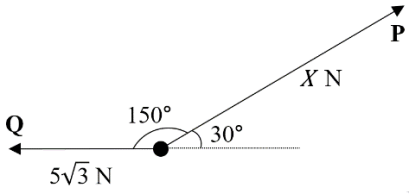
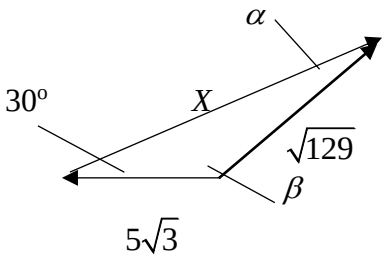
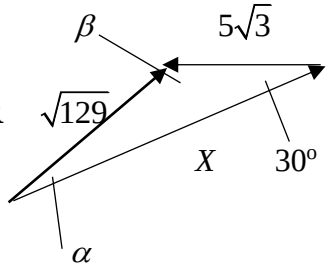
QUESTION NUMBER	SCHEME	MARKS
N.B. They may do (ii) first using the **OR** method to find α (and possibly β) and then use either angle to do (i), using the Sine Rule or Cosine Rule.		
4	  **OR** 	
4(i)	Complete method to find an equation in X only: • Using correct vector triangle with cosine rule: $129 = X^2 + \left(5\sqrt{3}\right)^2 - 2X \times 5\sqrt{3}\cos 30^\circ$ • 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

QUESTION NUMBER	SCHEME	MARKS
4(ii)	**EITHER** Finds an equation in β only using their X: e.g. $\dfrac{18}{\sin\beta}=\dfrac{\sqrt{129}}{\sin 30^\circ}$ or $18^2=(5\sqrt{3})^2+129-2\times5\sqrt{3}\times\sqrt{129}\cos\beta$ 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: $\alpha=\sin^{-1}\left(\dfrac{\sin 30^\circ\times5\sqrt{3}}{\sqrt{129}}\right)$ = 22.4109^o Or: $\alpha=\cos^{-1}\left(\dfrac{18^2+129-(5\sqrt{3})^2}{2\times18\times\sqrt{129}}\right)$ = 22.4109^o • Using components: Resultant force = $\left(18\cos30^\circ-5\sqrt{3}\right)\mathbf{i}+\left(18\sin30^\circ\right)\mathbf{j}$ 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	M2 A1 A1 M1 A1
	Completes the method to find required angle (β) eg • $150^o-\alpha$ or $210^o+\alpha$ • 180° – 52.411^o or 180° + 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 150° is used in either the sine or cosine rule, they are using an incorrect vector triangle and no M marks are available.		
(i)		
M1	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)	
A1	Correct equation	
M1	Provided they have found an X value, not necessarily correctly, this mark can be awarded.	
A1	Correct answer. If seen, a negative value must be rejected.	
(ii)	**EITHER**	
M2	Complete method to find an equation in β only	
A1	Correct equation	
A1	cao	
	OR	
M1	Complete method to find a relevant angle	
A1	Correct relevant angle: $22.4109^o, 37.589^o, 52.411^o$	
M1	Completes the method to find the required angle	
A1	cao	