

## Physics 423, Spring 2019

**Notice:** We will have an in-class exam on Monday, Jan 28:

- The exam covers Chapter 1 of Griffiths and is worth 50 points.
- There will be  $3 \pm 1$  problems, similar to past homework.
- You may bring a 4x6 card with notes if you like. I will provide something like the formulae on the endpapers of your text.
- I will hold a review session in class Friday, Jan 25.

### Homework Set # 3

1. Due Wednesday, Jan 23 (Read §1.5):

(a) In class we found that

$$\int_0^{\infty} f(x) \delta(x^2 - 2) dx = \frac{f(\sqrt{2})}{2\sqrt{2}}.$$

Verify this result by factoring the argument of the delta function, and then using the identity

$$\int_{-\infty}^{\infty} f(x) \delta([x - b]c) dx = \frac{f(b)}{|c|}.$$

(b) Let  $\mathbf{v}(\mathbf{r}) = (1 + \cos \theta)\hat{\mathbf{r}}/r^2$ .

- Calculate  $\nabla \cdot \mathbf{v}$ .
- Calculate  $\oint \mathbf{v} \cdot d\mathbf{a}$  for the sphere  $r = R$ .
- If necessary, correct the divergence result with what you learned in the previous part.

2. Due Friday, Jan 25 (Read §1.6):

- The “vector area” of surface  $\mathcal{S}$  is defined by  $\mathbf{a} \equiv \int_{\mathcal{S}} d\mathbf{a}$ . Show that the vector area of a closed surface is zero.<sup>1</sup>
- Similarly, show that  $\oint d\mathbf{l} = 0$ .
- Use the theorems in Section 1.6 to show that  $\mathbf{F} = yz\hat{\mathbf{x}} + xz\hat{\mathbf{y}} + xy\hat{\mathbf{z}}$  can be written both as the gradient of a scalar and as the curl of a vector. Then, find the scalar and vector potentials for  $\mathbf{F}$ .

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<sup>1</sup>Hint: calculate the components one at a time, for example  $a_x = \hat{\mathbf{x}} \cdot \mathbf{a}$ .