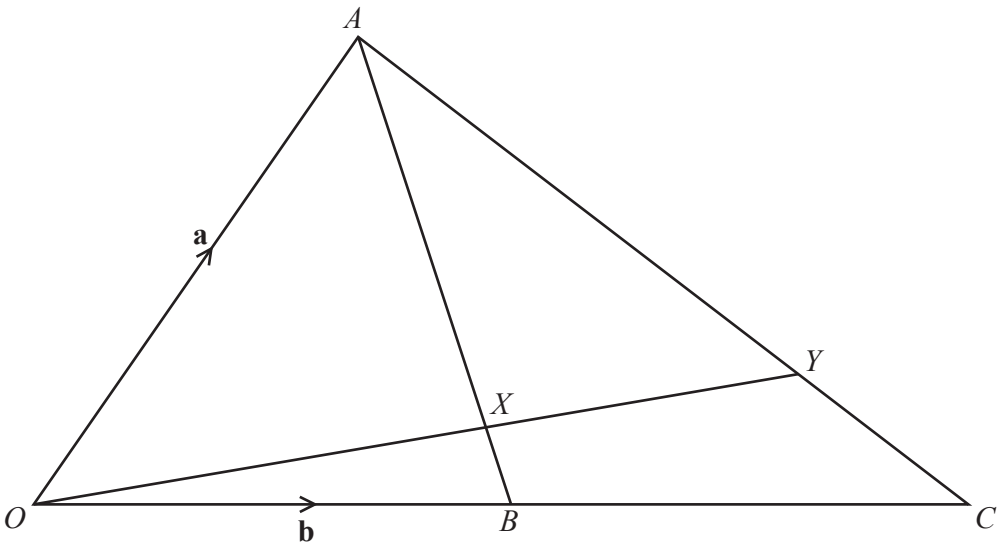
9



The diagram shows the triangle OAC. The point B is the midpoint of OC. The point Y lies on AC such that OY intersects AB at the point X where $AX : XB = 3:1$. It is given that $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Find $\overrightarrow{OX}$ in terms of **a** and **b**, giving your answer in its simplest form. [3]

(b) Find $\overrightarrow{AC}$ in terms of **a** and **b**. [1]

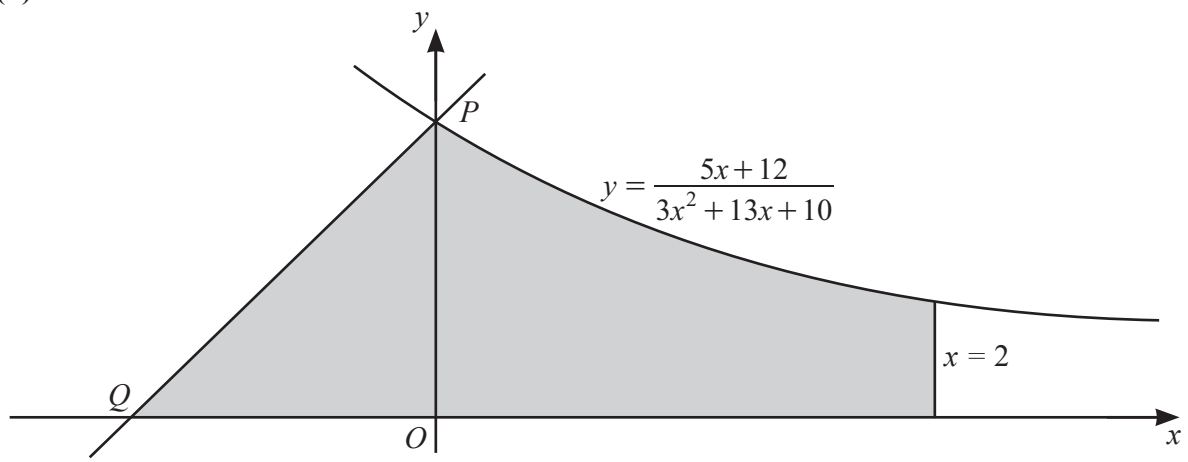
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(c) Given that $\overrightarrow{OY} = h\overrightarrow{OX}$, find $\overrightarrow{AY}$ in terms of **a**, **b** and h. [1]

(d) Given that $\overrightarrow{AY} = m\overrightarrow{AC}$, find the value of h and of m. [4]

10 **(a)** Show that $\frac{1}{x+1}+\frac{2}{3x+10}$ can be written as $\frac{5x+12}{3x^2+13x+10}$. [1]

(b)



The diagram shows part of the curve $y=\frac{5x+12}{3x^2+13x+10}$, the line $x=2$ and a straight line of gradient 1. The curve intersects the y-axis at the point P. The line of gradient 1 passes through P and intersects the x-axis at the point Q. Find the area of the shaded region, giving your answer in the form $a+\frac{2}{3}\ln\left(b\sqrt{3}\right)$, where a and b are constants. [9]

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