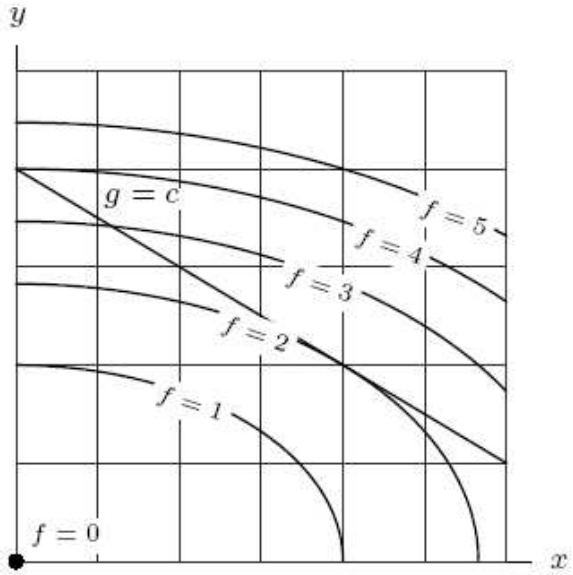
Classroom Voting Questions: Multivariable Calculus

15.3 Constrained Optimization: Lagrange Multipliers

1. Find the maximum and minimum values of f on $g = c$.



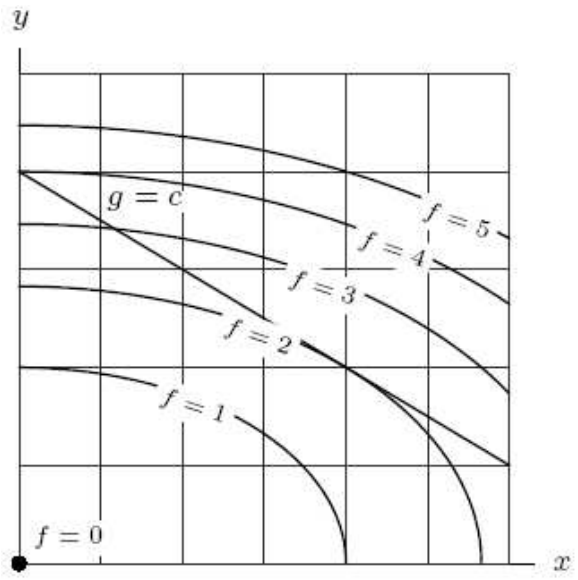
   (a) max = 5, min = 0

   (b) max = 4, min = 0

   (c) max = 3, min = 2

   (d) max = 4, min = 2

2. Find the maximum and minimum values of f on the trapezoidal region below $g = c$ in the first quadrant.



(a) max = 5, min = 0

(b) max = 5, min = 2

(c) max = 4, min = 1

(d) max = 4, min = 0

(e) max = 3, min = 2

(f) max = 3, min = 0

(g) max = 4, min = 2

(h) max = 5, min = 2

(i) max = 2, min = 0

3. Find the maximum of the production function $f(x, y) = xy$ in the first quadrant subject to each of the three budget constraints. Arrange the x coordinates of the optimal point in increasing order.

I $x + y = 12$

II $2x + 57y = 12$

III $3x + y/2 = 12$

(a) $I < II, < III$

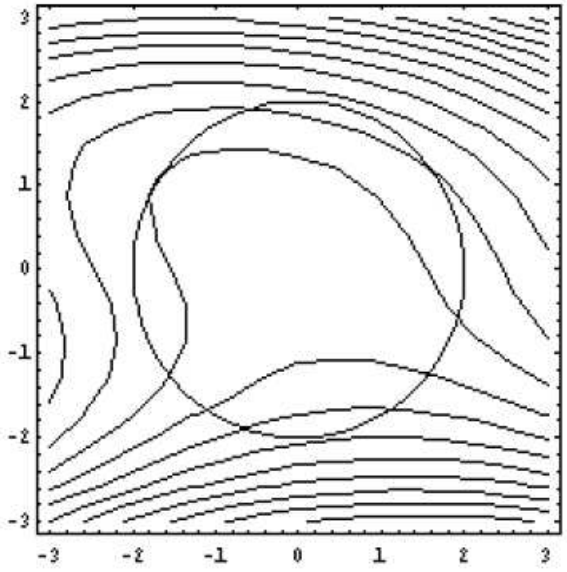
(b) $III < II < I$

(c) $II < III < I$

(d) $II < I < III$

(e) $III < I < II$

4. This contour plot of $f(x, y)$ also shows the circle of radius 2 centered at (0,0). If you are restricted to being on the circle, how many local maxes and mins does $f(x, y)$ have?



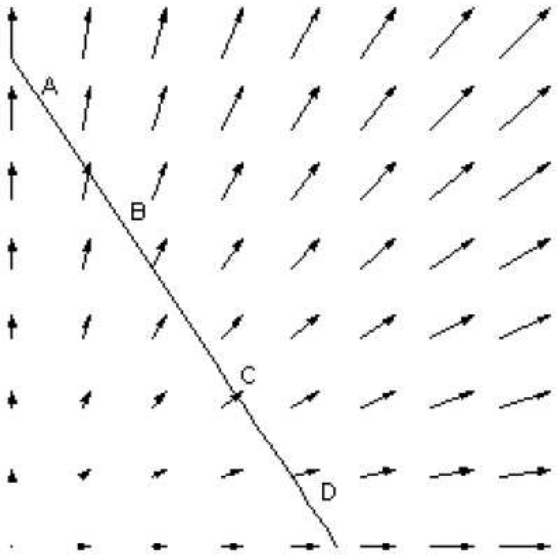
(a) 1

(b) 2

(c) 3

(d) 4

5. This plot shows the gradient vectors for a (hidden) function $f(x, y)$ and a linear constraint. Which point is closest to the global min of $f(x, y)$ on this constraint?



(a) A

(b) B

(c) C

(d) D

6. How many local maxs and mins does the function $f(x, y, z) = ax + by + cz$ have on the sphere $x^2 + y^2 + z^2 = 1$?

   (a) 1

   (b) 2

   (c) 3

   (d) 4

   (e) None

7. How many points will produce local max/min of $f(x, y) = x^2 - y^2$ over the region $x^2 + y^2 \leq r^2$?

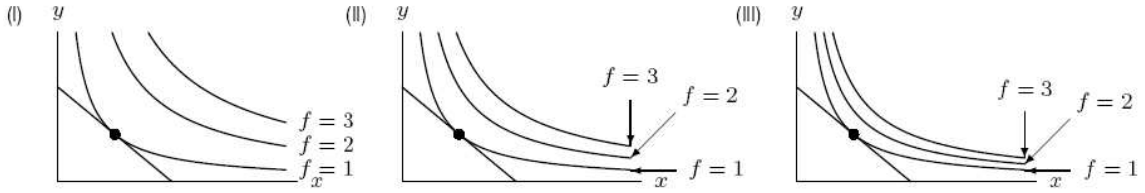
   (a) 1

   (b) 2

   (c) 3

   (d) 4

8. The figure below shows the optimal point (marked with a dot) in three optimization problems with the same constraint. Arrange the corresponding values of λ in increasing order. (Assume λ is positive.)



   (a) $I < II < III$

   (b) $II < III < I$

   (c) $III < II < I$

   (d) $I < III < II$

9. Minimize $x^2 + y^2$ subject to $x^2y^2 = 4$

(a) 1
(b) 2
(c) $2\sqrt{2}$
(d) 4
(e) 8
(f) 16

10. Maximize x^2y^2 subject to $x^2 + y^2 = 4$.

(a) 1
(b) 2
(c) $2\sqrt{2}$
(d) 4
(e) 8
(f) 16

11. Maximize x^2y^2 subject to $x + y = 4$ with $x, y \geq 0$.

(a) 1
(b) 2
(c) $2\sqrt{2}$
(d) 4
(e) 8
(f) 16