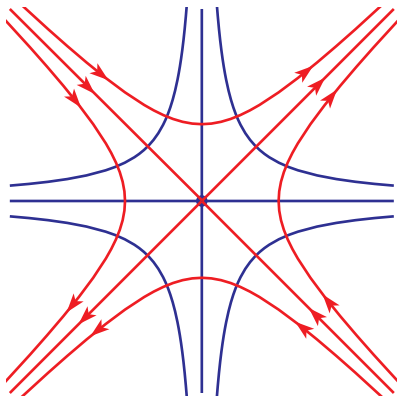
MATHEMATICS 317 April 2010 Final Exam Answers

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

   (b)



2. (a) $\sqrt{5}\,t$ (b) $\mathbf{a}_T(t) = \sin t\,\hat{\boldsymbol{\imath}} + \cos t\,\hat{\boldsymbol{\jmath}} + 2\,\hat{\mathbf{k}}$ (c) $\mathbf{a}_N(t) = t\cos t\,\hat{\boldsymbol{\imath}} - t\sin t\,\hat{\boldsymbol{\jmath}}$

   (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) $\boldsymbol{\nabla} \cdot \mathbf{F}(x, y, z) = 0$ except at $(x, y, z) = (0, 0, 0)$, where $\mathbf{F}$ is not defined.

   (b) 4π (c) No. (d) 4π (e) 0

5. (a) $\frac{\pi}{4} + \frac{\pi(b+d)}{6}$

   (b) $\iint_{\sigma_1 \cup \sigma_3} \mathbf{F} \cdot \hat{\mathbf{n}}\,\mathrm{d}S$ is zero if and only if $d = -b$.

   (c) $\iint_{\sigma_1 \cup \sigma_3} \mathbf{F} \cdot \hat{\mathbf{n}}\,\mathrm{d}S$ 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. $a = 4$