Examiners' Report
Principal Examiner Feedback

October 2020

Pearson Edexcel GCE
In Physic (9PH01)
Paper 1: Advanced Physics I

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Introduction

This paper was taken by a relatively small number of candidates. These comments are based on their work.

The questions on this paper yielded a wide range of responses and some very good answers were seen.

The time allocation appeared to be appropriate. Most candidates finished the paper but answers to the last part of question 18 were often very sketchy either because candidates were running out of time or because they found this question difficult.

Questions requiring straightforward calculations were completed confidently by almost all candidates. Many candidates produced a pleasing attempt at the questions involving multiple calculations.

Questions requiring explanations produced varied responses and resulted in a range of marks being awarded.

The indicative content question, Question 17a, produced a wide range of marks. The best answers were well-constructed and clearly but succinctly explained.

Candidates did struggle with particular topics on this examination. Both electrical questions (12a and 15) were often poorly understood. Candidates also found the two questions examining field potential (question 6 and 14a) challenging.

The following comments and observations relate to individual questions.

11a This question was answered well by many candidates who generally understood that this is the point through which the weight acts. Some answers incorrectly made references to mass acting at the centre which is a special case or suggested mass acts through the point, inferring that mass is a vector

11b This question required candidates to take moments around P and recognising that the weight of the slab acts at its centre. A few candidates tried to take moments around Q. Some responses didn't recognise that the weight of the slab would be at its centre and tried to distribute it either side of P. In general, many responses demonstrated a good grasp of moments.

12a This question examined parallel circuits. The most common error was to assume the current in the shunt was 2 A rather than to subtract 1mA (the current through the 18 Ω resistor). These answers could still gain credit if there was a calculation of potential difference across the pair of resistors. Some responses were a jumble of numbers with little or no method or explanation.

12b This calculation, using resistivity, was well answered by almost all candidates.

13a This question required candidates to realise that friction is the centripetal force required to keep the car on its curved track. Common errors included confusion about the direction of this force. Some answers suggested that this force acted outwards and caused the car to fly off the track. Some responses suggested that there was a centripetal force in addition to another force such as friction rather than identifying friction as responsible for the centripetal force.

13b Two calculations well answered by almost all candidates. It was pleasing to note that single stage calculations were handled very well.

13c This question required students to consider the different lengths of each track. The tighter bend of the inner track would also mean the speed of this car would need to be reduced in order to stay on the track. This was clearly explained by the majority of candidates. Some answers referred to different radii or different lengths of track without distinguishing between the inner or the outer track.

14a This question relied on candidates pointing out that the gravitational potential energy of a ball bearing on the surface of the metal "hill" is inversely proportional to *r*. This is similar to electric field potential *V* also being inversely proportional to *r* (Spec point 114). Some candidates alluded to the first point about gravitational potential energy but then compared it with the electric field strength equation often confusing the various relationships, $\propto \frac{1}{r}$ and $\propto \frac{1}{r^2}$, in the process.

14b This question elicited some very good responses. Many candidates had learnt the results of the alpha particle experiment and related at least one set-up with the ball bearing to obtain full marks. Those responses that fell short were usually because they missed a comparative note between the different scenarios such as "most" alpha particles went straight through the foil undeflected. Some answers referred to just one observation such as "very few alpha particles are deflected through an angle of 180^{o}" and then explained the corresponding setup for the demonstration. This would gain half the marks available.

Question 15, as a whole, was quite poorly answered. Some candidates may not be familiar with this method of drawing an electrical circuit. They are perhaps more used to a cell and a continuous loop of circuit.

15a This examined the charging of a capacitor through a resistor. A number of candidates drew discharge curves. Some calculated the time constant but didn't make relevant use of it when drawing their graph.

15b This involved two short calculations. It was pleasing to note that a good proportion of the candidates used a relevant exponential equation confidently.

15c This question tested whether candidates understand electrical circuits and can appreciate potential differences across each component in a series circuit. Some answers suggested the potential difference across either or both resistors was 2 V. A good starting point with circuit analysis is to firstly calculate the current using *V = IR* when possible and appreciate that *V* is the corresponding potential difference across the relevant resistance *R.*

16ai This question tested whether candidates could use a time-frame diagram to take some simple measurements of a projectile-type motion to deduce that horizontal velocity is constant and vertical velocity is changing (specification point 15). Quite a high proportion of answers didn't use the hint in the question – "take measurements from the diagram". Some answers took some measurements of distances between the images but made no mention of velocities.

16aii This question produced a full range of responses. Many candidates successfully calculated the horizontal velocity. The use of the equations of motion in the vertical direction was less consistent with incorrect measurements or incorrect time intervals being used. The correct use of Pythagoras to calculate a resultant velocity was regularly seen and rewarded.

16aiii Few candidates appreciated this question was best tackled by considering work done and kinetic energy. A number of candidates tried to calculate an acceleration using $v = u + at$

but invented their own values of time interval as this was not given in the question. The use of $v^2 = u^2 + 2as$ can lead to a correct alternative method shown in the mark scheme.

16b This question required candidates to apply resultant force = *ma* as the spider is brought to a stop. The two forces acting on the spider are the tension in the thread and the weight. Many students misunderstood the question either thinking it was about the spider taking off from the platform or about the spider in mid-jump. Some answers simply agreed with the student's suggestion that the tension was equal to the weight.

17a This indicative content question produced some very good responses. Many candidates achieved the 3 indicative points for explaining the basic principles of a generator. A few missed out the word "linkage" if discussing rate of change of flux linkage with the coil. The motor was less well answered with some candidates trying to explain the motor by continuing their explanation for the generator and then muddling the two applications. The perpendicular nature of the force with either the current or magnetic field was often omitted in the explanation of the motor, as was the rotation being produced by a moment of a force.

17bi This produced some very good responses with candidates correctly applying their knowledge of the relationship between emf and terminal potential difference competently. Some answers either attempted to use *E = V+Ir* or *P=IV* rather than combine both. Some answers used the idea that Power from the battery = power dissipated by the internal resistance + power output from motor, a good approach for full credit.

17bii This question tested the use of *Q = It* and was generally well answered. Some answers calculated the time (40 s) and compared this with 7 s, others tended to compare the charge stored on the battery with the charge required. Both approaches scored full credit.

18a The command word in the question was "deduce". Answers such as "not charged because neutrinos have no charge" were not given any credit. Many answers collected one mark for "not charged because the antineutrino did not leave a track". Fewer answers collected the second mark for "charge conservation because both the pion and muon are charged negative".

18b This required a particle equation. The symbols for all particles mentioned in the specification should be known. A number of answers confused an antineutrino ($\bar{\upsilon}$) with an antineutron. The symbol for a muon was not required as this particle is not listed in the specification.

18c This question demonstrated that most candidates had a sound knowledge of particle classification. A few students mixed the two particles suggesting the muon was a meson and the pion a lepton but could still score the other 2 marks if they correctly explained that a meson was a quark-antiquark combination and the lepton was a fundamental particle. A few students confused baryons, hadrons and mesons.

18d The first three marks for measuring a radius from the diagram, substituting into the equation *B = p/Qr* and the answer with the units T were often seen. Although a wide tolerance was given for the measurement of the radius a number of candidates were quite a long way out with their measurement or forgot the scaling factor. Many candidates did not deduce the correct direction of the magnetic field, with the most common error to suggest it was directed into the page.

18e This question examined specification 14 and 99. Very few good answers were seen. Many candidates did not know how to start the question and, if they did, were drawing freehand

lines with little idea of labelling a vector with an arrow and stating whether it was the “pion” or “muon”. The extra materials required for this examination were ruler and protractor but this appeared to have been missed by many.