It is given that $f(x) = \frac{6}{x^2} + 2x$.

(i) Find $f'(x)$. **[3]**

(ii) Find $f''(x)$. **[2]**

Given that $y = 2x^5 + 7 + \frac{1}{x^3}$, $x \neq 0$, find, in their simplest form,

(a) $\frac{dy}{dx}$, **(3)**

(b) $\int y \, dx$. **(4)**

The curve C has equation

$$y = \frac{1}{2}x^3 - 9x^{\frac{3}{2}} + \frac{8}{x} + 30, \qquad x > 0$$

(a) Find $\frac{dy}{dx}$. **(4)**

(b) Show that the point $P(4, -8)$ lies on C. **(2)**

(c) Find an equation of the normal to C at the point P, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers. **(6)**

Given that

$$y = 8x^3 - 4\sqrt{x} + \frac{3x^2 + 2}{x}, \qquad x > 0$$

find $\frac{dy}{dx}$. **(6)**

Differentiate the following expressions (with respect to x):

1. $(8x + 7)e^x$
2. $\ln(6x^2 + 2x + 5)$
3. $\sin(-5x^2 - 8x + 2)$
4. $(-7x^2 - 5x)\cos x$
5. e^{x^2-8x+7}
6. $(4x^2 - 3x - 7)\ln x$

Integrate the following expressions (with respect to x):

1. $(x + 9)^3$
2. $\sin x \ln(\cos x)$
3. $2x\sqrt{1 + x^2}$
4. $e^{\cos x} \sin x$
5. $x^2 \sin x$
6. $e^x \cos x$