Answer on Question 57617, Physics, Other

Question:

A rock is thrown straight down with an initial velocity of 10.5 m/s from the Verrazano Narrows Bridge in New York City. The roadway of this bridge is 70 m above water. Take upwards to be the positive direction.

a) Calculate the displacement at a time of 1.0 s.

b) Calculate the velocity at a time of 1.0 s.

c) Calculate the displacement at a time of 1.5 s.

d) Calculate the velocity at a time of 1.5 s.

e) Calculate the displacement at a time of 2.0 s.

f) Calculate the velocity at a time of 2.0 s.

g) Calculate the displacement at a time of 2.5 s.

h) Calculate the velocity at a time of 2.5 s.

Solution:

a) In order to find the displacement we can use the formula:

$$y = y_0 + v_0 t + \frac{1}{2}at^2,$$

here, $y_0 = 0\ m$ is the point of release, $v_0 = -10.5\ m/s$ is the initial velocity, t is the time, $a = g = -9.8\frac{m}{s^2}$ is the acceleration due to gravity.

Then, the displacement at the time of 1.0 s will be:

$$y_1 = y_0 + v_0 t_1 + \frac{1}{2}at_1^2 = 0\ m + \left(-10.5\ \frac{m}{s}\right)\cdot 1.0\ s + \frac{1}{2}\cdot\left(-9.8\frac{m}{s^2}\right)\cdot(1.0\ s)^2 =$$
$$= -15.4\ m.$$

b) In order to find the velocity we can use the formula:

$$v = v_0 + at,$$

here, $v_0 = -10.5\ m/s$ is the initial velocity, t is the time, $a = g = -9.8\frac{m}{s^2}$ is the acceleration due to gravity.

Then, the velocity at the time of 1.0 s will be:

$$v_1 = v_0 + at_1 = \left(-10.5\ \frac{m}{s}\right) + \left(-9.8\frac{m}{s^2}\right) \cdot 1.0\ s = -20.3\ \frac{m}{s}.$$

c) The displacement at the time of 1.5 s will be:

$$y_2 = y_0 + v_0 t_2 + \frac{1}{2}at_2^2 = 0\ m + \left(-10.5\ \frac{m}{s}\right) \cdot 1.5\ s + \frac{1}{2} \cdot \left(-9.8\frac{m}{s^2}\right) \cdot (1.5\ s)^2 = = -26.8\ m.$$

d) The velocity at the time of 1.5 s will be:

$$v_2 = v_0 + at_2 = \left(-10.5\ \frac{m}{s}\right) + \left(-9.8\frac{m}{s^2}\right) \cdot 1.5\ s = -25.2\ \frac{m}{s}.$$

e) The displacement at the time of 2.0 s will be:

$$y_3 = y_0 + v_0 t_3 + \frac{1}{2}at_3^2 = 0\ m + \left(-10.5\ \frac{m}{s}\right) \cdot 2.0\ s + \frac{1}{2} \cdot \left(-9.8\frac{m}{s^2}\right) \cdot (2.0\ s)^2 = = -40.6\ m.$$

f) The velocity at the time of 2.0 s will be:

$$v_3 = v_0 + at_3 = \left(-10.5\ \frac{m}{s}\right) + \left(-9.8\frac{m}{s^2}\right) \cdot 2.0\ s = -30.1\ \frac{m}{s}.$$

g) The displacement at the time of 2.5 s will be:

$$y_4 = y_0 + v_0 t_4 + \frac{1}{2}at_4^2 = 0\ m + \left(-10.5\ \frac{m}{s}\right) \cdot 2.5\ s + \frac{1}{2} \cdot \left(-9.8\frac{m}{s^2}\right) \cdot (2.5\ s)^2 = = -56.9\ m.$$

h) The velocity at the time of 2.5 s will be:

$$v_4 = v_0 + at_4 = \left(-10.5\ \frac{m}{s}\right) + \left(-9.8\frac{m}{s^2}\right) \cdot 2.5\ s = -35.0\ \frac{m}{s}.$$

Answer:

a) $y_1 = -15.4\ m$, c) $y_2 = -26.8\ m$, e) $y_3 = -40.6\ m$, g) $y_4 = -56.9\ m$,

b) $v_1 = -20.3\ m/s$, d) $v_2 = -25.2\ m/s$, f) $v_3 = -30.1\ m/s$, h) $v_4 = -35.0\ m/s$.