Question		Answer	Marks	AO	Guidance
8	(a)	6 5 4	B 1	3.3	Straight line segment with positive gradient from the origin
		5.4	B1	3.3	Subsequent line segment horizontal and above the given line
		5	B1	3.3	Gradient change in their graph labelled with 5 and 6. (May be on axes)
			[3]		
8	(b)	velocity of the boy $[t < 5 s]$ v = 1.2t = 5.4	M1	3.1b	Equates an expression for boy's velocity to 5.4
		giving $t = 4.5$ s	A1	1.1b	Mark final answer
			[2]		

8	(c)	Max distance when $t = 4.5$	M1	3.1b	recognises that max distance occurs when speeds are equal. Allow for their $t < 5$ from (b) used. Allow for $u = 0$, $v = 5.4$ and $a = 1.2$ in $v^2 = u^2 + 2as$
		boy travels $\frac{1}{2} \times 1.2 \times 4.5^2 = 12.15$	M1	3.1b	attempt to use <i>suvat</i> or area under the graph and their time $t \le 5$ to find distance travelled by boy.
		bus travels 4.5× 5.4=24.3 m Max distance is 24. 3 – 12.15 =12.15 m	A1	1.1b	Cao
		Alternative method 1			
		Max distance gained by the bus ahead of the boy is represented by the area of the triangle on velocity-time graph	M1		recognises that max distance occurs when the speeds are equal. Allow for their time from (b) used
		Distance $=\frac{1}{2} \times 5.4 \times 4.5 = 12.15$ m	M1 A1		Attempt to find area of the triangle Cao
		Alternative method 2			
		Distance <i>S</i> at time <i>t</i> between $[t < 5]$		1	
		$[S =]5.4t - \frac{1}{2} \times 1.2t^2$	M1		Combines expressions from <i>suvat</i> equations to find expression for the distance between
		Max occurs when $\frac{ds}{dt} = 5.4 - 1.2t = 0$	M1		Equates the derivative of their expression to zero leading to a value for t
		When $t = 4.5$, max distance is 12.15 m	A1		Cao
			[3]		

8	(d)	Let the time from start to catch the bus be T s			
		Boy's distance is area of trapezium $\frac{1}{2} \times 6(T + T - 5) [= 6T - 15]$	B1	3.1b	Expression for the total distance for the boy (area method) oe, e.g. sum of two distances $\frac{1}{2} \times 5 \times 6 + (T-5) \times 6$
		Bus's distance $5.4T$ equate distances $5.4T = 6T - 15$	M1	3.1b	equates their expression for distance to the distance travelled by the bus and attempt to solve for T
		distance travelled in 25 s is 135 m	A1	1.1b	Cao. The value for <i>T</i> need not be seen explicitly
		Alternative method (relative speed)			
		At $t = 5$ the boy has travelled $\frac{1}{2} \times 5 \times 6 = 15$ m			
		and the bus $5.4 \times 5 = 27$ m Boy needs to catch up 12 m	B 1		12 m seen if clear that it is a distance between the boy and the bus
		Boy catches up 12 m at 0.6 ms ⁻¹ So time is $\frac{12}{0.6}$ [=20 s]	M1		Uses relative speed to find the time to catch up
		Total time 25 s gives distance 135 m	A1		Cao. 25 s need not be seen explicitly
		Alternative (numerical) method			
		Finds at least one correct distance for boy for $t > 5$	B1		
		Working towards the time and distance at which the distances are equal	M1		May be awarded for incorrect time and distances eg $0.6t^2$ used for the boy
		For 25 s distance travelled 135 m	A1		25 s must be seen as well as 135 m
		No method seen			SC2 for 135 m www where $t = 25$ not seen
			[3]		