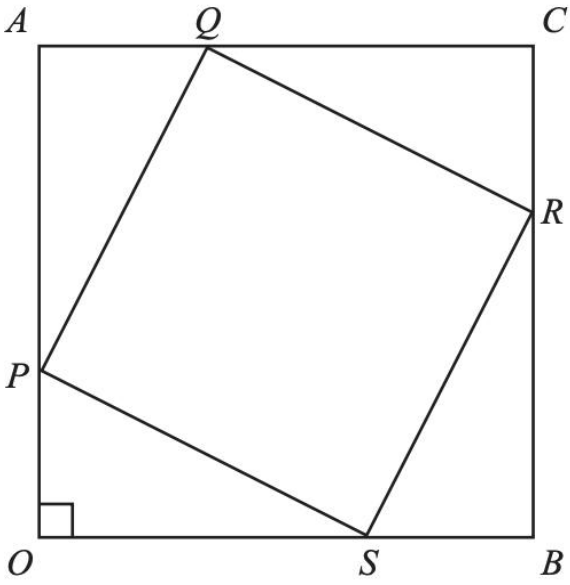
Question 20 **(9 marks)**

Consider square $OACB$ where point O is the origin. Let the position vectors for points A, B be defined as $\underset{\sim}{a}, \underset{\sim}{b}$ respectively i.e. $\overrightarrow{OA} = \underset{\sim}{a}$ and $\overrightarrow{OB} = \underset{\sim}{b}$.

Let points P, Q, R and S be defined so that $\overrightarrow{OP} = k\underset{\sim}{a}$, $\overrightarrow{AQ} = k\underset{\sim}{b}$, $\overrightarrow{RC} = k\underset{\sim}{a}$ and $\overrightarrow{SB} = k\underset{\sim}{b}$ where $0 \leq k \leq 1$. This means that points P, Q, R and S are positioned along their respective sides in equal proportion.



(a) Using vector methods, prove that the size of $\angle PQR = 90°$. (5 marks)

Now suppose that in square $OACB$, it is known that $OA = 10$ cm and that point P is moving away from the origin at a speed of 0.2 cm per second. This means that points Q, R and S are moving at the same speeds along their respective sides.

Let $x =$ the distance OP.

(b) Determine the rate at which the area of square $PQRS$ is changing when $x = 3$ cm.

(4 marks)