Answer on Question #44517, Physics, Mechanics | Kinematics | Dynamics

Question:

A drinking fountain shoots water out from a height of 3.5cm above its basin. The water follows a parabolic arc which extends 15cm horizontally before hitting the basin. The arc reaches a maximum height of 11cm above the basin. Determine:

a) The time a single drop spends in the air.

b) The initial speed of the water.

c)The angle at which it was shot out of the fountain.

Answer:

a) Vertical coordinate of water drop equals:

$$y = h_0 + v_y t - \frac{gt^2}{2}$$

Maximum height from law of conservation of energy:

$$h - h_0 = \frac{v_y^2}{2g}$$

Therefore:

$$v_y = \sqrt{2g(h - h_0)} = 1.21 \frac{m}{s}$$

Now substitute v_y into equation for y. Drop in air when $y > 0$. Getting quadratic equation:

$$0.035 + 1.21t - \frac{9.8t^2}{2} = 0$$

with one solution >0:

$$t = 0.273\ s$$

b) Horizontal coordinate of water drop equals:

$$x = v_x t$$

Therefore:

$$v_x = \frac{x}{t} = 0.549 \frac{m}{s}$$

The initial speed of the water equals:

$$v = \sqrt{v_x^2 + v_y^2} = 1.33 \frac{m}{s}$$

c) The tangent of angle at which drop was shot out of the fountain equals:

$$\tan \alpha = \frac{v_x}{v_y}$$

Therefore angle equals:

$$\alpha = \arctan 0.452 = 24.3°$$