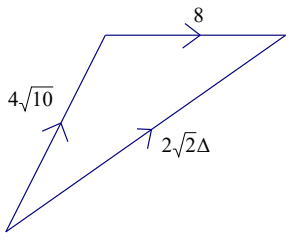
5a	Impulse-momentum equation.	M1	Dimensionally correct. Subtraction seen or implied. Condone subtraction in wrong order.
	$(\pm\mathbf{I}=)$ $2(\lambda\mathbf{i}+\lambda\mathbf{j})-2(4\mathbf{i})\left(=(2\lambda-8)\mathbf{i}+2\lambda\mathbf{j}\right)$	A1	Or equivalent Ignore $4\sqrt{10}$ if seen here
	$\left(\lvert\mathbf{I}\rvert^2=\right)160=(2\lambda-8)^2+(2\lambda)^2$	DM1	Use of Pythagoras to obtain an equation in λ Dependent on the previous M1
	$\left(\Rightarrow 0=\lambda^2-4\lambda-12\right)$	A1	Or any correct unsimplified equation in λ
	$\Rightarrow(\lambda=)6$	A1	Correct only.
	SC Allow 5/5 in (a) if working with **-I.** They will lose marks later.		
		[5]	
5a alt	Form vector triangle for impulse or for momentum.	M1	Dimensionally correct. Must be subtracting. Condone subtraction in wrong order.
	Correct triangle	A1	 e.g.
	$160=64+8\lambda^2-32\sqrt{2}\lambda\times\frac{1}{\sqrt{2}}$	DM1	Use of Cosine Rule to obtain an equation in λ Dependent on the previous M1
	$\Rightarrow 0=8\lambda^2-32\lambda-96$	A1	Or equivalent equation in λ
	$\Rightarrow(\lambda=)6$	A1	Correct only
		[5]	
5b	$\mathbf{I}=4\mathbf{i}+12\mathbf{j}$	B1ft	Follow their λ $\left(\mathbf{I}=(2\lambda-8)\mathbf{i}+2\lambda\mathbf{j}\right)$ B0 for a column vector. B0 if still in terms of lambda. Ignore second solution for negative lambda if seen
		[1]	
5c	$\tan\theta°=\frac{12}{4}$ or $\cos\theta°=\frac{16}{4\times4\sqrt{10}}$	M1	Correct use of trig or scalar product for the required angle with *their* **I** provided both components are non-zero Do not allow for the reciprocal
	$\theta=72$	A1	72 or better (71.56505…) from correct work only Ignore second solution for negative lambda if seen
		[2]	