

Answers

Gravitation (with Circular Motion)

$$G = 6.67E-11 \text{ Nm}^2/\text{kg}^2$$

	Mass (kg)	radius (km)
Earth	5.98E24	6380
Moon	7.3E22	1740
Pluto	1.3E22	1190
Uranus	8.68E25	27346
Venus	4.87E24	6051
Sun	1.99E30	

1. A satellite (2340 kg) is orbiting Venus at an altitude of 20 km.

- a. Find the speed of the satellite

$$V = 7314.7 \text{ m/s}$$

$$\frac{GMm}{r^2} = \frac{mv^2}{r}$$

$$V = \sqrt{\frac{GM}{r}}$$

- b. Find the period of the satellite's orbit.

$$V = \frac{2\pi r}{T}$$

$$r = (6051E3 + 20E3)$$

$$T = 5214.9 \text{ s}$$

$$V = \sqrt{\frac{6.67E-11(4.87E24)}{(6051E3 + 20E3)}}$$

2. Find the acceleration due to gravity near the surface of Uranus.

$$g = \frac{GM}{r^2} = \frac{G(8.68E25)}{(27346E3)^2} = 7.74 \text{ m/s}^2$$

3. A man weighs 690 N on Earth.

- a. What is the man's weight on the moon?

$$F_g = \frac{GMm}{r^2} = \frac{G(7.3E22)(7240)}{(1740E3)^2} = 113.2 \text{ N}$$

- b. What is the man's mass on the moon?

$$m = 70.4 \text{ kg}$$

$$\frac{690}{9.8} = mg \quad F_g = mg$$

- c. What is the man's mass on Venus?

$$70.4 \text{ kg}$$

4. Determine the speed Pluto is traveling if it has an orbital distance from the sun of 5900E6km.

$$V = \sqrt{\frac{G(1.99E30)}{5900E9}} = 4743 \text{ m/s}$$

5. Find the acceleration due to gravity near the surface of Venus.

$$g = \frac{G(4.87 \times 10^{-24})}{(6051 \times 10^3)^2} = 8.87 \text{ m/s}^2$$

6. How fast is a satellite moving if it is 3.59E7 meters above the surface of Uranus? What is that satellite's orbital period?

$$V = \sqrt{\frac{G(8.68 \times 10^{-25})}{(3.59 \times 10^7 + 27346 \times 10^3)}} = \frac{9587.7 \text{ m/s}}{T}$$

$T = 41534.3 \text{ sec}$

7. Determine the force between the sun and Venus if their orbital distance is 108E9 km.

$$F = \frac{G(1.99 \times 10^{30})(4.87 \times 10^{-24})}{(108 \times 10^9)^2} = 5.5 \times 10^{22} \text{ N}$$

8. What is the orbital speed of Uranus if it has an orbital radius of 2870E9 km from the sun?

$$V = \sqrt{\frac{G(1.99 \times 10^{30})}{2870 \times 10^9}} = 6800.6 \text{ m/s}$$

9. A 1500 kg satellite is put 150 km above Pluto, and set into orbit.

- a. What is the speed of this satellite?

$$V = \sqrt{\frac{G(1.3 \times 10^{-22})}{(150 \times 10^3 + 1190 \times 10^3)}} = 8044 \text{ m/s}$$

- b. What is the period of this satellite (in hours)?

$$T = 10466.55$$

$$= \underline{\underline{2.9 \text{ hours}}}$$