

The thread breaks.

Explain the motion of the ball.

(2)
(Total 9 marks)

2

The distance between the Sun and the Earth is 1.5×10^{11} m

What is the gravitational force exerted on the Sun by the Earth?

- A 3.5×10^{22} N
- B 1.7×10^{26} N
- C 5.3×10^{33} N
- D 8.9×10^{50} N

(Total 1 mark)

3

A spacecraft of mass 1.0×10^6 kg is in orbit around the Sun at a radius of 1.1×10^{11} m
The spacecraft moves into a new orbit of radius 2.5×10^{11} m around the Sun.

What is the total change in gravitational potential energy of the spacecraft?

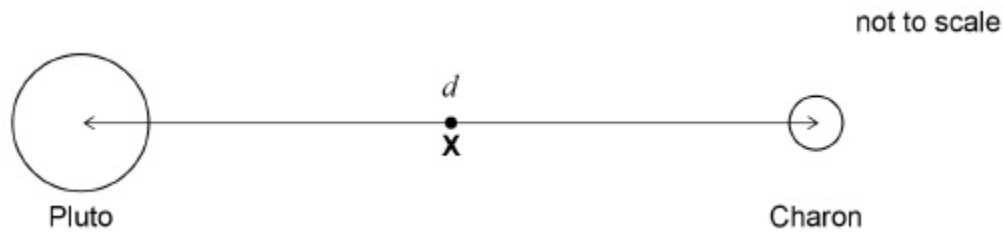
- A -6.76×10^{14} J
- B -3.38×10^{14} J
- C 3.38×10^{14} J
- D 6.76×10^{14} J

(Total 1 mark)

5 Charon is a moon of Pluto that has a mass equal to $\frac{1}{9}$ that of Pluto.

The distance between the centre of Pluto and the centre of Charon is d .

X is the point at which the resultant gravitational field due to Pluto and Charon is zero.



What is the distance of **X** from the centre of Pluto?

- A $\frac{2}{9}d$
- B $\frac{2}{3}d$
- C $\frac{3}{4}d$
- D $\frac{8}{9}d$

(Total 1 mark)

6 The distance between the Sun and Mars varies from 2.1×10^{11} m to 2.5×10^{11} m. When Mars is closest to the Sun, the force of gravitational attraction between them is F .

What is the force of gravitational attraction between them when they are furthest apart?

- A $0.71F$
- B $0.84F$
- C $1.2F$
- D $1.4F$

(Total 1 mark)

7

(a) Define the gravitational potential at a point.

(2)

(b) Explain why gravitational potential is always negative.

(2)

(c) Show that the magnitude of the gravitational potential at the Earth's surface due to the mass of the Earth is about $6.3 \times 10^7 \text{ J kg}^{-1}$.

(2)

(d) A satellite is launched into a geostationary orbit.

Describe and explain **two** features of a geostationary orbit.

1. _____

2. _____

(2)

- (e) The satellite has a mass of 1200 kg and the radius of its orbit is 4.23×10^7 m.

Calculate the gain in gravitational potential energy of the satellite when it is placed into orbit from the Earth's surface.

gain in potential energy = _____ J

(3)

- (f) Impulse engines are used to place the satellite into an orbit with a longer period.

Discuss any changes this makes to the orbital motion of the satellite.

(4)

(Total 15 marks)