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H

Wednesday 22 May 2019 – Afternoon

GCSE (9–1) Physics A (Gateway Science)

J249/03 Paper 3 (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Physics A (inserted))

You may use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

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SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

Write your answer to each question in the box provided.

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]**

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]**

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]**

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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]**

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]**

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]**

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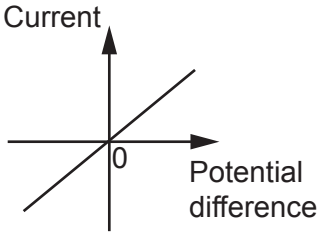
7 A student investigates four different electrical components.

She plots current-potential difference graphs for the components.

A



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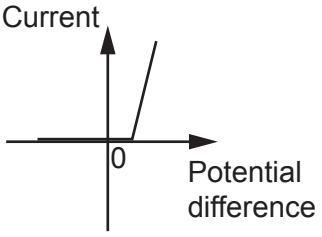
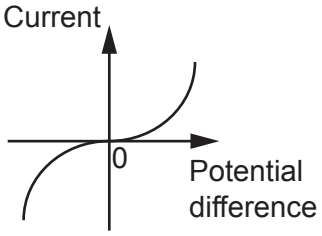
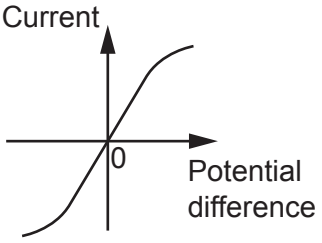


C



D



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

Your answer ☐ **[1]**

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]**

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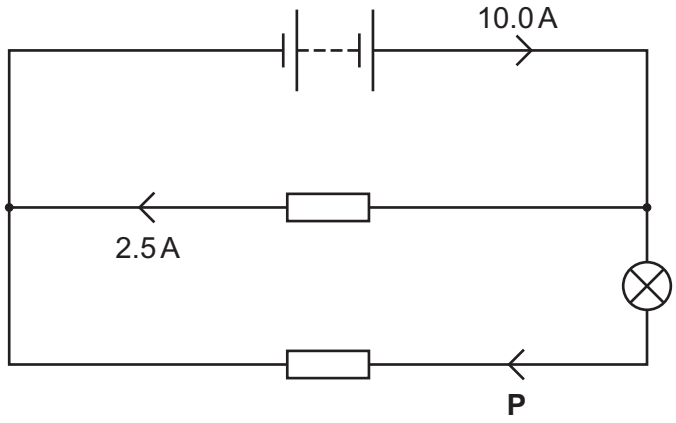
9 Look at the circuit diagram.



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

A 2.5A

B 5.0A

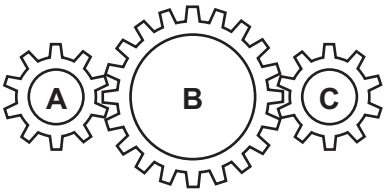
C 7.5A

D 10.0A

Your answer ☐ **[1]**

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]**

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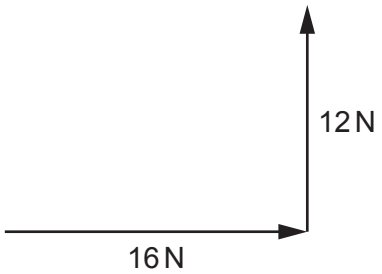
11 Two forces act at right angles to each other.



What is the magnitude of the resultant force?

A 18 N

B 20 N

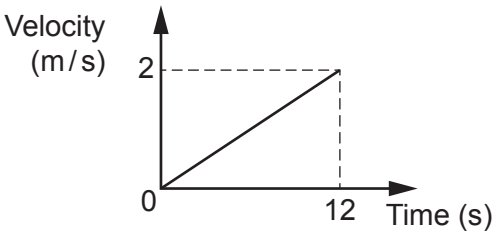
C 22 N

D 24 N

Your answer ☐ **[1]**

12 Look at the motion graphs.

A



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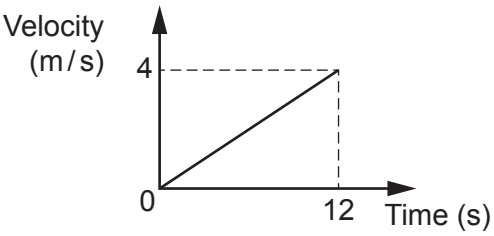

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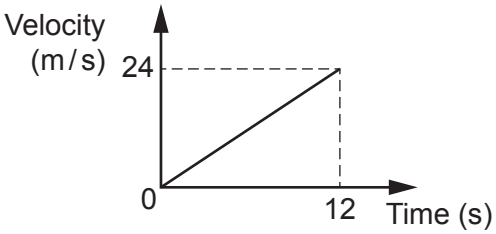

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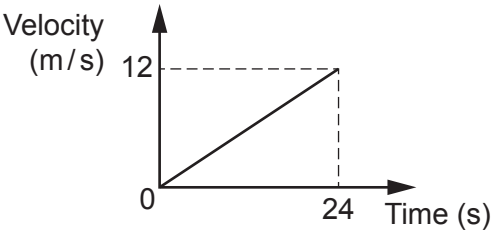

Which graph shows a journey with a distance of 24 m?

Your answer ☐ **[1]**

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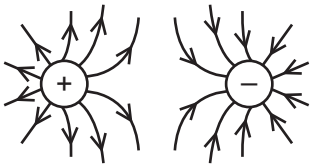
13 Look at the field line diagrams for positive and negative charges.

A



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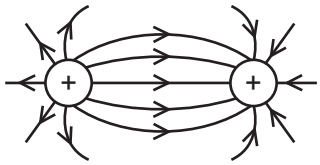
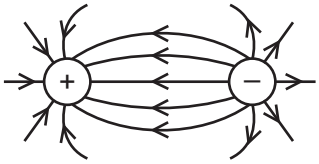
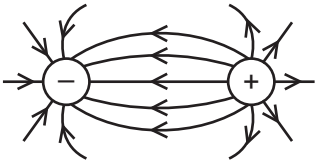


C



D

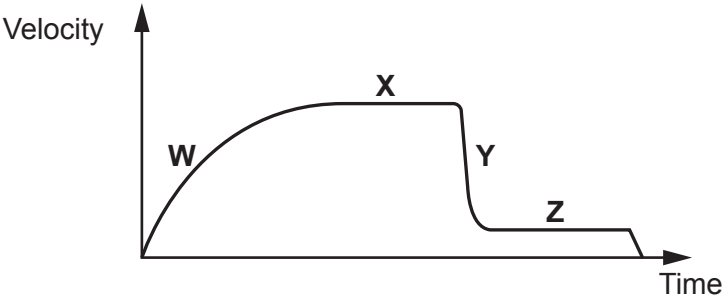


Which field line diagram is correct?

Your answer ☐ **[1]**

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]**

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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]**

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SECTION B

Answer **all** the questions.

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]**

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

.....

.....

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

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

.....

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

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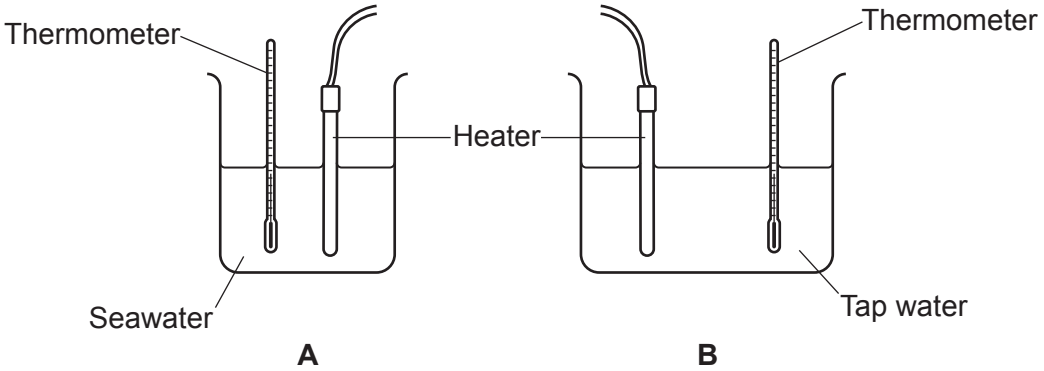
(c) A student does an experiment to find the difference between the specific heat capacities of seawater and tap water.

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]

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

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

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

1 .....

2 .....

[2]

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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]**

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

Calculate the energy transferred by the TV.

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

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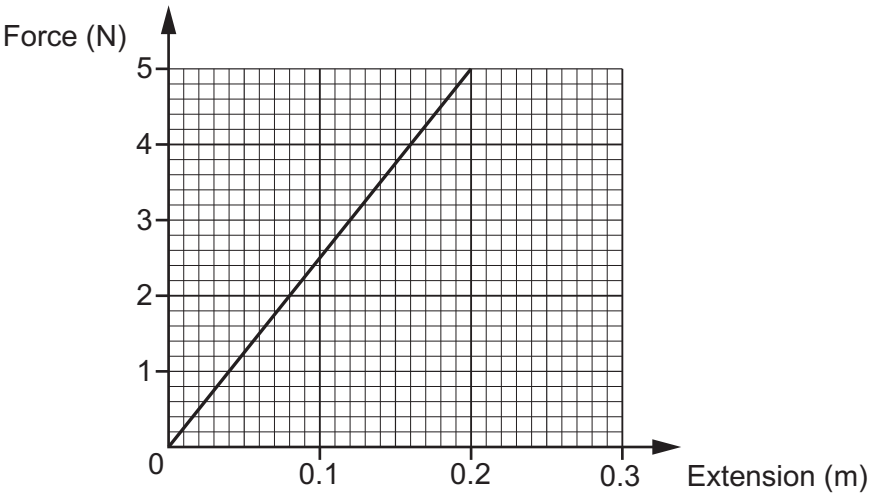
18 A student investigates how a spring stretches when a force is added.

Look at a graph of his results.



(a) Calculate the spring constant of the spring.

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

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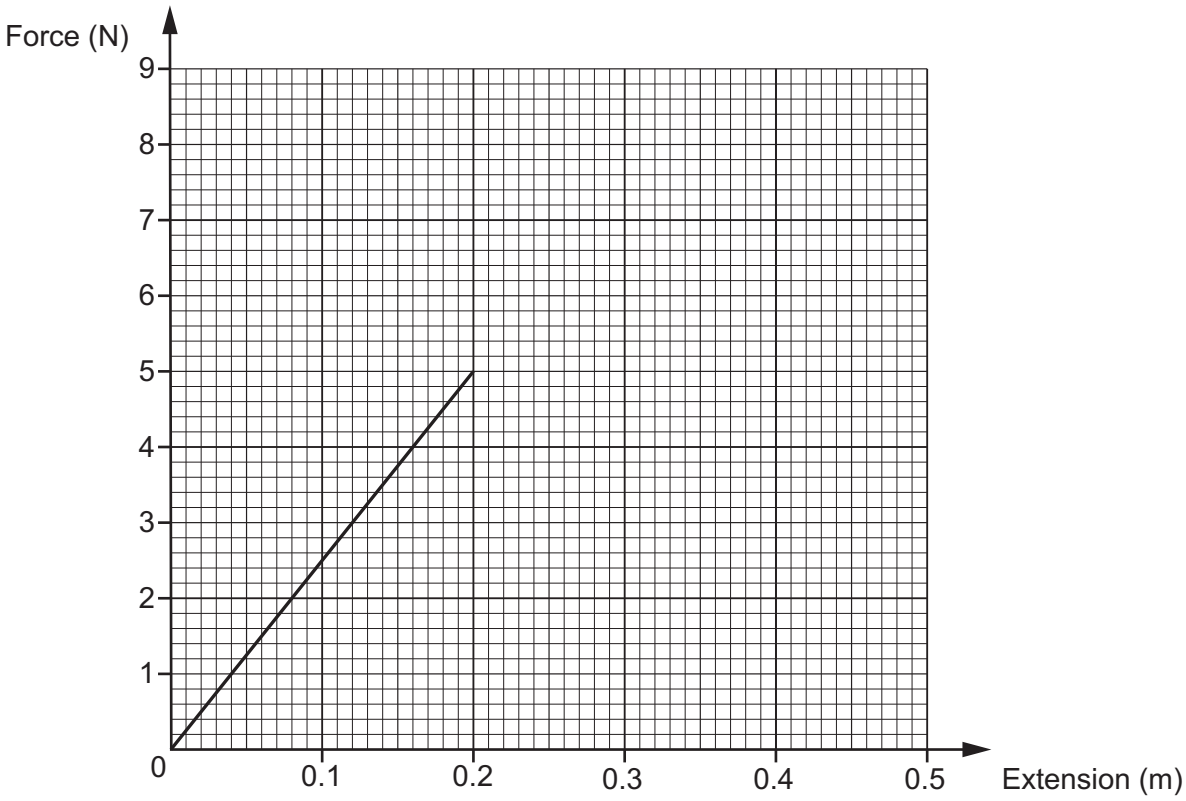
(b) The student continues to load the spring until it passes its elastic limit.

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



[2]

(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]

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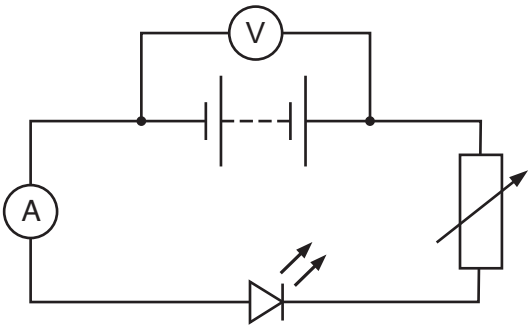
19 A student investigates the electrical characteristics of a light emitting diode (LED).

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.

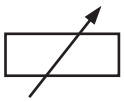


(a) **(i)** The student has made **two** errors connecting the circuit.

Identify the errors.

1 .....

2 .....
[2]

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

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

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

(i) Calculate the resistance of the LED.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

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

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

(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]**

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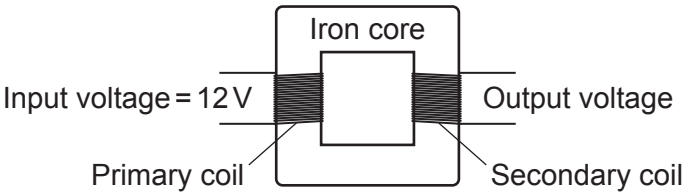
20 A student investigates building model transformers in the laboratory.

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.

.....

.....

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

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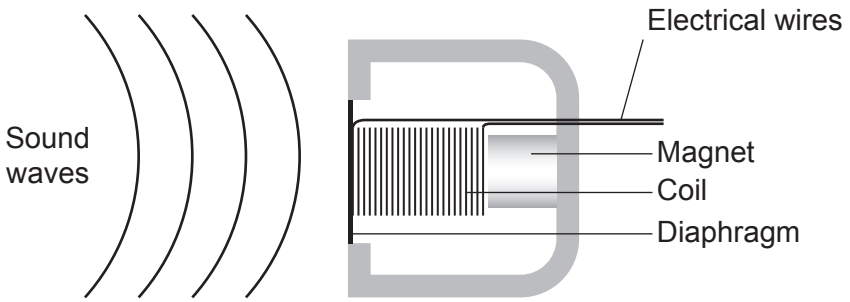
(b) A student completes a project on how dynamic microphones work.

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

Dynamic Microphones



A sound wave is a pressure wave.
Sound waves cause areas of high and low pressure.
As the diaphragm moves in and out so does the coil. The coil is surrounded by a magnet.
A resistance is induced across the ends of the wire. This is the electrical signal that the microphone produces.
A microphone is similar to a motor.

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

Incorrect word .....

Corrected sentence .....

.....
[2]

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

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

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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.

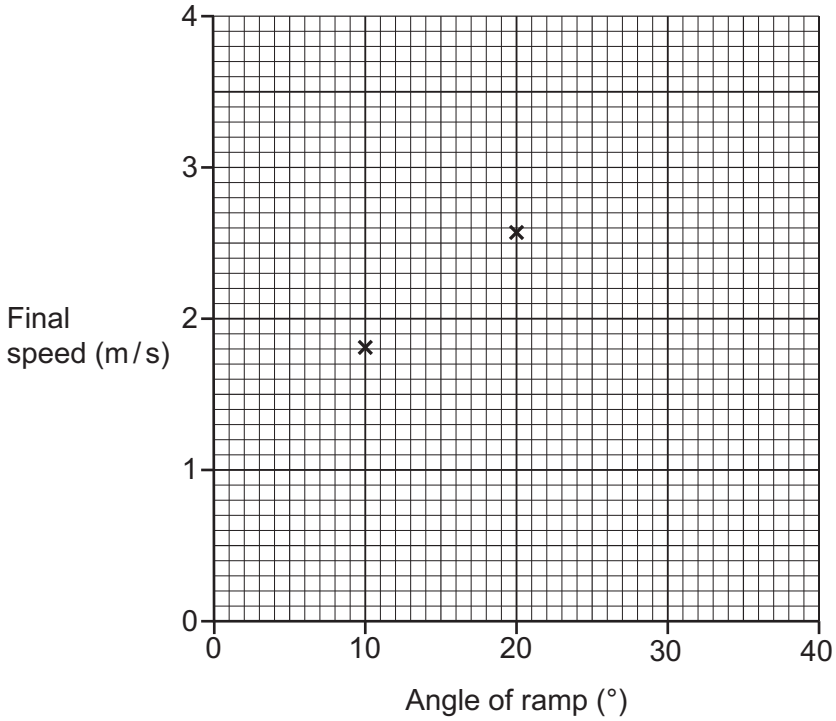
The student releases the trolley from rest at the same point on the ramp each time.

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]

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(ii) Describe the pattern shown by the results.

Use data from the table or graph in your answer.

.....

.....

.....

.....

.....

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

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

In your answer use ideas about energy.

.....

.....

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

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

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

.....

.....

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

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

He is **not** correct.

Explain why.

.....

.....

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

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(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]**

(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]**

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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]

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

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

.....

.....

.....

.....

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

(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]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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