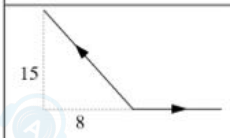
QUESTION NUMBER	SCHEME	MARKS
1(a)	Resultant force $(6\mathbf{i}+8\mathbf{j})+(-16\mathbf{i}+2\mathbf{j})+(-2\mathbf{i}+8\mathbf{j})$	M1
	N2L $-12\mathbf{i}+18\mathbf{j}=2.5\mathbf{a}$ oe **OR** $\sqrt{((-)12)^2+18^2}=2.5a$ oe	M1
	Pythagoras $\sqrt{((-)4.8)^2+(7.2)^2}$ **OR** $\sqrt{((-)12)^2+18^2}$	M1
	8.7 or better (m s^{-2})	A1
		(4)
1(b)	$-12\mathbf{i}+18\mathbf{j}+p\mathbf{i}+p\mathbf{j}=(-12+p)\mathbf{i}+(18+p)\mathbf{j}$	M1
	$\frac{-12+p}{18+p}=\frac{7}{2}$	M1 A1
	$p=-30$	A1
		(4)
		(8)
	Notes for Question 1	
	Accept column vectors throughout	
1(a)		
M1	Find the resultant force by finding the sum of $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ **i**'s and **j**'s do NOT need collecting	
M1	Use of N2L, in vector or scalar form, with their resultant force	
M1	Use of Pythagoras to find a magnitude. This may be magnitude of acceleration or magnitude of their resultant force if carried out before N2L.	
A1	Correct answer from correct working. Exact value is $\frac{12}{5}\sqrt{13}$, accept 8.7 or better. (8.653323061..)	
1(b)		
M1	Find the resultant **force** AND collect **i**'s and **j**'s. Can be scored for a clear **attempt** at adding $p\mathbf{i}+p\mathbf{j}$ to their possibly incorrect resultant from (a)	
M1	Use direction $7\mathbf{i}+2\mathbf{j}$ with their **i** and **j** components of their resultant **force** to form a ratio equation in p ONLY. Condone a sign error and reciprocal, but must be using 7 and 2. May use $(-12+p)\mathbf{i}+(18+p)\mathbf{j}=\lambda(7\mathbf{i}+2\mathbf{j})$, equate components AND eliminate $\lambda\ (=-6)$ to form an equation in p ONLY.	
A1	Correct unsimplified equation in p ONLY.	
A1	Correct answer.	

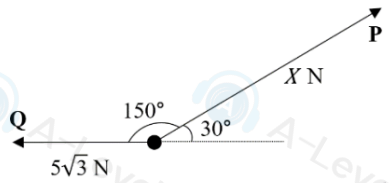
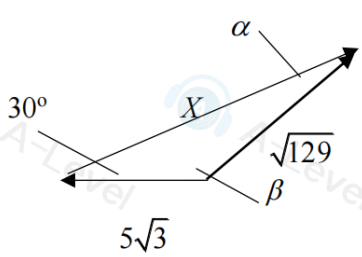
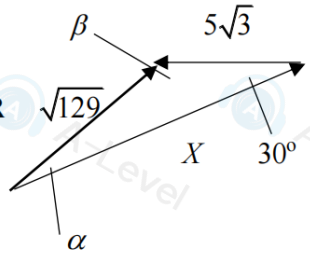
Question Number	Scheme	Marks
2(a)	$\mathbf{F}_3 + (3c\mathbf{i} + 4c\mathbf{j}) + (-14\mathbf{i} + 7\mathbf{j}) = \mathbf{0}$ oe	M1
	$\mathbf{F}_3 = (14 - 3c)\mathbf{i} + (-7 - 4c)\mathbf{j}$	A1
		(2)
2(b)	Resultant force $\mathbf{F}_1 + \mathbf{F}_2 = (6 - 14)\mathbf{i} + (8 + 7)\mathbf{j}$ $(= -8\mathbf{i} + 15\mathbf{j})$	M1
	 Find any relevant angle for **their (even if they've subtracted)** resultant (need not be acute nor positive)	M1
	any of $\tan^{-1}\left(\pm\frac{8}{15}\right), \tan^{-1}\left(\pm\frac{15}{8}\right), \sin^{-1}\left(\pm\frac{8}{17}\right), \cos^{-1}\left(\pm\frac{8}{17}\right), \ldots$	A1**ft**
	120° or better (118.0724…) **OR** 240° or better (241.9276..) In radians 2.1 or better (2.0607..) **OR** 4.2 or better (4.2224…)	A1
		(4)
2(c)	Use of Pythagoras on their resultant : $\sqrt{(-8)^2 + 15^2}$ **or** their acceleration: $\sqrt{(\frac{-8}{m})^2 + (\frac{15}{m})^2}$	M1
	Use of $\lvert\text{their } \mathbf{R}\rvert = 8.5m$ **or** their Resultant = $m\mathbf{a}$	M1
	A correct equation in m only eg $17 = m \times 8.5$	A1**ft**
	$m = 2$	A1
	N. B. $\sqrt{\left(\frac{-8}{8.5}\right)^2 + \left(\frac{15}{8.5}\right)^2}$ M1 $-8\mathbf{i} + 15\mathbf{j} = 8.5m$ M1 $\sqrt{\left(\frac{-8}{8.5}\right)^2 + \left(\frac{15}{8.5}\right)^2} = m$ A1ft $2 = m$ A1	
		(4)
		(10)

Notes	
	Accept column vectors throughout apart from answer for (a)
(a)	
M1	Uses the vector **sum** of all 3 forces being equal to zero oe **N.B.** $\mathbf{F}_3 = \mathbf{F}_1 + \mathbf{F}_2$ is M0
A1	cao Must be in terms of c, **i** and **j** but allow uncollected **i**'s and **j**'s and apply isw if necessary.
(b)	
M1	Finds the resultant using $\mathbf{F}_1 + \mathbf{F}_2$ or $-$ their $\mathbf{F}_3$
M1	Uses trig to find a relevant angle **for their resultant**
A1ft	Any **correct** relevant angle (does not need to be acute), ft on their resultant
A1	Cso.
(c)	
M1	Use of Pythagoras to find the magnitude of their resultant force **or** their acceleration
M1	Allow their $\mathbf{R} = 8.5\ m$
A1ft	A correct scalar equation in m only eg $17 = m \times 8.5$, ft on their resultant
A1	cso

Question Number	Scheme	Marks
2(a)	$(-10\mathbf{i}+a\mathbf{j})+(b\mathbf{i}-5\mathbf{j})+(2a\mathbf{i}+7\mathbf{j}) = 3(3\mathbf{i}+4\mathbf{j})$ $a-5+7=12 \Rightarrow a=10$ $-10+b+2a=9 \Rightarrow b=-1$	M1 M1 A1 M1 A1 (5)
(b)	$20\mathbf{i}+20\mathbf{j}=\mathbf{u}+4(3\mathbf{i}+4\mathbf{j})$ $\mathbf{u}=(8\mathbf{i}+4\mathbf{j})$ $u=\sqrt{8^2+4^2}=\sqrt{80}=8.9$ (or better)	M1 A1 M1 A1 (4) **9**
	Notes	
2(a)	First M1 for applying **F** = *m***a**; need all terms but allow slips and allow *m* instead of 3 Second M1 (independent but M0 if they have **0** instead of *m***a**) for equating *coefficients* of **j** First A1 for $a = 10$ Third M1 (independent but M0 if they have **0** instead of *m***a**) for equating *coefficients* of **i** Second A1 for $b = -1$	
(b)	First M1 for applying **v** = **u** + *t***a**; need all terms and must be vector **u** First A1 for 8**i** + 4**j** Second M1 (independent) for finding magnitude of their vector **u** Second A1 for √80 or 8.9 or better	

Question Number	Scheme	Marks
7. (a)	$\tan\theta = \frac{9}{13}$ $\theta = 34.7°$	M1 A1 A1 (3)
(b)	$a(2\mathbf{i}-\mathbf{j})+b(\mathbf{i}+3\mathbf{j})=(9\mathbf{i}+13\mathbf{j})$ $2a+b=9$ $-a+3b=13$ $a=2,\ b=5$ $\mathbf{P}=(4\mathbf{i}-2\mathbf{j})\text{N};\ \mathbf{Q}=(5\mathbf{i}+15\mathbf{j})\text{N}$	M1 A2 M1 M1 A1 A1 A1 A1 (9) **12**
Notes		
7. (a)	M1 for $\tan\theta = 9/13$ or $13/9$ First A1 for a correct equation (allowing for a correct adjustment to their angle in the subsequent working) Second A1 for $\theta = 35^o$ or better or 325° or better	
(b)	First M1 for $\mathbf{P}+\mathbf{Q}=9\mathbf{i}+13\mathbf{j}$ or $\mathbf{P}+\mathbf{Q}=\mathbf{F}$ (can occur anywhere) First A2; Treat as B1 for $a(2\mathbf{i}-\mathbf{j})$ seen or implied; B1 for $b(\mathbf{i}+3\mathbf{j})$ seen or implied. If they use the same a and b, they lose one of the B marks. Second M1 for equating their **i**- cpts *and* their **j**- cpts to produce two equations in two unknowns Third independent M1 for eliminating one unknown from 2 simultaneous equations Third A1 for $a = 2$ oe Fourth A1 for $b = 5$ oe Fifth A1 for $\mathbf{P}=(4\mathbf{i}-2\mathbf{j})$ (N) Sixth A1 for $\mathbf{Q}=(5\mathbf{i}+15\mathbf{j})$ (N) N.B. Can score all the marks if they 'spot' the answers.	

Question Number	Scheme	Marks	Notes
5(a)	$\tan\theta = \frac{2}{3}$	M1	Use trig to find a relevant angle $(56.3°,\ \ 33.7°)$
	Angle is $\theta + 90^{\circ} = 123.69°..$	A1	$124°$ or better (2.16 radians)
		(2)	
(b)	$\mathbf{F}_1 + \mathbf{F}_2 = (a\mathbf{i} + 3\mathbf{j}) + (-4\mathbf{i} + b\mathbf{j})\ (= k(3\mathbf{i} - 2\mathbf{j}))$	M1	Resultant force seen or implied: must be the sum, NOT the difference As a column vector or in **i** / **j** form
	Use direction to form equation in a and b	M1	From ratio of scalars or 2 separate equations involving $k \neq 1$
	$\frac{a-4}{3+b} = \frac{3}{-2}$	A1	Correct unsimplified equation
	$0 = 2a + 3b + 1$ Given answer	A1	Obtain **given answer** from correct working- need to see evidence
		(4)	
		(6)	

QUESTION NUMBER	SCHEME	MARKS
	N.B. They may do (ii) first using the **OR** method to find α (and possibly β) and then use either angle to do (i), using the Sine Rule or Cosine Rule.	
4	  **OR** 	
4(i)	Complete method to find an equation in X only: • Using correct vector triangle with cosine rule: $$129 = X^2 + \left(5\sqrt{3}\right)^2 - 2X \times 5\sqrt{3}\cos 30^\circ$$ • Using correct vector triangle with sine rule to find α: $$\frac{\sqrt{129}}{\sin 30^\circ} = \frac{5\sqrt{3}}{\sin\alpha}$$ $\alpha = 22.4109..^o \Rightarrow \beta = 180^o - 30^o - 22.4109..^o = 127.589..^o$ Then sine rule: $\frac{X}{\sin\beta} = \frac{\sqrt{129}}{\sin 30^\circ} = \frac{5\sqrt{3}}{\sin\alpha}$ or cosine rule: $(5\sqrt{3})^2 = X^2 + 129 - 2X\sqrt{129}\cos\alpha$ or $X^2 = (5\sqrt{3})^2 + 129 - 2\times 5\sqrt{3}\times\sqrt{129}\cos\beta$ to find X. • Using components with magnitude: $$\sqrt{129} = \sqrt{\left(X\cos 30^\circ - 5\sqrt{3}\right)^2 + \left(X\sin 30^\circ\right)^2}$$	M1 A1
	Solves their equation (if quadratic, must include an X term) to find an X value.	M1
	$X = 18$	A1
4(ii)	**EITHER** Finds an equation in β only using their X: e.g. $$\frac{18}{\sin\beta} = \frac{\sqrt{129}}{\sin 30^\circ}$$	M2

	or $18^2 = (5\sqrt{3})^2 + 129 - 2\times 5\sqrt{3}\times\sqrt{129}\cos\beta$ or $\cos\beta = \dfrac{\mathbf{R.Q}}{\lvert\mathbf{R}\rvert\lvert\mathbf{Q}\rvert}$ *where* **R** *is the resultant* $(\beta) = 128^o$ to nearest degree **OR** Finds a relevant angle (not β) first • Using triangle of forces: $\alpha = \sin^{-1}\left(\dfrac{\sin 30^\circ \times 5\sqrt{3}}{\sqrt{129}}\right) = 22.4109^o$ Or: $\alpha = \cos^{-1}\left(\dfrac{18^2 + 129 - (5\sqrt{3})^2}{2\times 18\times\sqrt{129}}\right) = 22.4109^o$ • Using components: Resultant force $= \left(18\cos 30^\circ - 5\sqrt{3}\right)\mathbf{i} + \left(18\sin 30^\circ\right)\mathbf{j}$ Leading to $\tan^{-1}\left(\dfrac{4\sqrt{3}}{9}\right) = 37.589^o$ or $\tan^{-1}\left(\dfrac{9}{4\sqrt{3}}\right) = 52.411^o$ or e.g $\sin^{-1}\left(\dfrac{9}{\sqrt{129}}\right) = 52.411^o$	A1 A1 M1 A1
	Completes the method to find required angle (β) eg • $150^o - \alpha$ or $210^o + \alpha$ • $180^o - 52.411^o$ or $180^o + 52.411^o$ • $90^o + 37.859^o$ or $270^o - 37.859^o$	M1
	$(\beta) = 128^o$ to nearest degree Accept 232°	A1
		(8)
	Notes for question 4	
	N.B. If 150º is used in either the sine or cosine rule, they are using an incorrect vector triangle and no M marks are available.	
(i) **M1** **A1**	Complete method to form an equation in X only. This could involve cosine rule and/or sine rule or components. Note the component forms: $\mathbf{P} = X\cos 30^\circ\,\mathbf{i} + X\sin 30^\circ\,\mathbf{j}$, condone cos/sin confusion $\mathbf{Q} = -5\sqrt{3}\mathbf{i}$ oe (they could have chosen different + directions) Correct equation	

Question Number	Scheme	Marks
7.(i)	$P^2 = 8^2 + 6^2 - 2\times 8\times 6\cos 60^O$	M1A1
	$P = \sqrt{52} = 7.2$ (N) or better	A1
(ii)	$\frac{\sin\alpha}{6} = \frac{\sin 60^O}{\sqrt{52}}$ or $\frac{\sin\beta}{8} = \frac{\sin 60^O}{\sqrt{52}}$ $6^2 = 8^2 + P^2 - 2\times 8\times P\cos\alpha$ or $8^2 = 6^2 + P^2 - 2\times 6\times P\cos\beta$	M1A1 **ft**
	$\alpha = 46.(1..)^o$ $\beta = 73.(897..)$ or $106.(103..)$	A1
	Bearing is 74° to nearest degree	A1 cso
		(7)
	Alternative using column vectors	
(i)	$P^2 = (8\cos 30^0)^2 + (6 - 8\sin 30^0)^2$	M1A1
	$P = \sqrt{52} = 7.2$ (N) or better	A1
(ii)	$\tan\beta = \frac{8\cos 30^0}{6 - 8\sin 30^0}$ or $\sin\beta = \frac{8\cos 30^0}{\sqrt{52}}$ or $\cos\beta = \frac{6 - 8\sin 30^0}{\sqrt{52}}$ or equivalents for $(90^0 - \beta)$	M1A1 **ft**
	$\beta = 73.(897..)^o$ or $(90^0 - \beta) = 16.103\ldots$	A1
	Bearing is 74° to nearest degree	A1
	N.B. If 4 is consistently used instead of 8, max marks are:	
	(i) M1A0A0 (ii) M1A1ftA0A0 i.e. 3/7	
	Notes for qu 7	
7(i)	First M1 for use of the cosine rule (with P, 6, 8 and 60° or their α or (120° – their α).	
	First A1 for a correct equation	
	Second A1 for a correct magnitude	
(ii)	Second M1 for a complete method to find a relevant angle – must be using their P, 60° (or 120°) and either 6 or 8 if using the sine rule or their P, 6, and 8 if using the cosine rule.	
	Third A1 ft for a correct equation, ft on their P	
	Fourth A1 for at least one correct angle, accurate to nearest degree	
	Fifth A1 cso for a correct bearing to nearest degree	
	Alternative using column vectors	
(i)	First M1 for use of Pythagoras with correct structure allowing for sin/cos confusion and sign errors	
	First A1 for a correct equation	
	Second A1 for a correct magnitude	
(ii)	Second M1 for a complete method to find a relevant angle – must be using their P components with correct structure allowing for cos/sin confusion and sign errors	

Question Number	Scheme	Marks
	Third A1 ft for a correct equation, ft on their P components	
	Fourth A1 for at least one correct angle, accurate to nearest degree	
	Fifth A1 cso for a correct bearing to nearest degree	

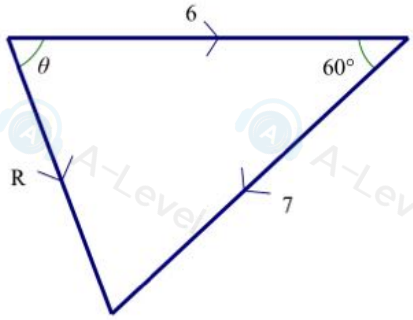
1

Question Number	Scheme	Marks	Notes
5.(a)	$(2\mathbf{i}-3\mathbf{j})+(p\mathbf{i}+q\mathbf{j})=(p+2)\mathbf{i}+(q-3)\mathbf{j}$	M1	Resultant force = $\mathbf{F}_1+\mathbf{F}_2$ in the form $a\mathbf{i}+b\mathbf{j}$
	$\frac{p+2}{q-3}=\frac{1}{2}$ or $\left.\begin{matrix}p+2=n\\q-3=2n\end{matrix}\right\}$ for $n\neq 1$	M1	Use parallel vector to form a scalar equation in p and q.
		A1	Correct equation (accept any equivalent form)
	$4+2p=-3+q$	DM1	Dependent on no errors seen in comparing the vectors. Rearrange to obtain given answer. At least one stage of working between the fraction and the given answer
	$2p-q+7=0$	A1	**Given Answer**
		(5)	
5.(b)	$q=11\Rightarrow p=2$	B1	
	$\mathbf{R}=4\mathbf{i}+8\mathbf{j}$	M1	$(2+p)\mathbf{i}+8\mathbf{j}$ for their p
	$4\mathbf{i}+8\mathbf{j}=2\mathbf{a}$ $(\mathbf{a}=2\mathbf{i}+4\mathbf{j})$	M1	Use of $\mathbf{F}=m\mathbf{a}$
	$\lvert\mathbf{a}\rvert=\sqrt{2^2+4^2}$	DM1	Correct method for $\lvert\mathbf{a}\rvert$ Dependent on the preceding M1
	$=\sqrt{20}=4.5$ or 4.47 or better (m s^{-2})	A1	$2\sqrt{5}$
		(5)	
	Alternative for the last two M marks:		
	$\lvert\mathbf{F}\rvert=\sqrt{16+64}\left(=\sqrt{80}\right)$ M1		Correct method for $\lvert\mathbf{F}\rvert$
	$\sqrt{80}=2\times\lvert\mathbf{a}\rvert$ DM1		Use of $\lvert\mathbf{F}\rvert=m\lvert\mathbf{a}\rvert$ Dependent on the preceding M1
		[10]	

Question Number	Scheme	Marks	Notes
1.	$(2\mathbf{i}+3a\mathbf{j})+(2a\mathbf{i}+b\mathbf{j})+(b\mathbf{i}+4\mathbf{j})=\mathbf{0}$	M1	Use of resultant force = 0 (Seen or implied)
	$2a+b+2=0;\ 3a+b+4=0$	M1	In an equation involving all three forces once and once only, compare **i** or **j** components to form an equation in a and b. Allow with **i** or **j**. $\lambda\mathbf{i}=\mu\mathbf{j}$ is M0
		A1	Two correct scalar equations. No i/j
	$a=-2; b=2$	DM1	Solve simultaneous equations to find a or b. Dependent on the previous M1
		A1	a correct
		A1	b correct
		6	
2(a)	$2mu-km3u=-2m\frac{1}{2}u+kmv$	M1	Conservation of momentum. Must have all four terms but condone sign errors and consistent omission of m or g included in all terms
	$(3u=kv+3ku)$	A2,1,0	-1 for each error. All correct A1A1, one error A1A0, two or more errors A0A0
	$v=(1-k)\frac{3u}{k}$ or $k=\frac{3u}{v+3u}$	A1	Correct expression for v or for kv or for k
	$v>0 \Rightarrow$	M1	Correct inequality for their v
	$\Rightarrow k<1$ *	A1	Reach **given answer** correctly
		(6)	
(b)	$I=2m(\frac{1}{2}u--u)$	M1	Impulse = change in momentum for A or for B. Condone sign errors.
		A1	Correct unsimplified expression in terms of m and u. Allow +/-
	$=3mu$	A1	Correct answer only.
		(3)	
		9	

Question Number	Scheme	Marks
	Third A1 for $4m(0.8u-2u)$ or $-4m(0.8u-2u)$ **OR** for $m(0.8u+4u)$ or $-m(0.8u+4u)$ Fourth A1 for $4.8mu$ (must be positive since magnitude)	
4(i)	$\lvert\mathbf{F}_2\rvert^2 = 8^2+14^2-2\times8\times14\cos30$	M1 A1
	Solve for $\lvert\mathbf{F}_2\rvert$ = 8.1 (N) or better	M1 A1 (4)
	OR: $\lvert\mathbf{F}_2\rvert\cos\alpha = 14\cos30-8$ $\lvert\mathbf{F}_2\rvert\sin\alpha = 14\sin30$	M1 A1
	Solve for $\lvert\mathbf{F}_2\rvert$ = 8.1 (N) or better	M1 A1 (4)
4(ii)	$\frac{\sin\theta}{8} = \frac{\sin30}{8.12467}$ or $\frac{\sin\phi}{14} = \frac{\sin30}{8.12467}$	M1 A1
	Solve: $\theta = 29.49^o$ or $\phi = 120.51^o$	M1 A1
	Bearing is 149° (nearest degree)	A1 (5)
	OR: $\lvert\mathbf{F}_2\rvert\cos\alpha = 14\cos30-8 = 4.124(355.)$ $\lvert\mathbf{F}_2\rvert\sin\alpha = 14\sin30$	M1 A1
	Solve: $\alpha = 59.49^o$	M1 A1
	Bearing is 149° (nearest degree)	A1 (5)
	Notes	
4(i)	First M1 for use of cos rule with 30° First A1 for a correct equation **OR:** First M1 for 'resolving' in 2 directions with 30° / 60° (**N.B.** M0 here if cos/sin confused) First A1 for TWO correct equations Second M1 for solving for $\lvert\mathbf{F}_2\rvert$, independent *but* must be solving a 'correct cosine formula but with wrong angle' if using method 1 **OR** for eliminating α from two equations, independent *but* equations must have the correct structure if using method 2 Second A1 for 8.1 (N) or better	
4(ii)	First M1 for use of sin rule with 30° First A1 for a correct equation (allow 8.12 or better) **OR:** First M1 for 'resolving' in 2 directions with 30° / 60°	

Question Number	Scheme	Marks
	First A1 for TWO correct equations (allow 4.12 or better) Second M1, independent, for solving a 'correct sine formula' for θ or ϕ **OR** independent for solving two equations, with correct structure, for α Second A1 for $\theta =$ **AWRT** 29° or $\phi =$ **AWRT** 121° **OR** $\alpha =$ **AWRT** 59°	
	Third A1 for Bearing is 149° (nearest degree)	
	N.B. First M1A1 Could use cos rule to find an angle	
	N.B. If the resolving method is used and there are no (i) or (ii) labels, only award M1A1 in both cases when an answer is reached.	
5a	$0 = 14.7^2 - 2 \times 9.8h$	M1A1
	$h = 11.025$	A1
	max ht $= 13.5$ or 14 (m)	A1 (4)
5b	$-1.5 = 14.7t - 4.9t^2$	M1A1
	$4.9t^2 - 14.7t - 1.5 = 0$	
	$t = \dfrac{14.7 \pm \sqrt{14.7^2 + 6 \times 4.9}}{9.8}$	**DM1**
	$t = 3.1$ or 3.10 (s)	A1 (4)
5c	$v^2 = 14.7^2 + 2 \times (-9.8) \times (-2.5)$	M1 A1
	$v = 16.3$ or 16 (m s^{-1})	A1 (3)
		11
	Notes	
5a	**N.B.** If they use $g = 9.81$, lose first A mark (once for whole question) but all other A marks can be scored. First M1 for a complete method to find the height (Could involve two *suvat* equations) condone sign errors. First A1 for a correct equation (or equations) Second A1 for $h = 11$ (may be unsimplified) or better (For other methods, give this A1 for any correct (may be unsimplified) intermediate answer) Third A1 for 13.5 or 14 (m)	
5b	First M1 for a complete method to find the required time (they may find the time up (1.5 s) and then add on the time down. Condone sign errors First A1 for a correct equation or equations Second DM1, dependent, for solving to find required time Second A1 for 3.1 or 3.10 (s)	

Question Number	Scheme	Marks
3		
Method 1	Horizontal component $= 6 - 7\cos 60$ (N)	M1A1
	Vertical component (N) $= 7\cos 30$	M1A1
	Use Pythagoras: $\sqrt{2.5^2 + 6.06^2} = \sqrt{43} = 6.6$(N) or better	M1A1
	Use trig: angle = $\tan^{-1}\left(\frac{7\cos 30}{2.5}\right) = 68^o$(below **P**) or better Also allow 112^0, 292^0 or 248^0	M1A1
		(8)
Alt		
	Cosine rule to find $\lvert\mathbf{R}\rvert$: $R^2 = 36 + 49 - 2\times 6\times 7\times\cos 60 \left(= 43\right)$	M2 A2
	R = 6.6 (N) or better	M1 A1
	Solve Sine rule for θ: $\sin^{-1}\left(\frac{7\sin 60}{R}\right)$	M1
	$= 68^o$ or better Also allow 112^0 or 292^0 or 248^0	A1
		[8]
	Notes	
Method 1	First M1 for attempt, allow sin/cos confusion, to find component parallel to **P**	
	First A1 for a correct expression	
	Second M1 for attempt, allow sin/cos confusion to find component perp to **P**	
	First A1 for a correct expression	
	Third M1 for using Pythag to find magnitude of **R**	
	Third A1 for $\sqrt{43}$, 6.6 (N) or better	
	Fourth M1 for complete method to find angle (M0 if 6 used for 'horiz' cpt) Fourth A1 for 68° or better (67.589089…) 112^0 or 292^0 or 248^0	

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Question Number	Scheme	Marks
	Notes	
Alt	First M2 for use of cosine rule with correct structure but allow $\cos 120^o$ and allow R^2 First A2 for a correct equation. (A0 if 120° used) Third M1 for solving for R Third A1 for $\sqrt{43}$, 6.6 (N) or better Fourth M1 for complete method (e.g. sine rule) to find angle between their **R** and **P** Fourth A1 for 68° or better	

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