Question Number	Answer	Mark
4(a)	Resultant force $(3\mathbf{i}+\mathbf{j})+(5\mathbf{i}-16\mathbf{j}) = ...\mathbf{i}+...\mathbf{j}$	M1
	N2L $\left\|(3+5)\mathbf{i}+(1-16)\mathbf{j}\right\| = 68m$	M1
	Magnitude $\sqrt{8^2+(-15)^2}$	M1
	$m = 0.25$ o.e.	A1
		(4)
4(b)	$(3\mathbf{i}+\mathbf{j})+k(5\mathbf{i}-16\mathbf{j}) = ...\mathbf{i}+...\mathbf{j}$	M1
	Correct method using the direction vector $\pm(-\mathbf{i}+2\mathbf{j})$ to form an equation in k only	M1
	$\frac{3+5k}{1-16k} = -\frac{1}{2}$	A1
	$k = \frac{7}{6}$	A1
		(4)
		(8)
	Notes for Question 4	
	Accept column vectors throughout	
4(a)		
M1	Find the resultant force by finding the sum of $\mathbf{F_1}$ and $\mathbf{F_2}$ only and collect **i**'s and **j**'s. If no addition is explicitly seen, one correct component sum can imply a correct method. M0 for the difference of $\mathbf{F_1}$ and $\mathbf{F_2}$	
M1	Use of N2L with their resultant force (must come from a vector sum). M0 if a weight term is included. Condone $(3+5)\mathbf{i}+(1-16)\mathbf{j} = 68m$	
M1	Use of Pythagoras to find the magnitude of their resultant force (must come from a vector sum). Condone use of Pythagoras on mass written as a vector. If no addition is explicitly seen, one correct component sum can imply a correct method. M0 if a weight term is included. M0 for magnitude of separate vectors $\lvert\mathbf{F_1}\rvert$ or $\lvert\mathbf{F_2}\rvert$	
A1	Correct answer.	
4(b)		
M1	Find the resultant force in terms of k and collect **i**'s and **j**'s	

	If no addition is explicitly seen, one correct component sum can imply a correct method i.e. one of $(3+5k)$ or $(1-16k)$	
M1	Use direction $\pm(-\mathbf{i}+2\mathbf{j})$ with their **i** and **j** components, to form an equation in *k* only. Accept equivalent forms. May use $(3+5k)\mathbf{i}+(1-16k)\mathbf{j}=\lambda(-\mathbf{i}+2\mathbf{j})$ where $\lambda \neq 1$ and equate components to form an equation in *k* only. May use scalar product correctly to form an equation in *k* only $\begin{pmatrix}3+5k\\1-16k\end{pmatrix}\bullet\begin{pmatrix}2\\1\end{pmatrix}=0 \Rightarrow 2(3+5k)+1(1-16k)=0$ Condone **i** and **j** appearing in fraction.	
A1	Correct unsimplified equation in *k* only.	
A1	Correct exact answer. Allow $1.1\dot{6}$ (with recurring notation).	

5. A motor race between two cars, A and B, takes place on a straight horizontal track.

At time $t = 0$, A has speed $35\,\text{m s}^{-1}$ and is 1 km from the finishing line. It then moves with constant acceleration $0.4\,\text{m s}^{-2}$ until it reaches the finishing line at time $t = T$ seconds.

(a) Find the value of T.

(3)

At time $t = 0$, B has speed $44\,\text{m s}^{-1}$ and is 200 m behind A.

Car B then moves with constant acceleration $0.5\,\text{m s}^{-2}$ until it reaches the finishing line.

(b) Find the length of time, from the instant when the speed of B is $9.5\,\text{m s}^{-1}$ **greater than** the speed of A, to the instant when B catches up with A.

(7)