1. (a) Convert the polar function $r = \dfrac{6}{2\cos\theta - \sin\theta}$ into a Cartesian function $y = f(x)$.

   (b) Find the slope of the curve $r = \theta \sin\theta$ at the point where $\theta = \pi/2$

2. (a) A curve is described by parametric equations $x = 1 + 2\cos t$ and $y = 2\sin t$ for $0 < t < \pi$. Find an equation for this curve in Cartesian form and describe its shape.

   (b) Using the Cartesian equation in part (a), or otherwise, find an expression for the curve in the polar form $r = f(\theta)$.

3. A small pebble is stuck in the tread of a tire which has radius 1 unit. Initially the pebble is on the ground.

   (a) Show that as the tire rolls through an angle θ the pebble traces out a path which can be described parametrically as

   $$x = \theta - \sin\theta \qquad \text{and} \qquad y = 1 - \cos\theta$$

   (b) Suppose θ varies with time according to the function $\theta = t$. Find a vector expression for velocity $\vec{v}$ and acceleration $\vec{a}$.

   (c) Find $\vec{a} \cdot \vec{v}$.

   (d) Find the distance traveled by the pebble during one complete revolution of the wheel.

4. Write down a Cartesian expression for an ellipse with one focus at (0,0) and the other at (6,0) if the eccentricity is 0.6.