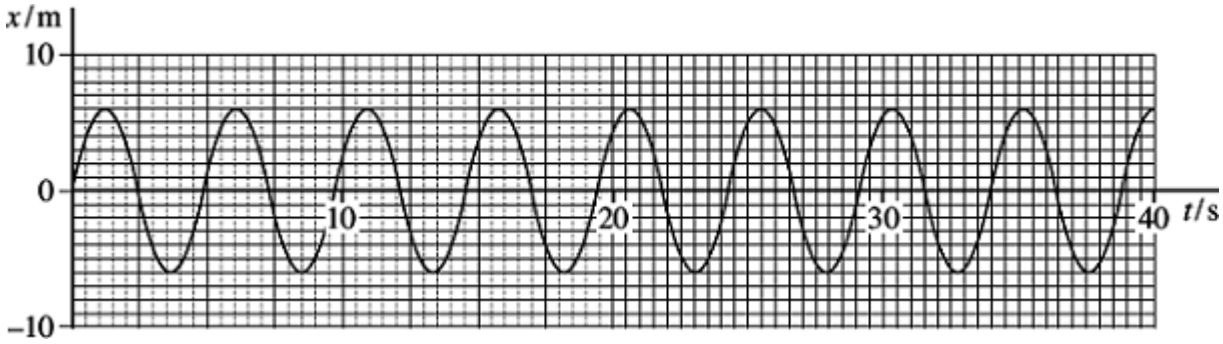
Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

A pirate ship is a type of amusement park pendulum ride in which a gondola carrying passengers is made to oscillate. The ride can be modelled using a simple pendulum consisting of a mass on a string.

The figure below shows how the displacement x of the mass varies with time *t*.



(a) (i) Define amplitude.

_____

_____

(1)

(ii) Determine the amplitude of the oscillations of the mass.

amplitude _____ m

(1)

(iii) Calculate the period of the pendulum.

Downloaded from www.merit-minds.com

period _____ s

(2)

(b) Another model was constructed using a pendulum of frequency 0.25 Hz with the mass having an initial amplitude of 4.5 m.

(i) Calculate the maximum velocity of the mass.

maximum velocity _____ ms^{-1}

(2)

(ii) Calculate the maximum acceleration of the mass.

maximum acceleration _____ ms^{-2}

(2)

(iii) Calculate the length of the simple pendulum that has a frequency of 0.25 Hz.

length _____ m

(2)

(c) To simplify the driving mechanism of the actual ride it is suggested that the gondola should be pushed each time it reaches the centre moving in one direction.
Explain why this would lead to large amplitude oscillations.

_____

_____

_____

_____

_____

_____

Downloaded from www.merit-minds.com

(2)

(d) When the force is no longer applied the gondola will naturally come to rest. The time for this to happen will usually be too long to satisfy the ride operators. External dampers are used to reduce the time taken to stop the gondola.
Explain why the gondola would come to rest naturally and what feature of an energy efficient ride design would make this a lengthy process.

_____

_____

_____

_____

_____

_____

_____

(3)
(Total 15 marks)

Q2.

(a) State, in words, Newton's law of gravitation.

_____

_____

_____

_____

_____

(3)

(b) By considering the centripetal force which acts on a planet in a circular orbit, show that $T^2 \propto R^3$, where T is the time taken for one orbit around the Sun and R is the radius of the orbit.

_____

_____

_____

_____

_____

(3)

(c) The Earth's orbit is of mean radius 1.50×10^{11} m and the Earth's year is 365 days long.

(i) The mean radius of the orbit of Mercury is 5.79×10^{10} m. Calculate the length of Mercury's year.

_____

Downloaded from www.merit-minds.com

(ii) Neptune orbits the Sun once every 165 Earth years.

Calculate the ratio $\frac{\text{distance from Sun to Neptune}}{\text{distance from Sun to Earth}}$.

(4)

(Total 10 marks)

Downloaded from www.merit-minds.com