Answer on Question 71890, Physics, Other

Question:

A brass ball is shot vertically upward from the surface of an atmosphere-free planet with an initial speed of 20 m/s. One second later, the ball has an instantaneous velocity in the upward direction of 15 m/s. How high does the ball rise?

Solution:

Let's first find the acceleration due to gravity on the planet from the kinematic equation:

$$v = v_0 + gt.$$

Then, we get:

$$g = \frac{v - v_0}{t} = \frac{15\ \frac{m}{s} - 20\ \frac{m}{s}}{1.0\ s} = -5.0\ \frac{m}{s^2}.$$

The sign minus indicates that the acceleration due to gravity directed downward to the surface of the planet.

Then, we can find the time, t_{max}, that needs the ball to reach the maximum height from the same kinematic equation (also, at maximum height $v = 0$):

$$0 = v_0 + gt_{max},$$

$$t_{max} = -\frac{v_0}{-g} = -\frac{20\ \frac{m}{s}}{-5.0\ \frac{m}{s^2}} = 4.0\ s.$$

Finally, we can find how high does the ball rise from another kinematic equation:

$$h_{max} = v_0 t_{max} + \frac{1}{2} g t_{max}^2 = 20\ \frac{m}{s} \cdot 4.0\ s - \frac{1}{2} \cdot 5.0\ \frac{m}{s^2} \cdot (4.0\ s)^2 = 40.0\ m.$$

Answer:

$h_{max} = 40.0\ m.$

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