Homework No. 04 (2020 Fall)

PHYS 320: Electricity and Magnetism I

Due date: Friday, 2020 Sep 4, 2:00 PM, on D2L

1. (**80 points.**) (Based on problem 1.44,45/1.43,44 Griffiths 4th/3rd edition.)
   Evaluate the following integrals:

$$\int_2^6 dx \left[3x^2 - 2x - 3\right] \delta(x-3) \tag{1a}$$

$$\int_{-7}^7 dx \, \sin x \, \delta(x - \pi) \tag{1b}$$

$$\int_{-\pi}^{\pi} dx \, \sin x \, \delta\left(x - \frac{3\pi}{2}\right) \tag{1c}$$

$$\int_0^3 dx \, x^3 \, \delta(x+1) \tag{1d}$$

$$\int_{-2}^2 dx \left[3x + 3\right] \delta(3x) \tag{1e}$$

$$\int_{-2}^2 dx \left[3x + 3\right] \delta(-3x) \tag{1f}$$

$$\int_0^2 dx \left[3x + 3\right] \delta(1 - x) \tag{1g}$$

$$\int_{-1}^1 dx \, 9x^3 \, \delta(3x + 1) \tag{1h}$$

2. (**10 points.**) Evaluate the integral

$$\int_{-1}^1 \frac{\delta(1 - 3x)}{x} \, dx. \tag{2}$$

   Hint: Be careful to avoid a possible error in sign.

3. (**30 points.**) (Based on problem 1.47/1.46 Griffiths 4th/3rd edition.)

   (a) Express the charge density $\rho(\mathbf{r})$ of a point charge Q positioned at $\mathbf{r}_a$ in terms of δ-functions. Verify that the volume integral of ρ equals Q.

   (b) Express the charge density of an infinitely long wire, of uniform charge per unit length λ and parallel to z-axis, in terms of δ-functions.