How much work is required to bring a 600 kg space rock on the moon to a height of 400 km above the surface of the moon?

3.16×10^{8} J

A planet is in a circular orbit around a star which has a mass of 5.88 x 10^32 kg. If the radius of its circular orbit is 1.31 x 10^12 m, what are its orbital speed and period?

$1.73 \times 10^{5}\ \frac{m}{s}$

4.76×10^{7} s

A rock is dropped from a height of 40 m above the surface of a planet with a mass of 3.08 x 10^24 kg. If the rock reaches the ground in 4.7 s, what must be the radius of the planet?

7.53×10^6 m

A rock is dropped from a height of 6000 km above the surface of Earth. What is its speed when it reaches the Earth's surface? Assume no friction forces.

7780 m/s

What is the total mechanical energy (kinetic and potential) of a 340 kg satellite orbiting a 3.21×10^{25} kg planet at a distance of 6.54×10^{7} m from the planet's centre?

-5.57×10^{9} J

How much work is required to bring a 600 kg space rock on the moon to a height of 400 km above the surface of the moon?

$R_i = R_M$

$= 1.74 \times 10^6$ m

$R_f = R_M + 400$ km

$= 2.14 \times 10^6$ m

$$W = \Delta E_p$$

$$= E_{pf} - E_{pi}$$

$$= -G\frac{Mm}{R_f} - \left(-G\frac{Mm}{R_i}\right)$$

$$= GMm\left(\frac{1}{R_i} - \frac{1}{R_f}\right)$$

$$= (6.67\times10^{-11})(7.35\times10^{22})(600)\left(\frac{1}{1.74\times10^6} - \frac{1}{2.14\times10^6}\right)$$

$$= \boxed{3.16\times10^8 \text{ J}}$$

A planet is in a circular orbit around a star which has a mass of 5.88 x 10^32 kg. If the radius of its circular orbit is 1.31 x 10^12 m, what are its orbital speed and period?

v:

$$F_c = ma_c$$

$$F_g = ma_c$$

$$G\frac{M\cancel{m}}{r^2} = \cancel{m}\frac{v^2}{r}$$

$$v = \sqrt{\frac{GM}{r}} = \boxed{1.73 \times 10^5 \text{ m/s}}$$

T:

$$F_c = ma_c$$

$$F_g = ma_c$$

$$G\frac{M\cancel{m}}{r^2} = \cancel{m}\frac{4\pi^2 r}{T^2}$$

$$T = \sqrt{\frac{4\pi^2 r^3}{GM}} = \boxed{4.76 \times 10^7 \text{ s}}$$

A rock is dropped from a height of 40 m above the surface of a planet with a mass of 3.08 x 10^24 kg. If the rock reaches the ground in 4.7 s, what must be the radius of the planet?

① FIND g (ACCEL)

$$d = \cancel{v_1 t}^{\,0} + \frac{1}{2} a t^2$$

$$a = \frac{2d}{t^2} = 3.6215 \ m/s^2$$

② USING g TO FIND R

$$g = G\frac{M}{R^2}$$

$$R = \sqrt{\frac{GM}{g}} = \sqrt{\frac{(6.67\times10^{-11})(3.08\times10^{24})}{3.6215}}$$

$$= \boxed{7.53\times10^{6} \ m}$$

A rock is dropped from a height of 6000 km above the surface of Earth. What is its speed when it reaches the Earth's surface? Assume no friction forces.

$$E_i = E_f$$

$$\cancel{E_{K_i}}^{0} + E_{P_i} = E_{K_f} + E_{P_f}$$

$$-G\frac{Mm}{r_i} = \frac{1}{2}mv_f^2 - G\frac{Mm}{r_f}$$

$$G\frac{M\cancel{m}}{r_f} - G\frac{M\cancel{m}}{r_i} = \frac{1}{2}\cancel{m}v_f^2$$

$$v_f = \sqrt{2GM\left(\frac{1}{r_f} - \frac{1}{r_i}\right)}$$

$$= \sqrt{2(6.67\times10^{-11})(5.98\times10^{24})\left(\frac{1}{6.38\times10^6} - \frac{1}{1.238\times10^7}\right)}$$

$$= \boxed{7780\ \frac{m}{s}}$$

What is the total mechanical energy (kinetic and potential) of a 340 kg satellite orbiting a
3.21 x 10^25 kg planet at a distance of
6.54 x 10^7 m from the planet's centre?

$$F_c = ma_c$$

$$F_g = m\frac{v^2}{r}$$

$$G\frac{M\cancel{m}}{r^2} = \cancel{m}\frac{v^2}{r}$$

$$v = \sqrt{\frac{GM}{r}} = 5721.7\ \frac{m}{s}$$

$$E_T = E_k + E_p$$

$$= \frac{1}{2}mv^2 - G\frac{Mm}{r}$$

$$= \boxed{-5.57 \times 10^9\ J}$$