



COLLISIONS ASSIGNMENT SOLUTIONS

- 1 (a) Kinetic energy of ball X before collision

$$\begin{aligned} &= \frac{1}{2} m_X u_X^2 \\ &= \frac{1}{2} (0.24) (2.3)^2 \\ &= 0.6348 \approx 0.63 \text{ J} \end{aligned} \quad [1]$$

- (b) From Fig. 1.2, magnitude of change in momentum of ball
= area under $F - t$ graph

$$\begin{aligned} &= \frac{1}{2} (240) (5.00 \times 10^{-3}) \\ &= 0.60 \text{ kg m s}^{-1} \end{aligned} \quad [1]$$

- (c) Taking rightward as positive,

$$\begin{aligned} \Delta p_Y &= p_f - p_i \\ &= m_Y (v_Y - u_Y) \\ 0.60 &= 0.12 (v_Y - (-2.3)) \end{aligned} \quad [1]$$

$$v_Y = 2.7 \text{ m s}^{-1}$$

Velocity of ball Y after collision is 2.7 m s^{-1} to the right. [1]

2 (a) By conservation of momentum,

$$(m_{\text{bullet}})(u_{\text{bullet}}) + (m_{\text{block}})(u_{\text{block}}) = (m_{\text{bullet+block}})(v_{\text{bullet+block}}) \quad [1]$$
$$(0.100)(300) + (4.00)(0) = (4.10)(v_{\text{bullet+block}})$$

$$v_{\text{bullet+block}} = 7.317 \quad [1]$$
$$\approx 7.3 \text{ m s}^{-1}$$

(b) Initial KE of bullet & block

$$= \frac{1}{2}(0.100)(300)^2 \quad [1]$$
$$= 4500 \text{ J}$$

Final KE of bullet & block

$$= \frac{1}{2}(4.10)(7.317)^2$$
$$= 109.8 \quad [1]$$
$$\approx 110 \text{ J}$$

Ratio of final KE to initial KE

$$= \frac{110}{4500} = 0.0244 \quad [1]$$

(c) Since there is a change in total KE of system of bullet and block before and after collision, the collision is inelastic. [1]