| I(a) Image: constraint of the system of | Question | Scheme | Marks | AOs |
|---|-------------|---|-------|------|
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | 1(a) | | | |
| Condone B1 1.1b Second line correct and with correct start relative to the first line and steeper gradient $1 \cdot 1 = 1 \cdot $ | | One line correct | B1 | 3.4 |
| Key values shown B1 1.1b (3) (3) 1(b) Equate distances M1 3.4 Car: $\frac{1}{2} \times 30 \times 15 + 15(T - 30)$ A1 1.1b Motorbike: $\frac{1}{2} \times (T - 15) \times \frac{3}{2}(T - 15) \left(=\frac{3}{4}(T - 15)^2\right)$ A1 1.1b Motorbike: $\frac{1}{2} \times (T - 15) \times \frac{3}{2}(T - 15) \left(=\frac{3}{4}(T - 15)^2\right)$ A1 1.1b Motorbike: $\frac{1}{2} \times (7 - 15) \times \frac{3}{2}(T - 15) \left(=\frac{3}{4}(T - 15)^2\right)$ A1 1.1b Motorbike: $\frac{1}{2} \times (7 - 15) \times \frac{3}{2}(T - 15) \left(=\frac{3}{4}(T - 15)^2\right)$ A1 1.1b Motorbike: $\frac{1}{2} \times (7 - 15) \times \frac{3}{2}(T - 15) \left(=\frac{3}{4}(T - 15)^2\right)$ A1 1.1b $= \frac{3}{4}(T - 15)^2 = 15^2 + 15(T - 30)$ M1 1.1b Speed = $(35 - 15) \times 1.5$ M1 1.1b $= 30 \text{ (m s^{-1})}$ A1 2.2a (6) (6) | | Second line correct and with correct start relative to the first line and steeper gradient 0 15 30 T T | B1 | 1.1b |
| (3)1(b)Equate distancesM13.4Car: $\frac{1}{2} \times 30 \times 15 + 15(T - 30)$ A11.1bMotorbike: $\frac{1}{2} \times (T - 15) \times \frac{3}{2}(T - 15) \left(= \frac{3}{4}(T - 15)^2 \right)$ A11.1b $\Rightarrow \frac{3}{4}(T - 15)^2 = 15^2 + 15(T - 30)$ A11.1b $T^2 - 50T + 525 = 0$, $T = 35$ M11.1bSpeed = $(35 - 15) \times 1.5$ M11.1b $= 30 \ (m \ s^{-1})$ A12.2a(6) | | Key values shown | B1 | 1.1b |
| 1(b)Equate distancesM13.4Car: $\frac{1}{2} \times 30 \times 15 + 15(T - 30)$ A11.1bMotorbike: $\frac{1}{2} \times (T - 15) \times \frac{3}{2}(T - 15) \left(= \frac{3}{4}(T - 15)^2 \right)$ A11.1b $\Rightarrow \frac{3}{4}(T - 15)^2 = 15^2 + 15(T - 30)$ A11.1b $T^2 - 50T + 525 = 0$, $T = 35$ M11.1bSpeed = $(35 - 15) \times 1.5$ M11.1b $= 30 \ (m \ s^{-1})$ A12.2a(6) | | | (3) | |
| Car: $\frac{1}{2} \times 30 \times 15 + 15(T - 30)$ A11.1bMotorbike: $\frac{1}{2} \times (T - 15) \times \frac{3}{2}(T - 15) \left(= \frac{3}{4}(T - 15)^2 \right)$ A11.1b $\Rightarrow \frac{3}{4}(T - 15)^2 = 15^2 + 15(T - 30)$ A11.1b $T^2 - 50T + 525 = 0$, $T = 35$ M11.1bSpeed = $(35 - 15) \times 1.5$ M11.1b $= 30 \text{ (m s}^{-1})$ A12.2a(6) | 1(b) | Equate distances | M1 | 3.4 |
| $\begin{array}{ c c c c c c c c c } Motorbike: \frac{1}{2} \times (T-15) \times \frac{3}{2} (T-15) \left(= \frac{3}{4} (T-15)^2 \right) & A1 & 1.1b \\ & \Rightarrow \frac{3}{4} (T-15)^2 = 15^2 + 15 (T-30) & A1 & 1.1b \\ \hline T^2 - 50T + 525 = 0 \ , & T = 35 & M1 & 1.1b \\ \hline Speed = (35-15) \times 1.5 & M1 & 1.1b \\ & = 30 \ (m \ s^{-1}) & A1 & 2.2a \\ \hline \end{array}$ | | Car: $\frac{1}{2} \times 30 \times 15 + 15(T - 30)$ | A1 | 1.1b |
| $T^2 - 50T + 525 = 0$, $T = 35$ M1 1.1b Speed = $(35 - 15) \times 1.5$ M1 1.1b $= 30 \text{ (m s}^{-1})$ A1 2.2a (6) (6) | | Motorbike: $\frac{1}{2} \times (T - 15) \times \frac{3}{2} (T - 15) \left(= \frac{3}{4} (T - 15)^2 \right)$ $\Rightarrow \frac{3}{4} (T - 15)^2 = 15^2 + 15 (T - 30)$ | A1 | 1.1b |
| Speed = $(35-15) \times 1.5$ M1 1.1b = 30 (m s ⁻¹) A1 2.2a (6) (6) | | $T^2 - 50T + 525 = 0 , T = 35$ | M1 | 1.1b |
| $= 30 \text{ (m s}^{-1}) \qquad A1 \qquad 2.2a$ (6) | | Speed = $(35 - 15) \times 1.5$ | M1 | 1.1b |
| (6) | | $= 30 \text{ (m s}^{-1})$ | A1 | 2.2a |
| | | | (6) | |

(9 marks)

| Notes: | | | |
|-------------|----|--|--|
| 1(a) | B1 | Either line correct | |
| | B1 | Second line in correct position to the first and both continue until after the car reaches constant speed. | |
| | B1 | 15, 30, <i>T</i> and 15 shown | |
| 1(b) | M1 | Use the fact that to catch up they must both have travelled the same distances. | |
| | A1 | One distance expressed correctly in terms of <i>T</i> | |
| | A1 | Both distances correct. Correct equation in <i>T</i> in any equivalent form | |
| | M1 | Create and solve a quadratic in <i>T</i> . | |
| | M1 | Use their <i>T</i> to find the required speed. | |
| | A1 | Correct only. If speed = 0 seen then it must be rejected. | |