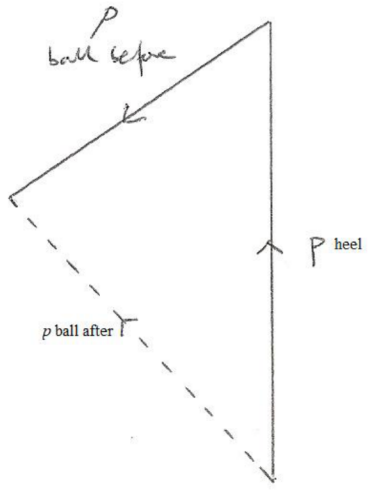
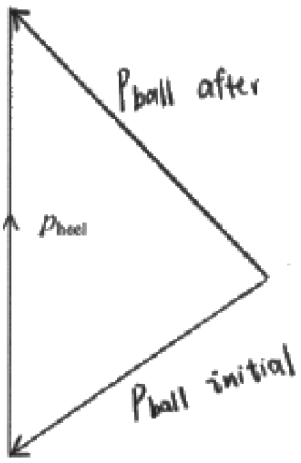
Question Number	Answer		Mark
16(a)	• Use of $\omega = \Delta\theta / \Delta t$ • Use of $v = r\omega$ • $v = 4.7\ \text{m s}^{-1}$ **Or** • Use of $\Delta s = r\,\Delta\theta$ • Use of $v = \Delta s / \Delta t$ • $v = 4.7\ \text{m s}^{-1}$ Example of calculation $\omega = 1.3\ \text{rads} / 0.22\ \text{s} = 5.9\ \text{rad s}^{-1}$ $v = 5.9\ \text{rad s}^{-1} \times 0.80\ \text{m} = 4.73\ \text{m s}^{-1}$	**(1)** **(1)** **(1)**	**3**
16(b)(i)	• Use of $p = mv$ • Use of the scale 1:2 • Adds scaled line at 56° to correctly represent initial momentum • Adds scaled line to correctly represent final momentum of ball • Concludes that conservation of momentum is obeyed as their diagram completes a triangle **Or** Concludes that conservation of momentum isn't obeyed as their triangle has a small gap **OR** • Use of $p = mv$ • Use of the scale 1:2 • Adds scaled line at 56° to correctly represent initial momentum • Adds line to complete triangle • Concludes that conservation of momentum is obeyed as their line is the right length **Or** Concludes that conservation of momentum isn't obeyed as their line is not the right length Example of vector diagram  **Or**  Example of calculation Momentum ball before = $0.16\ \text{kg} \times 13\ \text{m s}^{-1} = 2.08\ \text{N s}$, length = 4.16 cm Momentum ball after = $0.16\ \text{kg} \times 16\ \text{m s}^{-1} = 2.56\ \text{N s}$, length = 5.12 cm	**(1)** **(1)** **(1)** **(1)** **(1)**	**5**

16(b)(ii)	• Use of $E_k = \frac{1}{2}mv^2$ • Uses total kinetic energy before = E_k heel + E_k ball before • Total kinetic energy before = 21.0 (J) **or** kinetic energy after = 20.5 (J) • Elastic collision because total E_k before = E_k after **Or** Not elastic collision total E_k before is not the same as E_k after (**both** figures must have been correctly calculated) Example of calculation E_k heel = ½ × 3.0 Ns × 5.0 m s^{-1} = 7.5 J E_k ball before = $\frac{1}{2}$ 0.16 kg × 13^2 (m s^{-1})^2 = 13.5 J E_k after = $\frac{1}{2}$ 0.16 kg × 16^2 (m s^{-1})^2 = 20.5 J Total kinetic Energy before = 21.0 J	**(1)** **(1)** **(1)** **(1)**	**4**
	Total for question 16		**12**