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Section	A
Subject	Applied Calculs
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Find:-

Q1:- $\int_0^1 \frac{4t^3 - 2t^2 + 3t - 1}{2t^2 + 1}\, dt$

Sol:- $\int_0^1 \frac{4t^3 - 2t^2 + 3t - 1}{2t^2 + 1}\, dt$

$= \int_0^1 \frac{4t^3 + 3t - 2t^2 - 1}{2t^2 + 1}\, dt$

$= \int_0^1 \frac{t(4t^2 + 3) - (2t^2 + 1)}{2t^2 + 1}$

$= \int_0^1 \frac{t(4t^2 + 3)}{2t^2 + 1}\, dt \int_0^1 \frac{\cancel{2t^2} + \cancel{1}}{\cancel{2t^2} + \cancel{1}}\, dt$

$= \int_0^1 \frac{t(4t^2 + 3)}{2t^2 + 1}\, dt - \int_0^1 1\, dt$

$= \int_0^1 \frac{t(4t^2 + 3)}{2t^2 + 1}\, dt\, [1 - 0]$

$= \int_0^1 \frac{t(4t^2 + 3)}{2t^2 + 1} - 1 \longrightarrow (1)$

Now:-

Let $2t^2+1 = y \Rightarrow 2t^2+1 = y$

As $t = 1$ i.e $y = 3$ $\quad 2t^2 = y-1$

$t \to 0$ i.e $y = 1$ $\quad 4t^2 = 2y-2$

$4t^2+3 = 2y-2+3$

Now Diff

$= 4t = \frac{dy}{dt}$ $\quad 4t^2+3 = 2y+1$

$= dt = dy/4t$

$$= \int_1^3 t \left(\frac{(2y+1)}{4}\right) \frac{dy}{4t} - 1$$

$$= \int_1^3 \frac{2y+1}{4y}\, dy - 1$$

$$= \frac{1}{4}\left[\int_1^3 \frac{2y\,dy}{y} + \int_1^3 \frac{1}{y}\, dy\right) - 1$$

$$= \frac{1}{4}\left[\int_1^3 2\,dy + \int_1^3 \frac{1}{y}\, dy\right] - 1$$

$$\Rightarrow \frac{1}{4}\left[2y\Big|_1^3 + \ln y\Big|_1^3\right] - 1$$

$$\Rightarrow \frac{1}{4}\left[2(3) - (2(1)) + \ln(3) - \ln(1)\right] - 1$$

$$= \frac{1}{4}\left[6 - 2 + 1.0986\right) - 1$$

$$= \frac{1}{4}\left[5.0986\right] - 1$$

$$\Rightarrow 1.27465 - 1$$

$$\boxed{= 0.2746}$$ Ans

Q2:- $\int_{2}^{3} t \sin t^2 \, dt$

Sol:- let $t^2 = y$

Diff w.r.t t $\quad t^2$

$t^2 = y$

$(3)^2 = y$

$(9) = y$

$2t = dy/dt$

$dt = dy/2t$

Now

As $t \to 3$ than $y = 9$

As $t \to 2$ than $y = 4$

So $= \int_{2}^{3} t \sin t^2 \, dt = \int_{4}^{4} \cancel{t} \sin y \, \frac{dy}{\cancel{t}}$

$= \int_{4}^{9} \sin y \, dy$

$= -\cos y \Big|_{4}^{9}$

$= -\left[\cos(9) - \cos(4)\right]$