3 O, A and B are fixed points such that

$$\left|\overrightarrow{OA}\right| = 3\sqrt{5} \qquad \overrightarrow{AB} = \mathbf{i} + 3a\mathbf{j} \qquad \overrightarrow{OB} = 7\mathbf{i} + 2a\mathbf{j}$$

Given that $a > 0$

(a) find the value of a

(4)

(b) Hence find a unit vector parallel to $\overrightarrow{OA}$

(2)

P 7 4 2 8 5 R A 0 6 3 2

Question 3 continued

(Total for Question 3 is 6 marks)

P 7 4 2 8 5 R A 0 7 3 2

4 $f(x) = px^3 + qx^2 - 37x - 12q$ where p and q are constants.

When $f'(x)$ is divided by $(x + 2)$ the remainder is -33

Given that $(x + 5)$ is a factor of $f(x)$

(a) (i) show that $p = 2$

   (ii) find the value of q

(6)

(b) Hence, use algebra to factorise $f(x)$ completely.

(3)

(c) Hence solve the equation $f(x) = 0$

(2)

Question 4 continued

(Total for Question 4 is 11 marks)

5 The force F newtons between two magnetic poles is given by the formula

$$F = \frac{3}{20r^2}$$

where r is the distance, in centimetres, between the poles.

The distance between the two poles is increasing at a constant rate of 0.7 cm/s

Find the rate of change of F, in newtons/s to 3 significant figures, when the distance between the poles is 2.8 cm

(6)

Question 5 continued

(Total for Question 5 is 6 marks)