W5.04

Gravity

1. A satellite is put into Earth orbit at a radius of 8×10^8 m. How long does it take to orbit the Earth once? What is the speed of the satellite?

2. The moon's mass is about 1/80th the mass of the Earth and the acceleration of gravity on the moon is about 1/6th of Earth's. What fraction of the Earth's radius is that of the moon.

3. The radius of the Earth's orbit around the sun is 1.5×10^{11} m. What is the mass of the sun?

4. What is the acceleration of gravity on Planet X if its mass is twice that of Planet Y and its radius is three times that of Planet Y? The acceleration of gravity on Planet Y is 27 m/s^2.

5. One of Jupiter's moons was discovered by Galileo to have and orbital period of 1.44 million seconds. The average orbital radius for this moon was found to be 1.9 billion meters (measured from the center of the planet). Given this information, determine the mass of Jupiter.

6. The acceleration of gravity on Jupiter is about 3 times larger than on Earth and the radius of Jupiter is about 10 times greater than Earth's.
   a. What is the ratio of Jupiter's mass to Earth's mass?
   b. What is the ratio of densities and which is larger?

7. If a planet existed whose mass and radius were both half those of the earth, what would the acceleration of gravity at the surface be in terms of *g*?

8. The mass of the planet Saturn is 5.7×10^{26} kg and that of the sun is 2.0×10^{30} kg. The average distance between them is 1.4×10^{12} m.
   a. What is the gravitational force the sun exerts on Saturn?
   b. Assuming that Saturn has a circular orbit, find its orbital speed and period.

ANSWERS:

1. $T = 7.1 \times 10^6$ sec; $v = 2\pi R/T = 706$ m/s
2. $r_{moon}/r_{earth} = \sqrt{6/80} = 0.274$
3. 2.0×10^{30} kg
4. $g_X = (2/9)\ 27\ m/s^2 = 6\ m/s^2$
5. 2.0×10^{27} kg
6. $M_{Jupiter}/M_{earth} = 300$; $d_{Jupiter}/d_{Earth} = 0.300$
7. $g_{planet} = 2\ g_{Earth}$
8. a. $F_g = 3.88 \times 10^{22}$ N
   b. $T = 9.0 \times 10^8$ sec = 28.56 years; $v = 9761$ m/s