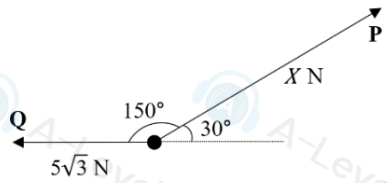
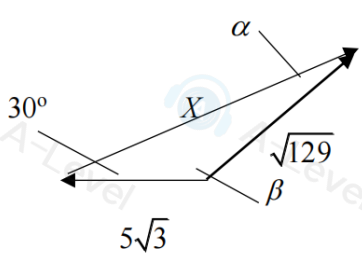
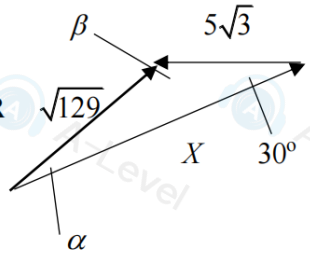
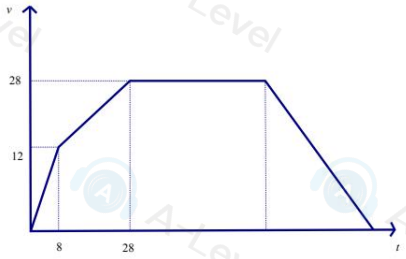
Question	Scheme	Marks	Notes
6. (a)	$\mathbf{v}=(10\mathbf{i}+4\mathbf{j})+6(-2\mathbf{i}+3\mathbf{j})$	M1	Use of $\mathbf{v}=\mathbf{u}+\mathbf{a}t$ with $t=6$
	$=-2\mathbf{i}+22\mathbf{j}$	A1	
	$\tan\theta=\pm\frac{22}{2}$ or $\tan\theta=\pm\frac{2}{22}$	M1	Correct use of trig to find a relevant angle for their $\mathbf{v}$
	$\theta=85^\circ$ or 5°	A1	Seen or implied
	bearing is 355°	A1	
		(5)	
(b)	$\mathbf{v}=(10\mathbf{i}+4\mathbf{j})+t(-2\mathbf{i}+3\mathbf{j})$	M1	Use of $\mathbf{v}=\mathbf{u}+\mathbf{a}t$
	$\left(=(10-2t)\mathbf{i}+(4+3t)\mathbf{j}\right)$	A1	Correct unsimplified
	$(10-2t)=(4+3t)$	DM1	Equate coefficients to give equation in t only
	$t=1.2$	A1	
		(4)	
		[9]	

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^o	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	Notes
6(a)	$v_1 = 8\times1.5\ (=12)$	M1	Use of $v = u + at$ or equivalent for $t = 8$
	$v_2 = 12 + 0.8\times20$	M1	Follow their 12
	$v_2 = 28$ m s^{-1}	A1 (3)	
(b)		B1 B1ft	shape nos: 8,28; 12,28 indicated. Follow their 12, 28
		(2)	
(c)	first 8 s: dist = $\frac{1}{2}\times8\times12\ \ (=48)$	M1 A1ft	Correct method for distance for the triangle (0-8) or the trapezium (8-28) Follow their 12
	next 20 s: dist = $\frac{1}{2}\times(12+28)\times20\ \ (=400)$	A1ft	Follow their 12, 28
	Total dist = 448 m	A1 (4)	Correct answer only (cao)
(d)	$0 = 28^2 - 2\times2.8s$	M1	Find area of right hand triangle or an expression in T for the trapezium (rectangle + triangle).
	$s = \frac{28^2}{2\times2.8}\ (=140)$	A1ft	Follow their 28
	$448 + 140 + 28T = 2000$	DM1	Form an equation in T for their 16, 448 and 140
	$T = \frac{2000-448-140}{28} = 50.4$	A1 (4)	Or better (50.42857...) Accept 50.
		[13]	

Question Number	Scheme	Marks
6(a)	Speed $= \sqrt{4^2+5^2} = \sqrt{41}$ or 6.4031...m s^{-1} (Accept 6.4 or better)	M1A1 (2)
(b)	$(\mathbf{r} =)(3\mathbf{i}-2\mathbf{j})+t(4\mathbf{i}+5\mathbf{j})$.	M1A1 (2)
(c)	**j** comp $= 6$	
	$5T-2=6$	M1
	$T=\frac{8}{5}\ (=1.6)$	A1 (2)
(d)	$t=1.6 \Rightarrow (\mathbf{r} =)(3+(4\times1.6))\mathbf{i}\ (+6\mathbf{j})$	M1A1**ft**
	boy travels $9.4-1=8.4$ m (allow 8.4**i**)	A1
	$\frac{8.4}{1.6}$ or $\frac{8.4\mathbf{i}}{1.6}$	**DM**1
	$v=5.25$	A1 (5) **[11]**

	Notes for qu 6
6a	M1 for attempt to find magnitude of velocity
	A1 6.4 or better
6b	M1 for attempt at pv with correct structure i.e. $\mathbf{r}_0 + t\mathbf{v}$
	A1 for a correct expression seen (ie use isw)
6c	M1 for equating **j** cpt of their **r** to 6 (Must be of form: $a+bT=6$ oe)
	A1 for 1.6 oe
6d	First M1 for substituting their answer for (c), their T, into **i** cpt of their answer for (b) oe
	First A1 **ft** , with or without **i**
	Second A1 for 8.4 or 8.4**i** cao
	Second DM1, dependent on first M1, for dividing their distance or vector (*c***i**) by their T (> 0) value to find the value of v. (9.4/T oe is DM0)
	Third A1 for 5.25 cao

3.(a)	$\tan\alpha = 1/3 \Rightarrow \alpha = 18.4^{o}$	M1 A1
	Bearing is 288° (nearest degree)	A1 (3)
(b)	$\mathbf{r} = (21\mathbf{i} + 5\mathbf{j}) + t(-6\mathbf{i} + 2\mathbf{j})$	B1 (1)
(c)	$21 - 6t = -(5 + 2t)$	M1 A1
	$t = 6.5$	A1 (3)
		7

NOTES

Question 3(a)

First M1 for $\arctan(\frac{\pm 2}{\pm 6})$

First A1 for a correct value from their expression, usually 18.4^{o} or 71.6^{o}

Second A1 for 288 (nearest degree)

Question 3(b)

B1 for $(21\mathbf{i} + 5\mathbf{j}) + t(-6\mathbf{i} + 2\mathbf{j})$

Question 3(c)

M1 for equating the negative of their **i**-component to their **j**-component oe

Allow equating the components for the M mark.

First A1 for a correct equation.

Second A1 for $t = 6.5$