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Course: MATH 104

1) For what values of $x$ is the function $y = 1/x - 2$ defined?
The Domain and Co-domain?

$$Y = \frac{1}{x-2}$$

Answer: It is defined for all set of real Numbers except two (2). The
Therefore, it is not defined for all set of real numbers because of it's denominator.
Domain: All set of real Numbers except 2 because $x = 0$
Co-Domain: All set of real Numbers except 2, because no value of $x$ will give $y = 0$.

2] If $K = \ln v$ differentiate $K$
N/B: $K = \ln v$
Recall $\frac{dK}{dv} = \frac{1}{v}$

$$\therefore \frac{dK}{dv} \ln v = \frac{1}{v}$$

3) Express $y$ as an explicit Function of in $x$ in the following
a) $2x - 3y - 2 = 0$

$$3y = 2x - 2$$

$$\therefore Y = \frac{2x - 2}{3}$$

b) $x^2 + y^2 = 4$

$$y^2 = 4 - x^2$$

$$y = \sqrt{4 - x^2}$$

$$y = 2 - x$$

4) If $P = \sin^{-1} t$, Find the derivative of $P$

$P = \sin^{-1} t$

$P = \frac{t}{\sin}$ $\qquad t = \sin P$ ---(1)

$\therefore \frac{dt}{dP} = \cos P$

but we looking for $dP/dt$

$\therefore \frac{dP}{dt} = \frac{1}{\cos P}$

Recall identity

$\cos^2 P + \sin^2 P = 1$

$\cos P = \sqrt{1 - \sin^2 P}$ From equ (1) $t = \sin P$

$\cos P = \sqrt{1 - t^2}$

Since $\cos P = \sqrt{1 - t^2}$ ---(2)

$\therefore$ Insert equ (2) into $\frac{dP}{dt} = \frac{1}{\cos P}$

Recall $\frac{dP}{dt} = \frac{1}{\sqrt{1-t^2}}$

$\therefore \frac{dP}{dt} = \frac{1}{\sqrt{1-t^2}}$ //

5) If $F(x) = 2x^2 - 5$, $g(x) = 4x - 2$, Find $F \circ g(x)$ and $g \circ F(x)$

Answer

a) $(F \circ g)x = F(g(x))$

$F(g(x)) = F(4x-2)$

$F(4x-2) = 2(4x-2)(4x-2) - 5$

$F(4x-2] = 2[16x^2 - 16x + 4) - 5$

$F(4x-2) = 32x^2 - 32x + 8 - 5$

$F(4x-2) = 32x^2 - 32x + 3$ //

b) $g \circ F(x) = g(F(x))$

$g(2x^2 - 5] = 4(2x^2 - 5) - 2$ $\qquad \therefore g(2x^2 - 5) = 8x^2 - 22$ //

$= 8x^2 - 20 - 2$

$g(2x^2 - 5) = 8x^2 - 22$

6) If $F(x) = 3x^2 - 2x + 1 = 0$, Show that $F_e(x) + F_o(x) = F(x)$

Answer

Find $F_e(x)$ Where $F(x) = 3x^2 - 2x + 1$

~~$F_e(x) = 3(-x)^2 - 2(-x) + 1 = 3x^2 + 2x + 1$~~

$$F_e(x) = \frac{F(x) + F(-x)}{2}$$ Since $F(-x)$ isn't given

$\therefore F(-x) = 3(-x)^2 - 2(-x) + 1 = 3x^2 + 2x + 1$

$F(-x) = 3x^2 + 2x + 1$

$$F_e(x) = \frac{3x^2 - \cancel{2x} + 1 + 3x^2 + \cancel{2x} + 1}{2} = \frac{6x^2 + 2}{2}$$

$$= \frac{\cancel{2}(3x^2 + 1)}{\cancel{2}} = 3x^2 + 1$$

$\therefore F_e(x) = 3x^2 + 1$

Find $F_o(x)$

$$F_o(x) = \frac{F(x) - F(-x)}{2} = \frac{3x^2 - 2x + 1 - [3x^2 + 2x + 1]}{2}$$

$$F_o(x) = \frac{\cancel{3x^2} - 2x + \cancel{1} - \cancel{3x^2} - 2x - \cancel{1}}{2} = \frac{-\cancel{4}x}{\cancel{2}} = -2x$$

$\therefore F(o)x = -2x$

To show that $F_e(x) + F_o(x) = F(x)$

$3x^2 + 1 + (-2x)$ rearrange

$3x^2 - 2x + 1 = F(x)$

It is Correct

7) Differentiate $y = \cos x$ from 1st Principle

$y = \cos x$

$y + \delta y = \cos(x + \delta x)$

$\delta y = \cos[x + \delta x] - y$

$\delta y = \cos[x + \delta x) - \cos x$

$\cos(A+B) = \cos A \cos B - \sin A \sin B$

$\cos(A \mp B) = \cos A \cos B \pm \sin A \sin B$

$\cos(A+B) - \cos(A-B) = -2\sin A \sin B$

$A + B = x + \delta x$ ---(i)

$A - B = x$ ---(ii)

$2A = 2x + \delta x$

$A = \frac{2x}{2} + \frac{\delta x}{2}$

$\boxed{A = x + \frac{\delta x}{2}}$

$A - B = x$

$B = A - x$

$B = \cancel{x} + \delta x/2 - \cancel{x}$

$\boxed{B = \delta x/2}$

$\delta y = -2\sin A \sin B$

$\delta y = -2\sin(x + \frac{\delta x}{2}) \sin[\delta x/2]$

divide both sides by $\delta x$

$\frac{\delta y}{\delta x} = \frac{-2\sin[x + \frac{\delta x}{2}]\sin[\frac{\delta x}{2}]}{\delta x}$

$\frac{\delta y}{\delta x} = \frac{-\sin[x + \frac{\delta x}{2}]\sin[\frac{\delta x}{2}]}{\frac{\delta x}{2}}$

$\frac{\delta y}{\delta x} = -\sin[x + \frac{\delta x}{2}]\frac{\sin[\frac{\delta x}{2}]}{\frac{\delta x}{2}}$

limit $\frac{\sin \delta x/2}{\delta x/2} \to 1$

$\delta x \to 0$

$\frac{\delta y}{\delta x} = \frac{dy}{dx} = -\sin(x+0)$

limit $\delta x \to 0$

$\frac{dy}{dx} = -\sin x$,,

8) Find $\frac{dy}{dx}$ if $y = 3t^2$ and $x = 1/t^2$

Sol

a) $y = 3t^2$

$\frac{dy}{dx} = ?$

$\frac{dy}{dt}$ $3 \times 2t^{2-1}$

$\frac{dy}{dt} = 6t$,,

b) $x = \frac{1}{t^2} = t^{-2}$

$\frac{dx}{dt} = -2t^{-3}$

$\therefore \frac{dy}{dx} = 2t^{-1} = \frac{1}{2t}$,,

9) Find $dy/dx$ if $y = x^2\cos 2x e^{4x}$

$\ln y = \ln x^2 + \ln\cos 2x + \ln e^{4x}$

$\frac{1}{y}\frac{dy}{dx} = \frac{d}{dx}[x^2] + \frac{d}{dx}[\cos 2x] + \frac{d}{dx}[e^{4x}]$

$\frac{1}{y}\frac{dy}{dx} = \frac{2x}{x^2} + -\frac{2\cos 2x}{\cos 2x} + \frac{4e^{4x}}{e^{4x}}$

$\therefore \frac{dy}{dx} = y[\frac{2}{x} - 2 + 4]$

$\frac{dy}{dx} = y[\frac{2}{x} + \frac{2}{1}] = y[\frac{2+2x}{x}]$

Recall $y = x^2\cos 2x e^{4x}$

$\therefore \frac{dy}{dx} = x^2\cos 2x e^{4x}\left[\frac{2+2x}{x}\right]$

10) Given that $y = \sin(3x^3+5]$ find the derivative of $y$

Sol

$F(x) = \sin x$

$g(x) = 3x^3 + 5$

Given this, The Chain Rule is that the derivation of $\sin(3x^3+5]$ will be : $F'(g(x)) \cdot g'(x)$

let differentiate F and g we get :

$F'(x) = \cos x$

$g'(x) = 9x^2$

let's substitute in

$\cos(3x^3+5) \cdot 9x^2$

$\therefore 9x^2\cos(3x^3+5]$,,