Question	Scheme	Marks	AOs
3(a)	$(4\mathbf{i}-\mathbf{j})+(\lambda\mathbf{i}+\mu\mathbf{j})=(4+\lambda)\mathbf{i}+(-1+\mu)\mathbf{j}$	M1	3.4
	Use **ratios** to obtain an equation in λ and μ *only*	M1	2.1
	$\dfrac{(4+\lambda)}{(-1+\mu)}=\dfrac{3}{1}$ or $\dfrac{\frac{1}{4}(4+\lambda)}{\frac{1}{4}(-1+\mu)}=\dfrac{3}{1}$	A1	1.1b
	$\lambda-3\mu+7=0$ * Allow $0=\lambda-3\mu+7$ but nothing else.	A1*	1.1b
		(4)	
(b)	$\lambda=2 \Rightarrow \mu=3$; Resultant force $=(6\mathbf{i}+2\mathbf{j})$ (N)	M1	3.1a
	$(6\mathbf{i}+2\mathbf{j})=4\mathbf{a}$ **OR** $\lvert(6\mathbf{i}+2\mathbf{j})\rvert=4a$	M1	1.1b
	Use of $\mathbf{r}=\mathbf{u}t+\frac{1}{2}\mathbf{a}t^2$ with $\mathbf{u}=\mathbf{0}$, their $\mathbf{a}$ and $t=4$: **Or** they may integrate their $\mathbf{a}$ twice with $\mathbf{u}=\mathbf{0}$ and put $t=4$: $\mathbf{r}=\frac{1}{2}\times\frac{(6\mathbf{i}+2\mathbf{j})}{4}4^2=(12\mathbf{i}+4\mathbf{j})$	DM1	2.1
	$\sqrt{12^2+4^2}$	M1	1.1b
	ALTERNATIVE 1 for last two M marks: Use of $s=ut+\frac{1}{2}at^2$, with $u=0$, their a and $t=4$: DM1 $s=\frac{1}{2}\times\sqrt{1.5^2+0.5^2}\times4^2$ Use of Pythagoras to find mag of $\mathbf{a}$: $a=\sqrt{1.5^2+0.5^2}$ M1		
	ALTERNATIVE 2 for last two M marks: Use of $s=ut+\frac{1}{2}at^2$, with $u=0$, their a and $t=4$: DM1 $s=\frac{1}{2}\times\left(\frac{\sqrt{6^2+2^2}}{4}\right)\times4^2$ Use of Pythagoras to find $\lvert(6\mathbf{i}+2\mathbf{j})\rvert$: $=\sqrt{6^2+2^2}$ M1		
	$\sqrt{160}$, $2\sqrt{40}$, $4\sqrt{10}$ oe or 13 or better (m)	A1	1.1b
		(5)	
			(9 marks)

Notes: Accept column vectors throughout

3a	M1	Adding the two forces, **i**'s and **j**'s must be collected (or must be a **single** column vector) seen or implied
	M1	Must be using ratios; Ignore an equation e.g. $(4+\lambda)\mathbf{i}+(-1+\mu)\mathbf{j}=3\mathbf{i}+\mathbf{j}$ if they go on to use ratios.

		However, if they write $4+\lambda=3$ and $-1+\mu=1$ then $3(-1+\mu)=3$ so $4+\lambda=3(-1+\mu)$ with no use of a constant, it's M0 They may use the acceleration, with a factor of $\frac{1}{4}$ top and bottom, see alternative **Allow one side of the equation to be inverted**
	A1	Correct equation
	A1*	Given answer correctly obtained. Must see at least one line of working, with the LH fraction 'removed'**.**
3b	M1	Adding $\mathbf{F}_1$ and $\mathbf{F}_2$ to find the resultant force, λ and μ must be substituted **N.B.** M0 if they use $\mu=2$ coming from $-1+\mu=1$ in part (a).
	M1	Use of $\mathbf{F}=4\mathbf{a}$ Or $\lvert\mathbf{F}\rvert=4a$, where **F** is <u>their</u> resultant. (including 3**i** + **j**) This is an independent mark, so could be earned, for example, if they have subtracted the forces to find the 'resultant' **N.B.** M0 if only using $\mathbf{F}_1$ or $\mathbf{F}_2$
	DM1	Dependent on previous M mark for **Either**: use of $\mathbf{r}=\mathbf{u}t+\frac{1}{2}\mathbf{a}t^2$ with **u** = **0**, their **a** and t = 4 to produce a displacement vector **Or** : integrate twice, with **u** = **0**, their **a** and t = 4 to produce a displacement Vector **Or**: use of $s=ut+\frac{1}{2}at^2$ with u = 0, their a and t = 4 to produce a length
	M1	Use of Pythagoras, with square root, to find the magnitude of their displacement vector, **a** or **F** **(**M0 if only using $\mathbf{F}_1$ or $\mathbf{F}_2$) depending on which method they have used.
	A1	cao