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3. [In this question  $\mathbf{i}$  and  $\mathbf{j}$  are perpendicular horizontal unit vectors.]

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

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

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)



### Question 3 continued

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**(Total 9 marks)****Q3**

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