In **(iii)** answers which in one way or another implied change of direction were the only ones worthy of a mark.

Question 4

(a) It was uncommon not to see the correct choice of matt black.

(b) Those candidates who could mark the correct directions of the change of levels in **(i)** usually went on to gain some credit in **(ii)**. In **(ii)** most could state that the matt black bulb absorbed more heat or that its temperature increased more. However a minority went on to suggest that the liquid was heated or evaporated, rather than that the air expanded or that its pressure increased, as was required.

Question 5

(a) The fact that latent heat causes change of state was generally known, but a minority of candidates failed to add that the change takes place at a constant temperature. Only a few showed confusion between latent heat and specific heat capacity.

(b) Most, including those who failed to mention temperature in **(a)**, could state a relevant time or range of times.

(c) Answers in terms of increased potential energy of the molecules would have been acceptable, but the majority referred to the use of energy to break bonds between molecules or imply the same with alternative wording, and gained the full complement of marks. A compensation mark was available for a reference to evaporation, again with possible alternative wording.

(d) (i) A number of candidates wrongly involved the 43 °C temperature rise in the calculation of the energy supplied. Others gained only mark for quoting power x time but then writing down the product of two numbers, one or both of which had the wrong units. Candidates should be reminded that, except in rare cases, numbers substituted in formulae need to be in the basic units, in this case watts and seconds.

[480 000 J]

(ii) A good number of candidates**,** many with the use of a wrong answer from **(i)** carried forward, obtained full credit for the numerical answer. The advantage of learning $Q = mc\theta$ (or $mc\Delta\theta$) rather than $Q = mct$ or mcT (any of which gained a mark) was demonstrated here. A significant number substituted a time for t or T, and would probably not have done so if θ had been used. Some had problems rearranging the formula.

[6.34 kg]

Question 6

(a) The starting point for the three answers has to be recall of the fact that the frequency of waves, once emitted by a source, does not change. The figure should then have reminded candidates that waves travelling from deep to shallow water undergo a reduction in wavelength. The reduction in speed could be arrived at by recall, or by reasoning from the formula relating speed to frequency and wavelength. The randomness of many answers suggested both faulty recall or poor reasoning, or both.

(b) Few candidates failed to state the formula and a large majority arrived at the correct frequency. Units such as cycles per second or waves per second, rather than Hz, were accepted, but candidates had been well trained and these were rarely seen.

[1.5 Hz]

(c) Those who could successfully recall what they had learnt were largely successful in completing the diagram. For others it was generally a case of a compensation mark for the correct direction of the refracted waves, interpreted generously.

Question 7

(a) All candidates are well aware that light travels faster than sound. Some went as far as to quote values for the different speeds.

(b) (i) Most candidates could select the 4 minute value.

(ii) It was apparent that some candidates had the right idea but found it difficult to express their idea with sufficiently clear wording. The phrases ‘the time difference is never zero’ or ‘there is always a time difference’ or their close equivalent were required.

(iii) Almost all the candidates wrote down the required formula. Some of these did not realise that the time value needed was 3.6 s.

[333 m/s]

(iv) Many candidates wrote assumptions regarded as irrelevant, often about the choice of numbers they had used in their calculation.

(c) There were many completely successful completions of the table. Some candidates only filled in three ticks, perhaps wrongly assuming that they could in this way gain the 3 marks available. There is possibly a need to warn future candidates never to make this kind of assumption.

Question 8

(a) (i) The formula relating voltage ratio to turns ratio is well known and few failed to gain the marks.
[12 turns]

(ii) The understanding of the working of a transformer varies widely. Most candidates referred to the presence of a magnetic field. Fewer stated that it changes or alternates or that it is cut by the coils of the secondary. A good proportion of these candidates could state that this changing field or cutting induces a voltage or current in the secondary coil. Common misconceptions were that the induction is due to current passing through the iron core and that voltage is induced in the primary.

Candidates tend to use the words 'induces' or 'induction' rather loosely, often describing the magnetic field as being induced by the current. The specialist use of the terms needs to be emphasised.

(iii) Many candidates could identify a source of energy loss.

(b) (i) The answer required a voltage and also the type of voltage, which many omitted.
[12 V d.c.]

(ii) The need for a diode or rectifier had to be recognised.

(c) The formula equating values of powers in the coils is not as well known as the ratio formula in **(a)(i)**. Many candidates worked with $I_1/I_2 = V_1/V_2$ or $I_1/I_2 = N_1/N_2$. Answers of 5000 A were frequent. It was not apparent that this unrealistic answer led to any attempt to re-think the basis of the calculation.

Question 9

(a) Fleming's left-hand rule or an equivalent aid to memory is clearly well known.

(b) (i) Most could name the parts of the motor. 'Split-ring' was an accepted label for the split-ring commutator, but those who gave 'slip-ring' lost a mark.

(ii) Only the answer 'clockwise rotation' or an alternative implying the same motion could be rewarded.

(iii) Candidates had little difficulty in stating two factors that would increase the speed of rotation.

Question 10

This question was about atoms rather than nuclei, so that answers referring to electrons as well as protons, neutrons, nucleons, atomic number and mass number were acceptable.

Answers to **(a)** and **(b)** suggested that most candidates have good recall of the similarity and difference in the numbers of particles in atoms of two isotopes.

In **(c)** the recall of the changes in an atom as the result of the emission of a β-particle was not as sound, and fewer marks were gained. Some of those who gained both marks first wrote down an equation representing such a decay.

Question 11

(a) (i) Accurate recall and use of $R = V/I$ was the general rule. In this case an answer with one significant figure was accepted.
[4.0 Ω]

(ii) The majority selected an appropriate electrical energy formula, but a common error was the failure to convert 9 minutes to seconds.
[437 J]

(b) This was a particularly demanding question. Few candidates got further than calculating the resistance of the new piece of wire. Further marks for the recall of the relationships between resistance and length and cross-section of the wire, and the use of these relationships were seldom awarded.

[0.375 or 3/8 or 37.5 %]

PHYSICS

Paper 0625/32
Extended Theory 32

General comments

A high proportion of candidates gave clear evidence of having been well taught and also preparing themselves carefully for this paper. Especially pleasing was the way even middle range candidates approached non-numerical questions and applied good Physics, including the correct use of appropriate terms and logical thought, to give well-worded answers. Many candidates set out their working to numerical questions well, although some still give little or no working so could not be given credit for possibly correct intermediate progress when producing incorrect final solutions. On harder questions, however, setting out of working was sometimes very confused, even breaking the rules of algebra. Examiners do their best in these situations to reward candidates for progress they have made, but can only do so when it is clear that this has been achieved. Generally candidates used the correct units.

The good performance of the majority of candidates indicated that they were able to demonstrate their knowledge and skills and were correctly entered for this Extended Theory paper. However, as in the past, a significant minority of candidates found the subject matter and level of questions so difficult that they could not do justice to their abilities and would have been better entered for the Core paper.

Comments on specific questions

Question 1

(a) The majority of candidates knew the formula for gravitational potential energy and were able to calculate the required answer. A few candidates used g as 9.8 m/s^2, rather than the value 10 m/s^2 given on the front of the paper, and they were rewarded with full marks where correct.

(b) Most candidates produced the answer 14.7 J but did not subtract the answer from **(a)** to obtain the actual energy given to the ball by the player. Indeed, of those candidates who recognised that the answer to **(a)** should be used, the majority added it rather than subtracting it. It was encouraging to see so many candidates who knew the formula for kinetic energy and who were able to apply it correctly.

(c) There were more correct answers in **(iii)** than in **(i)** since most candidates were able to suggest that energy was lost to heat during the bounce. Weaker candidates could not explain or even recognise the energy transformation involved. Part **(i)** required candidates to explain the mechanism of energy loss during the bounce. The formation of sound, or the fact that friction acts between the ball and the ground, were the most common acceptable answers, with few mentioning the deformation of the ball. Many candidates merely restated that energy was lost or had turned into other forms. The calculation in part **(ii)** can be approached in a number of different ways and was correctly answered by most candidates. Credit was given for any approach that involved the use of 78%, either directly multiplied by the initial height of the ball or involving energy. However, a surprising proportion of candidates used 88%.

Question 2

(a) The majority of candidates recognised that spring B was loaded beyond the limit of proportionality but only the better ones could explain this convincingly, either by recognising that the increase in length differs for different loads or correctly stating the relation between extension and load.

(b), (c) The values in **(b)(i)** and **(ii)** were usually correct but many candidates merely halved the spring length in **(c)** to obtain the incorrect answer 5.35 cm.

Question 3

(a), (b) It was encouraging to see that most of the able candidates could recognise and apply the equations for density and work. Some candidates tried to calculate work as force x distance but used mass rather than weight in their calculation. A mark was lost by many here for the incorrect unit.

(c) Whilst most candidates knew that power was work or energy divided by time, some did not use the correct work obtained from **(b)** or did not use the time in seconds. Again many lost a mark here for the incorrect unit.

(d) The correct expression was often evident for pressure, but many weaker candidates tried unsuccessfully to use an F/A approach.

Question 4

This was undoubtedly the least well answered question overall and even some quite strong candidates struggled with it. There were many correct answers to each part question, but few were able to score all or even nearly all the marks. The essence of the difficulty seemed to be that very few candidates were really secure in their understanding of the terms sensitivity, range and linearity.

(a) Many candidates could not express a definition for the sensitivity of a thermometer but often, instead, merely explained what is meant by a sensitive thermometer. The increase in length along the scale for a rise in temperature of 1°C would have been an ideal statement. Candidates were better able to explain how to achieve a sensitive thermometer in **(ii)** by enlarging the bulb or decreasing the width of the bore. Many who were on the right lines failed to score this mark because they referred to the diameter of the thermometer rather than that of the bore. A proportion of candidates confused sensitivity with speed of action and suggested that a sensitive thermometer is constructed with a thin glass bulb.

(b) Similarly, candidates were often unable to explain that the range of a thermometer was the difference between the highest and lowest temperatures. Often statements such as "the highest and lowest temperature" or "from the lower to the upper fixed point" were given. The design features accepted to achieve a desired range in **(ii)** included a wide enough bore or a longer thermometer, but candidates often confused this with sensitivity.

(c) The initial definition of linearity was poorly answered. Candidates' statements often failed to recognise that the distance along the thermometer must increase by the same amount for any given temperature change, for example 1°C. Achieving linearity by having a uniform bore was rarely given as an answer in **(ii)**.

Question 5

(a) Many candidates showed that they knew that forces of weight and air resistance acted upon the paper and coin and could sometimes explain that these two forces were equal for the paper. However, not many candidates (including some quite strong candidates) were able to link this to there being no acceleration; they simply repeated constant speed from the stem of the question. Weaker candidates displayed the usual confusion between mass and weight.

(b) Candidates sometimes failed to earn the mark by not explaining in enough detail and giving statements such as "they fall with constant speed", which is untrue. If they had explained that they fall at the same speed as one another this would have been accepted along with many other correct statements, such as the paper now accelerates.

Question 6

(a) The majority of candidates suggested that monochromatic means "one colour", and this was accepted on this occasion. A better definition is "one frequency", as, for example, the colour red spans a range of frequencies and wavelengths. The syllabus states that candidates should be able to use the term monochromatic so teachers are advised that "one colour" may not be accepted in future. Weaker candidates suggested that monochromatic light has the same colour or made statements about black and white.

(b), (c) Answers were generally correct.

(d) The formula for refractive index was well known. Some candidates appeared to obtain the value 1.4585246 on their calculator and wrote down 1.45. Candidates should be encouraged to round their answers correctly to the number of significant figures that they choose.

(e) Many candidates suggested that the angle of incidence was larger than the critical angle but did not mention why refraction occurs at C, rather than total internal reflection.

(f) The diagrams in this part were encouraging. When a candidate recognised that there was no deviation at B they often obtained full marks for bending the ray correctly at the second surface and leaving it parallel to the incident ray. Weaker candidates bent the ray in the wrong direction at the second face.

Question 7

(a) Values for the order of magnitude of the speed of sound in air were generally known although a significant number of candidates gave the speed of light. It was disappointing to find a number of candidates who knew the formula for speed, distance and time in part **(ii)** but were unable to transpose the equation to obtain the correct time.

(b) The majority of candidates suggested that there was an echo rather than that sound travels at different speeds in the air and the steel. Good candidates were able to suggest that the sound arrives first along the rail or that the speed of sound in steel is larger than in air.

Question 8

(a) The law of attraction was generally well known.

(b) Many candidates were not able to explain the situation convincingly. They often stated that the "shock" was repulsion between like charges on the hand and the handle rather than the flow of charge through the person. Full marks were given whether the candidates gave an explanation in terms of the person becoming charged or the car.

(c) Candidates did not always appear to understand the parts of this question adequately or failed to think through the logic and Physics of their answers.

(i) The question asks for a description of what happens to the charge on the ball. Instead of describing the movement of electrons, or negative charges, many answered merely that "unlike charges attract".

(ii) Most candidates scored the first mark for explaining how negative charges on the ball are attracted to the rod. Very few scored the second mark usually by explaining that this force was larger than the force of repulsion between the rod and the positive charge on the ball. A significant minority thought that there was transfer of charge between the rod and ball.

(iii) It was encouraging to see here a basic understanding of induction, with many candidates recognising that the ball becomes negative. Unfortunately some candidates suggested that the ball became neutral. Comparatively few candidates explained that negative charges, or better still electrons, flow from the earth to the rod in the process described.

Question 9

(a) The diode was known, in general, as the component although, strangely, it was sometimes confused with a logic gate or transistor, which, of course, made it very difficult for marks to be scored in part **(c)**.

(b) It was apparent that many candidates could not recognise that only the 2 ohm resistor was connected in **(i)** and that the 8 ohm resistor was in parallel with a 24 ohm resistor in **(ii)**. It was however encouraging to see many sensible attempts in **(ii)** which earned credit for using the formula for the combination of resistors in parallel.

(c) It was generally recognised that there was zero current but the explanation was sometimes only the property of a diode to pass current in only one direction, rather than explaining why it does not pass current in this situation.

(d) The calculations in this part were generally good attempts at using P=VI and V=IR or $P=V^2/R$ and led to a convincing calculation either that the power is 2 W when 8 ohm is used or that the resistance is 8 ohm when there is a power of 2 W. All such methods were accepted. However, the poor setting out of the working of a minority of candidates, which must have hindered them in their attempt to produce a correct answer, also made it impossible for Examiners to reward partially correct work as they were unable to determine if the candidate had made valid points.

Question 10

This produced a great variety of responses and it was evident that some candidates were not very familiar with the cathode-ray oscilloscope.

(a) There was an encouraging number of very good traces drawn, but obtaining exactly the correct trace when the frequency was increased to 1.5 times the previous value was difficult for some candidates, particularly if they did not take care in drawing the trace exactly. The amplitude, however, was often drawn correctly by weaker candidates.

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Question 11

Almost all candidates earned at least one mark in **(a)** for recognising that the gamma radiation is undeflected. A large percentage of candidates wrongly suggested that the alpha particles were deflected to the right, with a larger deflection than the deflection of the beta particles. It was disappointing that so few candidates realised or could apply correct understanding of the relative direction of magnetic field, force and movement of charged particles. Too often statements that the magnetic field is “from N to S” or “left to right” were unhelpful or failed to apply any knowledge to the actual situation. Ambiguous answers such as “top to bottom” were also frequently seen but failed to score.

PHYSICS

Paper 0625/33
Extended Theory 33

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A high proportion of candidates gave clear evidence of having been well taught and also preparing themselves carefully for this paper. Especially pleasing was the way even middle range candidates approached non-numerical questions and applied good Physics, including the correct use of appropriate terms and logical thought, to give well-worded answers. Many candidates set out their working to numerical questions well, although some still give little or no working so could not be given credit for possibly correct intermediate progress when producing incorrect final solutions. On harder questions, however, setting out of working was sometimes very confused, even breaking the rules of algebra. Examiners do their best in these situations to reward candidates for progress they have made, but can only do so when it is clear that this has been achieved. Generally candidates used the correct units.

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PHYSICS

Paper 0625/04
Coursework

General comments

It is once again pleasing to see that points made from previous reports were noted. Although the following points are still relevant to some of the Centres and potential new Centres:

- It is advisable that a maximum of two skill areas should be assessed on each practical exercise.
- It should be noted that although Moderators do not expect to see written evidence of Skill C1, they do expect to be provided with details of how candidates achieved the marks awarded.

The majority of samples illustrated clear annotated marks and comments, which was helpful during the moderation process. The candidates at the majority of Centres were given many opportunities to demonstrate their practical skills using a varied range of tasks from different areas of the specification; clearly a large amount of good work has been completed by teachers and candidates.

PHYSICS

Paper 0625/51

Practical 51

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include

- graph plotting,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources or error,
- control of variables,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

Candidates entering this paper scored the full range of marks. They were well prepared and it was pleasing to see that the range of practical skills being tested proved to be accessible to the majority of the candidature. The majority of candidates demonstrated good practical skills and understanding, and were able to use their practical expertise in carrying out the different tasks. All parts of every practical test were attempted and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record observations clearly and perform calculations accurately and correctly. Units were well known and were invariably included, writing was legible and ideas were expressed logically. However, many candidates seemed less able to derive conclusions backed up by evidence, or to present well thought out conclusions.

All questions provided opportunities for differentiation, but particularly good were **Questions 1** and **4**, where the conclusions, and the justifications in support of them, allowed the better candidates to demonstrate their ability. The gathering and recording of data presented few problems for any candidates. There was evidence of some candidates not having the use of a calculator.

The ability to quote an answer to a given number of significant figures, or to an appropriate number of decimal places, still causes difficulty for many candidates. There were also many examples of instances where a candidate had repeated a measurement and had overwritten their first answer. This often made it difficult for the Examiner to see what the reading was, and sometimes the Examiner was unable to award the mark. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity.

Comments on specific questions

Question 1

(a),(b) Most candidates measured the length of the spring correctly, but a significant minority measured in centimetres and then divided by 10 to express their answer in millimetres. The length of the spring was generally marked correctly on the diagram, but credit was often lost because the distance marked was too vague, and it was not clear from their diagram where they would begin and end their measurements. The calculation of the extension caused by the load was almost invariably correct.

(c) Candidates were asked to show their working when calculating the average value of the two extensions. Some ignored this instruction, gave a correct answer, but lost the method mark.

(d) Surprisingly few candidates were able to decide whether or not their results supported the theory, and most found it difficult to justify their decision by reference to their results. The majority of candidates compared their average extension with the two values used to obtain it, and demonstrated that they had not understood what they were expected to compare. Many ignored the instruction to make reference to their results in their conclusion, with only the most able candidates referring to the possibility of experimental error in their measurements.

(e) Few suggested a sensible precaution, and of those who did, 'avoid parallax error' was the most popular response. No credit was awarded for this unless they went on to explain <u>how</u> they would achieve this aim.

Question 2

(a) The table was almost invariably completed correctly, with only the occasional candidate starting the table with room temperature. Temperatures were always expressed to 1 degree Celsius or better.

(b) The temperature drop in **(i)** was evaluated correctly by the majority of candidates, but many derived the temperature change in **(ii)** by subtracting from the initial temperature. The units of temperature were frequently omitted from candidates' answers.

(c) Only a minority of candidates chose scales which made best possible use of the grid provided. The y-axis scale chosen was usually much too small, and this resulted in the graph being squeezed into a very small area of the total space available. Points were plotted correctly, but best-fit curves were rare, many candidates contenting themselves with a point-to-point line. The line quality was usually good – most candidates drawing neat, thin lines/curves.

Question 3

(a) This straightforward part was often overlooked by candidates, with many scripts containing no response. When attempted, the voltmeter symbol was generally well known, but its position, much less so.

(b) The table was almost invariably completed. *V* was rarely out of range, and scarcely ever expressed to less than 1 decimal place. The calculation of *V/I* was generally correct, with only the odd candidate calculating the reverse ratio. Where a mark was lost in this part, it was usually because the unit of *V/I* could not be deduced – ohms was a popular, incorrect choice here.

(c) Most candidates realised that the potential difference across the lamp was not directly proportional to the length of the resistance wire, and were able to justify this by reference to the results that they had obtained.

(d) It was surprising to find that only a minority of candidates were able to suggest a sensible precaution to obtain accurate results in such a standard electrical experiment. Where correct answers were seen they were almost invariably 'repeat readings' or 'switch off between readings'.

Question 4

The ray diagrams were, in the main, neat, complete and generally accurate, although a significant minority lost the first mark as their rays did not meet at G. When this occurred, candidates had often double penalised themselves, because they found it difficult to measure the angles in parts **(i)** and **(n)** accurately. Many candidates did not place their pins sufficiently far enough apart to ensure a sufficient degree of accuracy in the drawing of their ray diagram. The calculation of the angles in part **(n)** proved surprisingly difficult for a number of candidates and this had a knock on effect in part **(o)**. Only the better candidates were able to draw correct conclusions from their results, and even fewer were able to present a well-argued justification of their statement.

PHYSICS

Paper 0625/52

Practical 52

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include

- graph plotting,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources or error,
- control of variables,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

The general level of competence shown by the candidates was sound. Very few candidates failed to attempt all sections of each of the questions and there was no evidence of candidates suffering from lack of time. However some candidates seem to have had little practical experience through their course to draw on when attempting the questions. This was particularly noticeable in **Questions 1** and **4**.

Many candidates, who appeared to have had a good level of practical experience, dealt well with the range of practical skills tested. Some candidates appeared to have attempted to learn responses from past papers. This was particularly noticeable in **Question 2** where candidates did not understand the difference between taking precautions to improve accuracy and the control of variables.

Comments on specific questions

Question 1

(a) Most candidates displayed their measurements and the calculation well, but some reduced the 1/*d* values to 1 significant figure and lost a mark. Very few gave *d* values above 50 cm but some measured *d* from the end of the rule rather than from the 50 cm mark.

(b) The graph was usually set up with sensible, labelled axes and the plotting correct. However many drew a line that was either not the best fit-line or too thick (or both).

(c) A large number of candidates failed to follow the instruction to 'show clearly on the graph' how they obtained the information necessary to calculate the gradient, although the calculation often showed that they knew what to do. Many candidates used a triangle that included less than half of their line showing that they were unaware of the greater accuracy that can be obtained by using a large triangle.

(d) Candidates who had followed the experimental procedure with care obtained a mass value within the tolerance allowed. Some lost a mark for missing the unit or for not expressing their answer to 2 or 3 significant figures.

Question 2

(a) A pleasing proportion of candidates scored full marks (or close to full marks) for the readings in the table. This showed good attention to detail. Some missed the units. Some gave the first temperature in the two temperature columns as room temperature instead of the temperature of the hot water.

(b) Most candidates correctly calculated the temperature changes.

(c) Most candidates knew which container had the greater rate of cooling but too many tried to justify their answer by a theoretical approach instead of by reference to the readings as requested in the question.

(d) Some candidates correctly suggested two variables to be controlled. Some, however, seemed to have learned answers from previous questions of this type and made suggestions that are not relevant in this case (e.g. using the same container). Others wrote about precautions to improve accuracy rather than control of variables. Some even had one of each.

Question 3

(a) – (e) Most candidates recorded the necessary readings sensibly but some missed the units. Others gave currents that were clearly a factor of 10 or 100 too large.

(f) It was pleasing to see the majority of candidates drawing a correct circuit diagram. Very few displayed a lack of practical awareness by drawing two voltmeters or a circuit that would not work. Some drew a series circuit and their readings usually showed their mistake also.

(g) The most confident candidates were able to state clearly from their results that the suggestion was not supported and justify their statement sensibly by adding the results from the first two circuits and showing that the third result was very different. As in **Question 2** a theoretical explanation was not required and if given attracted no marks.

Question 4

(a) – (g) This question required candidates to work with care and to be familiar with finding images in this type of experiment. Candidates with little or no experience were clearly at a disadvantage. Most ray traces were drawn neatly and if the candidate drew the normal and at least one of the two sets of lines correctly full marks could be scored for the trace (the Examiners were aware that finding the image for the 30˚ angle was challenging). Some drew emergent rays in completely the wrong area and so lost a mark. However they could still score the marks for placing the pins at least 5.0 cm apart. Unfortunately few candidates did this on either the incident or emergent rays, apparently not realising that this is part of the technique for obtaining accurate results.

(g) – (j) The angles were often measured correctly and the arithmetic was usually correct.

(k) The marks here were awarded based on the candidates own readings. It was disappointing to see the number of candidates who did not realise that values of ($\theta - 2i$) of 1, 2 or 3 degrees were well within the limits of experimental accuracy. A very small number of candidates failed to attach their ray-trace sheets.

PHYSICS

Paper 0625/61
Alternative to Practical 61

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include

- graph plotting,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources of error,
- control of variables,
- accurate measurements,
- choice of most suitable apparatus.

It is assumed that, as far as is possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics. This examination should not be seen as suggesting that the course can be fully and effectively taught without practical work.

Clearly, some of the skills involved in practical work can be practised without doing experiments – graph plotting, tabulation of readings, etc. However, there are parts of this examination in which the candidates are effectively being asked to answer from their own practical experience. The answers given by some candidates in this examination point to a lack of practical physics experience. Some candidates had a good overall understanding of what was required, backed by personal practical experience, and therefore scored high marks. Others, obtaining lower marks, appeared to have limited experience. The examination appeared to be accessible to the candidates and there was no mark that proved unobtainable. Many candidates had prepared for the examination (very sensibly) by working through some past papers. This examination showed that where this was done with little understanding, candidates gave answers that would have been correct in a similar question from a previous session, but were not appropriate to this question paper.

Comments on specific questions

Question 1

(a) and (b) Accurate measurements and calculations were expected and mostly achieved.

(c) Many candidates carried out the calculations correctly but failed to realise that the two results were close enough to justify the theory within the limits of experimental accuracy. Others gave a very clear and correct justification. As always in this type of question the answer was judged in relation to the results that the candidate had obtained and phrases that clearly expressed a correct justification (such as ‘close enough’ or ‘too different’) were awarded the mark.

(d) One precaution was asked for here and it is important that candidates give only one in case in trying to list more they write a wrong suggestion and so lose the mark. There are a number of sensible precautions that candidates might suggest. Many candidates know that ‘parallax should be avoided’ but do not say how that is to be achieved and so do not score a mark. It is not the word parallax that is important here but how to obtain an accurate reading. Candidates who clearly express the idea of the line of sight being perpendicular to the scale will gain the mark. Whist the Examiners are conscious that many candidates are writing in a second language, vague or wrong use of words such as vertical, horizontal and parallel will not gain marks.

Question 2

(a) Most candidates calculated the temperature changes correctly.

(b) Most candidates labelled the axes correctly but many chose a scale that used less than half of the available space. Plotting was usually correct but the line, whilst suitably thin, was often not the best fit curve but rather was drawn to 'visit each point'. Candidates need to be taught the significance of best-fit lines.

(c) Most candidates scored the first mark by sensibly quoting the values of T_1 and T_2. However fewer realised that the second mark required them to comment on the decreasing gradient (or 'steepness') of the graph line.

Question 3

(a) A few candidates failed to draw anything on the circuit diagram but most gave the correct symbol. Some however placed the voltmeter in the wrong position.

(b) Most candidates calculated the values correctly although some lost a mark due to 'rounding' errors. Not all candidates gave the answers consistently to 2 or 3 significant figures as required for the second mark. The most confident candidates worked out the unit (V/m) but many wrongly assumed that it must be Ω.

(c) It was pleasing to see that the majority of candidates scored both marks here.

(d) Most candidates were able to suggest a sensible precaution here.

Question 4

(a) Accurate measurements were expected and generally achieved. Many candidates marked pin positions at least 5 cm apart and gained a mark. Candidates should know from their own practical experience that greater accuracy is achieved if the pins are placed as far apart as practically possible. Most such experiments carried out in school will use an A4 sheet of paper for the ray trace sheet. So a pin separation of at least 5 cm is reasonable. Some candidates seem to have remembered the '5 cm' but not the 'at least' and therefore try to place their pins exactly 5.0 cm apart. The risk here is that any distance less than 5.0 cm by even the smallest margin will not score the mark whereas any distance in excess of 5.0 cm will score.

(b) Many candidates did not exercise sufficient care in this section. A significant number drew the second mirror position wrongly. Too many used their protractors carelessly. However most performed the calculation correctly.

(c) The marks here were awarded based on the candidates own readings and result. It was disappointing to see the number of candidates who did not realise that values of $(2\theta - \alpha)$ of 1, 2 or 3 degrees were well within the limits of experimental accuracy.

Question 5

(a) Many candidates completed the column headings successfully. However a common error was to give the unit for *d* as cm instead of m.

(b) Most candidates knew that the reason for timing 10 swings is to improve accuracy.

(c) The calculations were usually done correctly and candidates realised that *Td* is not constant and expressed that concisely. However some lost the mark by wrongly commenting on the differences between the *Td* values not being constant.

PHYSICS

Paper 0625/62
Alternative to Practical 62

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include

- graph plotting,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources of error,
- control of variables,
- accurate measurements,
- choice of most suitable apparatus.

It is assumed that, as far as is possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics. This examination should not be seen as suggesting that the course can be fully and effectively taught without practical work.

Clearly, some of the skills involved in practical work can be practised without doing experiments – graph plotting, tabulation of readings, etc. However, there are parts of this examination in which the candidates are effectively being asked to answer from their own practical experience.

There were clear differences in responses from those candidates who seemed to have been exposed to a thorough background in practical work and those who had been given limited experience. This was most apparent in the recording and manipulation of data and in the interpretation of experimental results. A large disparity was found in the treatment of significant figures, units and graphical scales and in the knowledge of the limits of experimental accuracy.

The practice of recording answers first in pencil and then overwriting in pen is to be discouraged. However, where this might disadvantage candidates who find this approach effective, care should be taken to fully erase underlying pencil marks. Where this is not done it is occasionally difficult for the Examiner to be sure of the candidate's intent, particularly with numerical answers where pencil digits may well be assumed to be part of the candidate's answer.

Pencil should be used for plotting graphs, but when candidates use very fine points these are sometimes difficult to see on the scripts. Small fine crosses are much more easily discernable, as are small points in a circle.

It was encouraging to find that most candidates were able to finish the paper and that few left answers to questions blank.

Comments on specific questions

Question 1

(a) Most correctly calculated the 1/d values but rounding errors and inconsistent significant figures lost marks. In particular, there was a reluctance to express the 0.0500 value to more than one significant figure.

(b) Many graphs were drawn well with clear, accurate plots and fine, well-judged lines. The main error was in the choice of scale. Without a 'false zero', the plots generally took up less than half of the grid.

(c) Whilst there was some indication that the 'triangle method' had been used, the chosen points were often too close together – indicating poor experimental practice. Some good, clear responses were seen but a significant number of candidates ignored the instruction to show clearly on the graph how information had been obtained.

(d) Totally correct answers were not common, those within the range frequently being spoiled by excessive significant figures or an inappropriate unit.

Question 2

(a) This was generally well done, with the main loss of marks being the careless writing of the unit for ^{0}C.

(b) Correct temperature changes were almost invariably obtained.

(c) Most correctly identified container B as having the greater rate of cooling, but this was often justified by its greater fall in temperature alone without reference to 'in the same time'. Ignoring instructions to refer to the readings, many lost marks by explaining that B had a greater surface area.

(d) This was well answered but it was felt that responses were often standard answers, learned previously and did not apply particularly to this question. A good deal of leeway was given, but candidates needed to be more specific with this type of answer, using, for example, 'initial temperature of water' rather than merely 'temperature'. A number of answers incorrectly referred to the use of a lid or identical beakers, missing the stated purpose of the experiment which was to investigate cooling in <u>different</u> containers.

Question 3

(a) A correct parallel circuit was generally drawn, but marks were lost through careless representation of symbols or the unnecessary use of multiple voltmeters.

(b) Headings were frequently correct although a small number were left blank or gave the quantity rather than the unit (for example: I/current rather than I/A). The majority of candidates calculated resistance values correctly, but often employed inconsistent numbers of significant figures, 6.13, 6.0, 3.11 being common.

(c) Statements were generally correct and the most able candidates gave the simplest justifications, quoting figures from the table, as required, to show that the sum of *R* values in Circuits 1 and 2 were not equal to that in Circuit 3. Many lost this mark by using theoretical explanations when 'reference to results' was stressed.

Question 4

Most candidates carefully followed the sequence of instructions given in the question but with varying degrees of success.

(a) The normal was almost invariably identified and correctly labelled.

(b) An adequate distance between the pins P_1 and P_2, which would have indicated an understanding of good experimental practice, was achieved by less than half of the candidates.

(c) Many were able to score the maximum mark for this question but some were spoiled by lack of care, with thick lines leading to inaccuracy in the measurement of the angle.

(d) Most calculated the difference correctly.

(e) This section, relating to the interpretation of experimental results, was not well done. Many saw a difference of 2^0 as indicating that the theory was not supported rather than recognising it as being within the limits of experimental accuracy. This suggested inexperience in the analysis of results from practical work. A common error was to suggest that one result (0^0) supported the theory while the other (2^0) did not.

Question 5

(a) Well over half of the candidates scored full marks on this question but a surprising number seemed unable to measure lengths to the nearest millimetre.
Magnification was generally calculated correctly but use of an inappropriate unit here or lack of unit for the lengths was the most common reason for loss of marks.

(b) Most candidates were able to give at least one sensible precaution. ‘Avoidance of parallax’ was common but, without a description of how this might be achieved, could not be awarded the mark. Vague answers regarding alignment of apparatus were often not specific enough to be credited.

(c) This question required the application of problem solving skills and many explained sensible, practical ways of overcoming the difficulty. Marking the top and bottom of the image carefully and then measuring later was the most common correct answer. Measuring from the back of the screen was not acceptable as an improvement unless it was stated that a translucent screen should be employed.

PHYSICS

Paper 0625/63
Alternative to Practical 63

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include

- graph plotting,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources of error,
- control of variables,
- accurate measurements,
- choice of most suitable apparatus.

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Comments on specific questions

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(b) Many graphs were drawn well with clear, accurate plots and fine, well-judged lines. The main error was in the choice of scale. Without a 'false zero', the plots generally took up less than half of the grid.

(c) Whilst there was some indication that the 'triangle method' had been used, the chosen points were often too close together – indicating poor experimental practice. Some good, clear responses were seen but a significant number of candidates ignored the instruction to show clearly on the graph how information had been obtained.

(d) Totally correct answers were not common, those within the range frequently being spoiled by excessive significant figures or an inappropriate unit.

Question 2

(a) This was generally well done, with the main loss of marks being the careless writing of the unit for °C.

(b) Correct temperature changes were almost invariably obtained.

(c) Most correctly identified container B as having the greater rate of cooling, but this was often justified by its greater fall in temperature alone without reference to 'in the same time'. Ignoring instructions to refer to the readings, many lost marks by explaining that B had a greater surface area.

(d) This was well answered but it was felt that responses were often standard answers, learned previously and did not apply particularly to this question. A good deal of leeway was given, but candidates needed to be more specific with this type of answer, using, for example, 'initial temperature of water' rather than merely 'temperature'. A number of answers incorrectly referred to the use of a lid or identical beakers, missing the stated purpose of the experiment which was to investigate cooling in different containers.

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(e) This section, relating to the interpretation of experimental results, was not well done. Many saw a difference of 2° as indicating that the theory was not supported rather than recognising it as being within the limits of experimental accuracy. This suggested inexperience in the analysis of results from practical work. A common error was to suggest that one result (0°) supported the theory while the other (2°) did not.

Question 5

(a) Well over half of the candidates scored full marks on this question but a surprising number seemed unable to measure lengths to the nearest millimetre.

Magnification was generally calculated correctly but use of an inappropriate unit here or lack of unit for the lengths was the most common reason for loss of marks.

(b) Most candidates were able to give at least one sensible precaution. 'Avoidance of parallax' was common but, without a description of how this might be achieved, could not be awarded the mark. Vague answers regarding alignment of apparatus were often not specific enough to be credited.

(c) This question required the application of problem solving skills and many explained sensible, practical ways of overcoming the difficulty. Marking the top and bottom of the image carefully and then measuring later was the most common correct answer. Measuring from the back of the screen was not acceptable as an improvement unless it was stated that a translucent screen should be employed.