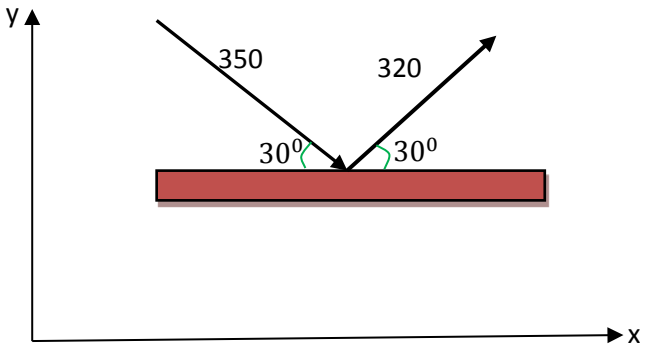
Answer Question #69144 Physics – Mechanics – Relativity

A bullet of mass 20 g, travelling at a speed of 350 m/s, strikes a steel plate at an angle of 30º with the plane of the plate. It ricochets off at the same angle, at a speed of320 m/s . What is the magnitude of the impulse that the steel plate gives to the projectile? If the collision with the plate takes place over a time $\Delta t = 10^{-3}s$, what is the average force exerted by the plate on the bullet?

Solution. Find magnitude of the impulse that equal to magnitude of the change linear momentum.



Consider the motion of a bullet in the coordinate system as shown in figure. The change linear momentum (x direction)

$$\Delta p_x = mv_f \cos 30^0 - mv_i \cos 30^0$$

where $m = 0.02$kg –mass of bullet; $v_i = 350\frac{m}{s}$ – initial velocity of the bullet; $v_f = 320\frac{m}{s}$ – final velocity of the bullet.

$$\Delta p_x = 0.02(320 - 350)\cos 30^0 \approx -0.52kg\frac{m}{s}$$

The change linear momentum (y direction)

$$\Delta p_y = mv_f \sin 30^0 + mv_i \sin 30^0$$

$$\Delta p_y = 0.02(320 + 350)\sin 30^0 = 6.7kg\frac{m}{s}$$

Hence magnitude of the impulse

$$\Delta p = \sqrt{(\Delta p_x)^2 + \left(\Delta p_y\right)^2} = \sqrt{(-0.52)^2 + 6.7^2} \approx 6.72kg\frac{m}{s}$$

On the other hand $\Delta p = F\Delta t$, where F – average force exerted by the plate on the bullet, $\Delta t = 10^{-3}s$ – collision time. Therefore

$$F = \frac{\Delta p}{\Delta t} = \frac{6.72}{10^{-3}} = 6720N$$

Answer. $6.72kg\frac{m}{s}$, $6720N$.

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