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$$\overrightarrow{OA} = \begin{pmatrix} 6 \\ -2 \\ -6 \end{pmatrix} \quad \text{and} \quad \overrightarrow{OB} = \begin{pmatrix} 3 \\ k \\ -3 \end{pmatrix},$$

where  $k$  is a constant.

(i) Find the value of  $k$  for which angle  $AOB$  is  $90^\circ$ .

[2]

This image shows a blank sheet of white paper with ten horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and extend across the width of the page. There is no handwriting or other markings on the paper.

**(ii)** Find the values of  $k$  for which the lengths of  $OA$  and  $OB$  are equal.

[2]

[illegible]

The point  $C$  is such that  $\overrightarrow{AC} = 2\overrightarrow{CB}$ .

(iii) In the case where  $k = 4$ , find the unit vector in the direction of  $\overrightarrow{OC}$ . [4]

[illegible]