



grav13july2018

Name: _____

Class: _____

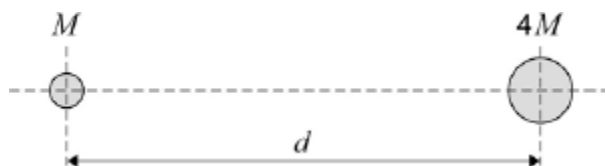
Date: _____

Time: **23 minutes**

Marks: **20 marks**

Comments:

- 1 Two stars of mass M and $4M$ are at a distance d between their centres.



The resultant gravitational field strength is zero along the line between their centres at a distance y from the centre of the star of mass M .

What is the value of the ratio $\frac{y}{d}$?

A $\frac{1}{2}$

B $\frac{1}{3}$

C $\frac{2}{3}$

D $\frac{3}{4}$

EPT - video walk through available

(Total 1 mark)

- 2 A geosynchronous satellite is in a constant radius orbit around the Earth. The Earth has a mass of 6.0×10^{24} kg and a radius of 6.4×10^6 m.

What is the height of the satellite above the Earth's surface?

A 1.3×10^7 m

B 3.6×10^7 m

C 4.2×10^7 m

D 4.8×10^7 m

(Total 1 mark)

- 3 (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.

- (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)

4

The planet Venus may be considered to be a sphere of uniform density $5.24 \times 10^3 \text{ kg m}^{-3}$. The gravitational field strength at the surface of Venus is 8.87 N kg^{-1} .

- (a) (i) Show that the gravitational field strength g_s at the surface of a planet is related to the density ρ and the radius R of the planet by the expression

$$g_s = \frac{4}{3} \pi G R \rho$$

where G is the gravitational constant.

(2)

(ii) Calculate the radius of Venus.

Give your answer to an appropriate number of significant figures.

radius = _____ m

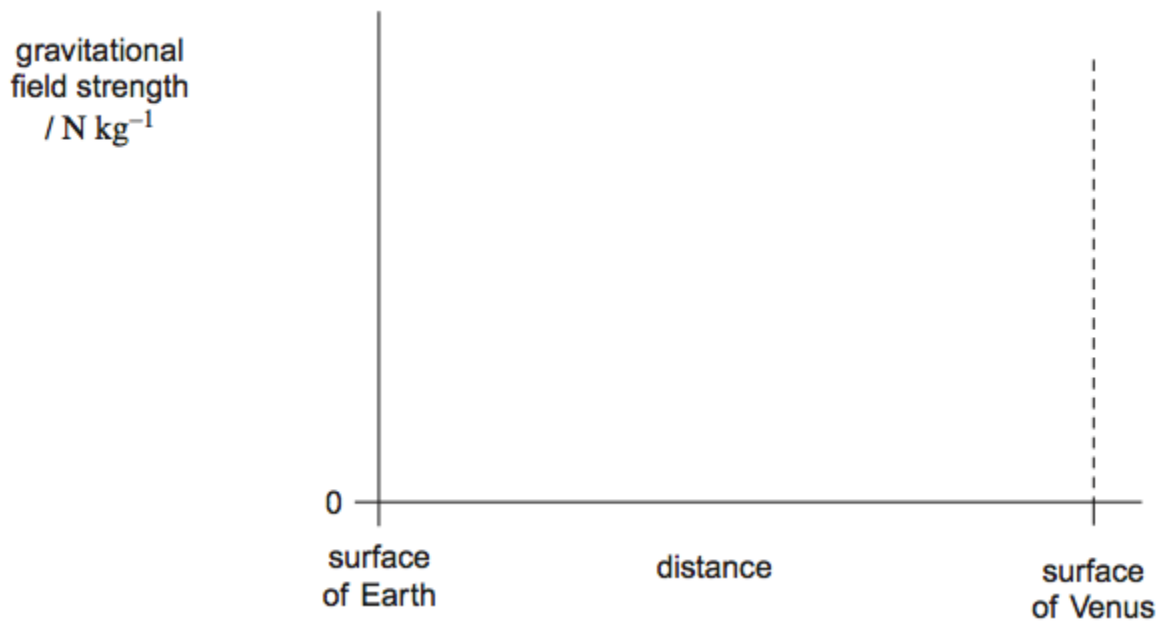
(3)

(b) At a certain time, the positions of Earth and Venus are aligned so that the distance between them is a minimum.

Sketch a graph on the axes below to show how the magnitude of the gravitational field strength g varies with distance along the shortest straight line between their surfaces.

Consider only the contributions to the field produced by Earth and Venus.

Mark values on the vertical axis of your graph.



(3)

(Total 8 marks)