

Rotating curves [40 marks]

1. [Maximum marks: 15]

This question asks you to investigate the rotation of a coordinate point.

- (a) The line $y = 0$ is rotated θ radians anti-clockwise about the origin. Find the equation of the new line in terms of y , x and θ . [2]

- (b) If we have a coordinate point (a, b) rotated θ radians anti-clockwise about the origin we can find the x, y coordinates of the new point by using the following parametric equations:

$$x = a \cos \theta - b \sin \theta \quad (1)$$

$$y = a \sin \theta + b \cos \theta \quad (2)$$

Rotate the point $(1, 1)$ anti-clockwise around the origin by $\frac{\pi}{6}$, $\frac{\pi}{4}$ and $\frac{\pi}{2}$ radians. Give your answers as coordinates. [4]

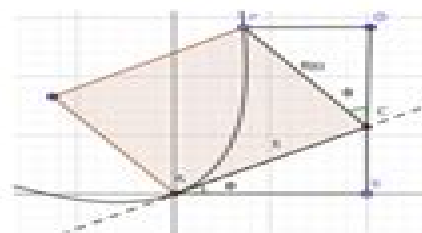
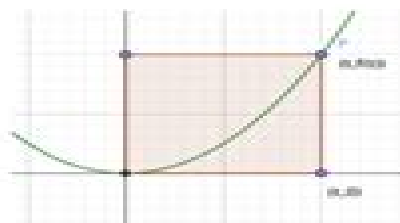
- (c) Draw a sketch of your points. What is the locus of points for this transformation? [4]

- (d) By squaring both equations (1) and (2) obtain an equation in terms of x and y only. What is the geometrical significance of this equation? [5]

2. [Maximum marks: 25]

This question expands this method to rotating a curve. We can derive the general equation as follows:

We start with a function $f(t)$, and draw a rectangle centred at the origin through point $P: (t, f(t))$. We then rotate the curve and the rectangle by θ radians anti-clockwise from the horizontal. Angles ABC and CDP are right angles.



- (a) Explain why angle CAB and PCD are equal. [2]

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