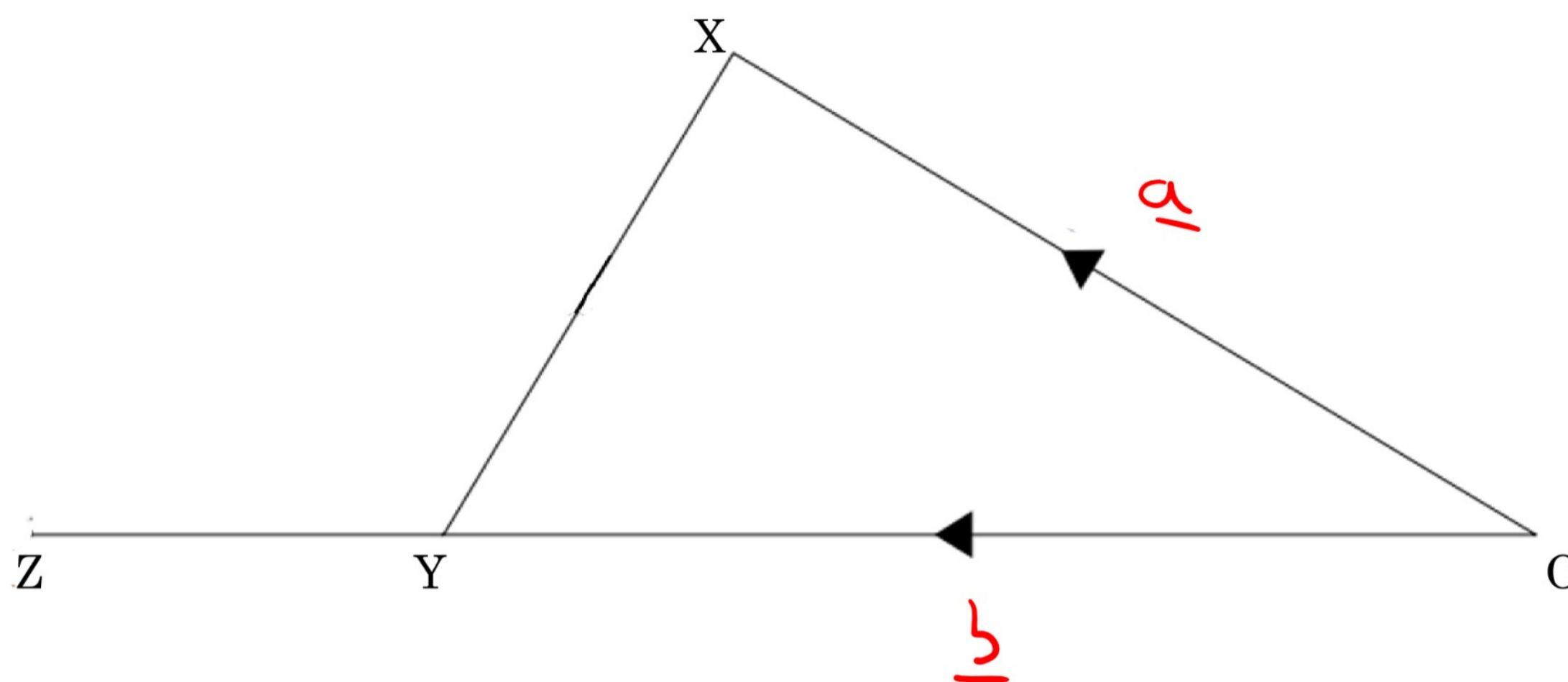


Vectors Exam Practice



Q1. In the diagram below, $\vec{OX} = \mathbf{a}$, $\vec{OY} = \mathbf{b}$, and OYZ is a straight line.



a) Find \vec{XY} in terms of \mathbf{a} and \mathbf{b}

$$\begin{aligned}\vec{XY} &= -\underline{\underline{a}} + \underline{\underline{b}} \\ &= \underline{\underline{b}} - \underline{\underline{a}}\end{aligned}$$

Answer: $\underline{\underline{b}} - \underline{\underline{a}}$
(2 marks)

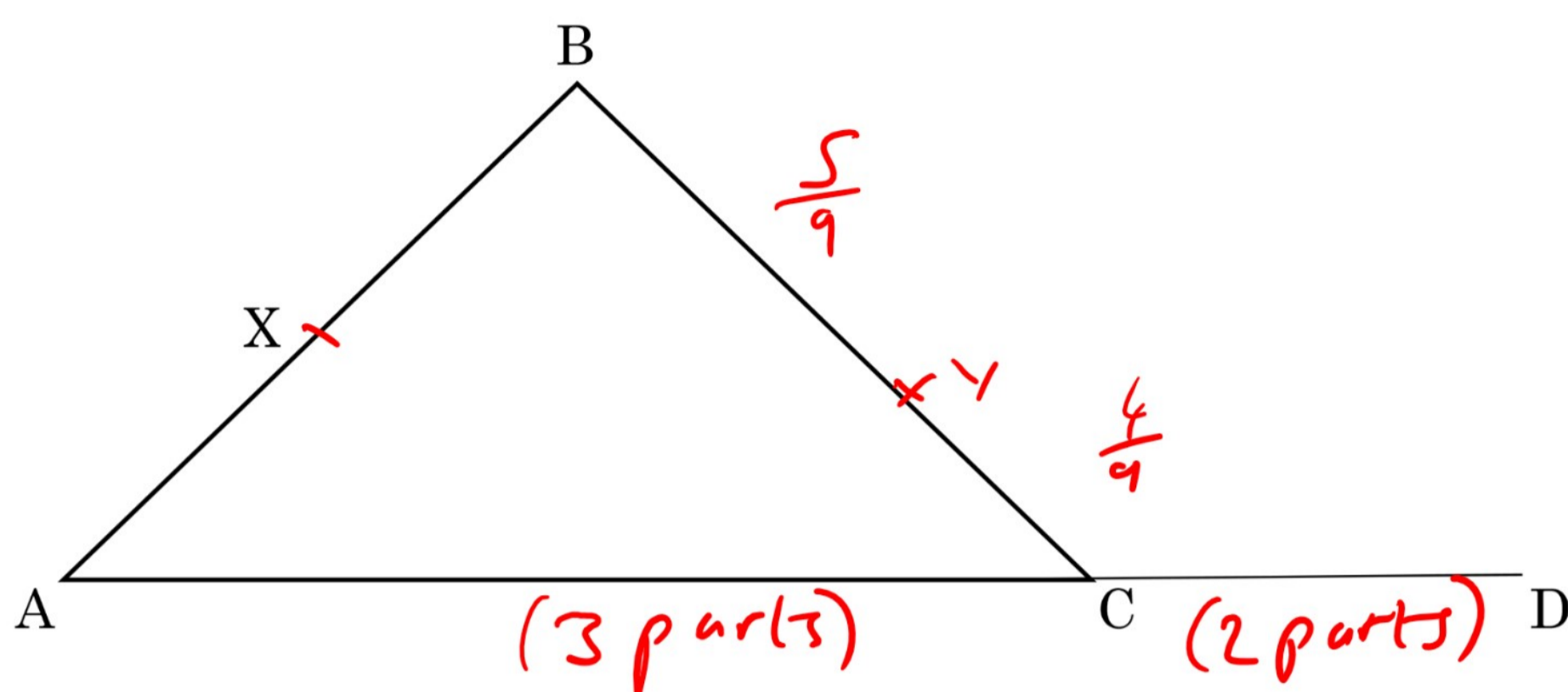
b) Given that Y divides the line OZ so that YZ : OY is 3 : 5, find \vec{ZX} in terms of \mathbf{a} and \mathbf{b}

$$\begin{aligned}\vec{ZX} &= \vec{ZY} + \vec{YX} \\ &= -\frac{3}{5}\underline{\underline{b}} + -(\underline{\underline{b}} - \underline{\underline{a}}) \\ &= -\frac{3}{5}\underline{\underline{b}} - \underline{\underline{b}} + \underline{\underline{a}}\end{aligned}$$

Answer: $\underline{\underline{a}} - \frac{8}{5}\underline{\underline{b}}$
(3 marks)



Q2. In the triangle ABC below, X is the midpoint of AC, and Y is on the line BC so that $BY : YC$ is $5 : 4$, and $AC : AD$ is $3 : 5$.



Prove that XYD is not a straight line.

$$\cdot \text{ let } \underline{a} = \overrightarrow{AB}, \quad \underline{c} = \overrightarrow{AC} \quad \Rightarrow \quad \overrightarrow{BC} = \underline{c} - \underline{a}$$

$$\cdot \quad \overrightarrow{XY} = \frac{1}{2} \underline{a} + \frac{5}{9} (\underline{c} - \underline{a})$$
$$= -\frac{1}{10} \underline{a} + \frac{5}{9} \underline{c}$$

$$\cdot \quad \overrightarrow{YD} = \frac{4}{9} (\underline{c} - \underline{a}) + \frac{2}{3} \underline{c}$$

$$\cdot \quad = \frac{10}{9} \underline{c} - \frac{4}{9} \underline{a}$$

$$= -\frac{4}{9} \underline{a} + \frac{10}{9} \underline{c}$$

Answer: _____

(5 marks)

$$\cdot \text{ Comparing the } \underline{a}'\text{s in } \overrightarrow{XY}, \overrightarrow{YD} : -\frac{4}{9} \div -\frac{1}{10} = \frac{40}{9}$$

$$\cdot \text{ Comparing the } \underline{c}'\text{s in } \overrightarrow{XY}, \overrightarrow{YD} : \frac{10}{9} \div \frac{5}{9} = 2$$

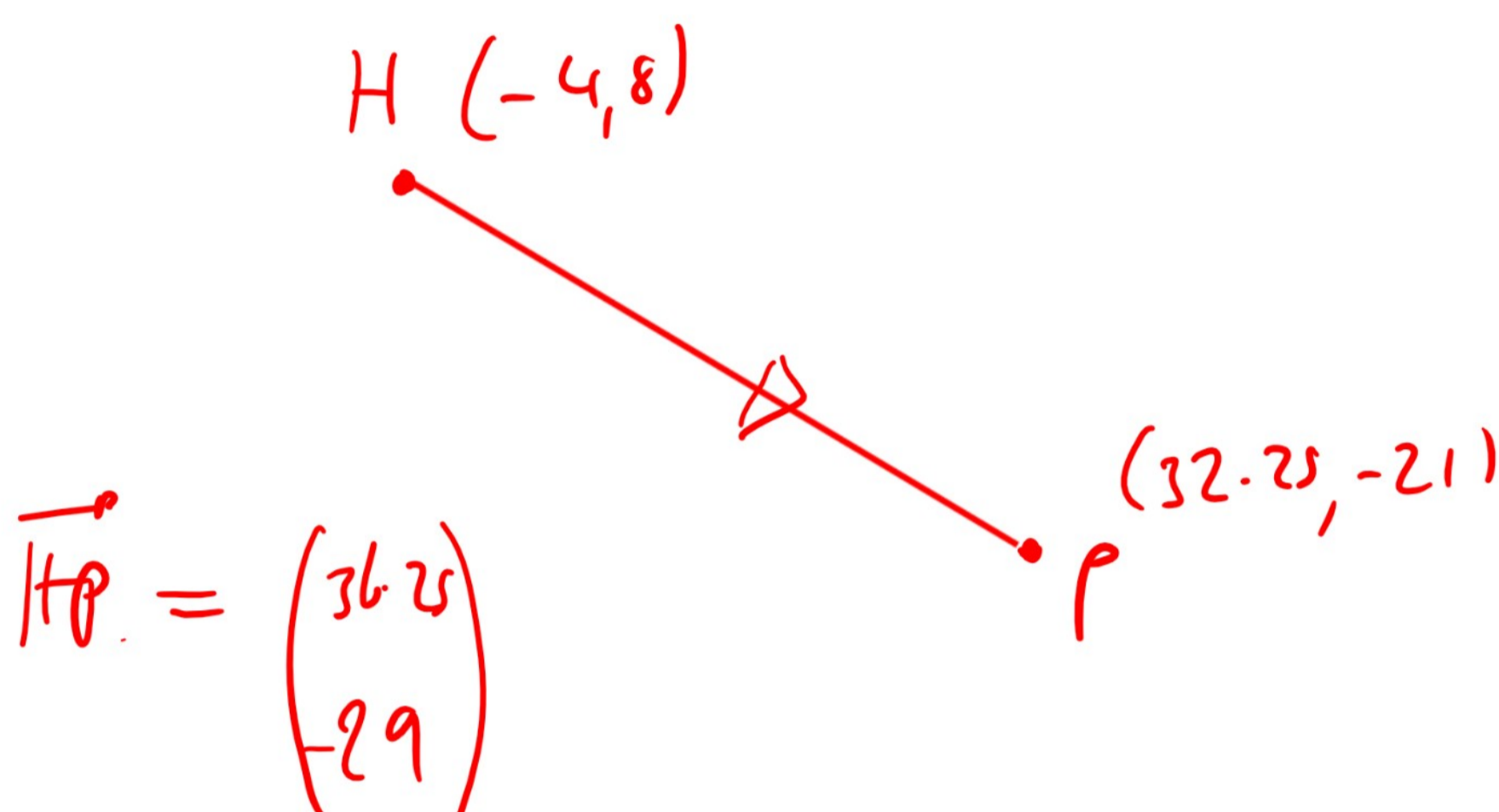
$$\therefore \overrightarrow{XY} \neq k \overrightarrow{YD} \text{ for any value of } k.$$

\therefore XYD is not a straight line.



Q3. A ship sets off from a harbour H, which is located at $(-4, 8)$ and is heading towards a port P which is located at $(32.25, -21)$.
The ship is travelling at $\begin{pmatrix} 5 \\ -4 \end{pmatrix}$ km/hour.

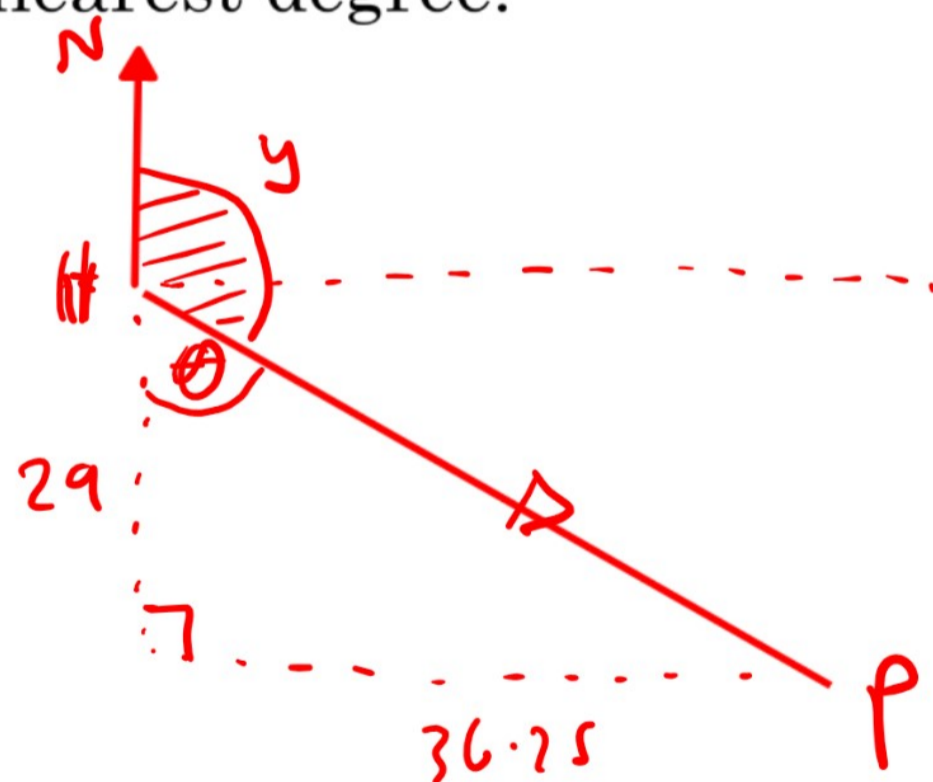
a) Find what time the boat reaches the port if it sets off at 3.15pm.



$$\vec{HP} = 7.5 \begin{pmatrix} 5 \\ -4 \end{pmatrix} \Rightarrow 7.5 \text{ hours}$$

Answer: 10.45 pm
(3 marks)

b) Calculate the bearing on which the ship is travelling. Give your answer to the nearest degree.



$$\theta = \tan^{-1} \left(\frac{36.25}{29} \right) = 51.34^\circ$$

$$\text{Bearing } y = 180 - 51.34 = 128.65^\circ$$

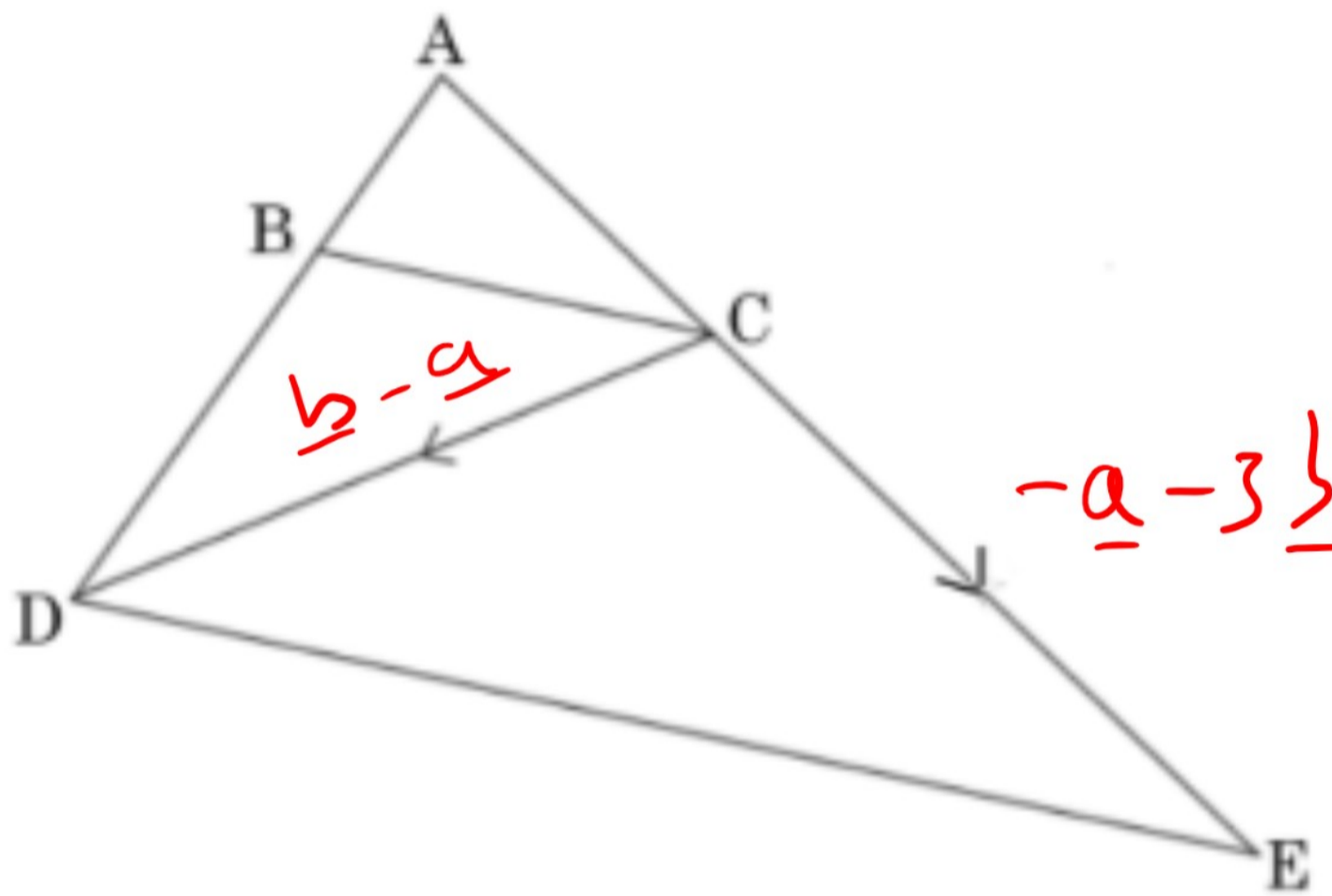
Answer: 129°
(3 marks)



Q4. In the diagram below, ADE is a triangle.

You are given that $\overrightarrow{CD} = \mathbf{b} - \mathbf{a}$, and $\overrightarrow{CE} = -\mathbf{a} - 3\mathbf{b}$, and that $\overrightarrow{CA} = \frac{1}{3}\overrightarrow{EC}$ and that $\overrightarrow{AB} = -\frac{1}{3}\mathbf{a}$

Prove that BC is parallel to DE.



$$\begin{aligned}\overrightarrow{ED} &= \overrightarrow{EC} + \overrightarrow{CD} \\ &= \mathbf{a} + 3\mathbf{b} + \mathbf{b} - \mathbf{a} \\ &= 4\mathbf{b}\end{aligned}$$

$$\begin{aligned}\overrightarrow{ED} &= 4\overrightarrow{CB} \\ \therefore \overrightarrow{ED} &\text{ is a } \\ &\text{multiple of } \overrightarrow{CB}\end{aligned}$$

$$\begin{aligned}\overrightarrow{CB} &= \overrightarrow{CA} + \overrightarrow{AB} \\ &= \frac{1}{3}(\mathbf{a} + 3\mathbf{b}) - \frac{1}{3}\mathbf{a} \\ &= \frac{1}{3}\mathbf{a} + \mathbf{b} - \frac{1}{3}\mathbf{a} \\ &= \mathbf{b}\end{aligned}$$

Answer: _____

(5 marks)