13. a) In the first case, the plane is where $z = 1$. In the second, it is where $x + z = 1$.
b) In the first case, the plane is where $2x - y = 2$. In the second, it is where $x + y - z = 1$.

14. $L = 2x - 5y + z$.

15. a) 2. b) 1. c) $-\sqrt{2}$.

16. $\nabla g = (-2, -4)$.

17. a) $\nabla f = (-\sin(x), 2y)$ so possible the critical points have the form $(n\pi, 0)$ with n an integer. The second derivative tests finds $(n\pi, 0)$ a local minimum when n is odd and a saddle when n is even.
b) $\nabla f = (-\sin(x)\sin(y), \cos(x)\cos(y))$ so the critical points have the form $(n\pi, (m + 1/2)\pi)$ and $((n + 1/2)\pi, m\pi)$ where n and m are integers. In the first case, if both n and m are odd or both are even, it is a local maximum. If one is odd and the other not, then it is a local minimum. In the second case, it is a saddle for all n and m. (Use the 2nd derivative test.)
c) $\nabla f = (2x, 3y^2 - 3)$ so the critical points are $(0, \pm 1)$. The point $(0, 1)$ is a local minimum and the point $(0, -1)$ is a local minimum.

18. The origin is the only interior critical point and it is a saddle. The extreme points on the boundary occur at $(\pm 3/\sqrt{2}, \pm\sqrt{2})$. The points $(3/\sqrt{2}, \sqrt{2})$ and $(-3/\sqrt{2}, -\sqrt{2})$ are maxima and the others are minima.

19. The maxima occur at $(\pm 1, 0, 0)$ and the minima at $(0, \pm 1, 0)$.

20. The maximum is at $(1, 0, 0)$.

21. The closest points are $(0, \pm 1, \pm 1)$ with distance $\sqrt{2}$.

22. The square of the length of **E** is $x^4 + 4y^2 + z^2 + z^2y^2 - 2zy + 1$ which is smallest at the origin.

23. $3(\pi/2 - 1)$.

24. $4/(3\pi)$. (Remember to divide the integral of x by the area.)

25. $\pi/8$.

26. $\sin(1)/2$.