b. $TME_{\text{before}} = TME_{\text{after}}$

$$\frac{1}{2}k(\Delta x)^2 = \frac{1}{2}mv^2 + mgh + \frac{1}{2}k(\Delta x)^2$$

$$\frac{1}{2} \times 250 \times (2.0)^2 = \frac{1}{2} \times 20 \times v^2 + 20 \times 10 \times 1.0 + \frac{1}{2} \times 250 \times (1.0)^2 \quad \text{1 mark}$$

$$500 = 10v^2 + 200 + 125$$

$$175 = 10v^2$$

$$v = \sqrt{17.5}$$

$$v = 4.18 \text{ m s}^{-1} \quad \text{1 mark}$$

Question 9 (6 marks)

a. total momentum prior to collision = total momentum after collision (right is positive)

$$m_X u_X + m_Y u_Y = m_X v_X + m_Y v_Y$$

$$(4000 \times 1.0) + (6000 \times -0.5) = (4000 \times v_X) + (6000 \times 0.2)$$

$$4000 - 3000 = 4000v_X + 1200 \quad \text{1 mark}$$

$$v_X = \frac{-200}{4000}$$

$$= 0.05 \text{ m s}^{-1} \text{ left} \quad \text{2 marks}$$

1 mark for correct answer.
1 mark for correct position.

b. A comparison of the system's total kinetic energy before and after the collision is required.

$$\text{total kinetic energy before} = \left[\frac{1}{2} \times 4000 \times 1.0^2\right] + \left[\frac{1}{2} \times 6000 \times 0.5^2\right]$$

$$= 2750 \text{ J} \quad \text{1 mark}$$

$$\text{total kinetic energy after} = \left[\frac{1}{2} \times 4000 \times 0.05^2\right] + \left[\frac{1}{2} \times 6000 \times 0.2^2\right]$$

$$= 125 \text{ J} \quad \text{1 mark}$$

Since the total kinetic energy of the system has decreased as a result of the collision, the collision is inelastic with the difference in kinetic energy transferred to heat, sound and possibly crumpling. 1 mark

*Note: Consequential on answer to **Question 9a**.*

Question 10 (8 marks)

a. $\lambda = \frac{v}{f}$

$$= \frac{0.40}{20}$$

$$= 0.02 \text{ m} \quad \text{1 mark}$$

