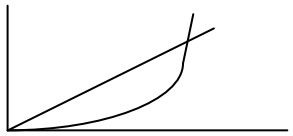
4728 Mechanics 1

1 i	$v = 4.2 + 9.8 \times 1.5$ $v = 18.9$ ms^{-1}.	M1 A1 [2]	Uses $v = u + gt$ 18.9(15) from g = 9.81
ii	$s = 4.2 \times 1.5 + 9.8 \times 1.5^2/2$ or $18.9^2 = 4.2^2 + 2 \times 9.8s$ s = 17.325 m	M1 A1 [2]	Uses $s = ut + gt^2/2$ or $v^2 = u^2 + 2gs$ Accept 17.3
iii	$v^2 = 4.2 + 2 \times 9.8 \times (17.3(25) - 5)$ $v = 16.1$ ms^{-1}	M1 A1 [2]	$18.9^2 = u^2 + 2 \times 9.8 \times 5$ $u = 16.1$ ms^{-1}. Accept answers close to 16.1 from correct working
2 i	Resolves a force in 2 perpendicular directions Uses Pythagoras $R^2 = (12+19\cos60)^2$ $+ (19\sin60)^2$ R = 27.1 N $\{R = \sqrt{((19+12\cos60)^2 + (12\sin60)^2)} = 27.1\}$	M1 DM1 A1 A1 A1 [5]	*Diagram for vector addition/subtraction* *Uses Cosine Rule* $R^2 = 12^2 + 19^2$ - $2 \times 12 \times 19\cos120$ *R = 27.1*
ii	Trig on a valid triangle for correct angle $\tan\theta = (19\sin60)/(12 + 19\cos60)$ etc Angle is 37.4°, 37.5°	M1 A1 A1 [3]	Either Pythagoras or vector add/sub triangle *sinθ/19 = sin120/ (27.1) etc*
3ia	$+/-(9m + 2 \times 0.8)$ $\{+/-(3.5\times0.8-2\times0.8)\}$ $+/-(-3.5m + 3.5 \times 0.8)$ $\{+/-(9m + 3.5m)\}$ $+/-(9m + 2 \times 0.8) = +/-(-3.5m + 3.5 \times 0.8)$ m = 0.096 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
ib	$+/-0.096(9+/-3.5)$ *OR +/-0.8(3.5 -2)* $+/-1.2$ kgms^{-1}	M1 A1ft [2]	Using before & after speeds of P or Q, no g ft 12.5 × cv(0.096)
ii	$(0.8+0.4)v$ or $0.8v + 0.4v$ $3.5 \times 0.8 + 0.4 \times 2.75 = (0.8+0.4)v$ $v = 3.25$ ms^{-1}	M1 A1 A1 [3]	Using Q and R common speed after, no g 2.8 +1.1 = 1.2v
4ia	0.3gcos 60 and 0.3gsin60 0.4gcos60 and 0.4gsin60 Calculates either relevant difference Perp = 0.1gcos60 and Para = +/- 0.1gsin60	B1 B1 M1 A1 [4]	Accept use of "m = 0.1 kg" for M1 and 0.1gcos60 (B1) 0.1gsin60 (B1) = 0.49 and = 0.849 (accept 0.85 and 0.84)
ib	$0.1g\sin60 = \mu 0.1g\cos60$ $= 1.73$ ($= \sqrt{3}$)	M1 A1 [2]	$F = \mu R$, F>R>0 From correct R, F values

4 ii	$0.5g - T = 0.5a$ $T - 0.4g = 0.4a$ $a = 1.09\ ms^{-2}$ $T = 4.36$ N	M1 A1 B1 B1 [4]	N2L for either particle no resolving, at least 1 unknown Formula round the pulley, M0A0. But award M1 for $T-0.4g = 0.4 \times 1.09$ etc later Both equations correct
5 i	$11 = 3 + 20a$ $(a = 0.4)$ $8 = 3 + (11-3)t/20$ $t = 12.5$	M1 M1 A1 [3]	Uses $v = u + at$, no zero terms Their $a>0$. $t/20 = (8-3)/(11-3)$ is M1M1
ii	$s(A,20) = 8 \times 20$ (=160) $s(B,20) = (3+11) \times 20/2 =$ $3 \times 20 + 0.4 \times 20^2/2$ (=140) $8T = (3+11) \times 20/2 + 11 \times (T-20)$ or $(160 - 140) = 11t - 8t$ $T = 26\ 2/3$	B1 B1 M1 A1 A1 [5]	Or $s(A) = 8T$ or as stage of $s(B)=(3+11)\times20/2 + 11\times(T-20)$ 3 part equation balancing distances Accept 26.6 or 26.7
iii		B1 B1 B1 [3]	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
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 $c = 0$ $L = 0.002 \times 28.4^3 - 0.09 \times 28.4^2 + 2 \times 28.4$ $L = 30.0$ 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

7 i	(Fr =) 0.15 × 600gcos10 (Wt cmpt =) 600gsin10 600 × 0.11 = T - 0.15 × 600gcos10 - 600gsin10 (66 = T - 868.6 – 1021) T = 1960 N	B1 B1 M1 A1 A1 [5]	Implied by Fr = 0.15×600gcos10 (=868.6..) N2L. T with at least 1 resolved forces and 600 × 0.11 1955.6..
ii a	a(up) = +/-(600gsin10+.15×600gcos10)/600 a(up) = +/-3.15 ms^{-2} AG	M1 A1 [2]	2 resolved forces and 600a or "unit mass" Disregard sign, accept 3.149
b	UP $v^2 = 2 \times 0.11 \times 10$ v = 1.48 when cable breaks t = 1.48/3.149 (t = 0.471 time for log to come to rest) $s = 1.48^2/(2 \times 3.149)$ s = 0.349 distance for log to come to rest DOWN a(down) = (600gsin10-0.15×600gcos10)/600 10+0.349= $0.254t^2/2$ t = 9.025 T = (9.025 + 0.471) = 9.5 s	M1 A1 M1 M1 A1 B1 M1 A1 A1 [9]	 Correct, need not be accurate Or 1.48 = 0 + 3.15t Correct, need not be accurate = 0.254 Needs a< 3.15, s>10. Or V^2= 2×0.254× (10+0.349) [V= 2.29..], V=0.254t Correct, need not be accurate Accept 9.49