Examiners' Report
Principal Examiner Feedback

Summer 2023

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

Summer 2023
Publications Code 2306_8PH0_01_ER

Introduction

Section A of the paper consisted of 8 multiple choice questions followed by 7 questions of increasing length or complexity comprising of short open, open-response, calculation and extended writing style questions and is worth 56 marks. Section A examined material from the topics Working as a Physicist, Mechanics and Electric Circuits.

Section B is worth 24 marks on this paper and examined material from the whole AS specification. It contained two questions worth 12 marks each including a practical question based on linear motion. Although this is not a core practical, it uses techniques that should be familiar to students from core practical 1. The second question in section B was a synoptic question based on forces and motion and Youngs modulus.

This paper enabled students of all abilities to apply their knowledge to a variety of styles of examination questions. Many students showed a good progression from GCSE to AS level, with prior knowledge extended and new concepts taught and understood well. The longer calculation questions were generally not answered well by many students who found the multi-step approach challenging. Some questions were not answered as well as would have been expected by many candidates. Q17, requiring a graph to be drawn and a gradient calculated should have been a straightforward response, however, as with the Summer 2022 series , many students were not confident in their approach which may reflect a lack of practical experience over the last few years.

In the open response and the extended writing questions, candidates that had a sound understanding of the physics involved did not always demonstrate this in their responses due to a lack of precision when applying their knowledge to the context, poor use of subject specific language and missing the point of the question due to being unfamiliar with the command terms. However, candidates from across the ability range managed to score some marks within these questions.

Timing was an issue for a small number of learners. Q17 was mostly affected by this issue with some blank responses seen.

Q09

This was a simple potential divider question. It was expected that candidates would realise that when the resistance of the variable resistor was 0Ω, then the voltmeter across the fixed resistor would read all 6V. A calculation was then necessary for when the variable resistor read 40Ω.

This candidate using the principles of a potential divider correctly showing clear working. The working for the 6V answer was not required.

$V_{out} = V_{in} \left(\frac{R_2}{R_2 + R_1}\right)$

$0\,\Omega \qquad V_{out} = 6 \times \left(\frac{10}{10}\right) \qquad V_{out} = 6$

$40\,\Omega \qquad V_{out} = 6 \times \frac{10}{10+40} \qquad V_{out} = 1.2$

Maximum reading on voltmeter = 6 V

Minimum reading on voltmeter = 1.2V

Some candidates who attempted this method calculated the potential difference across the variable resistor instead of the fixed resistor.

This candidate has also answered correctly, this time by using V=IR for the whole circuit and then for the fixed resistor.

Max: $R_T = 10 + 0 = 10\,\Omega$ $\qquad$ Min: $R_T = 10 + 40 = 50\,\Omega$

$V = 6V$ $\qquad$ $V = IR$

$V = IR$ $\qquad$ $6 = I \times 50$

$V = 0.12 \times 10$ $\qquad$ $I = 0.12A$

$V = 1.2V$

Maximum reading on voltmeter = 6.0V

Minimum reading on voltmeter = 1.2V

Some candidates used this method but calculated the current in the circuit when the variable resistor was 0Ω, and then used this current for a further calculation once the variable resistor was 40Ω. They did not appreciate that changing the resistance also changed the current.

Q10a

Most candidates were successful in calcualting the distance as the area under the graph. A few tried to used the equations for uniformly accelerated motion, but this was only successful if they split the motion into two sections.

This candidate calculated the distance successfully.

Show that the rocket reaches a maximum height of about 68 m.

(2)

$\frac{1}{2} \times 30 \times 4.5 = 67.5 \approx 68m$

This candidate tried to use equations but made mistakes when reading data from the graph.

Show that the rocket reaches a maximum height of about 68 m.

(2)

$S = \frac{(u+v)t}{2}$

$S = \frac{(0+30)1.5}{2}$

$= 22.5$

$S = \frac{(u+v)t}{2}$

$= \frac{(30+0)3}{2}$

$= 45$

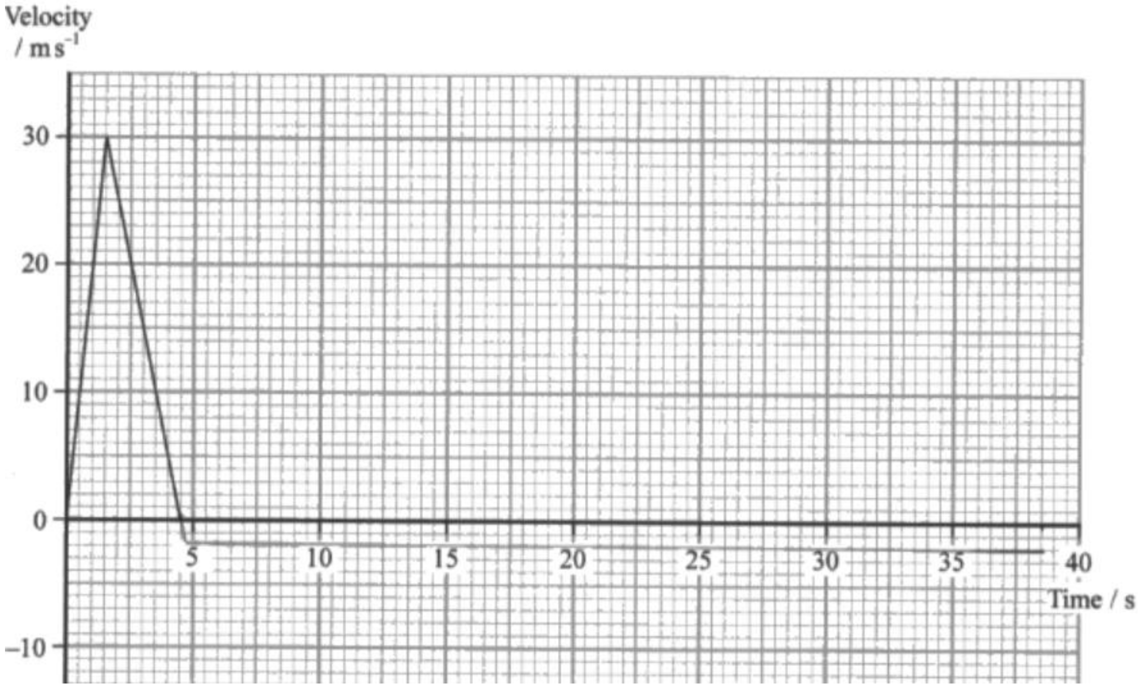
$\boxed{22.5 + 45 = 67.5 \approx 68}$

Q10b

Candidates here were expected to work out how long the rocket descent would take, and to realise that as the rocket was now falling not rising, the velocity would be negative.

This candidate has drawn the line correctly and finished at the correct time.

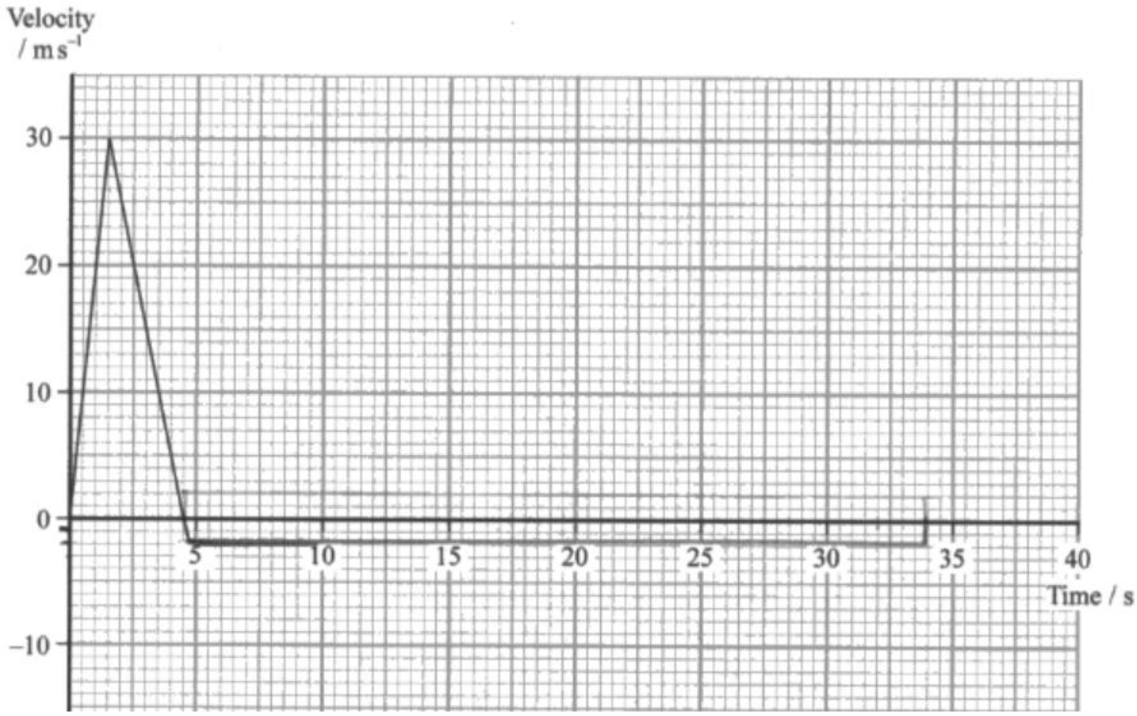
$\frac{68}{2} = 34$ (2)



Whereas this candidate calculated the time for the descent correctly and realised the velocity would be negative, but failed to add on the 4.5s that the rocket had already been in the air for when calculating the time for the descent to finish. This was a common error.

(2)

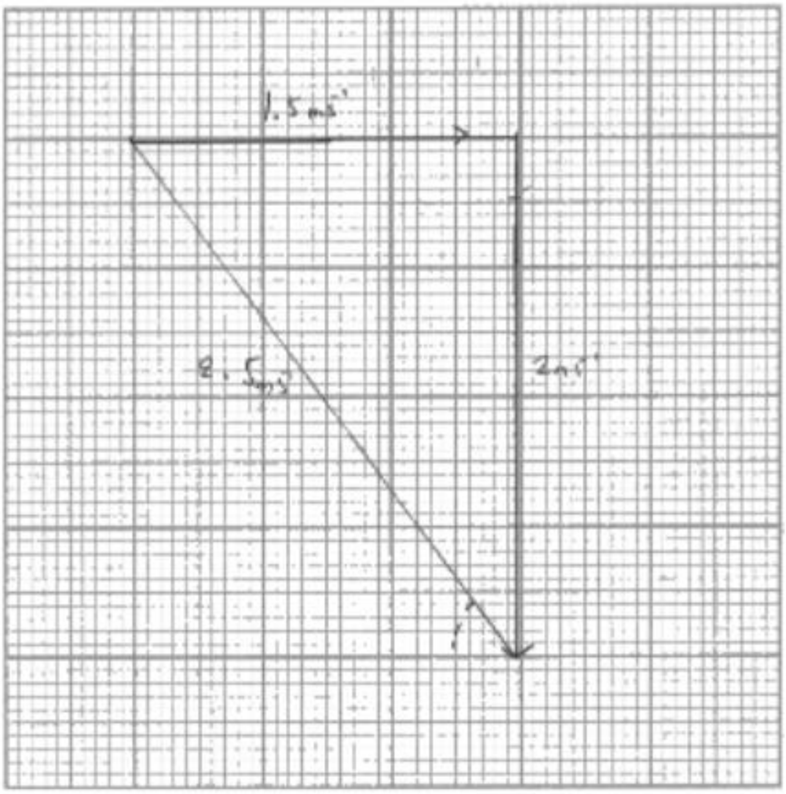
$s = \frac{d}{t}$ $t = \frac{d}{s}$ $\frac{68}{2} = 34s$



Q10c

This question was testing the candidates ability to draw a vector diagram correctly. The velocities were horizontal and vertical so this was a simple diagram to draw, and candidates were expected to draw correct arrows showing the resultant in the correct direction for the original velocities.

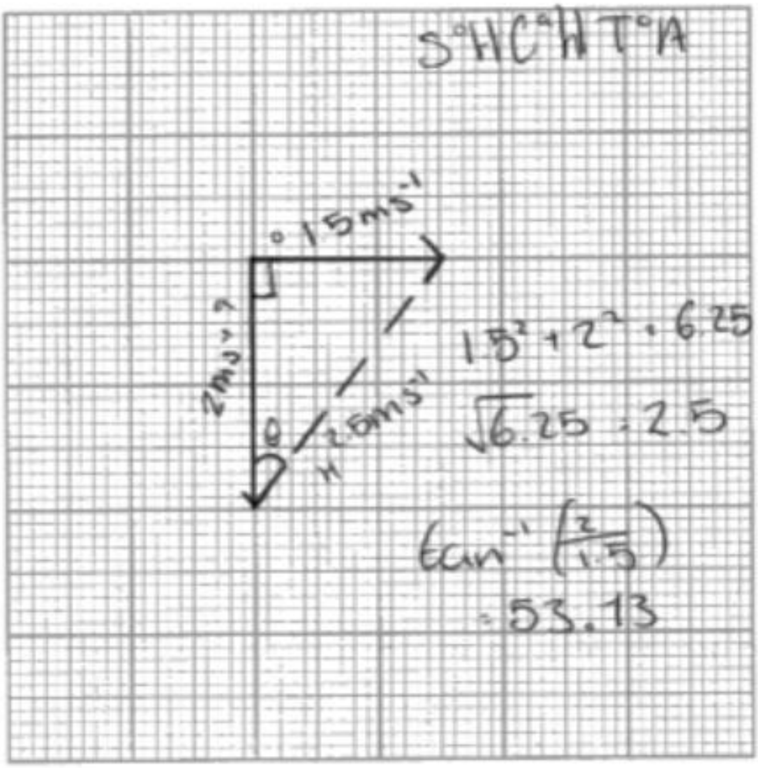
This candidate has put arrows on all three vectors, and has chosen a scale that is suitable for the grid size, resulting in correct values for the resultant velocity.



Magnitude of velocity = 2.5 ms^{-1}

Angle to the horizontal of velocity = 53 °

However, this candidate has drawn the diagram too small. The resultant does not have an arrow and is not in the correct direction. They have managed to get correct values for magnitude and angle however. This diagram was seen many times.



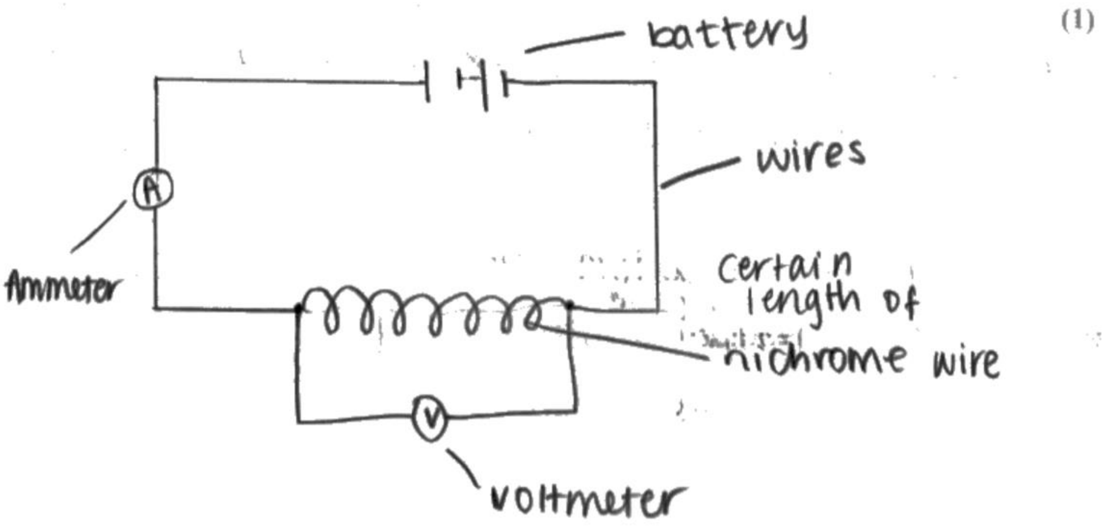
Magnitude of velocity = 2.5 ms^{-1}

Angle to the horizontal of velocity = 53.1 °

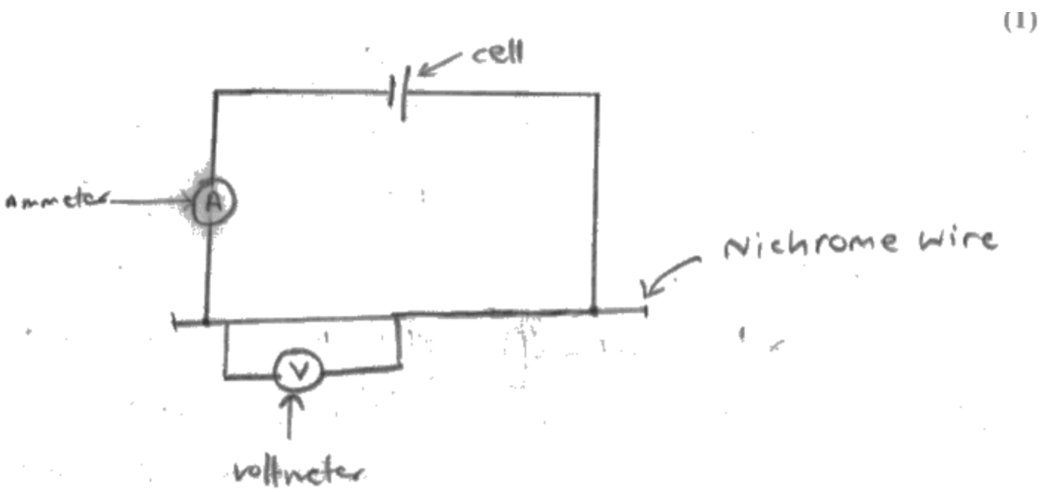
Q11ai

This circuit was quite simple. Candidates should be very familiar with a circuit with an ammeter and voltmeter in. Candidates drew the coil of wire in many ways. Labelling was not required unless it was unclear which part of the circuit was the wire and which was the electrical leads connecting it.

This candidate has drawn the coil differently to the electrical leads in the rest of the circuit and has labelled it as well, making it very clear.



This candidate has drawn the circuit and has the wire clearly labelled, but has the voltmeter attached across only part of the wire. This was a common error and may have been made by candidates who have recalled a practical for investigating how the potential along a uniform current-carrying wire varies with the distance along it, and confused it with the circuit needed here.



Q11aii

This question was testing a simple practical technique. Candidates are likely to have come across this when investigating thermistors. Most candidates used a thermometer to measure the temperature of the water however, a significant minority tried to measure the temperature of the wire with the thermometer directly. Many candidates said that they would take repeat readings and calculate a mean. This would not necessarily make the result more accurate as the thermometer could have a systematic error. Few explained the practical techniques which could improve accuracy here.

This candidate was successful and gave a good explanation.

Place a thermometer inside the water bath and leave the wire inside at the desired temperature for enough time to allow it to reach the same temperature as the water bath.

Q11b

This question tested candidates knowledge of particle behaviour within metals. Most candidates attempted an answer. A few described semiconductors and therefore did not access the marks. Of those on the right track, many could not be awarded marks due to the vagueness of their language, using word such as particles and atoms instead of lattice ions, and charge carriers when they should know that it is electrons that carry the charge in metals. There were also many examples of vagueness such as 'vibrating more' and 'more collisions' which were on the right track but not where the language let them down.

The candidate has used language well to give a full description of what is happening.

As temperature increases, the particles in the wire gain more kinetic energy. The amplitude of lattice ion vibrations increase. This means that the charge carriers i.e electrons collide with lattice ions more frequently, thus reducing drift velocity. Since $I = nAve$ and n, A and e are constant $I \propto v$. As drift reduces, current also reduces. Since ~~B~~ ~~R~~ $I \propto \frac{1}{R}$, as current ~~inc~~ decreases, this has to mean the resistance ~~incr~~ of the wire increases.

This candidate used vague expressions such as 'particles' and 'more collisions' and therefore could not be awarded marks.

As temperature increases particles within the wire have more energy. This means the lattice electrons oscilate ~~more~~ and at higher amplitudes. This results in more collisions with the current and so the higher the temperature to more collisions and so the lower the current and the higher the resistance.

Q12a

This question was a straightforward calculation using the resistivity equation. Most candidates were successful in this and also showed clear working like this candidate.

$R = \frac{\rho l}{A}$ $\quad l = \frac{RA}{\rho} = \frac{80 \times \pi \times (0.14\times10^{-3})^2}{4.9\times10^{-7}}$

$r = (0.28 \div 2)\times10^{-3} = 0.14\times10^{-3}$ $\quad = 10.05$

$= 10\,m$

Length = 10.1m

Common mistakes included using the diameter value given as the radius. This candidate has done this, but has not shown the working for it, and has therefore not been awarded a working mark either. Candidates must always show full working to maximise the marks they can be awarded if they make a mistake.

diameter of wire = 0.28 mm → $0.00028\,m$ (3)

$2.46 \times 10^{-7}\,m^2$

$R = \frac{\rho L}{A}$

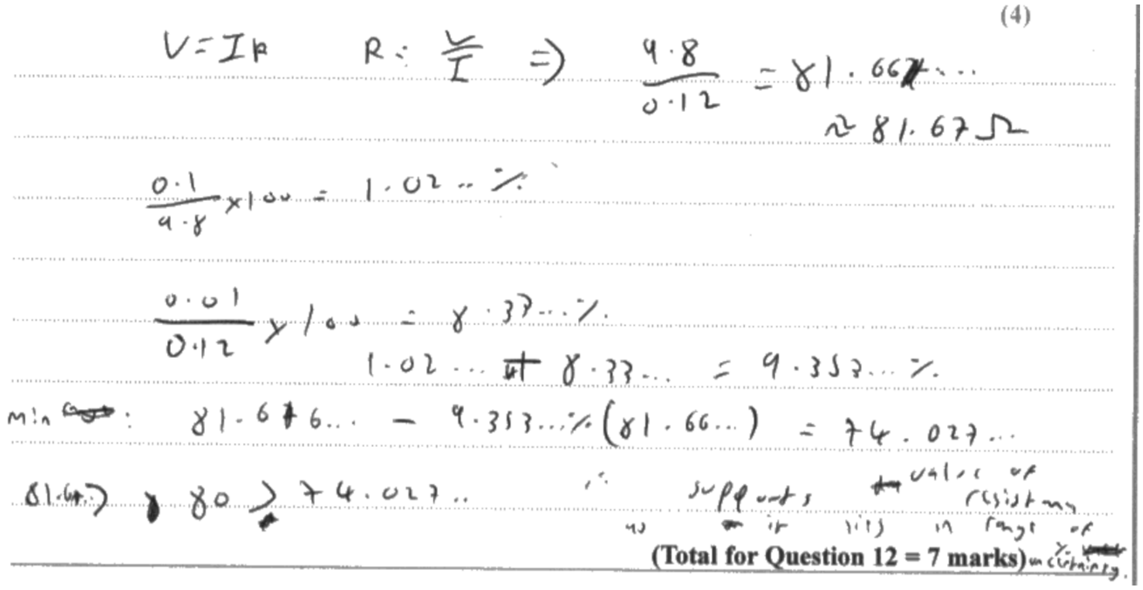
$\frac{80 \times \cancel{A}\, 2.46 \times 10^{-7}}{4.9 \times 10^{-7}}$ $\quad 1.97 \times 10^{-5}$ $\quad = 40.21$

Length = 40 m

Q12b

This question used a simple equation to test candidates' ability to work with uncertainties. There were two main methods for this. The first involved calculating the percentage uncertainty for both V and I, then combining these to find the percentage uncertainty and hence the uncertainty and the limits of the value of R. The second involved adding or subtracting the uncertainty from the value for V and I, and then calculating R using the correct combination of values to find the limits. As the value of R calculated from V and I was greater than the 80Ω quoted on the resistor, candidates only needed to find the lower limit using one of the methods to come to a conclusion. Most candidates chose to find both limits however.

This candidate has used the first method to find both limits and come to a correct conclusion.


(4)

$V = IR \quad R = \frac{V}{I} \Rightarrow \frac{9.8}{0.12} = 81.667\ldots \approx 81.67\,\Omega$

$\frac{0.1}{9.8} \times 100 = 1.02\ldots\%$

$\frac{0.01}{0.12} \times 100 = 8.33\ldots\%$

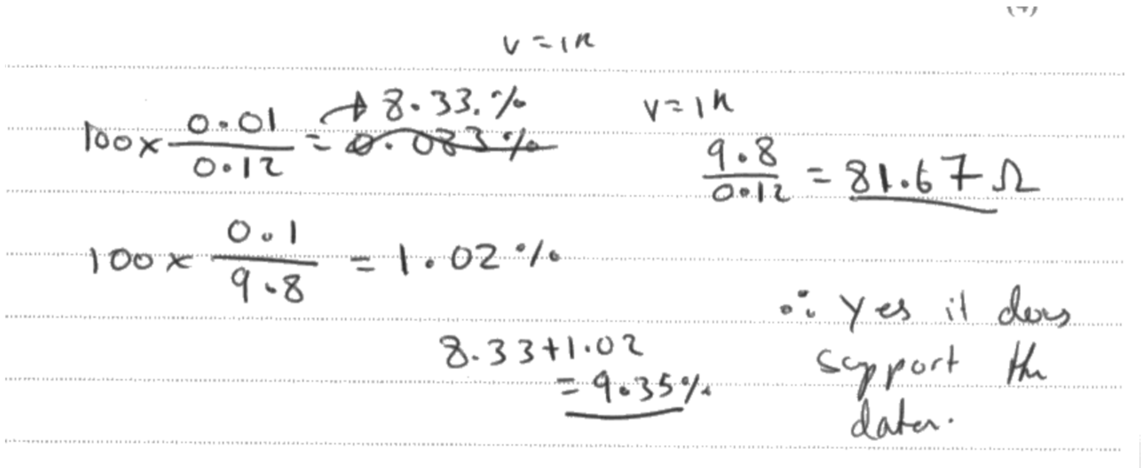
$1.02\ldots + 8.33\ldots = 9.353\ldots\%$

min: $81.66\ldots - 9.353\ldots\%(81.66\ldots) = 74.027\ldots$

$81.67 > 80 > 74.027\ldots$ ∴ supports the value of resistance as it lies in range of % uncertainty.

(Total for Question 12 = 7 marks)

This candidate has also used the first method but has stopped once the percentage uncertainty for R has been found. Many candidates did this, showing that they were somewhat familiar with the method but could not remember enough to see it through to its conclusion.


$V = IR$

$100 \times \frac{0.01}{0.12} = \cancel{0.083\%}\ 8.33\%$

$V = IR \quad \frac{9.8}{0.12} = 81.67\,\Omega$

$100 \times \frac{0.1}{9.8} = 1.02\%$

$8.33 + 1.02 = 9.35\%$

∴ Yes it does support the data.

13ai

Candidates were able to use W=mg correctly in nearly all cases. Nearly all candidates knew to give their answer to one more decimal place than the 'show that' value.

13aii

This question required candidates to choose the correct pivot to enable them to calculate the force at the wall. Candidates needed to understand that there was also an unknown support force at the point of contact of the plank with the rock and that choosing this point as the pivot eliminated this force from the equation. When applying the principle of moments, many candidates got confused about the correct distances to use. Many of the candidates who calculated the force successfully drew the distances clearly onto the diagram in the question which helped avoid the error.

This candidate has laid out the working clearly and has chosen the correct distances.

Σclockwise moments = Σanticlockwise moments

$(245.25)(2.5) = (F)(\cancel{t}5-1.4)$

$613.125 = 3.6F$

$F = 170.31N$

$= 170N$

Force exerted by wall on plank = 170N

This second candidate has got confused about which pivot to take moments about and has tried to take moments about the right hand end of the plank. Unfortunately this does not eliminate the support force at the rock and therefore this should have been included in the calculation.

$5/2 = 2.5$

$2.5 - 1.4 = 1.1m$

$245.25 \times 2.5 = 613.125N$

$613.125 = f(1.4)$

$437.9 = f$

Force exerted by wall on plank = 437.9N

13aiii

This part of the question required the candidates to realise that as the plank starts to tip there is a loss of contact of the plank with the rock and therefore the support force at the rock would be aero. Moments can then be taken about the wall, with simply the weight force of the plank on the left of the wall and the weight force of the student on the other.

This candidate has realised both of these things and has calculated the clockwise and anticlockwise moments about the wall if the student were right at the end of the plank, showing that the clockwise moment caused by the students is greater than the anticlockwise moment caused by the plank and therefore that the plank will tip.

CW Moment = $550 \times 1 \cdot 4 = 770$ Nm

A CW Moment = $250 \times 1 \cdot 1 = 275$ Nm

770 Nm > 275 Nm $\therefore$ Yes, the plank will tip

Q14

Very few candidates understood the principle of a parallel circuit for this question. Almost all of them assumed that as more bulbs were added, the current in each branch of the circuit got smaller as the total current stayed the same, failing to appreciate that each additional bulb increased the current through the battery. Some candidates started off well by stating that as more bulbs were added the total circuit resistance decreases and so the current increased, but still went on to write about the current in the branches as above, therefore contradicting themselves. This fuundamental misunderstanding of parallel circuits may come from considering a parallel circuit in isolation as far back as Key Stage 3, and describing the current as 'splitting' between the branches. This could be overcome by investigating adding bulbs in parallel to a circuit and observing that the current increases as each new branch current is added. This candidate has started off well as mentioned above, but has still described the same misunderstanding about the current in the branches, fortunately not going far enough to contradict totally the good physics above it

The bulbs are connected in parallel, so because of the conservation of energy, the voltages in each branch (each bulb) is equal. And for the conservation of charge, the current through each bulb has to add up to the total current in the circuit (that leaves & enters the battery). So, as you add more bulbs in parallel, the total Resistance of the circuit decreases: $\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{R_T}$. ~~Since the total resistance decreases~~ So, as you add more bulbs, the current has to be shared/split equally between more branches/components - so each bulb receives relatively lower current which makes them go dimmer. And since the total resistance lowers, the total current in the circuit increases, causing more current to pass through the battery. Higher current through the battery x its internal resistance increases the lost volts/p.d used up by the battery: higher energy is released by each charge, so the battery gets hotter (temperature increases).

This response was more typical basing the entire answer around their incorrect understanding of parallel circuits.

The student observes that the bulbs get dimmer. This is because when components are added in parallel to eachother (in this case, filament bulbs), the current splits into each parallel connection. This means that as the number of bulbs increase, the amount of current received by each bulb is smaller. If each bulb has less current going through it, they will have less power since P = IV. If each bulb has less power as number of bulbs increase, than the bulbs will get more and more dim.

Q15ai

This straightforward calculation of momentum was answered well by most.

Q15aii

This question required candidates to realise that a collision was taking place between the bullet and the block and therefore a momentum calculation would have to be carried out. Once the block was in motion, then there was a straightforward transfer of it's kinetic energy to gravitational potential energy.

This candidate has realised that this is a collision. The small diagrams allow the candidate to see clearly what is happening before and after the collision and then apply the principle of conservation of momentum correctly. Once the candidate has established the initial velocity of the block, it's initial kinetic energy is equated to its final gravitational potential energy to calculate the maximum height.

(3)

$450(0.012) + 2.5(0) = 2.512(\alpha)$

$\cancel{2+}\ \frac{450(0.012)}{2.512} = 2.1496\ldots\ ms^{-1}$

$\frac{1}{2}mv^2 = mgh \therefore \frac{1}{2}(2.512)(2.1496\ldots)^2 = 2.512(9.81)h$

$\div 2.512(9.81) \qquad \div 2.512(9.81)$

$h = 0.2355\ldots \approx 0.236$

Maximum change in vertical height = 0.236 m

This response was commonly seen. The candidate assumes that energy is conserved and equates the kinetic energy of the bullet to the gravitational potential energy of the block (in this case, forgetting the mass of the bullet embedded in it). There is no appreciation of the fact that work is done and energy is transferred to other stores as the bullet embeds itself in the block.

$\frac{1}{2} \times 0.012 \times 450^2 = 2.5 \times 9.81 \times h$

$\therefore h = 49.54\,m$ (2dp)

Maximum change in vertical height = 49.54 m

This candidate starts well by considering conservation of momentum, but then fails to appreciate that the swinging block does not move with linear acceleration and therefore equations of linear acceleration cannot be used to calculate an answer. The result of using incorrect physics in the calculation is that the final answer mark cannot be awarded wither even though in this case it comes to the same numerical value.

$\cancel{\sum M_{before} = \sum M_{after}}$ $\quad P = mv$

$\sum P_{before} = \sum P_{after}$ $\quad P_b = 0.012 \times 450$ $\quad 2.5 + 0.012$

$5.4 = m \times v$ $\quad = 5.4$ $\quad = 2.512$

$5.4 = 2.512 \times v$

$v = 2.15\ ms^{-1}$

Maximum change in vertical height = 0.24

s	
u	2.15
v	0
a	-9.81
t	

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

$$s = \frac{v^2 - u^2}{2a} = \frac{0^2 - (2.15)^2}{2(-9.81)} = 0.24m$$

Q15b

Many candidates failed to consider momentum in this answer, concentrating instead on the tiny difference in mass between the wooden block with the bullet embedded, and the steel block without the bullet embedded, or on the fact that the steel block would have a smaller volume and therefore less air resistance (a negligible effect at these speeds). Those that did concentrate on momentum scored quite well, but failed to explain each step, making jumps for instance from the higher initial velocity of the steel block, straight to its increased maximum height, with no mention of gravitational potential energy.

This candidate concentrated on momentum and did well at describing the intermediate steps to link one change to the other.

(5)

Because due to conservation of momentum, the momentum before a collision = momentum after a collision. With the steel block, the bullet rebounds so it has a negative velocity and hence a negative momentum. This means that the steel block must have a higher momentum than the wooden block as it has to make up ~~the~~ for the bullets negative momentum as ~~the~~ both ~~that~~ scenarios had the same momentum before the collision. The steel blocks higher momentums means it has a higher velocity as both blocks have the same mass, and higher velocity means more kinetic

(Total for Question 15 = 10 marks)

TOTAL FOR SECTION A = 56 MARKS

energy which gets converted to more gravitational potential energy which leads to a higher maximum height.

This candidate was less successful. Whilst realising that momentum was important, the candidate missed several important steps in the explanation.

(5)

The momentum of the bullet when it got stuck in the wooden block was 0, but in the metal block it has rebounded so velocity is in the opposite direction, therefore negative. When you pass this negative momentum to the other side of the equation it is now adding so overall the velocity of the ~~metal~~ steel block would be greater, reaching a greater height than the wooden block

Q16a

This question was testing candidates ability to apply a skill learnt in core practical 1. Many candidates misread the question as ‘calculate’ not ‘measure’ and described a way of calculating h from other measurements. Those that described measuring h often used a metre rule but did not describe how to check it was vertical. Of those that used a set square there were several candidates using it to check that the metre rule was straight instead of vertical. Very few answered by drawing on the diagram which was an easy way to gain the second mark point.

This candidate has done well. Despite forgetting the name of the set square the second mark point has been able to be awarded for the diagram.

(2)

the students called of used a ~~m~~ metre ruler and the 90°c triangle ~~ruller~~ ruler. this is because the ~~ruller~~ metre ruler could be vertically up and accurate to get the measurements without it being slanted.

shown a demonstration on how the student can ensure the ruler is standing ~~180~~ 90° up.

Whereas this candidate has not explained why the set square was used.

(2)

The student should use a set square to position a metre ruler against the ramp and ~~to on~~ make readings at eye level to measure h accurately

Q16bi

Candidates should always use y=mx+c when asked to test whether a relationship is a straight line. Many candidates instead simply referred to h and v^2 being directly proportional. This is only true if g is constant, which most did not mention.

This candidate has compared the equation to y=mx+c and linked the variables. 1/2g has been identified as the gradient and a statement made that it is constant, producing a good response.

(2)

$y = mx + c$

where m is a constant and c is a constant

$h = \frac{1}{2g} \times v^2 + 0$ $\frac{1}{2g}$ is a constant (gradient ~~ent~~)

$y = m \; x + c$ 0 is a constant ~~[illegible]~~ (y intercept)

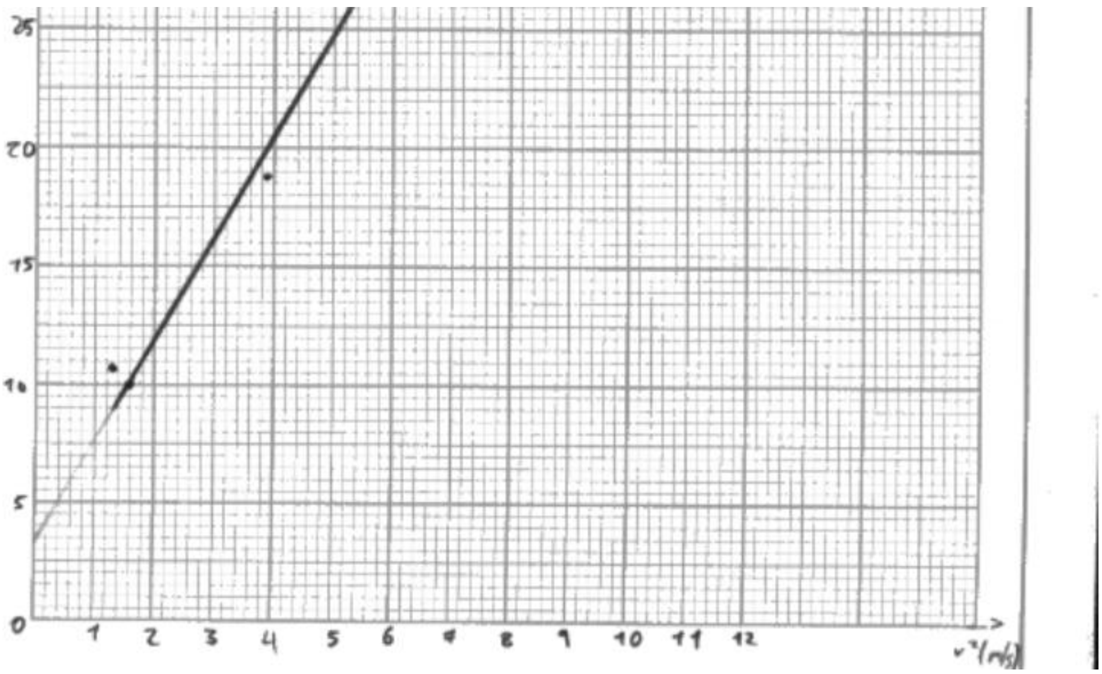
Q16bii

Most candidates attempted this question and scored some marks. The vast majority plotted the correct graph, though with varying degrees of success. Some candidates were not awarded the mark given for the values of v^2 on the table due to giving values to an inconsistent number of significant figures.

Only a small number of candidates were able to state the unit for v^2 correctly when labelling the graph axes. Almost all candidates plotted points on the correct axes, although some chose a scale that did not fill the grid vertically. It is the data rather than the scale that must take up at least half of the grid in each direction. Candidates continue to use scales in 4's, 2.5's and other multiples, which are not acceptable. These must be discouraged as both the scale and the plotting mark cannot be awarded if they use these non-standard scales.

Candidates should be reminded to take a sharp writing implement into the examination to avoid best fit lines a thick as the one below. If the line is 1mm thick, then this is not considered accurate. Candidates should also be encouraged to plot using crosses not dots as these can often turn into 'blobs' as below which are again not considered accurate plots and therefore are not awarded the plotting mark.

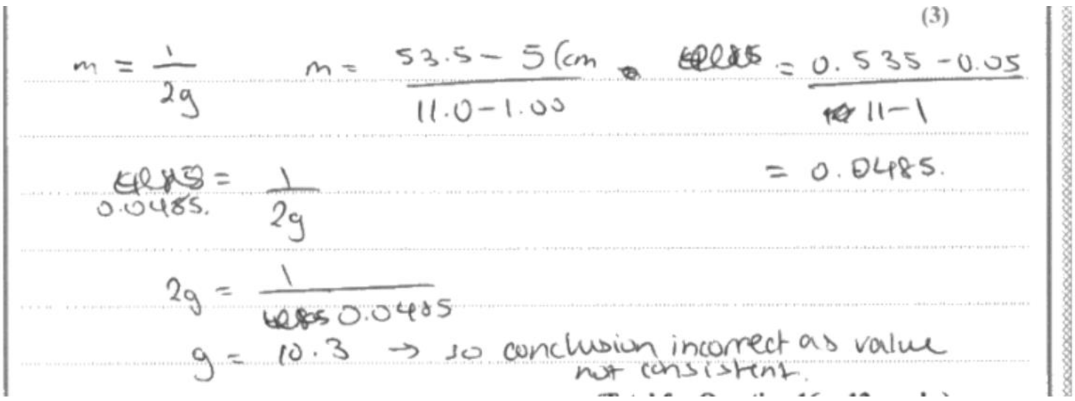
The best fit line for correct plots should have fallen just above the origin. Most candidates chose to put their best fit lines through the origin which was acceptable for this graph, however, candidates should be encouraged to plot a best fit line that best fits the data without being influenced by their expectation that the line will pass through the origin.



Q16biii

Most candidates were able to calculate a value for the gradient of the graph. Most candidates used a large triangle which was pleasing to see, but a surprising number read the data from the graph incorrectly. Many candidates, upon getting a gradient approximately equal to 5, then simply doubled it to find g instead of equating it to 1/2g.

This candidate both completed the gradient calculation and found a value for g correctly, and then gave a valid conclusion.


(3)

$m = \frac{1}{2g}$ $\quad m = \frac{53.5 - 5\ (cm)}{11.0 - 1.00} = \frac{0.535 - 0.05}{11 - 1}$

$= 0.0485.$

$0.0485 = \frac{1}{2g}$

$2g = \frac{1}{0.0485}$

$g = 10.3$ → so conclusion incorrect as value not consistent.

This candidate successfully found the gradient of the graph but then did not equate it to 1/2g and therefore was only awarded the first mark.

(3)

gradient $= \frac{g}{2}$ → the value given for $g = 9.81\,ms^{-1}$ so her results are quite close and her conclusion is valid

gradient $= \frac{45}{9.4}$
$= 4.787$

$4.787 = \frac{g}{2}$ $\quad g = 9.574\,ms^{-1}$

Q17a

This was quite a straightforward calculation. The most common errors were forgetting that there were six cables, and power of ten errors, often resulting from candidates not being able to interpret 'giga' correctly.
Quite a few candidates did not use the equations from the specification, but instead amalgamated them into one equation. When candidates do this, they risk losing the first two method marks if they make a mistake and get the wrong answer as this equation is not given in the specification.

This candidate used the equations from the specification correctly, remembering that there were 6 cables, and getting powers of ten correct.

(3)

$12\,kN = 12000\,N$ $\quad \sigma = \frac{12000}{3.1\times10^{-4}} = 38709677.42$

$200GPa = 2\times10^{11}$

$2\times10^{11} = \frac{\sigma}{\varepsilon}$

$\varepsilon = 0.00019$

$0.00019 = \frac{\Delta x}{50}$ $\quad \Delta x = 0.0096$

$\frac{0.0096}{6} = 0.0016m$ $\quad$ Extension = $0.0016\,m$

This candidate tried to amalgamate the equations, but has made a mistake. As there in then a substitution into an incorrect equation, no marks could be awarded.

$$E = \frac{\sigma}{\varepsilon} = \frac{F \times \Delta x}{A \times x}$$

$$200 \times 10^9 = \frac{1200x\ x}{3.1 \times 10^{-4} \times 50}$$

$$\frac{258.38}{6} = 6\Delta x$$

$$\Delta x = 43.06m$$

Extension = $43.1m$

Q17bi

This simple calculation was made more complicated by the need to interpret the force-time graph to find the weight of the lift and the people. The question stated clearly that the lift only started moving after 5s, which it was hoped would enable to candidates to realise that during that period, tension = weight. Once that had been established, it became a simple calculation using W=mg.

This candidate has done this correctly.

(3)

$$(19 \times 10^3) - (12 \times 10^3) = 7000\ N$$

$$W = mg$$

$$m = \frac{7000}{9.81} = 713.56\ kg$$

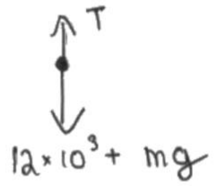
$$= 710\ kg$$

Mass of people = 710 kg

Whereas this candidate has decided that the tension is 19.5kN showing that the graph has been misinterpreted. Most candidates were able to be awarded the second mark point however for use of W=mg.

(i) Calculate the total mass of the people in the lift.

weight of lift = 12 kN



(3)

Tension = 19.5 kN

$$19.5 \times 10^3 = 12 \times 10^3 + mg$$

$$7.5 \times 10^3 = mg$$

$$m = \frac{7.5 \times 10^3}{9.81} = 764.5 = 765\ kg$$

Mass of people = 765 kg

Q17bii

Candidates had to consider the resultant force on the lift for this part of the question to enable them to deduce the motion. Descriptions of the motion were common, but many could not access the first mark point as they did not give any times for reference. A surprising number of candidates read the times incorrectly from the graph. Those that used the forces to explain the motion were normally successful at comparing the tension force to the weight.

This response references the time correctly and explains the motion in terms of the resultant force for two of the three sections as well as giving a good overview of the whole motion.

Between 5 - 6.5s the lift begins to accelerate upwards, ~~before~~ after ~~6.5~~ from 6.5s - 27.5s the lift remains ~~sta~~ ~~in~~ at a constant velocity as it is not accelerating no resultant force on the lift (lift in terminal velocity), however from 27.5s - 29s the lift begins to decelerate, resultant force down on lift, velocity not constant so decelerates.

This candidate however had a more typical answer to this question, simply describing the motion with no explanation of it. Answers such as these were limited to one mark.

At 5 seconds it accelerates ~~a~~ unit 6.5s then it has a constant velocity up to 27.5s and then decelerates for 1.5 seconds until 29s. Tension is constant when force is constant

Examiners tip

Look for the command word at the beginning of the sentence asking you to do something. 'Describe' has a different meaning to 'explain'. All the command words can be found towards the back of the specification.

Q17c

Most candidates realised that the extension of the remaining cables would increase, however, few could link them together fully. Many started with an increased tension in the remaining cables but failed to mention stress and/or strain to explain how this linked to the extension.

The best answers quoted the equations from the specification as evidence of the relationships between force, stress, strain and finally extension, like the one below.

Remove of one cable will reduce ~~to~~ the total cross-sectional area of cable. $\sigma = \frac{F}{A}$, F is constant, lower A means higher strees on the cable. Then base on $E = \frac{\sigma}{\varepsilon}$, E is constant for stell, higher σ means higher ε. Base on $\varepsilon = \frac{\Delta L}{L}$, L is constant, higher ε means higher ΔL, therefore extension will increase.

This response is more typical. The candidate realises that the tension has increased and that the extension will therefore increase but is unable to link them together.

(3)

Removing one cable would increase the extension of the remaining cables as the tension ~~per~~ for each of them would increase.

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 always 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:

- Practise questions under timed conditions to ensure that you do not run out of time on the last question.

- Note units that will need converting as you read through a question. Highlighting them is useful at this stage, or even converting them before you start to ensure that you don't forget later.

- Use technical language precisely, especially if there is more than one value for a particular quantity, such as different currents in a circuit or moments taken about different pivots. Make sure it is clear exactly which bit you are discussing.

- When referencing sections on a graph, always give values to indicate which section you are discussing.

- For longer answer explanations, make sure when you have finished, that you read the question again to check where your explanation should end, and ensure that your answer links from the start right through to the end.

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