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**3.** [*In this question* **i** *and* **j** *are perpendicular horizontal unit vectors.*]

Three forces, $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$, are given by

$$\mathbf{F}_1 = (5\mathbf{i} + 2\mathbf{j})\,\text{N} \qquad \mathbf{F}_2 = (-3\mathbf{i} + \mathbf{j})\,\text{N} \qquad \mathbf{F}_3 = (a\mathbf{i} + b\mathbf{j})\,\text{N}$$

where $a$ and $b$ are constants.

The forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ act on a particle $P$ of mass 4 kg.

Given that $P$ rests in equilibrium on a smooth horizontal surface under the action of these three forces,

(a) find the size of the angle between the direction of $\mathbf{F}_3$ and the direction of $-\mathbf{j}$.

**(4)**

The force $\mathbf{F}_3$ is now removed and replaced by the force $\mathbf{F}_4$ given by $\mathbf{F}_4 = \lambda(\mathbf{i} + 3\mathbf{j})\,\text{N}$, where $\lambda$ is a positive constant.

When the three forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_4$ act on $P$, the acceleration of $P$ has magnitude $3.25\ \text{m s}^{-2}$

(b) Find the value of $\lambda$.

**(5)**

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**Question 3 continued**

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**Question 3 continued**

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**Question 3 continued**

**Q3**

**(Total 9 marks)**