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DEPARTMENT OF MATHEMATICS

LINE INTEGRALS:

Suppose C is an arc and $\vec{r} = \chi \vec{i} + y \vec{j} + z \vec{k}$ is the position vector of any point $P(\chi, y, z)$ on it and \vec{f} is a vector point function at P. Then $\int \vec{f} \cdot d\vec{r}$ is called a line integral of \vec{f} over C.

Line integral $\int \vec{F} \cdot d\vec{r}$ is also known as the total work done by the force \vec{F} during a displacement from A to B.

Tevaluate $\int \vec{F} \cdot d\vec{r}$ where $\vec{F} = \chi^2 y^2 \vec{i} + y \vec{j}$ and the curve c is $y^2 = 4x$ in the xy-plane from (0,0) to (4,4).

$$d\vec{r} = dx\vec{i} + dy\vec{j}$$
Given: $\vec{F} = x^2y^2\vec{i} + y\vec{j}$

$$\vec{F} \cdot d\vec{r} = (x^2y^2\vec{i} + y\vec{j}) \cdot (dx\vec{i} + dy\vec{j})$$

$$= x^2y^2dx + y dy$$

Given:
$$y^2 = 4\pi$$

 $2y dy = 4 dx$
 $y dy = 2 dx$

$$\vec{F} \cdot d\vec{r} = \pi^2 y^2 dx + 2 dx = \pi^2 (4\pi) d\pi + 2 d\pi$$

$$\int \vec{F} \cdot d\vec{r} = \int (4\pi)^3 + 2 d\pi$$

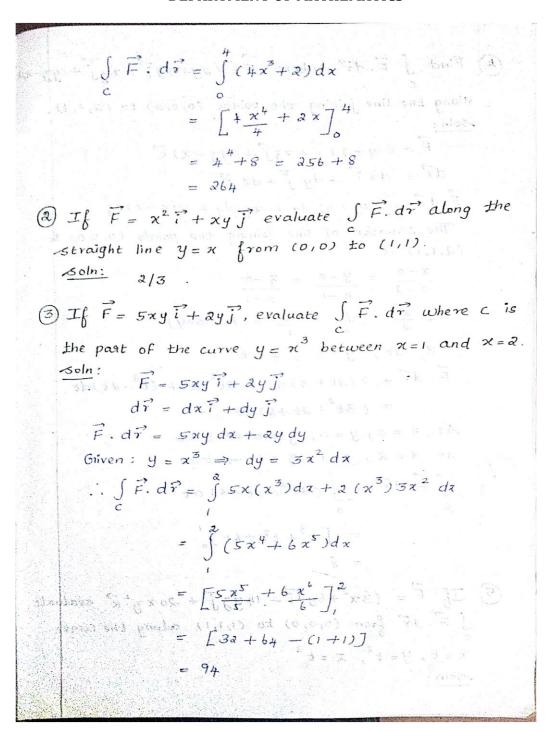
$$c$$





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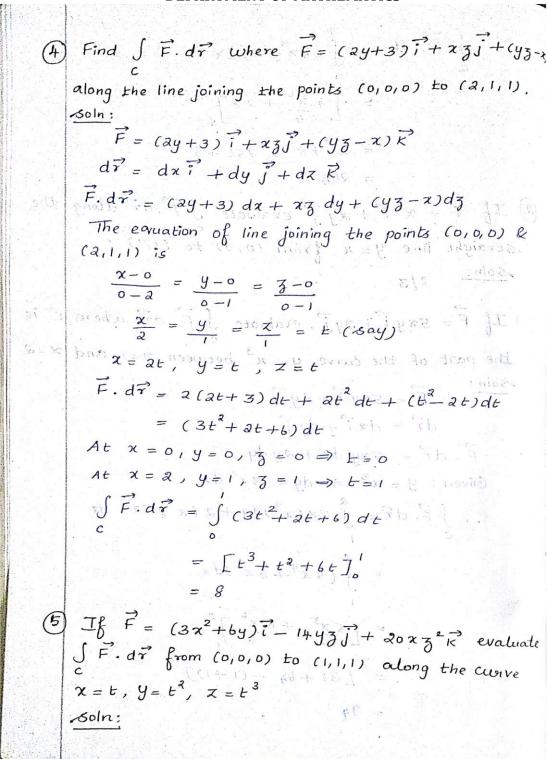






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DEPARIMENT OF MATHEMATICS

$$F = (3x^2 + 6y)\vec{i} - 14y\vec{j} + 30x\vec{j}^2 \vec{k},$$

$$d\vec{i} = dx\vec{i} + dy \vec{j} + dx\vec{k}$$

$$F \cdot d\vec{i} = (3x^2 + 6y)dx - 14y\vec{j} dy + 30x\vec{j}^2 dz$$
Given: $x = t$, $y = t^2$, $z = t^3$

$$dx = dt$$
, $dy = xtdt$, $dz = 3t^2dt$

$$F \cdot d\vec{i} = (3t^2 + 6t^2)dt - 14(t^3 t^3)xtdt + 20(t t^6)3\vec{i}$$

$$= (9t^2 - 28t^6 + 60t^9)dt$$

$$G = \frac{1}{3}(9t^2 - 28t^6 + 60t^9)d$$



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