

**Advanced Higher Mathematics - Methods in Algebra and Calculus  
Unit Assessment Preparation - Further Practice Questions**

**Methods in Algebra and Calculus Assessment Standard 1.2**

1. (Chain Rule) - Differentiate the following with respect to  $x$ :

(a)  $f(x) = (4x + 3)^5$       (b)  $f(x) = (x^4 + 1)^5$       (c)  $y = \frac{1}{\sqrt{(2x^3 - 1)}}$       (d)  $y = \frac{1}{2x^3 + 1}$   
 (e)  $f(x) = e^{2x^2+1}$       (f)  $f(x) = e^{\sin(2x)}$       (g)  $y = \ln(2x^2 + 1)$       (h)  $y = \ln(\ln x)$   
 (i)  $y = \sin^3 x$       (j)  $y = \sin^2 3x$       (k)  $y = \cos^3(4x)$       (l)  $y = \tan^2 4x$

2. (Product & Quotient Rules) - Differentiate the following with respect to  $x$ :

(a)  $y = x^2 \sin 4x$       (b)  $y = \sin(2x)\cos(3x)$       (c)  $e^x \sin x$       (d)  $x^2 \ln x$   
 (e)  $y = \frac{1 + \sin x}{1 + \cos x}$       (f)  $y = \frac{x^2}{\sqrt{x^3 + 1}}$       (g)  $\frac{e^{2x}}{x^2}$       (h)  $\frac{x^2}{\ln x}$

3. (Trig Functions) - Differentiate the following with respect to  $x$ :

(a)  $y = \sin^{-1}(2x)$       (b)  $y = \tan^{-1}(4x)$       (c)  $y = \cos^{-1}(4x)$       (d)  $y = \sin^{-1}(3x)$   
 (e)  $y = \cos^{-1}(6x)$       (f)  $y = \tan^{-1}(3x)$       (g)  $y = \sin^{-1}(6x)$       (h)  $y = \tan^{-1}(2x)$

**Answers:**

1 (a)  $20(4x + 3)^4$ , (b)  $20x^3(x^4 + 1)^4$ , (c)  $\frac{3x^2}{(2x^3 - 1)^{\frac{3}{2}}}$ , (d)  $-\frac{6x^2}{(2x^3 + 1)^2}$   
 (e)  $4xe^{2x^2+1}$  (f)  $2\cos(2x)e^{\sin(2x)}$  (g)  $\frac{4x}{2x^2 + 1}$  (h)  $\frac{1}{x \ln x}$  (i)  $3\sin^2 x \cos x$   
 (j)  $6\sin(3x)\cos(3x)$  (k)  $-12\cos^2(4x)\sin(4x)$  (l)  $8\sec^2(4x)\tan(4x)$

2 (a)  $2x(2x \cos(4x) + \sin(4x))$  (b)  $2\cos(2x)\cos(3x) - 3\sin(2x)\cos(3x)$   
 (c)  $\frac{1 + \cos x + \sin x}{(1 + \cos x)^2}$  (d)  $\frac{x(x^3 + 4)}{2(x^3 + 1)^{\frac{3}{2}}}$  (e)  $e^x(\cos x + \sin x)$  (f)  $x(1 + 2 \ln x)$   
 (g)  $\frac{2(x - 1)e^{2x}}{x^3}$  (h)  $\frac{x(2 \ln x - 1)}{(\ln x)^2}$

3 (a)  $\frac{2}{\sqrt{1 - 4x^2}}$  (b)  $\frac{4}{1 + 16x^2}$  (c)  $-\frac{4}{\sqrt{1 - 16x^2}}$  (d)  $\frac{3}{\sqrt{1 - 9x^2}}$  (e)  $-\frac{6}{\sqrt{1 - 36x^2}}$   
 (f)  $\frac{3}{1 + 9x^2}$  (g)  $\frac{6}{\sqrt{1 - 36x^2}}$  (h)  $\frac{2}{1 + 4x^2}$