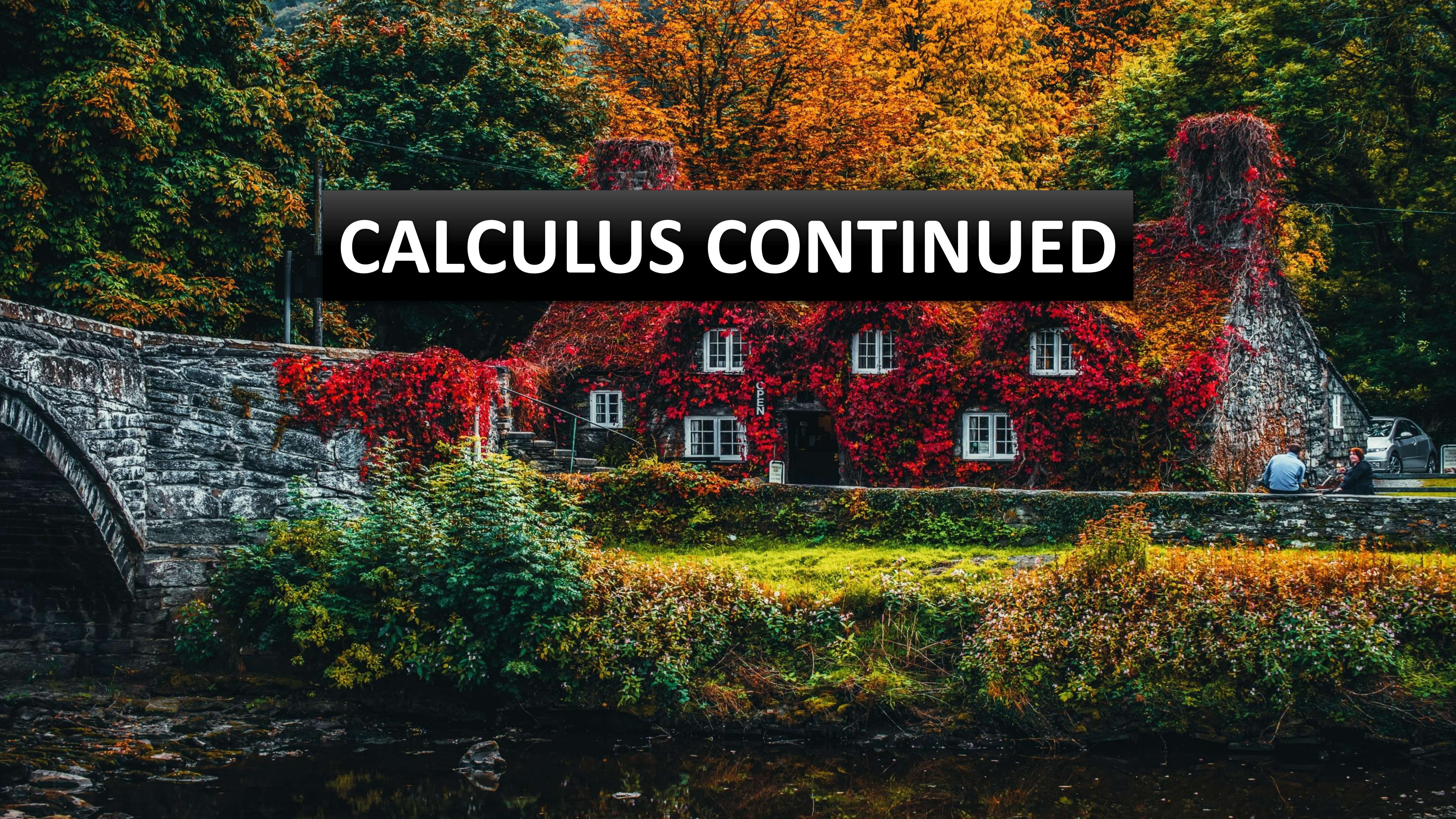
CALCULUS CONTINUED



Derivative of exponential functions

Suppose we have the following…

$$y = e^{f(x)} = \hat{\mathrm{e}}^{u} \ldots \mathrm{u} = \mathrm{f(x)}$$

$$\frac{dy}{dx} = \frac{dy}{du} . \frac{du}{dx} \ldots chain\ rule$$

$$= e^{u} . \frac{du}{dx}$$

$$= e^{f(x)} . f'(x)$$

MEMORISE THESE RULES!!!

Lets have a look at some examples…

a)

$$y = 2e^{x} + e^{-3x}$$

$$\frac{dy}{dx} = 2e^{x}.(1) + e^{-3x}.(-3)$$

$$= 2e^{x} - 3e^{-3x}$$

b)

$$y = x^{2}.e^{-x}$$

$$\frac{dy}{dx} = (2x)(e^{-x}) + (e^{-x})(-1)(x^{2})$$

$$= 2x.e^{-x} - x^{2}.e^{-x}$$

c)

$$y = \frac{e^{2x}}{x}$$

$$= \frac{(e^{2x})(2)(x) - e^{2x}}{x^{2}}$$

$$= \frac{2x.e^{2x} - e^{2x}}{x^{2}} = \frac{e^{2x}(2x-1)}{x^{2}}$$

1.

$$y = e^{x^3}$$

2.

$$y = e^{\frac{1}{x^2}}$$

3.

$$y = (e^x - e^{-x})^5$$

4.

$$y = \frac{e^x}{x^3}$$

1.

$$y = e^{x^3}$$

$$\frac{dy}{dx} = 3x^2 e^{x^3}$$

2.

$$y = e^{\frac{1}{x^2}}$$

$$\frac{dy}{dx} = -2x^{-3}.e^{x^{-2}} \text{ ... chain rule}$$

$$e^u$$

$$= \frac{1}{x^2}.e.x^{-3}$$

$$= \frac{-2e^{\frac{1}{x^2}}}{x^3}$$

3.

$$y = (e^x - e^{-x})^5$$

$$\frac{dy}{dx} = 5(e^x - e^{-x})^4(e^x + e^{-x})$$

4.

$$y = \frac{e^x}{x^3}$$

$$\frac{dy}{dx} = \frac{e^x.x^3 - 3x^2.e^x}{(x^3)^2}$$

$$= \frac{x^2e^x(x-3)}{x^6}$$

$$= \frac{e^x(x-3)}{x^4}$$

5.

Find the equation of the tangent to the curve $y = e^{1-3x}$ at the point where $x = \frac{1}{3}$

Take the $x = \frac{1}{3}$…and substitute into the

ORIGINAL EQUATION

$$y = e^{1-3x}$$

$$\frac{dy}{dx} = -3e^{1-3x}$$

$$when\ x = \frac{1}{3}$$

$$\frac{dy}{dx} = -3e^{1-3\left(\frac{1}{3}\right)}$$

$$= -3e^{0}$$

$$= -3$$

Next…take the $x = \frac{1}{3}$ and substitute into the DERIVATIVE.
The answer will be the value of the gradient…m

Now we have the x value…y value and gradient m.

$$y = e^{1-3x}$$

$$= e^{1-3\left(\frac{1}{3}\right)}$$

$$= 1$$

We can now calculate the equation of the straight line…

$$y = mx + c$$

$$1 = (-3)\left(\frac{1}{3}\right) + c$$

$$c = 2$$

Equation of tangent of gradient $m = -3$ passing through $\frac{1}{3}$ is…

$$y - y_1 = m(x - x_1)$$

$$y = -3x + 2$$

Find the equation of the tangent to the curve $y = x^2 + 3x$ at the point where $x = 1$

$$\textit{Substitute } x = 1 \textit{ in the original equation} \ldots$$
$$y = (1)^2 + 3(1)$$
$$y = 4$$
$$\textit{So now I have } x = 1 \textit{ and } y = 4$$

$$y = x^2 + 3x$$
$$y' = 2x + 3$$
$$\textit{Substitute } x = 1 \textit{ in the derivative}!$$
$$y' = 2(1) + 3$$
$$y' = 5 = m$$

$$x = 1 \ldots y = 4 \ldots m = 5$$
$$y = mx + c$$
$$4 = (5)(1) + c$$
$$c = -1$$
$$y = 5x - 1$$

1 Find the gradient function for $f(x)$ equal to:

a e^{4x} **b** $e^{x}+3$ **c** e^{-2x} **d** $e^{\frac{x}{2}}$

e $2e^{-\frac{x}{2}}$ **f** $1-2e^{-x}$ **g** $4e^{\frac{x}{2}}-3e^{-x}$ **h** $\dfrac{e^{x}+e^{-x}}{2}$

i e^{-x^2} **j** $e^{\frac{1}{x}}$ **k** $10(1+e^{2x})$ **l** $20(1-e^{-2x})$

m e^{2x+1} **n** $e^{\frac{x}{4}}$ **o** e^{1-2x^2} **p** $e^{-0.02x}$

2 Find the derivative of:

a xe^{x} **b** x^3e^{-x} **c** $\dfrac{e^{x}}{x}$ **d** $\dfrac{x}{e^{x}}$

e x^2e^{3x} **f** $\dfrac{e^{x}}{\sqrt{x}}$ **g** $20xe^{-0.5x}$ **h** $\dfrac{e^{x}+2}{e^{-x}+1}$

1. a)

$$f(x) = e^{4x}$$
$$f'(x) = e^{4x}.4$$
$$= 4e^{4x}$$

b)

$$f(x) = e^{x} + 3$$
$$f'(x) = e^{x}$$

c)

$$f(x) = e^{-2x}$$
$$f'(x) = e^{-2x}.(-2)$$
$$= -2e^{-2x}$$

d)

$$f(x) = e^{\frac{x}{2}}$$
$$f'(x) = \frac{1}{2}e^{\frac{x}{2}}$$

e)

$$f(x) = 2e^{-\frac{x}{2}}$$
$$f'(x)2e^{-\frac{x}{2}}.(-\frac{1}{2})$$
$$= -e^{-x}$$

f)

$$f(x) = 1 - 2e^{-x}$$
$$f'(x) = -2e^{-x}.(-1)$$
$$= 2e^{-x}$$

g)

$$f(x) = 4e^{\frac{x}{2}} - 3e^{-x}$$
$$f'(x) = \left(4e^{\frac{x}{2}}.\frac{1}{2}x\right) - 3e^{-x}.(-1)$$
$$= 4e^{\frac{x}{2}}.\frac{1}{2}x + 3e^{-x}$$
$$= 2e^{\frac{x}{2}} + 3e^{-x}$$

h)

$$f(x) = \frac{e^{x} + e^{-x}}{2}$$
$$= \frac{e^{x}}{2} + \frac{e^{-x}}{2}$$
$$= \frac{1}{2}e^{x} + \frac{1}{2}e^{-x}$$
$$= \frac{1}{2}e^{x} + \left(\frac{1}{2}e^{-x}\right).(-1)$$
$$= \frac{1}{2}e^{x} - \frac{1}{2}e^{-x}$$
$$= \frac{e^{x} - e^{-x}}{2}$$

i)

$$f(x) = e^{-x^2}$$
$$f'(x) = e^{-x^2}.-2x$$
$$= -2xe^{-x^2}$$

j)

$$f(x) = e^{\frac{1}{x}}$$
$$f'(x) = e^{\frac{1}{x}}.(-x^{-2})$$
$$= -x^{-2}.e^{\frac{1}{x}}$$
$$= -\frac{e^{\frac{1}{x}}}{x^2}$$

k)

$$f(x) = 10(1 + e^{2x})$$
$$= 10 + 10e^{2x}$$
$$f'(x) = 10e^{2x}.2$$
$$= 20e^{2x}$$

l)

$$f(x) = 20(1 - e^{-2x})$$
$$= 20 - 20e^{-2x}$$
$$f'(x) - 20e^{-2x}.-2$$
$$= 40e^{-2x}$$

m)

$$f(x) = e^{2x+1}$$
$$f'(x) = e^{2x+1}.2$$
$$= 2e^{2x+1}$$

n)

$$f(x) = e^{\frac{x}{4}}$$
$$= e^{\frac{1}{4}x}$$
$$f'(x) = e^{\frac{1}{4}x}.\frac{1}{4}$$
$$= \frac{e^{\frac{x}{4}}}{4}$$

o)

$$f(x) = e^{1-2x^2}$$
$$f'(x) = e^{1-2x^2}.-4x$$
$$= -4xe^{1-2x^2}$$

p)

$$f(x) = e^{-0.02x}$$
$$f'(x) = e^{-0.02}x.(-0.02)$$
$$= -0.02e^{-0.02x}$$

2. a)

$$y = x.e^{x}$$
$$\frac{dy}{dx} = e^{x}.e^{x}.x$$

b)

$$y = x^{3}.e^{-x}$$
$$\frac{dy}{dx} = (3x^{2})(e^{-x}) + (e^{-x}).(-1)(x^{3})$$
$$= 3x^{2}.e^{-x} - x^{3}.e^{-x}$$

c)

$$y = \frac{e^{x}}{x}$$
$$\frac{dy}{dx} = \frac{(e^{x})(x) - e^{x}}{x^{2}}$$
$$= \frac{xe^{x} - e^{x}}{x^{2}}$$

d)

$$y = \frac{x}{e^{x}}$$
$$\frac{dy}{dx} = \frac{e^{x} - e^{x}.x}{(e^{x})^{2}}$$
$$= \frac{e^{x} - x.e^{x}}{(e^{x})^{2}}$$
$$= \frac{e^{x}(1-x)}{e^{x}.e^{x}}$$
$$= \frac{(1-x)}{e^{x}}$$

e)

$$y = x^{2}.e^{3x}$$
$$\frac{dy}{dx} = 2x.e^{3x} + e^{3x}.3.x^{2}$$
$$= 2x.e^{3x} + 3x^{2}.e^{3x}$$

g)

$$y = 20x.e^{-0.5x}$$
$$y' = (20)\left(e^{-0.5x}\right) + (e^{-0.5x})(-0.5)(20x)$$
$$= 20e^{-0.5x} - 10xe^{-0.5x}$$

Derivative of log functions

$$y = \ln x$$
$$y' = \frac{1}{x}$$

$$y = \ln f(x)$$
$$ý = \ln u \ldots u = f(x)$$

$$\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx} \ldots chain\,rule$$
$$= \frac{1}{u}.\frac{du}{dx}$$
$$= \frac{f'(x)}{f(x)}$$

Lets have a look at some examples…

Find the derivative of the following functions:

$a)\ \ y = \ln(kx)$

$b)\ \ y = \ln(1 - 3x)$

$c)\ \ y = x^3 . \ln x$

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a)

$$y = \ln(kx)$$
$$\frac{dy}{dx} = \frac{k}{kx}$$

b)

$$y = \ln(1 - 3x)$$
$$\frac{dy}{dx} = \frac{-3}{1 - 3x}$$

c)

$$y = x^3 . \ln x$$
$$\frac{dy}{dx} = (3x^2)(\ln x) + (\frac{1}{x})(x^3)$$
$$= 3x^2 \ln x + \frac{x^3}{x}$$
$$= 3x^2 \ln x + x^2$$
$$= x^2 (3 . \ln x + 1)$$

Here is a gentle reminder for you all…

$$\ln(ab) = \ln a + \ln b$$
$$\ln\left(\frac{a}{b}\right) = lna\ - \ln b$$
$$\ln(a^n) = n.\ln a$$

DON'T FORGET YOUR LOG RULES!

a)

$$y = \ln(x.e^{-x})$$
$$= lnx + lne^{-x}$$
$$= lnx - x.\ln e$$
$$= lnx - x$$
$$\frac{dy}{dx} = \frac{1}{x} - 1$$

b)

$$y = ln\left(\frac{x^2}{(x+2)(x-3)}\right)$$
$$= lnx^2 - \ln((x+2)(x-3))$$
$$= 2\ln x - \ln(x+2) - \ln(x-3)$$
$$\frac{dy}{dx} = \frac{2}{x} - \frac{1}{x+2} - \frac{1}{x-3}$$

1.

$$f(x) = 2\hat{e}^x - 8^x$$

2.

$$g(t) = 4\log_3 t - \ln t$$

3.

$$f(x) = 3^x . \log x$$

4.

$$y = z^5 - e^z . \ln z$$

5.

$$h(y) = \frac{y}{1 - e^y}$$

6.

$$f(t) = \frac{1 + 5t}{\ln t}$$

1.

$$f(x) = 2\hat{e}^x - 8^x$$
$$f'(x) = 2e^x - \ln 8.8^x$$

2.

$$g(t) = 4\log_3 t - \ln t$$
$$g'(t) = \frac{4}{t.\ln 3} - \frac{1}{t}$$

3.

$$f(x) = 3^x.\log x$$
$$f'(x) = (\ln 3\,.\,3^x)(\log x) + \frac{3^x}{x.\ln 10}$$

4.

$$y = z^5 - e^z.\ln z$$
$$y' = 5z^4 - e^z.\ln z + \frac{1}{z}.e^z$$
$$= 5z^4 - e^z.\ln z + \frac{e^z}{z}$$

5.

$$h(y) = \frac{y}{1 - e^y}$$
$$h'(y) = \frac{(1)(1 - e^y) - (-e^y)(y)}{(1 - e^y)^2}$$
$$= \frac{1 - e^y + ye^y}{1 - e^y}$$

6.

$$f(t) = \frac{1 + 5t}{\ln t}$$
$$f'(t) = \frac{5.\ln t - \frac{1}{t}.(1 + 5t)}{(\ln t)^2}$$
$$= \frac{5.\ln t - \frac{1}{t} - 5}{(\ln t)^2}$$

EXERCISE 2G

1 Find the gradient function of:

a $y = \ln(7x)$ **b** $y = \ln(2x+1)$ **c** $y = \ln(x - x^2)$

d $y = 3 - 2\ln x$ **e** $y = x^2 \ln x$ **f** $y = \dfrac{\ln x}{2x}$

g $y = e^x \ln x$ **h** $y = (\ln x)^2$ **i** $y = \sqrt{\ln x}$

j $y = e^{-x} \ln x$ **k** $y = \sqrt{x}\ln(2x)$ **l** $y = \dfrac{2\sqrt{x}}{\ln x}$

m $y = 3 - 4\ln(1-x)$ **n** $y = x\ln(x^2+1)$ **o** $y = \dfrac{\ln x}{x^2}$

2 Find $\dfrac{dy}{dx}$ for:

a $y = x\ln 5$ **b** $y = \ln(x^3)$ **c** $y = \ln(x^4 + x)$

d $y = \ln(10 - 5x)$ **e** $y = [\ln(2x+1)]^3$ **f** $y = \dfrac{\ln(4x)}{x}$

g $y = \ln\left(\dfrac{1}{x}\right)$ **h** $y = \ln(\ln x)$ **i** $y = \dfrac{1}{\ln x}$

1. a)

$$y = \ln(7x)$$
$$y' = \frac{1}{x}$$

b)

$$y = \ln(2x+1)$$
$$y' = \frac{2}{2x+1}$$

c)

$$y = \ln(x - x^2)$$
$$y' = \frac{-2x+1}{x-x^2}$$

d)

$$y = 3 - 2\ln x$$
$$y' = -\frac{2}{x}$$

e)

$$y = x^2 . \ln x$$
$$y' = (2x)(\ln x) + (\frac{1}{x})(x^2)$$
$$= 2x.\ln x + \frac{x^2}{x}$$
$$= 2x.\ln x + x$$

f)

$$y = \frac{\ln x}{2x}$$
$$y' = \frac{\left(\frac{1}{x}\right)(2x) - (2)(lnx)}{(2x)^2}$$
$$= \frac{\frac{2x}{x} - 2\ln x}{(2x)^2}$$
$$= \frac{2 - 2\ln x}{2x.2x}$$
$$= \frac{2(1 - lnx)}{2x.2x}$$
$$= \frac{1 - \ln x}{2x^2}$$

g)

$$y = e^x . \ln x$$
$$y' = (e^x)(lnx) + \frac{1}{x}.e^x$$
$$= e^x.\ln x + \frac{e^x}{x}$$

h)

$$y = (lnx)^2$$
$$\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$$
$$= 2(\ln x).\frac{1}{x}$$
$$= \frac{2\ln x}{x}$$

i)

$$y = \sqrt{lnx}$$
$$\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$$
$$= \frac{1}{2}(lnx)^{-\frac{1}{2}}.\frac{1}{x}$$
$$= \frac{1}{2x\sqrt{lnx}}$$

j)

$$y = e^{-x}.\,lnx$$

$$y' = (e^{-x})(-1)(lnx) + \left(\frac{1}{x}\right)(e^{-x})$$

$$= -e^{-x}.\,lnx + \frac{e^{-x}}{x}$$

k)

$$y = \sqrt{x}.\ln(2x)$$

$$= (x)^{\frac{1}{2}}.\ln(2x)$$

$$y' = \left(\frac{1}{2}x\right)^{-\frac{1}{2}}.\left(\ln(2x)\right) + \left(\frac{1}{x}\right)(x^{\frac{1}{2}})$$

$$= \frac{ln2x}{2\sqrt{x}} + \frac{x^{\frac{1}{2}}}{x}$$

$$= \frac{\ln(2x)}{2\sqrt{x}} + x^{-\frac{1}{2}}$$

$$= \frac{\ln(2x)}{2\sqrt{x}} + \frac{1}{\sqrt{x}}$$

l)

$$y = \frac{2x^{\frac{1}{2}}}{lnx}$$

$$y' = \frac{\left(x^{-\frac{1}{2}}\right)(lnx) - (\frac{1}{x})(2x^{\frac{1}{2}})}{(lnx)^2}$$

$$= \frac{lnx - (\frac{1}{x}.\,2x^{\frac{1}{2}})}{\sqrt{x}.\,(lnx)^2}$$

$$= \frac{lnx - \left(\frac{2x^{\frac{1}{2}}}{x}\right)}{\sqrt{x}.\,(lnx)^2}$$

$$= \frac{lnx - 2}{\sqrt{x}.\,(lnx)^2}$$

m)

$$y = 3 - 4\ln(1-x)$$

$$y' = -4.\frac{1}{1-x}.(-1)$$

$$= \frac{4}{1-x}$$

n)

$$y = x.\ln(x^2+1)$$

$$y' = \ln\left(x^2+1\right) + \frac{1}{x^2+1}.(2x)(x)$$

$$= \ln\left(x^2+1\right) + \frac{2x^2}{x^2+1}$$

o)

$$y = \frac{lnx}{x^2}$$

$$y' = \frac{\left(\frac{1}{x}\right)(x^2) - (2x).\,lnx}{(x^2)^2}$$

$$= \frac{\frac{x^2}{x} - 2x.\,lnx}{x^4}$$

$$= \frac{x(1-2lnx)}{x(x^3)}$$

$$= \frac{(1-2lnx)}{x^3}$$

2. a)

$$y = x.\,ln5$$
$$y' = ln5$$

b)

$$y = \ln(x^3)$$
$$y' = \frac{1}{x^3}.\,3x^2$$
$$= \frac{3x^2}{x^3}$$
$$= \frac{3}{x}$$

c)

$$y = \ln(x^4 - x)$$
$$y' = \frac{1}{x^4 - 4}.\,(4x^3 - 1)$$
$$= \frac{4x^3 - 1}{x^4 - x}$$

d)

$$y = \ln(10 - 5x)$$
$$y' = \frac{1}{10 - 5x}.\,(-5)$$
$$= \frac{-5(1)}{-5(-2 + x)}$$
$$= \frac{1}{-2 + x}$$
$$= \frac{1}{x - 2}$$

e)

$$y = [\ln(2x + 1)]^3$$
$$\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$$
$$= 3[\ln(2x + 1)]^2.\frac{2}{2x + 1}$$
$$= \frac{6}{2x + 1}.\,[\ln(2x + 1)]^2$$

f)

$$y = \frac{\ln(4x)}{x}$$
$$y' = \frac{\left(\frac{1}{x}\right)(x) - ln4x}{x^2}$$
$$= \frac{1 - ln4x}{x^2}$$

g)

$$y = \ln\left(\frac{1}{x}\right)$$
$$y' = \frac{1}{\frac{1}{x}} - x^{-2}$$
$$= \frac{-x^{-2}}{\frac{1}{x}}$$
$$= -x^{-2}.\,x$$
$$= -x^{-1}$$
$$= -\frac{1}{x}$$

h)

$$y = \ln(lnx)$$

$$y' = \frac{1}{lnx}.\frac{1}{x}$$

$$= \frac{1}{x.lnx}$$

Derivatives of trigonometric functions

If $f(x) = \sin x \ldots then \ldots f'(x) = \cos x$

If $f(x) = \cos x \ldots then \ldots f'(x) = -\sin x$

If $f(x) = \tan x \ldots then \ldots f'(x) = \frac{1}{\cos^2 x}$

If $f(x) = \sin[f(x)] \ldots then\ f'(x) = \cos[f(x)] \,.\, f'(x)$

If $f(x) = \cos[f(x)] \ldots then \ldots f'(x) = -\sin[f(x)] \,.\, f'(x)$

If $f(x) = \tan[f(x)] \ldots then \ldots f'(x) = \frac{f\prime(x)}{\cos^2[f(x)]}$

Differentiate with respect to x:

$a)\ \ x.sinx$

b) $4\tan^2 3x$

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a)

$$y = x.sinx$$

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

$$= \sin x + xcos\ x$$

b)

$$y = 4\tan^2 3x$$

$$4u^2 \ldots$$

$$\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$$

$$= 8u.\frac{du}{dx}$$

$$= 8\tan 3x \times \frac{3}{\cos^2 3x}$$

$$= \frac{24.\sin 3x}{\cos^3 3x}$$

EXERCISE 2H

1 Find $\frac{dy}{dx}$ for:

a $y = \sin 2x$ **b** $y = \sin x + \cos x$ **c** $y = \cos 3x - \sin x$

d $y = \sin(x+1)$ **e** $y = \cos(3-2x)$ **f** $y = \tan 5x$

g $y = \sin(\frac{x}{2}) - 3\cos x$ **h** $y = 3\tan \pi x$ **i** $y = 4\sin x - \cos 2x$

2 Differentiate with respect to x:

a $x^2 + \cos x$ **b** $\tan x - 3\sin x$ **c** $e^x \cos x$

d $e^{-x}\sin x$ **e** $\ln(\sin x)$ **f** $e^{2x}\tan x$

g $\sin 3x + 4\cos 2x$ **h** $\cos(\frac{x}{2})$ **i** $3\tan 2x$

j $x\cos x$ **k** $\frac{\sin x}{x}$ **l** $x\tan x$

1. a)

$$y = sin2x$$
$$y' = cos2x.2$$
$$y' = 2cos2x$$

b)

$$y = sinx + cosx$$
$$y' = cosx - sinx$$

c)

$$y = cos3x - sinx$$
$$y' = -3sin3x - cosx$$

d)

$$y = \sin(x + 1)$$
$$y' = \cos(x + 1).(1)$$

e)

$$y = \cos(3 - 2x)$$
$$y' = -\sin(3 - 2x).(-2)$$
$$= 2\sin(3 - 2x)$$

f)

$$y = tan5x$$
$$y' = \frac{5}{\cos^2 5x}$$

g)

$$y = \sin\left(\frac{x}{2}\right) - 3cosx$$
$$y' = \cos\left(\frac{x}{2}\right).\frac{1}{2} + 3sinx$$

h)

$$y = 3tan\pi x$$
$$y' = \frac{3\pi}{\cos^2(\pi x)}$$

i)

$$y = 4sinx - cos2x$$
$$y' = 4cosx + sin2x.2$$
$$= 4cosx + 2sin2x$$

2. a)

$$y = x^2 + cosx$$
$$y' = 2x - sinx$$

b)

$$y = tanx - 3sinx$$
$$y' = \frac{1}{\cos^2 x} - 3cosx$$
$$= \frac{-3cosx}{\cos^2 x}$$

c)

$$y = e^x.cosx$$
$$y' = (e^{-x})(cosx) - (sinx)(e^x)$$

d)

$$y = e^{-x}.sinx$$
$$y' = (e^{-x})(-1)(sinx) + (cosx)(e^{-x})$$
$$= -e^{-x}.sinx + e^{-x}.cosx$$

e)

$$y = \ln(sinx)$$
$$y' = \frac{1}{sinx}.cosx$$
$$= \frac{cosx}{sinx} = \frac{1}{tanx} = cotx$$

f)

$$y = e^{2x}.tanx$$
$$y' = (e^{2x})(2)(tanx) + \frac{1}{\cos^2 x}.(e^{2x})$$
$$= 2e^{2x}.tanx + \frac{e^{2x}}{\cos^2 x}$$

g)

$$y = sin3x + 4cos2x$$
$$y' = 3cos3x - 8sin2x$$

h)

$$y = \cos(\frac{x}{2})$$
$$y' = -\frac{1}{2}\sin(\frac{x}{2})$$

i)

$$y = 3tan2x$$
$$y' = \frac{6}{\cos^2 2x}$$

j)

$$y = x.cosx$$
$$y' = (cosx) - (sinx)(x)$$
$$= cosx - xsinx$$

k)

$$y = \frac{sinx}{x}$$
$$y' = \frac{(cosx)(x) - (sinx)}{x^2}$$
$$= \frac{xcosx - sinx}{x^2}$$

l)

$$y = x.tanx$$
$$y' = tanx + \frac{1}{\cos^2 x}.x$$
$$= tanx + \frac{x}{\cos^2 x}$$