1. (a) \( z = \frac{1}{3}(x - 2) - \frac{8}{3}(y - 1) + 2 \)

(b) \( f(2.03, 0.97) \approx 2.09 \)

2. (a) \( v(t) = \langle 2, 2t, t^{-1/2} \rangle, \ a(t) = \langle 0, 2, -\frac{1}{2}t^{-3/2} \rangle \)

(b) HINT: We know that \( a(t) = a_N N(t) + a_T T(t) \). If acceleration is parallel to the unit normal vector, the tangential component of acceleration must be equal to 0. In particular, since \( a_T = \frac{r' \cdot r''}{|r'|} \), we seek the point(s) at which \( r' \cdot r'' = 0 \).

ANSWER: \( (0, \frac{1}{4}, \frac{2}{\sqrt{2}}) \)

(c) i. \( (-\frac{1}{2}, 0) \)

ii. HINT: Apply the second derivative test: \( D\left(-\frac{1}{2}, 0\right) = -2c \). If the critical point gives a saddle point, then \(-2c\) must be negative.

ANSWER: \( c > 0 \)

(d) HINT: Here is the region over which you’re integrating:

![Graph of the region D]

ANSWER: \( \int_0^1 \int_{-\cos x}^{\cos x} e^{\sin x} \, dy \, dx = 2(e - 1) \)

(e) HINT: The depth of the pool is a linear function of \( x \). At \( x = -15 \), the depth is 3, and at \( x = 15 \), the depth is 15. Find the equation for the depth in terms of \( x \)—you want the integral that gives the volume “under” that depth function over the peanut-shaped region.

\[
V = \int_0^{2\pi} \int_0^{10 + 5\cos(2\theta)} \left( \frac{2}{5} r \cos(\theta) + 9 \right) r \, dr \, d\theta
\]