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i) $\int \frac{\sqrt{x^2-4}}{x}\, dx$

ii) $\int \frac{1}{(\sqrt{x+1})^3}\, dx$

$= \int \frac{1}{(x+1)^{3/2}}\, dx$

$= \int (x+1)^{-\frac{3}{2}}\, dx$

$= \frac{(x+1)^{-\frac{1}{2}}}{-1/2} + C$

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

iii) $\int$

v) $\int \sec^2 x\, dx$

$= \tan x + C$

vi) $\int \frac{1}{x}\, dx$

$= \ln x + c$

vii) $\int \frac{\cos x}{\sin^2 x}\, dx$

Let, $u = \sin x$

$\frac{du}{dx} = \cos x$

$= \int \frac{\cancel{\cos x}}{u^2} \frac{du}{\cancel{\cos x}}$

$= \int \frac{1}{u^2}\, du$

$= \int u^{-2}\, du$

$= -u^{-1} \cancel{du} + C$

$= -\frac{1}{\sin x} + C$

vii) $\int \frac{\cos x}{\sin^2 x}\, dx$

$= \int \frac{\cos x}{\sin x} \cdot \frac{1}{\sin x}\, dx$

$= \int \cot x \cdot \operatorname{cosec} x\, dx$

$= -\operatorname{cosec} x + C$

Integration 1

ix) $\int \frac{1}{1-\sin x}\, dx$

$= \int \frac{1+\sin x}{(1-\sin x)(1+\sin x)}\, dx$

$= \int \frac{1+\sin x}{1-\sin^2 x}\, dx$

$= \int \frac{1+\sin x}{\cos^2 x}\, dx$ $[\sin^2 x + \cos^2 x = 1]$

$= \int \frac{1}{\cos^2 x} + \frac{\sin x}{\cos^2 x}\, dx$

$= \int \frac{1}{\cos^2 x} + \frac{\sin x}{\cos x} \cdot \frac{1}{\cos x}\, dx$

$= \int \sec^2 x + \tan x \cdot \sec x\, dx$

$= \tan x + \sec x + C$

viii) $\int \sqrt{1+\sin 2x}\, dx$

We know,

$(\sin x + \cos x)^2$

$= \sin^2 x + 2\sin x \cos x + \cos^2 x$ $[\sin^2 x + \cos^2 x = 1]$

$= 1 + \sin 2x$ $[\sin 2x = 2\sin x \cos x]$

$\Rightarrow \int \sqrt{1+\sin 2x}\, dx$

$\Rightarrow \int \sqrt{(\sin x + \cos x)^2}\, dx$

$= \int \sin x + \cos x\, dx$

$= -\cos x + \sin x + C$

$= \sin x - \cos x + C$

FIGURE NO. ....

(10) $\int 5x^3\, dx$

$= \frac{5x^4}{4} + c$

(11) $\int \frac{2}{x}\, dx$

$= 2\int \frac{1}{x}\, dx$

$= 2\ln x + c$

(12) $\int \frac{x^4+1}{x^2}\, dx$

$= \int \frac{x^4}{x^2} + \frac{1}{x^2}\, dx$

$= \int x^2 + x^{-2}\, dx$

$= \frac{x^3}{3} - x^{-1} + c$

$= \frac{x^3}{3} - \frac{1}{x} + c$

(13) $\int \frac{1+x}{x}\, dx$

$= \int \frac{1}{x} + \frac{x}{x}\, dx$

$= \int \frac{1}{x} + 1\, dx$

$= \ln(x) + x + c$

(14) $\int (x^2 + e^x + 2^x)\, dx$

$= \frac{x^3}{3} + e^x + \frac{2^x}{\ln(2)} + c$

(15) $\int (4x^3 + 3x^2 - 2x + 5)\, dx$

$= \frac{4x^4}{4} + \frac{3x^3}{3} - \frac{2x^2}{2} + 5x + c$

$= x^4 + x^3 - x^2 + 5x + c$

(16) $\int (1-3x)(1+x)\, dx$

$= \int (1 + x - 3x - 3x^2)\, dx$

$= \int (1 - 2x - 3x^2)\, dx$

$= x - x^2 - x^3 + c$

(31) $\int \frac{\cos\sqrt{y}}{\sqrt{y}}\, dy$

Let, $u = \sqrt{y}$

$\frac{du}{dy} = \frac{1}{2\sqrt{y}}$

$dy = du \cdot 2\sqrt{y}$

$\therefore \int \frac{\cos u}{\cancel{\sqrt{y}}}\, du\, 2\cancel{\sqrt{y}}$

$\Rightarrow 2\int \cos u\, du$

$\Rightarrow 2\sin(\sqrt{y}) + c$

(36) $\int \frac{\sqrt{\tan^{-1}x}}{1+x^2}\, dx$

Let, $u = \tan^{-1}x$

$\frac{du}{dx} = \frac{1}{1+x^2}$

$\Rightarrow \int \frac{\sqrt{u}}{\cancel{1+x^2}} (\cancel{1+x^2})\, du$

$= \int (u)^{1/2}\, du$

$= \frac{2}{3} u^{3/2} + c$

$= \frac{2}{3} (\tan^{-1}x)^{3/2} + c$

Integration 2

(17) $\int (3x^{-1} + 4x^2 - 3x + 8)\, dx$

$\{3\int \frac{1}{x} + \int 4x^2 - \int 3x + \int 8\}\, dx$

$= 3\ln(x) + \frac{4}{3}x^3 - \frac{3}{2}x^2 + 8x + c$

(18) $\int (8e^x - 4a^x + 3x^{-1} + \sqrt[4]{x})\, dx$

$= 8e^x - \frac{4a^x}{\ln(a)} + 3\ln(x) + \frac{4}{5} x^{5/4} + c$

(19) $\int (2x+9)^5\, dx$

Let, $u = 2x+9$

$\frac{du}{dx} = 2$

$\Rightarrow \int u^5 \frac{du}{2}$

$\Rightarrow \frac{1}{2}\int u^5\, du$

$\Rightarrow \frac{1}{2} \cdot \frac{1}{6} u^6 + c$

$\Rightarrow \frac{1}{12}(2x+9)^6 + c$

(20) $\int \sqrt{(5x+7)^3}\, dx$

$= \int (5x+7)^{3/2}\, dx$

Let, $u = 5x+7$

$\frac{du}{dx} = 5$

$\Rightarrow \int u^{3/2} \frac{du}{5}$

$\Rightarrow \frac{1}{5} \cdot \frac{2}{5} u^{5/2} + c$

$\Rightarrow \frac{2}{25}(5x+7)^{5/2} + c.$

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Integration 3

(21) $\int (x^3+2)^3 \cdot 3x^2\, dx$

Let,

$u = x^3+2$

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

$\int u^3 \cdot 3x^2 \frac{du}{3x^2}$

$\Rightarrow \int u^3\, du$

$= \frac{u^4}{4} + c$

$= \frac{(x^3+2)^4}{4} + c$

(22) $\int x^2 2e^x\, dx$

$= 2\int x^2 e^x\, dx$

we know $\int u\, dv = uv - \int v\, du$

Let,

$u = x^2$, $dv = e^x dx$

$du = 2x\,dx$, $v = e^x$

$= 2\{uv - \int v\, du\}$

$= 2\{x^2e^x - \int e^x \cdot 2x\, dx\}$

$= 2x^2e^x - 2\int e^x 2x$

$u = e^x$, $dv = 2x\, dx$

$du = e^x dx$, $v = \cancel{2}\, x^2$

$= 2x^2e^x - 2\{e^x \cdot \cancel{2}x^2 - \int 2e^x\, dx\}$

$\cancel{= 2x^2e^x - 4e^x}$

$= 2x^2e^x - 2x^2e^x + 4e^x + c$

$= 2e^x(x^2 - x + 1) + c$

(24) $\int x^2\sqrt{x-1}\, dx$

$= \int x^2 (x-1)^{1/2}\, dx$

Let, $u = x-1$

$\frac{du}{dx} = 1$

$\therefore x = u+1$

$= \int (u+1)^2 (u)^{1/2}\, du$

$= \int (u^2+2u+1)(u)^{1/2}\, du$

$\cancel{= \int u^{1/2}} \cdot \int u^{5/2} + u^{3/2} + u^{1/2}\, du$

$= \frac{2}{7}u^{7/2} + \frac{2}{5}u^{5/2} + \frac{2}{3}u^{3/2} + c$

$= \frac{2}{7}(x-1)^{7/2} + \frac{2}{5}(x-1)^{5/2} + \frac{2}{3}(x-1)^{3/2} + c$

(26) $\int y^4 \cdot \sqrt[3]{5-4y^5}\, dy$

$= \int y^4 \cdot (5-4y^5)^{1/3}\, dy$

Let,

$u = 5-4y^5$

$\frac{du}{dy} = -20y^4$

$\therefore \int y^4 \cdot (5-4y^5)^{1/3} \cdot \frac{du}{-20y^4}$

$= -\frac{1}{20}\int u^{1/3}\, du$

$= -\frac{1}{20} \cdot \frac{3}{4} u^{4/3} + c$

$= -\frac{3}{80}(5-4y)^{4/3} + c$

(28) $\int x^2 \ln x\, dx$

Let, $u = \ln x$, $dv = x^2 dx$

$du = \frac{1}{x}dx$, $v = \cancel{2x}\, \frac{x^3}{3}$

$\therefore \ln x \cdot \frac{x^3}{3} - \int \frac{x^{\cancel{3}\,2}}{3} \cdot \frac{1}{\cancel{x}}\, dx$

$= \frac{x^3 \ln x}{3} - \frac{1}{3}\int x^2\, dx$

$= \frac{x^3 \ln x}{3} - \frac{1}{3} \cdot \frac{1}{3}x^3 + c$

$= \frac{x^3 \ln x}{3} - \frac{x^3}{9} + c$

(29) $\int x^2\sqrt{1+x}\,dx$

Let, $u = 1+x$, $\frac{du}{dx} = 1$, $x = u-1$

$= \int x^2(1+x)^{1/2}\,dx$

$= \int (u-1)^2(u)^{1/2}\,du$

$= \int (u^2-2u+1)(u)^{1/2}\,du$

$= \int u^{\frac{5}{2}} - 2u^{\frac{3}{2}} + u^{1/2}\,du$

$= \frac{2}{7}u^{5/2} - \frac{4}{5}u^{5/2} + \frac{2}{3}u^{3/2} + c$

(34) $\int (x^{-3} - 3x^{1/4} + 8x^2)\,dx$

$= -\frac{1}{2}x^{-2} - \frac{12}{5}x^{5/4} + \frac{8}{3}x^3 + c$

$= -\frac{1}{2x^2} - \frac{12(\sqrt[4]{x})^5}{5} + \frac{8x^3}{3} + c$

(32) $\int \frac{e^x}{\sqrt{1-e^{2x}}}\,dx$

$\Rightarrow \int \frac{e^x}{\sqrt{1-(e^x)^2}}\,dx$

Let,

$u = e^x$

$\frac{du}{dx} = e^x$

$\Rightarrow \int \frac{e^x}{\sqrt{1-u^2}} \cdot \frac{du}{e^x}$

$\Rightarrow \int \frac{1}{\sqrt{1-u^2}}\,du$

$\Rightarrow \sin^{-1}(u) + c$

$\Rightarrow \sin^{-1}(e^x) + c$

Integration 4

(33) $\int x^2 e^{-2x}\,dx$

Let,

$u = x^2$, $du = 2x\,dx$ | $dv = e^{-2x}\,dx$, $v = -\frac{1}{2}e^{-2x}$

$\Rightarrow x^2\cdot(-\frac{1}{2}e^{-2x}) - \int -\frac{1}{2}e^{-2x}\,2x\,dx$

$\Rightarrow -\frac{1}{2}x^2e^{-2x} + \int e^{-2x}x\,dx$

Let,

$u = x$, $du = 1\,dx$ | $dv = e^{-2x}\,dx$, $v = -\frac{1}{2}e^{-2x}$

$\Rightarrow -\frac{1}{2}x^2e^{-2x} + \{x(-\frac{1}{2}e^{-2x}) - \int -\frac{1}{2}e^{-2x}\,dx\}$

$\Rightarrow -\frac{1}{2}x^2e^{-2x} - \frac{1}{2}xe^{-2x} + \frac{1}{2}(-\frac{1}{2}e^{-2x}) + c$

$\Rightarrow -\frac{1}{2}x^2e^{-2x} - \frac{1}{2}xe^{-2x} - \frac{1}{4}e^{-2x} + c$

$\Rightarrow -\frac{1}{2}e^{-2x}(x^2 + x + \frac{1}{2}) + c$

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(1) $\lim_{x\to 0}\left(\frac{1}{x}-\frac{1}{e^x-1}\right)$

$= \text{—}\left(\frac{e^x-1-x}{xe^x-x}\right)$ [L]

$= \text{—}\left(\frac{e^x-1}{x\cdot e^x+e^x\cdot 1-1}\right)$ [L]

$= \text{—}\left(\frac{e^x}{x\cdot e^x+e^x\cdot 1+e^x}\right)$

$= \frac{1}{0.1+1+1}$

$= \frac{1}{2}$

(4) $\lim_{x\to\infty}\left(\sqrt{x^2+x}-x\right)$

$= \text{—}\left(\frac{(\sqrt{x^2+x})^2-(x^2)}{\sqrt{x^2+x}+x}\right)$

$= \text{—}\ \frac{x^2+x-x^2}{\sqrt{x^2+x}+x}$

$= \text{—}\ \frac{\frac{x}{|x|}}{\frac{\sqrt{x^2+x}}{|x|}+\frac{x}{|x|}}$

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

$= \text{—}\ \frac{1}{\sqrt{1+\frac{1}{x}}+1}$

$= \frac{1}{\sqrt{1}+1}$

$= \frac{1}{2}$

(2) $\lim_{x\to 0}\frac{5x^3-2x^2+1}{3x+5}$

$= \frac{1}{5}$

(7) $\lim_{x\to 0}(e^x+x)^{1/x}$

Let,

$y = \lim_{x\to 0}(e^x+x)^{1/x}$

$\Rightarrow \ln y = \text{—}\ \frac{1}{x}\ln(e^x+x)$

$\Rightarrow \ln y = \text{—}\ \frac{1}{1}\frac{1}{e^x+x}\cdot(e^x+1)$ [L]

$\Rightarrow \ln y = \frac{e^0+1}{e^0+0}$

$\Rightarrow \ln y = \frac{2}{1}$

$\Rightarrow y = e^2$

(8) $\lim_{x\to 0}\left(\frac{x-\tan^{-1}x}{x^3}\right)$

$= \text{—}\left\{\frac{1-\left(\frac{1}{1+x^2}\right)}{3x^2}\right\}$ [L]

$= \text{—}\left(\frac{\frac{1+x^2-1}{1+x^2}}{3x^2}\right)$

$= \text{—}\left(\frac{x^2}{1+x^2}\cdot\frac{1}{3x^2}\right)$

$= \text{—}\ \frac{1}{3+3x^2}$

$= \frac{1}{3}$

(3) $\lim_{x\to 0}(1+x)^{1/x}$

Let,

$y = \lim_{x\to 0}(1+x)^{1/x}$

$\Rightarrow \ln y = \text{—}\ \frac{1}{x}\ln(1+x)$ [L]

$\Rightarrow \ln y = \text{—}\ \frac{1}{1}\frac{1}{1+x}\cdot 1$ [L]

$\Rightarrow \ln y = \frac{1}{1}$

$\Rightarrow y = e$

(5) $\lim_{x\to\infty}\left(\frac{x^3-x+7}{\sqrt{9x^6+1}}\right)$

$= \text{—}\left(\frac{\frac{x^3}{x^3}-\frac{x}{x^3}+\frac{7}{x^3}}{\sqrt{\frac{9x^6}{x^6}+\frac{1}{x^6}}}\right)$

$= \text{—}\left(\frac{1-\frac{1}{x^2}+\frac{7}{x^3}}{\sqrt{9+\frac{1}{x^6}}}\right)$

$= \frac{1-0+0}{\sqrt{9+0}}$

$= \frac{1}{\sqrt{9}}$

$= \frac{1}{3}$

Limit 1

FIGURE NO. ....

(9) $\lim_{x\to 1}\left(\dfrac{x^3+x^2-5x+3}{x^3-3x+2}\right)$ [L]

$= \dfrac{3x^2+2x-5}{3x^2-3}$ [L]

$= \dfrac{6x+2}{6x}$

$= \dfrac{6+2}{6}$

$= \dfrac{8}{6}$

$= \dfrac{4}{3}$

(10) $\lim_{x\to 0}\left(\dfrac{1}{x}-\dfrac{1}{\sin x}\right)$

$= \left(\dfrac{\sin x - x}{x\sin x}\right)$ [L]

$= \left(\dfrac{\cos x - 1}{x\cos x+\sin x\cdot 1}\right)$ [L]

$= \left(\dfrac{-\sin x}{x(-\sin x)+\cos x\cdot 1+\cos x}\right)$ [L]

$= \left(\dfrac{0}{0+1+1}\right)$

$= 0$

(11) $\lim_{x\to \pi/4}(1-\tan x)(\sec 2x)$

$= \left(1-\dfrac{\sin x}{\cos x}\right)\left(\dfrac{1}{\cos 2x}\right)$

$= \left(\dfrac{\cos x-\sin x}{\cos x}\right)\dfrac{1}{\cos 2x}$

$= \dfrac{\cos x-\sin x}{\cos x\cdot\cos 2x}$

$= \dfrac{-\sin x-\cos x}{-\cos x\cdot 2\sin 2x+\cos 2x(-\sin x)}$ [L]

$= \dfrac{-(\sin x+\cos x)}{-(2\cos x\sin 2x+\sin x\cos 2x)}$

$= \dfrac{\frac{\sqrt{2}}{2}+\frac{\sqrt{2}}{2}}{2\cdot\frac{\sqrt{2}}{2}\cdot 1+0}$

$= \dfrac{\frac{2\sqrt{2}}{2}}{\frac{2\sqrt{2}}{2}}$

$= 1$

(11) $\lim_{x\to \frac{\pi}{4}}(1-\tan x)(\sec 2x)$

$= \left(\dfrac{1-\tan x}{\cos 2x}\right)$

$= \dfrac{0-\sec^2 x}{-2\sin 2x}$ [L]

$= \dfrac{-\frac{1}{\cos^2 45}}{-2\sin 90}$

$= \dfrac{\frac{1}{\left(\frac{\sqrt{2}}{2}\right)^2}}{2\times 1}$

$= \dfrac{4}{2}\times\dfrac{1}{2}$

$= \dfrac{4}{4}$

$= 1$

Limit 2

(12) $\lim_{x\to 0}\left(\frac{x^2}{e^x+e^{-x}-2}\right)$

$= \left(\frac{2x}{e^x-e^{-x}-0}\right)$ [L]

$= \left(\frac{2}{e^x+e^x}\right)$ [L]

$= \frac{2}{1+1}$

$= 1$

(13) $\lim_{x\to\infty}\sqrt[3]{\frac{3x+5}{6x-8}}$

$= \sqrt[3]{\frac{3+5/x}{6-8/x}}$

$= \sqrt[3]{\frac{3}{6}}$

$= \left(\frac{3}{6}\right)^{1/3}$

$= \left(\frac{1}{2}\right)^{1/3}$

$= \frac{1}{\sqrt[3]{2}}$

(15) $\lim_{x\to 0} x\ln x$

$= x\cdot\frac{1}{x}+\ln x\cdot 1$ [L]

$= 1+\ln x$

$= 0+\frac{1}{x}$ [L]

$= +\infty$

(14) $\lim_{x\to\infty}\left(\sqrt{x^2+3x}-x\right)$

$= \frac{\left(\sqrt{x^2+3x}\right)^2-(x)^2}{\sqrt{x^2+3x}+x}$

$= \frac{x^2+3x-x^2}{\sqrt{x^2+3x}+x}$

$= \frac{\frac{3x}{|x|}}{\sqrt{\frac{x^2}{x^2}+\frac{3x}{x^2}}+\frac{x}{|x|}}$ $\boxed{|x|=\sqrt{x^2}}$

$= \frac{3}{\sqrt{1+\frac{3}{x}}+1}$

$= \frac{3}{\sqrt{1}+1}$

$= \frac{3}{2}$

Limit 3

~~(16) $\lim_{x\to 0}\left(\frac{1x-\cos 3x}{x^3}\right)$~~

~~$= \frac{1+3\sin 3x}{3x^2}$ [L]~~

~~$= \frac{9\cos 3x}{6x}$ [L]~~

~~$= \frac{-27\sin 3x}{6}$ [L]~~

~~$= 0$~~

(19) $\lim_{x\to 0}\frac{1-\cos x}{x^2}$

$= \frac{0+\sin x}{2x}$ [L]

$= \frac{\cos x}{2}$ [L]

$= \frac{1}{2}$

(19) $\lim_{x\to 0}\frac{1-\cos x}{x^2}$

$= \left(\frac{2\sin^2\frac{x}{2}}{x^2}\right)$ $\left[2\sin^2 A = 1-\cos 2A\right.$
$\left.\therefore 2\sin^2\frac{A}{2} = 1-\cos A\right]$

$= 2\left(\frac{\sin\frac{x}{2}}{\frac{x}{2}}\cdot\frac{1}{2}\right)^2$

$= 2\cdot\left(1\cdot\frac{1}{2}\right)^2 = \frac{1}{2}$

FIGURE NO. ....

(17) $\lim_{t \to 2} \left(\frac{t^3 - 3t^2 - 12t + 4}{t^3 - 4t} \right)$

$= \frac{3t^2 - 6t - 12}{3t^2 - 4}$ [L]

$= \frac{6t - 6}{6t}$ [L]

$= \frac{12 - 6}{12}$

$=$

(16) $\lim_{x \to 0} \left(\frac{1 - \cos 3x}{x^2} \right)$

$= \left(\frac{2\sin^2 \frac{3x}{2}}{x^2} \right)$ $[2\sin^2 A = 1 - \cos 2A]$ $[\Rightarrow 2\sin^2 \frac{A}{2} = 1 - \cos \frac{A}{2}]$

$= 2 \left(\frac{\sin \frac{3x}{2}}{\frac{3x}{2}} \cdot \frac{3}{2} \right)^2$

$= 2 \left(1 \cdot \frac{3}{2} \right)^2$

$= 2 \cdot \frac{9}{4}$

$= \frac{9}{2}$

(16) $\lim_{x \to 0} \left(\frac{1 - \cos 3x}{x^2} \right)$

$= \left(\frac{0 + 3\sin 3x}{2x} \right)$ [L]

$= \frac{9\cos 3x}{2}$ [L]

$= \frac{9 \cos 0}{2}$

$= \frac{9 \cdot 1}{2}$

$= \frac{9}{2}$

(18) $\lim_{x \to \infty} \left(\sqrt{x^6 + 5x^3} - x^3 \right)$

$= \frac{\left(\sqrt{x^6 + 5x^3} - x^3 \right)\left(\sqrt{x^6 + 5x^3} + x^3 \right)}{\sqrt{x^6 + 5x^3} + x^3}$

$= \frac{\left(\sqrt{x^6 + 5x^3} \right)^2 - (x^3)^2}{\sqrt{x^6 + 5x^3} + x^3}$

$= \frac{x^6 + 5x^3 - x^6}{\sqrt{x^6 + 5x^3} + x^3}$

$= \frac{\frac{5x^3}{|x^3|^3}}{\frac{\sqrt{x^6 + 5x^3}}{|x^3|^3} + \frac{x^3}{|x^3|^3}}$ $\left[|x^3|^3 = x^3, \; |x^3|^3 = \sqrt{x^6} \right]$

$= \frac{5}{\sqrt{\frac{x^6}{x^6} + \frac{5x^3}{x^6}} + 1} = \frac{5}{\sqrt{1 + 0} + 1}$

$= \frac{5}{2}$

Limit 4

(16) $\lim_{x \to 0} \left(\frac{1 - \cos 3x}{x^3} \right)$

$= \frac{0 + 3\sin 3x}{3x^2}$ [L]

$= \frac{9\cos 3x}{6x}$ [L]

$= \frac{-27\sin 3x}{6}$ [L]

$= \frac{-27 \cdot 0}{6} = 0$

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Gamma Beta

EXPT. NO.

1) $\Gamma(\frac{1}{2}) = \sqrt{\pi}$

=> We know that,

$$\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$$

If

=> $m = \frac{1}{2}$, $n = \frac{1}{2}$

$$\beta(\tfrac{1}{2}, \tfrac{1}{2}) = \frac{\Gamma(\frac{1}{2})\Gamma(\frac{1}{2})}{\Gamma(1)}$$

$$= \{\Gamma(\tfrac{1}{2})\}^2$$

Again,

$$\beta(m,n) = \int_0^1 x^{m-1}(1-x)^{n-1}\,dx$$

$$\beta(\tfrac{1}{2},\tfrac{1}{2}) = \int_0^1 x^{1/2-1}(1-x)^{1/2-1}\,dx$$

$$\{\Gamma(\tfrac{1}{2})\}^2 = \int_0^1 x^{1/2-1}(1-x)^{1/2-1}\,dx \quad \text{--- (1)}$$

Let, $x = \sin^2\theta$, $dx = 2\sin\theta\cos\theta$ | $x=0, \theta=0$; $x=1, \theta=\pi/2$

$\Gamma\beta(1)$

From 1,

$$\{\Gamma(\tfrac{1}{2})\}^2 = \int_0^{\pi/2} (\sin^2\theta)^{1/2-1}(1-\sin^2\theta)^{1/2-1}\, 2\sin\theta\cos\theta$$

$$= \int_0^{\pi/2} (\sin^2\theta)^{-1/2}(\cos^2\theta)^{-1/2}\cdot 2\sin\theta\cos\theta$$

$$= \int_0^{\pi/2} \frac{1}{\sin\theta}\cdot\frac{1}{\cos\theta}\cdot 2\sin\theta\cos\theta$$

$$= 2\int_0^{\pi/2} d\theta$$

$$= 2[\theta]_0^{\pi/2} = 2\frac{\pi}{2} = \pi$$

Taking Root on both sides,

$$[\{\Gamma(\tfrac{1}{2})\}^2] = (\pi)^{1/2}$$

$$\Gamma(\tfrac{1}{2}) = \sqrt{\pi}$$ (proved)

FIGURE NO. ....

(2) $\int_0^1 x^9(1-x)^4\,dx$

$\int_0^1 x^{10-1}(1-x)^{5-1}\,dx$

$\beta(10,5) = \frac{\Gamma(10)\Gamma(5)}{\Gamma(15)}$

$= \frac{\cancel{\Gamma(10)}\,4\times3\times2\times1}{14\times13\times12\times11\times10\,\cancel{\Gamma(10)}}$

$=$

(4) $\int_0^1 x^3(1-x)^{1/2}\,dx$

$\int_0^1 x^{4-1}(1-x)^{1-1/2}\,dx$

$\beta(4,1) = \frac{\Gamma(4)\Gamma(1)}{\Gamma(5)}$

$= \frac{\cancel{\Gamma(4)}\times1}{4\times\cancel{\Gamma(4)}}$

$= \frac{1}{4}$

(3) $\int_0^1 x^7(1-x)^3\,dx$

$= \int_0^1 x^{8-1}(1-x)^{4-1}\,dx$

$\beta(8,4) = \frac{\Gamma(8)\Gamma(4)}{\Gamma(12)}$

$= \frac{\cancel{\Gamma(8)}\times3\times2\times1}{11\times10\times9\times8\,\cancel{\Gamma(8)}}$

$=$

(5) $\int_0^1 x^{3/2}(1-x)^{5/2}\,dx$

$= \int_0^1 x^{5/2-1}(1-x)^{7/2-1}\,dx$

$\beta\left(\frac{5}{2},\frac{7}{2}\right) = \frac{\Gamma\left(\frac{5}{2}\right)\Gamma\left(\frac{7}{2}\right)}{\Gamma(6)}$

$= \frac{\frac{3}{2}\times\frac{1}{2}\times\sqrt{\pi}\times\frac{5}{2}\times\frac{3}{2}\times\frac{1}{2}\times\sqrt{\pi}}{5\times4\times3\times2\times1}$

$=$ ______

$\Gamma\ \beta(2)$

6) $\int_0^\infty x^5 e^{-4x}\, dx$

Let, $y = 4x$

$x = y/4$

$\frac{dx}{dy} = \frac{1}{4}$

$\Rightarrow \int_0^\infty \left(\frac{y}{4}\right)^5 e^{-y} \frac{dy}{4}$

$\Rightarrow \frac{1}{4^6}\int_0^\infty y^5 e^{-y}\, dy \Rightarrow \frac{1}{4^6}\int_0^\infty e^{-y}\, y^{6-1}\, dx$

$\Rightarrow \Gamma(n) = \int_0^\infty e^{-x} x^{n-1}\, dx$

$\Rightarrow \frac{1}{4^6}\{\Gamma(6)\} = 5\times4\times3\times2\times1$

$\Rightarrow \int_0^\infty x^5 e^{-4y} = \frac{5\times4\times3\times2\times1}{4^6}$

~~7) $\int_0^1 (1-x)^{-1/2}\, dx$~~

~~Let, $u = 1-x$~~

~~$\frac{du}{dx} = -1$~~

~~$\Rightarrow \int_0^1 -u^{-1/2}\, du$~~

7) $\int_0^1 (1-x)^{-1/2}\, dx$

$\Rightarrow \int_0^1 x^{1-1}(1-x)^{\frac{1}{2}-1}\, dx$

$\beta\left(1, \frac{1}{2}\right) = \frac{\Gamma(1)\Gamma(\frac{1}{2})}{\Gamma(\frac{3}{2})}$

$= \frac{1\times\sqrt{\pi}}{\frac{1}{2}\times\sqrt{\pi}}$

$= 2$

8) $\int_0^{\pi/2} \sin^4\theta \cos^2\theta\, d\theta$

$\therefore \int_0^{\pi/2} \sin^m\theta \cos^n\theta\, d\theta = \frac{1}{2}\beta\left(\frac{m+1}{2}, \frac{n+1}{2}\right)$

$\therefore \frac{1}{2}\beta\left(\frac{5}{2}, \frac{3}{2}\right) = \frac{1}{2} \cdot \frac{\Gamma(\frac{5}{2})\Gamma(\frac{3}{2})}{\Gamma(4)}$

$\Gamma \beta(3)$

(9) $\int_0^1 x^5(1-x)^{5/2}\,dx$

$\beta\left(6,\frac{7}{2}\right) = \frac{\Gamma(6)\Gamma(7/2)}{\Gamma(19/2)}$

$= \frac{5\times4\times3\times2\times1\times\cancel{\Gamma(7/2)}}{\frac{17}{2}\times\frac{15}{2}\times\frac{13}{2}\times\frac{11}{2}\times\frac{9}{2}\times\frac{7}{2}\times\cancel{\Gamma(7/2)}}$

$=$

(10) $\int_0^{\pi/2}\sin^5x\cos^4x\,dx$

$\int_0^{\pi/2}\sin^m\theta\cos^n\theta\,d\theta = \frac{1}{2}\beta\left(\frac{m+1}{2},\frac{n+1}{2}\right)$

$\Rightarrow \frac{1}{2}\beta\left(\frac{6}{2},\frac{5}{2}\right) = \frac{1}{2}\,\frac{\Gamma(3)\Gamma(5/2)}{\Gamma\left(\frac{11}{2}\right)}$

$=$

(11) $\int_0^{\pi/2}\sin^{12}x\,dx$

$\int_0^{\pi/2}\sin^m x\,dx = \frac{\sqrt{\pi}\times\Gamma\left(\frac{m+1}{2}\right)}{2\cdot\Gamma\left(\frac{m}{2}+1\right)}$

$\Rightarrow \frac{\sqrt{\pi}\times\Gamma\left(\frac{13}{2}\right)}{2\Gamma(7)}$

(13) $\int_0^{\pi/2}\sin^5x\,dx$

$\boxed{\frac{\sqrt{\pi}\times\Gamma\left(\frac{m+1}{2}\right)}{2\Gamma\left(\frac{m}{2}+1\right)}}$

$\Gamma\beta(4)$

(14) $\int_0^{\pi/2}\cos^m x\,dx$ / $\int_0^{\pi/2}\sin^{0}x\cos^{n}x$

$\Rightarrow \frac{\sqrt{\pi}\,\Gamma\left(\frac{m+1}{2}\right)}{2\Gamma\left(\frac{m}{2}+1\right)}$ | $\Rightarrow \frac{1}{2}\beta\left(\frac{m+1}{2},\frac{n+1}{2}\right)$

(11) $\int_0^{\pi/2}\sin^{12}x\cos^0x\,dx$

$\frac{1}{2}\beta\left(\frac{m+1}{2},\frac{n+1}{2}\right)$

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Partial

(8) ~~$f(x,y) = \log(x$~~

(10) $f(x,y) = \ln(x^2+y^2)$, prove $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} = 0$

$\therefore \frac{\partial f}{\partial x} = \frac{1}{x^2+y^2} \cdot 2x$

$\Rightarrow \frac{\partial^2 f}{\partial x^2} = \frac{(x^2+y^2) \cdot 2 - 2x \cdot 2x}{(x^2+y^2)^2}$

$= \frac{2(x^2+y^2) - 4x^2}{(x^2+y^2)^2}$

$\frac{\partial f}{\partial y} = \frac{1}{x^2+y^2} \cdot 2y$

$\frac{\partial^2 f}{\partial y^2} = \frac{(x^2+y^2) \cdot 2 - 2y \cdot 2y}{(x^2+y^2)^2}$

$= \frac{2(x^2+y^2) - 4y^2}{(x^2+y^2)^2}$

$\therefore \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} = 0$

$\Rightarrow \frac{2(x^2+y^2) - 4x^2}{(x^2+y^2)^2} + \frac{2(x^2+y^2) - 4y^2}{(x^2+y^2)^2} = 0$

$\Rightarrow \frac{4(x^2+y^2) - 4(x^2+y^2)}{(x^2+y^2)^2} = 0$

$\Rightarrow \frac{4x^2 + 4y^2 - 4x^2 - 4y^2}{(x^2+y^2)^2} = 0$

$\Rightarrow \frac{0}{(x^2+y^2)^2} = 0$

$\Rightarrow 0 = 0$

Partial 7

xy^{-1}

$-xy^{-2}$

FIGURE NO. ....

(11) $f(x,y) = y^{-\frac{3}{2}} \cdot \tan^{-1}(x/y)$

$$\frac{\partial F}{\partial x} = y^{-\frac{3}{2}} \cdot \frac{1}{1+(\frac{x}{y})^2} \cdot \frac{1}{y} + \tan^{-1}(\tfrac{x}{y}) \cdot 0$$

$$= y^{-\frac{3}{2}} \cdot \frac{1}{1+\frac{x^2}{y^2}} \cdot \frac{1}{y}$$

$$= \frac{1}{y^{3/2}} \cdot \frac{1}{\frac{y^2+x^2}{y^2}} \cdot \frac{1}{y}$$

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

$$= \frac{y}{(\sqrt{y})^3 (y^2+x^2)}$$

$$\frac{\partial f}{\partial y} = y^{-\frac{3}{2}} \cdot \frac{1}{1+\frac{x^2}{y^2}} \cdot \left(-\frac{x}{y^2}\right) + \tan^{-1}(\tfrac{x}{y}) \cdot -\frac{3}{2} y^{-5/2}$$

$$= y^{-\frac{3}{2}} \cdot \frac{\cancel{y^2}}{y^2+x^2} \left(-\frac{x}{\cancel{y^2}}\right) + \left(-\frac{3}{2} y^{-\frac{5}{2}} \tan^{-1}(\tfrac{x}{y})\right)$$

$$= -\frac{1}{y^{3/2}} \cdot \frac{x}{y^2+x^2} + \left\{-\frac{3}{2} y^{-5/2} \tan^{-1}(\tfrac{x}{y})\right\}$$

$$= \cancel{\frac{1}{(\sqrt{y})^3} - \frac{3}{2(\sqrt{y})^5} \cdot \frac{x \tan^{-1}(x/y)}{y^2+x^2}}$$

$$= \cancel{\frac{3x \tan^{-1}(x/y)}{\quad}}$$

$$= -\frac{x}{(\sqrt{y})^3 (y^2+x^2)} - \frac{3 \tan^{-1}(x/y)}{2(\sqrt{y})^5}$$

(12) $$\frac{\partial z}{\partial x} = e^x \cdot 0 + \cos y \cdot e^x$$

$$\frac{\partial^2 z}{\partial x^2} = \cos y \cdot e^x + e^x \cdot 0$$

$$= e^x \cos y$$

$$\frac{\partial z}{\partial y} = e^x(-\sin y) + \cos y \cdot 0$$

$$\frac{\partial^2 z}{\partial y^2} = e^x \cdot \cos y + (-\sin y) \cdot 0$$

$$= -e^x \cos y$$

Partial 2

(13) $f(x,y) = e^{xy} \sin(4y^2)$

$$\frac{\partial F}{\partial x} = e^{xy} \cdot 0 + \sin(4y^2) \cdot ye^{xy}$$

$$= ye^{xy} \sin(4y^2)$$

$$\frac{\partial f}{\partial y} = e^{xy} \cdot \cancel{\sin} \cos(4y^2)(8y) + \sin(4y^2) \cdot xe^{xy}$$

$$= 8ye^{xy} \cos(4y^2) + xe^{xy} \sin(4y^2)$$

$$= e^{xy} \{8y\cos(4y^2) + x\sin(4y^2)\}$$

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$z = \sqrt{x}\cos y$

(14) $\frac{\partial z}{\partial x} = \sqrt{x}\cdot 0 + \cos y \cdot \frac{1}{2\sqrt{x}}$

$= \frac{\cos y}{2\sqrt{x}}$

$\frac{\partial^2 z}{\partial x^2} = \frac{2\sqrt{x}\cdot 0 - \cos y \cdot 2\cdot\frac{1}{2\sqrt{x}}}{(2\sqrt{x})^2}$

$= \frac{-\frac{\cos y}{\sqrt{x}}}{4x}$

$= -\frac{\cos y}{4x\sqrt{x}}$

$\frac{\partial z}{\partial y} = \sqrt{x}\cdot(-\sin y) + \cos y \cdot 0$

$= -\sqrt{x}\sin y$

$\frac{\partial^2 z}{\partial y^2} = -\sqrt{x}\cos y + \sin y \cdot 0$

$= -\sqrt{x}\cos y$

Partial 3

(15) $z = x^4 \sin(xy^3)$

$\frac{\partial z}{\partial x} = x^4 \cdot \cos(xy^3)\cdot y^3 + \sin(xy^3)\cdot 4x^3$

$= x^4y^3\cos(xy^3) + 4x^3\sin(xy^3)$

$\frac{\partial z}{\partial y} = x^4 \cdot \cos(xy^3)\cdot 3xy^2 + \sin(xy^3)\cdot 0$

$= 3x^5y^2\cos(xy^3)$

2

(16) $z = x^2y^3 + x^4y$

$\frac{\partial z}{\partial x} = x^2\cdot 0 + y^3\cdot 2x + x^4\cdot 0 + y\cdot 4x^3$

$= 2xy^3 + 4x^3y$

$\frac{\partial^2 z}{\partial x^2} = 2y^3 + 12x^2y$

$\frac{\partial z}{\partial y} = 3x^2y^2 + x^4$

$\frac{\partial^2 z}{\partial y^2} = 6x^2y + 0$

FIGURE NO. ....

(1) $f(x,y) = x^3+y^3$

$\frac{\partial f}{\partial x} = 3x^2+0$ | $\frac{\partial f}{\partial y} = 0+3y^2$

(2) $f(x,y) = 3x^2+2xy+5y^2$

$\frac{\partial F}{\partial x} = 6x+2y+0$ | $\frac{\partial F}{\partial y} = 0+2x+10y$

(3) $f(x,y) = 9x^3+5x^2y+9y^2x+3y^2$

$\frac{\partial F}{\partial x} = 27x^2+10xy+9y^2+0$ | $\frac{\partial F}{\partial y} = 0+5x^2+18yx+6y$

Partial 4

(5) $F(x,y,z) = 3x^3+3x^2yz+3xy^2z+3y^3+3z^2yx+3z^3$

$\frac{\partial f}{\partial x} = 9x^2+6xyz+3y^2z+0+0+0$

$\frac{\partial f}{\partial y} = 0+3x^2z+9y^2+3z^2+0$

$\frac{\partial F}{\partial z} = 0+3x^2y+0+0+6zy+9z^2$

(6) $F(x,y) = ax^2+2hxy+by^2$

$\frac{\partial f}{\partial x} = 2ax+2hy+0$

$\frac{\partial F}{\partial y} = 0+2hx+2by$

(6) $F(x,y,z) = 4x^2y^2z+3xy^2z^3+9x^3y^2z$

$\frac{\partial F}{\partial x} = 8xy^2z+3y^2z^3+27x^2y^2z$

$\frac{\partial F}{\partial y} = 8x^2yz+6xyz^3+18x^3y^2z$

$\frac{\partial F}{\partial z} = 4x^2y^2+9xy^2z^2+9x^3y^2$

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Multiple Integration

EXPT. NO. ....

(1) $\int_0^1 \int_{-x}^{x^2} y^2 x \, dy \, dx$

$= \int_0^1 \left\{ \left[\frac{y^3}{3} \right]_{-x}^{x^2} \right\} x \, dx$

$= \int_0^1 \left\{ \left[\frac{x^6}{3} - \left(\frac{(-x)^3}{3} \right) \right] \right\} x \, dx$

$= \int_0^1 \left\{ \frac{x^6 + x^3}{3} \right\} x \, dx$

$= \int_0^1 \frac{x^7 + x^4}{3} \, dx$

$= \frac{1}{3} \int_0^1 x^7 + x^4 \, dx$

$= \frac{1}{3} \left[\frac{x^8}{8} + \frac{x^5}{5} \right]_0^1$

$= \frac{1}{3} \left[\frac{1}{8} + \frac{1}{5} \right] - \left[\frac{0}{8} + \frac{0}{5} \right]$

$= \frac{1}{3} \cdot \frac{13}{40}$

$= \frac{13}{120}$

(5) (8) $\int_{-1}^{2} \int_0^3 \int_0^2 12xy^2z^3 \, dz \, dy \, dx$

$\Rightarrow \int_{-1}^{2} \int_0^3 12xy^2 \left[\frac{z^4}{4} \right]_0^2 dy \, dx$

$= \int_{-1}^{2} \int_0^3 12xy^2 \cdot 4 \, dy \, dx$

$= \int_{-1}^{2} \int_0^3 48xy^2 \, dy \, dx$

$= \int_{-1}^{2} 48x \left[\frac{y^3}{3} \right]_0^3 dx$

$= \int_{-1}^{2} 48x \cdot 9 \, dx$

$= \int_{-1}^{2} 432x \, dx$

$= 432 \left[\frac{x^2}{2} \right]_{-1}^{2}$

$= 432 \left[2 - \frac{1}{2} \right]$

$= 432 \cdot \frac{3}{2}$

$= 648$

Multiple Integration

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Definite Integral

(1) $\int_{-1}^{1} x^2\,dx$

$= \left[\frac{x^3}{3}\right]_{-1}^{1}$

(2) $\int_{-1}^{1} (2x^2 - x^3)\,dx$

$= \cancel{\left[\frac{2x^3}{3}\right]_{-1}^{1} - \left[\frac{x^4}{4}\right]_{-1}^{1}}$

$= \left[\frac{2x^3}{3} - \frac{x^4}{4}\right]_{-1}^{1}$

(4) $\int_{0}^{\pi/2} \frac{\cos^2\theta}{1-\sin\theta}\,d\theta$

$= \int_{0}^{\pi/2} \frac{\cos^2\theta\,(1+\sin\theta)}{1-\sin^2\theta}\,d\theta$

$= \int_{0}^{\pi/2} \frac{\cancel{\cos^2\theta}\,(1+\sin\theta)}{\cancel{\cos^2\theta}}\,d\theta$

$= \cancel{[x]_{0}^{\pi/2} - [\cos\theta}$

$= [x - \cos\theta]_{0}^{\pi/2}$

$= \left(\frac{\pi}{2} - 0\right) - (0 - 1)$

$= \frac{\pi}{2} + 1$

(5) $\int_{2}^{3} 2x\,dx$

$= [x^2]_{2}^{3}$

$= 9 - 4$

$= 5$

(8) $\int_{0}^{1} \left(\sqrt{x} + \frac{1}{\sqrt{x}}\right) dx$

$= \int_{0}^{1} (x^{1/2} + x^{-1/2})\,dx$

$= \left[\frac{2}{3}x^{3/2} + 2x^{1/2}\right]_{0}^{1}$

$= \frac{2}{3} + 2$

$= 8/3$

(9) $\int_{-3}^{1} (x^3 + 2)\,dx$

$= \left[\frac{x^4}{4} + 2x\right]_{-3}^{1}$

$= \frac{9}{4} - \left(\frac{57}{4}\right)$

$= -12$

(6) $\int_{1}^{4} \frac{1}{x^3}\,dx$

$= \int_{1}^{4} x^{-3}\,dx$

$= \cancel{\left[-\frac{2}{x^2}\right]_{1}^{4}} = \left[\frac{x^{-2}}{-2}\right]_{1}^{4}$

$= \cancel{-\frac{2}{16} + 2}$

$= \left[-\frac{1}{2x^2}\right]_{1}^{4}$

$= -\frac{1}{32} + \frac{1}{2}$

$= \frac{15}{32}$

(14) $\int_{0}^{\ln 2} e^y (1+e^x)^{1/2}\,dy$

$= (1+e^x)^{1/2} \int_{0}^{\ln 2} e^y\,dy$

$= (1+e^x)^{1/2} [e^y]_{0}^{\ln 2}$

$= \text{——} [e^{\ln 2} - e^0]$

$= \text{——} [2 - 1]$

$= (1+e^x)^{1/2}$

Definite Integral 1

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Area finding 1 .... EXPT. NO. ......

$y = x^2$ & $y = x + 6$

$\therefore y = y$

$\Rightarrow x^2 = x + 6$

$\Rightarrow x^2 - x - 6 = 0$

$\Rightarrow x^2 - 3x + 2x - 6 = 0$

$\Rightarrow (x-3)(x+2) = 0$

$\therefore x = 3, -2$

if $x = 0$

$\therefore y = x^2 = 0$ | $y = x + 6 = 6$ ~~(top)~~ First

2nd ~~(bottom)~~

$\int_{-2}^{3} (x+6) - x^2$

$\Rightarrow \int_{-2}^{3} -x^2 + x + 6$

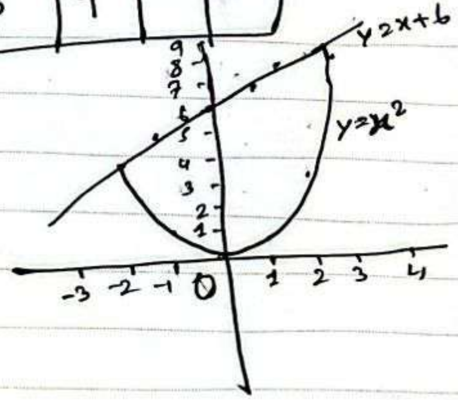
$= \left[-\frac{x^3}{3} + \frac{x^2}{2} + 6x \right]_{-2}^{3}$

$= \left[-9 + \frac{9}{2} + 18 \right] \boxed{\cancel{-\frac{1}{3} + \frac{1}{2} - 6}} - \left[\frac{8}{3} + \frac{4}{2} - 12 \right]$

$= \frac{27}{2} \boxed{\cancel{-\frac{31}{6}}} + \frac{22}{3}$

$= \boxed{\cancel{\frac{56}{3}}} = \frac{125}{6}$

$y = x^2$		$y = x + 6$	
x	y	x	y
-2	4	-2	4
-1	1	-1	5
0	0	0	6
1	1	1	7
2	4	2	8
3	9	3	9



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Absolute maxima & minima

Max^m & Min^m

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⑧ $f(x) = |6-4x|$; $[-3, 3]$

As modulus piecewise :

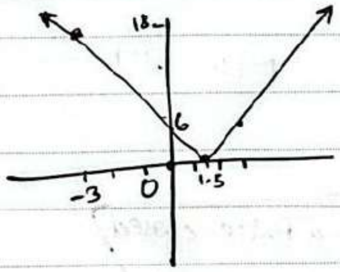
For +,
$\therefore |6-4x|$; $x \leq 1.5$

For −,
$|4x-6|$; $x > 1.5$

$6-4x \geq 0$
$-4x \geq -6$
$x \leq \frac{6}{4}$
$x \leq 1.5$

$4x-6 > 0$
$x > 1.5$

$f(-3) = 18$ (max^m)
$f(3) = 6$
$f(1.5) = 0$ (min^m)



⑦ $f(x) = 1+|9-x^2|$; $[-5, 1]$

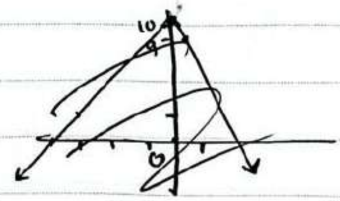
As modulus, piecewise :

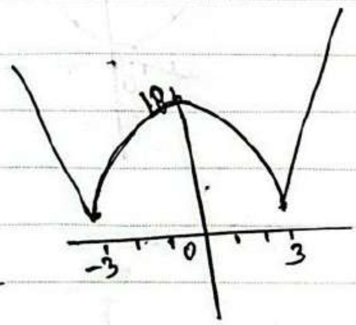
For +,
$1+|9-x^2|$; $-3 \leq x \leq 3$

For −,
$1+|x^2-9|$; $x > 3$

$f(-3) = 1$ (min^m)
$f(1) = 9$
$f(0) = 10$ (max^m)

modulus
+ always straight
+ in positive





$-x^2$ || ∩
x^2 || ∪

Max Min I

⑤ $f(x) = 8x - x^2$; $[0, 8]$

$f(x) = 0$
$\therefore x(8-x) = 0$
$\therefore x = 0, 8$

$f'(x) = 8 - 2x$
$\Rightarrow x = \frac{-8}{-2}$
$x = 4$ (critical point)

$f(0) = 0$ (min^m)
$f(8) = 0$ (min^m)
$f(4) = 16$ (max^m)

$f''(x) = -2$
$0 = 0$

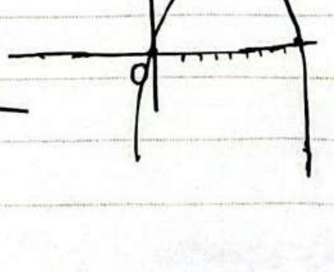


FIGURE NO. ....

(4) $f(x) = 4x^2 - 12x + 10 \; ; [1,2]$

$f'(x) = 8x - 12$

$0 = 8x - 12$

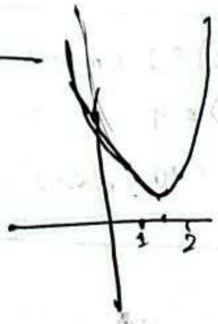
$\Rightarrow x = \frac{12}{8}$

$= 3/2$ (critical point)

$f(1) = 2$ (maxm)

$f(2) = 2$

$f(1.5) = 1$ (minm)



(3) $f(x) = 2x^3 - 15x^2 + 36x \; ; [1,5]$

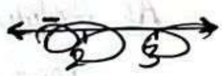
$f'(x) = 6x^2 - 30x + 36$

$\Rightarrow x^2 - 5x + 6 = 0$

$\Rightarrow x^2 - 3x - 2x + 6 = 0$

$\Rightarrow (x-3)(x-2) = 0$

$\therefore x = 2, 3$ (critical point)



$F(1) = 23$ (minm)

$f(5) = 55$ (maxm)

$f(2) = 28$

$f(3) = 27$

Max Min 2

Extreme value theorem: If a function f is continuous on a finite closed interval [a, b] then f has both an absolute maxima & absolute ~~maxima~~ minima.

maxima & minima are only on endpoints [a, b] & critical points

shortcut check