Examiners' Report
Principal Examiner Feedback

Summer 2019

Pearson Edexcel Advanced Subsidiary
In Physics (8PH0) Paper 01 Core Physics I

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Introduction

This is the fourth time that the Pearson Edexcel AS paper 8PH0-01, Core Physics I, has been sat by students. Section A of the paper is worth 56 marks and consists of 8 multiple choice questions followed by 6 questions of increasing length comprising of short open, open-response, calculation and extended writing style questions. Section A examines materials from the topics working as a Physicist, Mechanics and Electric Circuits. Section B is worth 24 marks on this paper and examines materials from the whole AS specification. It contains two questions worth 11 and 13 marks including a data analysis question based on density. The second question in section B was a synoptic question based on a filament and LED lightbulbs. The paper enabled students of all abilities to apply their knowledge to a variety of examination questions. Many students showed a good progression from GCSE to AS level, with their previous knowledge extended upon and new concepts understood well. The longer calculation questions that ranged from 4 to 6 marks were generally not answered well by many students who found the multi-step approach challenging. Some questions were not answered as well as expected by many learners. Q10, which is based on Core Practical 1 should have been straightforward, however many students were not confident in their approach and were shaky on the basic use of uncertainties. In the open response and extended writing questions, students that had a sound understanding of the physics did not always demonstrate this. Their responses lacked precision when applying their knowledge. There was poor use of subject specific language and points were missed due to the students being unfamiliar with the command terms. However, learners from across all ability ranges managed to score some marks within these questions. Timing was an issue for a small number of learners, due to spending a disproportionate amount of time answering the multiple choice items. 16(bii) was mostly affected by this issue with many learners not spending sufficient time reading the stem and thinking about their response.

Section A - Multiple Choice Questions 1-8.

Only the top end students were able to score at least 7 on the multiple-choice items. Whilst E grade students scored, on average scored 4 marks.
For mid-ability students the performance with these items was not indicative of their overall performance in the exam. This is usually due to a disproportionate amount of time spent on the multiple choice items, particularly for the less able learners. Taking time away from the higher scoring questions later in the paper

Question	Subject	Percentage of learners who answered correctly.
1	Internal Resistance	62
2	Unit conversion.	33
3	Motion graphs.	55
4	Motion of charge in a conductor.	53
5	Vector addition.	49
6	Resistivity.	81
7	Uncertainties.	38
8	Work done.	83

Q9.
This question asked the students to look at a current – potential difference characteristic graph and explain what component it shows.
Most students noticed that the graph showed currents in one direction, but not in the other, hence concluding that the component was a diode. A significant number were distracted by the negative current at high negative p.d. and concluded that it was a thermistor. Further information was required for the third mark. Many students were not awarded this mark as they did not use technical language in context; for example when referring to more negative p.d. as 'lower'.

Below is a good example of a student response.

Explain how the graph shows what the component is.

(3)

The graph is of a diode.
We can tell this by the fact that once critical p.d is reached the current increases massively in one direction allowing current to flow. In the opposite direction, only a small leakage current gets through until breakdown voltage is released and the current again begins to flow

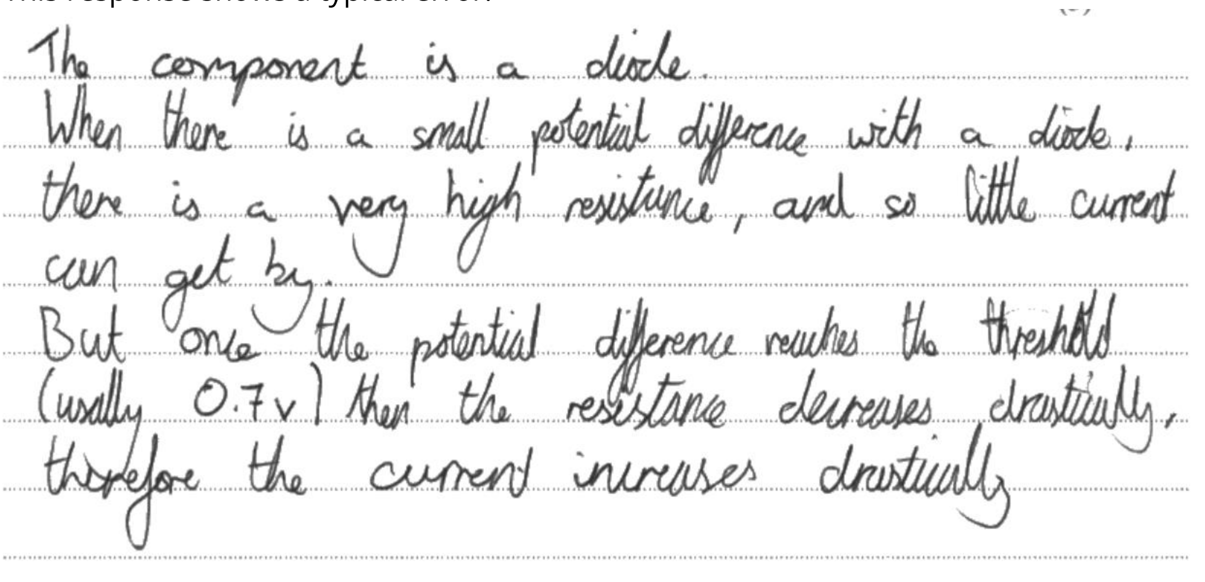
Examiner Review.
This student answered the question clearly and gained 3 marks.

The graph shows the component is a diode. Diodes only allow for the flow of electrons in one direction. When the circuit is reversed, there is no current, but when p.d. is positive, the electrons flow in the right direction to the bias of the diode, causing a current.

(Total for Question 9 = 3 marks)

Examiner Review.
This student clearly recognised the diode graph, and explained the difference between positive and negative p.d. well, but failed to expand upon what is no more than good GCSE knowledge.

This response shows a typical error.


The component is a diode.
When there is a small potential difference with a diode, there is a very high resistance, and so little current can get by.
But once the potential difference reaches the threshold (usally 0.7v) then the resistance decreases drastically, therefore the current increases drastically

Examiner Review.
This student has explained the characteristic of a positive p.d. well, adding details about the threshold p.d., change in resistance and current that occurs there. However, the negative characteristic has not been mentioned at all.

Tip.
When given a characteristic graph such as this one, make sure you refer to each different part of the graph in your answer.

Q10.
This question is based on Core Practical 1 and looks at how t^2 varies with s by using a graph to find a value of g and comparing it with the accepted value.
Help is given to the students by informing them that ‘the percentage uncertainty in g is the same as if calculated from just one pair of values’, this may have accounted for the number of students who did not calculate a gradient from a best fit line on the graph, but simply used a data point.
Students were expected to use $s = ut + \frac{1}{2}at^2$ to realise that $= \frac{2}{gradient}$.
The use of the uncertainties given in the question to calculate the overall percentage uncertainty of 7% was answered well, although a significant minority of students used $3\%^2$ instead of 3% x 2, and many ignored the 1% for h entirely.
Students should then have gone on to either calculate the range of their g, or the percentage difference from the accepted value and make a suitable comment. The

calculations were performed well, but many students were unable to make a satisfactory comment on what they had found.

Below is a good example of a student response.

The student concluded that her value for *g* was consistent with the accepted value.

Comment on the student's conclusion. Your answer should include a calculation of *g* from the student's data.

You may assume that the percentage uncertainty in your value of *g* is the same as if the value were calculated from just one pair of readings.

(5)

$2\frac{s}{t^2} = a$ gradient $= \frac{t^2}{s}$

gradient $= \frac{0.20}{0.81} = 0.247$

$0.247^{-1} \times 2 = g = 8.1$

$2 \times 3 + 1 = \pm 7\%$ $8.1 + (0.07 \times 8.1) = 8.67$

$8.1 - (0.07 \times 8.1) = 7.53$

Invalid conclusion, 9.81 doesn't lie between the values 7.53 and 8.67

Examiner Review.

This student has scored full marks. Every stage of the calculation is clearly displayed and the conclusion follows logically from the working.

$s = h$ $\quad s = ut + \frac{1}{2}at^2$ $\quad$ free fall $= 9.81\,ms^{-2}$

$u = 0$

v $\quad h = \frac{1}{2}at^2$

$a = ?$

$t = t$

gradient $= \frac{1}{2}a$ $\quad a =$ gradient $\times 2$.

~~Gradient $= \frac{0.39 - 0.05}{1.78 - 0.4} = ?$~~

$\frac{0.39 - 0.05}{1.78 - 0.4} = \frac{17}{69} = 0.246$

$\frac{17}{69} \times 2 = \frac{34}{69} = 0.49$

$\frac{1}{m} = 4.0588 \left(\frac{69}{17}\right)$ $\quad$ gradient $\times 2 = 8.117647059$

$= 8.12\,ms^{-2}$

combined uncertainties $= 3\% + 3\% + 1\% = 7\%$

$\frac{\text{uncertainty}}{\text{measurement}} \times 100$ $\quad \frac{1}{2} \times$ range

Examiner Review.

This student has scored 3 marks. The gradient is correctly determined, and g is calculated from it using the correct relationship. The combining of percentage uncertainties is correct, but the student has been unable to convert this into a range, and therefore is unable to comment on it.

The student concluded that her value for *g* was consistent with the accepted value.

Comment on the student's conclusion. Your answer should include a calculation of *g* from the student's data.

You may assume that the percentage uncertainty in your value of *g* is the same as if the value were calculated from just one pair of readings.

(5)

From the line of best fit at a height of 1m the time was 0.447 s and as we know initial velocity was 0 then:

$s = 1\text{m}$
$u = 0\text{ ms}^{-1}$
$v = /$
$a = ?$
$t = 0.447\text{s}$

$s = ut + \frac{1}{2}at^2$
$1 = 0 \times t + \frac{1}{2} \times a \times 0.2$
$1 = \frac{1}{2} \times a \times 0.2$
$\frac{1}{1/2} = a \times 0.2$

$2 = a \times 0.2$
$a = 2/0.2$
$a = 10\text{ ms}^{-2}$

The actual value for $g = 9.81\text{ ms}^{-2}$ and for the student to get $10\text{ms}^{-2} \approx 9.81\text{ms}^{-2}$ it is safe to say it is consistent (as line of best fit is straight) and has an accepted value.

Examiner Review

This student has used a data point from the graph and inputted the values for s and t^2 into the equation. The first mark has been lost as the gradient has not been calculated. This student has not done any working out with the uncertainties given in the question and therefore has been unable to come to a meaningful conclusion.

Q11.

Question 11 focusses on the understanding of a voltmeter and the problems which arise when the resistance isn't high enough for the circuit in which it is connected to.

Q11(a)(i)

Many students did not attempt a calculation for this question despite there being direction in the question itself. Students failed to recognise the significance of the resistance of the voltmeter and were distracted by the term 'analogue'.

Those that did recognise the importance of the voltmeters resistance, went on mainly to do a successful calculation of total resistance for the voltmeter and the thermistor in parallel but again were often unable to comment on this clearly.

This is an example of a good response.

(3) Q11ai

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$ $\quad \frac{1}{45000} + \frac{1}{9700} = \frac{1}{R_T} = 1.25\times10^{-4}$

$\frac{1}{1.25\times10^{-4}} = 7979.89\ \Omega$

$= 8.0\ k\Omega$

∴ Since the analogue voltmeter has a low resistance it lowers the overall resistance in the circuit whereas a digital one has infinite resistance and so it does not impact the reading

Examiner Review

This student has gained full marks by successfully calculating the total resistance and then comparing this with the resistance of the thermistor alone.

• ~~more suitable as it provides~~

less suitable as it provides a less accurate result/reading.

$1/R_T = 1/R_1 + 1/R_2$

$1/R_T = 1/45 + 1/9.7$ | $R_T = 7.98$

$R_T = 8k\Omega$

Examiner Review.

This student has done a successful calculation, but the comment is vague and does not use the result of the calculation.

Q11(a)(ii)

Many students focussed on the effect (if any) on the reading on the voltmeter in their answer, failing to realise that the effect on the ammeter was the most significant.

This is a good response.

Would mean that the current is measured that is going solely to the thermistor and not the voltmeter, therefore more accurate measurements of the resistance can be taken.

Examiner Review.

This student realises that a current is going through the voltmeter as well as the thermistor and explains that putting the ammeter on the parallel branch with the thermistor would result in an accurate reading on the ammeter. This gains full marks.

By connecting the voltmeter across both the ammeter and themister the current flowing through the themister and ammeter will be the same.

Examiner Review.

There is a good explanation here of why the ammeter reading will be accurate, but as the current through the voltmeter has not been mentioned there is no comparison with the previous voltmeter position to explain why the new position is better.

Q11(b).

This part of the question focused on the behaviour of a thermistor. Most students were able to attempt this and made reference to the number of charge carriers increasing. Some were unable to carry reasoning through and link the increasing current to a decreasing resistance. Instead, they linked an increasing current to increasing potential difference, failing to realise that resistance is decreasing and therefore their conclusion isn't valid. Others mentioned the interference to the charge flow of ions vibrating at higher amplitudes. They failed to realise that in a semiconductor this is not the significant effect. Very few students used the sharing of potential difference according to the ratio of the resistances as part of their answer.

This response scores 2 marks.

- Temperature increases, electrons gain ~~[illegible]~~ energy and kinetic energy
- electrons have enough energy to leave valence band and move to conducting band
- Increases the current available / number of charge carriers per cubic metre, resistance decreases
- the potential difference decreases as less is a needed to drive current through wire

Examiner Review.
This student links temperature, number of charge carriers, current and the resistance correctly to gain the first mark. A jump is then made straight to the correct conclusion of the potential difference decreasing but without referring to the change in the proportion of the total resistance of the circuit that the thermistor now has.

As the temperature increases the resistance of the thermistor will also increase too. This is because the kinetic energy of the atoms in the thermistor will increase which will also increase the ~~temp~~ resistance; the atoms will collide with each other more frequently and will ~~no~~ make it harder for electrons to pass through the thermistor.

Examiner Review.
This student uses the Physics of a metal conductor instead of a semiconductor to try to explain what happens. There is no reference to the potential difference, so this response gets no marks.

Q12.
This is the first question on the paper based mainly on calculations.

Q12(a)
Students were required to use the principle of conservation of energy to calculate the velocity of the water as it leaves the fountain. Most students were able to calculate the useful energy per second transferred to the water by the pump, but many did not account for the gravitational potential energy transfer required as the water travelled up the nozzle.

This is an example of a good response.

$160\ J/s$ $\quad 160 \times 0.76 = 121.6\ W$

$3.5\ kg/s$ $\quad E_k = \frac{1}{2}mv^2$

$$\frac{2E_k}{m} = v^2$$

$E_{gravity} = m \times h \times g = 3.5 \times 0.45 \times 9.81 = 15.45...$

$121.6 - 15.45... = 106.14925\ J$

$$\frac{2 \times 106.14...}{3.5} = v^2$$

$\sqrt{60.65...} = v = 7.788 \approx \underline{8\ ms^{-1}}$

Examiner Review.
This student gained full marks. The gravitational potential energy gain has been subtracted from the correctly calculated useful energy transfer, and the kinetic energy equation has then been used to find the initial speed of the water jet.

(5)

$160 \times 0.76 = 121.6\,W$

$E = \frac{1}{2}mv^2$

mgh

$P = \frac{W}{T}$ $P = \frac{E}{T}$

$\frac{E}{T}$ $\frac{\frac{1}{2}mv^2}{t} = 121.6$

$\frac{1}{2} \times 3.5 \times v^2 = 121.6$

$v^2 = \frac{121.6}{\frac{1}{2} \times 3.5}$

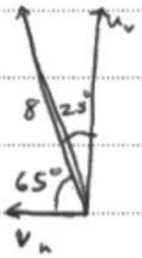
$v = \sqrt{\frac{121.6}{0.5 \times 3.5}} = 8.335809456\,m\,s^{-1}$

$8.3\,m\,s^{-1}$

Examiner Review.
Here we see a common mistake. Gravitational potential energy has not been accounted for and therefore the final answer is greater than it should be.

Q12(b)
Students were required to use equations of motion to find the range of the water as it projects. Some students overcomplicated this by failing to realise that the top of the edge of the pond was level with the top of the nozzle.

Here is an example of a good response.



$U_h = \cos 65 \times 8 = 3.38\ldots$

$U_v = \sin 65 \times 8 = 7.25\ldots$

$V = \frac{s}{t}$

$Vt = s$

$3.38\ldots \times 1.478\ldots = \underline{4.9976\ldots m}$

$v = u + at$

$\frac{v-u}{a} = t$

$\frac{0 - 7.25\ldots}{-9.81} = t = 0.739\ldots$

$0.739 \times 2 = 1.478\ s$

Minimum horizontal distance = 5.00 m

Examiner Review.

This response shows a correct answer which gained full marks. This student has correctly calculated the horizontal and vertical components of the velocity before continuing to find the top of the waters flight path. This has then been doubled to find the time of the whole path recognising that the path is symmetrical. Finally the student has used the horizontal velocity component and the time to calculate the range.

<u>y-direction</u>

$u = 8ms^{-1}$

$u_y = 8ms^{-1} \times \cos 25$

$u_y = 7.25\ ms^{-1}$

$y = ut + \frac{1}{2}at^2$

$-0.45m = 7.25ms^{-1}\ t + \frac{1}{2}(-g)t^2$

$t^2(-4.905) + t(7.25) + 0.45 = 0.$

$t = \frac{\pm b^2 - \sqrt{b^2 + 4ac}}{2a}$

$t = 1.54\ s$ //

$t = -0.0597$ (reject).

<u>x-direction</u>

v_x - constant

$s = v_x \cdot t$

$s = u \cdot \sin 25 \times t$

$s = 8ms^{-1} \sin 25 \times 1.54\ s$

$s = 5.21\ m$

$s = 5.2\ m$ //

Minimum horizontal distance = 5.2m

Examiner Review.
This student has worked with correct velocity components, but when considering the vertical motion the student has not realised that the edge of the pond and the nozzle are at the same height. This has led to an error in the time of flight which has carried through to the answer.

Examiners Tip:
Take note of any information you are given in the question that may be useful. It may be that in a later part of the question you are required to use information you were given much earlier on.

Q12c.
Very few students were able to give a convincing reason for the calculated distance to be an overestimate. Some sited air resistance, showing that they had not read the question carefully enough.

This is an example of a good response.

water experiences friction against the nozzle as it leaves, causing its velocity to decrease, and therefore travels a shorter distance

Examiner Review.
This student has gained both marks.

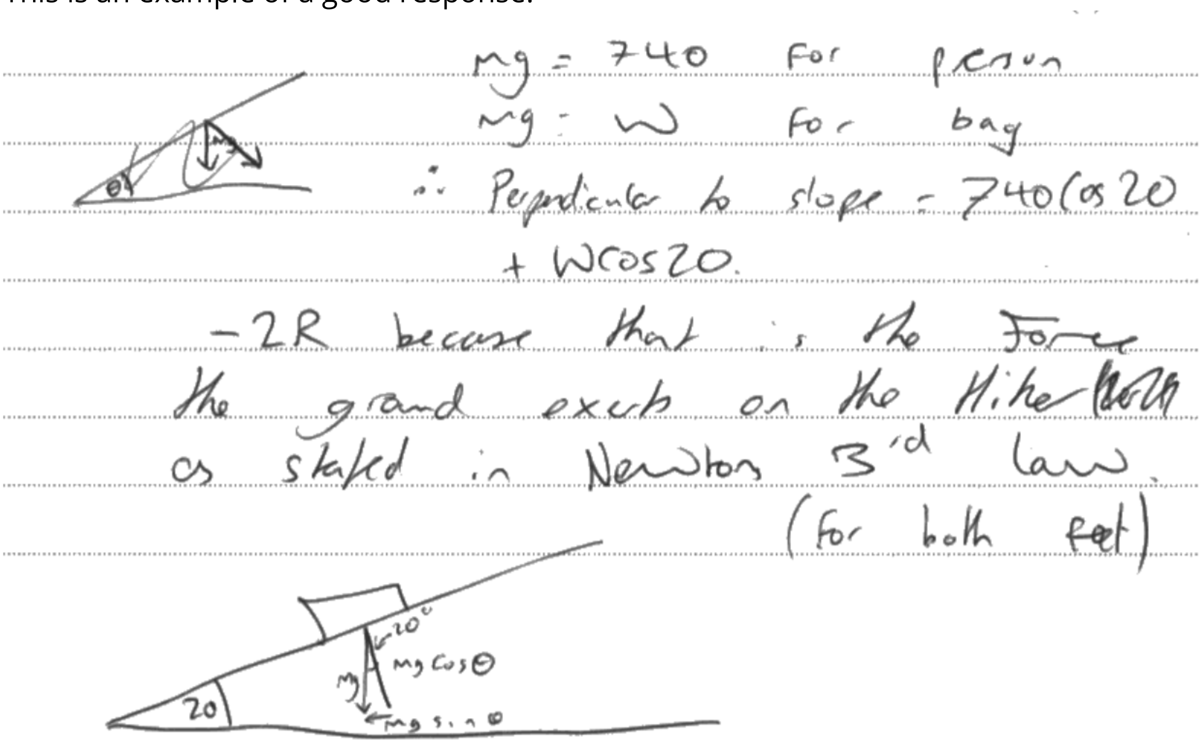
It is only 76% efficient so it would be an overestimate because it is assuming the pump is 100% efficient.

Examiner Review.
This student referred to the efficiency of the pump, failing to realise that this had already been taken into account.

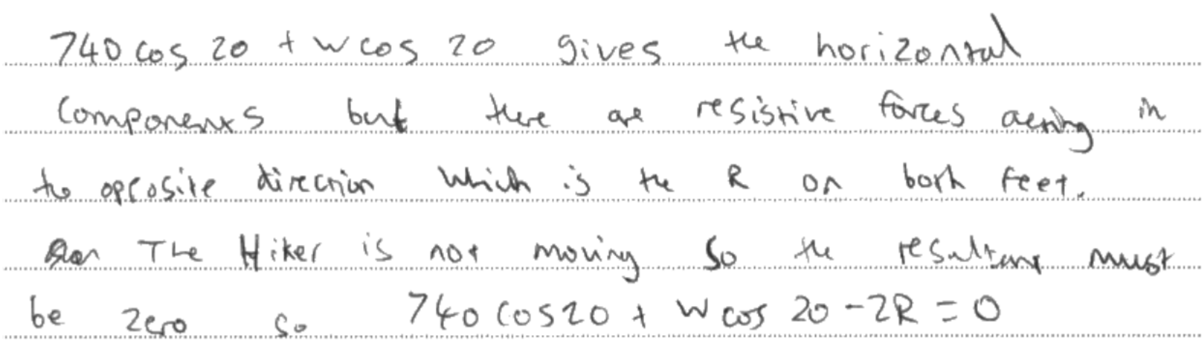
Q13.

Q13(a)
Students found it hard to explain why this numerical expression was correct, failing to use phrases such as 'component perpendicular to the slope' which would have gained them marks. There was also incorrect reference on many responses to Newton's 3rd Law which was given as the reason for 2R to equal the components of the weight forces.

This is an example of a good response.


mg = 740 for person
mg = W for bag
∴ Perpendicular to slope = 740cos20 + Wcos20.
= 2R because that is the Force the ground exerts on the Hiker both as stated in Newton's 3rd law. (for both feet)

Examiner Review.
This student scores both marks. There is a clear reference to the perpendicular component of the weight of the hiker and the bag, and that R is the force of the ground on the hiker.


740 cos 20 + w cos 20 gives the horizontal components but there are resistive forces acting in the opposite direction which is the R on both feet. The Hiker is not moving so the resultant must be zero so 740 cos20 + W cos 20 − 2R = 0

Examiner Review.

This response refers to the **horizontal** components of the weight. This was a common error. However, the student scores a mark for linking the fact that the hiker is not moving, to the fact that the resultant force is zero.

Q13(a)(ii)
Most students scored the first three marks on this item. Despite being given the forces and distances clearly on the diagram. Many students were unable to work out which forces caused clockwise moments and which anticlockwise moments.

This is an example of good response.

Σ of clock wise moments = Σ anti clock wise moments

~~zero~~ ~~cos20~~

$740 \cos 20 \times 0.25 = 0.4R + W \cos 20 \times 0.1$

$173.8 = 0.4R + w \cos 20 \times 0.1$

$\frac{173.8 - 0.1w \cos 20}{0.4} = R$

$740 \cos 20 + w \cos 20 - 2R = 0$

$695.37 + w \cos 20 = \frac{173.84 - 0.1 w \cos 20}{0.2}$

$139.07 + 0.2w \cos 20 = 173.84 - 0.1 w \cos 20$

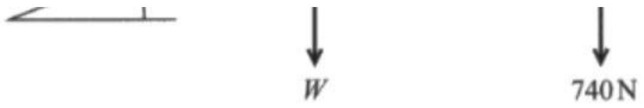
$0.3w \cos 20 = 34.77$

~~w cos20~~

$\frac{34.77}{0.3 \cos 20} = w = 123.3\ N$

$W =$ 123.3 N

Examiner Review.
This response scored full marks. The principle of moments was used correctly and the student substitutes for R using the expression from 13ai correctly and clearly.



$R_1 = \tan 20 = \frac{0.1}{R_1}$

$R_1 = 0.275$

$R_2 = \tan 20 = \frac{0.4 - 0.25}{R_2}$

Determine W. You should take moments about O. **(6)**

$R_2 = 0.412$

clockwise = anti clockwise

W + 740 → 2R

clockwise : $W\cos 20 \times 0.1 + 740\cos 20 \times 0.25$

anticlockwise : $R_1 \times 0 + R_2 \times 0.4$

$W\cos 20 \times 0.1 + 740\cos 20 \times 0.25 = 0.4R \rightarrow 0.4 \times 0.412$

$0.1W\cos 20 + 185\cos 20 = 0.1648$

$W\cos 20 = \frac{0.1648 - 185\cos 20}{0.1}$

$W = -1848.25\text{ N}$

$W = 1848.25\text{ N}$

Examiner Review.
This student has the correct expression for each moment but has not correctly worked out which are clockwise and which are anticlockwise.

Q13(b)
Most students answered this question using their own experience rather than applying the principle of moments to the situation.

Here is an example of a student who has applied the principle of moments to the situation.

The centre of gravity ~~~~ changes position, and it is at a further distance than before from the pivot. This creates a larger anticlockwise moment from the back, so the anticlockwise moment from the front foot ~~~~ becomes smaller to balance the moments.

Examiner Review.

This student has correctly grasped the idea that the centre of gravity of the bag has moved backwards, increasing its anticlockwise moment. The principle of moments has then been applied as the student reasons that this means the other anticlockwise moment must be reduced to keep the hiker in equilibrium. If the student had said ‘at a further <u>perpendicular</u> distance’ this would have been an even better answer.

There is now more weight on the back foot so R on that foot increase but also as there is less weight on the front foot R on the front foot decreases

Examiner Review.
This student is using experience rather than Physics to explain this situation. The student also mistakenly thinks there is a greater weight in the repacked bag. This scores no marks.

Examiner Tip
Make sure you read the question carefully so you don’t get the wrong impression of the situation you are explaining.

Because ~~the force~~ the normal is equal to weight, and the placing the items at the bottom will lower the centre of mass.

Examiner Review.
This student has not realised that it is the horizontal movement of the Centre of Gravity that is important here as this is the perpendicular distance from a vertical weight force. Many students referred to a lower Centre of Gravity.

Q14

This question refers to the motion of a Newton's cradle of 2 identical metal spheres. The responses indicated that students were familiar with this idea.

Q14(a)

This question asked students to use Newton's Laws of Motion to explain the motion of the spheres <u>during the collision</u>. Many students chose to explain the whole of the motion, starting from (A) being released to (B) reaching its highest point. For many students half of their answer was irrelevant to the question. As students learnt from previous exam series, they are becoming more adept at applying Newtons's Laws and referencing the laws they are using in their explanations. However, many students still found it difficult to use terminology correctly to describe forces, commonly mixing up terminology used for energy, using phrases such as 'force is transferred from A to B' for instance. The Conservation of Momentum was also quoted often for the collision itself, resulting in students concentrating on masses and velocities instead of forces.

This is an example of a good response.

Initially, sphere A is given GPE and then when let go, ~~GPE~~ GPE turns to KE of sphere A and collides with sphere B. Sphere A exerts a force on sphere B to the right. Due to N3 law, sphere B also exerts an equal ~~and~~ in magnitude and opposite in direction F ~~to sph~~ (to the left) on sphere A. Now there is a resultant force on sphere A to the left, and due to N2 law, sphere A decellerates to the left, and stops. But there is also a resultant force to the right on sphere B, so due to N2 law, sphere B accelerates to the right and reaches ~~the~~ same height or little bit lower than sphere A's initial height. Momentum ~~& E~~ and energy is conserved.

Examiners Review.

This student has used the correct terminology when referring to forces and has correctly used Newton's Laws to validate the statements made. Most of the response refers to the collision.

Once released A moves due to an imbalance of forces acting on it (N1), when A hits B it exerts a force on B but B also exerts an equal and opposite force on A (N3). ~~as these force~~ The force of B on A cancels out ~~A~~ the force previously on A resulting in A having no resultant force and ∴ no acceleration so it stops still (N1 + N2). As A also exerted a force on B, B moves due to an external force acting on it (N1).

Examiner Review.
This student starts well with a correct reference to Newton's 3rd Law. However, a common error occurs when the student states that the force on A results in no resultant force so (A) stops still. In reality, a resultant force is needed to decelerate A so it can stop.

(6)

photograph 1: A is ~~been~~ lifted by hand, ~~the gravity~~ Egrav of it increases since h is bigger. When it is realeased, Egrav changes into Ek, and the total energy should be in conservation.

photograph 2: A touches B, giving all Ek to B

photograph 3: B moves ~~becau~~ due to the Ek ~~it~~ it receives from A, and the energy conservation makes the time and height the same from the motion of A.

Examiner Review.
This was also a common response and scored no marks. The student has written only one line about the collision itself, and has focussed on energy conservation instead of Newton's Laws.

Q14(b)
Most students gained at least 2 marks on this calculation, but few scored 4 or 5. Many took 11cm as the change in height for the sphere despite being told to take measurements from the photograph. Those that took the measurements often measured either the height of the sphere from the table, or the length of the string. Most students applied conservation of energy using whichever height they had chosen, although a few tried to use equations of motion vertically which was not valid as the acceleration is not 9.81ms^{-2} as it swings rather than free falls.

This is an example of a good response.

(5)

$\frac{11}{4.8} = 2.292.$

1cm = 4.8cm IRL

$2.292 \times 3 = 6.875$ cm dropped.

0.06875m.

$0.022 \times 0.06875 \times 9.81$

$= 0.014840.$

$0.01484 = \frac{1}{2}mv^2.$

$0.02968 = mv^2$

$1.349 = v^2.$

$1.162 = v.$

$1.162 \times 0.022 = 0.0256$ kgms⁻¹

Examiner Review.

This student has scored full marks. A correct scale factor has been found using 11/4.8, and this has been used using the correct change in height from the image to find the actual change in height. Equating mgh and ½ mv^2 gives a velocity which is used to calculate the momentum.

~~$p = mv$~~

~~$v^2 = u^2 + 2as$~~

~~$v^2 = 0^2 + 2 \times 9.81 \times 0.11$~~

~~$v = 1.47\ ms^{-1}$~~

~~[illegible]~~

$gpe = mgh$

$= 0.022 \times 9.81 \times 0.11$

$= 0.0237$ J

$ke = \frac{1}{2}mv^2$

$0.0237 = \frac{1}{2}mv^2$

$v = \sqrt{\frac{0.0237 \times 2}{0.022}}$

$v = 1.47\ ms^{-1}$

$p = mv$

$p = 0.022 \times 1.47$

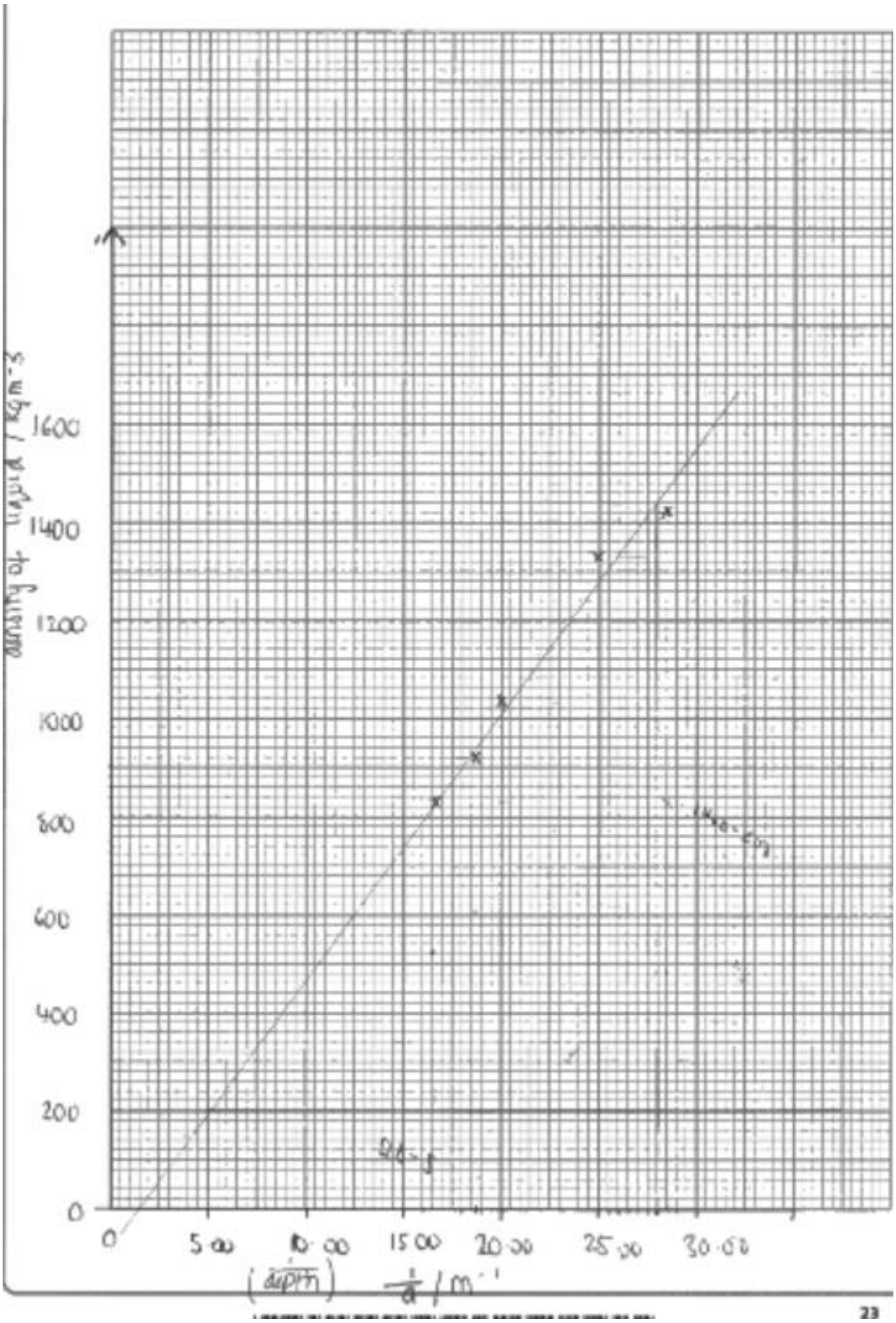
$= 0.032$ Kgm

Examiner Review.

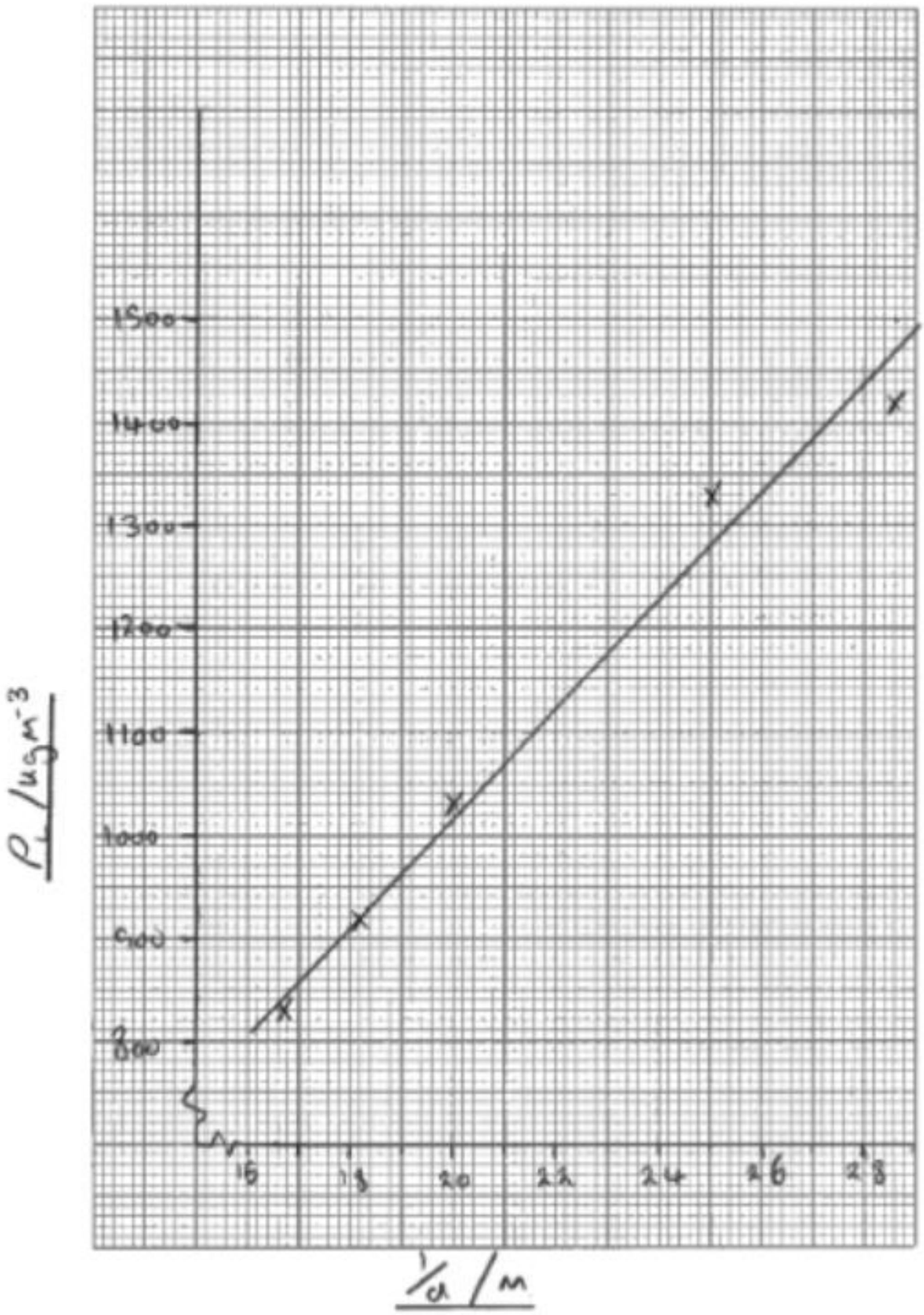
This response shows a student who has not taken measurements from the photograph and instead has used 11cm as the change in height. From there the calculation is correct, but this answer gains only 2 marks.

Q15

Q15(a)
Most students attempted this question and scored some marks. The vast majority plotted the correct graph, though there was varying degrees of success.
Most students lost the mark given for the values of 1/d on the table due to giving values to an inconsistent number of significant figures. Either two **or** three significant figures was acceptable.
Almost all students were capable of working out which graph to plot for this question. However, many lacked the skills needed to determine a suitable scale. As the students were testing a proportional relationship between ρ_L and 1/d, some chose to include the origin on their graph, whilst others chose scales that ensured their data range covered half of the available grid. Both of these approaches were acceptable, but some students chose to start just one scale from zero, giving an unacceptable range and therefore losing the scale mark. Students continue to use scales in 4's, 2.5's and other mulitples, which are not acceptable. These must be discouraged as both the scale and the plotting mark will be forfeited if they use these non standard scales. Best fit lines covered a range of gradients depending on whether the student decide to treat a data point as an anomaly. This was acceptable provided that there was an indication that this was the path the student had chosen. Some students chose to ring or label the anomalous point which allowed them to access the best fit line mark.



Examiner Review.
This student has plotted a graph with the origin included correctly. Both scales are sensible for the data involved, and the axes labels are correct.



This graph also has sensible scales, this time not including the origin but with a good range of data. This student has made the common mistake of using ‘m’ as the quantity for 1/d instead of m^{-1}.

Q15(b)

Most students were able to point to the straight line on their graph as evidence here, but few referred to the need for it to pass through the origin.

the ~~value of~~ $\frac{1}{d}$ is directly proportional to density of liquid producing a straight ~~st~~ line

Examiner Review.

This was a typical response scoring for the reference to the straight line.

Q15(c)

Many students correctly calculated a gradient from the line of best fit. Most chose a large gradient triangle which was good. Those that had chosen the standard scales were more likely to read their scales correctly. Most students could then process their gradient to find ρ_s and make a correct judgement on the type of wood used. A significant number of students used a set of values from the table given to them in part a, and substituted the numbers into the given formula. Although this gave them a value, they had not calculated a gradient and so could not be awarded either of the first two marks.

This is an example of a good response.

$\rho_L = \rho_S r \frac{1}{d}$

gradient = $\rho_S r$

gradient = $\frac{1430-800}{28-16} = 52.5$

$\rho_S r = 52.5$

$\rho_S = \frac{52.5}{r}$

$\rho_S = \frac{52.5}{0.09}$

$\rho_S = 583$ kgm^{-3} It is Chestnut

Examiner review.

This response scored full marks.

$P_L = \frac{P_J x}{d}$ Honey: $P_L = 1420$. $d =$ ~~0.05~~ 0.035.

$P_J x = P_L d$

$P_J = P_L d / x$

$= 1420 \times 0.035 / 0.09 = 552.2$

= Chestnut

Examiner Review.
This student has used data from the table and therefore is limited to scoring only the last two mark points.

Q16

This question focused on filament and fluorescent light bulbs. Information about fluorescent bulbs was given in the question and students were expected to apply their knowledge to this unfamiliar application.

Q16(a)(i)

Most students answered this correctly on an atomic level. Students understood that the electrons collided but often used words such as 'atoms' and 'the wire' to explain what they collided with. Many understood energy was transferred, but jumped straight to the wire being hot rather than explaining the intermediate step of the lattice ions vibrating with higher amplitude.

This is an example of a good response.

current increases so electrons gain energy so more energy is transferred through collisions between electrons and lattice ions. Amplitude of the lattice ion vibration increases so temp rises.

Examiner Review.

This student has gained both marks. The student has used terminology correctly in the explanation.

It gets hot because the electrons in the wire collide with the lattice of metal ions and therefore transfer energy to the metal ions, causing them to heat up.

Examiner Review.

This student correctly described the collisions between the electrons and lattice ions but has missed out on the second mark as the transfer of energy has been mentioned but not the increase in amplitude of vibration.

Q16(a)(ii)

Few students gained two marks on this question. The second mark point was most commonly awarded. Very few students could explain that collision of free electrons with the mercury atoms provided the energy for an electron in the mercury atom to jump to a higher energy level. Many students resorted to quoting large parts of the information given to them in the question which scored them no marks.

This is an example of a good response.

When p.d is appied to the fluorescent bulb; the electrons start flowing through the tube. These electrons colide with; and exite; the mercury atoms. As the electrons around these exited atoms return to the ground state; they emit photons of a specific wavelength and frequency.

Examiner Review.
This student explained the whole process using clear physics terminology.

~~The photoelectron Electron~~ Electrons absorb energy and move up to higher energy levels. After some time, they move back down to a lower energy level. The energy from the move is given out as a photon and the energy of the photon is equal to the energy difference between energy levels.

Examiner Review.
This student has given a more typical answer. The issue of where the energy comes from to excite the atom is not referred to, but there is a correct description of how the photon is emitted.

Q16(b)(i)
Most students could access this calculation and many scored full marks. Some got working correct but errors occurred during calculation.

This is an example of a good response.

room temp. (5)

$R = \frac{\rho L}{A}$ $A = (1.9 \times 10^{-5})^2 \pi = 1.13 \times 10^{-9}\ m^2$

$R = (5.6 \times 10^{-8} \times 1.6) / 1.13 \times 10^{-9} = 79.292\ \Omega$.

$max = 79.292 \times 14 = 1110.1\ \Omega$.

$P = \frac{V^2}{R} = 240^2 / 1110.1 = 51.89 W$.

Power = 51.89W.

Examiner Review.

This response gained full marks. The working was set out well showing the various stages of the calculation clearly.

(5)

$R = \frac{\rho L}{A}$ $\frac{1}{2}(3.8 \times 10^{-5})^2 \pi =$
$2.268 \times 10^{-9}\ m^2$

$\frac{5.6 \times 10^{-8} \times 1.6}{2.268 \times 10^{-9}} = 39.5\ \Omega$

$V = IR$ $\frac{V}{R} = I$ $\frac{240}{39.5} = 6.07$

$P = VI$ $6.07 \times 240 =$

Power = 1458 W

Examiner Review.

This student has made two errors. The use of an incorrect equation for area was a common error. The student has also forgotten to multiply the resistance by the factor of 14 resulting in a power that is 14 x larger than it should be. This was the most commonly seen error on this question. This response scored 2 marks out of 5.

Q16(b)(ii)

Students scored very badly on this item. This is often the case on the last part of the paper as the students are under pressure to finish. Many students simply repeated information from the stem of the question which did not answer the question. Most students thought that the filament would be more likely to break whilst the bulb was in use, illustrating the fact that most students nowadays do not come across filament bulbs in everyday life. Amongst those who realised it would break when switched on, a common theme was the 'sudden surge' of current that the bulb experienced. Many focused on the fact that the speed of this in some way shocked the filament forcing it to break. Of those that knew that current was highest when it was switched on, few related that either to the resistance or the power and even fewer used an equation to back up their statements.

(4)

At initial use $P = \frac{V^2}{R} = \frac{240^2}{79} = 729.1W$

After warming up $P = \frac{V^2}{R} = \frac{240^2}{79 \times 14} = 52.1W$

As the power of the bulb ~~a~~ when being switched on is significantly larger than the power of the bulb after it has warmed up and is in use. I ~~would~~ think the bulbs ~~bread~~ filament is more likely to break as the bulb is switched on than when it is in use.

(Total for Question 16 = 13 marks)

Examiner Review.

Information from previous parts of the question has been used in this response. It can be marked using the second method on the mark scheme and scores 3 marks.

When the bulb is turned on there is a sudden current, however when in use the flow of current is steady. ∴ it is more likely to break when being switched on as the sudden current causes a sudden change in temperature which may cause the filament to break.

Examiner Review.

This uses the erroneous idea of a sudden change in current causing the filament to break.

Paper Summary

This paper provided students with a wide range of contexts from which their knowledge and understanding of the physics could be tested. A sound knowledge of the subject was evident for many but the responses seen did not reflect this as the language lacked precision and its ambiguity prevented some marks from being awarded. Based on their performance on this paper, candidates are offered the following advice:

Ensure that key words or directions in the multiple choice questions are not missed. However, do not spend a disproportionate amount of time on these questions as you may run out of time towards the end of the paper.

Do not quote laws and principles. If a question requires you to use them then apply them to the context of the question as part of your answer.

Practice moments and forces calculations which involve the resolving of forces, especially for examples based on a slope.

If you are assuming a plot on your graph is an anomaly, then label it as such.

Check what one small square on each of your axes represents. It should be a scale of 1, 2 or 5, or powers of 10 of these.

Review the Core Practicals, making sure you understand what you would plot on a graph and how this relates to the relevant constant.

For questions which provide information, read thoroughly but do not quote large portions of it in your answer. Phrases from the stem of the question will not normally be credited in the mark scheme.