1. **16.3 # 4, # 5** Keep in mind that for f, on the rectangle $[x_{i-1}, x_i] \times [y_{j-1}, y_j]$ the maximum value is obtained at (x_i, y_{j-1}) and the minimum at (x_{i-1}, y_j). Then use the definitions.

   (a) **# 4 Answers:** $U_P(f) = \frac{7}{16}$, $L_P(f) = \frac{-7}{16}$

   (b) **# 5 Answers:** $U_P(f) = \frac{7}{24}$, $L_P(f) = \frac{-7}{24}$

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2. **17.5 # 19**

$$A = \oint_C x\mathrm{d}y \text{ where } C = C_1 \cup C_2;$$

$$C_1 : \mathbf{r}(u) = u\mathbf{i} + \frac{4}{u}\mathbf{j}, 1 \leq u \leq 4;$$

$$C_2 : \mathbf{r}(u) = (4 - 3u)\mathbf{i} + (1 + 3u)\mathbf{j}, 0 \leq u \leq 1;$$

$$\oint_{C_1} x\mathrm{d}y = \int_1^4 u \left(\frac{-4}{u} \right) \mathrm{d}u = -4 \ln 4$$

$$\oint_{C_2} x\mathrm{d}y = \int_0^1 (4 - 3u)3\mathrm{d}u = \frac{15}{2};$$

Therefore, $A = \frac{15}{2} - 4 \ln 4$.

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3. **17.5 # 20**

$$A = \frac{1}{2} \oint_C x\mathrm{d}y - y\mathrm{d}x, \text{ where } C = C_1 \cup C_2;$$

$$C_1 : \mathbf{r}(u) = \sqrt{5} \tan u\mathbf{i} + \sqrt{5} \sec u\mathbf{j}, \tan^{-1}\left(\frac{-2}{\sqrt{5}} \right) \leq u \leq \tan^{-1}\left(\frac{2}{\sqrt{5}} \right);$$

$$C_2 : \mathbf{r}(u) = (2 - 4u)\mathbf{i} + 3\mathbf{j}, 0 \leq u \leq 1;$$

$$\frac{1}{2} \oint_{C_1} x\mathrm{d}y - y\mathrm{d}x = \frac{5}{2} \ln 5, \frac{1}{2} \oint_{C_2} x\mathrm{d}y - y\mathrm{d}x = 6;$$

Therefore,

$$A = 6 + \frac{5}{2} \ln 5.$$
