

Quiz 6

Name: _____ Student Number: _____

1. (4 marks) A 5 kg rifle fires a 3 gm bullet with a muzzle velocity of 200 m/sec. If the bullet remains in the barrel 0.1 seconds, find

a) The recoil velocity of the rifle

$$\text{Cons. of Mom} \Rightarrow m_{\text{Rifle}} v_{\text{Rec}} = -m_{\text{Bullet}} v_{\text{Bullet}}$$

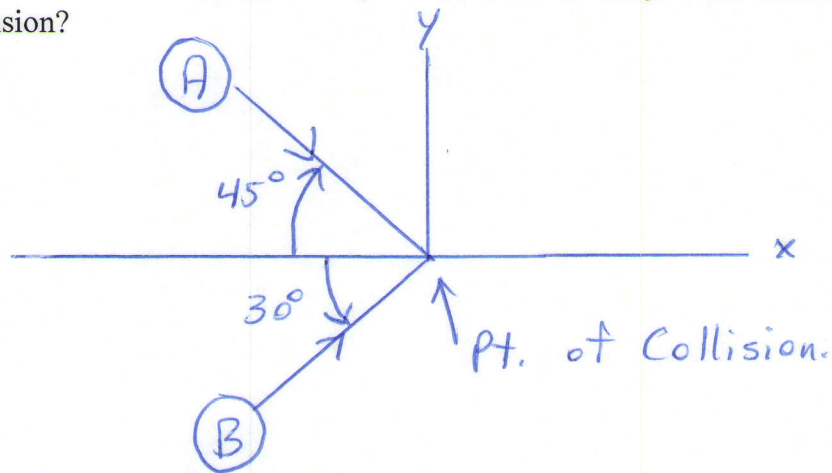
$$\begin{aligned} v_{\text{Rec}} &= - \frac{.003 \times 200}{5} \\ &= -0.12 \text{ m/sec} \end{aligned}$$

b) The average force acting on the bullet while it is in the barrel

$$\begin{aligned} \text{Acceleration of Bullet in gun } a &= \frac{200 \text{ m/sec}}{0.1 \text{ sec}} \\ &= 2000 \text{ m/sec}^2 \end{aligned}$$

$$\begin{aligned} \text{Force of gun on bullet } F &= m_{\text{Bul}} a \\ &= .003 \times 2000 \\ &= 6 \text{ N} \end{aligned}$$

2. (6 marks) Two particles A and B moving as shown below collide and stick together. The masses of A and B are 1 and 3 kilograms respectively and the initial speeds of A and B are 10 and 20 m/sec, respectively. What is the velocity of the combined particle after the collision?



$$\vec{u}_A = 10(\cos 45^\circ, -\sin 45^\circ)$$

$$\vec{u}_B = 20(\cos 30^\circ, \sin 30^\circ)$$

Initial Momentum $\vec{P}_i = m_A \vec{u}_A + m_B \vec{u}_B$

Final Momentum $\vec{P}_f = (m_A + m_B) \vec{v}_f$

Mom. Cons. $\Rightarrow (m_A + m_B) \vec{v}_f = m_A \vec{u}_A + m_B \vec{u}_B$

$$4 \vec{v}_f = 1 \times 10(\cos 45^\circ, -\sin 45^\circ) + 3 \times 20(\cos 30^\circ, \sin 30^\circ)$$

$$= (7.1, -7.1) + (52.0, 30)$$

$$\therefore \vec{v}_f = (14.8, 5.7)$$