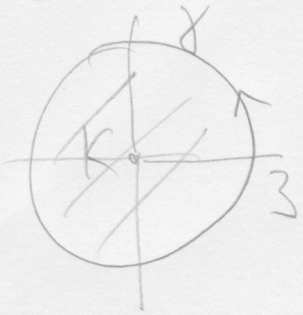
(1) $$\oint_\gamma P\,dx + Q\,dy = \iint_K \operatorname{rot} F \cdot \underline{k}\, dx\,dy$$



$$\operatorname{rot} F = \frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} = 3x^2 + 3y^2 = 3r^2$$

$x = r\cos\theta$
$y = r\sin\theta$

$dx\,dy = r\,dr\,d\theta$

$$= \iint_K 3x^2 + 3y^2\,dx\,dy = 3\int_{\theta=0}^{2\pi}\int_{r=0}^{3} r^2 \cdot r\,dr\,d\theta$$

$$= 3\,\frac{r^3}{3}\Big|_0^3 \quad \theta\Big|_0^{2\pi} = \underbrace{3^3}_{27} \cdot 2\pi$$

$$= \boxed{54\pi}$$