Intermediate Physics Challenge Task 1 ANSWERS BOOKLET

Part 1: Measuring the time for free fall [4 marks]

Explain why this method of calculating the acceleration due to gravity is **unlikely** to produce reliable results.

……

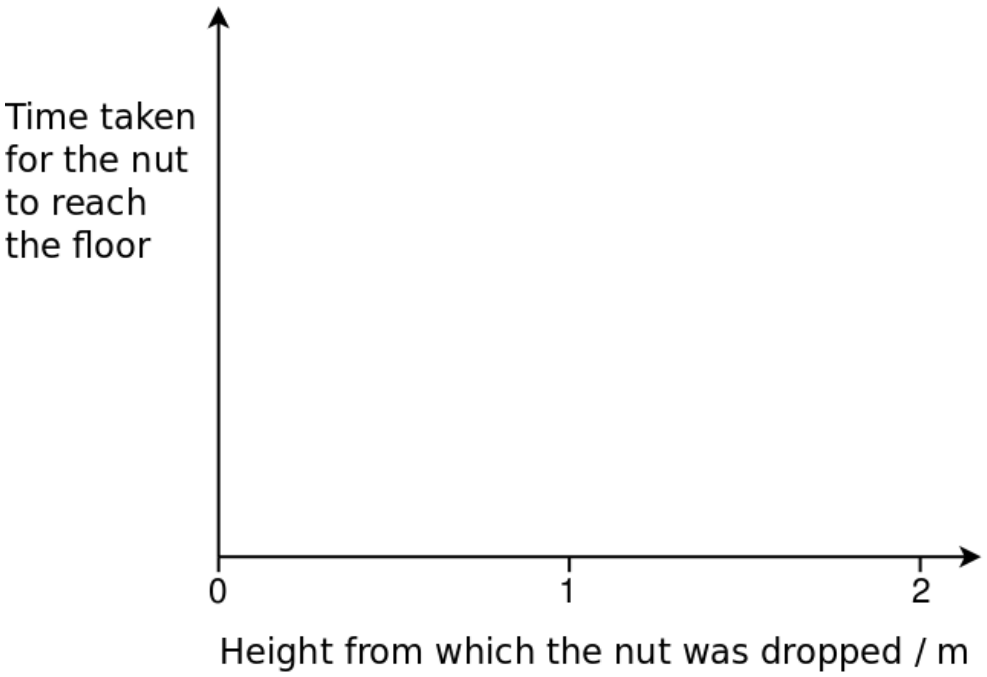
……

……

……

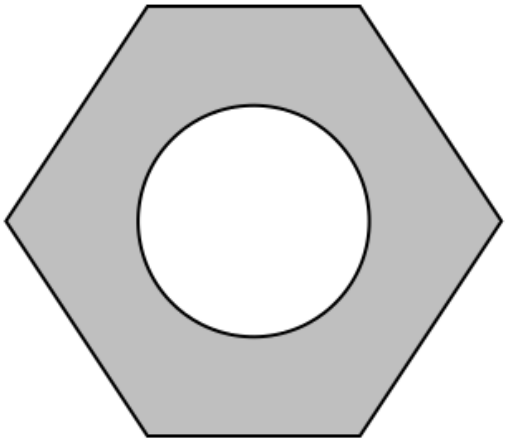
Sketch the ideal graph of the **time** against **height**.

You do **NOT** need to add numerical values to the y-axis.



Part 2: Centre of mass [1 mark]

Mark the position of the centre of mass of the nut.

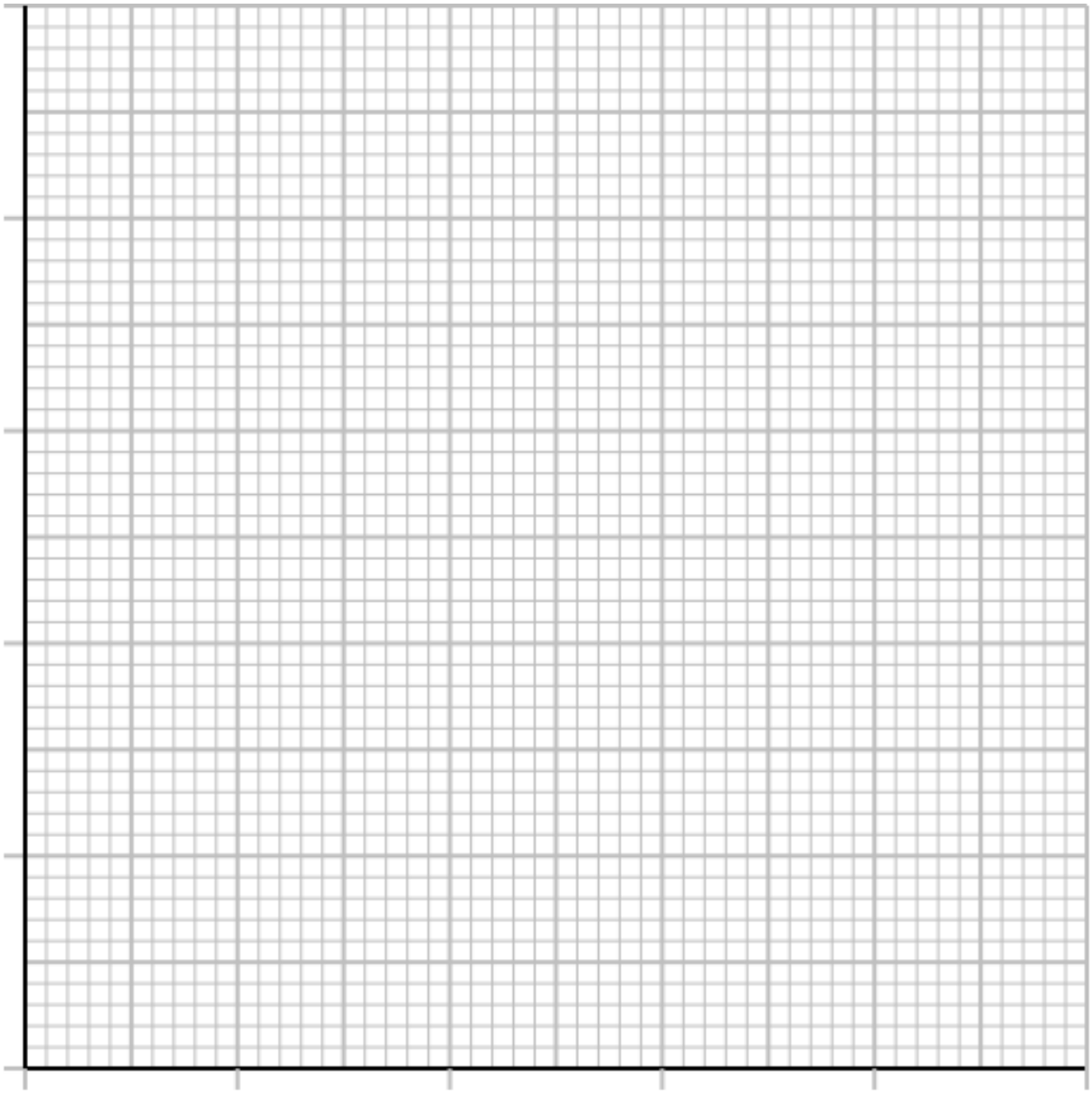


Part 3: Measuring g using a pendulum [12 marks]

Record the results of the pendulum experiment.

Length (L) of pendulum in metres	1st time recorded for 20 swings in seconds	2nd time recorded for 20 swings in seconds	3rd time recorded for 20 swings in seconds	Average time for 20 swings in seconds	Average time for 1 swing (T) in seconds	Average time squared (T^2) for 1 swing in seconds squared

Plot a graph of T^2 on the y-axis against length, L, on the x-axis.



Calculate the gradient of the graph.

……

……

……

……

Gradient of graph = ……

Calculate the acceleration due to gravity from the results of the pendulum experiment.

……

……

……

……

Acceleration due to gravity = ……

Part 4: Testing the pendulum equation [8 marks]

Independent variable(s) would be ……

Dependent variable(s) would be ……

Control variable(s) would be ……

Method.

……

……

……

……

……

……

……

……

Results table (in the space below).

Conclusion.

……

……

……

……

Part 5: Pendulum clocks [5 marks]

Calculate the length of a pendulum with a time period of **1 second**.

……

……

……

……

Explanation.

……

……

……

……

……

……

Calculation of the maximum energy required **per swing**.

……

……

……

……

……

……

Intermediate Physics Challenge Task 2 ANSWERS BOOKLET

Part 1: Measuring the speed of water waves [8 marks]

Measure the internal dimensions and volume of the small plastic box

Length ……..

Width ……..

Depth ……..

Internal Volume of plastic box ……..

Measure the internal dimensions of the shallow plastic tray

Length of tray ……..

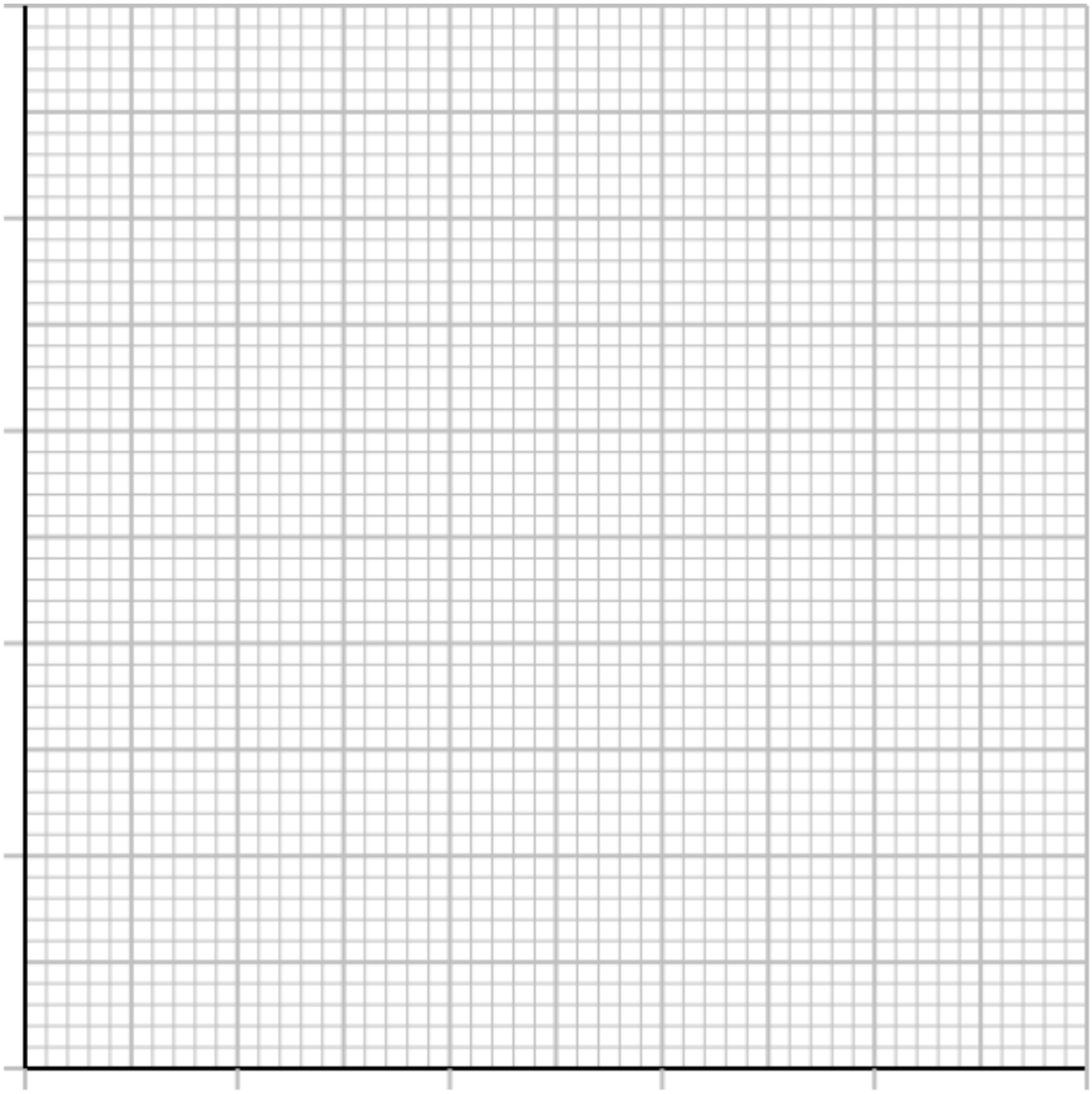
Width of tray ……..

Record your results in the table

Add the appropriate UNITS to each column. Add the units to the grey shaded second row

Volume of water added	Depth of water	Time taken for wave to travel twice the length of the tray			Average time taken	Speed (v) of water wave	Calculated value of v^2
		1st trial	2nd trial	3rd trial			

Part 2: Graphical Analysis [8 marks]



Part 3: Determine the gradient of the graph [8 marks]

……

……

……

……

Values of acceleration due to gravity

Pendulum experiment g = …… m/s^2

Water waves experiment g = …… m/s^2

Percentage difference

Calculate the percentage difference between your two values for the acceleration due to gravity

……

……

……

……

Which result is more reliable?

State which value you think is more reliable or whether you consider both results to be equally reliable

……

……

……

……

Explanation 1

……

……

……

……

Explanation 2

……

……

……

……

Part 4: Refraction [6 marks]

Describe the relationship between the speed of the water waves (ripples) and the depth of the water

……

……

……

……

Calculate the speed of the ripples (v) in the shallower water

……

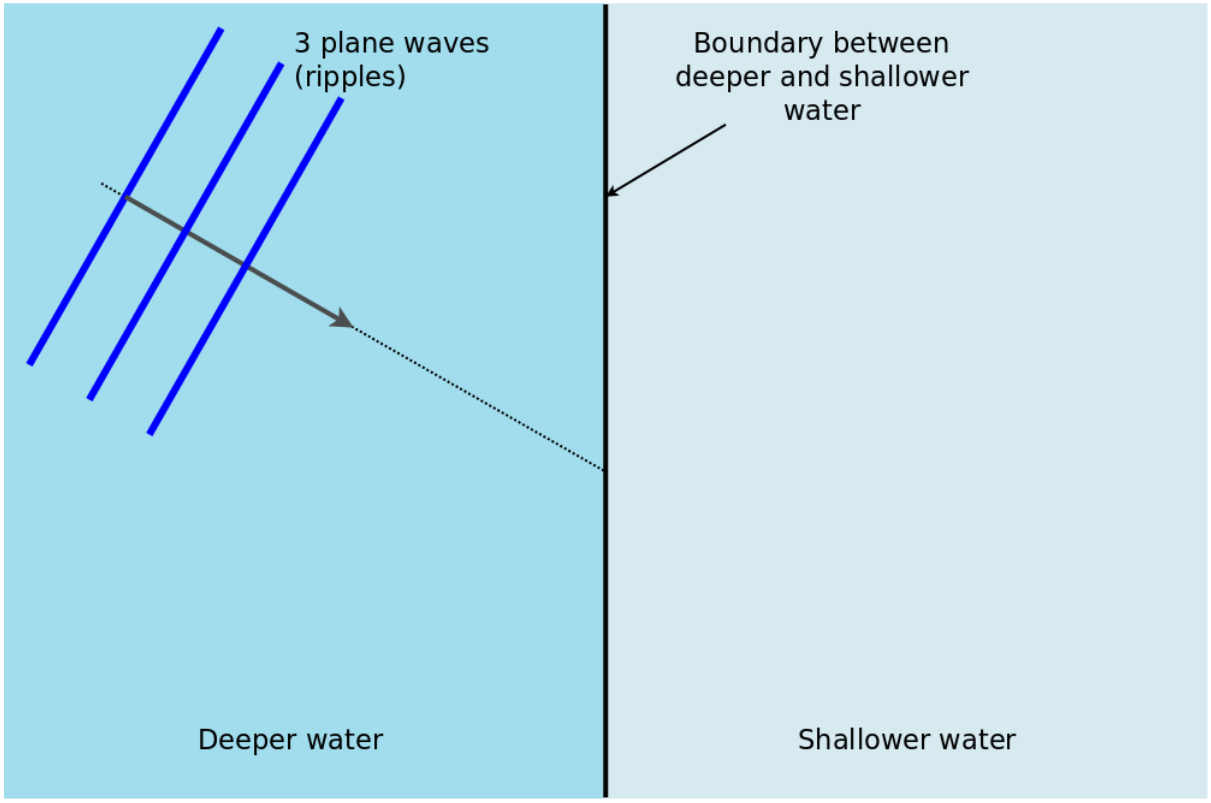
……

……

……

Show what happens to the ripples as they approach and cross the boundary

Add to the diagram



Intermediate Physics Challenge Task 3 ANSWERS BOOKLET

Part 1: Measuring Density [15 marks]

Centre of mass of the ruler

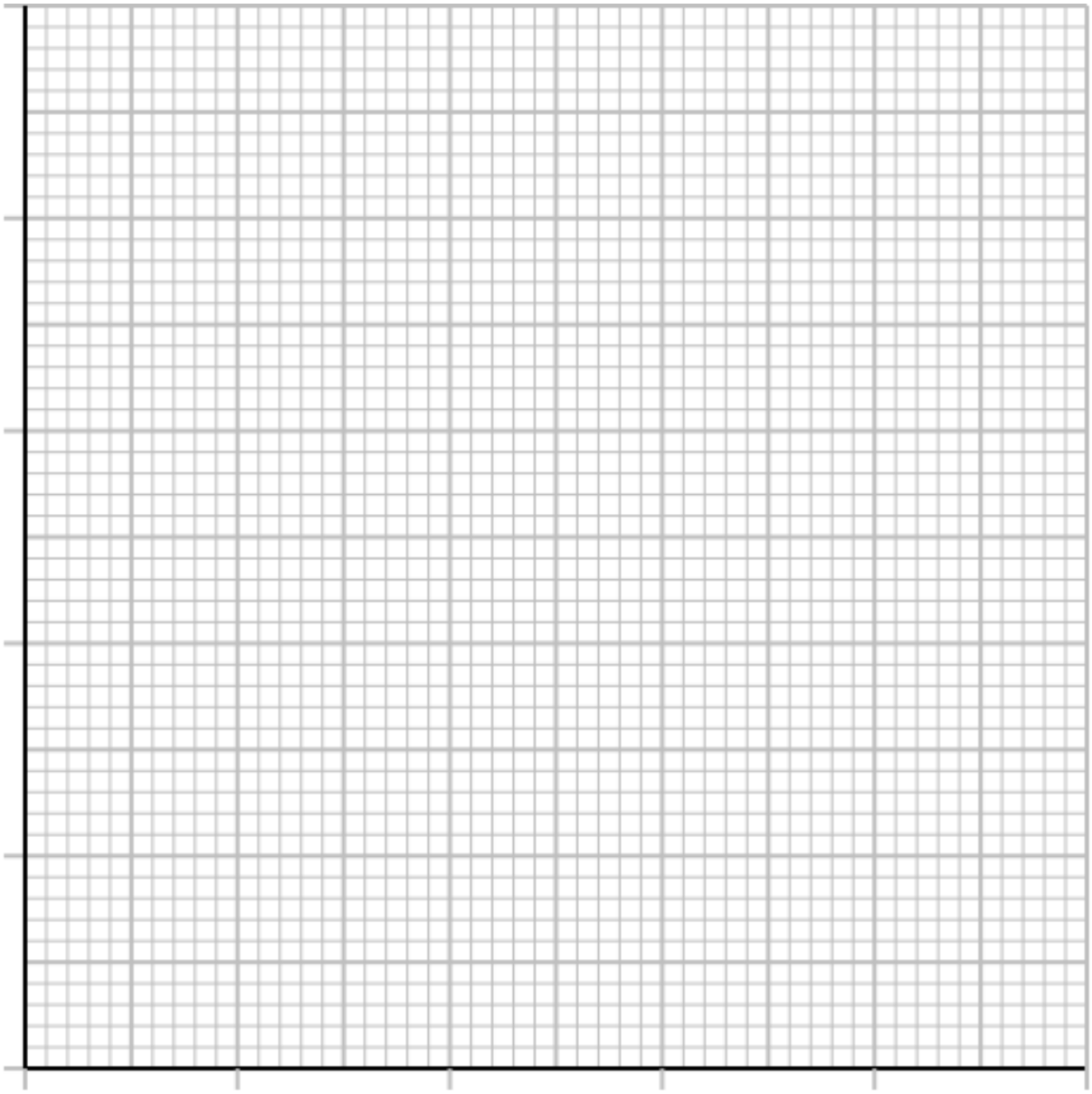
Position of the centre of mass of the ruler .....

Mass of the empty plastic box

Record your results in the table

Distance from dowel to centre of mass of the empty box (x) in cm	Distance from dowel to the centre of mass of the bolt (y) in cm

Use the graph paper on the next page to plot the required graph



Calculate the gradient of the best fit straight line

……

……

……

Calculate the mass of the empty box

……

……

……

Volume of gravel in the box

Depth of gravel in the box …….

Length of box …….

Width of box …….

Volume of gravel in the box …….

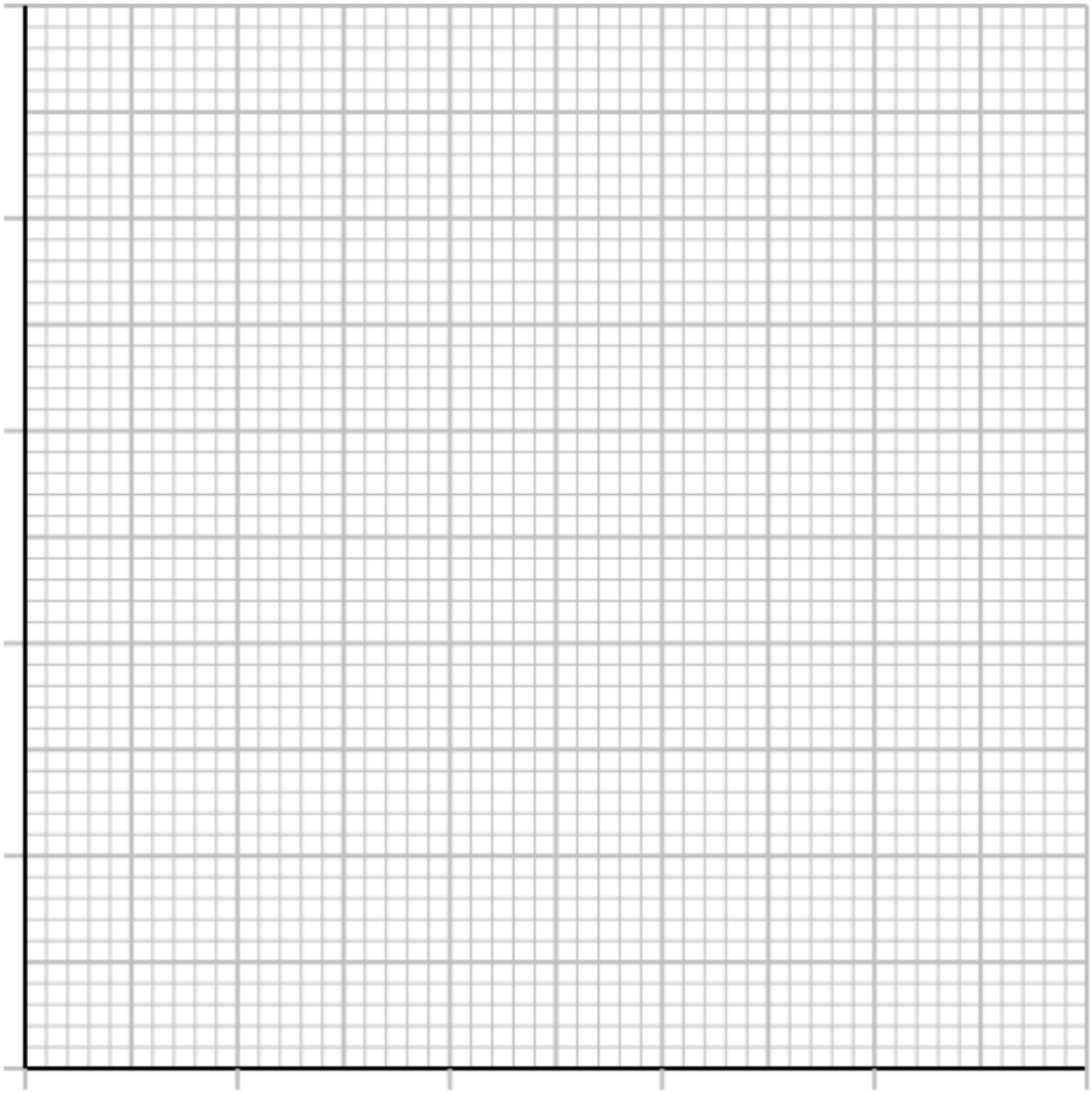
Mass of gravel in the box

Combined mass of nuts and bolt ……

Record your results in the table

Distance from dowel to centre of mass of the box containing gravel (x) in cm	Distance from dowel to the centre of mass of the nuts and bolt (y) in cm

Use the graph paper on the next page to plot the required graph



Calculate the gradient of the best fit straight line

……

……

……

Calculate the mass of the box and gravel

……

……

……

Mass of just the gravel in the box ……

Density of the gravel

Calculate the density of the gravel

……

……

……

Advantage of using a large amount of gravel

……

……

……

Advantage of using a small amount of gravel

……

……

……

Part 2: A different way to measure density [5 marks]

Change of water level in the bottle ……

Measured diameter of bottle ……

How did you measure the diameter of the bottle? Draw a diagram

……

……

……

Calculate the volume of water displaced

……

……

……

Volume = ……

Calculate the density of the gravel

……

……

……

Density = ……

Part 3: Radius of Earth [10 marks]

Chosen value of acceleration due to gravity g = ……

Explanation: ……

……

……

Chosen value of density ρ = ……

Explanation: ……

……

……

Calculate the radius of Earth

……

……

……

……

……

……

Calculate the distance to the equator

……

……

……

……

Calculate the number of days taken to reach the equator

……

……

……

……

Suggest a reason why the average density of Earth is greater than the value you have determined

……

……

……

……