ANSWERS.

1. 8.

2. $21(1 - 1/\sqrt{2})$.

3. 2.

4. $S = S_0 \cup S_1 \cup S_2$, where S_0 can parameterized as $r(u,v) = (u, 3\cos v, 3\sin v)$, $-1 \leq u \leq 1$, $0 \leq v \leq 2\pi$ with a normal $n = (0, 3\cos v, 3\sin v)$; S_1 can parameterized as $r(u,v) = (-1, u\cos v, u\sin v)$, $0 \leq u \leq 3$, $0 \leq v \leq 2\pi$ with a normal $n = (1,0,0)$; S_2 can parameterized as $r(u,v) = (1, u\cos v, u\sin v)$, $0 \leq u \leq 3$, $0 \leq v \leq 2\pi$ with a normal $n = (1,0,0)$.

$$\iint_S x dS = 0.$$

5. $\text{curl}F = (z, x, 1)$, $\text{div}F = z + y$. F is not conservative, since $\text{curl}F \neq 0$.

6. S can parameterized as $r(u,v) = (u, v, \sqrt{4 - u^2 - v^2})$, $u^2 + v^2 \leq 4$ (another way is $r(u,v) = (2\cos u \sin v, 2\sin u \sin v, 2\cos v)$, $0 \leq u \leq 2\pi$, $0 \leq v \leq \pi/2$).

$$\iint_S \text{curl}F \cdot dS = -4\pi.$$