9.4) The product rule

Worked example	Your turn
Differentiate with respect to x: $y = x^2 e^{3x}$ $f(x) = x^5 e^{2x}$	Differentiate with respect to x: $y = x^3 e^{2x}$ $\frac{dy}{dx} = x^2 e^{2x}(2x + 3)$

Worked example	Your turn
Differentiate with respect to x: $y = x^2 \ln 3x$	Differentiate with respect to x: $y = x^3 \ln 2x$
	$\dfrac{dy}{dx} = x^2(1 + 3\ln 2x)$
$f(x) = x^4 \ln 5x$	

Worked example	Your turn
Differentiate with respect to x: $y = 2x^3(4x-5)^6$	Differentiate with respect to x: $y = 3x^2(6x-5)^4$
	$\frac{dy}{dx} = 6x(6x-5)^3(18x-5)$
$f(x) = 6x^5(4x-3)^2$	

Worked example	Your turn
Differentiate with respect to x: $y = x^3 \sin x$ $f(x) = x^4 \cos x$	Differentiate with respect to x: $y = x^2 \sin x$ $\frac{dy}{dx} = x(x \cos x + 2 \sin x)$

Worked example	Your turn
Differentiate with respect to x: $y = e^{3x}\sin^4 2x$	Differentiate with respect to x: $y = e^{4x}\sin^2 3x$
	$\frac{dy}{dx} = e^{4x}\sin 3x\,(6\cos 3x + 4\sin 3x)$
$f(x) = e^{2x}\cos^3 4x$	

Worked example	Your turn
Determine the coordinates of the turning point:	Determine the coordinates of the turning point:
$y = xe^{3x}$	$y = xe^{2x}$
	$\left(-\frac{1}{2}, -\frac{1}{2e}\right)$
$f(x) = xe^{4x}$	

Worked example	Your turn
Differentiate with respect to x: $$y = x^2\sqrt{5x-2}$$	Differentiate with respect to x: $$y = x^2\sqrt{3x-1}$$ $$\frac{dy}{dx} = \frac{x(15x-4)}{2\sqrt{3x-1}}$$

Worked example	Your turn
Find the equation of the tangent to the curve with equation $y = x^2 \sin(x^2)$ at the point $\left(\frac{\sqrt{\pi}}{2}, \frac{\pi\sqrt{2}}{8}\right)$ in the form $ax + by + c = 0$ where a, b and c are exact constants.	Find the equation of the tangent to the curve with equation $y = x^2 \cos(x^2)$ at the point $\left(\frac{\sqrt{\pi}}{2}, \frac{\pi\sqrt{2}}{8}\right)$ in the form $ax + by + c = 0$ where a, b and c are exact constants. $\sqrt{2\pi}(\pi - 4)x + 8y - \pi\sqrt{2}\left(\frac{\pi - 2}{2}\right) = 0$

Worked example	Your turn
Differentiate with respect to x: $$\frac{dy}{dx} = \frac{1}{5x(x+1)^{\frac{1}{2}}}$$	Differentiate with respect to x: $$\frac{dy}{dx} = \frac{1}{6x(x-1)^{\frac{1}{2}}}$$ $$\frac{d^2y}{dx^2} = \frac{2-3x}{12x^2(x-1)^{\frac{3}{2}}}$$