2 **(a)** Find the coefficient of x^2 in the Maclaurin's series for $-\ln\cos x$. [4]

(b) Find the length of the arc of the curve with equation $y = -\ln\cos x$ from the point where $x = 0$ to the point where $x = \frac{1}{4}\pi$. [4]

4 The curve C has equation

$$4y^3 + (x+y)^6 = 109.$$

(a) Show that, at the point $(-4, 3)$ on C, $\frac{dy}{dx} = \frac{1}{17}$. [3]

(b) Find the value of $\frac{d^2y}{dx^2}$ at the point $(-4, 3)$. [5]

3 Find the first three terms in the Maclaurin's series for $\tanh^{-1}\left(\frac{1}{2}e^x\right)$ in the form $\frac{1}{2}\ln a + bx + cx^2$, giving the exact values of the constants a, b and c. [6]

5 It is given that

$$x = \sinh^{-1}t, \quad y = \cos^{-1}t,$$

where $-1 < t < 1$.

(a) By differentiating $\cos y$ with respect to t, show that $\frac{dy}{dt} = -\frac{1}{\sqrt{1-t^2}}$. [4]

(b) Find $\frac{d^2y}{dx^2}$ in terms of t, simplifying your answer. [5]

2 The curve C has parametric equations

$$x = \sinh t \quad \text{and} \quad y = t + \cosh t.$$

(a) Find $\dfrac{dy}{dx}$ in terms of t. [2]

(b) Show that $\dfrac{d^2y}{dx^2} = \dfrac{1 - \sinh t}{\cosh^3 t}$. [4]

(c) Find the Maclaurin's series for y in terms of x up to and including the term in x^2. [2]

2 It is given that

$$x = 1 + \frac{1}{t} \quad \text{and} \quad y = \cos^{-1} t \quad \text{for } 0 < t < 1.$$

(a) Show that $\dfrac{dy}{dx} = \dfrac{t^2}{\sqrt{1-t^2}}$. [2]

(b) Show that $\dfrac{d^2y}{dx^2} = -t^a\left(1-t^2\right)^b\left(2-t^2\right)$, where a and b are constants to be determined. [4]