

Exercise 6C

Q. 1. $I = Mv - Mu$

$$= (0.125)(40) - (0.125)(0)$$

$$= 5 \text{ Ns}$$

Q. 2. $I = Mv - Mu$

$$= \left(\frac{1}{4}\right)(20) - \frac{1}{4}(-40)$$

$$= 15 \text{ Ns}$$

Q. 3. $M_1U_1 + M_2U_2 = M_1V_1 + M_2V_2$

(Hammer) (Stake) (Hammer) (Stake)

$$\Rightarrow 4(2) + 1(0) = 4(0) + 1(V_2)$$

$$\Rightarrow V_2 = 8 \text{ m/s}$$

(i) $\vec{I} = M\vec{v} - M\vec{u}$

$$= (1)(-8\vec{j}) - (1)(0)$$

$$= -8\vec{j} \text{ Ns}$$

(ii) $\vec{I} = M\vec{v} - M\vec{u}$

$$= 4(\vec{0}) - 4(-2\vec{j})$$

$$= 8\vec{j} \text{ Ns}$$

Q. 4. $I = |M\vec{v} - M\vec{u}|$

$$= |(0.1)(0) - (0.1)(8)|$$

$$= 0.8 \text{ Ns}$$

Q. 5. $I = |M\vec{v} - M\vec{u}|$

$$= |2(0) - 2(5)|$$

$$= 10 \text{ Ns}$$

Q. 6. (i) $4m(12) + m(0) = 5m(v)$... divide by m

$$\Rightarrow 5v = 48$$

$$\Rightarrow v = 9.6 \text{ m/s}$$

(ii) $5m(12) + nm(0) = (5 + n)m(7.5)$

... divide by m

$$\Rightarrow 60 = 37.5 + 7.5n$$

$$\Rightarrow 7.5n = 22.5$$

$$\Rightarrow n = 3$$

Q. 7. $M_1U_1 + M_2U_2 = M_1V_1 + M_2V_2$

$$\Rightarrow (0.15)(200) + (3)(0) = (0.15)(100) + (3)V_2$$

$$\Rightarrow V_2 = 5 \text{ m/s}$$

Q. 8. $M_1\vec{U}_1 + M_2\vec{U}_2 = (M_1 + M_2)\vec{v}^2$

$$(0.1)400\vec{i} + (3)(10\vec{j}) = (0.1 + 3)\vec{v}^2$$

$$\Rightarrow 3.1\vec{v}^2 = 40\vec{i} + 30\vec{j}$$

$$\Rightarrow \vec{v} = \frac{10}{31}(40\vec{i} + 30\vec{j})$$

$$\Rightarrow |\vec{v}^2| = \frac{10}{31}\sqrt{40^2 + 30^2}$$

$$= \frac{500}{31} = 12.9 \text{ m/s}$$

Q. 9. $M_1U_1 + M_2U_2 = (M_1 + M_2)\vec{V}$

$$(0.1)(200) + M_2(0) = (0.1 + M_2)10$$

$$\Rightarrow 20 = 1 + 10M_2$$

$$\Rightarrow M_2 = 1.9 \text{ kg}$$

Q. 10. $M_1U_1 + M_2U_2 = (M_1 + M_2)V$

$$(0.05)U_1 + (1.45)(0) = (0.05 + 1.45)(4)$$

$$\Rightarrow 0.05U_1 = 6$$

$$\Rightarrow U_1 = 120 \text{ m/s}$$

Q. 11. Step 1: Find the speed of the joint mass after impact.

$$\frac{1}{2}MV_1^2 + Mgh_1 = \frac{1}{2}MV_2^2 + Mgh_2$$

$$\frac{1}{2}(3)V_1^2 + (3)g(0) = \frac{1}{2}(3)(0)^2 + (3)(9.8)(10),$$

since it rises 10 m.

$$\Rightarrow V_1^2 = 196$$

$$\Rightarrow V_1 = 14 \text{ m/s}$$

Step 2: To find speed of the bullet before impact:

$$M_1U_1 + M_2U_2 = (M_1 + M_2)V$$

$$(0.1)U_1 + (2.9)(0) = (0.1 + 2.9)(14)$$

$$\Rightarrow U_1 = 420 \text{ m/s}$$