

Solutions

$$\text{Q1 a) } f(x) = (x^2 + 6x)^2 (1 - 3x)^4$$

$$f'(x) = 2(x^2 + 6x)(2x + 6)(1 - 3x)^4 + 4(1 - 3x)^3(-3)(x^2 + 6x)^2$$

$$\text{Hence } f'(1) = 2 \cdot 7 \cdot 8(-2)^4 - 12(-2)^3(7)^2$$

$$= 1792 + 4704$$

$$= 6496$$

$$f(1) = 784$$

the equation of the normal line at $x=1$ is

$$y - 784 = \frac{-1}{6496}(x - 1)$$

$$\text{b) } f(x) = x \cos 2x$$

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

$$f''(x) = -2 \sin 2x - 2 \sin 2x - 4x \cos 2x$$

$$= -4 \sin 2x - 4x \cos 2x$$

$$f'''(x) = -8 \cos 2x - 4 \cos 2x + 8x \sin 2x$$

$$f'''\left(\frac{\pi}{4}\right) = 2\pi$$