

**No calculators or notes allowed**

1. The curve given by  $x = \sin t$ ,  $y = 1 + \sin t \cos t$  has two tangents at the point  $(0, 1)$ .
  - a. Find the tangents.
  - b. Find the angle between them.
  
2. Consider the curve  $C$  given by:  $x = \frac{1}{2} \cos 2t$ ,  $y = 1 + \sin t \cos t$ ,  $t \in [0, \frac{\pi}{2}]$ .
  - a. Determine if the tangent of  $C$  is horizontal at any point (and find the point).
  - b. Find the surface area obtained by rotating  $C$  around the  $x$ -axis.
  
3. Given the points  $P = (2, 0, 0)$ ,  $Q = (0, 1, 0)$  and  $R = (0, 0, -5)$ .
  - a. Find a vector that is normal to the plane through  $P$ ,  $Q$  and  $R$ .
  - b. At which point does the line  $x = 1 + t$ ,  $y = 1 - t$ ,  $z = -3 - 3t$  intersect the plane?
  
4.
  - a. Show that the four points  $(2, 0, -3)$ ,  $(0, 5, 4)$ ,  $(1, 1, -1)$  and  $(5, -12, -18)$  lie in a plane.
  - b. Find the distance between this plane and the parallel plane  $x - y + z = 2$ . (Hint: Find the distance between a point on one plane and the other plane.)