INTERNATIONAL GCSE

Physics (9-1)

EXEMPLARS WITH COMMENTARIES

Pearson Edexcel International GCSE in Physics (4PH1)

For first teaching September 2017
First examination June 2019

Introduction

This booklet has been produced to support International GCSE physics teachers delivering the International GCSE Physics specification for first teaching in September 2017 and first assessment in June 2019.

This booklet looks at questions from the Sample Assessment Materials. It shows real student responses to these questions, and indicates how the examining team will follow the mark schemes to demonstrate how students would be awarded marks in these questions.

For this pre-assessment exemplar, we have used responses from 52 International GCSE students. We have selected a range of responses to 6 questions, with mark schemes, from the sample assessment materials, with accompanying examiner commentaries on how the mark scheme has been applied.

Other teaching and learning materials for this specification are available on the International GCSE Physics subject page here.

How to use this document

Comments on the Mark Scheme

When the Principal Examiner and Chief Examiner first see completed scripts, they **adapt** the mark scheme to make sure that all candidates get the mark they deserve. This often means they expand the mark scheme or add brackets to show which parts of the answers do not need to be seen.

Comments on the demand of questions

The Principal Examiner and Chief Examiner design live examination papers so that some questions are targeted at different grades. Generally, questions at the start of the examination paper and the start of each question are targeted at grades 1 to 3 whilst questions at the end of the question paper are targeted at grades 7 to 9. Some longer answer questions are designed so that everyone can try them.

Also, within a question, all parts with the same *letter* link together in some way e.g. Q2bi and 2bii are linked because they both are about temperatures in Kelvin.

Question 1.

Almost everyone got full marks for **Q1a** which is good as this question was targeted at levels 1 to 3.

This is one of the few that was incorrect.

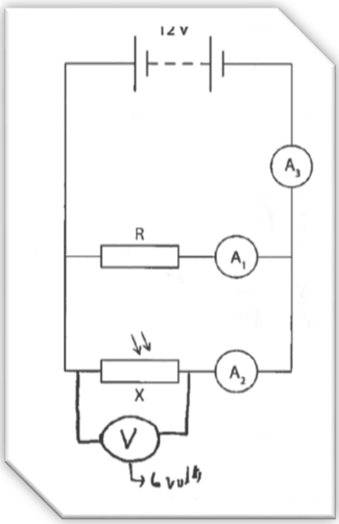

(a) (i) State the name of component X.

(1)

thermistor

In **Q1aii**, examiners will ignore any incorrect information unless it directly contradicts correct answers.

In this example, the '6Volts' is incorrect but this does not negate the correct positioning of the voltmeter, so it has been ignored.



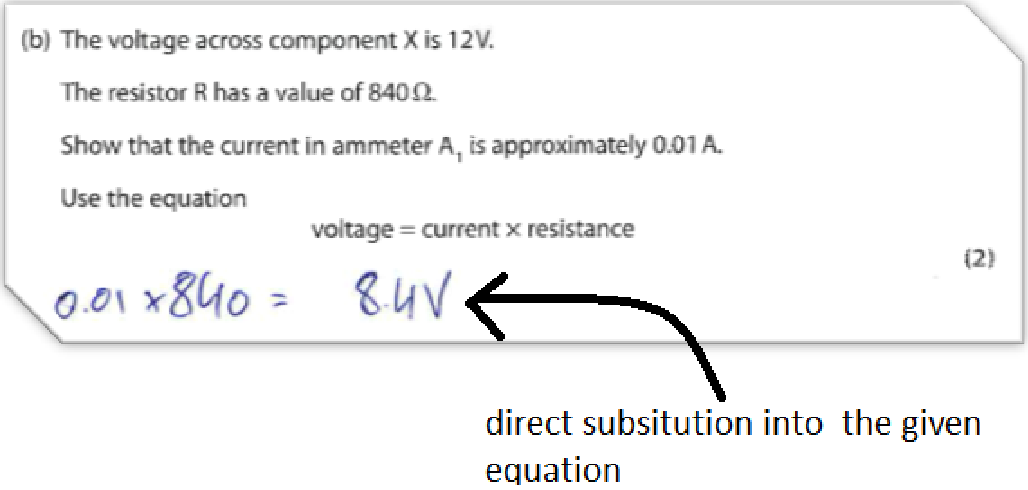
Many students don't understand why examiners sometimes ask a 'show that' calculation. The reason is that the examiners want to use the value calculated in the next part of the question.

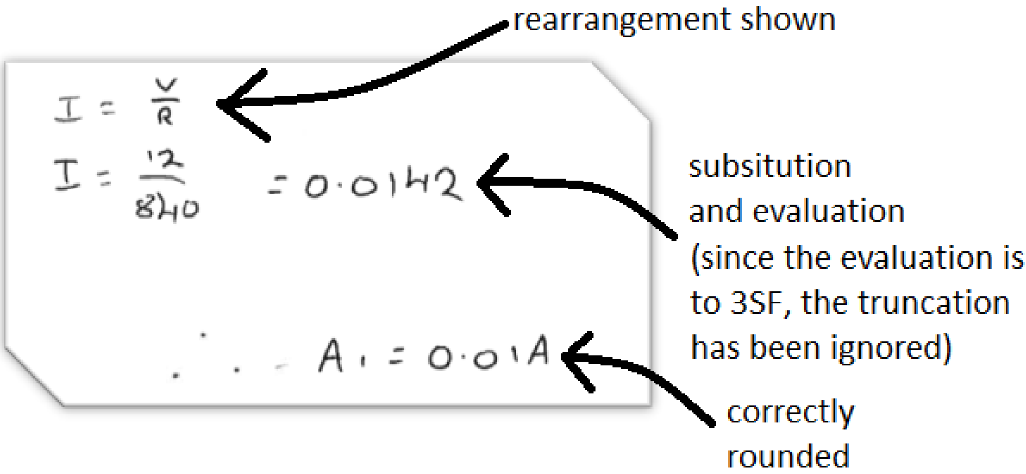
In **Q1b**, most of the students gained full marks. A few students attempted the calculation the wrong way round (using the value of current they had been given to calculate the voltage) and did not gain marks.

This is what the Mark Scheme states

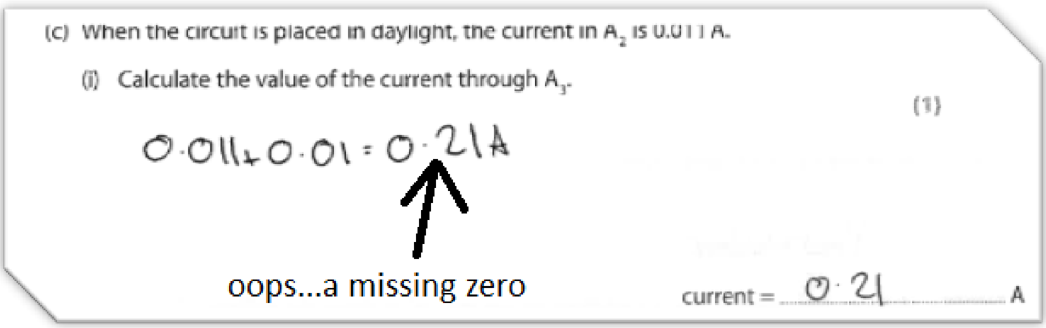
rearrangement • $I = V/R$ (1) substitution • $I = 12/840$ (= 0.014 (A)) (1)	0.01429 (A) some evidence of working required for two marks

These are two responses - the first one gets zero because nothing matches the mark scheme, and the second one gets both marks



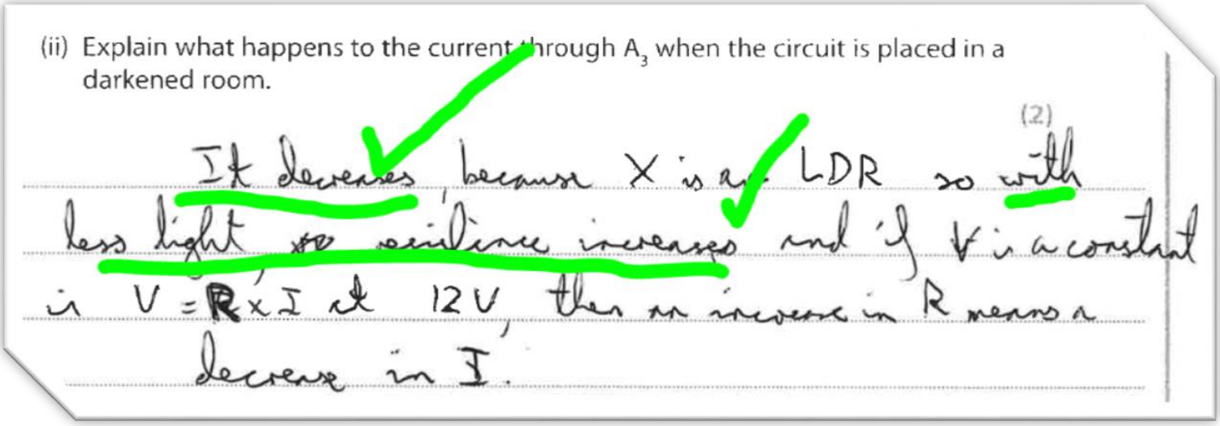


In **Q1ci**, quite a few students understood what they had to do but then made arithmetical errors.



A lot more students found **Q1cii** more difficult (nearly 40% failed to get this right). It is harder than the rest of the question and is therefore placed at the end. As an explanation, it needs a 2-stage answer: a statement of what does happen when the circuit (with an LDR) is placed in a darkened room AND a reason why. The two stages can be given in reverse order e.g. a statement about the resistance AND a consequent effect on the current.

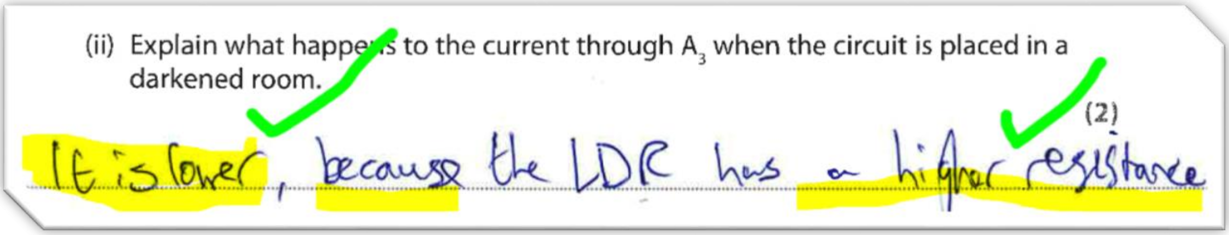
This is a very full correct answer


(ii) Explain what happens to the current through A_3 when the circuit is placed in a darkened room.

(2)

It decreases, because X is an LDR so with less light the resistance increases and if V is a constant i.e. $V = R \times I$ at 12V, then an increase in R means a decrease in I.

Not all answers have to be this full….this also got full marks


(ii) Explain what happens to the current through A_3 when the circuit is placed in a darkened room.

(2)

It is lower, because the LDR has a higher resistance

Inevitably, many students got the current increasing and resistance decreasing and so lost the marks.

Question 2

90% of the students got the first question, **2ai**, correct. In this case there was no mark for the equation because it was given on page 2, so the marks were for substitution, rearrangement and evaluation. When you are doing any question on pressure it is a good idea to check the units for pressure: if they are both the same then don’t convert them.

In this case, both the pressure units are the same and so are the volume units. This student did get the calculation correct. The examiner could see the right answer on the answer line. However, the working out does not show good practice as linking the equals signs means that all three quantities have the same value.

(i) Before compression, the gas pressure is 100 kPa and the volume of the gas is 7.5 cm³.

After compression, the volume of the gas is 5.0 cm³.

Calculate the pressure of the gas after compression.

(3)

$\cancel{\frac{100}{7.5} = 75.}$

$100 \times 7.5 = 7500 \div 5 = 150$

pressure = 150 kPa

this is not good practice

This was much clearer!

Calculate the pressure of the gas after compression.

(3)

$P_1 \times V_1 = P_2 \times V_2$

$100 \times 7.5 = P_2 \times 5$

$750 \div 5 = P_2$

$P_2 = 150$

pressure = 150 kPa

As was this!

Calculate the pressure of the gas after compression.

(3)

$100 \times 7.5 = 5P$

$\frac{750}{5} = 150$

pressure = 150 kPa

Also all methods are accepted. This student spotted the ratio and got the correct answer.

(i) Before compression, the gas pressure is 100 kPa and the volume of the gas is 7.5 cm^3. $\div 1.5$

After compression, the volume of the gas is 5.0 cm^3.

Calculate the pressure of the gas after compression.

(3)

100 kPa $\times$ 1.5 = 150

pressure = 150 kPa

In **Q2aii**, just over 10% of students gained full marks. This was unexpected as the question was targeted at grades 4-6. So why did students not get the marks? Mostly it was because of a lack of precision in the responses. Certain key ideas were left out or were incomplete. As it is an explanation, the cause and effect link is needed. Let's look at the MS: the ideas that were often omitted have been underlined

An explanation that makes reference to the following points: • particles collide <u>with walls</u> (of container) (1) And any two from: • <u>more</u> <u>frequently</u>/time between collisions is less (1) • (resulting in) larger force (1) • (over a) smaller <u>surface area</u> (1)	 allow 'more often'

This student gained all 3 marks - notice that the student has mentioned collisions with other particles. This has been ignored because it is not relevant to pressure and is an idea that is more relevant to Chemistry.

You should use ideas about particles in your answer.

(3)

When the volume of the syringe decreases the particles in the air collide more often with the walls of the syringe and (other particles) The particles move quicker and collide more often with the wall increasing the force and therefore ∴ pressure on the syringe.

In this next example the student has only gained 1 mark. What word has been omitted in the last line?

> You should use ideas about particles in your answer. (3)
>
> In the syringe, the particles of gas are moving around freely, occasionally bumping into the side of the syringe, creating a small force (pressure) when the volume of the syringe decreases, the particles have less space to move around in and so there are more collisions, creating a higher pressure.

Q2bi is a description so no cause and effect links need to be made. Both **Q2bi** and **Q2bii** should mention temperatures in Kelvin which many students failed to spot. Approximately 10% got full marks for bi and almost 30% got full marks for **bii**.

This is an example of a full mark answer for **2bi**. The student did not get the marks in the same order as the mark scheme but that does not matter.

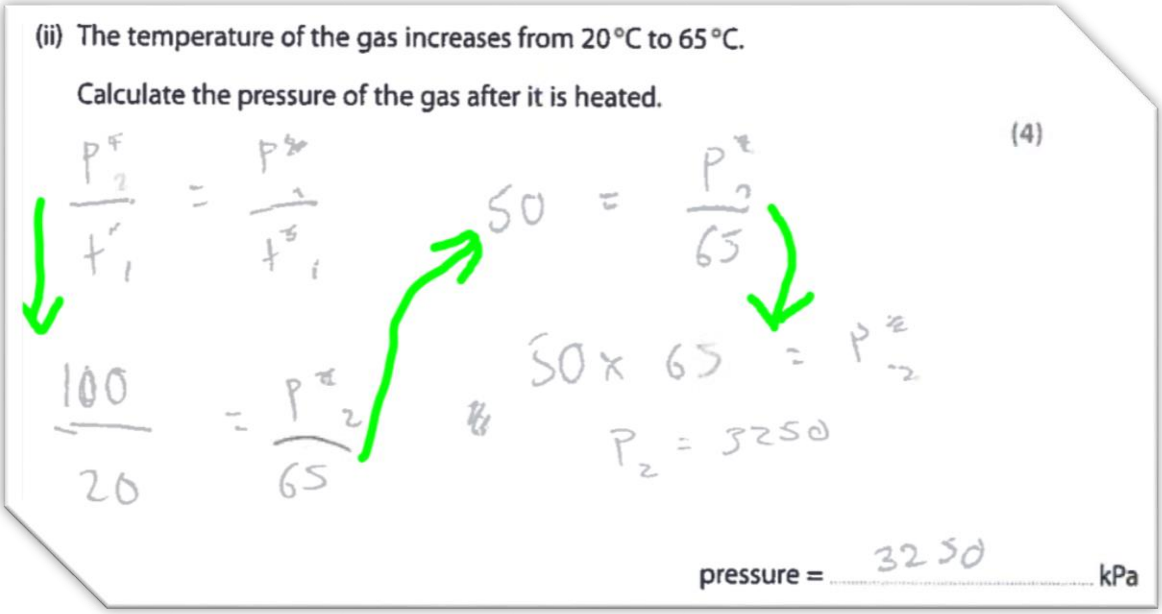
> (3)
>
> The average kinetic energy of the gas particles increase because temperature in kelvin is ~~tooth~~ directly proportional to kinetic energy and as temperature increases the speed of the particles increase, causing more collisions between particles, giving them more kinetic energy.

The majority of the students gained just one mark. This a rare example of a student who got 2 marks.

> As the gas is heated gas particles convert this heat energy into Kinetic energy so as temperature increases the Kinetic energy of the gas particles increases. The two are directly proportional.

In part **2bii**, the lack of temperatures in Kelvin lost students 2 out of 4 marks.

The following shows a beautify set out answer that only gains 2 marks.


(ii) The temperature of the gas increases from 20 °C to 65 °C.

Calculate the pressure of the gas after it is heated.

(4)

$$\frac{P_2}{t_1} = \frac{P_1}{t_1}$$

$$\frac{100}{20} = \frac{P_2}{65}$$

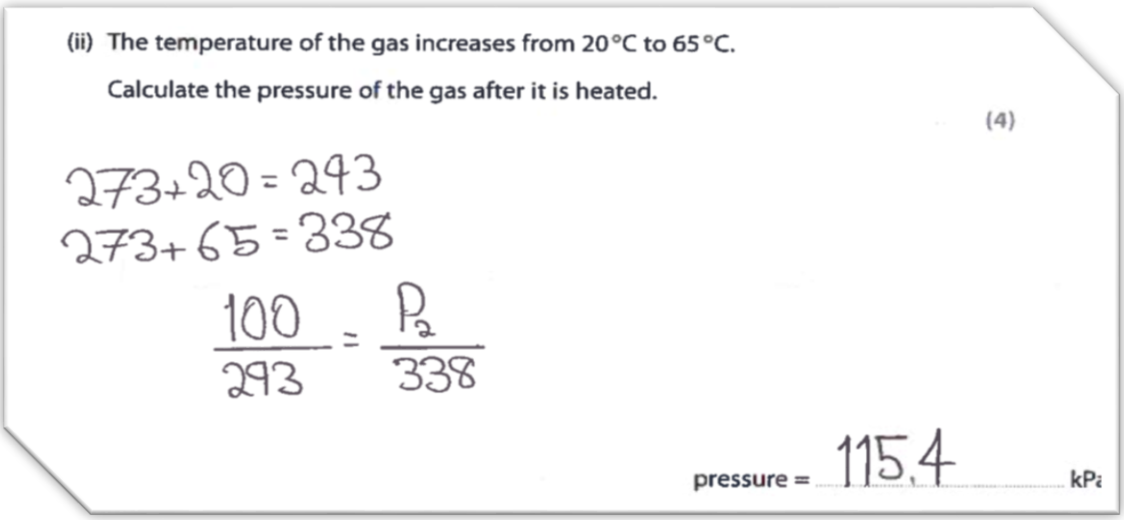
$$50 = \frac{P_2}{65}$$

$$50 \times 65 = P_2$$

$$P_2 = 3250$$

pressure = 3250 kPa

This is an example of a full mark answer


(ii) The temperature of the gas increases from 20 °C to 65 °C.

Calculate the pressure of the gas after it is heated.

(4)

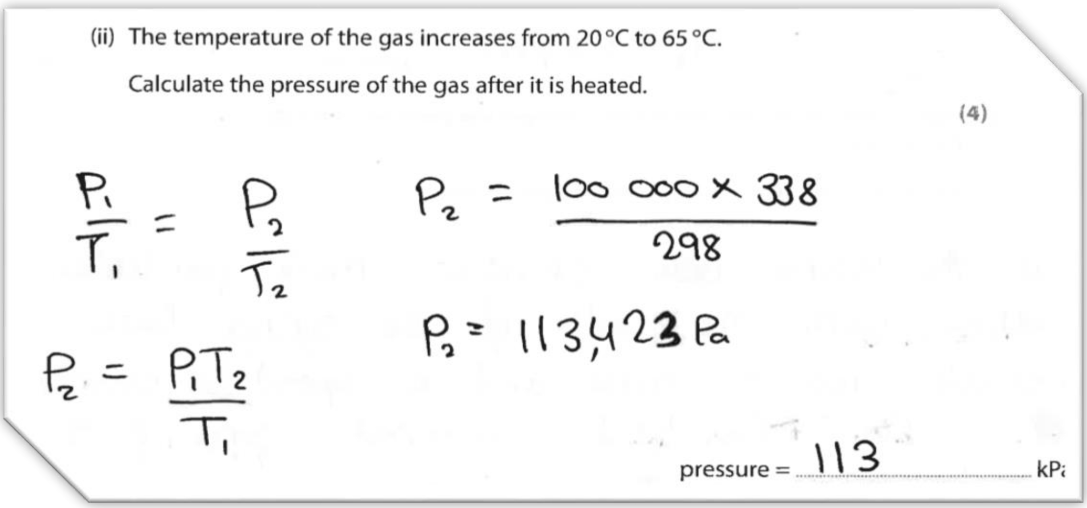
$273 + 20 = 293$

$273 + 65 = 338$

$$\frac{100}{293} = \frac{P_2}{338}$$

pressure = 115.4 kPa

Can you spot why this student got 3 marks and not 4?


(ii) The temperature of the gas increases from 20 °C to 65 °C.

Calculate the pressure of the gas after it is heated.

(4)

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$P_2 = \frac{P_1 T_2}{T_1}$$

$$P_2 = \frac{100\,000 \times 338}{298}$$

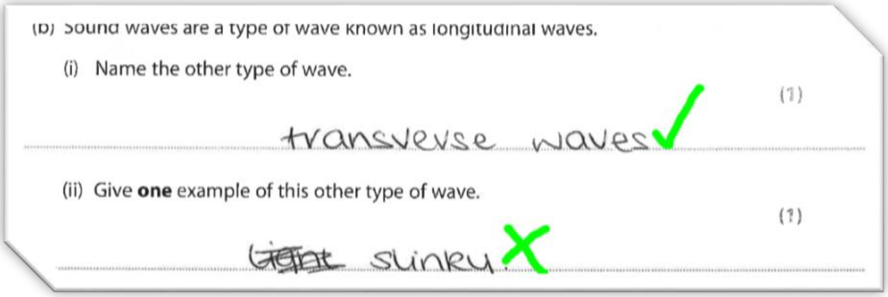
$P_2 = 113,423$ Pa

pressure = 113 kPa

Question 3

The multiple choice in **Q3a** was well done with over 80% of the students getting the mark. Also well done was **Q3b**. Notice how the question was structured to point you to the answer; it mentioned longitudinal and asked for the other type with an example.

Not everyone got both marks as this shows


(b) Sound waves are a type of wave known as longitudinal waves.

(i) Name the other type of wave. (1)

transverse waves

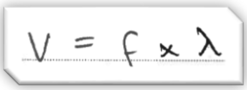
(ii) Give **one** example of this other type of wave. (1)

~~Giant~~ slinky

There has been a change in how examiners ask for an equation. Previously they asked for the relationship (which was sometimes confusing to some international students) now they ask for 'the equation' or 'the formula'.
In **part (c)** the equation can be stated in words or in correct symbols.


$v = f \times \lambda$

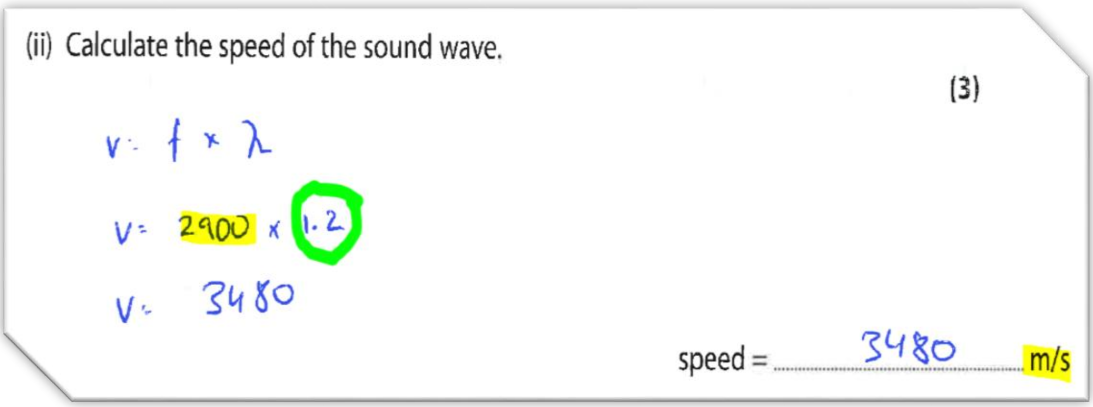
This is only just passable as the lambda is rather odd


$V = f \times \lambda$

This is much better

The calculation is made harder because of the units which some students did not spot or converted incorrectly: the unit given is in m/s, which is SI, so all the other units must be SI for the calculation to be correct.

This student has converted the 2.9kHz correctly but not the 12cm. This loses the student a mark.


(ii) Calculate the speed of the sound wave. (3)

$v = f \times \lambda$

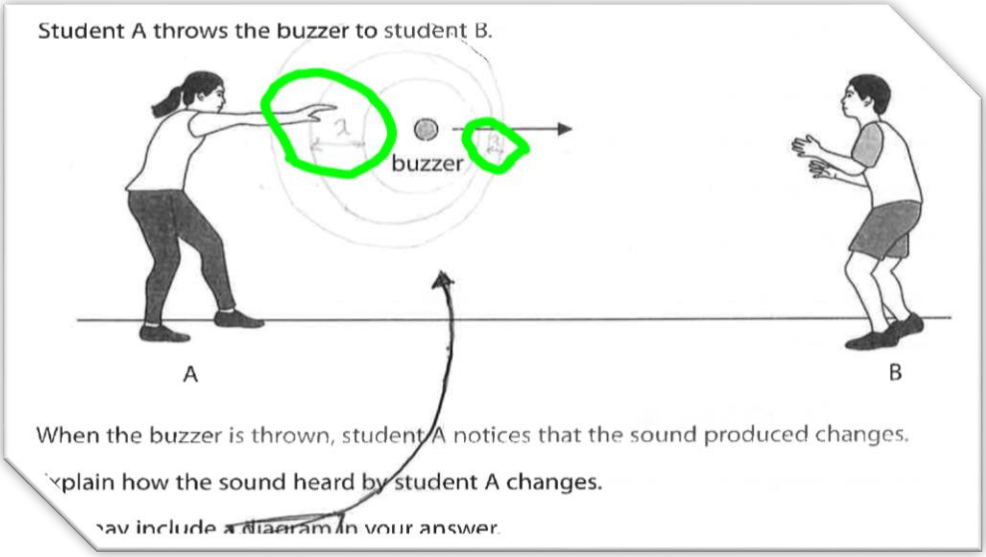
$v = 2900 \times 1.2$

$v = 3480$

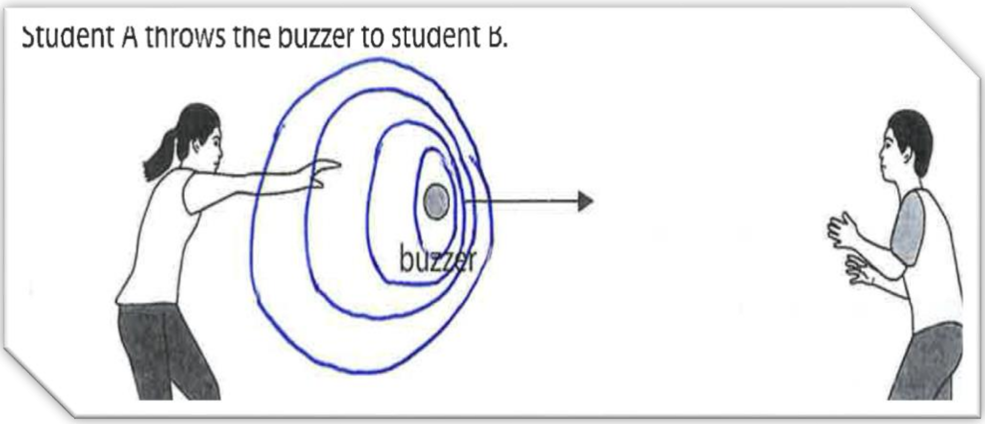
speed = 3480 m/s

Q3d is about the Doppler effect. This was not well answered as no one gained full marks. Students often gave the first two marking points, decreasing frequency (or pitch) and increasing wavelength, but usually forgot to mention that the wave speed is constant.

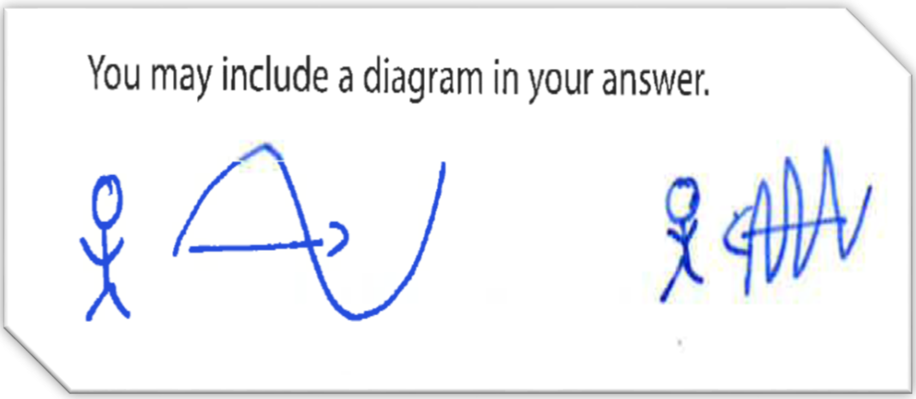
There was room for a diagram and some students took advantage of the space. The first of these has labels, which showed the second marking point.



The second example has a lovely clear diagram, but no labels so no mark at this point. Do not expect the examiner to interpret your diagrams for you - put labels on them!



The third diagram is unlabelled and confusing……it did not get a mark.

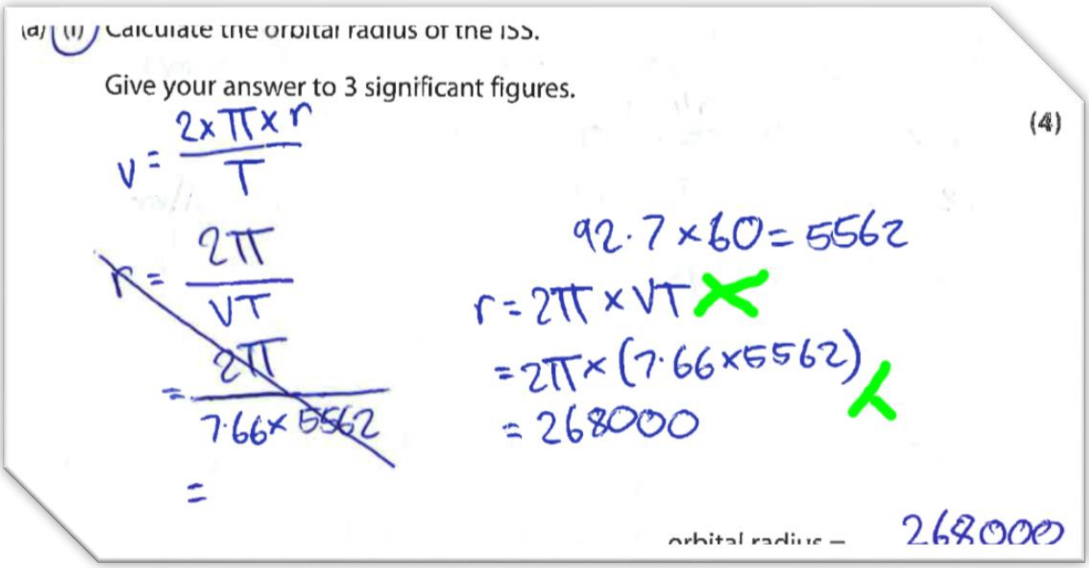


Question 4

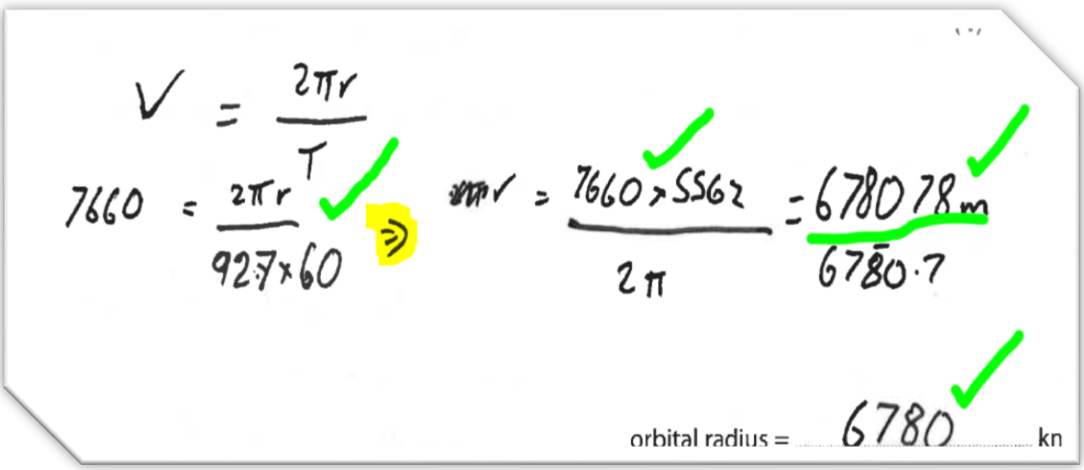
This was a quite tough but straightforward calculation with about 2/3rds of students getting full marks. Again, the correct units were important. However, since this is further into the paper, there is no separate mark for unit conversion. It is assumed to be part of the substitution mark.

Many students did spot that the time was given in minutes when the SI unit of time is seconds, so they converted to seconds by multiplying by 60. The km/s can be left in km/s as km is the unit on the answer line.

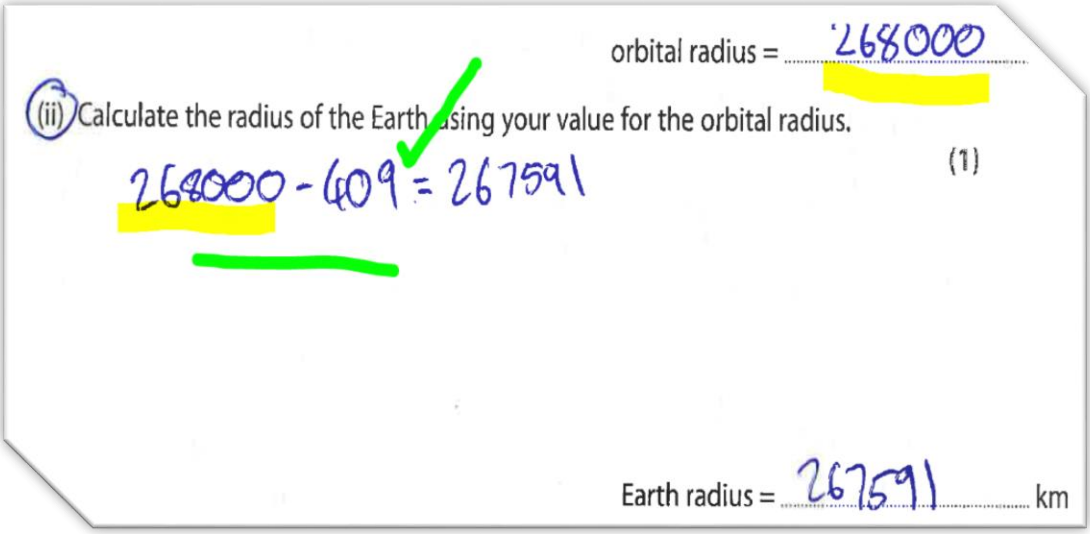
In this example the student has done the rearrangement first and got it wrong, so only the fourth marking point would have been possible. However, this student did not evaluate their incorrect answer to more than 4 SF, (which would have been 267 694) and so the examiner can't check if the rounding was correct.



In this example, the student has done the substitution first, and then written the calculation out correctly. Note the use of the arrow instead of incorrect equals signs. This got all 4 marks



In **part aii**, examiners will allow for an 'error carried forward' (ecf). In this example, the incorrect first answer has been carried forward and the student has subtracted 409. So this gets an ecf mark.


orbital radius = 268000

(ii) Calculate the radius of the Earth using your value for the orbital radius.

(1)

268000 - 409 = 267591

Earth radius = 267591 km

Question 5

All the students who attempted this question got very good marks.

For these extended writing questions, there are no marks for spelling, punctuation or grammar. You do not have to write in sentences and paragraphs: numbered lists are fine as are bullet points and even flow diagrams.

Please compare these three students who ***all*** got full marks. Which one did too much? (and maybe wasted time that was needed elsewhere?)

Student A

The low mass stars after they join the main sequenc they become red giant, and then it turn into supernova. After that it change to white dwarf and finally to black dwarf.

the high mass stars after they join the main sequence, they become super red giant, and then to supernova, ~~an~~ After that it become nuetron star. Finally it become black hole.

Student B

Describe the evolution of both low mass stars and high mass stars after they join the main sequence.

(6)

Both high mass ~~(~~ and low mass stars fuse Hydrogen into.
A ~~&~~ star with a mass of less than 4 times the mass of our sun has a long main sequence stage whereas a star with a high mass has a quite short main sequence stage.
After the main sequence stage they split with high mass stars turning into super red giants and low mass stars turning into red giants. initialy the star implodes as it runs out of Hydrogen to fuse at this smaller size there is a ~~very~~ ~~the~~ very high pressure leading to a rise in temperature meaning force due to thermal expansion is bigger than force due to gravity and the star explodes with super red giants growing to over 1000 times their original size both fuse heavier elements up to iron. The implosion then explosion is repeated

⇒ Here they properly split with a low mass star turning into a white dwarf all the outer layers have drifted away theyre is no more ~~ra~~ nuclear fusion and is left to cool down into a black dwarf. It is now a stellar remenant.
But a High mass star next turns into a super nova which is really bright and huge it then splits again if the mass is more than 25 x ~~the~~ our sun ~~if~~ it will form a black hole so dense with such high pull due to gravity even light/Photons cant escape but less tha 25 x ~~b~~ will turn into a ~~p~~ neutron star, where electrons are pulled in to the nucleus neutralising protons leaving only neutrons.

Student C

After joining the main sequence, lower mass stars will gain volume, becoming a ~~&~~ red giant, it will then lose heat, and then become a white dwarf. It will then slowly burn out, becoming a black dwarf

Higher massed stars will become Red Supergiants, but then they will Supernova, and the remnants of this implosion will ~~either~~ be a black hole, ~~or~~

Incidentally, student B was NOT the student who wrote the most.

Question 6

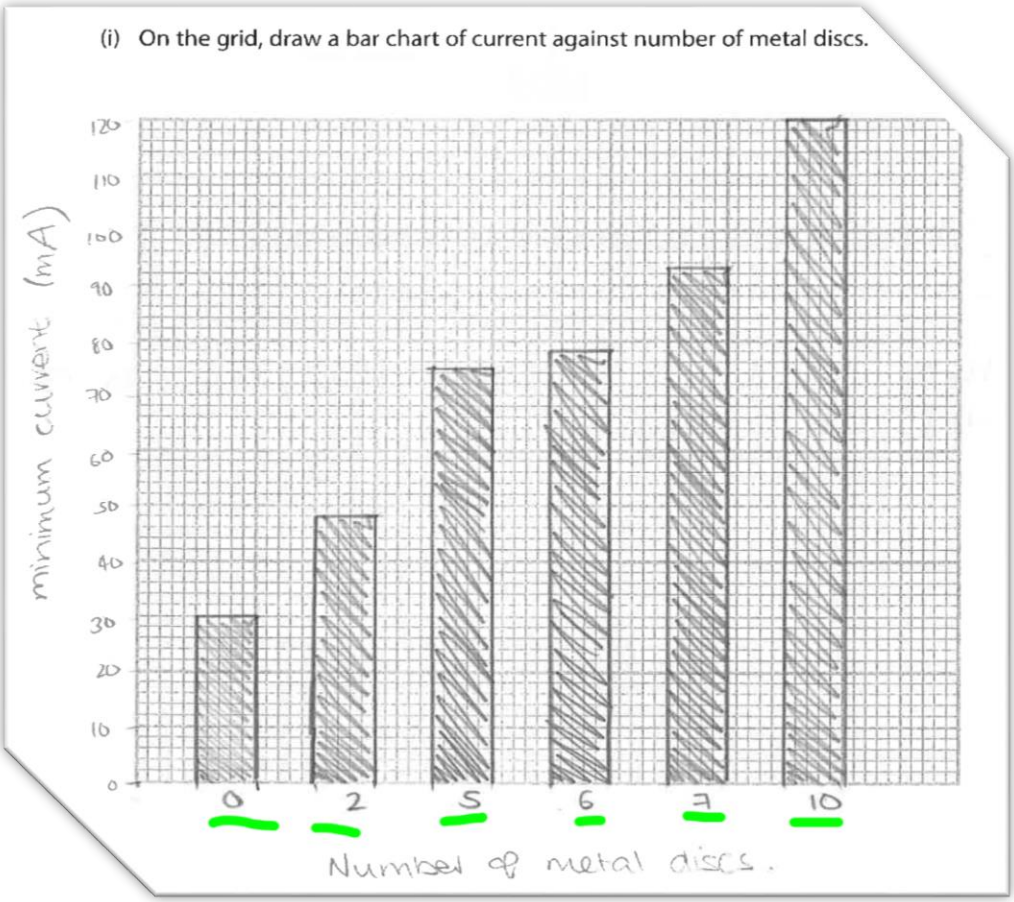
This question is designed to test Assessment Objective 3 (**AO3**) which is about experimental skills, analysis and evaluation of data and methods in physics which is 20% of the marks available. It is set in the context of an electromagnet and the question mixes content and skills.

Almost 25% of students could not name the independent variable in **Q6ai**. This just needs practice: the variable that you choose to vary is the independent variable, the one that you have to alter or measure as a result is the dependent variable.

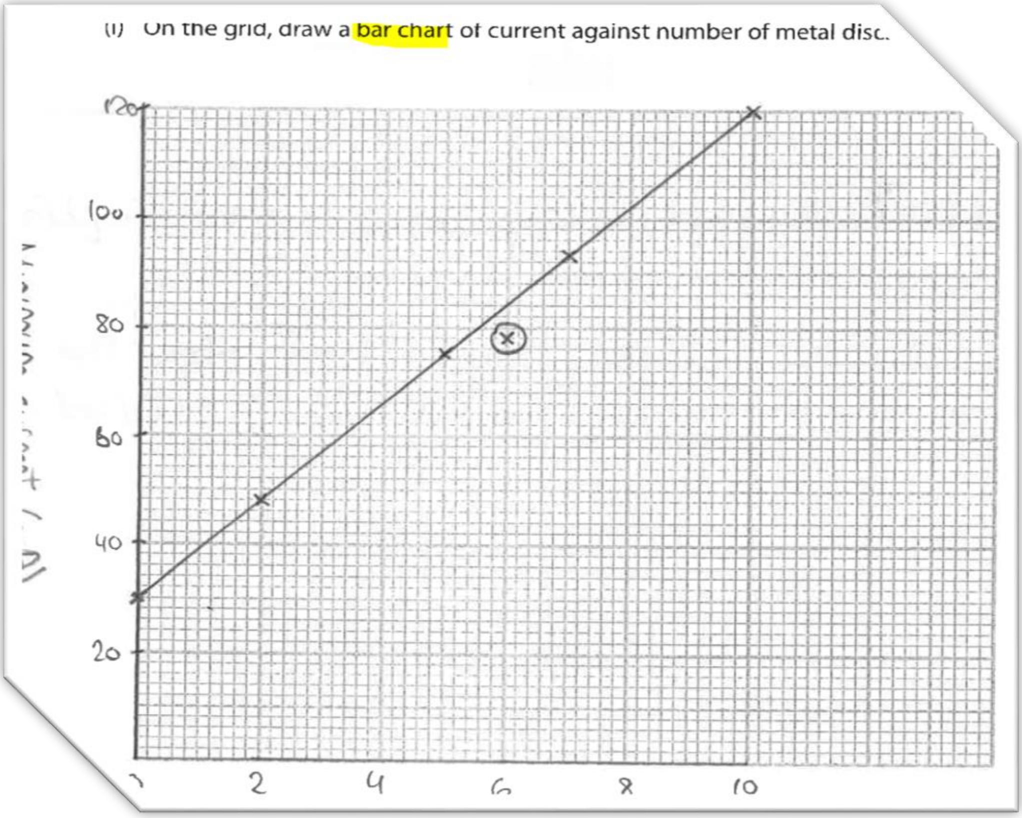
In **Q6aii**, almost half of the students got it wrong, with the most common confusion being that iron conducts electricity.

Many students made simple errors when drawing the bar chart.

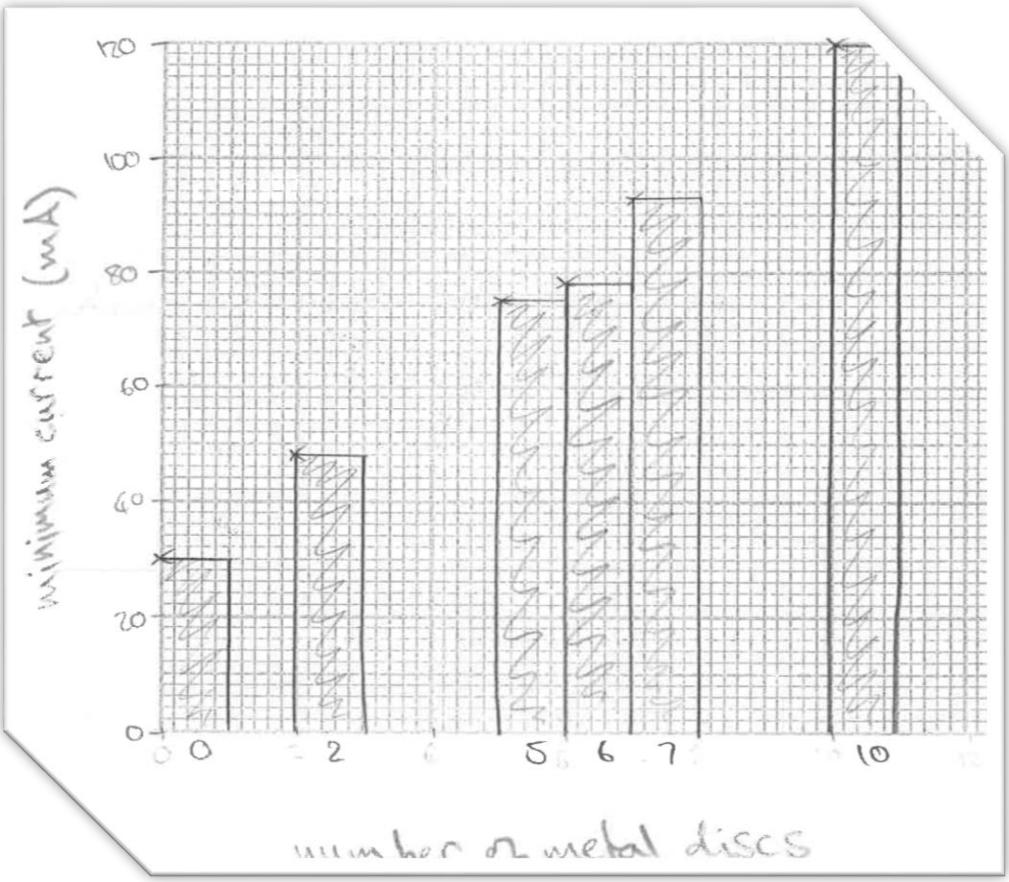
This student gave a non-linear scale and so lost a mark.



This student got the scales correct but attempted a scatter-gram or line graph and omitted a label. Two marks only awarded.



Finally, someone who got full marks



The last parts of the question were quite variable and showed that some students had run out of time.

About 2/3rds got the answer correct in **Q6bii** by realising that the bar needed to be held up even when there were no discs attached.

Just one student got all three marks for **Q6 biii**

> (iii) Explain how the student can improve his results.
> (3)
>
> The student could repeat the experiment another 2 times to increase the accuracy of his results and take an average. He could also take values for every amount of disks from 0-10, instead of just 4. Finally, he could use specific weights instead of metal disks to more accurately measure the relationship between the weight and current

But there were some good attempts

> (iii) Explain how the student can improve his results.
> (3)
>
> The student can take measurements at regular intervals rather than several different numbers of discs, repeat the experiment several times to obtain an average, and increase the amount of measurements taken.

APPENDIX 1 – EXEMPLAR QUESTION PAPER AND MARK SCHEME

Write your name here

Surname	Other names

Pearson Edexcel International GCSE (9 - 1)

Centre Number

Candidate Number

Physics

Sample Assessment Material for first teaching September 2017

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 52.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

PEARSON

EQUATIONS

You may find the following equations useful.

energy transferred = current × voltage × time	$E = I \times V \times t$
$\text{frequency} = \dfrac{1}{\text{time period}}$	$f = \dfrac{1}{T}$
$\text{power} = \dfrac{\text{work done}}{\text{time taken}}$	$P = \dfrac{W}{t}$
$\text{power} = \dfrac{\text{energy transferred}}{\text{time taken}}$	$P = \dfrac{W}{t}$
$\text{orbital speed} = \dfrac{2\pi \times \text{orbital radius}}{\text{time period}}$	$V = \dfrac{2 \times \pi \times r}{T}$
$(\text{final speed})^2 = (\text{initial speed})^2 + (2 \times \text{acceleration} \times \text{distance moved})$	$v^2 = u^2 + (2 \times a \times s)$
pressure × volume = constant	$p_1 \times V_1 = p_2 \times V_2$
$\dfrac{\text{pressure}}{\text{temperature}} = \text{constant}$	$\dfrac{p_1}{T_1} = \dfrac{p_2}{T_2}$

Where necessary, assume the acceleration of free fall, g = 10 m/s^2.

DO NOT WRITE IN THIS AREA

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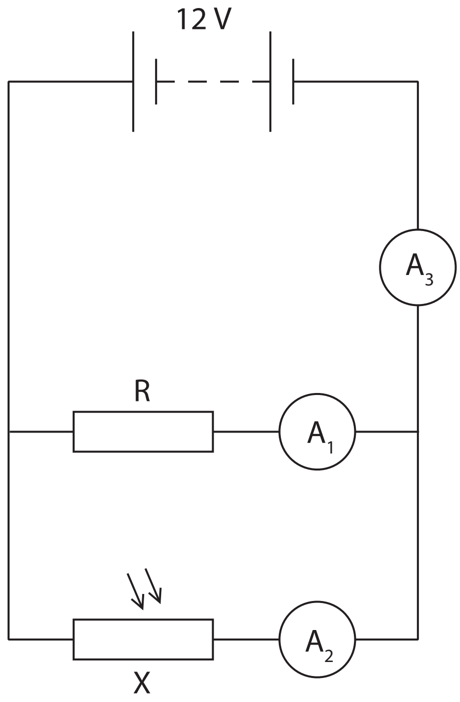
DO NOT WRITE IN THIS AREA

1 A 12 V battery is connected to a component, X, and a fixed resistor, R, as shown.



(a) (i) State the name of component X.

(1)

....

(ii) Draw a voltmeter on the circuit diagram connected to show the voltage of component X.

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) The voltage across component X is 12 V.

The resistor R has a value of 840 Ω.

Show that the current in ammeter A_1 is approximately 0.01 A.

Use the equation

$$\text{voltage} = \text{current} \times \text{resistance}$$

(2)

(c) When the circuit is placed in daylight, the current in A_2 is 0.011 A.

(i) Calculate the value of the current through A_3.

(1)

current = ... A

(ii) Explain what happens to the current through A_3 when the circuit is placed in a darkened room.

(2)

....

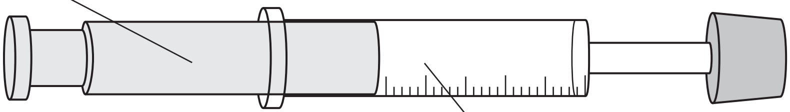
....

....

....

DO NOT WRITE IN THIS AREA

2 A gas is contained inside a sealed syringe.



(a) The plunger is pushed so that the gas is compressed and its volume reduces at constant temperature.

(i) Before compression, the gas pressure is 100 kPa and the volume of the gas is 7.5 cm^3.

After compression, the volume of the gas is 5.0 cm^3.

Calculate the pressure of the gas after compression.

(3)

pressure = ... kPa

(ii) Explain why decreasing the volume changes the pressure of the gas in the syringe.

You should use ideas about particles in your answer.

(3)

....

....

....

....

....

....

....

....

....

(b) The plunger of the syringe is released and the gas returns to its original pressure of 100 kPa.

The plunger is then held in position so that the volume of the gas cannot change.

The gas is now heated and its temperature increases.

(i) Describe how the average kinetic energy of the gas particles changes when the temperature of the gas increases.

(3)

....

....

....

....

....

....

(ii) The temperature of the gas increases from 20 °C to 65 °C.

Calculate the pressure of the gas after it is heated.

(4)

pressure = ... kPa

3 Sound travels as a wave.

(a) Which of these statements about sound waves is **incorrect**?

(1)

☒ **A** they can be reflected

☒ **B** they can travel through a vacuum

☒ **C** they can be refracted

☒ **D** they transfer energy

(b) Sound waves are a type of wave known as longitudinal waves.

(i) Name the other type of wave.

(1)

....

(ii) Give **one** example of this other type of wave.

(1)

....

(c) A buzzer produces a sound wave of frequency 2.9 kHz and wavelength 12 cm.

(i) State the equation relating wave speed, frequency and wavelength.

(1)

....

(ii) Calculate the speed of the sound wave.

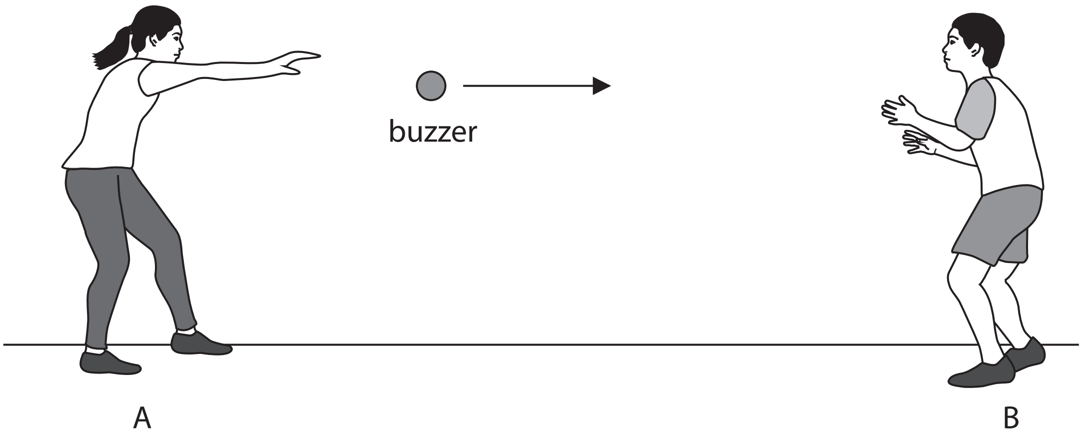
(3)

speed = ... m/s

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

(d) Two students investigate the Doppler effect by throwing a buzzer to each other.

Student A throws the buzzer to student B.



When the buzzer is thrown, student A notices that the sound produced changes.

Explain how the sound heard by student A changes.

You may include a diagram in your answer.

(3)

....

....

....

....

....

....

....

4 The International Space Station (ISS) is a satellite that orbits the Earth at a height of 409 km above the surface of the Earth.

The ISS has an orbital speed of 7.66 km/s and a period of 92.7 minutes.

(a) (i) Calculate the orbital radius of the ISS.

Give your answer to 3 significant figures.

(4)

orbital radius = ... km

(ii) Calculate the radius of the Earth using your value for the orbital radius.

(1)

Earth radius = ... km

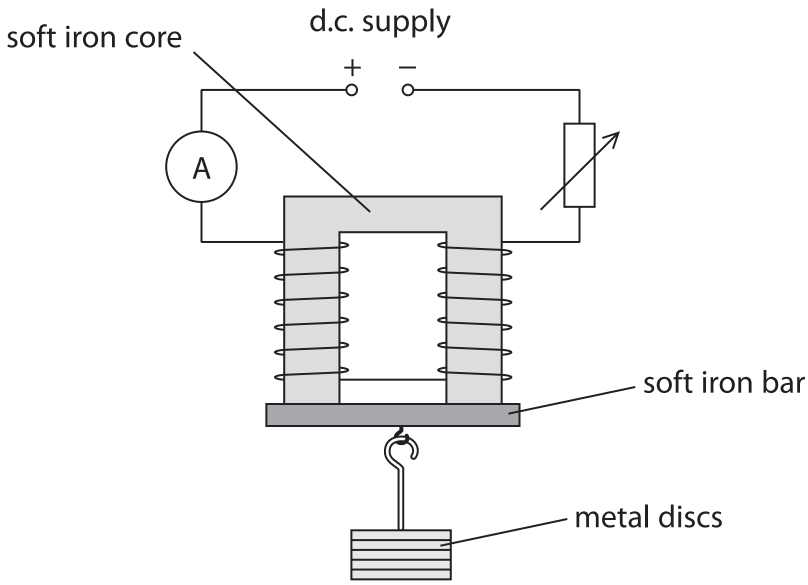
5 Main sequence stars can vary in brightness, colour and mass.

Describe the evolution of both low mass stars and high mass stars after they join the main sequence.

(6)

6 A student investigates how the minimum current required to support a load using an electromagnet varies as the load is increased.

He uses metal discs to increase the load and changes the current using a variable resistor.



(a) (i) State the independent variable in this investigation.

(1)

....

(ii) Give a reason for using a core and a bar made from soft iron.

(1)

....

....

(b) The student's results are given in the table.

Number of metal discs	Minimum current / mA
0	30
2	48
5	75
6	78
7	93
10	120

(i) On the grid, draw a bar chart of current against number of metal discs.

(4)

(ii) State why a current is needed when there are no metal discs added to the load.

(1)

....

....

....

....

(iii) Explain how the student can improve his results.

(3)

....

....

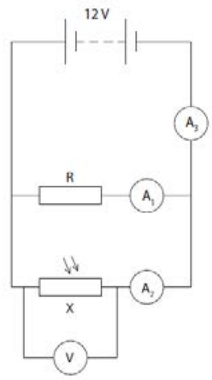
....

....

....

....

Question number	Answer	Mark
1(a)(i)	An LDR (light-dependent resistor)	**1**

Question number	Answer	Mark
3(a)(ii)	• correct symbol (1) • correct position in parallel with X (1) 	**2**

Question number	Answer	Additional guidance	Mark
1(b)	rearrangement • $I = V/R$ (1) substitution • I = 12/840 (= 0.014 (A)) (1)	0.01429 (A) some evidence of working required for two marks	**2**

Question number	Answer	Additional guidance	Mark
1(c)(i)	correct addition of current in A_1 with current in A_2 = 0.021 (A) (1)	ecf from 3(b) 0.025 (A) award full marks for correct numerical answer without working	**1**

Question number	Answer	Mark
1(c)(ii)	An explanation that makes reference to the following points: • resistance of LDR increases (1) • hence current in A_2/A_3 decreases (1)	**2**

Question number	Answer	Mark
2(a)(i)	Process should include: • substitution • rearrangement • evaluation e.g. $100 \times 7.5 = p_2 \times 5.0$ (1) $p_2 = (100 \times 7.5)/5.0$ (1) (p_2 =) 150 (kPa) (1)	**3**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that makes reference to the following points: • particles collide with walls (of container) (1) And any two from: • more frequently/time between collisions is less (1) • (resulting in) larger force (1) • (over a) smaller surface area (1)	allow 'more often'	**3**

Question number	Answer	Additional guidance	Mark
2(b)(i)	A description that makes reference to the following points: • (average kinetic energy) increases (1) • in (direct) proportion to (1) • Kelvin temperature (1)	 dependent on point 1 dependent on point 1	**3**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	Process should include: • conversion of temperatures to Kelvin scale (1) • rearrangement (1) • substitution (1) • evaluation (1) e.g. 20 °C = 293 K OR 65 °C = 338 K (1) $(p_1/T_1)/T_2 = p_2$ (1) p_2 = (100 x 338)/293 (1) (p_2 =) 115 (kPa) (1)	not converting to Kelvin gains 2 marks max. $100/293 = p_2/338$ allow 115.358…	**4**

Question number	Answer	Mark
3(a)	B	1

Question number	Answer	Additional guidance	Mark
3(b)(i)	Transverse	allow any recognisable spelling	1

Question number	Answer	Additional guidance	Mark
3(b)(ii)	Any transverse wave e.g. electromagnetic named part of EM spectrum (surface) water waves waves on a rope seismic S waves	ignore waves on a slinky unless correctly clarified	1

Question number	Answer	Additional guidance	Mark
3(c)(i)	wave speed = frequency × wavelength	equation can be given in words or symbols	1

Question number	Answer	Additional guidance	Mark
3(c)(ii)	• Conversion of kHz to Hz OR cm to m • Substitution • Evaluation e.g 2.9 kHz = 2900 Hz (1) (v =) 2900 x 0.12 (1) (v =) 350 (m/s) (1)	seen anywhere allow 348 (m/s) 0.348, 0.35, 34800, 35000 gains 2 marks 34.8, 35 gains 1 mark	3

Question number	Answer	Additional guidance	Mark
3(d)	An explanation including: • frequency decreases (1) • wavelength increases (1) • (because) wave speed is constant (1)	Ignore references to volume or loudness Allow 'pitch' for frequency	**3**

Question number	Answer	Mark
4(a)(i)	Process includes: • rearrangement (1) • substitution (1) • evaluation of orbital radius (1) • answer to 3 s.f. (1) e.g. $r = v \times T/2\pi$ (1) $r = (7.66 \times 92.7 \times 60)2\pi$ (1) r = 6781 (km) (1) r = 6780 (km) (1)	**4**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	Earth radius = r − 409 = 6370 (km)	Allow ecf Allow 6 371 (km) Allow 6 372 (km)	**1**

Question number	Answer	Additional guidance	Mark
5	A description that makes reference to six of the following points: • **all** main sequence stars fuse H into He (1) • lower mass stars stay on the MS line for longer (1) • lower mass stars become red giants (1) • higher mass stars become red super giants (1) • red giant becomes a white dwarf (1) • supergiant becomes a supernova (1) • supernova becomes a neutron star (1) • supernova becomes a black hole (1)	accept numerical values allow red giant to planetary nebula	**6**

Question number	Answer	Additional guidance	Mark
5(a)(i)	Number of metal discs	allow load	**1**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	(Soft) iron is a magnetic material	easy to magnetise/demagnetise	**1**

Question number	Answer	Mark
5(b)(i)	• Scale on the y-axis (1) • Both axes labelled with variable and unit (1) • Plotted (1) • Bars drawn (1)	**4**

Question number	Answer	Mark
5(b)(ii)	To support the weight of the (soft iron) bar (1)	**1**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that makes reference to three of the following points: • repeat and average (1) • repeat anomalous result (1) • use intermediate weights e.g. 1, 3, 5, 7, 9 (1) • extend the range of the results beyond 10 weights (1) • use standard masses (1)	however expressed	**3**