Answer on Question #43405 – Physics - Mechanics | Kinematics | Dynamics

When a gun is fired, a bullet accelerates through the gun barrel, a distance of .855 m, and exits the barrel with a speed of 457 m/s. What is the magnitude of the acceleration of the bullet?

Solution:

$\mathrm{d} = 0.855\mathrm{m} - \text{traveled distance};$

$\mathrm{V} = 457\frac{\mathrm{m}}{\mathrm{s}} - \text{final speed of the bullet};$

$\mathrm{t} - \text{time of traveling};$

$\mathrm{a} - \text{acceleration of the bullet};$

Rate equation for the bullet:

$$\mathrm{V} = \mathrm{a} \cdot \mathrm{t}$$

$$\mathrm{t} = \frac{\mathrm{V}}{\mathrm{a}} \quad (1)$$

Equation of motion for the bullet ($\mathrm{V}_0 = 0 - \text{initial velocity of the bullet}$)

$$\mathrm{d} = \frac{\mathrm{at}^2}{2} \quad (2)$$

$$(1)\text{in}(2):$$

$$\mathrm{d} = \frac{\mathrm{a}\left(\frac{\mathrm{V}}{\mathrm{a}}\right)}{2} = \frac{\mathrm{V}^2}{2\mathrm{a}}$$

$$\mathrm{a} = \frac{\mathrm{V}^2}{2\mathrm{d}} = \frac{\left(457\frac{\mathrm{m}}{\mathrm{s}}\right)^2}{2 \cdot 0.855\ \mathrm{m}} = 122\ 100\frac{\mathrm{m}}{\mathrm{s}^2}$$

Answer: magnitude of the acceleration of the bullet is equal to $122\ 100\frac{\mathrm{m}}{\mathrm{s}^2}$.