1

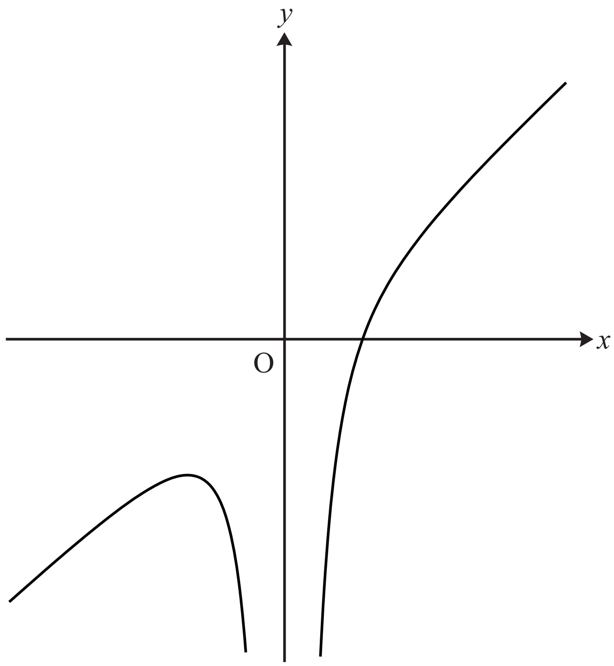

Fig. 11

Fig. 11 shows a sketch of the curve with equation $y = x - \dfrac{4}{x^2}$.

(i) Find $\dfrac{dy}{dx}$ and show that $\dfrac{d^2y}{dx^2} = -\dfrac{24}{x^4}$. **[3]**

(ii) Hence find the coordinates of the stationary point on the curve. Verify that the stationary point is a maximum. **[5]**

(iii) Find the equation of the normal to the curve when $x = -1$. Give your answer in the form $ax + by + c = 0$. **[5]**

2 Fig. 9 shows a sketch of the curve $y = x^3 - 3x^2 - 22x + 24$ and the line $y = 6x + 24$.

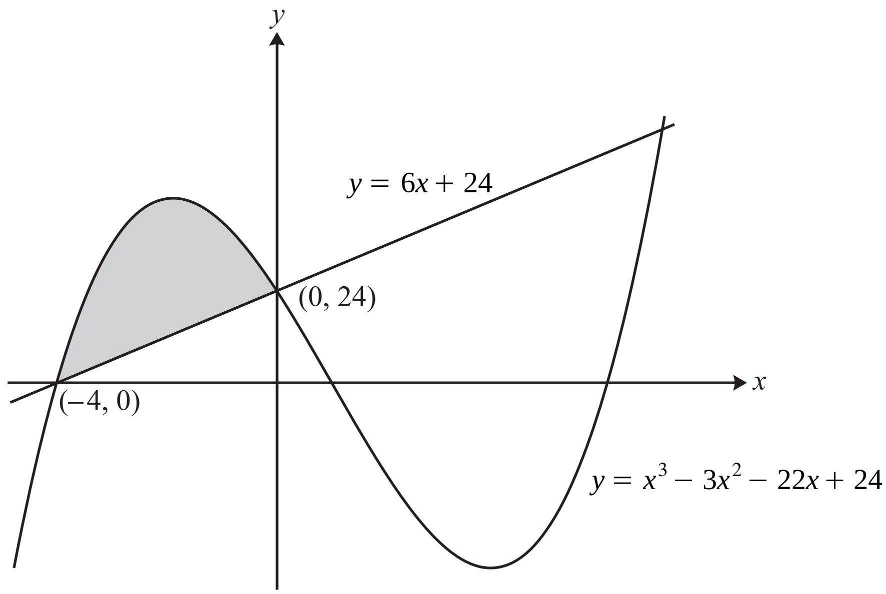

Fig. 9

(i) Differentiate $y = x^3 - 3x^2 - 22x + 24$ and hence find the x-coordinates of the turning points of the curve. Give your answers to 2 decimal places. **[4]**

(ii) You are given that the line and the curve intersect when $x = 0$ and when $x = -4$. Find algebraically the x-coordinate of the other point of intersection. **[3]**

(iii) Use calculus to find the area of the region bounded by the curve and the line $y = 6x + 24$ for $-4 \leqslant x \leqslant 0$, shown shaded on Fig. 9. **[4]**

3 **(i)** The standard formulae for the volume V and total surface area A of a solid cylinder of radius r and height h are

$$V = \pi r^2 h \qquad \text{and} \qquad A = 2\pi r^2 + 2\pi r h.$$

Use these to show that, for a cylinder with $A = 200$,

$$V = 100r - \pi r^3.$$ **[4]**

(ii) Find $\dfrac{dV}{dr}$ and $\dfrac{d^2V}{dr^2}$. **[3]**

(iii) Use calculus to find the value of r that gives a maximum value for V and hence find this maximum value, giving your answers correct to 3 significant figures. **[4]**

4 **(i)** Differentiate $x^3 - 6x^2 - 15x + 50$. **[2]**

(ii) Hence find the x-coordinates of the stationary points on the curve $y = x^3 - 6x^2 - 15x + 50$. **[3]**

5 Use calculus to find the x-coordinates of the turning points of the curve $y = x^3 - 6x^2 - 15x$.

Hence find the set of values of x for which $x^3 - 6x^2 - 15x$ is an increasing function. **[5]**