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International AS and A-level

Physics (9630)
PH05 Physics in practice
Report on the examination

June 2024

REPORT ON EXAMINATION: INTERNATIONAL A-LEVEL PHYSICS (9630) PH05 JUNE 2024

This paper was similar to those of previous years in terms of specification coverage, balance of assessment objectives, and mathematical and physical demand. Students could demonstrate their skills and understanding in a range of contexts. The usual variety of question styles was used. The questions were set in a range of both familiar and unfamiliar contexts.

QUESTION 01

01.1 Many students are still choosing to use awkward and non-linear scales as well as using dots to plot points when drawing graphs. Students should be advised that only crosses and + signs should be used when plotting points as specified in the practical handbook. Some students did not show the scale or only showed it every four large squares. It would help the students if centres could provide students with additional graph paper when necessary.

01.2 Whilst many are aware of the need to use a large triangle to work out the gradient, a surprising number used $\boldsymbol{\Delta y}/_{\boldsymbol{\Delta x}}$. Misreading the scale was quite common. This was particularly the case for those who had used awkward and non-linear scales.
The fact that the axes started at 12 and 4 also led to incorrect subtraction of values in determining Δx and Δy.

01.3 Rearranging the equation in the form $\boldsymbol{y = mx + c}$ proved to be challenging for some.

QUESTION 02

02.1 There was confusion between the temperature of the water and the temperature of the apparatus. The majority of students were not able to provide any reasonable explanation. Some common responses were:

- energy used to change temperature of apparatus is negligible
- glass has a low specific heat capacity.

02.2 Quite a few students simply restated the information that was supplied in the stem. Stating that the temperatures were the same allowed many to gain marking point 1; the reference to total heat transfer with *t* being the same was needed for the second mark.

02.3 There were many responses where students either ignored Q or simply multiplied out the '*show that*' equation and then rearranged it.

02.4 – 02.8 Students should be advised that percentage and absolute uncertainty should only be quoted to 1 or 2 significant figures (sf). In addition, the unit for absolute uncertainty in (T_2-T_1), a temperature difference, should be kelvin (or °C).

QUESTION 03

03.1 Responses indicated that many students do not know how to use a potentiometer (potential divider). There were many circuits involving fixed or no resistors at all, meaning that the pd could not be adjusted. Those who tried to use a potentiometer often showed only two connections to it. There were many carelessly drawn circuits. Students should be advised to use a ruler and to take care.

03.2 Whilst many were able to access marking point 1, very few were aware that θ had to be the absolute temperature. The direct-proportional relationship was often referred to as a linear relationship. The fact that the straight line had to pass through the origin was missed by many.

03.3 Although there were many who referred to repeat measurements, the idea that this was to find an average or to remove anomalies was often omitted. Use of video and increased precision of equipment were also commonly suggested. Changing the resistance to get values for θ were also seen often. There was some confusion in use of larger range and smaller interval as a way of improving the data.

QUESTION 04

04.1 Nearly 70% of students plotted the data accurately.

04.2 Nearly 80% of students drew correct best-fit lines.

04.3 There were a significant number of students who had a value for the gradient but showed no working out. Others used values from the table which were only allowed as long as they were lying on the lines drawn.

04.4 Students often misinterpreted the question and suggested reasons why their values were inaccurate rather than commenting on accuracy itself. Often only one relevant comment was made, with students not taking note of the number of marks allocated to the question.

04.5 and 04.6 These were very poorly attempted, with most answers relating to threshold voltage, stopping potential and in some cases, work function. Many wrote that in order to get maximum brightness (to be able to see), more voltage was needed past the initial lighting up. In 04.6 repeating readings or using a voltmeter with 'better resolution' were two of the most common answers.

QUESTION 05

05.1 There were students who used $\boldsymbol{V = \frac{4}{3}\pi r^3}$ rather than appreciating that *volume* = *area* x *length*. It was clear that there were some students who had experience of attempting calculations of this nature whilst there were others who struggled to make any headway. Early rounding also led to values that were not close enough to the '*show that*' value.

05.2 A significant number penalised themselves by substituting straight into $\boldsymbol{s = ut + \frac{1}{2}at^2}$ but then often forgot to either multiply $u \sin 43$ by t or did not realise that a needed to be equivalent to $-g$.

05.3 It was rare to see marking point 2. Students need to be aware that they must be more specific when answering questions such as this. The majority of answers were in more general terms such as different speeds, mean different distances, etc.

05.5 Whilst generally well attempted, the main error in 05.5 was either not resolving F or using an incorrect component of F. Some used the radius of the jet from 05.1 rather than the radius of the sprinkler.

QUESTION 06

06.1 Use of diameter rather than radius was a fairly common mistake in this part.

06.3 The majority were able to quote the two sets of alternative equations needed to show the required value. However, many were often unable to access the second marking point as they failed to combine the two equations correctly or, having quoted ε_r, then made it disappear in the final equation without referring to it.

06.4 There were some students who correctly calculated the energy value but then attempted to use $\frac{\textbf{energy out}}{\textbf{power input}}$ to work out the efficiency.

06.5 It was good to see some very clear and concise responses. There were many, however, who struggled to make any progress. The specific charge was often ignored or m was taken to be 1.

QUESTION 07

07.1 There were many alternative approaches to this question. All correct and valid alternatives were credited.

07.2 Very few referred to the fact that ^{238}U was non-fissile. Many wrote about the percentage of ^{235}U being high but missed the idea that the probability of neutron absorption would be higher, their expectation being that all neutrons would create a fission event. The need for the percentage of ^{235}U to be greater than the critical mass was a common argument. Students should be advised that whilst the term '*collide*' rather than '*absorb*' was condoned on this occasion, they must normally refer to neutrons being *absorbed*.

07.4 and 07.5 Students were expected to suggest a property rather than a condition of the rock and of the water. Answers such as temperature were not credited. Purity of water was also not credited as water in the rock would be impure in any case and also has little effect on the boiling point.

07.6 This was generally well attempted with some students using a reverse method to show that a mass of 4×10^{-28} kg would release about 225 MeV.

07.7 Once again there were some very clear and concise responses. Most students were able to access at least one mark by evaluating the number of fissions.

07.8 The suggestion that the percentage of ^{235}U left was less than the critical mass was seen fairly frequently. An unqualified statement of '*lack of water as it escaped*' was also common but insufficient to gain any credit. Students needed to refer to any geological changes that might have led to the lack of water. Some lost sight of the context and referred to the insertion of control rods.