1	**(i)**	$R = W\cos\alpha$ Magnitude is 96 N	M1 A1	2	For resolving forces perpendicular to the plane
	(ii)	Magnitude is 24 N	B1	1	AG From correct work.
	(iii)	$P = 100\times0.28 - 24$ $P = 100\times0.28 + 24$ (a) $P = 4$ (b) $P = 52$	M1 A1 A1	3	For resolving 3 forces parallel to the plane (either case)

2	**(i)**	Momentum of A and B before collision $= 0.4\times6 - 1.2\times2$ Momentum of A and B after collision $= 0.4v + 1.2\times1$ $0.4\times6 - 1.2\times2 = 0.4v + 1.2\times1$ ($v = -3$) Speed is 3 ms^{-1} Direction is away from B	B1 B1 M1 A1 A1 ft	5	Alternatively: Momentum lost by $A = 0.4\times(6 - v)$ B1 Momentum gained by B $= 1.2\times(1 + 2)$ B1 For using the principle of conservation of momentum Positive answer only ft from v
	(ii)	$1.2\times1 - 4m = -1.2\times0.5 + 2m$ or $1.2\times1 + 1.2\times0.5 = 4m + 2m$ $m = 0.3$	 B1 B1 B1	3	For momentum equation :- with lhs correct with rhs correct
					SR If mgv used for momentum instead of mv, then (i) Speed is 3 ms^{-1} B1 Direction is away from B B1 ft (ii) m = 0.3 B1

3	**(i)(a)**	 $X = 2\times8\cos30^o - 5\sin40^o$ Component is 10.6 N	M1 A1 A1 ft		For resolving 3 forces parallel to the x-axis ft for 4.17 from sin/cos mix only
	(i)(b)	$Y = 5\cos40^o$ Component is 3.83 N	B1 B1 ft	5	ft for 3.21 from sin/cos mix only
	(ii)	$R^2 = 10.64^2 + 3.83^2$ Magnitude is 11.3 N $\tan\theta = 3.83/10.64$ Direction is 19.8^o anticlockwise from +ve x-axis	M1 A1 ft M1 A1 ft	4	For using $R^2 = X^2 + Y^2$ For using $\tan\theta = Y/X$

4	**(i)**	Acceleration is $1 + 0.2t$	M1 A1	2	For using $a = \dot{v}(t)$
	(ii)	$t = 9$ $s(9) = 9^2 \div 2 + 9^3 \div 30 - (0 + 0)$ $(= 40.5 + 24.3)$ Distance is 64.8 m	M1 A1 M1* A1 A1 dep*M1 A1 ft	7	For solving $a(t) = 2.8$ for t For integrating $v(t)$ to find $s(t)$ For $t^2 \div 2$ correct in $s(t)$ For $t^3 \div 30$ correct in $s(t)$ For correct use of limits or equivalent ft their $a = \dot{v}(t)$ from (i)

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)	$0 = 7 - 9.8t$ $t = 5/7$ or 0.714 Difference is 2.5 m	M1 A1 A1 ft	3	For using $v = u - gt$ with $v = 0$ ft value of t
	(iv)	$t = 1$ Greater than 5/7 (may be implied) or $7 - g \times 1$ is -ve Direction is downwards	B1 ft M1 A1	3	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
	(v)	$h_A = 7 \times 1 - \frac{1}{2} 9.8 \times 1^2$ Height is 2.1 m	M1 A1	2	For using $h = ut - \frac{1}{2} gt^2$ with relevant t

6	**(i)**	Accelerating for 4 s	M1 A1	2	For using the idea that the gradient represents acceleration or for using $v = u + at$
	(ii)	$AB = ½ (16 + 20)8$ Distance is 144 m	M1 A1ft A1	3	For using the idea that the distance is represented by the area of the trapezium or using suitable formulae for the two stages of the journey
	(iii)		B1 B1	2	Graph is single valued and continuous and consists of two straight line segments with one segment from the origin and the other parallel to the t axis Graph for Q is the reflection of the graph for P in the t axis
	(iv)		B1 B1 B1	3	Graph is single valued and continuous and consists of two parts, one of which is a straight line segment,with x increasing from 0 for the interval $0 < t < 20$ $x_P(20)$ appears to be equal to $x_Q(0)$ Graph for P appears to be the reflection in $x =$ ans(ii) ÷ 2 of graph for Q
	(v)	t = 20 – (½ 144 ÷ 8) or 16 + 8(t-4) = 128 – 8(t-4) or equivalent Value of t is 11	M1 A2	3	For complete method of finding the required time SR Allow B1 for t = 11 without explanation

7	**(i)**	$T – F = 0.3a$ $0.2g\sin70^o - T = 0.2a$ $R = 0.3g$ $F = 0.4(0.3g)$ $0.2g\sin70^o - 0.4(0.3g) = 0.5a$ Acceleration is 1.33 ms^{-2} Tension is 1.58 N	M1 A1 A1 B1 M1 M1 A1 A1	8	For applying Newton's second law to either particle For using $F = \mu R$ For eliminating F and T or a
	(ii)	$a = -0.4g$ $0 = 1.5^2 – 2 \times 3.92s$ Distance is 0.287 m	B1 M1 A1	3	May be scored in (iii) For using $v^2 = u^2 + 2as$ with $v = 0$
	(iii)	$0 = 1.5 – 3.92t$ $t = 0.383$ (may be implied) $a = g\sin70^o$ $s = 1.5(0.383) + ½9.8\sin70^o(0.383)^2$ (= 0.574 + 0.674) Distance is 1.25 m	M1 A1ft A1 B1 M1 A1	6	For using $v = u + at$ or equivalent with $v = 0$ for A ft value of a from (ii) For acceleration of B For using $s = ut + ½ at^2$ or equivalent with $u \neq 0$