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GCSE (9-1)

Examiners' report

GATEWAY SCIENCE PHYSICS A

J249
For first teaching in 2016

J249/03 Summer 2019 series

Version 1

Contents

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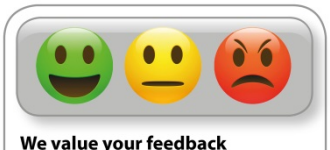

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

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Paper 3 series overview

The paper is designed to assess content from Topics P1 to P4 and P9. The practical skills specified in section P9 of the specification will form the basis of 15% of the marks on the paper.

There was no evidence to suggest that candidates were short of time in answering the paper. Most candidates answered all the multiple-choice questions. In section B, all the questions were attempted.

Section A of the paper has fifteen multiple-choice questions, each worth one mark. Candidates should be given the opportunity to practise these types of questions under timed conditions. In particular, candidates should be encouraged not to spend too long on any question but also to read the whole question including all the possible responses. Other helpful tips include using the "white" space around the question to write done working and/or equations (to assist with answering the question and to help them to check their answer at the end of the examination) and eliminating incorrect options as they read through the question.

Several questions required candidates to analyse information and ideas. Candidates should be encouraged to practise interpreting data both qualitatively and quantitatively from different sources. In particular candidates need to understand how to test for linear, directly proportional and inversely proportional relationships.

There were a number of questions where candidates needed to carry out a numerical calculation. Where an equation needs to be recalled, candidates should be encouraged to write the equation down as a first step. In other numerical questions, candidates should identify the data to use and substitute the data into the equation, before calculating the answer. Candidates should also carefully consider the units of their data.

On this paper, there was one question, 20 (a), where candidates had the opportunity to demonstrate their knowledge and understanding of physics by constructing their own answer. It is important that candidates answer the question set in a logical way with clear explanations. Candidates should also make sure that they answer the question set.

There are a number of questions where an explanation is required. Candidates should be encouraged to use the number of answer lines and the marks for the sub-part as a guide to the length of their answers. Candidates should also make sure that they use appropriate physics terms correctly in their answers.

The comments that follow tend to relate mainly to the opportunities that were missed by the candidates or not fully understood.

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Section A

Question 1

1 A 2.0 kg object moves at a velocity of 40 m/s.

What is the momentum of the object?

Use the equation: momentum = mass × velocity

A 20 kg m/s

B 38 kg m/s

C 42 kg m/s

D 80 kg m/s

Your answer ☐ **[1]**

This was a straightforward question to begin section A. Almost all the candidates correctly substituted the numbers into the given equation.

Some candidates wrote their working in the space around the question. The advantages of this method are that there is a smaller chance of making a mistake by using the wrong numbers and it is easier to check the answer later.

Question 2

2 What is the typical diameter of an atom?

A 1.0×10^{-15} m

B 1.0×10^{-10} m

C 1.0 μm

D 1.0 mm

Your answer ☐ **[1]**

The majority of the candidates correctly recalled the diameter of the atom. A small but significant number of candidates incorrectly chose response A.

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Question 3

3 A liquid has a volume of $0.01\,m^3$ and a mass of 12 kg.

What is the density of the liquid?

Use the equation: density = mass ÷ volume

A $0.12\,kg/m^3$

B $12\,kg/m^3$

C $120\,kg/m^3$

D $1200\,kg/m^3$

Your answer ☐ **[1]**

Most candidates correctly substituted the numbers into the given equation.

Question 4

4 Which one of the following uses of forces causes a rotation?

A Lowering a book vertically from a shelf

B Opening a door

C Lifting a book vertically onto a shelf

D Sitting in the centre of a see-saw

Your answer ☐ **[1]**

Most candidates understood that a moment is required to cause a rotation.

Question 5

5 Which of these factors affects the strength of the magnetic field around a current-carrying wire?

A Direction of the current only

B Size of the current only

C Distance from the wire only

D Size of the current and distance from the wire

Your answer ☐ **[1]**

The majority of the candidates scored this mark. Some candidates chose response B.

It is important that candidates read all the responses in these types of multiple-choice questions. A good technique is to eliminate responses first perhaps by placing a small cross next to (in this case A). Since both the size of the current and the distance from the wire are correct, then response D is selected.

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Question 6

6 On the Moon, a 10 kg mass has a weight of 16 N.

What is the gravitational field strength on the Moon?

A 1.6 N / kg

B 6.0 N / kg

C 26 N / kg

D 160 N / kg

Your answer ☐ **[1]**

This question was generally answered well.

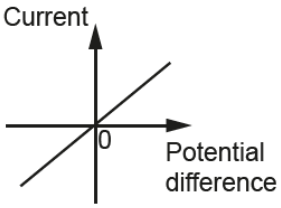
Candidates should be encouraged to consider the units. In the units in each answer is given as N / kg, then 16 N should be divided by 10 kg giving an answer of 1.6 N / kg.

Question 7

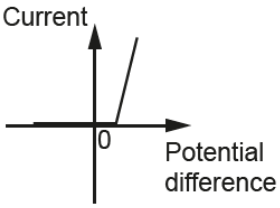
7 A student investigates four different electrical components.

She plots current-potential difference graphs for the components.

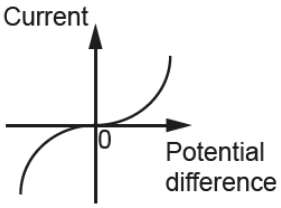
A



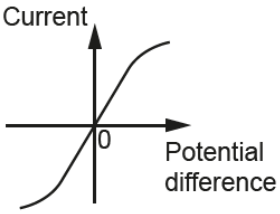
B



C



D



Which of the above shows the characteristic graph for a diode?

Your answer ☐ **[1]**

Overall this question was very well answered. Some lower ability candidates incorrectly selected response C.

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Question 8

8 Which object has the **most** gravitational potential energy?

A 1 kg bag on a shelf 1 m above the ground

B 2 kg bag on a shelf 1 m above the ground

C 2 kg bag on a shelf 2 m above the ground

D 1 kg bag on a shelf 2 m above the ground

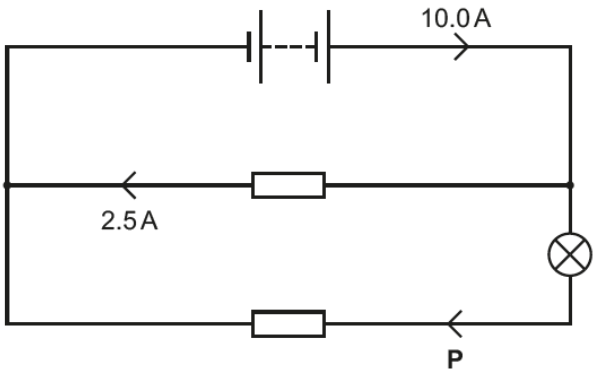
Your answer ☐ **[1]**

The majority of candidates realised that the mass ($\times g$) $\times$ distance above the ground was needed.

For this type of question, it is good to calculate the potential energy for each option.

Question 9

9 Look at the circuit diagram.



What is the current at point **P** in the circuit?

A 2.5A

B 5.0A

C 7.5A

D 10.0A

Your answer ☐ **[1]**

A number of candidates chose A, assuming that the current was the same in each resistor, or B, assuming that the 10.0 A was equally shared. Candidates should be encouraged to read all of the question without guessing what the question is asking.

Many candidates helpfully wrote tables to the right comparing currents and potential differences in series and parallel circuits. Some candidates helpfully wrote 10 – 2.5 and in some cases, this was added to the diagram.

It is helpful in these types of question to underline quantities as the question is read.

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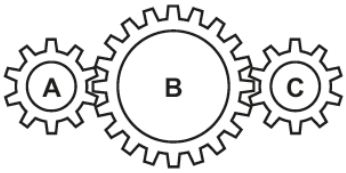
Question 10

10 A student investigates cogs and gears.

Cogs **A** and **C** have 10 teeth. Cog **B** has 20 teeth.



Cog **A** is turned 5 times.

How many times does cog **C** turn?

A 5 times

B 10 times

C 20 times

D 50 times

Your answer ☐ **[1]**

This question was generally answered well. For the cogs shown since the reverse must also be true, response A was straightforward.

Candidates who did not gain this mark often chose response B.

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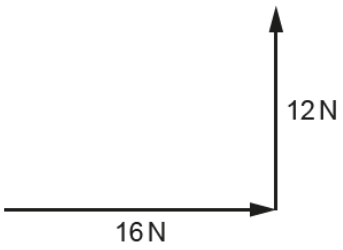
Question 11

11 Two forces act at right angles to each other.



What is the magnitude of the resultant force?

A 18 N

B 20 N

C 22 N

D 24 N

Your answer ☐ **[1]**

This question was generally well answered. Candidates should be encouraged to use the space around the question for their working.

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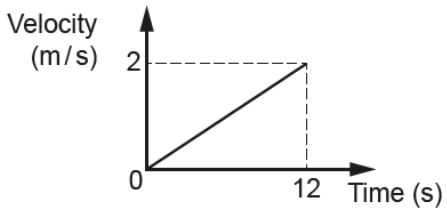
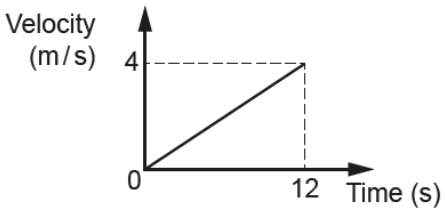
Question 12

12 Look at the motion graphs.

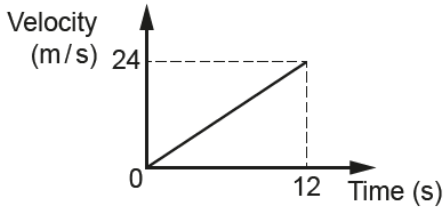
A



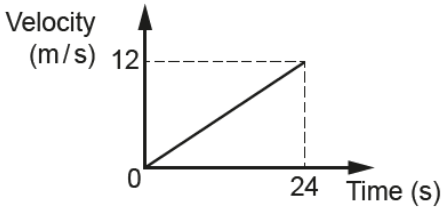
B



C



D



Which graph shows a journey with a distance of 24 m?

Your answer ☐ **[1]**

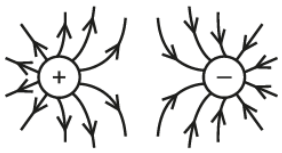
A very large number of candidates incorrectly chose A.

Higher ability candidates worked out the area for each graph. Candidates should be encouraged to check each of the four responses.

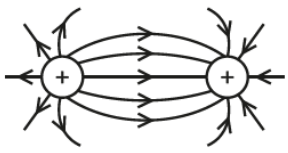
Question 13

13 Look at the field line diagrams for positive and negative charges.

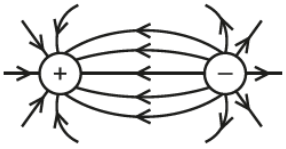
A



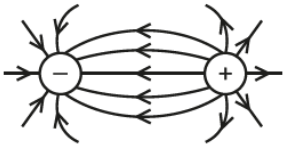
B



C



D



Which field line diagram is correct?

Your answer ☐ **[1]**

This was generally well answered. Candidates who did not gain the correct answer often chose C indicating that the direction of the electric field was not fully understood.

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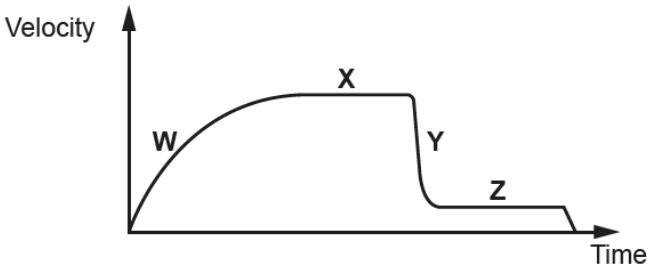
Question 14

14 A skydiver falls from a plane. His parachute opens and he lands safely.

Look at the velocity-time graph of his journey.



Which parts of the graph show balanced forces on the skydiver?

A **X** only

B **Y** and **Z**

C **X** and **Z**

D **Y** only

Your answer ☐ **[1]**

This question was well answered.

Candidates should be encouraged to consider each letter of the diagram, adding a small cross to the ones that are eliminated.

Question 15

15 A spring stretches by 2.0 cm when a force is added.

The spring constant is 60 N/m.

Calculate the energy transferred to the spring when it is stretched.

A 0.012 J

B 0.024 J

C 120 J

D 240 J

Your answer ☐ **[1]**

This was well answered by higher ability candidates. Often the half or the change of unit (cm to m) was missing.

Higher ability candidates wrote the equation from the data sheet, then substituted the numbers into the equation and then carried out the calculation.

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Section B

Question 16 (a) (i)

16 A student puts an ice cube into a beaker. The mass of the ice cube is 40 g.

The ice cube melts.

(a) (i) Write down the mass of the water produced.

Mass = ... g **[1]**

Most candidates correctly stated that the mass was 40 g.

Question 16 (a) (ii)

(ii) Explain your answer to **(a)(i)**.

.....

.....

..... **[2]**

Most candidates were able to state that the mass was conserved; few candidates explained their answer in terms of the number of particles (atoms or molecules) not changing but particles are rearranging.

Question 16 (b)

(b) Describe **one** difference between a **physical change** and a **chemical change**.

.....

..... **[1]**

Most candidates answered this question in terms of a physical change being reversible while a chemical change was not (easily) reversible. Some candidates confused their answers in terms of products.

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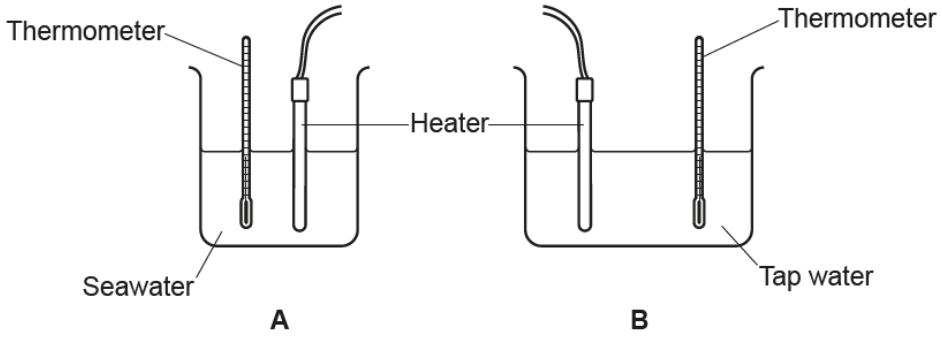
Question 16 (c) (i)

(c) A student does an experiment to find the difference between the specific heat capacities of seawater and tap water.

The student places a heater and a thermometer into two beakers, **A** and **B**.
Look at the diagram.



(i) There are 5 steps to the method for this experiment.

Complete the missing steps for this method.

Step 1 – Put seawater into beaker **A** and tap water into beaker **B**.

Step 2 – .....

Step 3 – .....

Step 4 – .....

Step 5 – Calculate the temperature change of beaker **A** and beaker **B**.

[3]

Many candidates did not gain full marks on this question by repeating the question, e.g. place heater and thermometer in the beakers.

Ideally candidates were expected to measure the temperature of both beakers at the start of the experiment before switching on the heaters for a set time. It was then expected that candidates would measure the temperature at the end.

Other workable alternatives were allowed. Credit was also given for appropriate methods to measure the mass of the water or to determine the energy.

Question 16 (c) (ii)

(ii) Suggest **one** mistake the student made when choosing their equipment.

..... **[1]**

Most candidates identified that the beakers were different sizes. Credit was also allowed for identifying that the beakers were not insulated or did not have a lid. Some candidates correctly referred to the heaters not being totally submerged.

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Question 16 (c) (iii)

(iii) Suggest **two** improvements to the method followed.

1 .....

2 .....

[2]

The majority of the candidates gained at least one mark for this question. One easy improvement was linked to the previous question.

Examiners did not allow same amounts of water. Candidates need to use specific terms such as mass, or volume.

Question 17 (a)

17 A TV has the label below on it.

OCR TV

Voltage: 230 V
Power: 65 W
Frequency: 50 Hz

(a) Calculate the **current** in the TV when it is turned on.

Use the equation: power = potential difference × current

Give your answer to **2** significant figures.

Current = ... A **[4]**

Higher ability candidates rearranged the equation, substituted the numbers and wrote the answer as 0.2826 before rounding the answer as 0.28 (two significant figures).

A number of candidates wrote their answer exactly from the calculator as $0.28\dot{2}$ which was not acceptable for two significant figures.

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Exemplar 1

17 A TV has the label below on it.

OCR TV

Voltage: 230 V
Power: 65 W
~~Frequency: 50 Hz~~

(a) Calculate the **current** in the TV when it is turned on.

Use the equation: power = potential difference × current

Give your answer to **2** significant figures.

Current = Power / Potential difference

= 65 / 230

= 0·28 26...

Current = 0·28 A **[4]**

This candidate has clearly rearranged the equation and then substituted the correct numbers from the data box. It is then clear that the candidate has then calculated the correct answer before rounding it correctly to two significant figures.

The candidate has perhaps helpfully crossed out the frequency as this is not needed for this part. Candidates need to be careful about crossing out quantities as the crossed out quantities might be needed in later parts. Underlining the quantities needed is probably a better method.

	AfL	For calculations, candidates should show their working. The following steps are useful: 1. Recall equation or select the appropriate equation from the data sheet (if not given in the question) 2. rearrange equation, if necessary 3. substitute the numbers into the equation 4. calculate the answer 5. consider significant figures or decimal places.

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Question 17 (b)

(b) The TV is turned on for 30 minutes.

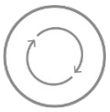
Calculate the energy transferred by the TV.

Energy used = ... J **[4]**

Candidates did not always know which equation to use. Many recalled correctly the equation relating energy, power and time but did not always remember that the energy needed to be measured in seconds.

Higher ability candidates clearly showed their working including the conversion of 30 minutes to 1800 seconds.

Some candidates recalled that $E = Q \times V$ and $Q = I \times t$ or $E = I \times t \times V$ and used the answer from 17(a). This was correct physics and thus gained full credit.

	**AfL**	When carrying out calculations, candidates should consider units. Normally time is measured in second. Candidates should be aware of exceptions to the normal units, e.g. when energy transferred is measured in kW h, then the power is measured in kilowatt, kW and time in hour h. Similarly, if a speed is measured in measured in km / h, then the distance should be measured in kilometre, km and the time in hour, h.

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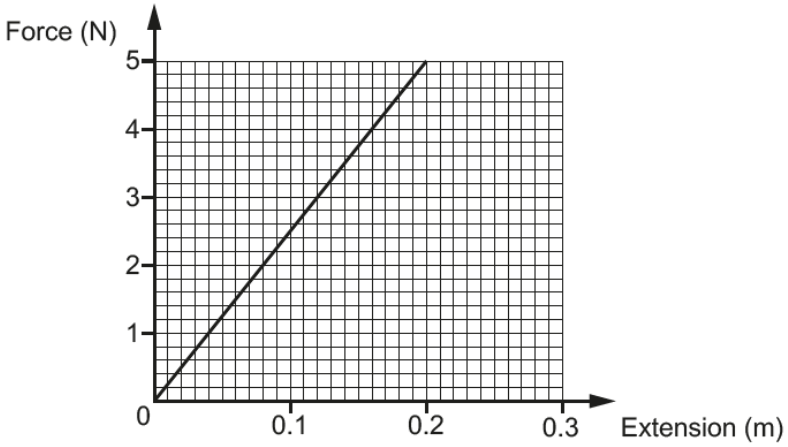
Question 18 (a)

18 A student investigates how a spring stretches when a force is added.

Look at a graph of his results.



(a) Calculate the spring constant of the spring.

Spring constant = ... N/m **[3]**

The majority of candidates scored highly on this question. Higher ability candidates stated either the equation for spring constant or stated that the spring constant was the gradient of the graph. It was then expected that candidates would substitute into their equation appropriate values from the graph. A small but significant minority of candidates tried to use the same equation from the data sheet which had been used to determine the energy transferred and substituted in a force for the energy. This approach was not creditworthy.

	AfL	Candidates should be able to read information from graphs and determine a gradient.

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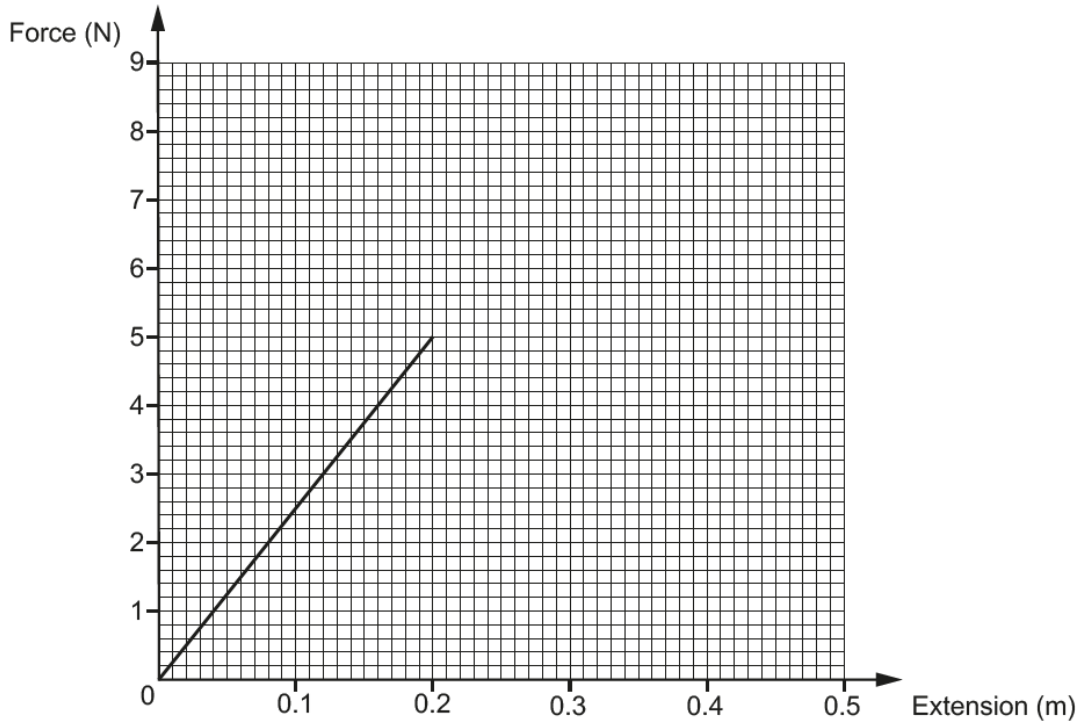
Question 18 (b)

(b) The student continues to load the spring until it passes its elastic limit.

Complete the force-extension graph and label the elastic limit.



[2]

This question required candidates to demonstrate that they understood how a spring stretched with an increasing force and the term "elastic limit". For marks to be given the straight line section (if any) should be drawn with a ruler and the curve should be smooth.

Sometimes the labelling of the elastic limit was vague. Higher ability candidates added a small cross at the elastic limit and then labelled the cross.

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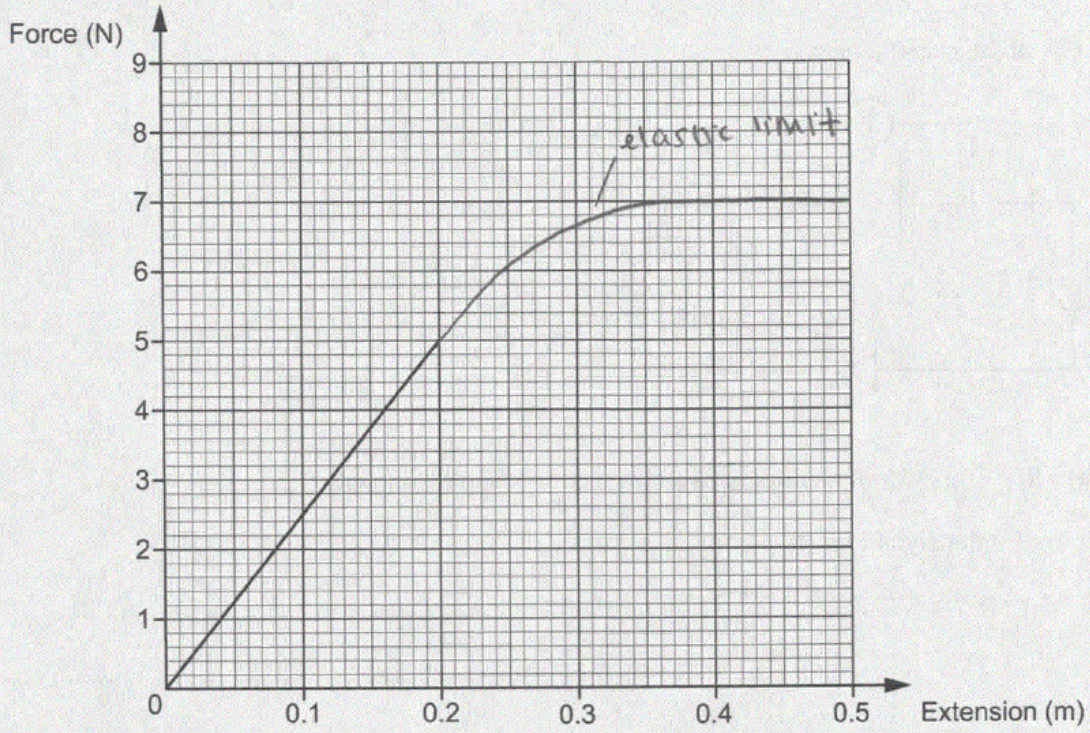
Exemplar 2

(b) The student continues to load the spring until it passes its elastic limit.

Complete the force-extension graph and label the elastic limit.



[2]

This candidate has clearly extended a straight line and then drawn a curve with decreasing gradient which gains the first mark.

The labelling of the elastic limit is vague and incorrect. It would have been helpful if this candidate had indicated precisely on the line with a dot or cross where the elastic limit is located and then added a label.

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Question 18 (c)

(c) The student puts a small load on the spring. It is in equilibrium.

Draw and label a free body force diagram for the load at the end of the spring.

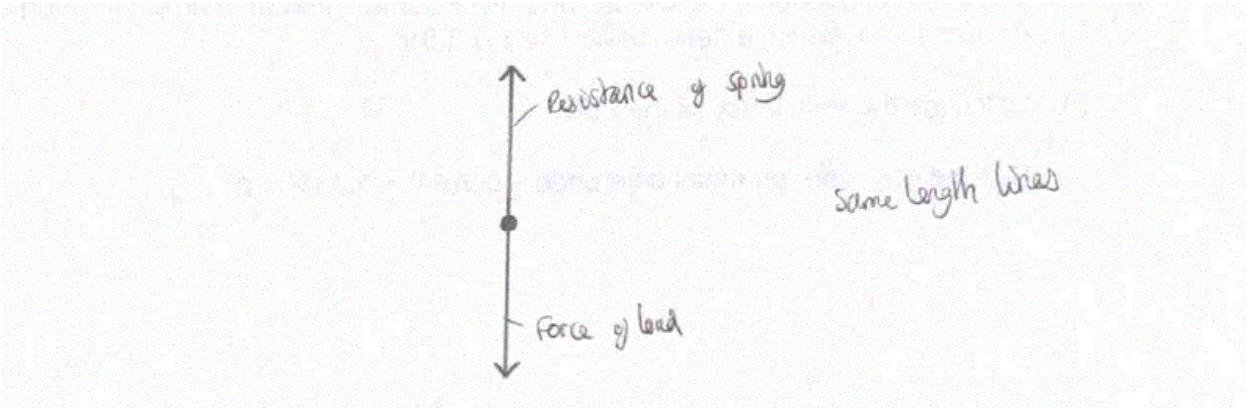
[3]

A small majority of candidates gained at least two marks for this question. Most of these candidates drew two arrows of equal length and labelled correctly the weight or gravitational force. Few candidates labelled the upwards arrow "tension" or "force from spring". A common misconception was the use of the term "upthrust". When representing vectors by straight lines, candidates should be encouraged to use a ruler with a millimetre scale.

Ideally candidates should refer to the gravitational force as "weight" or "force due to gravity" rather than "gravity".

A few candidates did not understand a "free body force diagram" and drew the apparatus and labelled the apparatus. Other errors were the drawing of many arrows on the diagram in varying directions.

Exemplar 3



This candidate has drawn a "free body force diagram" with two arrows of the same length – the candidate confirms that the arrows are the same length. Force of load was allowed for one of the label marks.

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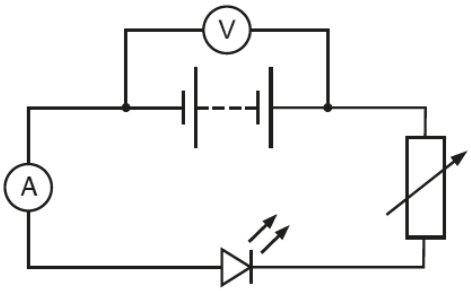
Question 19 (a) (i)

19 A student investigates the electrical characteristics of a light emitting diode (LED).

The student builds a circuit to investigate how the current through an LED and the potential difference across it vary when the LED lights up.

Look at the circuit diagram.



(a) (i) The student has made **two** errors connecting the circuit.

Identify the errors.

1 .....

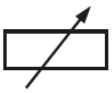
2 .....

[2]

The majority of the candidates gained at least one mark. Vague answers such as "voltmeter is in the wrong place" did not gain credit. Higher ability candidates stated for one of the errors that the LED (or cells) were connected the wrong way around or the LED (or cells) needed to be reversed. For the other error, it was expected that the candidates would indicate that the voltmeter was not measuring the potential difference across just the LED, but across the battery. Candidates gained a mark for this error by suggesting connecting the voltmeter across the LED.

Incorrect answers given by many candidates included the ammeter being in the wrong place or the variable resistor being in the wrong place. Often candidates incorrectly suggested that the order of the components mattered.

Question 19 (a) (ii)

(ii) What is the purpose of the component  in the circuit?

..... **[1]**

A large number of candidates answered this question by stating that the component was a variable resistor or to vary the resistance of the circuit. Few candidates answered the question in term of the purpose of the variable resistor was to vary the potential difference across the LED or vary the current through the LED (by varying the resistance in the circuit).

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Question 19 (b) (i)

(b) The student then connects the circuit correctly. He measures the current through the LED as 0.03A when the potential difference across it is 3.0V.

(i) Calculate the resistance of the LED.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

The majority of the candidates were able to rearrange the given equation and substitute into the rearranged equation the correct values to give an answer of 100 Ω. A very small minority of candidates used 0.3 A rather than 0.03 A. Candidates often underline the quantities in the question, which was good practice.

Question 19 (b) (ii)

(ii) Calculate the charge which flows when this LED operates for 2.5 minutes.

Charge = ... C **[4]**

In this question, higher ability candidates who did not obtain the correct answer, but showed their working, could still gain marks from their working.

In this case, the equation for charge flow needed to be recalled and the time of 2.5 minutes needs to be changed to 150 seconds, before the answer could be calculated.

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Question 19 (b) (iii)

(iii) Calculate the energy transferred when this LED operates for 2.5 minutes.

Use the equation: energy transferred = charge × potential difference

Energy transferred = ... J **[2]**

Most candidates were able to multiply their answer to (b)(ii) by 3.0 to gain the correct answer.

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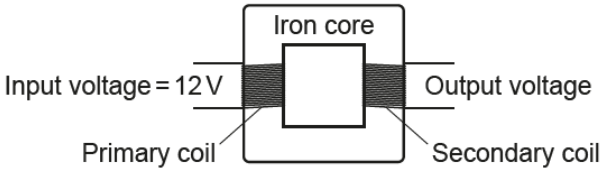
Question 20 (a)

20 A student investigates building model transformers in the laboratory.

Look at the diagram.



The student builds four different transformers, each with different primary and secondary coils.

Using an input voltage of 12 V the student measures the output voltage.

Look at the results.

Attempt	Number of turns in primary coil	Number of turns in secondary coil	Output voltage (V)
A	100	200	23
B	200	100	6
C	300	600	23
D	600	300	6

(a)* Explain how a transformer works and if this data supports the expected output voltages.

.....

.....

.....

.....

.....

..... **[6]**

This question gave candidates the opportunity to apply their knowledge and understanding of the operational of a transformer and to demonstrate that they are able to use the equation linking number of turns and potential difference given on the data sheet. The question is open ended so that candidates have the opportunity of demonstrating their knowledge as well as having the opportunity to structure their answers logically.

The question required candidates to explain the operation of the transformer. Most candidates were able to select an appropriate equation from the data sheet and discuss the meaning of step-up and step-down transformers in terms of the turns ration and the p.d. ratio.

Few candidates mentioned that transformers worked on a.c. or clearly explained the alternating magnetic field in the iron core of the transformer inducing an alternating p.d. across the secondary coil.

For the highest marks, it was expected that clear calculations for each of the four transformers would be shown with a comment as to whether they supported the theoretical predictions. Many candidates did not show any working. There was also the opportunity to discuss energy losses in transformers particularly about transformer A and transformer C.

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Exemplar 4

A transformer can either increase or decrease the voltage depending whether it is a step-up transformer or a step-down transformer. The input alternating voltage in the primary coil allows a alternating current to flow and a current through a wire creates a magnetic field which is trapped inside the an iron core. The ~~the~~ secondary coil is ~~cutted~~ cutting magnetic field lines so through the process of electromagnetic induction, an induced potential difference is created in the secondary coil as the output voltage along both ends of the wire. The ~~induced~~ induced potential difference in the secondary coil depends on the number of turns in the secondary coil. The formula $\frac{V_1}{V_2} = \frac{n_1}{n_2}$ shows the voltage in the primary coil / voltage in the secondary coil = Number of turns in primary coil / number of turns in secondary coil. Therefore, the expected output voltage in attempt B and attempt D ~~are correct~~ is supporting data and expected, however the output voltage in attempt A and C ~~are incorrect and should be 24V according to the formula~~ doesn't support the how a transformer works as the output voltage is expected to be 24V, not 25V. **[6]**

This candidate has written a plan of how they intend to answer the question.

The initial part of the plan explains how the transformer works. The candidate includes the alternating current, the alternating magnetic field in the iron core and the alternating p.d. induced across the secondary coil. The candidate then discusses step-up and step-down transformers.

Before using the data, an equation is given with each of the symbols defined. Working is then shown for the four transformers with a reason why the step-up transformers do not agree with the predicted data.

This candidate's response demonstrates a detailed explanation of how the transformer works and there is a quantitative line between the coils and potential difference ratios in relation to the expected output voltages. This is a Level 3 response. The response has a well-developed line of reasoning which is clear and logically structured and the information is relevant so this candidate is given six marks.

	AfL	Candidates should practice explaining physics concepts.

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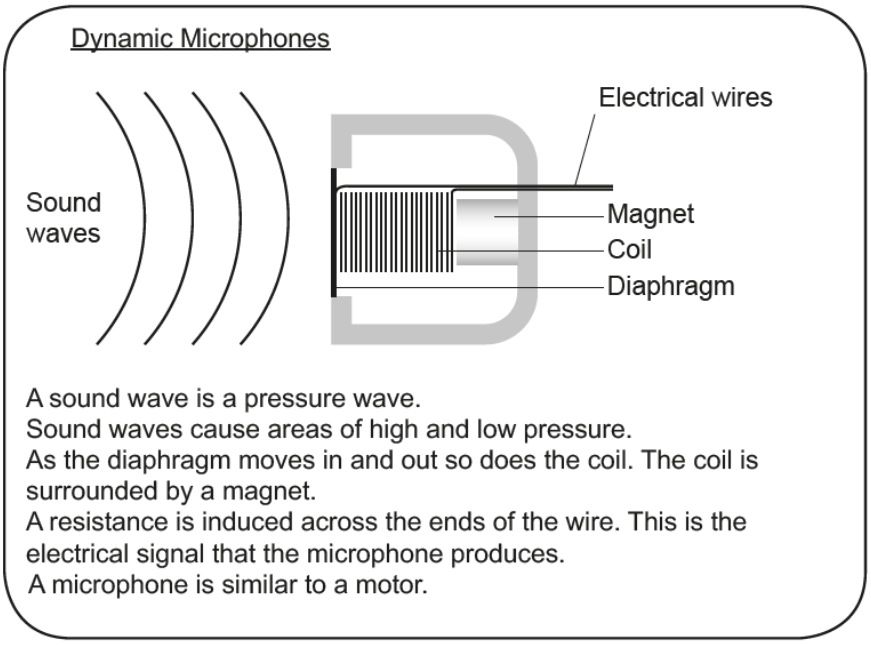
Question 20 (b) (i)

(b) A student completes a project on how dynamic microphones work.

Look at her project. The student uses two incorrect words in her work.



(i) Identify **one** of the incorrect words **and** write a correct sentence to replace the mistake.

Incorrect word .....

Corrected sentence .....

.....

[2]

A large number of candidates correctly identified that "resistance" was incorrect. Many realised that a potential difference is induced across the ends of the wire. The Examiners on this occasion also allowed a current is induced across the end of the wire.

Other candidates identified "motor" as incorrect and substituted "generator" in the sentence

A significant number of candidates stated that pressure was incorrect and re-wrote the sentence with longitudinal. A few candidates replaced "similar" with "not similar" which did not gain credit.

Question 20 (b) (ii)

(ii) Name a device which uses this effect in reverse.

..... **[1]**

Most candidates stated speaker(s). It is important that candidates stated a relevant device as opposed to an appliance such as a phone.

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Question 21 (a) (i)

21 A student investigates how the angle of a ramp affects the final speed of a trolley.

He uses light gates to record the speed of the trolley at the bottom of the ramp.

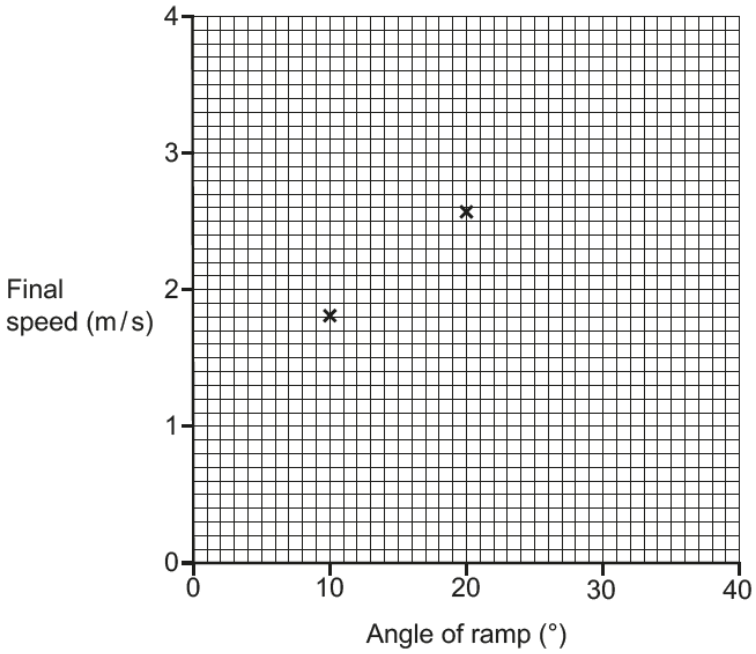
The student releases the trolley from rest at the same point on the ramp each time.

Look at his results.

Angle of ramp (°)	Final speed (m/s)			
	Attempt 1	Attempt 2	Attempt 3	Mean
10	1.81	1.80	1.81	1.81
20	2.58	2.56	2.57	2.57
30	3.1	3.11	3.11	3.11
40	3.52	3.51	3.50	3.51

(a) (i) Plot the results on the graph and draw a line of best fit.

Two results have been plotted for you.



[2]

Candidates needed to plot the last two data points before drawing the best fit line. Many candidates incorrectly drew a straight line through plots that appeared to lie on a curved trend. Other candidates did not draw smooth curves, or had many lines.

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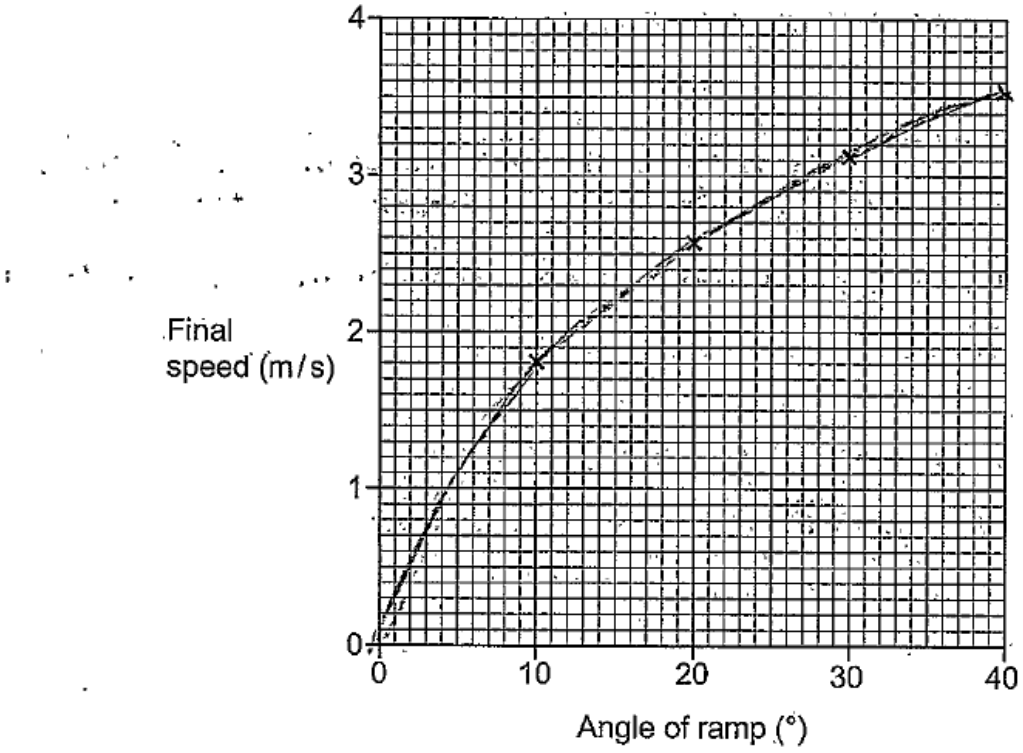
Exemplar 5



This candidate has clearly indicated the correct positions of the two missing plots using two small crosses.

The smooth line was not considered good enough in that there appeared to be more than one line in several places.

This candidate has correctly assumed that the graph starts from the origin.

	AfL	Candidates should be encouraged to plot graphs using a sharp pencil. The points should be indicated with a small cross. It may help candidates to draw smooth curves by rotating the paper so that the curve can be drawn naturally with the arc of the candidates' arm. Candidates should be encouraged to check the plotting of their data points - particularly points which do not appear to fit a pattern. The line of best fit may not pass through every data point. There should be a balance of data points about the line of best fit.

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Question 21 (a) (ii)

(ii) Describe the pattern shown by the results.

Use data from the table or graph in your answer.

.....

.....

.....

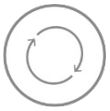
.....

.....

..... **[3]**

Most candidates correctly stated that the as the angle of the ramp increased the speed increased. It was essential that candidates included a comparison between the angle of the ramp and the speed.

The next two marks were more challenging and required candidates to state that the angle of the ramp and the speed were not directly proportional or linear since there was not a constant increase in speed for the same increase in angle. Candidates were expected to demonstrate this by carrying out two calculations using data from the table or graph.

	**AfL**	Understand how to test from a graph whether two quantities are directly proportional. 1. Take the quantity on the *x*-axis and double it and read off the *y*-axis values and see whether they double as well 2. See whether there is a straight line through the origin.

Question 21 (a) (iii)

(iii) Explain why the final speed changes when the angle of the ramp increases.

In your answer use ideas about energy.

.....

.....

..... **[2]**

Most candidates found this question challenging to gain two marks due to some vague answers relating to the transfer energy from the PE store to the KE store without specifically referring to the greater energy in the PE store being transferred so that there more energy in the KE store.

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Question 21 (a) (iv)

(iv) The student made a mistake when recording one of his results.

Identify the mistake **and** explain what he should have done.

.....

.....

..... **[2]**

Many candidates correctly identified that the first attempt (3.1) at an angle of 30° was only recorded to one decimal place. Most candidates then suggested that that the raw data should have been recorded to the same number of decimal places and the reading should have been recorded as 3.10.

Some candidates referred to significant figures, which was allowed this year. Candidates need to understand that raw data should be recorded to the same number of decimal places while calculated data is recorded to a number of significant figures which is dependent on the number of significant figures in the raw data.

Question 21 (a) (v)

(v) The student thinks this data shows that his results are **reproducible**.

He is **not** correct.

Explain why.

.....

.....

..... **[2]**

Most candidates discussed apparatus details such as not indicating what sort of surface was used, etc. Few candidates realised that reproducible results would need to be reproduced by someone else.

A few candidates did state that the experiment is repeatable since the repeated reading are close to each other.

	AfL	Understand the terms used in the language of measurement. See the Glossary of terms on the OCR website at: https://www.ocr.org.uk/Images/467774-glossary-of-terms.doc

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Question 21 (b) (i)

(b) (i) The mean final velocity for the ramp at a 40° angle is 3.51 m/s. The distance from the top of the ramp to the light gate at the bottom is 1.0 m.

Calculate the acceleration of the trolley when the ramp is at a 40° angle.

Give your answer to **2** decimal places.

Acceleration = ... m/s^2 **[5]**

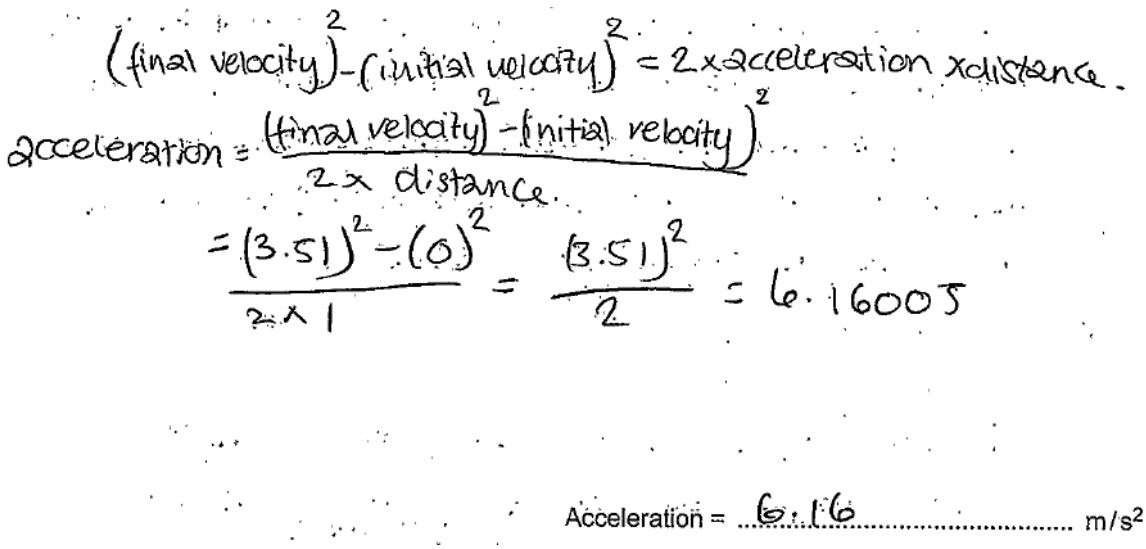
About half the candidates gained full marks for this question.

It was expected that candidates would select an appropriate equation from the data sheet, rearrange the equation and substitute in the numbers from the question before calculating the answer.

It was expected that the initial speed of zero would be shown in any calculation.

Many candidates who did not gain full marks attempted to gain the answer by using the definition of acceleration and the equation linking average speed with distance and time without realising the importance of the word "average". Candidates using this method often arrived with an incorrect answer of 12.32 m / s^2.

Exemplar 6



This candidate has correctly selected the equation from data sheet. The candidate has then rearranged the equation before substituting in the values form the question. Helpfully the candidate has indicated that the initial velocity was zero.

The candidate then correctly calculates the answer as 6.16005 before correctly rounding the answer to two decimal places.

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Question 21 (b) (ii)

(ii) The trolley has a mass of 2.0 kg.

Calculate the kinetic energy of the trolley at a speed of 3.0 m/s.

Kinetic energy = ... J **[3]**

Candidates who were able to recall the equation for kinetic energy scored well on this question. Candidates should be encouraged to show their working.

Question 22 (a)

22 A student investigates four gases.

Look at her data.

Gas	Pressure (Pa)	Volume (m^3)
A	5	0.5
B	10	0.4
C	20	0.2
D	40	0.2

Two readings are for the same mass of the same gas at a constant temperature.

(a) Which two readings are for the **same mass** of the **same gas** at a constant temperature?

Use calculations in your answer.

[3]

This question required candidates to use the data in the table which was generally well answered by all candidates.

Higher ability candidates clearly stated that pressure is inversely proportional to volume and then went on to state that pressure × volume = constant. Most candidates then calculated for each gas pressure × volume before stating that B and C were the same.

A few candidates demonstrated that doubling the pressure halved the volume and gained full credit with the appropriate conclusion.

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Question 22 (b)

(b) The student investigates another gas at **constant volume**.

Explain, using ideas about particles, how temperature affects gas pressure.

.....

.....

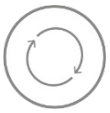
.....

.....

..... **[3]**

There were a range of marks in this question. Candidates needed to be able to explain either how an increase in temperature affects the gas pressure or a decrease in temperature affects the gas pressure. The direction of the temperature change needed to be clear.

Most candidates realised that an increase in temperature resulted in the gas molecules having more kinetic energy and thus a higher average speed. Candidates were then expected to state that the molecules collided more frequently with the walls of the container. Often, "frequently" was omitted from candidates' answers. The final mark was for stating that the more frequent collisions resulted in a large force over the same area which causes a greater pressure. Some candidates correctly explained the larger force in a greater rate of change of momentum.

	**AfL**	Candidates should be encouraged to practise explaining physics concepts in terms of the effect of increasing a quantity on another quantity.

Question 22 (c)

(c) Calculate the pressure at the bottom of a 0.5 m tall measuring cylinder filled with a liquid.

Density of the liquid = 1100 kg / m^3.

Pressure = ... Pa **[3]**

Most of the candidates correctly selected an equation from the data sheet and used an appropriate value for *g*.

Candidates who did not gain credit for this question, tended to just multiply 0.5 by 1100. By understanding that the unit of pressure is Pa or N / m^2, candidates should be able to reason that m × kg / m^3 is not valid.

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