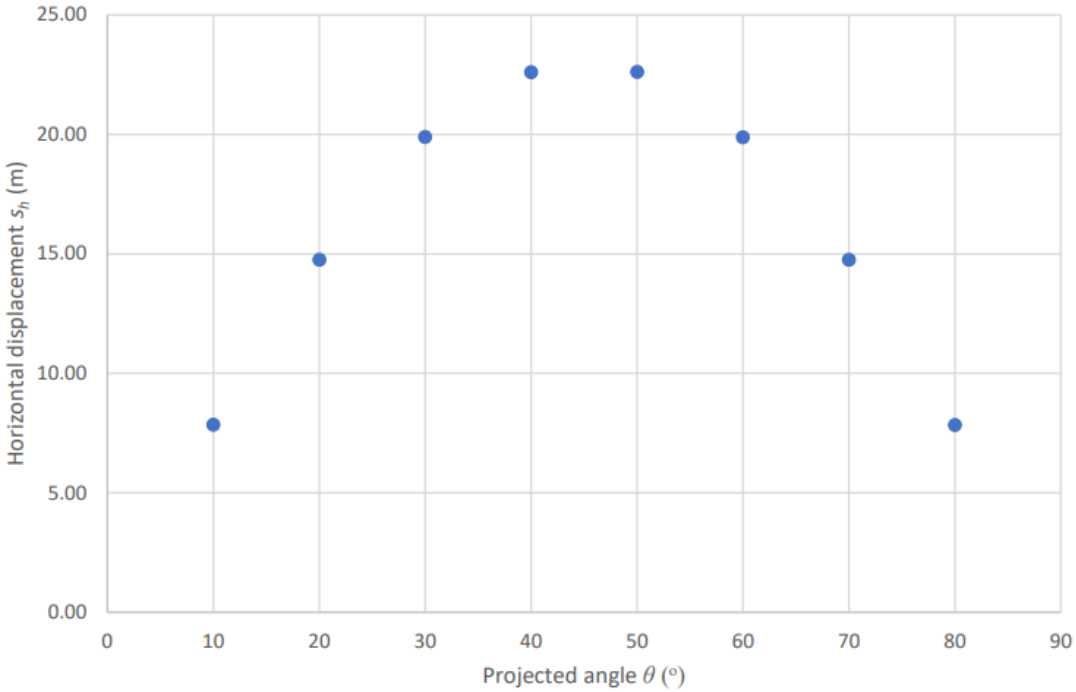
Physics Data Test Preparation 1

What is the relationship between the projected angle ($10° \leq \theta \leq 80°$) of a golf ball and its horizontal displacement (range) when launched from ground level with a constant initial velocity of 15.0 m/s?

The experimental data was collected and processed, and is presented in Graph 1.

Graph 1: Horizontal displacement of golf ball projected at various angles



Question 5 (1 mark)

Identify the two projected angles that produced a horizontal displacement of 20 m.

Question 6 (2 marks)

Calculate the initial horizontal component of the velocity of the golf ball when it was projected at an angle of 20°.

Question 7 (1 mark)

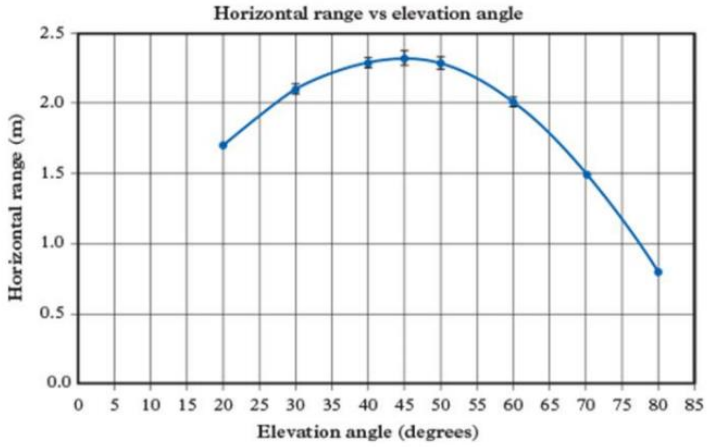
Identify the trend between the projected angle θ and the horizontal displacement s_h of the golf ball.

Question 8 (2 marks)

Infer which projected angle would result in the largest horizontal displacement. Give a reason for your response.

What is the effect of launch angle on the horizontal range of a projectile?

A small metal ball was fired at various angles from the launcher with a fixed initial speed of $4.77\,\text{ms}^{-1}$. The horizontal range was measured with a tape measure. The trial was repeated, and the distances averaged. Seven more trials were done at different angles and the uncertainty in the range (δx) was calculated for each angle. The results are shown in Table 1.



Item 1 (apply understanding) – 1 mark

Identify the angle that produces the same horizontal range as 60°.

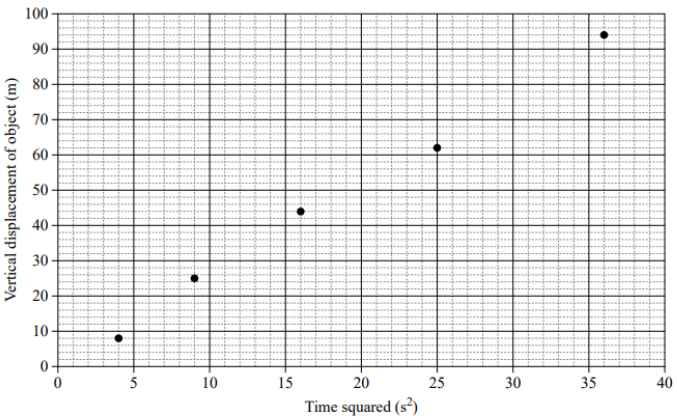
Item 3 (apply understanding) – 1 mark

Calculate the initial horizontal component of the velocity that gives maximum range. Show your working.

QUESTION 7 (6 marks)

An object on a planet is launched horizontally from a cliff. Its vertical displacement is measured over 6 seconds.

The graph shows the object's vertical displacement with respect to time squared.

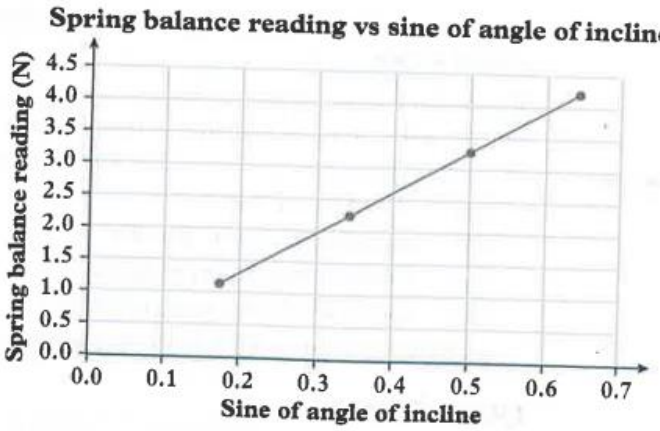


a) Determine the mathematical relationship between vertical displacement (s) and time (t). *[3 marks]*

b) Calculate the acceleration due to gravity on the planet. *[3 marks]*

Inclined Plane

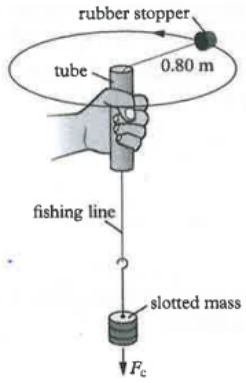
The following graph shows the results of the experiment.



Calculate the mass of the trolley using the complete set of data. Show your working. Express your answer to 2 decimal places.

Circular Motion

An experiment was conducted to investigate the relationship between centripetal force and velocity of a rubber stopper being whirled in a horizontal circle. The apparatus is shown below. The slotted masses provided the centripetal force and the fishing line was kept in position so that the radius of the orbit was 0.80 m. Three different centripetal forces were tried, and the velocity of the stopper was recorded for each. The results are shown in the table.



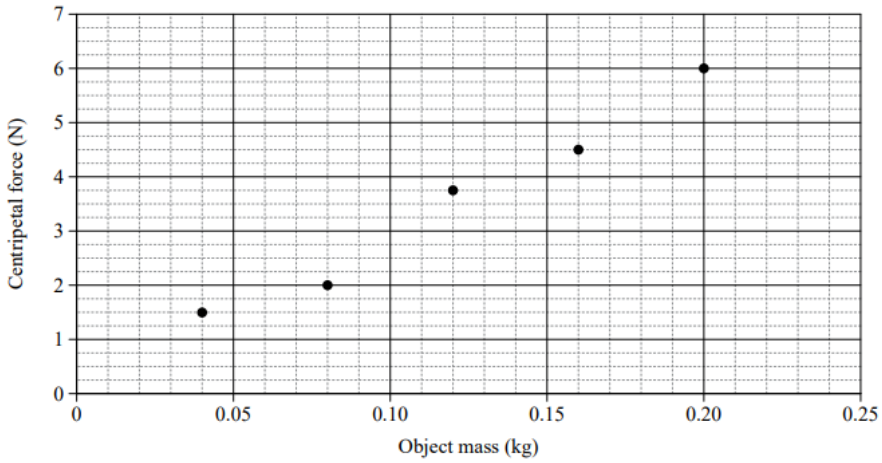
Centripetal force, F_c (N)	Velocity, v (m s^{-1})
1.0	4.8
2.0	6.8
3.0	8.3

a) Are the data consistent with the centripetal force formula? *[3 marks]*

b) Determine the mass of the rubber stopper. Express you answer in grams to the nearest whole number. There is no need to draw a graph. *[1 mark]*

QUESTION 25 (4 marks)

The graph shows the centripetal forces required to keep objects with different mass in uniform circular motion with a constant speed and constant radius of 20 cm.

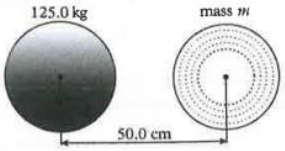


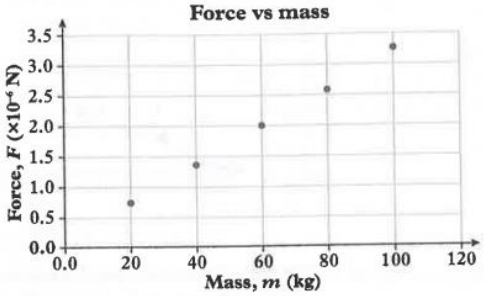
Determine the speed of the objects.

Gravity

QUESTION 9 (5 marks)

Two solid metal spheres are separated by a distance of 50.0 cm between their centres. The gravitational force between the two objects is measured as the mass of the rightmost sphere is varied from 20.0 kg to 100.0 kg while the mass of the leftmost sphere is kept constant at 125.0 kg. The data are plotted in the graph below.



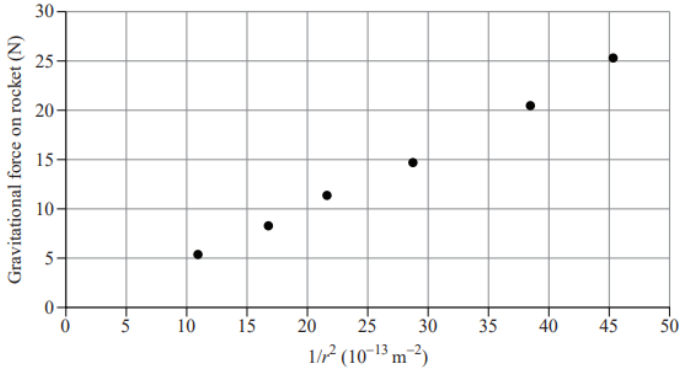


a) Identify the mathematical relationship represented by a linear trend line from the graph. Show your working. *[2 marks]*

b) Use the information provided and the mathematical relationship between F and m identified in (a) to determine an experimental value for the gravitational constant, G. Show your working. Express the solution using scientific notation to 1 decimal place. *[3 marks]*

QUESTION 8 (4 marks)

The graph shows the gravitational force experienced by a rocket of mass 750 kg as it approaches an asteroid.



Determine the mass of the asteroid. Show your working.

Orbits

QUESTION 13 (3 marks)

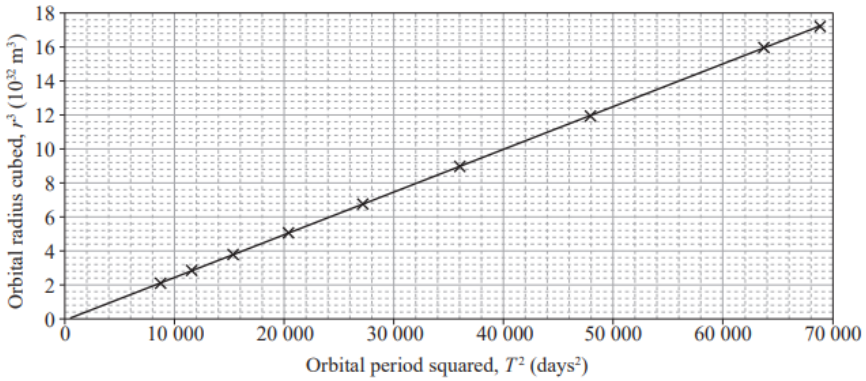
To investigate the relationship between orbital radius and mass in our solar system, data were collected to show the orbital radius and period of five moons, and the mass of the four corresponding planets they orbit. This is shown in the data table below.

Planet	Mass of the planet M (kg)	Natural satellite ('moon')	Kepler's ratio, $\frac{T^2}{r^3}$ (s^2m^{-3})
Mars	6.44×10^{23}	Phobos	9.19×10^{-13}
Earth	5.97×10^{24}	Moon	9.79×10^{-14}
Neptune	1.02×10^{26}	Triton	5.77×10^{-15}
Jupiter	1.90×10^{27}	Io	3.12×10^{-16}
Jupiter	1.90×10^{27}	Europa	3.12×10^{-16}

Do the data confirm the expected relationship between orbital radius and mass? Explain your answer by referring to the data.

QUESTION 9 (5 marks)

Nine planets orbit the same star. The orbital radius and orbital period of each planet was measured. The graph shows the cube of the orbital radius of each planet, r^3, compared to its orbital period squared, T^2.

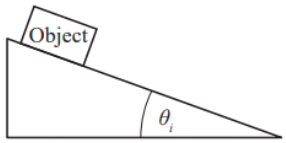


Determine the mass of the star. Show your working.

Extra

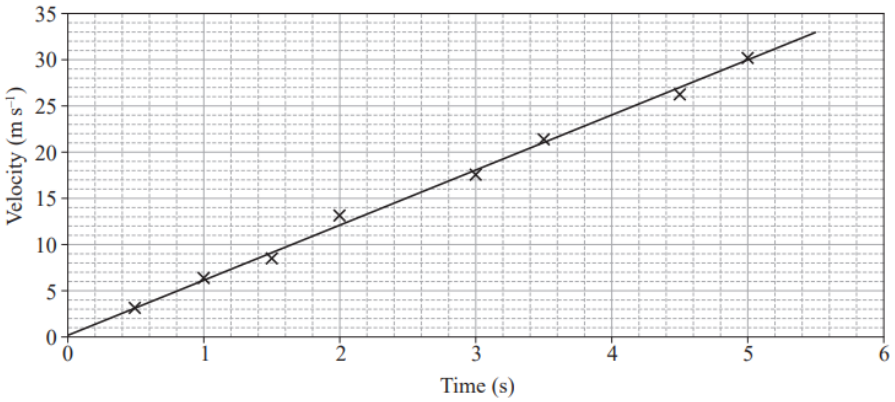
QUESTION 8 (4 marks)

The diagram shows an object sliding down a frictionless inclined plane.



Not drawn to scale

The graph shows the velocity of the object measured at various times.



Determine the angle of incline, θ_i, of the inclined plane. Show your working.