More problems for section 14.7 of *Calculus, Early Transcendentals* by James Stewart, 8e.

1. Find those points $(x, y)$ at which the given function has a relative extreme value or a saddle point.

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|---|---|---|
| a. $x^2 + xy + y^2 + 3x - 3y + 4$ | b. $2xy - 5x^2 - 2y^2 + 4x + 4y + 1$ | c. $x^2 + xy + 3x + 2y + 5$ |
| d. $5xy - 7x^2 + 3x - 6y + 2$ | e. $x^2 - 4xy + y^2 + 6y$ | f. $2x^2 + 3xy + 4y^2 - 5x + 2y$ |
| g. $x^2 - y^2 - 2x + 4y + 6$ | h. $x^2 + 2xy$ | i. $x^3 - y^3 - 2xy + 6$ |
| j. $6x^2 - 2y^3 + 3y^2 + 6xy$ | k. $9x^3 + \frac{1}{3}y^3 - 4xy$ | l. $x^3 + y^3 + 3x^2 - 3y^2$ |
| m. $4xy - x^4 - y^4$ | | |

2. Find the absolute extrema of the function on the given (closed) domain.

a. $2x^2 - 4x + y^2 - 4y + 1$ on the triangular region in the first quadrant bounded by $x = 0$, $y = 2$, and $y = 2x$.
b. $x^2 + y^2$ on the region bounded by $x = 0$, $y = 0$, and $y + 2x = 2$ in the first quadrant.
c. $x^2 + xy + y^2 - 6x + 2$ on the rectangular plate $0 \le x \le 5$, $-3 \le y \le 0$.
d. $x^2 + 2y^2 - x$ on the circular region $x^2 + y^2 \le 1$.

Answers

1a. loc. min at $(-3, 3)$. 1b. loc. max at $(\frac{2}{3}, \frac{4}{3})$. 1c. saddle at $(-2, 1)$. 1d. saddle at $(\frac{6}{5}, \frac{69}{25})$. 1e. saddle at $(2, 1)$. 1f. min at $(2, -1)$. 1g. saddle at $(1, 2)$ 1h. saddle at $(0, 0)$. 1i. saddle at $(0, 0)$. loc. max at $(-\frac{2}{3}, \frac{2}{3})$. 1j. loc. min at $(0, 0)$. saddle at $(1, -1)$. 1k. saddle at $(0, 0)$. loc. min at $(\frac{4}{9}, \frac{4}{3})$. 1l. saddle at $(0, 0)$. loc. min at $(0, 2)$. loc. max at $(-2, 0)$. saddle at $(-2, 2)$. 1m. saddle at $(0, 0)$. loc. max at $(1, 1)$. loc. max at $(-1, -1)$. 2a. abs.max: 1 at $(0, 0)$. abs.min: $-5$ at $(1, 2)$. 2b. abs.max: 4 at $(0, 2)$. abs.min: 0 at $(0, 0)$. 2c. abs.max: 11 at $(0, -3)$. abs.min: $-10$ at $(4, -2)$. 2d. abs.max: $\frac{9}{4}$ at $(-\frac{1}{2}, \frac{\sqrt{3}}{2})$ and at $(-\frac{1}{2}, -\frac{\sqrt{3}}{2})$. abs.min: $-\frac{1}{4}$ at $(\frac{1}{2}, 0)$.