

OXFORD

INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL PHYSICS

(9630) PH03: Fields and their consequences
Report on the examination

January 2021

REPORT ON EXAMINATION: INTERNATIONAL A LEVEL PHYSICS 9630 PH03 – Fields and their consequences – JANUARY 2021

This paper was accessible to the students and discriminated well, with a mean mark of around 50% and a high standard deviation. The cohort performed in a similar way in the multiple-choice section to section A, with a similar mean percentage mark in both sections. As in previous series, students answered calculation-type questions generally better than those that required written explanations. Also, as in previous series, many students seemed ill-prepared to define quantities.

QUESTION 01

1.1 was a two-mark definition question, where the quantity itself is being defined together with a statement about the value quoted in the question; it was not well answered. Students could only score the marks when they included the full units in their statement. The calculations were better answered in questions 1.2-1.4. In 1.4, many students did not subtract the radius of the moon to obtain the height. Question 1.5 was less well answered. Throughout Question 01, some students tried to use the kinematic equations ('*suvat*') or to show otherwise that they thought that the acceleration due to gravity was constant. It would not be constant on these length scales. It should be emphasised that *suvat* equations are *only* appropriate when the acceleration of an object is constant.

QUESTION 02

Question 02 was well answered in general. 2.1 and 2.2 were found to be straightforward: however, students are advised that when we ask them to '*show that a quantity is approximately...*', then an answer to at least one extra significant figure than the quoted value is required. In 2.2, some students tried to use the equation for a pendulum, gaining no credit. 2.3 was very well answered, with two thirds of students gaining all three marks. In 2.4, a graph sketch, few students scored full marks: very few used suitable axes labels or scales. For a suitable scale labelled intervals were required. Students also struggled to sketch the \sin^2 (or \cos^2) graph correctly. 2.5 was not badly answered, although some students did not provide enough detail for the second mark. Few students suggested the idea that damping force varies within each cycle.

QUESTION 03

Question 03 was well answered in general, although some misconceptions about radioactivity were seen. 3.1 was not well answered: as in previous series, many students did not seem well prepared to define a quantity. It is important to note that 'the proportion of nuclei that decay per unit time' refers to plural nuclei, and 'the probability of a particular nucleus decaying per unit time' refers to a single nucleus. Some students confused these two alternatives and did not score the mark. 3.2-3.4 were all well answered and found to be straightforward. Again, the 'show-that' question in 3.4 required *at least* two significant figures. 3.5 was not well answered, with only a fifth of students scoring full marks, and some misconceptions were seen. Some students suggested that carbon-14 decays into carbon-12, which is incorrect; others suggested that it was the carbon-12 that decays, which showed a misunderstanding of information already presented. 3.6 was better answered, although some students struggled to manipulate the exponential-decay equation, and others did not convert from seconds to years. 3.7 was poorly answered, and significant misconceptions were seen. For example, a significant number of students suggested that outside factors, such as incident ultraviolet rays, could affect the rate of radioactive decay. Others made brief mention of background radiation or simply stated that the data may be inaccurate; these suggestions were neither detailed nor specific enough to gain the mark. Other suggestions including weathering, or chemical and biological decay reducing the mass of carbon in the object, which showed a misunderstanding of ratios; however, there were some impressive suggestions of biological processes causing contamination by modern carbon, which received credit.

QUESTION 04

4.1 and 4.2 were surprisingly poorly answered: students forgot that the electric-field direction is opposite to the direction of the electric force on the electrons, and many failed to use Fleming's Left-Hand Rule or other direction rule correctly. 4.3 and 4.4 were much better answered, with over 80% scoring full marks in each. 4.5 was not so well answered. Many students did not understand that v is a specific value of velocity, rather than the general velocity variable, and therefore misunderstood the meaning of the equation in 4.3. They thought that it applied for all values of E and B . Of those who understood the deflection direction and the increase in magnetic force, many did not go on to discuss fully the change in electric force; they scored only two of the marks.

QUESTION 05

The cohort found Question 05 challenging. Less than one-third of students scored full marks in this question. While many arrived at a unit for flux linkage, it did not score a mark when it was not made up of the fundamental base units. In 5.2, many students left off the 'change in' symbols in their Faraday's Law and gradient equations and did not score any credit. 5.3 was also poorly answered, with only a quarter scoring full marks; some did not realise that a tangent was required, and others did not use a large enough range of values in determining their gradient. 5.4 was found to be the most challenging question part in the paper, with under a quarter scoring at least two of the three marks. Only a few students realised that a large surge of voltage would be measured by the voltmeter, due to the rapid change in flux linkage. Some recognised this but did not give a detailed enough explanation. Only very few stated that the reading would be of the opposite sign to the previous reading. 5.5 was well answered overall, with most students making correct reference to eddy currents, but around one in ten of the students left this question blank.

QUESTION 06

The cohort found Question 06 challenging. 6.1 and 6.2 were found to be straightforward calculations. Around half of the students scored one mark out of two in 6.3, with few scoring the second mark; many understood that heat would be dissipated in the resistor, but few addressed the 'half'. 6.4 differentiated well: many students either calculated the ratio or converted mWh to J correctly, but not both. 6.5 also differentiated: most students understood that the duration of the flash would be increased, but only a small number understood that both initial current and initial voltage would be unchanged, leaving the initial brightness also unchanged. Finally, 6.6 was found to be difficult and a significant proportion left this part blank. Some excellent answers constructed an equation 'number of flashes = total energy/energy of each flash' to justify their answer.

SECTION B

The average percentage mark in section B was similar to the average percentage mark in section A. Questions that were answered particularly well were the ones requiring a straightforward recall of fact, such as 7, 8 and 13. Those that were answered particularly poorly were ones involving interpretation of diagrams or graphs, such as 9, 15, and 18.

7 was a straightforward identification of vectors and scalars. Over 80% of answers were correct.

8 was recall of facts in circular motion. Three-quarters answered correctly.

9 required interpretation of a diagram of circular motion. Under half were correct.

10 was about phase in simple harmonic motion; around two-thirds answered this correctly.

11 was about the inverse-square law in gravitation, also requiring a calculation of percentage increase and decrease; just over half answered correctly.

12 was about the energy of orbits, and over half answered correctly.

13 was recall of facts in electric fields. Almost three-quarters gave the correct response.

14 was a diagram of charges in an electric field, and over half answered correctly.

15 was a graph of the electric field strength between two charges, and under a third answered this correctly. It was analogous to the more familiar situation of the gravitational field strength between the Earth and the Moon; however, many students opted for the distracter that had the charges being of opposite sign.

16 and 17 were about capacitors in circuits and around half answered these correctly, which was better than Question 06, the capacitor question in section A.

18 was about capacitor charging graphs and about a third answered correctly.

19 was a Lenz's Law question, although it was perhaps an unusual context for the Law; around 40% answered correctly.

20 was a practical question about oscilloscopes. This is an area that has challenged students in the past, but almost half scored correctly here.

Few students, less than 40%, calculated the peak-to-peak voltage correctly in 21. Many chose the peak voltage (half the correct answer).

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