1. A curve C is defined implicitly by $xe^y = x^2 + y^2$. Find the equation of the tangent to C at the point $(1, 0)$.

(Total 7 marks)

2. Find the equation of the normal to the curve $5xy^2 - 2x^2 = 18$ at the point $(1, 2)$.

(Total 7 marks)

3. The curve C has equation $y = \dfrac{1}{8}(9 + 8x^2 - x^4)$.

    (a) Find the coordinates of the points on C at which $\dfrac{dy}{dx} = 0$.

    (4)

    (b) The tangent to C at the point P(1, 2) cuts the x-axis at the point T. Determine the coordinates of T.

    (4)

    (c) The normal to C at the point P cuts the y-axis at the point N. Find the area of triangle PTN.

    (7)
    (Total 15 marks)

4. The function f is defined by $f(x) = e^{x^2 - 2x - 1.5}$.

   (a)   Find $f'(x)$.

                                                                                                                   (2)

   (b)   You are given that $y = \dfrac{f(x)}{x-1}$ has a local minimum at $x = a$, $a > 1$. Find the value of a.

                                                                                       (6)
                                                                 (Total 8 marks)

5. Find the equation of the normal to the curve $x^3 y^3 - xy = 0$ at the point $(1, 1)$.

                                                                                       (Total 7 marks)

6. The point P, with coordinates (p, q), lies on the graph of $x^{\frac{1}{2}} + y^{\frac{1}{2}} = a^{\frac{1}{2}}$, $a > 0$.
   The tangent to the curve at P cuts the axes at $(0, m)$ and $(n, 0)$. Show that $m + n = a$.

                                                                                        (Total 8 marks)

7. Consider $f(x) = \dfrac{x^2 - 5x + 4}{x^2 + 5x + 4}$.

    (a)   Find the equations of all asymptotes of the graph of f.

                                                                         (4)

    (b)   Find the coordinates of the points where the graph of f meets the x and y axes.

                                                                         (2)

    (c)   Find the coordinates of

            (i)   the maximum point and justify your answer;

            (ii)   the minimum point and justify your answer.

                                                                        (10)

    (d)   Sketch the graph of f, clearly showing all the features found above.

                                                                         (3)

                                                              (Total 19 marks)

8. The normal to the curve $xe^{-y} + e^{y} = 1 + x$, at the point $(c, \ln c)$, has a y-intercept $c^2 + 1$.

    Determine the value of c.

                                                                        (Total 7 marks)

9. The line $y = m(x - m)$ is a tangent to the curve $(1 - x)y = 1$.

    Determine m and the coordinates of the point where the tangent meets the curve.

                                                                        (Total 7 marks)

10. The diagram below shows a sketch of the gradient function $f'(x)$ of the curve $f(x)$.
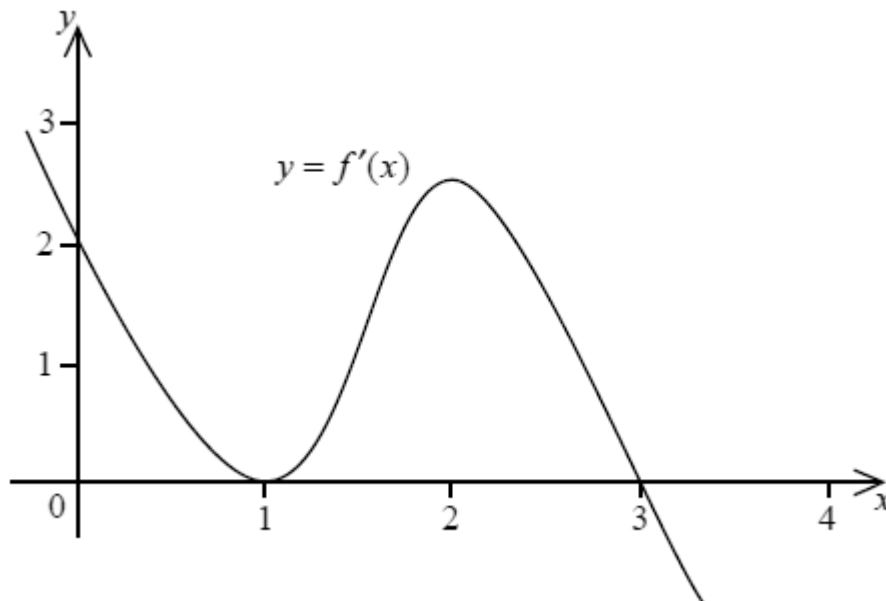
On the graph below, sketch the curve $y = f(x)$ given that $f(0) = 0$. Clearly indicate on the graph any maximum, minimum or inflexion points.

(Total 5 marks)

11. A normal to the graph of $y = \arctan (x - 1)$, for $x > 0$, has equation $y = -2x + c$, where $c \in \mathbb{R}$.

Find the value of c.

(Total 6 marks)