# Outcome 1 – The Product Rule with basic functions

## Worked Example:

Differentiate $y = x^3 sinx$

**Key Facts/Formulae:**

The product rule enables us to differentiate a function consisting of two other functions that are multiplied together.

E.g. If $y = uv$, then $\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$

**Essential prior knowledge!**

$f(x) = sinax$ $f'(x) = acosax$

$f(x) = cosax$ $f'(x) = -asinax$

1. Define the functions.

Let $y = uv$ where $u = x^3$ and $v = sinx$

2. Differentiate both functions.

$$\frac{du}{dx} = 3x^2 \qquad \frac{dv}{dx} = cosx$$

3. Find $\frac{dy}{dx}$.

$$\frac{dy}{dx} = x^3 cosx + 3x^2 sinx$$

## Questions…

Differentiate each of the following with respect to x.

1. $y = x \sin x$
2. $y = 6x^2 \cos x$
3. $y = 2x^3 \cos x$
4. $y = x^5 \sin x$
5. $y = 2x^{10} \cos x$
6. $y = \frac{1}{2}x^6 \sin x$

# Answers

1 $\frac{dy}{dx} = x\cos x + \sin x$

2 $\frac{dy}{dx} = -6x^2 \sin x + 12x \sin x$

3 $\frac{dy}{dx} = -2x^3 \sin x + 6x^2 \cos x$

4 $\frac{dy}{dx} = x^5 \cos x + 5x^4 \sin x$

5 $\frac{dy}{dx} = -2x^{10} \sin x + 20x^9 \cos x$

6 $\frac{dy}{dx} = -\frac{1}{2}x^6 \cos x + 3x^5 \sin x$