10/06/25

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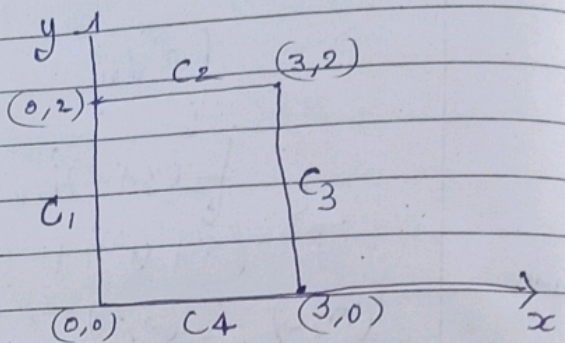
Q.3 Evaluate line integration for $\vec{F} = (x+y^2)\hat{i} + (y^2-x^3)\hat{j}$ when Partical moves along straight line from (0,0) to (0,2) (0,2), (3,2) from (3,2), (3,0), from (3,0), (0,0)




(0,0) to (0,2)
(0,2) to (3,2)
(3,2) to (3,0)
(3,0) to (0,0)

$C_1 \Rightarrow x=0, dx=0$

$C_2 \Rightarrow y=2, dy=0$

$C_3 \Rightarrow x=3, dx=0$

$C_4 \Rightarrow y=0 \Rightarrow dy=0$

$$\int_C \vec{f}\,d\vec{r} = \int_{C_1} \vec{f}\,d\vec{r} + \int_{C_2} \vec{f}\,d\vec{r} + \int_{C_3} \vec{f}\,d\vec{r} + \int_{C_4} \vec{f}\,d\vec{r}$$

$$\int_{C_1} \{(x+y^2)\hat{i} + (y^2-x^3)\hat{j}\}\{\hat{i}dx + \hat{j}dy\} + \int_{C_2} \{(x+y^2)\hat{i} + (y^2-x^3)\hat{j}\}\{\hat{i}dx + \hat{j}dy\}$$

$$+ \int_{C_3} \{(x+y^2)\hat{i} + (y^2-x^3)\hat{j}\}\{\hat{i}dx + \hat{j}dy\} + \int_{C_4} \{(x+y^2)\hat{i} + (y^2-x^3)\hat{j}\}\{\hat{i}dx + \hat{j}dy\}$$

$$\int_{C_1} (x+y^2)dx + \int_{C_1} (y^2-x^3)dy + \int_{C_2} (x+y^2)dx + \int_{C_2} (y^2-x^3)dy$$

$$+ \int_{C_3} (x+y^2)dx + \int_{C_3} (y^2-x^3)dy + \int_{C_4} (x+y^2)dx + \int_{C_4} (y^2-x^3)dy$$

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for (0,0) to (0,2)

$C_1 \Rightarrow x=0, dx=0$

So

$$\int_{C_1}(x+y^2)dx+\int_{C_1}(y^2-x^3)dy$$

$$\int_{C_1}(x+y^2)0+\int_{C_1}(y^2-0^3)dy$$

$$\int_{C_1}\{y^2\}dy \Rightarrow \int_0^2\{y^2\}dy \Rightarrow \left\{\frac{y^3}{3}\right\}_0^2 \Rightarrow \left\{\frac{2^3}{3}-\frac{0^3}{3}\right\} \Rightarrow \frac{8}{3}$$

for (0,2) to (3,2)

$C_2 \Rightarrow y=2, dy=0$

$$\int_{C_2}(x+y^2)dx+\int_{C_2}(y^2-x^3)dy$$

$$\int_{C_2}\{x+2^2\}dx+\int_{C_2}\{y^2-x^3\}0 \Rightarrow \int_{C_2}\{x+4\}dx$$

$$\Rightarrow \int_0^3\{x+4\}dx$$

$$\Rightarrow \left\{\frac{x^2}{2}+4x\right\}_0^3 \Rightarrow \left(\frac{3^2}{2}+4(3)\right)-\left(\frac{0^2}{2}+4(0)\right) \Rightarrow \frac{9}{2}+12$$

$$\Rightarrow \frac{9+24}{2}$$

$$\Rightarrow \frac{33}{2}$$

for (3,2) to (3,0)

$C_3 \Rightarrow x=3, dx=0$

$$\int_{C_3}(x+y^2)dx+\int_{C_3}(y^2-x^3)dy$$

$$\int_{C_3}(x+y^2)0+\int_{C_3}(y^2-3^3)dy \Rightarrow \int_{C_3}(y^2-27)dy$$

$$\int_2^0(y^2-27)dy = \int_0^2(27-y^2)dy \Rightarrow \left(27y-\frac{y^3}{3}\right)_0^2$$

$$\Rightarrow \left(27\times 2-\frac{2^3}{3}\right) = 54-\frac{8}{3}=\frac{154}{3}$$

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for (3,0) to (0,0)

$C_4 \Rightarrow y = 0 \Rightarrow dy = 0$

$$\int_{C4} (x+y^2)dx + \int_{C4} (y^2 - x^3)dy$$

$$\int_{C4} (x+0^2)dx + \int_{C4} (y^2 - x^3)0$$

$$\int_{C4} (x)\,dx$$

$$\int_3^0 (x)dx \Rightarrow \int_0^3 (-x)dx = -\frac{x^2}{2} = -\frac{3^2}{2} = -9/2$$

final answer

$$\frac{8}{3} + \frac{33}{2} + \frac{154}{3} - \frac{9}{2} = \frac{16+99+308-27}{6}$$

$$\frac{16+99+308-27}{6} = \frac{396}{6}$$

$$\frac{396}{6} = 66 \text{ Ans}$$

Shot on Y19