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

Homework: The second homework will be due on Friday 8 May and will consist of TO BE UPDATED. *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 $4^{\text{th}} \mapsto 3^{\text{rd}}$ 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 $4^{\text{th}} \mapsto 3^{\text{rd}}$ 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 $\theta_1 \le \theta \le \theta_2$ (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 $0 \le x \le 1$, 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.