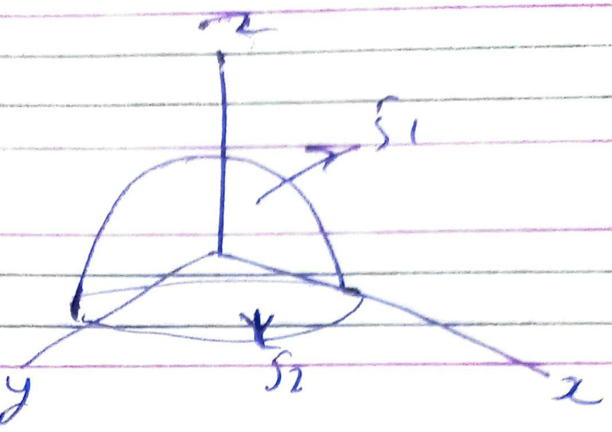
$S_1 \to$ surface of upper hemisphere



$S_2 \to Z = 0$

$$\iint_{S_1} F\cdot n\, dS_1 + \iint_{S_2} F\cdot n\, dS_2 = \iiint \nabla F\, dV \quad \text{—} \quad (1)$$

here $\vec{F} = x^3 e^y \hat{i} - 3x^2 e^y \hat{j}$

$\nabla \vec{F} = 3x^2 e^y - 3x^2 e^y = 0$

from (1)

$$\iint_{S_1} F\cdot n\, dS_1 = - \iint_{S_2} F\cdot n\, dS_2$$

$\hat{n} = -\hat{k}$

$$= \iint (x^3 e^y \hat{i} - 3x^2 e^y \hat{j})\cdot \hat{k}\, dx\, dy$$

$= \boxed{0}$ Ans

0 lies in $[0,1) \times [-1,2]$

option (b) & (c) are correct