Question			Expected response	Max mark	Additional guidance
3.	(a)		$m_x u_x + m_y u_y = m_x v_x + m_y v_y$ **(1)** $(760 \times 12.0) + (840 \times 4.0)$ $= (760 \times v_x) + (840 \times 8.5)$ **(1)** $v_x = 7.0 \text{ m s}^{-1}$ **(1)**	**3**	Accept: 7, 7.03, 7.026 Equating the <u>total</u> momenta before and after **(1)** All substitutions **(1)** Final answer **(1)** If a direction is stated it must be to the right otherwise MAX 2 marks.
	(b)		$E_k = \frac{1}{2}mv^2$ *Before* $E_k = \frac{1}{2}m_x u_x^2 + \frac{1}{2}m_y u_y^2$ $E_k = (\frac{1}{2} \times 760 \times 12.0^2) + (\frac{1}{2} \times 840 \times 4.0^2)$ $E_k = 61440$ (J) *After* $E_k = \frac{1}{2}m_x v_x^2 + \frac{1}{2}m_y v_y^2$ $E_k = (\frac{1}{2} \times 760 \times 7.0^2) + (\frac{1}{2} \times 840 \times 8.5^2)$ $E_k = 48\,965$ (J) (Total) E_k before is greater than (total) E_k after, (the collision is inelastic).	**4**	Or consistent with (a) 1 mark for relationship 1 mark for **<u>all</u>** substitutions 1 mark for **<u>both</u>** total kinetic energies 1 mark for correct final statement Suspend significant figure rule for calculated values of total kinetic energies in this question. <u>Kinetic</u> energy is lost.(Therefore inelastic.) E_k before ≠ E_k after is insufficient.
	(c)		$Ft = mv - mu$ **(1)** $F \times 0.82 = (840 \times 8.5) - (840 \times 4.0)$ **(1)** $F = 4.6 \times 10^3$ N **(1)**	**3**	Accept: 5, 4.61, 4.610 Accept: Impulse = $mv - mu$ u and v must be substituted correctly If the force that car Y exerts on car X is calculated, then there must be a statement that the forces have equal magnitude for final mark, otherwise MAX 2 marks. For this method – Accept: 5, 4.63, 4.634 (when v = 7.0) Or consistent with (a)
	(d)		(During a collision the tyre wall will) increase the time of contact (between the car and the wall). **(1)** (this will) reduce the (magnitude of the) force (experienced by the driver). **(1)**	**2**	**INDEPENDENT MARKS** Accept: time/duration of collision Accept: 'rate of change in momentum' for force.