

## DIFFERENTIATION WORKSHEET IV SOLUTIONS

Find the following derivatives:

$$(1) \frac{d}{dx}(3x \cos(x)) = \frac{d(3x)}{dx} \cos(x) + 3x \frac{d \cos(x)}{dx} = 3 \cos(x) - 3x \sin(x)$$

$$(2) \frac{d}{d(2x)}(\cos(2x)) = -\sin(2x). \text{ Not to be confused with } \frac{d}{dx}(\cos(2x)) = -2 \sin(2x)$$

which requires the chain rule.

$$(3) \frac{d}{dy} \left( \frac{2y}{e^y} \right) = \frac{(2y)'e^y - 2y(e^y)'}{e^{2y}} = \frac{2e^y - 2ye^y}{e^{2y}}$$

$$(4) (x^4 \sin(x))' = (x^4)' \sin(x) + x^4(\sin(x))' = 4x^3 \sin(x) + x^4 \cos(x)$$

$$(5) (\sin(3x^2 + 4))' = 6x \cos(3x^2 + 4) \text{ by the chain rule}$$

$$(6) \frac{d}{dx}(e^x \sin(x^2)) = \frac{de^x}{dx} \sin(x^2) + e^x \frac{d \sin(x^2)}{dx} = e^x \sin(x^2) + e^x \frac{d \sin(x^2)}{dx^2} \frac{dx^2}{dx} = e^x \sin(x^2) + e^x \cos(x^2) 2x$$

$$(7) \frac{d}{dt}(e^{e^t}) = \frac{d}{de^t}(e^{e^t}) \frac{d}{dt}(e^t) = e^{e^t} e^t$$

$$(8) \frac{d}{dx} \left( \frac{2x \sin(x)}{e^x} \right) = \frac{(2x \sin(x))' e^x - 2x \sin(x) (e^x)'}{e^{2x}} = \frac{(2 \sin(x) + 2x \cos(x)) e^x - 2x \sin(x) e^x}{e^{2x}}$$

$$(9) (e^{5x^2+3x+1})' = e^{5x^2+3x+1} (10x + 3) \text{ by the chain rule}$$