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PHYSICS

Paper 0443/13
Multiple Choice

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

General comments

Candidates performed best in questions **2**, **5**, **8**, **10**, **15**, **32**, **33** and **38**. The greatest difficulty was with questions **12** and **34**.

Comments on individual questions

Question 1

Although a sizeable majority of responses to this measuring cylinder question were correct, a significant number of chose **C**. Possibly they judged by eye how many extra cubes would fit into the cylinder, or they failed to read the question carefully and included the cube already there.

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Question 3

A number of candidates opted for **D** here, despite this distractor including the phrase 'at constant These candidates probably did not realise that a car that is slowing down is accelerating, albeit negative rejected option A, which was the key.

Question 6

This question on resultant force and acceleration was generally well answered, although distractor **C** was chosen quite commonly. These candidates failed to add the two resistive forces and then realise that their total was less than the force from the engine.

Question 11

The most common error here was caused by a lack of understanding that the *useful* work done by the escalator and the lift was the same in each case.

Question 12

This question concerned the simple barometer, and candidates needed to be aware that the *difference* in liquid levels could be used to find the atmospheric pressure. A significant number opted for **C**, failing to appreciate that the lower level was not zero.

Question 20

Many candidates were not aware that television pictures are transmitted from satellites to Earth using microwaves. The syllabus gives this as one of several specific examples of uses of electromagnetic waves.

Question 25

This question concerned the magnetisation of iron rods inside a solenoid. The most common mistake was to think that reversing the battery connections would cause the rods to repel, whereas before the change they had attracted.

Question 26

In any question involving echoes students must always take care that they have considered the time taken for the sound to travel out *and return* to its source, and many failed to do so here.

Question 29

A significant number of candidates chose **D** in this question, not realising that a thin wire would have a higher resistance than an otherwise similar thick wire.

Question 34

All distractors were popular in this question on fuses, with option **C** attracting more candidates than the key (**D**). It was explained that the lamp was not faulty, so the wrong choice of fuse would not be apparent and the lamp would work normally. The point is that a fuse that is rated too highly for a particular purpose is a hidden danger.

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PHYSICS

Paper 0443/23

Core Theory

Key Messages

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

Candidates should concentrate on answering the question just as it has been asked. Marks are only awarded for the specific answers required, not for comments on related matters or a general discourse about the situation.

In calculations, candidates must set out and explain their working correctly. If poor or no working is shown by the candidate and it leads to the correct answer, the Examiner may be able to give credit due to the merit of the work. However, when a candidate gives a wrong final answer and no working is shown, it is often impossible for the Examiner to give due reward for those parts that are correct.

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. Equations were generally well known by better and by slightly below average candidates but many struggled when required to rearrange the equations.

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 could become confused and display a lack of breadth of understanding. More practice in applying knowledge and understanding in unfamiliar situations would deepen candidates' understanding and improve their marks in the examination.

Failure to read the question carefully and the subsequent omission of part of an answer was a major factor in weaker candidates losing marks.

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 so accessible to them that they would have been better 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.

Comments on specific questions

Question 1

(a) (i) The majority of candidates correctly calculated the time. However, a significant number made errors including adding the two times.

(ii) Most candidates gained full credit. Candidates were not penalised again for any mistakes carried forward from **(a)(i)**.

(b) (i)(ii) Most candidates correctly read the volume and divided by 50 to give a correct answer for one drop.

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Question 2

(a) Many candidates thought the barometer was filled with water.

(b) Many candidates thought that the space above the liquid was occupied by air.

(c)(d) Many candidates seemed to have a poor understanding of how the barometer worked.

(e) Many candidates thought that the liquid level would rise if air leaked into the space above the liquid.

Question 3

(a) The majority of candidates gained credit for this section.

(b) Descriptions were generally poor, with most candidates gaining only partial credit, usually for the idea that the molecules move apart during melting.

(c) Most candidates knew freezing point, but a large number thought that this was 1 ºC for ice turning into water.

Question 4

(a) Only the better candidates seemed able to explain why metals were good conductors. A large number of weaker candidates failed to score on this part.

(b) Most candidates gained credit for this section, as the majority recognised that the rod would become charged.

Question 5

(a) Only the weakest candidates failed to identify the component as a lamp.

(b) (i) Many candidates correctly calculated the current in the circuit and gained full credit; others would have scored more if they had shown their method of working.

(ii) Many candidates did not realise that the readings on the ammeters would be the same as that in **(b)(i)**.

(c) (i) The majority of candidates knew the correct symbol for a voltmeter, but far fewer were able to draw it correctly connected across the resistor.

(ii) Candidates were not penalised again for any mistakes carried forward from **(b)(i)**.

Question 6

(a) The majority of candidates scored some credit for their description of how to permanently magnetise a steel rod.

(b) Most candidates correctly identified the force between a N and S pole.

(c) Most candidates correctly stated the induced poles on the iron rod.

(d) A large number of candidates thought there would be an attractive force between the magnet and the rod.

Question 7

The majority of candidates scored the first marking point, but many thought that a sound wave was a transverse wave and a surface water wave was a longitudinal wave.

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Question 8

(a) (i) A number of candidates only ticked **one** box. This was usually the box indicating that soun through air.

(ii) The majority of candidates recognised that sound cannot travel through a vacuum.

(b) (i) A number of candidates failed to state that the first sound heard would travel direct from the explosion.

(ii) Many candidates scored most or all of the available credit for calculating the speed of sound. The most common error was in using 6.0 seconds as a time instead of 0.6 seconds.

Question 9

(a) (i) Many candidates found the calculation involving the transformer equation difficult but could possibly have gained some more credit if they had clearly set out their method of working.

(ii) Many candidates recognised that the lamp would be dimmer, but failed to state that the voltage would be lower.

(b) (i) Very few candidates stated that the transformer was used to increase voltage.

(ii) Many candidates did not realise that a **step-down** transformer was needed.

Question 10

(a) Most candidates were successful, but many tried to read too much into a straightforward item and attempted to write an equation based on the efficiency equation.

(b) Despite their problems with part **(a)**, the vast majority recognised that for a high efficiency the wasted energy needed to be kept as low as possible.

(c) This was probably one of the best scoring questions on the paper, with the majority of candidates gaining most or all of the available credit.

Question 11

(a) Only the very best candidates gained any credit for this question. Very few candidates were able to see the link between alpha particles and the distances involved meaning that the only radiation detected would be background. However in part **(b)** many candidates mentioned that alpha particles could only travel a few centimetres in air.

(b) Most candidates scored in part **(i)** by stating that the detection rate would decrease, but were let down by weak explanations in **(ii)**.

Question 12

(a) (i)(ii) Only the best candidates gained full credit, with very few candidates giving a clear description of nucleon number.

(b) Part **(i)** was poorly understood by most candidates, but some were able to score in part **(ii)** since allowance was made so as not to penalise again their earlier error.

(c) Not all candidates realised that the number of electrons in a neutral atom is the same as the proton number. However, most candidates were able to describe where electrons are found in an atom.

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PHYSICS

Paper 0443/33
Extended Theory

Key Messages

This paper mainly examines supplementary topics from the syllabus. In order to score well on this paper, candidates need to be familiar with the entire syllabus including the core material. Although questions concentrate on the extension material, it is inevitable that certain core topics will be also tested.

Candidates who perform well are able to produce thorough and accurate answers to questions that test several different skills. Some credit is awarded for the simple recall of facts, formulae and relationships. Other, often more abstract, questions require the candidate to give explanations that require a detailed understanding of some aspect of the topic examined. Some questions require accurate and thoughtful calculations. The most challenging of these are likely to involve calculations in which more than one stage is necessary before the answer can be reached.

When a calculation is requested, candidates should be especially careful in the operation of their calculators. It is always unfortunate when a candidate who has produced the correct working out, does not obtain the correct answer because the addition button has been pressed instead of the multiplication button. Other common errors include calculations such as 12 / 2 / 3 where the candidate is trying to calculate 12 / (2 / 3). When calculations involve angles, the candidate should usually ensure that the degrees mode is selected.

General Comments

An occasional candidate finds the time to write out answers in pencil before tracing over them in ink; not only is this a waste of the candidate's time but it can lead to an answer which is less legible than it would otherwise be. This should be strongly discouraged.

Similarly, answers which are written sideways in the margin or above crossed out material can be difficult to read or even to interpret. The amount of space available for written answers should be enough for an answer that obtains full marks but when a candidate has filled this space up and wishes to write more, it is best to write the rest of the answer in a blank space elsewhere in the paper and to make reference to the location in the original answer space. Under no circumstances should any answers be written on the front page.

Comments on Specific Questions

Question 1

(a) (i) This answer was very commonly correct with the overwhelming majority of candidates stating that the line was straight or had a uniform gradient. A few candidates, who might well be advised to read the question more carefully, made no reference to the graph and simply offered a definition of constant acceleration.

(ii) This part was a calculation using numbers which the candidate was expected to obtain from the graph. Most candidates produced the correct numerical answer from the values 36 m / s and 48 s. Other correct values, however, could be used to calculate the acceleration. There remain some candidates who are unsure of the unit of acceleration; a common misunderstanding leads to the incorrect unit m / s^{-2}.

(b) (i) The correct, horizontal line was very commonly given, here. Candidates who did not use a ruler to produce the answer could still gain the credit, provided a little care was taken to produce the line.

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Candidates should be advised, however, to bring a set of correct drawing equipment (ruler, protractor, compasses) to the examination in case they are needed.

(ii) This final section of the question proved rather more testing. The candidates that realised th total area under the graph could be determined by adding the area of a triangle and a rectang frequently scored full credit here. Those candidates that used kinematics formulae, or average speed calculations, were rarely so successful.

Question 2

(a) (i) This calculation was very frequently correctly performed. Some candidates were less familiar with the definition of density and tried to incorporate the time 7.0 hours into the working out. It is unfortunate that some candidates obtained the correct numerical value but followed it with an N to represent the unit as the newton.

(ii) An encouraging proportion of the candidates calculated this answer correctly and produced the correct power of ten and gave the correct unit. Sometimes candidates obtained full credit for using their incorrect answer to **(i)** entirely correctly in this part of the question.

(iii) This part was disappointingly answered. Many candidates, of course, gave the correct answer with the correct unit but there were also those who left the answer space blank, did not divide their value of **(ii)** by the time period given in the question or used a time of 7.0 (units usually unspecified) or more commonly 420 s. Candidates should be encouraged to show full, clear working.

(b) (i) Most candidates gained credit by giving an acceptable definition of *renewable*. Candidates should be discouraged from simply defining the meaning of the word in a more general context; simply stating that such an energy source is one that can be renewed was considered to be simply a restatement of the question and was not given credit.

(ii) Many candidates were able to give two examples of renewable energy sources.

(iii)

Question 3

(a) This was generally well answered with many candidates correctly distinguishing between *speed* and *velocity*. An occasional candidate gave the correct distinction the wrong way round.

(b) (i) This was very frequently well answered. A very few candidates drew an arrow that was either approximately in the direction of the resultant velocity or that was so poorly drawn as to be in no obvious direction at all.

(ii) It was encouraging when candidates drew the correct vector diagram and showed the resultant velocity arrow in the correct direction. Surprisingly, however, rather fewer candidates used the diagram to determine the size of the resultant velocity. It was very disappointing that very few candidates realised that the direction needed to be give as an angle. The most commonly stated direction was *south-east*. This is a horizontal direction that does not apply to this parachutist.

(iii) Only a minority of candidates used the resultant velocity from **(ii)** to calculate the kinetic energy here.

Question 4

(a) Almost all candidates were successful here. The few confusions that did arise, led some candidates to divide 8500 by 10 or to give the unit of weight as the kilogram. A very small number of candidates converted 8500 kg to grams before multiplying by the gravitational field strength.

(b) (i) Many candidates calculated the pressure exerted correctly. Many others omitted the factor of two and obtained an answer that was double the correct value. More rarely, confusion led to an answer that was half the correct value. Almost all candidates gave the unit of pressure as Pa or slightly more long-windedly as N / m^2.

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(ii) This explanation was, to some extent at least, asking the candidates to explain what *pressure*. There were a significant number of candidates who performed well on the question but who scored very poorly here. Phrases such as *the plank spreads out the* reveal that the idea of pressure is not as thoroughly understood as it might be. A few cand made no reference to the increased area of contact produced by using a plank. Some candida produced very good answers which commented on the ratio of the area of contact of the plank t that of the crane driver's boots.

(c) (i) This was often correctly answered. A few candidates gave answers such as *the instant a force is applied*. These candidates need to be more familiar with every part of the syllabus.

(ii) Whilst some answers showed that the candidate had a clear idea of what was required, other candidates gave answers which were not sufficiently exact to gain credit. Examples included *all the moments are equal* and *the upward force equals the weight*; these statements are only true in certain circumstances.

Question 5

(a) Many candidates gained full credit here. A rather disappointing answer was the statement that evaporation is natural whereas boiling is caused by humans.

(b) Many candidates scored the first marking point by referring to the breaking of bonds or otherwise but few candidates scored the second point by explaining what happens to the thermal energy supplied.

(c) This was poorly answered by a very large number of candidates. Only a minority of candidates made any reference at all to the measurements that need to be made. Determining the mass of the steam produced or condensed is not, of course, straightforward. It was, however, particularly disappointing to see candidates suggesting methods such as those that involved determining the mass of steam collected in a balloon by placing the balloon on an electronic balance.

Question 6

(a) (i) Many candidates scored two marks here. The question, however, refers to the molecular structure of a gas and of a liquid. Answers that offered information not related to the structure did not score here.

(ii) Many candidates supplied good statements and explanations, but those explanations that did not refer to the forces between the molecules were not able to gain credit.

(b) (i) Many candidates calculated the correct answer here. Candidates who attempted to answer the question using proportions, frequently gave a volume that was smaller than the original volume of the helium in the cylinder.

(ii) The only correct answers here referred either to the reduced speed or kinetic energy of the molecules. Any reduction in the separation of the molecules is likely to be opposed by the reduced pressure encountered by the rising balloon and so this suggestion was not credited.

Question 7

(a) (i) A very high fraction of the candidates gave an answer in terms of light of a single colour and gained credit this way. Rather fewer mentioned frequency which is technically more correct, or even wavelength.

(ii) Whilst many candidates simply wrote down the correct value given in the question, others either attempted a calculation of some sort or gave a written definition of frequency.

(b) (i) An encouraging number of candidates was able to calculate the refractive index from the two relevant speeds and only a relatively small minority attempted to use the ratio $\sin(i)/\sin(r)$.

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(ii) There were many correct calculations here and the unit supplied was nearly always

Question 8

(a) This was frequently correct. Many correct answers used terms such as *de-localised electrons* o more simply *free electrons*.

(b) Some candidates gave answers which made it clear that the concept of electrostatic induction was understood. Other candidates, however, gave answers in which charge was scraped from the nylon rod on to the copper sphere. Those candidates who gave answers that charged the sphere by induction but then removed the charged rod before the earth connection, did not score full credit here.

(c) The majority of candidates correctly indicated the direction of the electric field that surrounded the charged sphere, but a rather smaller number drew the pattern of the field with sufficient attention to detail. In some cases the diagram was difficult to interpret and did not spread the field lines at all evenly.

Question 9

(a) (i) Most candidates identified the common feature of the two uranium isotopes' nuclei. References to the number of electrons in the atom were ignored as the question asked about the nuclei.

(ii) This mark was very commonly scored by the candidates.

(b) Only a minority of candidates gave answers that suggested a familiarity with the results of this experiment. A few candidates produced very good answers indeed that addressed both the description and the explanation. A common confusion was to suggest that the weak penetrating property of α-particles would prevent any detection to the right of the thin gold foil.

Question 10

(a) This factual recall was very often correct but some candidates revealed confusion with the output tables of other logic gates. The candidates whose output for the input 0, 1 differed from that for the input 1, 0 might have given more careful consideration to what such an answer implied.

(b) (i) Many candidates gave answers which were consistent with the answer given in **(a)** and this revealed an understanding of what is happening here.

(ii) There were many correct answers to this part.

(c) The majority of candidates answered this part either correctly or in accordance with the previous answers supplied.

Question 11

(a) (i) Many candidates gained full credit here by the correct application of the formula $P = VI$. A minority of candidates took the power to be 18 W and lost a single mark for a factor of ten error. There were candidates who attempted to use other formulae such as $I = V / R$.

(ii) This calculation was performed inaccurately by a large number of candidates. In addition to candidates who did not convert 30 minutes to seconds or did so wrongly, there was a significant minority of candidates who did not attempt to use $E = Pt$ or even $E = V I t$.

(b) Most candidates scored at least some credit here for stating that the current is reduced when the transmission voltage is high and many candidates also scored one or two other marks. There remain candidates who state that the higher voltage produces a lower resistance in the cables and some answers reveal that the distinction between current and voltage is not always thoroughly understood.

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PHYSICS

Paper 0443/04

Coursework

General comments

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

Comments on specific skills

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 plan is 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.

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