2. **Differentiation**

(1994-CE-A MATH 1 #04) (6 marks)

4. Let $y = \tan\left(\dfrac{1}{x}\right)$.

Show that $x^2 \dfrac{\mathrm{d}y}{\mathrm{d}x} + (y^2 + 1) = 0$.

Hence show that $\dfrac{\mathrm{d}^2 y}{\mathrm{d}x^2} + \dfrac{2(x + y)}{x^2} \dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$.

(1996-CE-A MATH 1 #01) (3 marks)

1. Let $f(x) = \sin^3 x$.

Find $f'(x)$ and $f''(x)$.

(1997-CE-A MATH 1 #01) (3 marks)

1. Let $f(x) = \sqrt{3 + x^2}$. Find $f'(-1)$.

(1997-CE-A MATH 1 #02) (3 marks)

2. $P(8,1)$ is a point on the curve $y^2 + \sqrt[3]{x}\, y - 3 = 0$. Find the value of $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ at P .

(1999-CE-A MATH 1 #01) (4 marks)

1. Find

   (a) $\dfrac{\mathrm{d}}{\mathrm{d}x} \sin(x^2 + 1)$,

   (b) $\dfrac{\mathrm{d}}{\mathrm{d}x} \left[\dfrac{\sin(x^2 + 1)}{x} \right]$.

(2000-CE-A MATH 1 #02) (4 marks)

2. Find

   (a) $\dfrac{\mathrm{d}}{\mathrm{d}x} \sin^2 x$,

   (b) $\dfrac{\mathrm{d}}{\mathrm{d}x} \sin^2(3x + 1)$.

(2001-CE-A MATH #01) (3 marks)

1. Find $\dfrac{\mathrm{d}}{\mathrm{d}x}\left(\dfrac{x^2}{2x + 1}\right)$.

(2002-CE-A MATH #03) (4 marks)

3.   Let $x \sin y = 2002$.

Find $\dfrac{dy}{dx}$.

(2003-CE-A MATH #04) (4 marks)

4.   Given that $3x^2 + 3y^2 - 2xy = 12$, find $\dfrac{dy}{dx}$ when $x = 2$, $y = 0$.

(2005-CE-A MATH #09) (6 marks)

9.   (a)   Find $\dfrac{d}{dx} \sin^3(x^2 + 1)$.

(b)   Let $xy + y^2 = 2005$. Find $\dfrac{dy}{dx}$.

(2006-CE-A MATH #01) (3 marks)

1.   Find $\dfrac{d}{dx} \left[\dfrac{\sin(2x + 1)}{x} \right]$.

(2010-CE-A MATH #01) (4 marks)

1.   Find

(a) $\dfrac{d}{dx} \cos(x^3 + 1)$,

(b) $\dfrac{d}{dx} \left[x \cos(x^3 + 1) \right]$.

(PP-DSE-MATH-EP(M2) #07) (5 marks)

7.   Let $f(x) = e^x(\sin x + \cos x)$.

(a)   Find $f'(x)$ and $f''(x)$.

(b)   Find the value of x such that $f''(x) - f'(x) + f(x) = 0$ for $0 \le x \le \pi$.

(2014-DSE-MATH-EP(M2) #04) (3 marks)

4.   Let $x = 2y + \sin y$. Find $\dfrac{d^2y}{dx^2}$ in terms of y .

(2015-DSE-MATH-EP(M2) #02) (5 marks)

2.　　Let $y = x \sin x + \cos x$.

　　(a)　Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ and $\dfrac{\mathrm{d}^2 y}{\mathrm{d}x^2}$.

　　(b)　Let k be a constant such that $x \dfrac{\mathrm{d}^2 y}{\mathrm{d}x^2} + k \dfrac{\mathrm{d}y}{\mathrm{d}x} + xy = 0$ for all real values of x . Find the value of k .

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ANSWERS

(1994-CE-A MATH 1 #04) (6 marks)

(1996-CE-A MATH 1 #01) (3 marks)

1. $f'(x) = 3\sin^2 x \cos x$

   $f''(x) = 6 \sin x \cos^2 x - 3\sin^3 x$

(1997-CE-A MATH 1 #01) (3 marks)

1. $-\dfrac{1}{2}$

(1997-CE-A MATH 1 #02) (3 marks)

2. $\left.\dfrac{dy}{dx}\right|_{(8,1)} = \dfrac{-1}{48}$

(1999-CE-A MATH 1 #01) (4 marks)

1.   (a) $2x \cos(x^2 + 1)$

   (b) $\dfrac{2x^2 \cos(x^2 + 1) - \sin(x^2 + 1)}{x^2}$

(2000-CE-A MATH 1 #02) (4 marks)

2.   (a) $2 \sin x \cos x$

   (b) $6 \sin(3x + 1)\cos(3x + 1)$

(2001-CE-A MATH #01) (3 marks)

1. $\dfrac{2x(x + 1)}{(2x + 1)^2}$

(2002-CE-A MATH #03) (4 marks)

3. $\dfrac{dy}{dx} = \dfrac{-\tan y}{x}$

(2003-CE-A MATH #04) (4 marks)

4.   3

(2005-CE-A MATH #09) (6 marks)

9.   (a) $6x \sin^2(x^2 + 1)\cos(x^2 + 1)$

   (b) $\dfrac{dy}{dx} = \dfrac{-y}{x + 2y}$

(2006-CE-A MATH #01) (3 marks)

1. $\dfrac{2x \cos(2x + 1) - \sin(2x + 1)}{x^2}$

(2010-CE-A MATH #01) (4 marks)

1.   (a) $-3x^2 \sin(x^3 + 1)$

   (b) $-3x^3 \sin(x^3 + 1) + \cos(x^3 + 1)$

(PP-DSE-MATH-EP(M2) #07) (5 marks)

7.   (a) $f'(x) = 2e^x \cos x$

   $f''(x) = 2e^x(\cos x - \sin x)$

   (b) $x = \dfrac{\pi}{4}$

(2014-DSE-MATH-EP(M2) #04) (3 marks)

4. $\dfrac{d^2 y}{dx^2} = \dfrac{\sin y}{(2 + \cos y)^3}$

(2015-DSE-MATH-EP(M2) #02) (5 marks)

2.   (a) $\dfrac{dy}{dx} = x \cos x$

   $\dfrac{d^2 y}{dx^2} = -\sin x + \cos x$

   (b) $k = -2$

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