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**TG 3**

Let  $A$  and  $B$  be points with position vectors  $\vec{a} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}$  and  $\vec{b} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$  respectively.

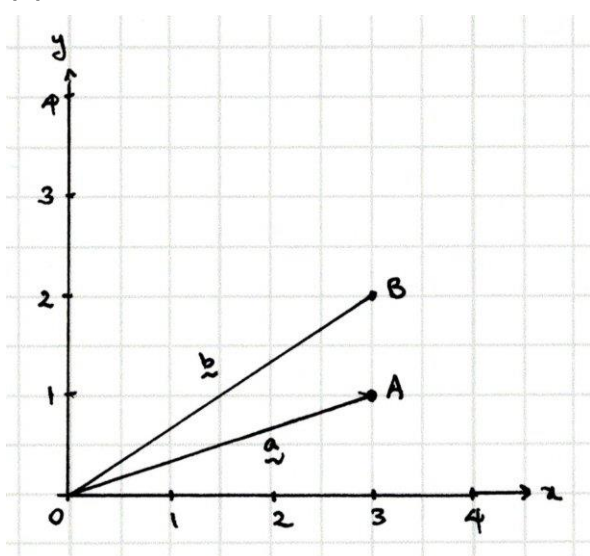
(a) Draw a diagram showing the points  $O$ ,  $A$  and  $B$ .

(b) Calculate the angle  $AOB$

(i) by finding the tangents of the angles  $\alpha$  and  $\beta$  between  $\vec{a}$  and the unit vector  $\vec{i}$ , and  $\vec{b}$  and the unit vector  $\vec{j}$ , and using the formula for  $\tan(\alpha - \beta)$ .

(ii) by using a method based on scalar products.

(a)



(b)(i) Let  $\angle BOx = \alpha$

$$\therefore \tan \alpha = \frac{2}{3}$$

Let  $\angle AOx = \beta$

$$\therefore \tan \beta = \frac{1}{3}$$

$$\tan(\alpha - \beta) = \frac{\tan \alpha - \tan \beta}{1 + \tan \alpha \tan \beta}$$

$$= \frac{\frac{2}{3} - \frac{1}{3}}{1 + \frac{2}{3} \times \frac{1}{3}}$$

$$= \frac{\frac{1}{3}}{1 + \frac{2}{9}}$$

$$= \frac{\frac{1}{3}}{\frac{11}{9}}$$

$$= \frac{3}{11}$$

$$\therefore \angle AOB = \tan^{-1} \frac{3}{11} = 15^\circ 15' \text{ (nearest min)}$$

(ii)  $|\vec{a}| = \sqrt{3^2 + 1^2}$

$$= \sqrt{10}$$

$$|\vec{b}| = \sqrt{3^2 + 2^2}$$

$$= \sqrt{13}$$

$$\cos \angle AOB = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}| |\vec{b}|}$$

$$= \frac{3 \times 3 + 1 \times 2}{\sqrt{10} \times \sqrt{13}}$$

$$= \frac{11}{\sqrt{130}}$$

$$\angle AOB = 15^\circ 15' \text{ (nearest min)}$$

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