(5) $\int_C ye^x\,dx + 2e^x\,dy$ $(0,0)$ $(3,0)$ $(3,4)$ $(0,4)$

$P = ye^x \quad Q = 2e^x$

$P_y = e^x \quad Q_x = 2e^x$

$$\int_0^4 \int_0^3 2e^x - e^x \, dy\,dx$$

$$= \int_0^4 dy \int_0^3 e^x \, dx$$

$$= 4(e^3 - e^0) = \boxed{4(e^3-1)}$$

(9) $\int_C y^3\,dx - x^3\,dy$ $\quad x^2+y^2 = 4$

$r^2 = 4$

$r \in [0,2]$

$P = y^3 \quad Q = -x^3$

$P_y = 3y^2 \quad Q_x = -3x^2$

$$\iint_D -3x^2 - 3y^2 \, dA = -3 \iint_D (x^2+y^2)\,dA$$

($x^2+y^2 = r^2$, $dA = r\,d\theta\,dr$)

$$= -3 \int_0^{2\pi} \int_0^2 r^3 \, d\theta\,dr$$

$$= -6\pi \left[\frac{16}{4}\right] = \boxed{-24\pi}$$

(13) $F(x,y) = \langle y - \cos y, x\sin y \rangle$

$P = y - \cos y \quad Q = x\sin y$

$P_y = 1 + \sin y \quad Q_x = \sin y$

$$\iint_D \sin y - \sin y - 1 \, dA = -\iint_D 1\,dA$$

$$= -\int_0^{2\pi} \int_0^2 r\,dr\,d\theta = \int_0^{2\pi} d\theta \int_0^2 r\,dr$$

$$= 2\pi \left[\frac{4}{2}\right] = \boxed{4\pi}$$

$(x-3)^2 + (y+4)^2 = 4$

$r \in [0,2]$

$\theta \in [0, 2\pi]$