

## Topic X4 Mechanics (Pre-TT A) [51] MARKSCHEME

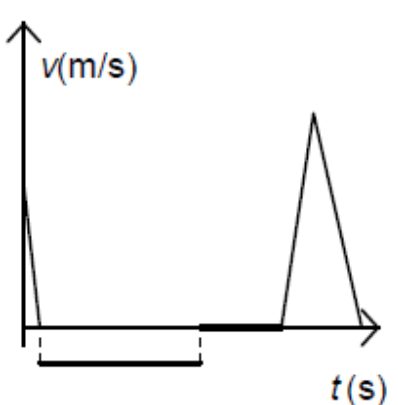
1.

(i)		B1  B1  B1	<p>Line segment <math>AB</math> (say) of +ve slope from origin Line segment <math>BC</math> (say) of steeper +ve slope and shorter time interval than those for <math>AB</math>. <b>SR</b>: If the straight line segments are joined by curves, this B1 mark is not awarded Line segment <math>CD</math> (say) of less steep slope compared with <math>BC</math>.</p> <p>(An <math>(x, t)</math> graph is accepted and the references to more/less steep are reversed.) May be implied; any 2 correct</p>
(ii)	Line joining $(0, 0)$ and $(160, 360)$	B1 ft	6
(iii)	$v = 360/160$  $s = 120 + 4.5(t - 80)$  $2.25t$  $t = 106 \frac{2}{3} \quad (107)$ <b>SR</b> Construction method Plotting points on graph paper $t$ between 104 and 109 inclusive	M1 M1  A1  M1   A1  M1 A1	5

2.

6 i	$a = 2 \times 0.006t - 0.18$ $a = 0.012t - 0.18$	M1 A1 [2]	Differentiates $v$ (not $v/t$ ) Award for unsimplified form, accept +c, not +k
ii	$0.012t - 0.18 = 0$ $t = 15$  $0.006 \times 15^2 - 0.18 \times 15 + k = 0.65$ $k = 2$	AG  M1* A1 D*M1 A1 A1 [5]	Sets $a = 0$ , and solves for $t$  Substitutes $t(v(\min))$ in $v(t)$
iii	$s = 0.006t^3/3 - 0.18t^2/2 + 2t (+c)$ $(s = 0.002t^3 - 0.09t^2 + 2t (+c))$ $t = 0, s = 0$ hence $c = 0$ $L = 0.002 \times 28.4^3 - 0.09 \times 28.4^2 + 2 \times 28.4$ $L = 30.0 \text{ m}$	M1A1  B1 M1 A1 [5]	Integrates $v$ (not multiplies by $t$ ). Award if +c omitted, accept $kt$ Explicit, not implied (or uses limits 0, 28.4) Substitutes 28.4 or 14.2 in $s(t)$ , (and $k=2$ ) Accept a r t 30(,0), accept +c

3.

<p>(i)</p>		<p>Graph with 5 straight line segments and with <math>v</math> single valued.</p> <p>Line segment for car stage Line segment for walk stage Line segment for wait stage</p> <p>2 line segments for motor-cycle stage</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p>	<p>‘Wait’ line segment may not be distinguishable from part of the <math>t</math> axis. Attempt at all lines segments fully straight. Mainly straight, ends on <math>t</math>-axis Horizontal below <math>t</math>-axis. Ignore linking to axis. Can be implied by gap between walk and motor-cycle stages Inverted V not U, mainly straight. Condone vertex below <math>x</math> intercept.</p>
<p>(ii)</p>	<p><math>d = 12/8</math></p> <p>Deceleration is <math>1.5 \text{ ms}^{-2}</math></p>		<p>M1</p> <p>A1</p>	<p>[5]</p> <p>[2]</p> <p>Using gradient represents accn Or <math>a = -1.5 \text{ ms}^{-2}</math></p>
<p>(iii)</p>	<p><math>t_{\text{walk}} = 420/0.7</math></p> <p><math>t_{\text{motorcycle}} = 42</math></p> <p><math>T = 8 + 600 + 250 + 42 = 900</math></p>		<p>M1</p> <p>B1</p> <p>B1</p> <p>A1</p>	<p>[4]</p> <p>Using area represents displacement. Accept 600 Ignore method</p>

4.

Question	Scheme	Marks	AOs
7(i)(ii)	Using a correct strategy for solving the problem by setting up two equations in $a$ and $u$ only and solving for either	M1	3.1b
	Equation in $a$ and $u$ only	M1	3.1b
	$22 = 2u + \frac{1}{2} a 2^2$	A1	1.1b
	Another equation in $a$ and $u$ only	M1	3.1b
	$126 = 6u + \frac{1}{2} a 6^2$	A1	1.1b
	$5 \text{ m s}^{-2}$	A1	1.1b
	$6 \text{ m s}^{-1}$	A1ft	1.1b

(7 marks)

**Notes:****M1:** For solving the problem by setting up two equations in  $a$  and  $u$  only and solving for either**M1:** Use of (one or more) *suvat* formulae to produce an equation in  $u$  and  $a$  only**A1:** For a correct equation**M1:** Use of (one or more) *suvat* formulae to produce another equation in  $u$  and  $a$  only**A1:** For a correct equation**A1:** For correct accln  $5 \text{ m s}^{-2}$ **A1:** For correct speed  $6 \text{ m s}^{-1}$  (The second of these A marks is an ft mark, following an incorrect value for  $u$  or  $a$ , depending on which has been found first)**N.B. Do not award the ft mark for absurd answers e.g.  $a > 15$ ,  $u > 50$** 

5.

(i)	Heights are $7t - \frac{1}{2}gt^2$ and $10.5t - \frac{1}{2}gt^2$	B1	1	
(ii)	Expression is $3.5t$	B1	1	From correct (i)
(iii)	$0 = 7 - 9.8t$	M1		For using $v = u - gt$ with $v = 0$
	$t = 5/7$ or $0.714$ Difference is $2.5 \text{ m}$	A1 A1 ft	3	
(iv)	$t = 1$ Greater than $5/7$ (may be implied) or $7 - g \times 1$ is -ve	B1 ft M1		For using ans(ii) = $3.5$ correctly For comparing this $t$ with the time to greatest height or considering the sign of $v_A$ for this $t$
	Direction is downwards	A1	3	
(v)	$h_A = 7 \times 1 - \frac{1}{2} 9.8 \times 1^2$	M1		For using $h = ut - \frac{1}{2}gt^2$ with relevant $t$
	Height is $2.1 \text{ m}$	A1	2	