

Gravity W.S. 12

Give the answer to the following problems to two significant figures.

Kepler's Law

1) Kepler's Law is $R^3/T^2 = K$ (a constant). Find the value of K, in MKS units, for the Solar System. Use the data for the Earth. (distance to Sun = 1.5×10^{11} m, one year = 3.2×10^7 s)

2) An asteroid revolves around the Sun with a radius of twice the Earth's orbital radius. Find the period of the asteroid in Earth years.

3) If a small planet in the solar system had a period of 32 Earth years, how far would it be from the Sun in Earth orbit radii?

4) Mars is 1.5 times as far from the Sun as the Earth is. Find the period of Mars in Earth years.

5) The period of the Moon is 2.4×10^6 s. The Moon's orbital radius 3.8×10^8 m. Find the period of a satellite which is 6700 km from the center of the Earth.

6) Using the information in question 5), find the distance from the Earth's center to a satellite which has a period of 24 hours. This satellite is said to be in a geosynchronous orbit.

Newton's Law of Gravitation

7) Find the force of gravity between John (75 kg) and Bob (53 kg) when they are standing 5.0 m apart.

8) Find the force of gravity between the Earth and the Moon. The Earth mass is 6.0×10^{24} kg and the Moon mass is 7.4×10^{22} kg. The distance from the Earth to the Moon is 3.8×10^8 m.

9) The acceleration due to gravity (g), is 9.8 m/s^2 at the Earth's surface. Find the height above the Earth's surface where $g = 5.0 \text{ m/s}^2$.

10) Find the gravitational field strength (acceleration due to gravity) of the

Earth at the Moon.

11)a) Find g at the surface of Mars. (Mars mass = 0.11 Earth masses, Mars radius = 0.53 Earth radii)

b) Find the weight of an 87 kg astronaut on Mars.

12)a) Calculate the speed of a satellite in an orbit 150 km above the Earth's surface.

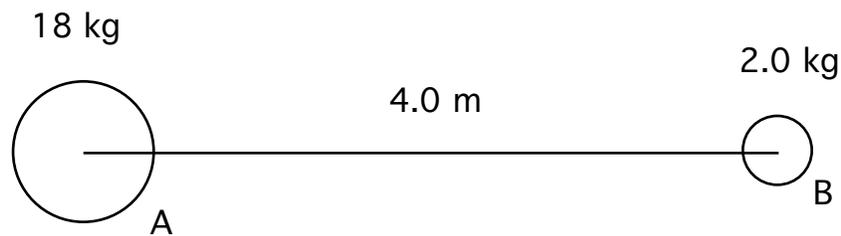
b) Find the period.

13) The planet Mercury has a mass of 3.3×10^{23} kg, and a radius of 2.4×10^6 m.

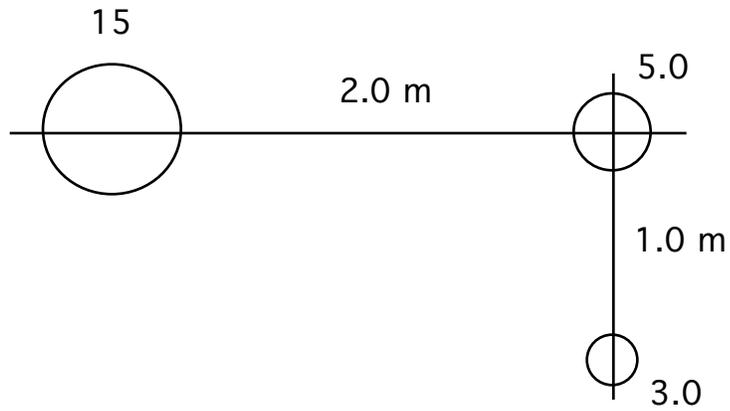
a) Find the speed of a satellite 250 km above the surface.

b) Find the period.

14) Find the distance from the center of mass A, where the force of gravity on an object equals zero.



15) Find the force on the three kilogram mass. (Give the magnitude and direction)



Answers: 1) 3.4×10^{18} , 2) 2.8, 3) 10., 4) 1.8, 5) 5.6×10^3 s, 6) 4.1×10^7 m, 7) 1.1×10^{-8} N, 8) 2.1×10^{20} N, 9) 2.6×10^6 m, 10) 2.7×10^{-3} m/s², 11) a) 3.8 m/s², b) 330 N, 12) a) 7.8×10^3 m/s, b) 5.3×10^3 m/s, 13) a) 2.9×10^3 m/s, b) 5.7×10^3 s, 14) 3.0 m, 15) $[-0.54, 1.3] \times 10^{-9}$ N, or, 1.4×10^{-9} N [27° N of W].