Answer to Question #70415, Physics / Mechanics | Relativity

Question:

Assume air resistance is negligible unless otherwise stated.
A coin is dropped from a hot-air balloon that is 250 m above the ground and rising at 14.0 m/s upward. For the coin, find the following.
(a)
the maximum height (in m) reached

(b)its position and velocity (in m and m/s, respectively) 3.90 s after being released (Assume that the +x-axis is to the right and the +y-axis is up along the page. Indicate the direction with the sign of your answer.)

c)the time (in s) before it hits the ground

Solution:

(a) Initialy the coin is rising with the balloon so we can assume that it had the initial speed of

$$v = 14.0\frac{m}{s}$$

The movement of the coin will then be slown down with the gravitation force acting with the acceleration

$$g = 9.81\frac{m}{s^2}$$

The time that will pass until the coin stops moving is

$$t = \frac{v}{g} = 1.43\ s$$

So the maximal height the coin will reach is

$$\boldsymbol{h} = h_0 + v_0 t - \frac{gt^2}{2} = 250 + 14 * 1.43 - 9.81 * \frac{1.43^2}{2} = \boldsymbol{260\ m}$$

(b) To calculate the velocity we will use

$$\boldsymbol{v} = v_0 - gt = 14 - 9.81 * 3.9 = \boldsymbol{-24.26\frac{m}{s}}$$

(the "-" sign means it is pointing downwards)
To calculate the position we will use the formula from task (a)

$$\boldsymbol{x} = h_0 + v_0 t - \frac{gt^2}{2} = 250 + 14 * 3.9 - 9.81 * \frac{3.9^2}{2} = \boldsymbol{230\ m}$$

(c) To hit the ground the coin needs to get to it, so

$$x = h_0 + v_0 t - \frac{gt^2}{2} = 250 + 14 * t - 4.905 * t^2 = 0$$

After solving this equation for t we get

$$\boldsymbol{t = 8.71\ s}$$