

## Math 241 - Section C1H - Homework 8

Assigned: 3/5/08

Due: 3/12/08 at the start of class.

Notation: Exercise a.b.c stands for Exercise c from Section a.b.

Problems to hand in:

- (1) 5.4.2.
- (2) 5.4.3.
- (3) 5.4.11.
- (4) Solve 5.4.15 and find the typo.
- (5) 5.4.18.
- (6) 5.4.30.
- (7) Let  $\vec{c}(t) = (\sin(t^2), \cos(t^2), t(\sqrt{2\pi} - t))$  for  $0 \leq t \leq \sqrt{2\pi}$  be a path in  $\mathbb{R}^3$ . Let

$$\vec{F}(x, y, z) = \left( xe^{x^3}, y^2 \sin(y) \cos(y), \frac{2}{1+z^2} \right).$$

Compute  $\int_{\vec{c}} \vec{F} d\vec{s}$ . [Hint: Show that  $\nabla \times \vec{F} = \vec{0}$  for any  $\vec{F}(x, y, z)$  of the form  $(f(x), g(y), h(z))$ , and note that  $\vec{c}(0) = \vec{c}(\sqrt{2\pi})$ .]

- (8) How fast do you have to launch something upward (from the surface of the Earth) so that it doesn't come back down? [The gravitational force field is given by

$$\vec{F}(x, y, z) = -\frac{GMm\vec{r}}{\|\vec{r}\|^3},$$

where  $G = 6.67 \cdot 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$  is the gravitational constant,  $M = 5.97 \cdot 10^{24} \text{ kg}$ , and  $m$  is the mass of the object thrown. Here, the Earth is placed at the origin and  $\vec{r}$  is the vector pointing from the center of the Earth to  $(x, y, z)$ . Note that the radius of the Earth is  $6.37 \cdot 10^6 \text{ m}$ .]