Parametrize the path as $2\cos t\mathbf{i} + 2\sin t\mathbf{j}$, $0 \le t \le \pi$, followed by $t\mathbf{i}$, $-2 \le t \le 2$. The work is

$$\int_C \mathbf{F}\cdot d\mathbf{R} = \int_0^\pi [2(2\cos t)^2 + 2(2\sin t)^2](-2\sin t)dt$$

$$+ \int_0^\pi [3(2\cos t) + 3(2\sin t)](2\cos t)dt + \int_{-2}^2 (2t^2)dt$$

$$= \int_0^\pi 8(\cos^2 t + \sin^2 t)(-2\sin t)dt + \int_0^\pi (12\cos^2 t + 12\sin t\cos t)dt + \frac{2t^3}{3}|_{-2}^2$$

$$= \int_0^\pi (-16\sin t)dt + \int_0^\pi (6(\cos 2t + 1) + 6\sin 2t)dt + \frac{32}{3}$$

$$= -32 + 6\pi + \frac{32}{3} = 6\pi - \frac{64}{3}.$$