

$$⑤ \iiint_E x e^{x^2+y^2+z^2} dV \quad x^2+y^2+z^2 \leq 1$$

$$x = \rho \sin \phi \cos \theta$$

$$x^2+y^2+z^2 = \rho^2$$

$$dV = \rho^2 \sin \phi \, d\rho \, d\theta \, d\phi$$

$$\rho^2 \leq 1$$

$$\rho \leq 1 \quad \rho \in [0, 1]$$

constant

$$\theta \in [0, \frac{\pi}{2}] \quad \phi \in [0, \frac{\pi}{2}]$$

$$\int_0^{\frac{\pi}{2}} \int_0^{\frac{\pi}{2}} \int_0^1 \rho \sin \phi \cos \theta e^{\rho^2} \rho^2 \sin \phi \, d\rho \, d\theta \, d\phi$$

$$= \int_0^{\frac{\pi}{2}} \sin^2 \phi \, d\phi \int_0^{\frac{\pi}{2}} \cos \theta \, d\theta \int_0^1 \rho^3 e^{\rho^2} \, d\rho$$

$$= \left(\int_0^{\frac{\pi}{2}} \left(\frac{1}{2} - \frac{\cos 2\phi}{2} \right) d\phi \right) \left(\int_0^{\frac{\pi}{2}} \cos \theta \, d\theta \right) \left(\left[\frac{\rho^2 e^{\rho^2}}{2} - \frac{e^{\rho^2}}{2} \right]_0^1 \right)$$

$$\left(\frac{\phi}{2} - \frac{\sin 2\phi}{4} \right)_0^{\frac{\pi}{2}} \left(\sin\left(\frac{\pi}{2}\right) - 0 \right) \left(0 - \left(0 - \frac{1}{2} \right) \right) = \left(\frac{\pi}{4} \right) (1) \left(\frac{1}{2} \right) = \boxed{\frac{\pi}{8}}$$

$$⑥ \oint_C 2xy \, dx + (x^2+y^2) \, dy$$

$$4x^2 + 9y^2 = 36$$

$$P = 2xy$$

$$Q = x^2 + y^2$$

$$\iint_D \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) dA$$

$$\frac{\partial P}{\partial y} = 2x$$

$$\frac{\partial Q}{\partial x} = 2x$$

$$= \iint_D (2x - 2x) \, dA$$

$$= 0 \iint_D dA = \boxed{0}$$