PHYSICS

Paper 0625/11
Multiple Choice (Core)

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

General comments

Some candidates found this paper challenging. Several questions were not well answered, in particular questions **2**, **18**, **23**, **29, 33** and **39**.

Comments on specific questions

Question 1

Weaker candidates often gave 29 mm as the answer, failing to subtract the 10 mm reading at the left hand end of the feather.

Question 2

In this question on average speed, a very large proportion of candidates chose option **A**. Students should be reminded always to check units in calculations.

Question 3

Confusion between the concepts of speed and acceleration led many to opt for option **D**.

Question 5

The topic here was weight and gravitational field strength, and weaker candidates did not appear confident and appeared to guess with all options proving attractive.

Question 7

A significant proportion of candidates of all abilities believed that pressure was an example of a force.

Question 10

All options were attractive to many of the candidates. Only the strongest candidates selected the correct answer.

Question 12

The most common error here was to believe that pressure depends on the mass of water in the container, leading to option **C**.

Question 14

Almost a third of candidates believed that a cold liquid near its freezing point does not evaporate.

Question 18

The concept of thermal capacity was not well understood, with option **D** being very popular.

Question 23

Many candidates could not identify the focal length of a converging lens, often choosing the object or image distance.

Question 29

Only one in four identified the volt as the correct unit for both meters. Students must be careful to read the answers in both of the columns before making their choice.

Question 33

This question involving an LDR was not well answered by even the stronger candidates with many believing that the LDR's resistance would decrease as the light level fell.

Question 34

A common mistake in this question on fuses was to think that a fuse would reduce the current to its rated value.

Question 39

This was another challenging question, with a high proportion of candidates of all abilities failing to identify the effect on a nucleus of α emission and β emission.

PHYSICS

Paper 0625/12
Multiple Choice (Core)

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

General comments

Overall many candidates found this a challenging paper. Several questions were not well answered, with particular problems being experienced with questions **5**, **16**, **17**, **32** and **33**. Question **2** was particularly well answered.

Comments on specific questions

Question 1

Weaker candidates often gave 29 mm as the answer, failing to subtract the 10 mm reading at the left hand end of the feather.

Question 3

Confusion between the concepts of speed and acceleration led many candidates to select option **D**.

Question 5

Few responses were correct here, with the popularity of option **D** suggesting that many had either failed to read the question carefully or believed that there must be an upward force on any object that is moving upwards.

Question 6

Many weaker candidates chose the object with the greatest volume and mass as having the greatest density and selected option **D**.

Question 7

Many weaker candidates appeared to associate zero resultant force with decreasing speed and therefore chose option **D**.

Question 10

Option **C** was very popular, probably because of an assumed link between boiling water and the 'hydro' part of 'hydroelectric'.

Question 13

This question involved a barometer and considerably more candidates thought that the space above the column of mercury would increase and so chose option **A**.

Question 16

Very many candidates were unclear about the process of melting and its lack of effect on temperature, with options **B** and **D** being common choices.

Question 17

In this question on thermometers, a large proportion candidates believed fixed points to be the highest and lowest recordable temperatures.

Question 32

Many candidates added the resistance values for the parallel arrangement shown, leading them to the incorrect choice of option **D**.

Question 33

This question involving an LDR was not well answered by even the stronger candidates with many believing that the LDR's resistance would decrease as the light level fell.

Question 34

A common mistake in this question on fuses was to think that a fuse would reduce the current to its rated value.

Question 38

The most common error here was to choose nuclides with the same nucleon number, rather than the same proton number.

Question 40

Weaker candidates often judged the likely continuation of the decay curve by eye and deduced that the activity would reduce to either 125 decays / s or to zero at 8 days.

PHYSICS

Paper 0625/13
Multiple Choice (Core)

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

General comments

Many candidates found this a very challenging paper. Many questions were not well answered, with particular problems being experienced with questions **4**, **6**, **7**, **8**, **10**, **17**, **18**, **19**, **27**, **34** and **38**.

Comments on specific questions

Question 1

Weaker candidates often gave 29 mm as the answer, failing to subtract the 10 mm reading at the left hand end of the feather.

Question 2

In this question most errors involved considering the options as speed-time graphs and therefore choosing option **A**.

Question 4

There was widespread confusion about the acceleration of a freely falling object, with many believing that acceleration, rather than speed, increases from zero as an object falls from rest.

Question 7

This question concerned the forces on an object falling at terminal velocity, and was not well answered. Options **B** and **D** were very popular, even with able candidates.

Question 8

Many candidates selected option **D** as the position of the centre of mass, not realising that it must be vertically below the point of suspension.

Question 10

Most candidates believed that wind is reliably available as well as being renewable.

Question 11

It was common to confuse work with power, leading to option **D** being slightly more popular than the correct answer, option **B**.

Question 13

This question involved a barometer and considerably more candidates thought that the space above the column of mercury would increase and so chose option **A**.

Question 15

A very large proportion of able candidates knew that the average speed of the molecules would increase, but also thought that their average separation would increase, even though the volume of the container was constant.

Question 16

Only the strongest candidates answered this question correctly with all options being popular choices.

Question 17

The popularity of option **A** in this question indicated that many candidates were not aware that ice at its melting point remains at a constant temperature whilst it is melting.

Question 28

Although many candidates knew whether iron or steel were hard or soft magnetic materials, weaker candidates did not show an understanding of what this actually means, and that steel would be needed for a permanent magnet.

Question 32

The most common error here was to confuse series and parallel circuits, leading to a choice of option **A.**

Question 33

Option **B** was a very popular choice in this question, indicating a lack of understanding of the effect of light level on the resistance of an LDR, as well as an incorrect understanding of the effect of decreased resistance on the p.d. across the LDR.

Question 34

In this question on fuses a common mistake of less able candidates was to think that a fuse would reduce the current to its rated value.

Question 38

A significant proportion of candidates of all abilities thought that isotopes must be radioactive/unstable.

PHYSICS

Paper 0625/21
Multiple Choice (Extended)

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

General comments

Many candidates coped well with this new multiple choice paper.

Comments on specific questions

Question 2

In this question about a speed-time graph candidates had to spot that the gradient, and hence the acceleration, were zero at 40 s. Many candidates opted for **B**, which would give the mean value of acceleration from 3 m/s to 15 m/s over 40 s.

Question 3

A common error here was to believe that runner 2 was slowing down, confusing reducing acceleration with reducing speed.

Question 4

This question concerned the forces on a satellite orbiting the Earth at constant speed, and a number of candidates thought that the resultant force on it must act in its instantaneous direction of travel and so chose option **C**.

Question 13

This question concerned a barometer, and a significant proportion of candidates believed that the space above the column of mercury would increase in length and so selected option **A**.

Question 18

Virtually all candidates were aware that the black car would show the greater temperature increase, but approximately half of these also thought that the white car would show the greater decrease, therefore choosing option **B**.

Question 20

The mistake made by many weaker candidates here was to fail to convert kHz to Hz, leading to option **C**.

Question 26

Weaker candidates often opted for **A** for this question, confusing magnetic and electric fields.

Question 28

Although a large proportion of candidates could calculate the current in this question, a significant number chose the wrong direction for electron flow.

Question 30

The most common mistake here was to choose **B**, not appreciating that the current would not be rectified.

Question 32

In this question on an LDR in a potential divider circuit, option **B** was popular among weaker candidates, indicating a lack of appreciation of the effect of light level on the resistance of an LDR, as well as an incorrect understanding of the effect of decreased resistance on the p.d. across the LDR.

Question 33

The most common mistake here was to think that a fuse would reduce the current to its rated value.

Question 36

Only the strongest candidates were able to select the correct answer to this question on deflection of β-particles.

Question 37

This question concerned an application of a radioactive source, which proved challenging for many candidates with only the strongest answering correctly.

PHYSICS

Paper 0625/22
Multiple Choice (Extended)

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

General comments

Many candidates performed well on this new multiple choice paper. Candidates answered particularly well on Questions **2**, **15** and **35**, while Question **5** was the most challenging.

Comments on specific questions

Question 3

Weaker candidates often chose option **D** here, believing that the acceleration of the stone as it fell would increase as well as its speed.

Question 5

This question tested the meaning and consequences of acceleration. Only stronger candidates gave the correct answer, with many believing that changing direction does not have to involve acceleration.

Question 6

The most common error in this moments question was to fail to add the 20 cm to 60 cm when determining the moment of force *F* about the pivot.

Question 8

A number of candidates opted for **A**, which is the value of the resultant force, rather than calculating the value of *R*.

Question 10

A large number of candidates either believed that oil did not derive its energy from the Sun, or they did not read the question carefully enough.

Question 13

This question concerned a barometer, and a significant proportion of candidates believed that the space above the column of mercury would increase in length and chose option **A**.

Question 14

A large number of candidates chose option **B** for this question on change of state.

Question 16

Virtually all candidates were aware that the black section would show the faster temperature increase, but many of these also thought that the white section would show the faster decrease, and chose option **B**.

Question 26

This question concerned the current-voltage characteristic of a filament lamp, and almost the same number of candidates chose option **C** as the correct option **A**; students should be able to recall the correct direction of the curve for given axes.

Question 29

The most common mistake here was to choose **B**, not appreciating that the current would not be rectified.

Question 32

In this question on an LDR in a potential divider circuit, option **B** was popular among weaker candidates, indicating a lack of appreciation of the effect of light level on the resistance of an LDR, as well as an incorrect understanding of the effect of decreased resistance on the p.d. across the LDR.

Question 33

Here the most common error was to think that a fuse would reduce the current to its rated value.

Question 39

A significant number of candidates thought that the protactinium nucleus absorbs a proton, possibly as a guess for those unfamiliar with the effect of β-particle emission in radioactive decay.

PHYSICS

Paper 0625/23
Multiple Choice (Extended)

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

General comments

Many candidates found this new multiple choice paper challenging. Question **10** was the best answered, with questions **6**, **18**, **25** and, particularly, **40** proving difficult for many candidates.

Comments on specific questions

Question 2

In this question the most common error was to choose option **A**, as many candidates read the distance-time graphs as speed-time graphs.

Question 3

Weaker candidates often chose option **D** here, believing that the acceleration of the stone, rather than its speed, would increase from zero as it fell.

Question 5

Here a number of candidates believed that the force on an object moving in a circle at constant speed would act in its direction of motion.

Question 6

This question was answered correctly by stronger students, with option **B** being slightly more popular than the correct answer **C**. This incorrect value is produced by multiplying each force by the distance shown immediately to its left on the diagram; students choosing this did not appreciate that the total distance to the pivot should be used in each case.

Question 8

Incorrect option **D** was a popular choice with many candidates who did not realise that the momentum does change because its direction changes.

Question 9

A significant proportion of candidates believed that hydroelectric energy is not derived from the Sun.

Question 11

Students should be advised to read questions carefully; many failed to take into account here that there were three boxes.

Question 13

This question concerned a barometer, and a significant number of candidates thought that the space above the column of mercury would increase in length and selected option **A**.

Question 15

Almost all candidates knew that the average speed of the molecules would increase, but many of them also believed that the average separation would increase, even though the volume of the container was constant.

Question 16

A common error, even for stronger candidates, was to think that increasing the length of the tube and stem would increase sensitivity.

Question 18

A very high proportion of candidates were aware that a black surface was the better absorber, but many of these also believed that a white surface was the better emitter.

Question 20

Many candidates thought that the frequency of the wave, rather than its wavelength, would decrease when refraction occurred.

Question 25

Many candidates believed that the speed of sound in gases is greater than in metals, leading to the incorrect option **A**.

Question 28

The most common mistake here was to choose **B**, not appreciating that the current would not be rectified.

Question 30

Many weaker candidates treated this as a series, rather than parallel, arrangement, leading to option **D**.

Question 33

Here a very common mistake was to think that a fuse would reduce the current to its rated value.

Question 40

This question proved challenging with only the strongest candidates answering correctly. Many candidates either forgot to add on background radiation at the end of their calculation, or ignored it completely.

PHYSICS

Paper 0625/31
Core Theory

Key messages

All candidates should be advised to check through their responses carefully. Errors such as failing to answer part of a question, the omission of a unit or checking that the appropriate number of ticks has been used in a tick box question can then be avoided.

As has been the case for a number of years, the questions on radioactivity proved to be more challenging for all but the highest scoring candidates. Candidates would benefit from more focus on this area.

General comments

Candidates of all abilities were able to access questions and provide responses to all questions. It was clear that many candidates had prepared well for the examination; many were able to apply their knowledge and understanding well to a broad range of contexts. Candidates demonstrated appropriate language skills and there was no evidence of candidates having insufficient time to complete the questions. The vast majority of candidates were able express their ideas clearly and received credit for their responses.

When completing calculations many candidates included the formula to be used and then set out the stages in their working clearly. Partial credit can be given when, despite obtaining the wrong answer, full working is shown.

All but the weakest candidates were able to use and apply standard equations such as P = F/A and V = IR. However, a significant proportion of these candidates were unsure about some basic facts. For example, the electromagnetic spectrum being shown in order of increasing frequency. In a very small number of cases candidates left parts of a question blank suggesting that their knowledge and understanding was not secure.

Comments on specific questions

Question 1

(a) Many candidates answered this question well. Most recognised that the cyclist and runner were accelerating and the cyclist was faster.

(b) This was answered correctly by almost all candidates. Those that gave an incorrect response usually suggested that the cyclist had stopped or was at rest.

(c) This was not a well answered question. A very common incorrect response from weaker candidates was to multiply speed by time (12×9) in order to get 108 m. A number of candidates partially calculated correct responses giving final values of 54 m or 27 m.

(d) There was a very high number of correct responses to this question. A common error was candidates drawing the correct line for the constant speed but then the deceleration line finishing at 4 m/s rather than 0 m/s.

Question 2

(a) This was answered well by almost all candidates.

(b) Correct responses were given by most candidates. Common incorrect responses were 44 kg and 64 kg. Some of those with incorrect values were able to gain partial credit for the correct use of weight = mass × gravity.

(c) As for part **(b)**, the question was well answered by most candidates. Common incorrect responses were 540 N or 640 N.

Question 3

(a) There were many correct responses to this question.

(b) This question was only answered well by the strongest candidates. There were many vague responses in terms of preventing heat loss or stating that shiny surfaces were good reflectors. A small number referred to the reflection of light rather than thermal energy.

(c) This question was very well answered by all candidates.

Question 4

(a) This question proved challenging for almost all candidates. Common errors were water, rivers, waves, geothermal and fossil fuels.

(b) There were many correct responses to this question. However, there were a small number of candidates who reversed input and output energy. Some weaker candidates could not be given credit as they gave more than the required number of ticks.

(c) This was generally well answered by candidates. Candidates had a good understanding of fossil fuels being a non-renewable resource.

Question 5

(a) Correct responses were given by many candidates. However, there were many incorrect answers in terms of the crawler board being a safety device, having more friction so as to stop the workers sliding or the hand rail providing additional protection.

(b) This question was well answered by many candidates. Many candidates, having obtained the correct value, did not gain full credit as they forgot to include, or gave an incorrect, unit. For example, N m or N m^2. There were some candidates who gained partial credit for calculating correctly the pressure exerted by the crawler board or the pressure exerted by the men.

Question 6

(a) (i) This question was not well answered. A very common incorrect response was to draw three straight lines drawn out from point P.

(ii) Many candidates gained some credit, normally for the idea of collisions. However, there were many vague responses in terms of particles and molecules without specifying that these particles were air particles.

(b) There were many correct responses to this question.

Question 7

(a) This question was well answered

(b) Only the best prepared candidates gained full credit on this question.

(c) This question proved challenging. There were a number of vague responses in terms of causing accidents, damage or fires.

Question 8

(a) (i) Many correct responses were given to this question. Incorrect answers included incidence line, critical line and line of symmetry.

(ii) There were many correct responses to this question.

(b) Stronger candidates answered this question well. Most candidates gained some credit.

(c) This question was well answered by only the better prepared candidates. A small number of candidates did not give a response to this question.

Question 9

(a) (i) There were many correct responses to this question. Incorrect responses included alpha, heat and sound waves.

(ii) Most candidates answered this question correctly. The most common incorrect response was wavelength.

(b) (i) Many candidates answered this question well. A number, however, failed to gain full credit for vague responses such as airports, hospitals or security.

(ii) Stronger candidates answered this well. A very common incorrect response was the wearing of goggles or lab coats or vague responses about protective clothing.

(iii) This question was only answered well by the strongest candidates.

Question 10

(a) There were many correct responses to this question.

(b) (i) Only the strongest candidates gained full credit for answers to this question.

(ii) This was answered correctly by many candidates.

(iii) Many candidates gained full credit. Other candidates gained partial credit for identifying the equation (V = IR) correctly.

Question 11

(a) This question was not well answered with many candidates ringing more than two metals.

(b) This was answered correctly by the majority of candidates.

(c) This was answered correctly by the majority of candidates.

Question 12

(a) Very few candidates gained full credit. Most answers, however, gained credit for the idea of using a sheet of paper to stop alpha radiation.

(b) This question was generally well answered by stronger candidates who recognised that gamma was less ionising and had greater penetration.

(c) There were many correct responses in terms of mutations of cells. There were also a number of vague responses in terms of causing harm, illness or death.

PHYSICS

Paper 0625/32

Core Theory

Key messages

- Candidates should note the number of marks available and the space allocated for responses as these factors provide a clear indication of the type of answer that is expected.
- Candidates must read the question carefully and make sure they follow the rubric of the question. In particular, candidates must not try to maximise their chances by giving more than the required number of answers to a question. If two alternative answers are given, one correct and the other incorrect, the candidate will almost always score no credit.
- Candidates are advised to read carefully through their responses to make sure that what they have written has the intended sense. Concise explanations are often the best.
- In calculations, candidates must set out and explain their working correctly. There may be credit available for working.
- Candidates should be encouraged to present their answers as carefully and neatly as possible.

General comments

A high proportion of candidates had clearly been well taught and prepared for this paper. There remains the tendency to think less rigorously and logically in non-numerical questions than in numerical questions. Some areas of the syllabus were better known than others; in particular temperature scales, the transfer of thermal energy by conduction, convection and radiation and radioactive decay were not well understood.

Equations were generally well known by all but the weakest candidates. Many candidates understood well how to apply equations to fairly standard situations. On occasions however, when asked to apply their knowledge to a new situation, they became confused and displayed a lack of breadth of understanding of the use of the equation. More practice in applying equations in unfamiliar situations would deepen candidates' understanding and improve their performance in the examination.

The majority of candidates indicated by their knowledge and skills that they were correctly entered for this Physics Core paper. However, a significant minority of candidates found the subject matter and level of some questions very easy, and they may have benefited from being prepared and entered for the Extended Theory paper.

The English language ability of the vast majority of the candidates was adequate for the demands of this paper. However, there was a small minority who struggled to express themselves adequately.

Candidates did not seem to find any difficulty in completing it in the allocated time and relatively few left answers to questions blank.

Comments on specific questions

Question 1

(a) Many candidates answered correctly. However, a large number gave volume as their answer.

(b) (i) The majority of candidates answered correctly. The most common error was to give 3.04 s as 3.40 s.

(ii) With e.c.f. from **b (i)**, the majority of candidates gained credit for this part. The most common mistake was to add the three times on the stopwatch, and then to divide by 2.

(iii) With e.c.f., many candidates answered this question well. A very common error was failing to convert the time in minutes to seconds, or only partially converting it, with 905 or 950 being frequently seen as the time in seconds.

Question 2

(a) Most candidates correctly determined the area under the graph to give the distance travelled by the student. Common errors were misreads of the speed, with 4.2 m/s very frequently seen. Weaker candidates inverted the equation and divided the speed by 10 instead of multiplying.

(b) Many candidates correctly selected the forces in diagram C and gave clear explanations to gain full credit. Weaker candidates tended to give only partial explanations.

(c) Most candidates correctly determined the pressure and gave the correct unit. Many candidates increased the complexity of the calculation by converting the area into metres in order to give their answer in pascals. There was no need to do this as N/cm^2 was an acceptable unit. Weaker candidates tended to invert the formula and consequently multiplied force by area.

Question 3

(a) Most candidates correctly gave 720 Nm as the value for the girl's moment about the pivot. Common errors were to divide by 2.4 metres or to multiply by the wrong distance.

(b) Many candidates correctly determined the weight of the boy as 450 N. However, very few candidates set out their working as a moments calculation, and so could gain no credit for any correct workings. Candidates should be encouraged to show their working for all stages of calculations.

Question 4

(a) (i) This question was generally well answered.

(ii) A large number of candidates identified zero as the temperature of a mixture of water and ice. Many candidates thought the reading was below minus 10 degrees Celsius, and others had temperatures as high as 25 degrees Celsius.

(b) Many candidates gave good descriptions of the melting of ice in terms of the molecules, forces, spacings and motion, with a significant number gaining full credit.

Question 5

(a) The majority of candidates were able to give two advantages of the lamps connected in parallel compared to those connected in series.

(b) (i) Only the weakest candidates failed to answer correctly.

(ii) The majority of candidates answered correctly.

(c) Many candidates gained partial credit for this question, but only the most able gave descriptions of advantages and disadvantages to gain full credit. Candidates should be reminded to give sufficiently detailed and precise answers.

Question 6

(a) Many candidates correctly identified X-rays and microwaves, but a significant number placed their responses in the wrong order. Weaker candidates failed to recall the correct waves, and entered responses such as sound waves.

(b) Many candidates correctly indicated radio waves, but a number chose gamma rays or another radiation in the spectrum.

(c) (i)(ii) Many candidates suggested suitable uses for gamma radiation and ultraviolet radiation. Weaker candidates tended to struggle finding a suitable use.

Question 7

(a) The majority of candidates answered correctly. The most common error was to only draw the normal in air.

(b) The majority of candidates answered correctly.

(c) Stronger candidates performed well on this question but weaker candidates appeared to find this challenging.

(d) Most candidates correctly drew a ray refracting further away from the normal at the second surface.

Question 8

(a) Most candidates recognised that the material Z would melt when the hot coffee was poured into the cup.

(b) Weaker candidates struggled with this question, giving vague statements about keeping heat in or stopping heat moving.

Question 9

(a) Most candidates gained some credit here, with even weaker candidates correctly stating the equation. Weaker candidates then often transposed the equation incorrectly to give an incorrect answer of 3 amps.

(b) (i) The majority of candidates answered correctly.

(ii) Most candidates recognised that the direction of the force would also be reversed to an upward direction.

(c) (i) Most candidates gave one or two ways of increasing the turning effect on the coil.

(ii) Most candidates recognised that the coil would turn in the opposite direction, but only the most able candidates gave a clear explanation of why this happened.

Question 10

(a) The majority of candidates were able to use the transformer equation to correctly determine the output voltage. In this question more candidates set out their working and some could be credited for this even when their final answer was incorrect.

(b) Many candidates recognised that this was a step-down transformer.

Question 11

(a) (i) Most candidates answered well, but a significant number confused the nucleon number and proton number.

(ii) Most candidates were able to determine the number of electrons and neutrons, but a significant number thought the number of electrons was 146 and the number of neutrons was 95.

(b) Many candidates gave clear explanations. Weaker candidates thought that isotopes contained the same number of neutrons but different numbers of protons.

Question 12

(a) The majority of candidates correctly stated that a beta particle was an electron, and that its charge was negative or minus 1. The most common mistake was to give a description of a helium nucleus.

(b) The majority of candidates correctly determined the half-life as 8 days.

(c) (i) Many candidates correctly calculated the count rate as 45 counts/min. Weaker candidates often gained partial credit by correctly stating that 60 years was two half-lives.

(ii) Many candidates gave valid suggestions.

PHYSICS

Paper 0625/33
Core Theory

Key messages

- Candidates should note the number of marks available and the space allocated for responses as these factors provide a clear indication of the type of answer that is expected.
- Candidates must read the question carefully and make sure they follow the rubric of the question. In particular, candidates must not try to maximise their chances by giving more than the required number of answers to a question. If two alternative answers are given, one correct and the other incorrect, the candidate will almost always score no credit.
- Candidates are advised to read carefully through their responses to make sure that what they have written has the intended sense. Concise explanations are often the best.
- In calculations, candidates must set out and explain their working correctly. There may be credit available for working.
- Candidates should be encouraged to present their answers as carefully and neatly as possible.

General comments

A high proportion of candidates had clearly been well taught and prepared for this paper. There remains the tendency to think less rigorously and logically in non-numerical questions than in numerical questions. Some areas of the syllabus were better known than others; in particular temperature scales, the transfer of thermal energy by conduction, convection and radiation and radioactive decay were not well understood.

Equations were generally well known by all but the weakest candidates. Many candidates understood well how to apply equations to fairly standard situations. On occasions however, when asked to apply their knowledge to a new situation, they became confused and displayed a lack of breadth of understanding of the use of the equation. More practice in applying equations in unfamiliar situations would deepen candidates' understanding and improve their performance in the examination.

The majority of candidates indicated by their knowledge and skills that they were correctly entered for this Physics Core paper. However, a significant minority of candidates found the subject matter and level of some questions very easy, and they may have benefited from being prepared and entered for the Extended Theory paper.

The English language ability of the vast majority of the candidates was adequate for the demands of this paper. However, there was a small minority who struggled to express themselves adequately.

Candidates did not seem to find any difficulty in completing it in the allocated time and relatively few left answers to questions blank.

Comments on specific questions

Question 1

(a) Many candidates answered correctly. However, a large number gave volume as their answer.

(b) (i) The majority of candidates answered correctly. The most common error was to give 3.04 s as 3.40 s.

(ii) With e.c.f. from **b (i)**, the majority of candidates gained credit for this part. The most common mistake was to add the three times on the stopwatch, and then to divide by 2.

(iii) With e.c.f., many candidates answered this question well. A very common error was failing to convert the time in minutes to seconds, or only partially converting it, with 905 or 950 being frequently seen as the time in seconds.

Question 2

(a) Most candidates correctly determined the area under the graph to give the distance travelled by the student. Common errors were misreads of the speed, with 4.2 m/s very frequently seen. Weaker candidates inverted the equation and divided the speed by 10 instead of multiplying.

(b) Many candidates correctly selected the forces in diagram C and gave clear explanations to gain full credit. Weaker candidates tended to give only partial explanations.

(c) Most candidates correctly determined the pressure and gave the correct unit. Many candidates increased the complexity of the calculation by converting the area into metres in order to give their answer in pascals. There was no need to do this as N/cm^2 was an acceptable unit. Weaker candidates tended to invert the formula and consequently multiplied force by area.

Question 3

(a) Most candidates correctly gave 720 Nm as the value for the girl's moment about the pivot. Common errors were to divide by 2.4 metres or to multiply by the wrong distance.

(b) Many candidates correctly determined the weight of the boy as 450 N. However, very few candidates set out their working as a moments calculation, and so could gain no credit for any correct workings. Candidates should be encouraged to show their working for all stages of calculations.

Question 4

(a) (i) This question was generally well answered.

(ii) A large number of candidates identified zero as the temperature of a mixture of water and ice. Many candidates thought the reading was below minus 10 degrees Celsius, and others had temperatures as high as 25 degrees Celsius.

(b) Many candidates gave good descriptions of the melting of ice in terms of the molecules, forces, spacings and motion, with a significant number gaining full credit.

Question 5

(a) The majority of candidates were able to give two advantages of the lamps connected in parallel compared to those connected in series.

(b) (i) Only the weakest candidates failed to answer correctly.

(ii) The majority of candidates answered correctly.

(c) Many candidates gained partial credit for this question, but only the most able gave descriptions of advantages and disadvantages to gain full credit. Candidates should be reminded to give sufficiently detailed and precise answers.

Question 6

(a) Many candidates correctly identified X-rays and microwaves, but a significant number placed their responses in the wrong order. Weaker candidates failed to recall the correct waves, and entered responses such as sound waves.

(b) Many candidates correctly indicated radio waves, but a number chose gamma rays or another radiation in the spectrum.

(c) (i)(ii) Many candidates suggested suitable uses for gamma radiation and ultraviolet radiation. Weaker candidates tended to struggle finding a suitable use.

Question 7

(a) The majority of candidates answered correctly. The most common error was to only draw the normal in air.

(b) The majority of candidates answered correctly.

(c) Stronger candidates performed well on this question but weaker candidates appeared to find this challenging.

(d) Most candidates correctly drew a ray refracting further away from the normal at the second surface.

Question 8

(a) Most candidates recognised that the material Z would melt when the hot coffee was poured into the cup.

(b) Weaker candidates struggled with this question, giving vague statements about keeping heat in or stopping heat moving.

Question 9

(a) Most candidates gained some credit here, with even weaker candidates correctly stating the equation. Weaker candidates then often transposed the equation incorrectly to give an incorrect answer of 3 amps.

(b) (i) The majority of candidates answered correctly.

(ii) Most candidates recognised that the direction of the force would also be reversed to an upward direction.

(c) (i) Most candidates gave one or two ways of increasing the turning effect on the coil.

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(a) The majority of candidates correctly stated that a beta particle was an electron, and that its charge was negative or minus 1. The most common mistake was to give a description of a helium nucleus.

(b) The majority of candidates correctly determined the half-life as 8 days.

(c) (i) Many candidates correctly calculated the count rate as 45 counts/min. Weaker candidates often gained partial credit by correctly stating that 60 years was two half-lives.

(ii) Many candidates gave valid suggestions.

PHYSICS

Paper 0625/41

Extended Theory

Key messages

- Candidates should be encouraged never to omit a unit and to check that they are using the correct unit.
- It is apparent that many candidates began to write without sufficient initial planning. If candidates spent time reading a question carefully and gathering their thoughts as a preliminary to writing, many would benefit accordingly.

General comments

There was no evidence that the time allowed for completion of the paper was insufficient.

The numerical work was in general good. Although most candidates managed it well, rearranging basic formulae such as $P = F/A$ proved to be problematic for some candidates. In questions, data is given with 2 significant figures, so answers are expected to this level. However, answers with more than 2 significant figures are accepted.

Most candidates achieved significantly less success with those questions requiring descriptions or explanations. This applied even to those candidates who had performed well overall on the paper.

In many cases it was apparent that candidates had read the questions with insufficient care. For example, an answer to a question that begins with 'State and explain' frequently only covered the 'state' aspect. A subsequent explanation was often absent or amounted only to a repetition of some wording from the question.

Comments on specific questions

Question 1

(a) This was generally answered well, but in some cases the final section of the graph was not always clearly steeper than the first section.

(b) Most candidates clearly attempted to use the area under the graph and gained credit for this. There was some misreading of data from the graph. However, there were many correct final values with, in this particular question, few errors in units.

Question 2

(a) (i) The majority of candidates had learnt momentum = mv and used it successfully to calculate the numerical value. Some multiplied or divided the correct value by g. There was less certainty over the unit, with kg/m/s sometimes seen along with other examples.

(ii) The object of the question was to test the knowledge that the impulse equalled change of momentum in **(i)**. This was not well done in many instances and many candidates started with a new, mostly unsuccessful, calculation. Many candidates quoted the correct numerical value but with the acceptable unit given as Ns rather than the kg m/s they had given in **(i)**.

(b) (c) These parts were generally well answered.

(d) Many misunderstandings over the use of an airbag were seen, with many candidates not addressing the given fact that the deceleration of the dummy or passenger is less than that of the passenger compartment. This fact should have led candidates to the idea that the force on the passenger is less than it would have been without the airbag, with consequent reduced injury.

Question 3

(a) (i) Those who used $P = hdg$ were usually successful. Less success was achieved by those who attempted to use $P = F/A$ or mg/A, with the volume of the tank being calculated instead of the base area.

(ii) Use of $P = F/A$ or mg/A was required in this case, and many candidates answered this correctly.

(b) Most candidates divided the weight of the oil by g mass correctly. Some multiplied the mass by g.

(c) There were very few wrong statements comparing the densities of the brass and the oil.

(d) Most candidates assumed that attaching a brass key to a piece of wood automatically meant that this would prevent the key from sinking in the oil. The relevance of the combined density of the wood and the key only featured in the strongest answers.

Question 4

(a) Many candidates wrote far more than necessary, but most succeeded in suggesting that gas molecules are widely spaced or have large gaps between them. The idea that liquid molecules are close to each other or touching was less clearly expressed. Many simply stated that they were closer together than gas molecules.

(b) (i) Most candidates realised that the reduction of temperature was the result of evaporation. Two ideas were then required: that the faster or more energetic molecules evaporated or escaped, and that the slower or less energetic molecules remained. The first idea was usually conveyed successfully. The second was sometimes missing from answers or wrongly expressed.

(ii) Most candidates correctly predicted that the greater rate of cooling applied to the container with the larger surface area of water. Fewer went on to suggest that evaporation from this container occurred at a faster rate.

Question 5

(a) (b) Three statements were required, any one of the three in **(a)** and the other two in **(b)**. The one suggesting that molecules in the container move faster or have more k.e. or momentum was usually made. The other two needed to refer to a greater frequency of collision with the walls of the container and that they exerted a greater force on the walls. Answers often omitted any mention of the walls.

(c) (i) A majority used PV = constant successfully and obtain the correct numerical value. Unfortunately a minority of these gave the unit as Pa rather than kPa.

(ii) Most candidates answered this well.

Question 6

(a) Many candidates did not include a reference to a long distance for the sound to travel, although mention of a specific distance of 100 m or more was acceptable. Some candidates also did not mention the use of the tape to measure the distance. The actions of the two candidates were often not described precisely enough. Very few candidates gained full credit on this question.

(b) (i) Many candidates quoted the formula $v = f\lambda$ and were credited for this. Some began their answer with a wrongly rearranged version of the formula however.

(ii) Many candidates had not learnt that the frequency of a wave does not change or that sound travels more slowly in a gas than in a liquid.

Question 7

(a) (i) Many candidates answered this well. However, some failed to draw a curved section of fibre. Others showed total internal reflection but with unequal angles of incidence and reflection.

(ii) This question proved challenging. Often after correctly stating that optical fibres can be used to look inside a patient's body, there was little essential physics in the rest of the answer. The idea that light travels up and down a bundle of fibres, not a fibre, into and out of the body was seldom addressed.

(b) The wrong connecting line that many candidates drew from the microwaves box suggested that a majority of candidates did not appreciate that microwaves are electromagnetic. The line from the 'sound in steel' box was almost equally likely to have been drawn to the boxes showing 90 m/s and 6000 m/s.

(c) Some answers began with the use of sin i/sin r, suggesting a misunderstanding of the situation. With the benefit of an error carried forward from **(b)**, many candidates calculated the correct numerical value. A minority wrote down a correct formula but rearranged it incorrectly. Others, not having written down a formula, wrote down numbers suggesting a wrong rearrangement was being used. There were many correct numerical answers with no unit added.

Question 8

(a) (i) Many candidates found this question challenging. To categorise the direction of the magnetic field at Y due to the current in X, candidates needed to imagine or draw the field surrounding X and know the direction of the field arrows. Only the strongest candidates provided good answers.

(ii) To answer this question, candidates needed to revisit the thinking that applied in **(i)**, or know that two parallel wires carrying currents in the same direction attract each other. Although there were some correct answers, some candidates suggested there was no force while others made vague statements that could not be credited.

(b) Some candidates treated this question as if it were a transformer with the normal type of input and gained little credit. Suggestions of current in the core were not uncommon.

Question 9

(a) (i) Most candidates coped with the addition for two series resistors. A minority mistakenly applied the rule for parallel resistors.

(ii) Most candidates applied the parallel rule successfully. Some made errors in the arithmetic, or included 3 resistors in their use of the formula.

(iii) This was generally answered correctly.

(b) (i) Many candidates answered this question well. Some used the value of 6 Ω in their calculation, but could have been given credit for the formula if this had been written down.

(ii) Many candidates used the correct formula with the correct numbers or with the previous wrong current value carried forward. A significant number used current x time and calculated a quantity of charge rather than a quantity of energy.

Question 10

(a) In **(i)**, recall of the name of a component was required; in **(ii)** recall of a component name. A good proportion of candidates succeeded in both.

(b) Candidates' recall of the function of an AND gate was in general sound, with few mistakes in column C. The entries in Column E were slightly more prone to error however.

(c) Suggestions of replacing the OR gate by an AND gate were credited. None of the other suggestions that were made would fulfil the requirement. A substantial number of candidates offered no response to this question.

Question 11

(a) Most candidates answered well. However, weaker answers included a number of electrons as being present in the nucleus.

(b) The nuclide notation of a β-particle is only well known by stronger candidates, with errors common in either the superscript or the subscript or both. Some candidates wrote down the notation for an α-particle.

(c) A good number of correct count rates were seen in answers, but many candidates were unsure as to how to continue. Some halved the mass number rather than the initial count rate. Others halved the initial count rate too few or too many times. In some cases there were mistakes in the arithmetic.

(d) Fear of cancer or mutations and the high cost of maintaining a storage facility were the most common suggestions, but many of the other possibilities allowed by the mark scheme were also seen. However, some candidates gave uses of nuclear materials and did not consider the storage of such materials at all.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

- Candidates should read the question carefully and answer the question that is asked, not the one the candidate thinks has been asked. Often a question is about a situation that the candidate thinks is familiar but the actual question is different from that expected. This was particularly the case throughout **Question 2** on the topic of momentum.
- Particularly in questions requiring extended calculation, candidates must set out and explain their working correctly. Where a final answer is incorrect but some correct working are shown it may be possible to award some credit for these workings.
- Answers should be given to 2 significant figures. Fractions should not be used in final answers but this was seen on a few occasions.
- All but the very strongest candidates would benefit from more practice in applying their knowledge in unfamiliar situations. This would deepen candidates' understanding and improve their performance in the examination. Many candidates, when asked to apply their knowledge to a new situation, became confused and unable to use what knowledge they had. Often candidates have learnt well how to apply equations to fairly standard situations but display a lack of breadth of understanding of their use in contexts outside of a physics laboratory.

General comments

A high proportion of candidates had clearly studied the material and prepared well for this paper. The majority of candidates were able to apply their knowledge and understanding of physics to the questions set, and produce correct responses. Only a very small minority of candidates found the subject matter and level of some questions so difficult that these questions were inaccessible to them and would have been better entered for the Core paper. The vast majority of candidates indicated by their knowledge and skills that they were correctly entered for this Extended Theory paper.

Generally candidates followed the rubric of the questions. However, candidates must not try to maximise their chances by giving more than one answer to a question. If two answers are given, one right and the other incorrect, the candidate will invariably gain no credit. There were a few examples in questions involving tick boxes where candidates gave more answers that instructed, some of which would obviously be mutually contradictory.

A high proportion of candidates displayed a good grasp of the English language, and almost all candidates had a sufficient understanding to be able to attempt the questions.

Equations were generally well known but the use of equations and the quantities represented were not always understood. There were frequent examples where candidates substituted numbers from the question in the wrong place in equations.

Overall the use of units by all candidates was good with the exception of the units for momentum and impulse in **Question 2**.

Comments on specific questions

Question 1

(a) On the whole the question was well answered. The good responses seen most often were change of speed and change of direction.

(b) (i) This was generally well answered with only a small number of unit errors, usually giving m/s.

(ii) The majority of candidates correctly calculated the skier's average speed.

(iii) The question asked for a valid suggestion linked to a suitable explanation such as "reduces air resistance to increase speed" but many weaker answers merely gave a suggestion or an explanation e.g. "to lower the centre of mass" or "to increase speed".

Question 2

Many stronger candidates had a good understanding of this topic and answered this question well, gaining full credit. Many less strong candidates made a reasonable attempt at various parts of the question but their depth of knowledge was insufficient so confusion and errors occurred. There were many unit errors for momentum and impulse; both kg m/s and Ns were acceptable for both. Perhaps because many momentum questions in textbooks are linked with kinetic energy, some candidates incorrectly introduced kinetic energy to parts of their answer.

There were many instances of candidates answering the question they were expecting and rather than the question as set on the paper.

(a) Most candidates correctly calculated the momentum of the truck. The most common errors included giving the wrong unit or calculating kinetic energy.

(b) (i) Many candidates correctly determined the impulse as being equal to the change in momentum of truck B. The most common error was to give the momentum of truck A after the collision. Many candidates determined the velocity of truck B after the collision, which was not part of the question. An error frequently seen with less strong candidates was the use of the incorrect equation for impulse e.g. force = impulse × time.

(ii) Many candidates were able to gain full credit here, sometimes thanks to correct subsequent working despite an earlier error.

(iii) Only a minority of candidates, even among the stronger candidates, answered this question correctly. Many candidates attempted an answer in terms of conservation of momentum but then used a mass of 11 000 kg, as if the trucks stayed together after the collision. Others who used an acceptable alternative approach using F = ma then confused themselves through not recognising momentum as a vector quantity. Consequently they failed to use the correct algebraic signs to take direction into account.

Question 3

(a) There was a wide range of answers for this question. However, many identified the two correct types of energy. The most common error was to state that the kinetic energy of the cabin increases even though it is moving at constant speed.

(b) Most candidates could find the gravitational potential energy.

(c) Most answers to this question were very vague. Specific statements such as "less fuel used", "less CO_2 produced" or a sensible use for the electricity generated were required. Vague statements gained no credit. Many candidates repeated the words of the question that the motor acted as a generator, which also gained no credit.

Question 4

(a) All parts of this question were generally well answered but weaker candidates did not use correct equations or transposed incorrectly.

(i) Weaker candidates could not remember the correct equation for pressure in this context - calculation of area was common here.

(ii) A number of candidates failed to appreciate that all that was needed was addition of atmospheric pressure.

(iii) Many candidates wrote down P = F/A with correct figures but then failed to transpose correctly thus dividing by 0.96 rather than multiplying by 0.96.

(b) Most candidates gave one valid reason but there were many vague responses such as weight or pressure instead of weight of the lid, upthrust on the lid. Other responses which gained credit were about corrosion of the hinges or clear statements about moments.

Question 5

(a) Most candidates gained credit on this part. A small number of candidates thought that the small pan had the greater rate of evaporation because it contained less water.

(b) Most candidates were able to give a clear difference between boiling and evaporation.

(c) (i) Many candidates failed to realise that, as boiling takes place at fixed temperature, the average KE is constant. Consequently many answers saying KE increases and molecules move faster were seen. A minority of these candidates went on to gain credit for saying that inter-molecular bonds could be broken or overcome.

(ii) Many candidates gained full credit on this part and provided clear and well set out working. Weaker candidates sometimes had the equation inverted or attempted to use an equation for specific heat capacity, which often involved the inclusion of 100 °C in the calculation. Other common mistakes were to divide power by time instead of multiplying, to give the amount of energy transferred or to substitute the time in minutes instead of in seconds.

Question 6

(a) (i) The majority of candidates were able to state the angle correctly but many others did not realise that the angle should be measured from the normal and gave answers of 55° or 125°.

(ii) Many candidates gained some credit on this question. Snell's Law was well known and used but often the reciprocal of the correct value was substituted. A small minority of candidates carried out the calculation without using sines.

(b) (i) Many responses were vague just referring to an angle instead of the angle of incidence.

(ii) This was generally well answered.

(c) (i) This was generally well answered.

(ii) This was generally well answered.

Question 7

(a) Some very good answers were seen here, many gaining full credit, although a significant number of candidates wrote about an inappropriate application despite the wording of the question. Many good responses contained clear diagrams of a typical airport security set up but this was not the only acceptable example. Many candidates included incorrect use of X-rays in the form of human scanning at the airport or having an X-ray of the bone taken in a hospital. Of the candidates talking about a security application, there were a number of poor or vague diagrams or a very vague mention of the object of the search.

(b) This was answered well by strong candidates. Students should realise that understanding the context can be an aid to recall e.g. no wave can travel faster than 3×10^8 m/s and knowing that ultrasound is a sound wave not an electromagnetic wave.

Question 8

(a) Many candidates gave strong answers, but there were often descriptions that were lacking in detail. Many weaker candidates failed to read in the question “No other apparatus is available” so heating or hammering were quite common incorrect responses. Many otherwise excellent responses mentioned the use of a.c. for demagnetisation but failed to mention that the rod had to be withdrawn or the current reduced.

(b) Many candidates gained full credit usually by calculating the current in the secondary to be 4.0 A for a current in the primary of 0.20 A. There were other possible alternatives by calculating a primary current of 0.15 A for a secondary current of 3.0 A or some sort of power comparison between the primary and secondary. These alternatives were seldom more than partially successful and the final link between the calculation and the fuse blowing was often not well expressed.

Question 9

(a) Strong candidates wrote clear, correct answers and gained full credit. Weaker candidates often gave explanations that involved the separation of the positive and negative charges on the ball. They went on to state that the negative charges on the left of the ball would be attracted to the positive plate but did not realise that the positive charges on the right of the ball would be attracted to the negative plate.

(b) Most candidates correctly identified the particles as electrons. However many weaker answers gave vague or contradictory descriptions of the direction in which they move through the ammeter.

(c) Whilst the correct equation was well known, the substitution for time proved to be more challenging. Few candidates knew how to use frequency to get the time. The most common error was to divide the charge by four instead of multiplying.

Question 10

Many strong candidates performed well on this question showing a good understanding as well as knowing the appropriate equations. However, often the correct equations had been memorised but there was little evidence of a true understanding of circuit electricity.

(a) Most candidates used an equation for electrical power to calculate correctly the resistance of heater X.

(b) Many candidates showed a lack of understanding as they simply halved their correct value of resistance from **(a)** for an answer to **(b)**.

(c) Many candidates gained full credit on this part. Alternative approaches were possible but the easiest way was to use $P = VI$. Candidates needed to choose correct values of voltage and power. As the heaters Y and Z are in series they have the same current. Successful answers used the power and voltage for Z on its own or for Y and Z together.

Question 11

(a) The majority of candidates gained full credit. Sometimes weaker candidates failed to give the number of neutrons or the number of electrons.

(b) This was well answered by the majority of candidates.

(c) The majority of candidates correctly recognised 4 half-lives were involved. However, a number showed fundamental misconceptions about how to apply this value. Commonly it was followed by 720 divided by 4 or 720×4.

PHYSICS

Paper 0625/43

Extended Theory

Key messages

- Candidates should ensure that the answer given responds to the question asked rather than a similar question on the same topic.
- A numerical answer should have an appropriate unit.
- Candidates should include the various stages of working out in a calculation as marks may be available for workings.
- Candidates need to be especially careful when using numbers expressed in standard form. Division by numbers that include a negative power of ten seem to cause problems and it is possible that some candidates are not fully familiar with the process for entering such numbers into a calculator.
- Candidates should be reminded to make their answers clear, particularly if they have crossed out one answer and replaced it with another. Particular care should be taken with numbers to make them clear.

General comments

The standard of answers varied enormously and while some candidates seemed to be familiar with every topic being assessed, there were some candidates who did not show such familiarity.

Comments on specific questions

Question 1

(a) This part was commonly correctly answered; occasionally a candidate gave an answer which referred to a scalar quantity.

(b) (i) This part was very commonly well answered although the answer *5.0 N* was given by weaker candidates.

(ii) Most candidates gave the correct numerical answer here although the erroneous re-arrangement $a = m/F$ was used in some answers. The significance of the unit of acceleration is not always fully understood and candidates who misremember it might simply use the unit of velocity or occasionally use m/s^{-2}.

(c) Only occasionally was this part answered well. Some diagrams were not drawn to scale and even when they were, the wrong diagonal was often chosen and measured. Where the diagram was correctly drawn, some candidates gave an answer that lay outside of the allowed range either through careless measurement or through simply using a diagram that was too small.

Question 2

(a) This correct answer with the correct unit was very frequently given.

(b) (i) Many candidates wrote down the value 21 000 kg m/s straight from the question rather than subtracting it from the answer to **(a)**.

(ii) The concept *impulse* was less well understood than *momentum* and only a minority of candidates gave the correct answer here.

(iii) The simplest way of obtaining the correct answer was to divide the impulse or momentum from **(b)(i)** or **(b)(ii)** by the time taken and many candidates did this. Candidates who calculated the deceleration and applied $F = ma$ could also obtain the correct answer but the larger number of stages in the calculation increased the possibility of an arithmetic error.

(c) Many candidates answered this part well but where a written explanation such as this was asked for, some answers were not sufficiently precise and lacked any reference to the physics involved.

Question 3

(a) Many candidates made one or two relevant points here but answers that omitted any mention of molecules could not be awarded full credit.

(b) There were some good answers here and many candidates related, in some way, the thermal energy supplied to the work done in separating the molecules of the solid.

(c) (i) This was frequently correct but some candidates either misread the scale or gave the unit as the degree (°) rather than the degree Celsius (°C).

(ii) This calculation involved two stages and many candidates stopped after the first stage and gave an answer of 10 500 J. Other sources of error included the use of a wrong time difference, (both 8.0 minutes and 15 minutes were chosen by several candidates).

Question 4

(a) (i) There were some good answers here and many candidates gave answers in terms of the frequency of the molecular collisions with the wall. There were two instructions here: *Describe* and *Explain*. A minority of candidates merely described what the graph showed.

(ii) The answer to this question required the candidate to read a pair of values from the graph (there were several simple possibilities) and to apply the formula $p_1V_1 = p_2V_2$ using the pressure given in the question. Many candidates tried simply to read a volume from the graph that corresponded to the given pressure. The graph did not, however, extend to the value given.

(b) Both parts **(i)** and **(ii)** were well answered by the majority of candidates.

Question 5

(a) (i) This part proved challenging for many candidates. The strongest answers mentioned the fact that ultrasound is inaudible to humans. Although the range of audible sound frequencies needs to be known, only a minority of candidates adapted this knowledge to deduce a minimum possible frequency of ultrasound waves.

(ii) This part revealed several misunderstandings although many candidates did produce strong answers.

(b) Most candidates approached this part in the correct way by using the equation $x = vt$ in some form. A very common mistake was to ignore the factor of 2 that is needed because the time given in the question is for the journey from X to Y and back.

Question 6

(a) (i) The angle of refraction is shown in the diagram but the angle of incidence needs to be calculated as it is its complement that is shown. Only a minority of candidates used the correctly calculated angle of incidence.

(ii) The appropriate formula was supplied by many candidates but only a small proportion of these used it correctly to calculate the critical angle.

(b) Both the endoscope and optical fibres featured very commonly although a few other uses were given by some candidates. The diagrams varied in quality.

Question 7

(a) Most candidates stated the sign of the charge correctly but some of these gave an incorrect explanation involving the movement of positive charges or even positive electrons. Some candidates suggested that the pole would gain negative charge from the cloud.

(b) (i) Although this was quite frequently correct, it was a part where the division by a number in standard form that included a negative power of ten caused some inaccurate answers to be given. Similarly, the equation $I = Q/t$ was not always rearranged correctly.

(ii) A correct suggestion was often given here.

(c) Most candidates gave the correct answer to this part.

Question 8

(a) (i) This was answered correctly by stronger candidates. The device was very frequently shown with only one input terminal.

(ii) Most candidates had some understanding of what was expected but only a minority gave the correct figures.

(b) (i) This was generally well answered.

(ii) Many candidates realised that the LED would switch off but a common incorrect answer suggested that the current would divert through the thermistor, in some way, as its resistance had decreased.

(c) Some candidates stated that in this circuit the LED would switch on as the temperature rose but others did not. Many candidates omitted the second part and did not suggest any possible use for this circuit.

Question 9

(a) (i) Many candidates offered one or two reasons and these were very usually correct.

(ii) Although some candidates gave a correct factor, many others suggested an answer that influenced the current by influencing the e.m.f. That this part was concerned with the current was not always noticed.

(b) (i) Most candidates aimed at a sinusoidal curve of some description but many of these drew curves that were not drawn with sufficient care and full credit could often not be awarded.

(ii) Many candidates drew a *T* at one of the peaks but there were other answers which were not correct.

(iii) Many candidates found this quite challenging but stronger candidates were often able to state what happened and explain why.

Question 10

(a) (i) This was correctly answered by many candidates although a few candidates simply wrote in the numbers 91 and 143 in either order.

(ii) This part was also well answered with many candidates realising the effect of the *-1* on the proton number of the uranium nucleus.

(b) (i) There were many good answers although answers such as *α-particles* suggested that the intention of the question had not been fully appreciated.

(ii) This was quite well answered with a significant number of candidates being awarded full credit for the completely correct answer with unit. Many of the candidates who were not awarded full credit made good progress and omitted to add on the background count at the end. Of these some did not take it off originally either.

(iii) This was generally not well answered and very few candidates hinted at the random variation that is a feature of radioactive emission.

PHYSICS

Paper 0625/51
Practical Test

Key messages

- Candidates need to have had a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations and justifications will need to be based on practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to different situations. Questions should be read carefully to ensure that they are answered appropriately.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- handling practical apparatus and making accurate measurements
- choosing the most suitable apparatus.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics.

Questions on experimental techniques were answered much more effectively by candidates who clearly had regular experience of similar practical work and much less successfully by those who, apparently, had not.

The practical nature of the examination should be borne in mind when explanations or justifications are required, for example in Questions **1(e)**, **2(b)** and **3(f)**.

Comments on specific questions

Question 1

(a) The majority of candidates successfully recorded the distances, and calculated *A* and *B* correctly.

(b) Most candidates labelled the graph axes correctly and drew them the right way round with the origin included, as instructed in the question. Plotting was generally accurate. Many candidates drew a well-judged straight line although some drew a 'dot-to-dot' line whilst others drew a straight line that did not match the plots. Some candidates drew lines which were too thick or the plots too large.

(c) Here candidates were asked to show clearly on the graph the method used to find the intercept. Many did this well but some did not continue the line drawn through the plots but changed the direction of the line to 'force' it through the origin.

(d) Most candidates successfully read the value for *Y* from the graph and went on to calculate *W* correctly.

(e) Candidates who wrote about a difficulty in a convincing manner, showing that they had thought about the experiment, answered well. Many sensibly chose to mention the difficulty in making the rule balance horizontally.

(f) Strong candidates followed the experiment through with care and accuracy and gave good answers.

Question 2

(a) Most candidates recorded realistic values for the potential difference and current. The potential difference had to be given to at least 1 decimal place, and the current to at least 2 decimal places. The majority of candidates calculated the resistance correctly. The units m, V, A and Ω were recorded correctly by many candidates. Some used cm for *d* and a few missed the unit for *d* in spite of correctly recording the other units.

(b) The response here had to match the candidate's experimental results. Many noted that the resistance was not constant but a significant proportion had difficulty in justifying their answer with reference to the results.

(c) Here candidates were expected to notice from their observation of the experiment that the lamp filament changed brightness. Then they needed to relate this to the change in temperature of the filament that caused the change in resistance.

(d) Many candidates correctly identified the variable resistor as the component but a whole range of other components were seen – most commonly the thermistor. The circuit symbol needed to be carefully drawn. The circuit itself had to be accurately drawn with the variable resistor in series with other components and all the circuit symbols correctly drawn.

Question 3

(a) Many candidates recorded a value of *v* within the tolerance allowed and went on to calculate f_1 correctly.

(b) The second *v* value was again often within tolerance. For full credit, both *f* values had to be within the tolerance allowed, showing that the candidate had carried out the procedure with care.

(c) Here the candidate was required to show knowledge of how to calculate an average value.

(d) Many candidates found the focal length by this second method to within the tolerance allowed. At this point candidates were tested on using the correct unit (cm).

(e) Candidates who had followed the experiment through with care and accuracy obtained values for *x* and *y* that were very similar, giving a small value for the difference.

(f) Successful candidates made a relevant suggestion from their experience. Others made more vague suggestions. Some candidates appeared to be relying on answers they had learned from past papers that were not appropriate for this experiment.

Question 4

This planning question was a new type of question for this paper. Many candidates coped well with the challenge. Successful candidates were able to write a brief, logical account, using the guidelines given. Firstly candidates had to decide which beaker to use. Next they needed to explain the method. Most chose to monitor the temperature of hot water as it cooled over a period of time. Repeats using each of the three insulating materials were required. The table headings had to match the method and be shown clearly with the correct units. The explanation of how to reach a conclusion also had to match the method.

PHYSICS

Paper 0625/52
Practical Test

Key messages

- To achieve well in this test, candidates need to have a thorough grounding in practical work during the course.
- Candidates should have as much personal experience of carrying out experiments as possible.
- The practical work should include reflection and discussion of the significance of results, precautions taken to improve reliability and control of variables.
- Centres are provided with a list of required apparatus well in advance of the examination date. Where centres wish to substitute apparatus, it is essential to contact Cambridge to check that the change is appropriate and that candidates will not be disadvantaged. Any changes must be recorded in the Supervisor's report.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical work carried out, rather than on theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to unusual situations. Papers will contain a planning question, requiring candidates to design an experiment to investigate a given brief.

General comments

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

- handling practical apparatus and making accurate measurements
- tabulation of readings
- graph plotting and interpretation
- manipulating data to obtain results
- drawing conclusions
- understanding the concept of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- choosing the most effective way to use the equipment provided

The majority of candidates were well prepared and able to demonstrate some ability and understanding across the whole of the range of practical skills being tested. All parts of every practical question 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 almost always included, writing was neat and 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.

The gathering and recording of data presented few problems for any candidates. However, there was evidence of some candidates not having the use of a calculator.

The ability to record readings to an appropriate precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, still causes difficulty for many candidates. On some occasions it was difficult to read corrected answered. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Some candidates still find difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

There were instances this year, of centres potentially disadvantaging their candidates by not supplying the correct apparatus or by changing the value of a component and not recording this on the Supervisor's Report sheet. It is important to provide details of changes made to the specified apparatus, and possibly specimen results if appropriate, so that full credit can be given to candidates' results which lie outside the expected tolerance values. Cambridge should agree major changes to apparatus in advance of the examination date.

Comments on specific questions

Question 1

(a) In many centres, all candidates' values for S_0 were out of range. Some candidates had *S* values decreasing. Since the apparatus was set up for candidates, this was the Supervisor's responsibility. Where modifications are made to the apparatus, a note must be written on the report form so that the examiner can make allowances for this. Some complete centres had a very large range for *S* – it would be helpful to know the spring constant, if a spring other than the suggested one was used. While most candidates could calculate the extension, *e* values correctly, some unexpected answers were seen, with no obvious method whereby these were obtained.

(b) It was rare to see a set-square or small ruler used to aid reliability of readings. Most precautions related to the avoidance of parallax when taking the readings. Take the reading at eye level was a common acceptable response. Waiting for the spring to stop bouncing was a common incorrect answer.

(c) The graph proved to be straightforward for most candidates. Only a minority of candidates reversed the axes, although some candidates did choose scales that made too little use of the graph paper available. Scales which involved multiples of 3, 7, etc. were much less evident this year than in previous years. Best-fit lines were usually well judged, but there were still many dot-to-dot lines or curves. The standard of point plotting and of line drawing continues to improve and there was not as much evidence this year of large dots or thick lines.

(d) Most candidates drew a good graph for this part, with relatively few omitting the unit of weight. A very small number multiplied their answer by 10 and then quoted their final answer in kg suggesting a fundamental misunderstanding about the relationship between mass and weight. Candidates occasionally lost credit by ignoring the instruction given in the question, namely to show on the graph how the information was obtained.

Question 2

(a)(b) The table was usually completed with a full set of temperatures for the cooling of beakers A, B and C. Correct units almost always given for the temperature and the time. Some candidates misunderstood the instruction to measure and record the temperature of the hot water at $t = 0$, and inserted a value for room temperature at the head of the table.

(c) (i) A sizeable minority of candidates did not tick the statement that best described the results that they had obtained.

(ii) Although most candidates attempted to justify the answer they had given in **(i)**, the instruction to make reference to the readings was often ignored, and the answer given was purely qualitative.

(d) Most candidates were able to give at least one condition that should be kept the same in order to make a fair comparison. A common answer which was not accepted was to use the same volume/amount of water. This was because the same volume of water was used by the candidates when investigating the cooling of the beakers.

(e) Most candidates produced a correct diagram. However, some candidates then went on to write something which contradicted what they had drawn on their diagram. Students should be advised that where a question states "you may draw a diagram", they should take advantage of this suggestion.

Question 3

(a) (i)(ii) In this question, some whole centres clearly used a lens other than that specified, resulting in out-of-range values for *a* and *b* and also h_1. It has been pointed out that a lens of focal length ~ 16.7 cm has a power of +6D and it is possible that such a lens may be more widely available than one of 15 cm and centres may have felt it was sufficiently close to 15 cm that it was unnecessary to mention it. Centres must first check with Cambridge and also report if a lens with a focal length different to the specified value has been used. Every effort was made to adjust the expected tolerance values for the distances involved in this experiment so that candidates were not disadvantaged.

Candidates were able to calculate the magnification, although it seems that many have been taught to always quote their answer to 3 significant figures, with no regard as to the precision of the measurements.

(c) Although many candidates seem to have grasped the concept of experimental uncertainty, far too many stated that the suggestion was false because the product did not exactly equal 1. There is a subtle difference between the results supporting the suggestion (that m_1 x m_2 = 1) and m_1 x m_2 *actually* equalling 1.

(d) Most candidates could state at least one valid precaution and "a darkened room" was a very common answer. However, fewer could get two, despite the wide range of options.

Question 4

In this planning question, many candidates failed to identify the resistance wire in the circuit they had drawn.

A large number of candidates thought that 3 (or 2 or even 1) different lengths were sufficient to carry out this investigation. Those who performed well usually increased the length of the wire in 5 cm increments from 5 cm, or 10 cm increments from 10 cm, or 20 cm increments from 20 cm. However, it was not uncommon to see very short wires of only a few millimetres or very long wires of several metres.

Overall the impression given was that that many candidates had never carried out this investigation or, in some cases, appeared not to have been taught about electricity.

A number of candidates wrote too much, giving far more information than was asked for. It was quite common to see a hypothesis, sample results and graph sketched. Candidates should confine their answers to the five bullet-pointed sentences at the end of the question that tells them what is required.

The strongest candidates performed well, giving a clear diagram and a table with correct headings and at least five suggested values for length with very little writing needed at all.

Centres should stress to students that the five different lengths that we accept are an absolute minimum, constrained by time limitations in an examination, and that in reality more are desirable.

PHYSICS

Paper 0625/53
Practical Test

Key messages

- To achieve well in this test, candidates need to have a thorough grounding in practical work during the course.
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- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical work carried out, rather than on theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
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General comments

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- choosing the most effective way to use the equipment provided

The majority of candidates were well prepared and able to demonstrate some ability and understanding across the whole of the range of practical skills being tested. All parts of every practical question 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 almost always included, writing was neat and 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.

The gathering and recording of data presented few problems for any candidates. However, there was evidence of some candidates not having the use of a calculator.

The ability to record readings to an appropriate precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, still causes difficulty for many candidates. On some occasions it was difficult to read corrected answered. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Some candidates still find difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

There were instances this year, of centres potentially disadvantaging their candidates by not supplying the correct apparatus or by changing the value of a component and not recording this on the Supervisor's Report sheet. It is important to provide details of changes made to the specified apparatus, and possibly specimen results if appropriate, so that full credit can be given to candidates' results which lie outside the expected tolerance values. Cambridge should agree major changes to apparatus in advance of the examination date.

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(b) It was rare to see a set-square or small ruler used to aid reliability of readings. Most precautions related to the avoidance of parallax when taking the readings. Take the reading at eye level was a common acceptable response. Waiting for the spring to stop bouncing was a common incorrect answer.

(c) The graph proved to be straightforward for most candidates. Only a minority of candidates reversed the axes, although some candidates did choose scales that made too little use of the graph paper available. Scales which involved multiples of 3, 7, etc. were much less evident this year than in previous years. Best-fit lines were usually well judged, but there were still many dot-to-dot lines or curves. The standard of point plotting and of line drawing continues to improve and there was not as much evidence this year of large dots or thick lines.

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Question 2

(a)(b) The table was usually completed with a full set of temperatures for the cooling of beakers A, B and C. Correct units almost always given for the temperature and the time. Some candidates misunderstood the instruction to measure and record the temperature of the hot water at $t = 0$, and inserted a value for room temperature at the head of the table.

(c) (i) A sizeable minority of candidates did not tick the statement that best described the results that they had obtained.

(ii) Although most candidates attempted to justify the answer they had given in **(i)**, the instruction to make reference to the readings was often ignored, and the answer given was purely qualitative.

(d) Most candidates were able to give at least one condition that should be kept the same in order to make a fair comparison. A common answer which was not accepted was to use the same volume/amount of water. This was because the same volume of water was used by the candidates when investigating the cooling of the beakers.

(e) Most candidates produced a correct diagram. However, some candidates then went on to write something which contradicted what they had drawn on their diagram. Students should be advised that where a question states "you may draw a diagram", they should take advantage of this suggestion.

Question 3

(a) (i)(ii) In this question, some whole centres clearly used a lens other than that specified, resulting in out-of-range values for *a* and *b* and also h_1. It has been pointed out that a lens of focal length ~ 16.7 cm has a power of +6D and it is possible that such a lens may be more widely available than one of 15 cm and centres may have felt it was sufficiently close to 15 cm that it was unnecessary to mention it. Centres must first check with Cambridge and also report if a lens with a focal length different to the specified value has been used. Every effort was made to adjust the expected tolerance values for the distances involved in this experiment so that candidates were not disadvantaged.

Candidates were able to calculate the magnification, although it seems that many have been taught to always quote their answer to 3 significant figures, with no regard as to the precision of the measurements.

(c) Although many candidates seem to have grasped the concept of experimental uncertainty, far too many stated that the suggestion was false because the product did not exactly equal 1. There is a subtle difference between the results supporting the suggestion (that $m_1 \times m_2 = 1$) and $m_1 \times m_2$ *actually* equalling 1.

(d) Most candidates could state at least one valid precaution and “a darkened room” was a very common answer. However, fewer could get two, despite the wide range of options.

Question 4

In this planning question, many candidates failed to identify the resistance wire in the circuit they had drawn.

A large number of candidates thought that 3 (or 2 or even 1) different lengths were sufficient to carry out this investigation. Those who performed well usually increased the length of the wire in 5 cm increments from 5 cm, or 10 cm increments from 10 cm, or 20 cm increments from 20 cm. However, it was not uncommon to see very short wires of only a few millimetres or very long wires of several metres.

Overall the impression given was that that many candidates had never carried out this investigation or, in some cases, appeared not to have been taught about electricity.

A number of candidates wrote too much, giving far more information than was asked for. It was quite common to see a hypothesis, sample results and graph sketched. Candidates should confine their answers to the five bullet-pointed sentences at the end of the question that tells them what is required.

The strongest candidates performed well, giving a clear diagram and a table with correct headings and at least five suggested values for length with very little writing needed at all.

Centres should stress to students that the five different lengths that we accept are an absolute minimum, constrained by time limitations in an examination, and that in reality more are desirable.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to unusual situations. Questions should be read carefully to ensure that they are answered appropriately.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:
- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurements
- choosing the most suitable apparatus

It is assumed that, as far as 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. Some of the skills involved in experimental work, including graph plotting and tabulation of readings, can be practised without doing experiments. However, there are parts of this examination in which the candidates are asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those who, apparently, had not.

The practical nature of the examination should be borne in mind when explanations, justifications or further developments are asked for. For example see **Questions 1(e)** and **(f)**, **2(b)**, **3(f)** and **5(e)**.

Comments on specific questions

Question 1

(a) The majority of candidates successfully calculated *A* and *B* and either knew, or worked out the unit N cm. Some candidates recorded N/cm or other inappropriate units.

(b) Most candidates labelled the graph axes correctly and drew them the right way round with the origin included, as instructed in the question. Plotting was generally accurate. Many candidates drew a well-judged straight line although some drew a 'dot-to-dot' line whilst others drew a straight line that did not match the plots. Some candidates did not gain credit because their line was too thick or the plots too large.

(c) Here candidates were asked to show clearly on the graph the method used to find the intercept. Many did this well but some did not continue the line drawn through the plots but changed the direction of the line to force it through the origin.

(d) A large number of candidates obtained a value for *W* that was within the tolerance allowed.

(e) This part gave candidates the opportunity to comment on the experiment, using their experience of similar experiments carried out during the course, and to identify a difficulty that they had encountered. Stronger candidates were able to explain simply that it is very difficult to exactly balance the metre rule on the pivot. There were many possible ways to answer this part and candidates were given credit for a suitable, considered comment.

(f) Here candidates were asked to consider how reliable they thought the readings might be, and to make a judgement on the results. Strong answers included a clear statement which was justified with comments on the closeness (or otherwise) of the two values.

Question 2

(a) The majority of candidates read the meters correctly and entered the correct units.

(b) Most candidates read the thermometer scale correctly.

(c) Many candidates drew a neat diagram showing the bottom of the meniscus read at right angles to the scale.

Question 3

(a) The majority of candidates calculated the resistance correctly. Consistent use of either two significant figures or three significant figures was credited. The units m, V, A and Ω were recorded correctly by many candidates. Some used cm for *d* and a few candidates missed the unit for *d* in spite of correctly recording the other units.

(b) Here candidates were expected to realise that the presence of a current reading showed that the filament was not broken.

(c) Here candidates were expected to notice from the table that the lamp filament changed brightness. Then they had to relate this to the change in temperature of the filament that caused the change in resistance.

(d) Many candidates correctly identified the variable resistor as the component but a whole range of other components were seen – most commonly the thermistor. It was expected that the circuit symbol could be carefully drawn. The circuit itself needed to be accurately drawn with the variable resistor in series with other components and all the circuit symbols correctly drawn.

Question 4

This planning question was a new type of question for this paper. Many candidates answered well. Successful candidates were able to write a brief, logical account, using the guidelines given. Firstly candidates had to decide which beaker to use. Next they needed to explain the method. Most chose to monitor the temperature of hot water as it cooled over a period of time. Repeats using each of the three insulating materials were required. The table headings needed to match the method and be shown clearly with the correct units. The explanation of how to reach a conclusion also had to match the method. Credit was available for other relevant suggestions involving precautions designed to improve the reliability of results or the control of variables.

Question 5

(a) Most candidates measured *u* and *v* accurately.

(b) Many candidates correctly multiplied by 10 to obtain the *U* and *V* values. Some divided by 10; a few gave results apparently unrelated to *u* and *v*. Some rounding errors were seen in the value for *f*. The answer was expected to be given to two or three significant figures. Many candidates did not take the value shown on the calculator and adjust to a suitable number of significant figures.

(c) Most candidates successfully calculated the average value from the results given.

(d) Here candidates were expected to realise that the difference in the two results was within the limits of experimental accuracy. This could be expressed in a number of ways as long as the meaning was clear.

(e) Successful candidates made a relevant suggestion from their experience. Weaker answers made vague suggestions that that did not go further than saying that they would follow the instructions carefully. Some candidates appeared to be relying on answers they had learned from past papers and these were generally were not appropriate for this experiment.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

- Candidates should have as much experience of carrying out practical experiments as possible.
- Candidates should be advised to read the questions through very carefully to ensure that they are answering the question as written, and not simply recalling the answer to a similar question.
- Candidates will need to have had a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability, and control of variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to unusual situations. Papers will contain a planning question requiring candidates to design an experiment to investigate a given brief.

General comments

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

- handling practical apparatus and making accurate measurements
- tabulating of readings
- graph plotting and interpretation
- manipulating data to obtain results
- drawing conclusions
- understanding the concept of results being equal to within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- choosing the most effective way to use the equipment provided.

Most of the candidates entering this paper were well prepared and the practical skills being tested proved to be accessible to the majority of the candidature. Most candidates demonstrated that they were able to draw upon their own practical experience to answer the questions. No parts of any question proved to be inaccessible to candidates and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record measurements clearly and perform calculations accurately and correctly. Units were well known and were invariably included, writing was legible and ideas were expressed logically. However, candidates seemed less able to derive conclusions from given experimental data and justify them.

The vast majority of candidates finished the paper and there were few scripts with substantial numbers of blank responses to the questions set. There were some scripts which showed an exemplary understanding of practical skills but equally, there were those which demonstrated a lack of graph skills, poor understanding of significant figures and a lack of comprehension of good practice in carrying out experiments.

Comments on specific questions

Question 1

(a) Most candidates measured the unstretched length of the spring from the diagram correctly. A minority of candidates ignored the unit given at the head of the column and quoted the length as 5.5 (cm) and not 55 (mm).

(b) (i) While most candidates could calculate the *e* values correctly, some unusual answers were seen, with no obvious method as to how these were obtained.

(ii) It was rare to see a set-square or small ruler used to aid reliability of readings. Avoiding parallax by placing the eye level with the reading was more common, and placing the rule close to the spring was also a popular acceptable answer. Waiting for the spring to stop bouncing was a common incorrect answer.

(c) The graph was accessible even for those candidates who obtained the wrong results for the experiment. Only a minority of candidates reversed the axes, although some candidates did choose scales that made too little use of the graph paper available. Scales which involved multiples of 3, 7 etc. were much less evident this year than in previous years. Best-fit lines were usually well judged, but dot-to-dot lines or curves were still in evidence. The standard of point plotting and of line drawing continues to improve and there was not as much evidence this year of large dots or thick lines.

(d) Many candidates drew a good graph for this part, with relatively few omitting the unit of weight. A very small number multiplied their answer by 10 and then quoted their final answer in kg – suggesting a fundamental misunderstanding about the relationship between mass and weight. Candidates occasionally ignored the instruction given in the question, namely to show on the graph how the information was obtained.

Question 2

(a) Many candidates defined *x* as the distance to the edge of P rather than the centre of mass. The arrows to indicate this distance were often not drawn with care, and it was often difficult to determine on which part of cube P the arrow ended.

(b) Although "cube" and "regular" shape were very common answers some answers were too vague to gain credit, suggesting definite or smooth shapes. Two-dimensional shapes were also accepted here.

(c) "Repeat and take the average" was a more common correct response given than allowing the beam to tip both ways. However, many candidates failed to average after repeating the experiment.

(d) Although there were some very good answers to this part, many candidates clearly had no idea that the markings would be covered up, suggesting they had never carried out an experiment of this type.

(e) Very many candidates assumed that the rule was uniform and simply suggested measuring the mid-point of the rule as a method of determining the position of its centre of mass – often by using another rule. The idea of balancing the unloaded rule on the knife-edge to determine the balance point was not well known.

Question 3

(a) Candidates were able to calculate the magnification, although it seemed that many have been taught to always quote their answer to 3 significant figures, with no regard as to the precision of the measurements.

(b) Most candidates answered well here. In weaker answers, the unit with the magnification was often missing, or candidates quoted the answer to too many significant figures.

(c) Although many candidates seem to have grasped the concept of experimental uncertainty, many stated that the suggestion was false because the product did not exactly equal 1.There is a subtle difference between the results supporting the suggestion (that $m_1 \times m_2 = 1$) and $m_1 \times m_2$ *actually* equalling 1.

(d) Most candidates could state at least one valid precaution and "a darkened room" was a very common answer. However, fewer could get two, despite the wide range of options.

(e) Only a small number of candidates answered this question well. The idea that the image appears to be well-focused over a range of lens positions was not widely known.

Question 4

In this planning question, many candidates failed to identify the resistance wire in the circuit they had drawn.

A large number of candidates thought that 3 (or 2 or even 1) different lengths were sufficient to carry out this investigation. Those who performed well usually increased the length of the wire in 5 cm increments from 5 cm, or 10 cm increments from 10 cm, or 20 cm increments from 20 cm. However, it was not uncommon to see very short wires of only a few millimetres or very long wires of several metres.

Overall the impression given was that that many candidates had never carried out this investigation or, in some cases, appeared not to have been taught about electricity.

A number of candidates wrote too much, giving far more information than was asked for. It was quite common to see a hypothesis, sample results and graph sketched. Candidates should confine their answers to the five bullet-pointed sentences at the end of the question that tells them what is required.

The strongest candidates performed well, giving a clear diagram and a table with correct headings and at least five suggested values for length with very little writing needed at all.

Centres should stress to students that the five different lengths that we accept are an absolute minimum, constrained by time limitations in an examination, and that in reality more are desirable.

Question 5

(a) The table was usually completed with a correct value read from the diagram of the thermometer scale. Correct units were almost invariably given for the temperature and the time, although occasionally the unit of time was missing.

(b) (i) A minority of candidates did not tick the statement that best described the results that they had obtained.

(ii) Although most candidates attempted to justify the answer they had given in **(i)**, the instruction to make reference to the readings was often ignored, and the answer given was purely qualitative.

(d) The majority of candidates were able to give the name of a suitable material for the lid of the beaker and support their choice with a correct reason.

(e) Most candidates produced a correct diagram. However, some candidates then went on to write something that contradicted what they had drawn on their diagram. Students should be advised that where a question states 'you may draw a diagram', they should take advantage of this suggestion.

PHYSICS

Paper 0625/63
Alternative to Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable.
- Candidates should be ready to apply their practical knowledge to unusual situations.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurements
- choosing the most suitable apparatus.

It is assumed that, as far as 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. Some of the skills involved in experimental work, including graph plotting and tabulation of readings, can be practised without doing experiments. However, there are parts of this examination in which the candidates are asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those who, apparently, had not.
This was seen in the clear practical details given by some candidates in **Questions 1(d)** and **(e)**, **Question 2(e)** and **Question 4(d)**.

It is expected that numerical answers will include a matching unit and will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate. These points were demonstrated in many good responses to **Question 2(d)** and **Question 4(e)**. Where explanations or justifications are required, candidates should base them on practical considerations, using data from the question. Theoretical responses are not usually acceptable. Good detail was seen in many of the answers to **Question 1(c)** and **Question 4(f)**.

<u>Comments on specific questions</u>

Question 1

(a) Most candidates answered correctly but 20.1 was seen on a few occasions.

(b) Although responses were generally good, many candidates omitted the temperature unit and sometimes the time unit. This was the main reason for not gaining full credit, rather than showing the units incorrectly.

(c) (i) Many concluded correctly that thermometer **A** cooled more quickly, citing the greater temperature change in the same time as an explanation. However, a number of candidates gave theoretical reasons rather than using results as evidence for the statement and did not gain credit. Some candidates arrived at their conclusion by comparing the final temperatures. This would be valid only if the starting temperatures were the same.

(ii) This was answered correctly by most candidates. A number of candidates gained credit by identifying that the initial and final cooling rate were the same. Weaker answers gave the decrease in cooling rate or the fact that it changed but these are not unusual and could not be credited.

(d) (i) Stronger answers identified that this action allowed cooling with wet and dry cotton wool to be compared. However, most candidates did not recognise the significance of this part of the procedure.

(ii) Only the stronger candidates answered this question correctly.

(e) Many candidates gained partial credit here. The need for starting temperatures to be the same was a common correct answer, although not mentioned in the previous question. Weaker candidates gave single word responses such as 'time'. Credit was given for clear reference to the duration of the cooling period but not for the intervals between recording successive temperatures.

Question 2

(a) Many candidates gave the correct answer and showed a clear, well-structured calculation based on the readings at the edges of the mass. Some assumed that the mass was placed symmetrically and used the average of 68.0 cm and 72.0 cm. This gave the correct answer but did not allow for adequate working for full credit.

(b) Most candidates obtained the correct values of F and presented them consistently to 2 decimal places. There were some transposition errors, particularly showing the last figure as 4.50, as well as mistakes with rounding or consistency of significant figures.

(c) There were many good responses to this graph question. Some candidates reversed the axes but scales were for the most part sensible. A small number of candidates equally spaced the F values on the vertical axis, producing an inconsistent scale. Plotting was mostly correct with many candidates indicating the plots with fine crosses as advised in previous reports to Centres. Many candidates produced a fine, straight, well-judged line of best fit but this proved to be a problem for a significant number of weaker candidates. The line was often forced through the origin although the trend of plots did not indicate this.

(d) (i) Most candidates obtained the correct value from their line. 0 was accepted here, although not for the weight of the rule in the following question.

(ii) Many good answers gave a value in the expected range, included a unit and expressed the value to 2 or 3 significant figures. However, a number of responses had no unit or were given to an excessive number of significant figures.

(e) Many candidates found this question challenging and most incorrect answers were based on poor experimental practice, such as misreading the forcemeter. Stronger candidates referred to the possibility of inexact values of the loads or a non-uniform rule, with a mass which was not at its centre. Unavoidable practical issues such as the mass sliding on the angled rule were accepted if clearly explained.

Question 3

This question proved to be the most challenging on the paper for many candidates. A number of candidates showed a knowledge of experimental techniques, but some had difficulty in interpreting the required practical approach to investigate the given relationship. There were some very clear answers with a significant amount of good detail. Most of these followed the structure suggested by the question and it was clear from some responses that the bullet points had been used by candidates as a checklist of what was to be included.

Only a few candidates drew the standard arrangement for a lens experiment. A number of candidates did not draw the required diagram at all and had subsequent difficulty in describing how the apparatus was to be arranged. The common mistake of not using a screen but looking through the lens to see the image suggested that many did not have experience of this type of practical work. Many candidates included a lamp, remembering the need for an illuminated object, but this was sometimes used to produce a shadow of the object rather than an image.

The most common error in the instructions for carrying out the experiment was to omit the need to move the screen in order to focus the image. Even the best candidates apparently assumed that a focused image would appear as soon as the apparatus was set up. The better answers were clear about the lengths to be measured and subsequently plotted on graphs, referring specifically to 'object distance' and 'height of image'. A number of candidates drew ray diagrams, a theoretical construct rather than a practical experiment. These responses could gain some credit by correctly referring to the graph.

A significant number of candidates did not answer this question, suggesting a possible lack of preparation for this type of question.

Question 4

(a) Many good answers were seen with a correct voltmeter symbol in parallel with lamp **P**. However, a lot of candidates, even those with otherwise good answers, gave incorrect answers, frequently showing the voltmeter in series.

(b) A number of candidates recorded the correct value but there were many errors, most commonly 0.215.

(c) Reading of the voltmeters was clearly better than the ammeter, with many correct answers recorded.

(d) (i) Many candidates recognised that the presence of a current was an indicator of the filament not being broken. The small potential difference across lamp **Q** was also acceptable as an indicator. A number of candidates giving this answer added that the potential difference would be 0.0 V if the filament was broken, rather than correctly identifying that it would be the value of the supply voltage. This part of any response was ignored, as it relied on theoretical knowledge rather than practical observation, and the initial statement was credited. Candidates also pointed out that lamp **P** was bright and this was credited if accompanied by a reference to the lamps being in series.

(ii) Candidates found this question more challenging as it required specific comparison of each potential difference to the working potential difference for full brightness. A number of responses gave a clear comparison for one lamp but not both. Many candidates attempted to use a theoretical answer rather than use the practical data from the question. A common incorrect answer in this case was that lamp **P** had taken all the power and there was none left for lamp **Q**.

(e) Many chose the correct values to be used in the equation, gave an answer to the expected 2 or 3 significant figures and included a unit. However, a large number of candidates could not be fully credited as they recorded a value of 13.04, made rounding errors or omitted the unit.

(f) A large number of candidates recognised correctly that the values did not have be identical for the suggestion to be true. The difference of 0.1 V was within the limits of experimental accuracy and full credit was given for a justification of this type, using values from the question and linked to a positive statement. Answers indicating that the values were not the same could gain no credit.