Answer on Question 57616, Physics, Other

Question:

A ball is thrown straight up with an initial velocity of $19\ m/s$. Take the point of release $y_0 = 0$, and the upwards to be the positive direction.

a) Calculate the displacement at the time of $0.50\ s$.

b) Calculate the velocity at the time of $0.50\ s$.

c) Calculate the displacement at the time of $1.0\ s$.

d) Calculate the velocity at the time of $1.0\ s$.

e) Calculate the displacement at the time of $1.5\ s$.

f) Calculate the velocity at the time of $1.5\ s$.

g) Calculate the displacement at the time of $2.0\ s$.

h) Calculate the velocity at the time of $2.0\ s$.

Solution:

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

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

here, $y_0 = 0\ m$ is the point of release, v_0 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 $0.50\ s$ will be:

$$y_1 = y_0 + v_0 t_1 + \frac{1}{2} a t_1^2 = 0\ m + 19\ \frac{m}{s} \cdot 0.50\ s + \frac{1}{2} \cdot \left(-9.8 \frac{m}{s^2}\right) \cdot (0.50\ s)^2 =$$
$$= 8.28\ m.$$

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

$$v = v_0 + at,$$

here, v_0 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 0.50 s will be:

$$v_1 = v_0 + at_1 = 19\ \frac{m}{s} + \left(-9.8\frac{m}{s^2}\right) \cdot 0.50\ s = 14.1\ \frac{m}{s}.$$

c) The displacement at the time of 1.0 s will be:

$$y_2 = y_0 + v_0 t_2 + \frac{1}{2} a t_2^2 = 0\ m + 19\ \frac{m}{s} \cdot 1.0\ s + \frac{1}{2} \cdot \left(-9.8\frac{m}{s^2}\right) \cdot (1.0\ s)^2 =$$
$$= 14.1\ m.$$

d) The velocity at the time of 1.0 s will be:

$$v_2 = v_0 + at_2 = 19\ \frac{m}{s} + \left(-9.8\frac{m}{s^2}\right) \cdot 1.0\ s = 9.2\ \frac{m}{s}.$$

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

$$y_3 = y_0 + v_0 t_3 + \frac{1}{2} a t_3^2 = 0\ m + 19\ \frac{m}{s} \cdot 1.5\ s + \frac{1}{2} \cdot \left(-9.8\frac{m}{s^2}\right) \cdot (1.5\ s)^2 = 17.5\ m.$$

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

$$v_3 = v_0 + at_3 = 19\ \frac{m}{s} + \left(-9.8\frac{m}{s^2}\right) \cdot 1.5\ s = 4.3\ \frac{m}{s}.$$

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

$$y_4 = y_0 + v_0 t_4 + \frac{1}{2} a t_4^2 = 0\ m + 19\ \frac{m}{s} \cdot 2.0\ s + \frac{1}{2} \cdot \left(-9.8\frac{m}{s^2}\right) \cdot (2.0\ s)^2 = 18.4\ m.$$

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

$$v_4 = v_0 + at_4 = 19\ \frac{m}{s} + \left(-9.8\frac{m}{s^2}\right) \cdot 2.0\ s = -0.6\ \frac{m}{s}.$$

The sign minus indicates that the ball is begin to fall.

Answer:

a) $y_1 = 8.28\ m$, c) $y_2 = 14.1\ m$, e) $y_3 = 17.5\ m$, g) $y_4 = 18.4\ m$,

b) $v_1 = 14.1\ m/s$, d) $v_2 = 9.2\ m/s$, f) $v_3 = 4.3\ m/s$, h) $v_4 = 0.6\ m/s$.