10 The curve C has equation $y = x^4 - 4x^3 - 2x^2 + 13x + 5$ and the line l_1 is the tangent to C at the point $R(1, 13)$.

(a) Find an equation for l_1

(4)

The points P and Q lie on C. The x-coordinates of P and Q are p and q respectively, where $p < q$. The tangent to C at P is parallel to l_1 and the tangent to C at Q is parallel to l_1

(b) Find the coordinates of P and the coordinates of Q.

(4)

The line l_2 passes through P and Q.

(c) Find an equation for l_2

(2)

(d) Show that l_2 is a tangent to C at P and a tangent to C at Q.

(1)

The normal to C at $R(1, 13)$ intersects l_2 at the point S.

(e) Find the exact length of RS.

(5)

(f) Find the area of the triangle PQR.

(2)

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 18 marks)

11 O, A, B and C are fixed points such that

$$\overrightarrow{OA} = \mathbf{p} + \mathbf{q} \quad \overrightarrow{OB} = 3\mathbf{p} - \mathbf{q} \quad \overrightarrow{OC} = 6\mathbf{p} - 4\mathbf{q}$$

(a) Find $\overrightarrow{AB}$ in terms of **p** and **q**.

(1)

(b) Show that the points A, B and C are collinear.

(2)

(c) Find the ratio $AB : BC$

(1)

The point D lies on AC produced such that $AC = 2CD$

(d) Find $\overrightarrow{OD}$ in terms of **p** and **q**, simplifying your answer.

(4)

Question 11 continued

Question 11 continued

(Total for Question 11 is 8 marks)

TOTAL FOR PAPER IS 100 MARKS