4728 Mechanics 1

1 (i)		M1	Uses CoLM
- (1)	0.5x6 = 0.5x0.8 + 4m	A1	
	m = 0.65	A1	If g used throughout, possible 3 marks
		[3]	8
		M1	After momentums opposite signs
(ii)	0.5x6 = -0.5x0.8 + 4m	A1	
	m = 0.85	A1	If g used throughout, 0 marks
		[3]	
2 (i)	T = 400 N	B1	Order immaterial
	D = 400 + 900	M1	Or T + 900; sign correct
	= 1300 N	A1	
		[3]	
(ii)			(Award M marks even if g included in ma terms.
			M marks require correct number forces)
		M1	Uses N2L one object only
	$500 \times 0.6 = T - 400$	A1	
	T = 700 N	A1	
		M1	Uses N2L other object
	$1250 \times 0.6 = D - 900 - 700$	A1ft	ft cv(T from (ii)); allow T instead of its value
	D = 2350 N	A1	
	OR		
	(500 1050) 0 C D 100 000	M1	Uses N2L for both objects
	(500 + 1250)x0.6 = D - 400 - 900	A1	
	D = 2350 N	A1	
3 (i)	5cos30 or 5 sin 60 or 4.33	[6] B1	Orden immeterial accept // May be availed in
5 (I)	5cos 60 or 5sin30 or 2.5	В1 В1	Order immaterial, accept +/ May be awarded in
	500s 00 01 581150 01 2.5	[2]	(ii) if no attempt in (i)
		[2]	
(ii)		M1*	Subtracts either component from either force
	7-4.33 (= 2.67) and 9 - 2.5 (= 6.5)	A1	
	$R^2 = 2.67^2 + 6.5^2$	D*M	
	R = 7.03	1	3sf or better
	$\tan\theta = 6.5/2.67$	A1	Valid trig for correct angle
	$\theta = 67.6, 67.7 degrees$	D*M	3sf or better
		1	
		A1	
	20 20	[6]	
4 (i)	20cos 30	M1	Resolves 20 (accept 20 sin30)
	$20\cos 30 = 3a$	M1	Uses N2L horizontally, accept g in ma term
	$a = 5.77 \text{ ms}^{-2}$	A1	
200		[3]	
(ii)		M1	Resolves vertically (accept -, cos if sin in i);
	$R = 3x9.8 + 20 \sin 30 (= 39.4)$	A1	correct no. terms
	$F = 20\cos 30 (= 17.3)$	B1	Correct (Neither R nor F need be evaluated)
	$17.3 = 39.4\mu$	M1	Uses $F = \mu R$
	$\mu = 0.44$	A1	
		[5]	

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v = $0.8t^2/2$ (+c) t = 0, v = 13, (c = 13) v = $0.4x$ 6 ² (+c) v = 27.4 ms ⁻¹ A1 A1 Award if c omitted (ii) $s = \int 0.4t^2 (+c) dt$ s = $0.4t^3/3 + 13t$ (+k) t = $0.s = 0$, (k=0) s = $0.4t^3/3 + 13x$ (s M1* A1 Attempt at integration of v(t) f c v(v(t) in (i)) (iii) $s = 0.4t^3/3 + 13t$ (+k) t = $0.s = 0$, (k=0) s = $0.4x6^3/3 + 13x6$ M1* A1 Attempt at integration of v(t) (iii) $s = 0.4t^3/3 + 13x$ (s D*M1 A1 A1 (iiii) Fig. 2 B1 (iii) Fig. 2 B1 (iii) Fig. 3 does not have a increasing velocity/gradient B1 v = 0.714 s or better or 5/7 A1 v = 7 ms ⁻¹ or 6.99 or art 7.00 X1 v = 7 ms ⁻¹ or 6.99 or art 7.00 X1 v = 7 ms ⁻¹ or 6.99 or art 7.00 X1 V = 7 ms ⁻¹ or 6.99 or art 7.00 X1 K1 R = 2x9.8xos60 (=9.8) B0 F = 0.2x16.97 (=3.395 or 3.4) M1 Cmpt weight = 2x9.8xos60 (=9.8) B1 $2a = 9.8 + 3.395$ M1 $a = 3.2 ms^{-2}$ B1 $0^2 = 2x3.2x5$ M1 $v = 5.66$ or 5.7 A1 $v = 8.66$ or 8.7 A1 $\sqrt{1}$ ft cv($\sqrt{(10a)}$) [9] M1 Use of v = u - 0.4t	5 (i)	$V = \int 0.8t dt$	M1*	Attempt at integration
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		-	A1	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			M1	
v = 27.4 ms ⁻¹ A1 (ii) s = $10.4t^2$ (+c)dt M1 s = $0.4t^3/3 + 13t$ (+k) A1ft t=0, s=0, (k=0) M1 s = 106.8 m D*M1 s = 106.8 m A1 (iii) Fig. 2 (iiii) Fig. 2 f iii) Fig. 1 has zero initial velocity/gradient Fig. 3 does not have a increasing B1 velocity/gradient [1] b [2] 6 (i) 2.5 = 9.8t ² /2 a t = 0.714 s or better or 5/7 b $v^2 = 2x9.8x2.5 OR v = 9.8 x 0.714$ v = 7 ms ⁻¹ or 6.99 or art 7.00 [2] (iii) R = 2x9.8sin60 (= 16.97 = 17) B1 With incorrect angle, e.g R = 2x9.8sin60 (= 16.97 = 17) B1 With incorrect angle, e.g M1 Q = 9.8 - 3.395 M1 a = 3.2 ms ² M1 Distance down ramp = 5 m B1 v = 2x0.4 (= 3.2) A1 v = 2x0.4 (= 0.2) A1 v = 2x0.4 (= 0.2) A1 y = 4 - 2x0.4 (= 3.2) A1			D*M1	
(ii) $s = \int 0.4t^2 (+c)dt$ M1* Attempt at integration of v(t) $s = 0.4t^3/3 + 13t (+k)$ A1ft M1* Attempt at integration of v(t) $s = 0.4t^3/3 + 13t (+k)$ M1 M1 ft cv(v(t) in (i)) $s = 0.4t^3/3 + 13x^6$ D*M1 All Allow if k=0 assumed. Accept 107 m. $s = 106.8 m$ [1] B1 Fig. 1 has zero initial velocity/gradient B1 Fig. 1 has zero initial velocity/gradient B1 B1 Image: Second 100 minor 100			A1	
(ii) $s = \int 0.4t^2 (+c)dt$ M1* Attempt at integration of v(t) $s = 0.4t^3/3 + 13t (+k)$ A1ft M1* Attempt at integration of v(t) $s = 0.4t^3/3 + 13t (+k)$ M1 M1 ft cv(v(t) in (i)) $s = 0.4t^3/3 + 13x^6$ D*M1 All Allow if k=0 assumed. Accept 107 m. $s = 106.8 m$ [1] B1 Fig. 1 has zero initial velocity/gradient B1 Fig. 1 has zero initial velocity/gradient B1 B1 Image: Second 100 minor 100				
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s = 106.8 m A1 Allow if k=0 assumed. Accept 107 m. (iii) Fig. 2 B1 (iii) Fig. 1 has zero initial velocity/gradient Fig. 3 does not have a increasing velocity/gradient B1 6 (i) $2.5 = 9.8t^2/2$ M1 a t = 0.714 s or better or 5/7 A1 b $v^2 = 2x9.8x2.5 \ OR v = 9.8 x \ 0.714$ M1 Uses $v^2 = 0 + /-2gs \ or v = u + /-gt$ v = 7 ms ⁻¹ or 6.99 or art 7.00 A1 Not awarded if - sign "lost" [2] [2] (ii) R = 2x9.8sin60 (= 16.97 = 17) B1 M1 R = 2x9.8cos60 (=9.8) B0 F = 0.2x16.97 (=3.395 or 3.4) A1ft Cmpt weight = 2x9.8cos60 (=9.8) B1 2a = 9.8 - 3.395 M1 a = 3.2 ms ⁻² M1 Distance down ramp = 5 m B1 $v^2 = 2x3.2x5$ M1 $v = 5.66 \text{ or } 5.7$ A1ft $y^2 = 2x0.4 (= 3.2)$ A1 $q = 1 - 2x0.4 (= 0.2)$ A1 M1 Use of $v = u - 0.4t$ $q = 1 - 2x0.4 (= 0.2)$ A1 M1 Use of $v = u - 0.2$ from $-1+2*0.4$ M1		t=0, s=0, (k=0)	M1	
(iii) Fig. 2 [5] Image: style s		$s = 0.4x6^{3}/3 + 13x6$	D*M1	
(iii) Fig. 2 B1 Fig. 1 has zero initial velocity/gradient [1] B1 B1 velocity/gradient [2] 6 (i) $2.5 = 9.8t^2/2$ t = 0. 714 s or better or $5/7$ A1 b V ² = $2x9.8x2.5 OR v = 9.8 \ge 0.714$ v = 7 ms ⁻¹ or 6.99 or art 7.00 A1 (ii) R = $2x9.8x160 (= 16.97 = 17)$ B1 With incorrect angle, e.g M1 With incorrect angle, e.g M1 R = $2x9.8xc50 (= 9.8)$ Cmpt weight = $2x9.8cos60 (= 9.8)$ B1 With incorrect angle, e.g M1 Cmpt weight = $2x9.8cos60 (= 9.8)$ B1 Cmpt weight = $2x9.8cos60 (= 9.8)$ B1 Cmpt weight = $2x9.8cos60 (= 9.8)$ B1 Cmpt weight = $2x9.8cos60 (= 9.8)$ B2 A1ft B1 $v^2 = 2x7.5x5$ v = 5.66 or 5.7 B1 v ² = $2x0.4 (= 3.2)$ M1 v = $4 - 2x0.4 (= 3.2)$ M1 q = $1 - 2x0.4 (= 0.2)$ M1 V ² = $2x0.4 (= 3.2)$ M1 q = $1 - 2x0.4 (= 0.2)$ M1		s = 106.8 m	A1	Allow if k=0 assumed. Accept 107 m.
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Fig.1 has zero initial velocity/gradient Fig. 3 does not have a increasing velocity/gradientB1 B1 B16 (i) $2.5 = 9.8t^2/2$ M1Uses $s = 0 +/-gt^2/2$ a $t = 0.714$ s or better or $5/7$ A1Not awarded if - sign "lost"b $v^2 = 2x9.8x2.5 \ OR v = 9.8 x \ 0.714$ M1Uses $v^2 = 0 +/-gg \ or v = u +/-gt$ $v^2 = 2x9.8x2.5 \ OR v = 9.8x \ 0.714$ M1Uses $v^2 = 0 +/-2gs \ or v = u +/-gt$ $v = 7 \ ms^{-1} \ or \ 6.99 \ or \ art \ 7.00$ A1Not awarded if - sign "lost"[2][2]M1Uses $v^2 = 0 +/-2gs \ or v = u +/-gt$ (ii) $R = 2x9.8sin60 \ (= 16.97 = 17)$ B1With incorrect angle, e.g $R = 2x9.8sin60 \ (= 16.97 = 17)$ B1With incorrect angle, e.g $R = 2x9.8sin60 \ (= 16.97 = 3.95 \ or \ 3.4)$ A1ft $F = 0.2x16.97 \ (= 3.395 \ or \ 3.4)$ $Cmpt weight = 2x9.8cos60 \ (= 9.8)$ B1Cmpt wei = 2x9.8sin60 \ (= 16.97) B0 $2a = 9.8 \cdot 3.395$ B1Cmpt wei = 2x9.8sin60 \ (= 16.97) B0 $2a = 9.8 \cdot 3.395$ B1Not awarded if $v = 2x7.5x5$ $v = 2x3.2x5$ M1 $2a = 7.5 \ A1$ ft cv($\sqrt{(10a)}$) $v^2 = 2x3.2x5$ M1 $v^2 = 2x7.5x5$ $v = 5.66 \ or \ 5.7$ A1ft $v = 8.66 \ or \ 8.7 \ A1$ ft cv($\sqrt{(10a)}$) $g = 4 - 2x0.4 \ (= 3.2)$ A1A1 $q = 1 - 2x0.4 \ (= 0.2)$ A1 $0.7x3.2 - 0.3x0.2 = (1x)v$ A1	(iii)	Fig. 2	B1	
Fig. 3 does not have a increasing velocity/gradientB1 [2]6 (i) $2.5 = 9.8t^{7/2}$ M1Uses $s = 0 +/-gt^{2/2}$ at = 0.714 s or better or 5/7A1Not awarded if - sign "lost"b $v^{2} = 2x9.8x2.5 OR v = 9.8 x 0.714$ M1Uses $v^{2} = 0 +/-2gs$ or $v = u +/-gt$ v = 7 ms ⁻¹ or 6.99 or art 7.00A1Not awarded if - sign "lost"(ii)R = 2x9.8sin60 (= 16.97 = 17)B1With incorrect angle, e.gM1R = 2x9.8sin60 (= 16.97 = 17)B1With incorrect angle, e.gF = 0.2x16.97 (=3.395 or 3.4)A1ftF = 0.2x9.8 (=1.96) M1A1 $$ Cmpt weight = 2x9.8cos60 (= 9.8)B1Cmpt wt = 2x9.8sin60 (=16.97) B02a = 9.8 - 3.395M12a = 16.97 - 1.96 M1a = 3.2 ms ⁻² M1a = 7.5 A1 $$ ft cv(R and Cmpt weight)Distance down ramp = 5 mW1 $v^{2} = 2x7.5x5$ v = 5.66 or 5.7M1Use of $v = u - 0.4t$ $q = 1 - 2x0.4 (= 3.2)$ A1Accept $q = -0.2$ from $-1+2*0.4$ $q = 1 - 2x0.4 (= 0.2)$ A1Uses CoLM on reduced velocities $0.7x3.2 - 0.3x0.2 = (1x)v$ A1H			[1]	
velocity/gradient[2]6 (i) $2.5 = 9.8t^2/2$ M1Uses $s = 0 +/- gt^2/2$ a $t = 0.714$ s or better or $5/7$ M1Uses $s = 0 +/- gt^2/2$ b $v^2 = 2x9.8x2.5 \ OR v = 9.8 \times 0.714$ M1Uses $v^2 = 0 +/-2gs \ or v = u +/- gt$ v = 7 ms^{-1} or 6.99 or art 7.00M1Uses $v^2 = 0 +/-2gs \ or v = u +/- gt$ (ii) $R = 2x9.8sin60 (= 16.97 = 17)$ B1With incorrect angle, e.gM1 $R = 2x9.8sin60 (= 16.97 = 17)$ B1With incorrect angle, e.gM2 $R = 2x9.8sin60 (= 16.97 = 17)$ B1With incorrect angle, e.gM2 $R = 2x9.8sin60 (= 16.97 = 17)$ B1With incorrect angle, e.gM2 $R = 2x9.8sin60 (= 16.97 = 17)$ B1With incorrect angle, e.gM3 $R = 2x9.8cos60 (= 9.8)$ B0 $2a = 9.8 - 3.395$ B1Cmpt wt = $2x9.8cos60 (= 9.8)$ $2a = 9.8 - 3.395$ B1Cmpt wt = $2x9.8sin60 (= 16.97)$ B0 $2a = 3.2 ms^{-2}$ B1M1Distance down ramp = 5 mB1 $v^2 = 2x3.2x5$ M1 $v^2 = 2x3.2x5$ M1 $v^2 = 2x3.2x5$ M1 $v = 8.66 \text{ or } 8.7 \text{ A1}$ M1Use of $v = u - 0.4t$ $q = 1 - 2x0.4 (= 3.2)$ A1 $q = 1 - 2x0.4 (= 0.2)$ A1M1Uses CoLM on reduced velocitiesM2M3Uses CoLM on reduced velocities		Fig.1 has zero initial velocity/gradient	B1	
6 (i) a2.5 = 9.8t²/2 t = 0.714 s or better or 5/7 v² = 2x9.8x2.5 OR v = 9.8 x 0.714 v = 7 ms¹ or 6.99 or art 7.00M1 A1 M1 M1 A1 V = 7 ms¹ or 6.99 or art 7.00Uses $v^2 = 0 +/-2gs$ or $v = u +/-gt$ Not awarded if - sign "lost"(ii)R = 2x9.8sin60 (= 16.97 = 17) F = 0.2x16.97 (=3.395 or 3.4) Cmpt weight = 2x9.8cos60 (= 9.8) 2a = 9.8 - 3.395 a = 3.2 ms² Distance down ramp = 5 m v² = 2x3.2x5 v = 5.66 or 5.7B1 M1 M1 M1 M1 M1 M1 M1 M1 M1 M1 M2 M1 M2 		Fig. 3 does not have a increasing	B1	
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$v^2 = 2x9.8x2.5 \ OR \ v = 9.8 \ x \ 0.714$ M1Uses $v^2 = 0 +/-2gs \ or \ v = u +/-gt$ (ii) $R = 2x9.8sin60 \ (= 16.97 = 17)$ B1With incorrect angle, e.g $F = 0.2x16.97 \ (= 3.395 \ or 3.4)$ M1 $R = 2x9.8cos60 \ (= 9.8) \ B0$ $Cmpt weight = 2x9.8cos60 \ (= 9.8)$ B1Cmpt wt = 2x9.8sin60 \ (= 16.97) \ B0 $2a = 9.8 - 3.395$ B1Cmpt wt = 2x9.8sin60 \ (= 16.97) \ B0 $2a = 9.8 - 3.395$ M1 $2a = 16.97 - 1.96 \ M1$ $v^2 = 2x3.2x5$ M1 $2a = 16.97 - 1.96 \ M1$ $v^2 = 2x3.2x5$ M1 $v^2 = 2x7.5x5$ $v = 5.66 \ or 5.7$ A1ft $v = 8.66 \ or 8.7 \ A1\sqrt{10}$ $p = 4 - 2x0.4 \ (= 3.2)$ M1Use of $v = u - 0.4t$ $q = 1 - 2x0.4 \ (= 0.2)$ A1Accept $q = -0.2 \ from -1+2*0.4$ $0.7x3.2 - 0.3x0.2 = (1x)v$ A1	a	t = 0.714 s or better or 5/7	A1	Not awarded if - sign "lost"
v = 7 ms ⁻¹ or 6.99 or art 7.00A1 [2]Not awarded if - sign "lost"(ii)R = 2x9.8sin60 (= 16.97 = 17)B1 M1With incorrect angle, e.g R = 2x9.8cos60 (=9.8) B0F = 0.2x16.97 (=3.395 or 3.4) Cmpt weight = 2x9.8cos60 (= 9.8)A1ft B1 Cmpt wt = 2x9.8sin60 (=16.97) B02a = 9.8 - 3.395 a = 3.2 ms ⁻² B1 Distance down ramp = 5 m v ² = 2x3.2x5 v = 5.66 or 5.7M1 B1 B1 V17 (i) $p = 4 - 2x0.4 (= 3.2)$ $q = 1 - 2x0.4 (= 0.2)$ M1 M1 M1Use of v = u - 0.4t M1 M1 M1 Uses CoLM on reduced velocities7 (i) $0.7x3.2 - 0.3x0.2 = (1x)v$ M1 A1V2 A1	b		[2]	
(ii)R = 2x9.8sin60 (= 16.97 = 17)B1 M1With incorrect angle, e.g R = 2x9.8cos60 (=9.8) B0F = 0.2x16.97 (=3.395 or 3.4)A1ftF = 0.2x9.8cos60 (=9.8) B0Cmpt weight = 2x9.8cos60 (= 9.8)A1ftF = 0.2x9.8 (=1.96) M1A1 $$ 2a = 9.8 - 3.395B1Cmpt wt = 2x9.8sin60 (=16.97) B02a = 9.8 - 3.395M12a = 16.97 - 1.96 M1a = 3.2 ms ⁻² A1fta = 7.5 A1 $$ ft cv(R and Cmpt weight)Distance down ramp = 5 mB1 $v^2 = 2x3.2x5$ M1 $v = 5.66$ or 5.7A1ft $v = 5.66$ or 5.7A1ft $v = 8.66$ or 8.7 A1 $$ ft cv($\sqrt{(10a)}$) $[9]$ 7 (i) $p = 4 - 2x0.4 (= 3.2)$ $q = 1 - 2x0.4 (= 0.2)$ $0.7x3.2 - 0.3x0.2 = (1x)v$ A1			M1	Uses $v^2 = 0 + -2gs$ or $v = u + -gt$
(ii) $R = 2x9.8sin60 (= 16.97 = 17)$ $B1$ With incorrect angle, e.g $F = 0.2x16.97 (=3.395 \text{ or } 3.4)$ $M1$ $R = 2x9.8cos60 (= 9.8) B0$ $Cmpt weight = 2x9.8cos60 (= 9.8)$ $A1ft$ $F = 0.2x9.8 (= 1.96) M1A1$ $2a = 9.8 - 3.395$ $B1$ $Cmpt wt = 2x9.8sin60 (= 16.97) B0$ $a = 3.2 ms^2$ $A1ft$ $B1$ $Cmpt wt = 2x9.8sin60 (= 16.97) B0$ $Distance down ramp = 5 mM12a = 16.97 - 1.96 M1v^2 = 2x3.2x5N1v^2 = 2x7.5x5v = 5.66 \text{ or } 5.7M1v^2 = 2x7.5x5v = 5.66 \text{ or } 5.7M1V = 8.66 \text{ or } 8.7 A1 ft cv(\sqrt{(10a)})[9]M1Use of v = u - 0.4tq = 1 - 2x0.4 (= 3.2)A1A10.7x3.2 - 0.3x0.2 = (1x)vA1$		$v = 7 \text{ ms}^{-1}$ or 6.99 or art 7.00	A1	Not awarded if - sign "lost"
M1R = 2x9.8cos60 (=9.8) B0F = 0.2x16.97 (=3.395 or 3.4) Cmpt weight = 2x9.8cos60 (= 9.8) 2a = 9.8 - 3.395 a = 3.2 ms ⁻² M1A1ftF = 0.2x9.8 (=1.96) M1A1 $$ Distance down ramp = 5 m v ² = 2x3.2x5 v = 5.66 or 5.7M12a = 16.97 - 1.96 M1 A1fta = 7.5 A1 $$ ft cv(R and Cmpt weight)N1 $v^2 = 2x7.5x5$ v = 8.66 or 8.7 A1 $$ ft cv($$ (10a))7 (i) $p = 4 - 2x0.4 (= 3.2)$ q = 1 - 2x0.4 (= 0.2)M1 A1 M1Use of v = u - 0.4t A1 A1 A17 (i) $p = 4 - 2x0.4 (= 3.2)$ q = 1 - 2x0.4 (= 0.2)M1 A1 A1 A1Uses CoLM on reduced velocities A1			[2]	
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$\begin{array}{ c c c c c c c c c c c c c c c c c c c$			M1	$R = 2x9.8\cos 60$ (=9.8) B0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		F = 0.2x16.97 (=3.395 or 3.4)	A1ft	F = 0.2x9.8 (=1.96) M1A1
$a = 3.2 \text{ ms}^{-2}$ A1ft $a = 7.5 \text{ A}1$ ft cv(R and Cmpt weight)Distance down ramp = 5 mB1 $v^2 = 2x3.2x5$ M1 $v = 5.66 \text{ or } 5.7$ M1 $v = 8.66 \text{ or } 8.7 \text{ A}1$ ft cv($$ (10a))[9]7 (i) $p = 4 - 2x0.4 (= 3.2)$ $q = 1 - 2x0.4 (= 0.2)$ M1 $0.7x3.2 - 0.3x0.2 = (1x)v$ A1		Cmpt weight = $2x9.8\cos 60$ (= 9.8)	B1	Cmpt wt = 2x9.8sin60 (=16.97) B0
Distance down ramp = 5 m $v^2 = 2x3.2x5$ $v = 5.66 \text{ or } 5.7$ B1 M1 M1 $y^2 = 2x7.5x5$ $v = 8.66 \text{ or } 8.7 \text{ A1}$ ft cv($\sqrt{(10a)}$)7 (i) $p = 4 - 2x0.4 (= 3.2)$ $q = 1 - 2x0.4 (= 0.2)$ M1 A1 A1Use of $v = u - 0.4t$ A1 A1 M1 M1 M1 Uses CoLM on reduced velocities A1			M1	2a = 16.97 - 1.96 M1
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$a = 3.2 \text{ ms}^{-2}$	A1ft	$a = 7.5 \text{ A1}\sqrt{\text{ft cv}(\text{R and Cmpt weight})}$
$v = 5.66 \text{ or } 5.7$ A1ft [9] $v = 8.66 \text{ or } 8.7 \text{ A1}$ ft $cv(\sqrt{(10a)})$ 7 (i) $p = 4 - 2x0.4 (= 3.2)$ $q = 1 - 2x0.4 (= 0.2)$ M1 A1 A1Use of $v = u - 0.4t$ A1 A1 Uses CoLM on reduced velocities A1				
[9] [9] 7 (i) $p = 4 - 2x0.4 (= 3.2)$ M1 Use of $v = u - 0.4t$ $q = 1 - 2x0.4 (= 0.2)$ A1 A1 $0.7x3.2 - 0.3x0.2 = (1x)v$ A1 Accept $q = -0.2$ from $-1+2*0.4$		$v^2 = 2x3.2x5$	M1	
7 (i) $p = 4 - 2x0.4 (= 3.2)$ M1Use of $v = u - 0.4t$ $q = 1 - 2x0.4 (= 0.2)$ A1A1Accept $q = -0.2$ from $-1+2*0.4$ $0.7x3.2 - 0.3x0.2 = (1x)v$ A1Uses CoLM on reduced velocities		v = 5.66 or 5.7	A1ft	$v = 8.66 \text{ or } 8.7 \text{ A1} \sqrt{\text{ft cv}(\sqrt{(10a)})}$
$ \begin{array}{c c} p = 4 - 2x0.4 \ (= 3.2) \\ q = 1 - 2x0.4 \ (= 0.2) \\ 0.7x3.2 - 0.3x0.2 = (1x)v \end{array} \begin{array}{c c} A1 \\ A1 \\ M1 \\ A1 \end{array} \begin{array}{c} A1 \\ Accept \ q = -0.2 \ from \ -1+2*0.4 \\ Uses \ CoLM \ on \ reduced \ velocities \\ A1 \end{array} $			[9]	
q = 1 - 2x0.4 (= 0.2)A1Accept $q = -0.2$ from $-1+2*0.4$ $0.7x3.2 - 0.3x0.2 = (1x)v$ A1Uses CoLM on reduced velocities	7 (i)			Use of $v = u - 0.4t$
$\begin{array}{c c} M1 \\ 0.7x3.2 - 0.3x0.2 = (1x)v \\ \end{array} \qquad \qquad$		1		
0.7x3.2 - 0.3x0.2 = (1x)v A1		q = 1 - 2x0.4 (= 0.2)		
				Uses CoLM on reduced velocities
$v = 2.18 \text{ ms}^{-1}$ A1				
		$v = 2.18 \text{ ms}^{-1}$		
[6]			[6]	

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Mark Scheme

January 2009

	B1	Straight line with larger y intercept slopes
		towards t axis, but does not reach it.
	B1	Straight line with negative y intercept slopes
		towards t axis,
	B1	and gets to t axis before other line ends.
	[3]	SR if t=2 in ii give B1 if line stops before axis
0 = 1 - 0.4t	M1	Finds when Q comes to rest (any method)
t = 2.5 s	A1	
	M1	Uses $s = ut - 0.4t^2/2$
$P = 4x3 - 0.5x0.4x3^2$	A1	
$Q = 1x2.5 - 0.5x0.4x2.5^2$	A1	(nb $0^{(2)} = 1^{(2)} - 0.4Q^2/2$ B1; convincing
PQ = 10.2 + 1.25 = 11.45 m	A1	evidence (graph to scale, or calculation that Q
	[6]	comes to rest and remains at rest at t less than
		3, M1A1;graph A1 needs –ve v intercept)
		SR if t=2 in iib, allow M1 for s= ut - $0.4t^2/2$
		And A1 for PQ=8.4
	t = 2.5 s P = 4x3 - 0.5x0.4x3 ² Q = 1x2.5 - 0.5x0.4x2.5 ²	$\begin{array}{cccc} B1 & & B1 & & \\ 0 = 1 - 0.4t & & & \\ t = 2.5 & & & A1 & \\ P = 4x3 - 0.5x0.4x3^2 & & A1 & \\ Q = 1x2.5 - 0.5x0.4x2.5^2 & & A1 & \\ PQ = 10.2 + 1.25 = 11.45 & m & & A1 & \\ \end{array}$

Alternative for Q3 where 7 N and 9N forces combined initially

3 (i)	5cos30 or 5 sin 60 or 4.33	B1	Order immaterial, accept +/ May be awarded
	5cos 60 or 5sin30 or 2.5	B1	in (ii) if no attempt in (i)
		[2]	
(ii)	$Z^2 = 7^2 + 9^2 (= 130, Z = 11.4017)$		Z is resultant of 7N and 9N forces only
	$\cos(\text{angle of Z with y axis}) = 9/11.4017$		
	angle of Z with y axis = 37.8746		
	Angle opposite R in triangle of forces =		R is resultant of all 3 forces
	180 - (37.8746+90+30)	M1*	Complete method
	= 22.125 (Accept 22)	A1	•
	$R^2 = 5^2 + 11.4017^2 - 2x5x11.4017\cos 22.125$	D*M1	Cosine rule to find R
	R (= 7.0269) = 7.03 N	A1	
	$11.4017^2 = 5^2 + 7.0269^2 - 2x5x7.0269\cos A$		Or Sine Rule. A is angle between R and 5N
	(A = 142.33)		forces
	Angle between R and y axis = $142.33-30$ -	D*M1	
	90 (=22.33)	2 111	Complete method
	θ (= 90-22.33) =67.7 degrees	A1	θ is angle between R and x axis
	0 (-90-22.33) - 07.7 degrees	[6]	o is angle between it and x axis
		۲IJ	