PHYSICS (US)

Paper 0443/13
Multiple Choice

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

General Comments

In this paper candidates found **Questions 1**, **2** and **24** the easiest. **Question 21** was found difficult by many.

Comments on Specific Questions

Question 3

This question involved calculating average speed, and many weaker candidates used the average value of the maximum and minimum speed to obtain option **C** rather than dividing the total distance by the total time.

Question 4

A majority of the less able candidates believed weight to be an example of mass, rather than force.

Question 6

Many candidates chose option **B** here, including many stronger candidates; although they correctly determined the size of the third force, they did not notice that the car was travelling at a constant speed. The resultant force therefore had to be zero, and the missing force (friction) must be backwards.

Question 15

Option **A** was chosen by more of the weaker candidates than the correct option (**B**); these candidates were not aware that the substance would be at constant temperature while it was melting.

Question 16

Much guessing by weaker candidates was evident in this question on thermal radiation.

Question 17

Many candidates believed that warm air would flow away from the heater under the cupboard.

Question 21

This question on the electromagnetic spectrum showed that most candidates were either unaware that infra-red causes the most heating, or that it is positioned just beyond the red end of the visible spectrum; many chose position **B**.

Question 26

A significant number of the weaker candidates chose option **C** in this question. As this is the exact opposite of the correct response, it is possible that these candidates were unclear about the meaning of 'open' and 'closed' with reference to a switch, even though the question was carefully worded to help any who were unsure about this.

Question 28

The great majority of candidates knew that a longer wire would have a higher resistance, but many of these were less sure about the effect of changing the diameter.

Question 32

Able candidates had little difficulty with this question about a potential divider, but others were unable to use the 1 : 2 ratio of the resistor values to arrive at a value of 8.0 V across the 20 Ω resistor. Most either thought that the voltage would be split evenly between the two resistors, or that each would receive the full 12 V.

Question 34

The popularity of option **B** with less able candidates suggests that they did not notice that the cell in experiments 2 and 3 had been turned round compared with experiment 1.

Question 39

A common mistake here was to confuse the loss of four *nucleons* when an α-particle is emitted with the loss of two *neutrons*. This led candidates to choose option **A** in relatively large numbers.

PHYSICS (US)

Paper 0443/23
Core Theory

Key Messages

Apart from basic matters of learning, there were three further aspects where candidates could have improved their performance:

- In order to improve their performance candidates should practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.
- In calculations, candidates must show clear working to support their answers. If unclear or no working is shown by the candidate and it leads to the correct answer, due credit may be given for the numerical answer. However, when a candidate makes an error that leads to an incorrect numerical answer and no working is shown, marks for the method may not be awarded.
- Greater care and accuracy are needed when drawing diagrams. In all instances ray diagrams must be drawn using a rule or straight edge.

General Comments

A high proportion of candidates had clearly been well taught and prepared for this paper. Equations were generally well known but many struggled when required to rearrange the equations.

The questions on the waves, electrostatics and radioactivity topics were generally not well answered by candidates. There were a significant number of candidates who either did not read the questions carefully, or gave answers that were related to the topic being tested, but did not answer the question.

Often candidates had been well taught how to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they displayed a lack of breadth of understanding. More successful candidates were willing to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations.

Comments on Specific Questions

Question 1

(a) Many candidates gave fully correct answers. The most common error was to forget that volume = length × cross-sectional area, and to try and use some variation of πr^2.

(b) Some candidates made errors in subtracting the times from the digital clock. The most common error was in converting 2 hours and 15 minutes into a decimal fraction; a large number put 2.15 instead of 2.25. With error carried forward allowed, most candidates gained at least partial credit on this section.

(c) Many candidates were successful, but a significant number used the inverse of the equation required.

(d) Many candidates were successful, but a large percentage did not give an adequate reason to support their statement about the boy's estimate.

Question 2

(a) The majority of candidates gave completely correct answers.

(b) (i) Most candidates gave correct answers. The most common error was an incorrect trans the equation density = mass ÷ volume.

(ii) With error carry forward allowed, the majority of candidates were successful here.

Question 3

This was one of the best answered questions on the paper, with candidates displaying a good recall of common units.

Question 4

(a) Many candidates were fully successful. The most common error was to add the two forces instead of subtracting.

(b) Most candidates gave a correct description of the effect of the resultant force on the car's motion. However, a significant number thought that it would make the car move backwards.

Question 5

This question was well answered by the majority of candidates, who displayed a sound understanding of distance-time graphs.

(a) The majority of candidates were successful.

(b) This part was answered well.

(c) The majority of candidates found this straightforward.

(d) Many candidates scored full marks. The most common error was not converting the time into seconds.

Question 6

(a) There were many responses gaining full marks, but a significant percentage did not link the type of power station to its correct energy source.

(b) The majority of candidates were able to complete the flow chart for the solar power station.

Question 7

(a) The majority of candidates were able to recall the names of the four changes of state.

(b) Most candidates displayed a good understanding about the arrangement and motion of particles in a gas. A common mistake was to think that the particles expand when the gas is heated.

(c) There were some very good responses seen, but the majority of candidates were unable to link the evaporation of the liquid to its cooling effect on the hand.

Question 8

(a) The majority of candidates answered this correctly.

(b) There were some very good answers seen, but the majority of candidates were unable to locate the position of the image in the mirror.

(c) Candidates found this question quite challenging, with very few fully correct answers. The most common error was to state that the position of the image was unchanged.

Question 9

Candidates found the question on waves challenging, with very few gaining full credit.

(a) (i) The majority of candidates scored only partial credit in this part.

(ii) A very common error was to give 'sound' as another type of transverse wave.

(iii) Most candidates correctly calculated the distance moved by the wavefront as 30 cm.

(b) (i) There were many good attempts at drawing the wavefronts in shallow water, and many of these scored full marks.

(ii) Few candidates were successful here.

Question 10

Many candidates found this question on electrostatics to be challenging.

(i) Most candidates were able to state that the cloth would be negatively charged; better candidates were able to name the electron as the particles that had been transferred to the cloth.

(ii) The more able candidates scored full credit; for others, explanations were lacking in detail or incorrectly referred to magnetic poles.

(iii) Few candidates scored full credit; many candidates did not go beyond the idea that the shirt became charged.

Question 11

(a) The majority of candidates were at least partially successful.

(b) Many candidates scored full credit, but a significant number used an incorrect transformation of $V = I \times R$.

(c) Many candidates could not identify component X as a lamp. Those who did often went on to give a correct description of its purpose.

(d) The best candidates gave adequate descriptions of how the fuse would prevent further damage to the circuit.

Question 12

(a) Many candidates scored full credit, but some thought that the electron was to be found in the nucleus and consequently placed the particles in the wrong order.

(b) Many candidates gained at least partial credit here.

(c) A large number of candidates scored full credit for this question. Many other candidates would possibly have gained more credit if they had set out their working more clearly.

PHYSICS (US)

Paper 0443/33
Extended Theory

Key Messages

Candidates could improve their performance by taking account of the following points.

- The numerical value of any quantity nearly always needs a unit after the number if the numerical value is to have any interpretable meaning. One exception is the quantity *efficiency* and another is *refractive index*. By leaving out a unit or by supplying the wrong one, a candidate's answer is likely not to be awarded full credit.
- It is important that candidates realise that the answers given need to be legible and answers that cannot be understood cannot be credited. Candidates who write on top of a previous answer risk producing answers that cannot be interpreted. This is sometimes the case even when the previous answer has been erased. The new answer should be written neatly next to the crossed-out original or in a blank space, with reference to its new location made in the original answer space.
- Although it is possible to obtain full credit by only supplying the correct answer on the answer line, in the absence of any working out, most errors will result in the awarding of no credit. Candidates should be advised to follow the advice on the front cover of the paper and show their working.

General Comments

There were many good scripts, where accurate and knowledgeable responses revealed a clear understanding of the subject at this level. There were also those who were less familiar with the topics tested and whose answers did not reveal a clear insight into the subject.

Comments on Specific Questions

Question 1

(a) Many candidates drew two correct lines on the graph grid and received full credit. A very few candidates drew a line for the runner suggesting an initial acceleration from zero to 10 m / s during the first second.

(b) (i) This answer could be obtained either from using the area under the graph or from the equation that defines speed. Many candidates obtained the correct answer by one or other of these methods but many more used the formula.

(ii) This was slightly more challenging and a few candidates multiplied the final speed of the car by the total time to obtain an answer that was too big. Many more candidates, however, calculated the correct answer using the area under this graph.

(iii) This was the most testing section of the paper and very few candidates showed any working out. The most popular answer given was 2.0 s which is the time when the speeds of the runner and the car are equal. The candidates who gave the correct answer were in the minority and very rarely offered any explanation as to why this was correct.

Question 2

(a) The correct answer was very commonly given here even by the candidates who performed less well elsewhere on the paper.

(b) (i) The correct formula was used by the majority of candidates but many of these did not co distance from kilometres to metres and gave an answer that was a thousand times too sma number of candidates who expressed the answer in standard form was rather small.

(ii) A very few candidates attempted this by setting the kinetic energy of the train equal to the work done and then determining the speed from the kinetic energy. A significant number of the answers received no credit here.

(iii) Many answers offered a correct suggestion but a few candidates suggested that the speed was smaller than the calculated answer because of safety requirements.

(c) Only a minority of candidates gave a correct answer to this part. The most common suggestions were: 'in the direction of motion' and 'away from the centre'.

Question 3

(a) This was correctly answered on most scripts and full credit was awarded very frequently. A few candidates misunderstood the wording and only drew one arrow from each box on the left.

(b) Most candidates gave a sensible answer here and were rewarded. The answer 'it releases a large quantity of energy' required further qualification and was not, when written on its own, given any credit.

(c) (i) This was frequently correct but a few candidates simply supplied the mass whilst a few others divided the mass by 500 m. A few candidates gave an answer in pounds.

(ii) This calculation was very commonly correct and the answer was almost invariably given in standard form.

(iii) This calculation was also frequently correct. The correct answer was sometimes spoiled by the addition of the unit *joule*.

Question 4

(a) Since the word *linear* is given in the question, it does not, on its own, constitute a satisfactory answer; more was required.

(b) The correct answer was commonly supplied and only occasionally was it spoiled by the omission of the negative sign.

(c) Many answers consisted of one or two correct differences, but there were also answers that suggest erroneously that the sensitivity is related to the speed of a thermometer's response to a sudden temperature change.

(d) (i) The number of answers that implied a slower rate of temperature fall was almost equal to the number of correct answers. Not all candidates realised that the painted thermometer would eventually reach equilibrium at room temperature.

(ii) The correct box was indicated infrequently.

Question 5

(a) There were many answers that related the specific latent heat of fusion to melting but only a small proportion of these obtained full credit by making a correct reference, in some way, to a unit mass.

(b) (i) There were those candidates who realised exactly what was required and easily produced the correct answer. Some others used a wrong mass or tried to use a temperature change of some sort.

(ii) This calculation produced two main types of response. Many candidates obtained the correct answer with the appropriate unit by substituting the correct figures into the correct formula. There

were others who did not reveal that they understood what was expected. There were a answers with the wrong unit.

(iii) Although the basic mechanism of convection was understood, only a minority of candidates referred to the greater density of the cooled water.

Question 6

(a) (i) The locations of the positions A and E were sometimes appropriate and sometimes not. Position E was quite commonly on the same side of the lens as A, which is not correct.

(ii) The correct answer to this part of the question depended on the location of position A given in the previous section. Only a minority of candidates ticked a box that corresponded to their previous answer.

(iii) Most candidates underlined at least one correct answer here and many underlined both correct answers.

(b) (i) There was a mixture of correct and incorrect answers here; often candidates overlooked to mention that the frequency of the light does not change.

(ii) There were many correct answers but some candidates gave answers that only referred to the frequency or the amplitude of violet light.

Question 7

(a) (i) There were many acceptable explanations given but some did not answer in a way that revealed the difference asked for.

(ii) In both parts of this section, there were some good answers. Candidates did not always give their explanations in terms of compressions.

(b) (i) This part was in the main correctly answered. The most common error was to multiply the wavelength of the sound by its speed.

(ii) Most candidates realised what was required here and were able to state why the sound could not be heard.

(iii) The correct calculation was commonly performed and full credit was commonly awarded. The most frequently made error involved the introduction of a factor of two either into the formula or into the final answer.

Question 8

(a) (i) This was correct very often. A few ammeter symbols were drawn in parallel with the battery, the wire, the variable resistor or even with a section of connecting wire.

(ii) Only a minority of candidates made an appropriate suggestion to this part.

(b) (i) Many candidates made some progress here supplying an intermediate answer of 300 (V). Rather fewer, however, produced a correct final answer. There were candidates who obtained *75 000 W* but who then subtracted some other quantity from it before giving a final answer.

(ii) Many candidates realised that the power loss would be reduced and most even gave the reason in terms of the decrease in the resistance. Of those who gave a numerical value to the reduction, the vast majority stated incorrectly that it would be halved.

Question 9

(a) Only a minority of candidates answered this correctly. Answers such as 'fission', 'radioactive' or 'chemical reaction' were not unusual. The answer 'fussion' cannot be credited.

(b) (i) Only a few candidates gave a complete answer here although many stated that the particles were either charged or moving.

(ii) Many candidates gave the correct equation and defined the additional term. A few other candidates gave equations that included $P = VI$ or other electrical equations.

(c) (i) Although some candidates obtained full credit for both parts, many candidates did not give a correct direction.

(ii) Only a small fraction of the candidates drew the arrow in the correct direction. Most other directions within the page were indicated by some candidates.

Question 10

(a) Electromagnetic induction is quite poorly understood by many candidates and only a minority gave a satisfactory explanation.

(b) Very few candidates referred to either the change in the direction of the deflection or to the increase in its magnitude. .

(c) Many good answers were given here and many candidates were awarded full credit and most of the remaining candidates were awarded some credit.

Question 11

(a) (i) There was a variety in the answers offered here with some candidates correctly stating that gamma-radiation would need to be emitted and then giving a correct explanation. Candidates who suggested other types of radiation (some suggested infra-red) usually found it impossible to explain the choice satisfactorily.

(ii) Many candidates explained why the isotope should not have a half-life that was long and others gave reasons for it not being too short. Many candidates made both points.

(b) This was well answered by some candidates but others put ticks in either the first column or the fourth column or in both.

PHYSICS (US)

Paper 0443/04
Coursework

General Comments

Many Centres have continued to produce work of a high standard, therefore justifying the credit awarded. Also the majority have used stimulating and 'open-ended' investigations which allow candidates to show their abilities to the best effect. It is pleasing to see that points made from previous reports were noted.

There were still a few Centres where the credit awarded did not accord with the standards expected. In these cases it was due either to teachers at the Centre being too generous in their marking or, more commonly to Centres choosing assessment tasks which were not appropriate to the skills being assessed.

A large number of samples illustrated clear annotated marks and comments, which was helpful during the moderation process. The candidates at the majority of Centres were given many excellent opportunities to demonstrate their practical skills using a varied range of tasks from different areas of the specification; clearly a large amount of good work has been completed by teachers and students. It is advisable that a maximum of two skill areas should be assessed on each practical exercise.

If more than one teacher has been involved in the assessment of practical skills, then it is very important that internal moderation is undertaken, to ensure that the standards applied for all candidates are comparable. This is made easier where all candidates do the same tasks, and the same mark schemes are used. It is acceptable to use different tasks, but this will require considerably more effort to be made to ensure that marks for one teaching group can be compared directly with those of another. It is best if just one teacher takes on the role of internal Moderator, as this is the only way to ensure that the same standards have been applied for the entire entry from one Centre. The external Moderators cannot change the rank order within a Centre; it is the Centre's responsibility to ensure that this is correct.

Skill C1: Using and Organising Techniques, Apparatus and Materials.

This skill involves following instructions and as such cannot be combined with skill C4 which involves writing instructions. The credit awarded depends on the complexity of the instructions followed, which may be simple one step instructions, more complex multi-step instructions, or instructions which are branched, that is, where there are, at some point, two possible routes to take. The decision as to which route is taken depends on interpretation of an observation.

Skill C2: Observing, Measuring and Recording.

This skill involves making and recording observations. Tasks may be quantitative, involving measurements of qualitative observations. Care must be taken not to provide too much guidance on exactly what to observe and how to record it. The provision of tables and other formats, even in outline, limits the credit which can be awarded.

Trivial exercises involving one or two readings are not sufficient evidence for the higher credit.

Skill C3: Handling Experimental Observations and Data.

This skill involves processing results and finding patterns to arrive at a conclusion. It is much easier to demonstrate this skill if there is data to process. Most suitable of all are tasks from which a graph is produced as this makes it easier to find and explain patterns.

Again care must be taken to not give too much help in the way of leading questions or pre-drawn axes. In this skill also such assistance lowers the credit available.

Skill C4: Planning and Evaluating Investigations.

Here a detailed plan must be written before the investigation is started. It is also essential that the pla then carried out as this enables an evaluation to be made and improvements suggested.

Very simple exercises are not really suitable as there must be opportunity to explain how variables are to be varied, measured or held constant.

Mark schemes should be related both to the task and to the criteria in the syllabus and should not be a slight rewording of the assessment criteria.

It is more straightforward, and can save extra work, if a Centre finds a number of suitable tasks and then sticks with them.