Answer on Question #84399, Physics / Astronomy | Astrophysics

What is the speed of a 1850 kg meteorite when it hits the moon's surface? This meteorite had a velocity of 1.4 x 10^3 m/s heading directly toward the moon. when it was 15000 m above the moon's surface.

Answer:

Total mechanical energy is conserved in the system, so

$$KE_i + PE_i = KE_f + PE_f$$

Where, $KE_{i,f}$ and $PE_{i,f}$ are initial and final kinetic energy and initial and final potential energy, respectively.

m is the masses of the asteroid (1850 kg)
M is the Moon (=7.35×10^{22}kg), respectively.
the radius of the moon and the initial height of the asteroid, respectively, so

R=1.737×10^{6} m
h=15000 m

$$KE_i = \frac{1}{2}mv_i^2 = 1.81 \times 10^9\ J$$

$$PE_i = -\frac{GMm}{R+h} = -\frac{6.67 \times 10^{-11} N \cdot \frac{m^2}{kg^2} \times 1850kg \times 7.35 \times 10^{22} kg}{1.737 \times 10^6\ m + 15000\ m} = -5.18 \times 10^9\ J$$

$$KE_f = \frac{1}{2}mv_f^2 = 925v_f^2$$

$$PE_f = -\frac{GMm}{R} = -\frac{6.67 \times 10^{-11} N \cdot \frac{m^2}{kg^2} \times 1850kg \times 7.35 \times 10^{22} kg}{1.737 \times 10^6\ m} = -5.22 \times 10^9\ J$$

$$v_f = \sqrt{\frac{5.22 \times 10^9\ J - 3.36 \times 10^9\ J}{925}} = 3.5 \times 10^3 m/s$$

Answer: 3.5×10^3 m/s