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ASSIGNMENT: Product and Quotient Rule
DIRECTIONS: The product and quotient rules are given on the IB paper.

Product: f(x)*g(x) ---> f'(x)*g(x) + g'(x)*f(x)

Quotient: $\frac{f(x)}{g(x)}$ --> $\frac{g(x)*f'(x) - f(x)*g'(x)}{[g(x)]^2}$

6.2		
	Derivative of x^n	$f(x)=x^n \Rightarrow f'(x)=nx^{n-1}$
	Derivative of $\sin x$	$f(x)=\sin x \Rightarrow f'(x)=\cos x$
	Derivative of $\cos x$	$f(x)=\cos x \Rightarrow f'(x)=-\sin x$
	Derivative of $\tan x$	$f(x)=\tan x \Rightarrow f'(x)=\frac{1}{\cos^2 x}$
	Derivative of e^x	$f(x)=e^x \Rightarrow f'(x)=e^x$
	Derivative of $\ln x$	$f(x)=\ln x \Rightarrow f'(x)=\frac{1}{x}$
	Chain rule	$y=g(u),\ u=f(x) \Rightarrow \frac{dy}{dx}=\frac{dy}{du}\times\frac{du}{dx}$
	Product rule	$y=uv \Rightarrow \frac{dy}{dx}=u\frac{dv}{dx}+v\frac{du}{dx}$
	Quotient rule	$y=\frac{u}{v} \Rightarrow \frac{dy}{dx}=\frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2}$

Differentiate each of the following with respect to x.

1.) (a) $y=\sin 4x$ *[2 marks]*

(b) $y=x\tan x$ *[2 marks]*

(c) $y=\frac{\ln x}{x}$ *[3 marks]*

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2.) *[Maximum mark: 7]*

Given that $f(x)=\frac{1}{x}$, answer the following.

(a) Find the first four derivatives of $f(x)$. *[4 marks]*

(b) Write an expression for $f^{(n)}(x)$ in terms of x and n. *[3 marks]*

3.) Let $f(x)=x\sin x$, for $0\le x\le 6$. *[3 marks]*

(a) Find $f'(x)$.

4.) Let $f(x)=\cos 2x$ and $g(x)=\ln(3x-5)$.

(a) Find $f'(x)$. *[2 marks]*

(b) Find $g'(x)$. *[2 marks]*

(c) Let $h(x)=f(x)\times g(x)$. Find $h'(x)$. *[2 marks]*

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Answer key (show all calculations to receive full marks)

1.) a) you can do this (ie see me in tutorials if you are feeling uncertain)
b) you can do this (ie see me in tutorials if you are feeling uncertain)
c) $dy/dx = \frac{1 - \ln x}{x^2}$

2.) a) $f''''(x) = \frac{24}{x^5}$
b) $f^n(x)$ = what pattern do you find through the derivatives? This one's tough, but you can do this! Write the numerator and the exponent on the variable as the denominator, and I promise you'll see the pattern! I found one way, but there must be others.

3.) f'(x) = use the product rule (ie see me in tutorials if you are feeling uncertain)

4.) c) $h'(x) = -2 \ln(3x - 5) \sin 2x + \frac{3 \cos 2x}{3x - 5}$