Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic : 12_Gravatational Fields

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

Q1.

The Moon has an orbit around the Earth of radius 3.86×10^8 m, with a time period of 2.36×10^6 s.

(a) (i) Using the data provided, show that the product GM is about 4.1×10^{14} m^3 s^{-2}, where M is the mass of the Earth.

(3)

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(ii) At the surface of the Earth g is measured to be 9.81 N kg^{-1}.
Calculate a value for the radius of the Earth.

(2)

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Radius of the Earth = ...

(b) It has been estimated that, at any one time, there may be about a thousand small asteroids orbiting the Earth. These asteroids orbit at between five to ten times the distance of the Moon from the Earth. Most make no more than one orbit before being pulled out of this orbit by the Sun.

Suggest why these asteroids do not remain in a stable orbit around the Earth.

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(Total for question = 7 marks)

Q2.

Mars is our nearest neighbour in the solar system. In August 2003 the distance between Mars and the Earth was the closest in recorded history at 5.6×10^{10} m.

mass of Mars = 6.4×10^{23} kg

mass of Earth = 6.0×10^{24} kg

Calculate the gravitational force between Mars and the Earth when they were at this distance.

(2)

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Gravitational force = ...

(Total for question = 2 marks)

Q3.

A small satellite has a weight of 1200 N at the Earth's surface. It is launched into a circular orbit with radius equal to twice the radius of the Earth. The weight of the satellite in this orbit is

- ☒ **A** 0 N
- ☒ **B** 300 N
- ☒ **C** 600 N
- ☒ **D** 1200 N

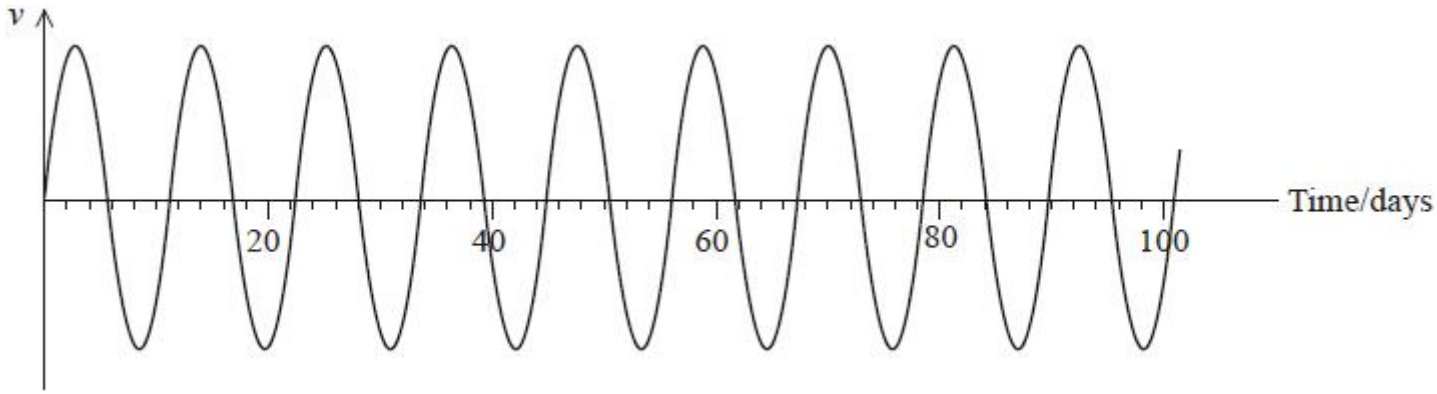
(Total for question = 1 marks)

Q4.

In 2016 astronomers announced the discovery of an Earth-like planet orbiting Proxima Centauri, the closest star to the Sun.

The planet was detected because of the small movement of the star as the planet orbited. The movement was detected using the Doppler shift in the frequency of light travelling to the Earth.

The graph shows how the component of the star's velocity *v* towards the Earth varied over time.



(i) Use the graph to show that the angular velocity of the planet is about 6×10^{-6} radian s^{-1}.

(3)

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(ii) The mass of Proxima Centauri is 0.12 times the mass of the Sun.

Determine the distance of the planet from Proxima Centauri.
mass of Sun = 1.99×10^{30} kg

(3)

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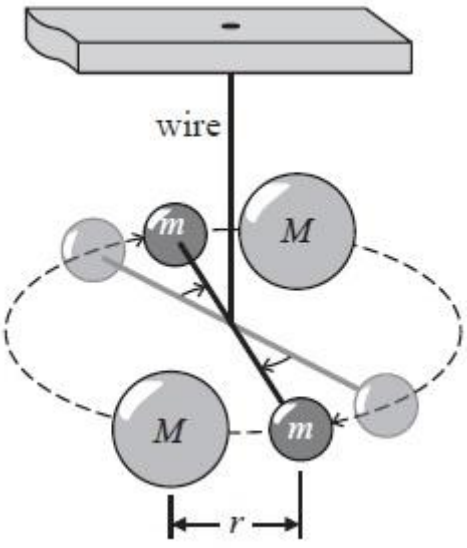
Distance = ...

(Total for question = 6 marks)

Q5.
In the 18th century Henry Cavendish devised an experiment to determine the average density of the Earth. This involved the first laboratory determination of the universal gravitational constant *G*.

A light horizontal rod with a small metal sphere at each end was hung from a fixed point by a very thin wire. Two large lead spheres were then brought close to the small spheres causing the rod to oscillate and then settle into a new position of equilibrium.



(a) In a modern version of the experiment the following data was obtained:

mass of large lead sphere M = 160 kg

mass of small sphere m = 0.75 kg

distance r = 0.23 m

gravitational force between adjacent large and small spheres $F = 1.5 \times 10^{-7}$ N.

Use this data to calculate a value for G.

(2)

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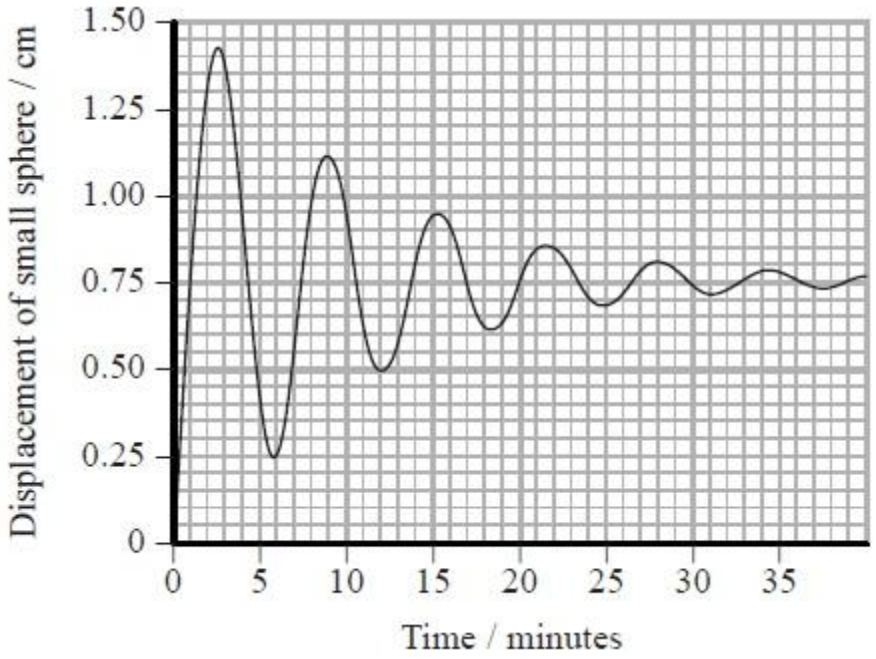
G = ...$Nm^2\ kg^{-2}$

(b) The graph shows how the displacement of one of the small spheres varies with time.



(i) Use the graph to determine the period of oscillation of the sphere.

(2)

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Period = ...

(ii) The amplitude of the oscillation decreases with each cycle.

Explain why this effect is observed.

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(iii) It is suggested that the decrease in amplitude is exponential. Use the graph to determine if this is approximately true.

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(Total for Question = 9 marks)