MATHEMATICS 317 April 2010 Final Exam Answers

1. (a) $\frac{x^2}{2} = \frac{y^2}{2} + C$
   (b)

![Diagram of intersecting lines](image)

2. (a) $\sqrt{5} t$  
   (b) $a_T(t) = \sin t \hat{i} + \cos t \hat{j} + 2 \hat{k}$  
   (c) $a_N(t) = t \cos t \hat{i} - t \sin t \hat{j}$  
   (d) $\kappa(t) = \frac{1}{5t}$

3. (a) See the solutions.
   (b) $f(r) = 0$ for all $r \geq 0$.
   (c) Any $f(r)$ which is a positive constant times $-\frac{1}{r^3}$ works.

4. (a) $\nabla \cdot \mathbf{F}(x, y, z) = 0$ except at $(x, y, z) = (0, 0, 0)$, where $\mathbf{F}$ is not defined.
   (b) $4\pi$  
   (c) No.  
   (d) $4\pi$  
   (e) 0

5. (a) $\frac{\pi}{4} + \frac{\pi(b+d)}{6}$
   (b) $\int_{\sigma_1 \cup \sigma_3} \mathbf{F} \cdot \hat{n} \, dS$ is zero if and only if $d = -b$.
   (c) $\int_{\sigma_1 \cup \sigma_3} \mathbf{F} \cdot \hat{n} \, dS$ is zero for all $a, b, c, d$.

6. (a) The projection of the curve on the $xy$-plane (i.e. the top view of the curve) is a circle.
   See the solution for more details.
   (b) (i) 0  
   (b) (ii) 0

7. $a = -4$