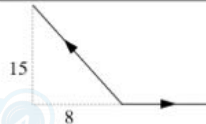


Q	Scheme	Marks	Notes
	<b>Allow column vectors throughout apart from in the answers to (a) and (b).</b>		
2a	Use of $\frac{1}{3}(10\mathbf{i} + 4\mathbf{j} - (-5\mathbf{i} + 16\mathbf{j}))$	M1	Condone subtraction in the wrong order and missing brackets
	$= (5\mathbf{i} - 4\mathbf{j})(\text{ms}^{-1})$	A1	Correct only
		(2)	
2b	$\{-5\mathbf{i} + 16\mathbf{j} - 2(5\mathbf{i} - 4\mathbf{j})\} + t(5\mathbf{i} - 4\mathbf{j})$ <b>OR</b> $\{10\mathbf{i} + 4\mathbf{j} - 5(5\mathbf{i} - 4\mathbf{j})\} + t(5\mathbf{i} - 4\mathbf{j})$	M1	Any equivalent unsimplified form using their $\mathbf{v}$ , with correct structure.
	$= (-15 + 5t)\mathbf{i} + (24 - 4t)\mathbf{j}$	A1	Correct simplified form
		(2)	
2c	Finding <b>AB</b> (or <b>BA</b> ) at $t = 5$ ( <b>AB</b> = $-5\mathbf{i} - 12\mathbf{j}$ ) <b>Must use given <math>\mathbf{r}</math> at <math>t = 5</math>.</b>	M1	Seen or implied, allow slips.
	e.g. $\theta = \tan^{-1}(\pm \frac{5}{12})$ or $\tan^{-1}(\pm \frac{12}{5})$ or $\sin^{-1}(\pm \frac{5}{13})$ or $\sin^{-1}(\pm \frac{12}{13})$ etc etc	M1	Correct use of trig to find a relevant angle, using their <b>AB</b> or <b>BA</b> , seen or implied
	Bearing $203(^{\circ})$	A1	Correct only, to nearest degree.
		(3)	
		(7)	



Question Number	Scheme	Marks
7. (a)	$\tan \theta = \frac{9}{13}$ $\theta = 34.7^\circ$	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)  <b>12</b>
<b>Notes</b>		
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 $\theta = 35^\circ$ or better or $325^\circ$ 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 <u>B1</u> for $a(2\mathbf{i} - \mathbf{j})$ seen or implied; <u>B1</u> for $b(\mathbf{i} + 3\mathbf{j})$ seen or implied. If they use the <u>same</u> $a$ and $b$ , they lose one of the B marks. Second M1 for equating their $\mathbf{i}$ - cpts <i>and</i> their $\mathbf{j}$ - 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
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
	 <p>Find any relevant angle for <b>their</b> (even if they've subtracted) resultant (need not be acute nor positive)</p>	M1
	any of $\tan^{-1}\left(\pm\frac{8}{15}\right), \tan^{-1}\left(\pm\frac{15}{8}\right), \sin^{-1}\left(\pm\frac{8}{17}\right), \cos^{-1}\left(\pm\frac{8}{17}\right), \dots$	A1ft
	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: $\sqrt{\left(\frac{-8}{m}\right)^2 + \left(\frac{15}{m}\right)^2}$	M1
	Use of $ \text{their } \mathbf{R}  = 8.5m$ or their Resultant = $ma$	M1
	A correct equation in $m$ only eg $17 = m \times 8.5$	A1ft
	$m = 2$	A1
	<b>N. B.</b> $\sqrt{\left(\frac{-8}{8.5}\right)^2 + \left(\frac{15}{8.5}\right)^2} \quad \text{M1}$ $-8\mathbf{i} + 15\mathbf{j} = 8.5m \quad \text{M1}$ $\sqrt{\left(\frac{-8}{8.5}\right)^2 + \left(\frac{15}{8.5}\right)^2} = m \quad \text{A1ft}$ $2 = m \quad \text{A1}$	
		(4)
		(10)

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