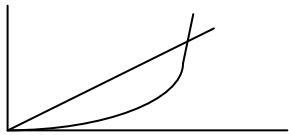


# 4728 Mechanics 1

<b>1 i</b>	$v = 4.2 + 9.8 \times 1.5$ $v = 18.9 \text{ ms}^{-1}$ .	M1 A1 [2]	Uses $v = u + gt$ 18.9(15) from $g = 9.81$
<b>ii</b>	$s = 4.2 \times 1.5 + 9.8 \times 1.5^2/2$ or $18.9^2 = 4.2^2 + 2 \times 9.8s$ $s = 17.325 \text{ m}$	M1 A1 [2]	Uses $s = ut + gt^2/2$ or $v^2 = u^2 + 2gs$ Accept 17.3
<b>iii</b>	$v^2 = 4.2^2 + 2 \times 9.8 \times (17.3(25) - 5)$ $v = 16.1 \text{ ms}^{-1}$	M1 A1 [2]	$18.9^2 = u^2 + 2 \times 9.8 \times 5$ $u = 16.1 \text{ ms}^{-1}$ . Accept answers close to 16.1 from correct working
<b>2 i</b>	Resolves a force in 2 perpendicular directions Uses Pythagoras $R^2 = (12+19\cos60)^2 + (19\sin60)^2$ $R = 27.1 \text{ N}$ { $R = \sqrt{(19+12\cos60)^2 + (12\sin60)^2} = 27.1$ }	M1 DM1 A1 A1 A1 [5]	<i>Diagram for vector addition/subtraction</i>  <i>Uses Cosine Rule</i> $R^2 = 12^2 + 19^2 - 2 \times 12 \times 19\cos120$ $R = 27.1$
<b>ii</b>	Trig on a valid triangle for correct angle $\tan\theta = (19\sin60)/(12 + 19\cos60)$ etc Angle is $37.4^\circ, 37.5^\circ$	M1 A1 A1 [3]	Either Pythagoras or vector add/sub triangle $\sin\theta/19 = \sin120/(27.1)$ etc
<b>3ia</b>	$+/- (9m + 2 \times 0.8)$ { $+/- (3.5 \times 0.8 - 2 \times 0.8)$ } $+/- (-3.5m + 3.5 \times 0.8)$ { $+/- (9m + 3.5m)$ } $+/- (9m + 2 \times 0.8) = +/- (-3.5m + 3.5 \times 0.8)$ $m = 0.096 \text{ kg}$	B1 B1 M1 A1 [4]	Before mom, or mom change Q, OK with g After mom, or mom change P, OK with g Equates moms, or changes, accept with g Do not award if g used
<b>ib</b>	$+/- 0.096(9 +/- 3.5)$ OR $+/- 0.8(3.5 - 2)$ $+/- 1.2 \text{ kgms}^{-1}$	M1 A1ft [2]	Using before & after speeds of P or Q, no g ft $12.5 \times cv(0.096)$
<b>ii</b>	$(0.8+0.4)v$ or $0.8v + 0.4v$ $3.5 \times 0.8 + 0.4 \times 2.75 = (0.8+0.4)v$ $v = 3.25 \text{ ms}^{-1}$	M1 A1 A1 [3]	Using Q and R common speed after, no g $2.8 + 1.1 = 1.2v$
<b>4ia</b>	$0.3g\cos 60$ and $0.3g\sin60$ $0.4g\cos60$ and $0.4g\sin60$ Calculates either relevant difference Perp = $0.1g\cos60$ and Para = $+/- 0.1g\sin60$	B1 B1 M1 A1 [4]	Accept use of "m = 0.1 kg" for M1 and $0.1g\cos60$ (B1) $0.1g\sin60$ (B1) $= 0.49$ and $= 0.849$ (accept 0.85 and 0.84)
<b>ib</b>	$0.1g\sin60 = \mu 0.1g\cos60$ $= 1.73 (= \sqrt{3})$	M1 A1 [2]	$F = \mu R, F > R > 0$ From correct R, F values

<p><b>4 ii</b></p>	$0.5g - T = 0.5a$ $T - 0.4g = 0.4a$ $a = 1.09 \text{ ms}^{-2}$ $T = 4.36 \text{ N}$	<p>M1 A1 B1 B1 [4]</p>	<p>N2L for either particle no resolving, at least 1 unknown Formula round the pulley, M0A0. But award M1 for <math>T - 0.4g = 0.4 \times 1.09</math> etc later Both equations correct</p>
<p><b>5 i</b></p>	$11 = 3 + 20a \quad (a = 0.4)$ $8 = 3 + (11-3)t/20$ $t = 12.5$	<p>M1 M1 A1 [3]</p>	<p>Uses <math>v = u + at</math>, no zero terms Their <math>a &gt; 0</math>. <math>t/20 = (8-3)/(11-3)</math> is M1M1</p>
<p><b>ii</b></p>	$s(A,20) = 8 \times 20 (=160)$ $s(B,20) = (3 + 11) \times 20/2 = 3 \times 20 + 0.4 \times 20^2/2 (=140)$ $8T = (3+11) \times 20/2 + 11 \times (T-20)$ <p>or <math>(160 - 140) = 11t - 8t</math> <math>T = 26 \frac{2}{3}</math></p>	<p>B1 B1 M1 A1 A1 [5]</p>	<p>Or <math>s(A) = 8T</math> or as stage of <math>s(B) = (3+11) \times 20/2 + 11 \times (T-20)</math> 3 part equation balancing distances Accept 26.6 or 26.7</p>
<p><b>iii</b></p>		<p>B1 B1 B1 [3]</p>	<p>Linear rising graph (for A) starting at B's start Non-linear rising graph for B below A's initially. Accept 2 straight lines as non-linear. Single valued graphs graphs intersect and continue</p>
<p><b>6 i</b></p>	$a = 2 \times 0.006t - 0.18$ $a = 0.012t - 0.18$	<p>M1 A1 [2]</p>	<p>Differentiates <math>v</math> (not <math>v/t</math>) Award for unsimplified form, accept <math>+c</math>, not <math>+k</math></p>
<p><b>ii</b></p>	$0.012t - 0.18 = 0$ $t = 15$ $0.006 \times 15^2 - 0.18 \times 15 + k = 0.65$ $k = 2$ <p style="text-align: right;">AG</p>	<p>M1* A1 D*M1 A1 A1 [5]</p>	<p>Sets <math>a = 0</math>, and solves for <math>t</math> Substitutes <math>t(v(\text{min}))</math> in <math>v(t)</math></p>
<p><b>iii</b></p>	$s = 0.006t^3/3 - 0.18t^2/2 + 2t (+c)$ $(s = 0.002t^3 - 0.09t^2 + 2t (+c))$ $t = 0, s = 0 \text{ hence } c = 0$ $L = 0.002 \times 28.4^3 - 0.09 \times 28.4^2 + 2 \times 28.4$ $L = 30.0 \text{ m}$	<p>M1A1 B1 M1 A1 [5]</p>	<p>Integrates <math>v</math> (not multiplies by <math>t</math>). Award if <math>+c</math> omitted, accept <math>kt</math> Explicit, not implied (or uses limits 0, 28.4) Substitutes 28.4 or 14.2 in <math>s(t)</math>, (and <math>k=2</math>) Accept a r t 30(.0), accept <math>+c</math></p>

