This week on the problem set you will get practice thinking about potential functions and calculating line integrals.

*Numbers in parentheses indicate the question has been taken from the textbook:

J. Rogawski, C. Adams, *Calculus, Multivariable*, 3rd Ed., W. H. Freeman & Company,

and refer to the section and question number in the textbook.

1. (Section 17.1) Questions 13 – 17, 22, 26, 28, 29, 38, 42, 44, 47, 52, 56*. (Use the following translations 4th $\mapsto$ 3rd editions: 47 $\mapsto$ 45, 52 $\mapsto$ 50, 56 $\mapsto$ 54, otherwise the questions are the same).

2. (Section 17.2) 3, 10, 12, 13, 21, 24, 28, 43, 44, 46, 47, 54, 55, 57, 63, 64, 67. (Use the following translations 4th $\mapsto$ 3rd editions: 43 $\mapsto$ 41, 44 $\mapsto$ 42, 46 $\mapsto$ 44, 47 $\mapsto$ 45, 54 $\mapsto$ 52, 55 $\mapsto$ 53, 57 $\mapsto$ 55, otherwise the questions are the same).

3. (17.2.24) Compute $\displaystyle\int_{\mathcal{C}} \boldsymbol{F} \cdot d\boldsymbol{r}$ for

$$\boldsymbol{F}(x, y) = \left\langle \frac{-y}{(x^2 + y^2)^2}, \frac{x}{(x^2 + y^2)^2} \right\rangle$$

   and $\mathcal{C}$ the circle of radius R with center at the origin oriented counterclockwise.

4. (17.2.63) Let $\mathcal{C}$ be a curve in polar form $r = f(\theta)$ for $\theta_1 \leq \theta \leq \theta_2$ (see figure below), parametrised by $\boldsymbol{r}(\theta) = (f(\theta)\cos\theta, f(\theta)\sin\theta)$ as in Exercise 60 (58 in 3rd ed.).

   (a) Show that the vortex vector field $\boldsymbol{F}(x, y) = \left\langle \dfrac{-y}{x^2 + y^2}, \dfrac{x}{x^2 + y^2} \right\rangle$ in polar coordinates is written $\boldsymbol{F}(r, \theta) = r^{-1}\langle -\sin\theta, \cos\theta \rangle$.

   (b) Show that $\boldsymbol{F} \cdot \boldsymbol{r}'(\theta)\, d\theta = d\theta$.

   (c) Show that $\displaystyle\int_{\mathcal{C}} \boldsymbol{F} \cdot d\boldsymbol{r} = \theta_2 - \theta_1$.

5. (17.2.67) Calculate the flux of the vector field $\boldsymbol{F}(x, y) = \langle e^y, 2x - 1 \rangle$ across the parabola $y = x^2$ for $0 \leq x \leq 1$, oriented left to right.

*The questions marked with an asterisk are more difficult or are of a form that would not appear on an exam. Nonetheless they are worth thinking about as they often test understanding at a deeper conceptual level.