Practice problems are posted for those who want a little more practice with the basics. Feel free to ignore them if they look too easy. There is nothing to turn in.

1 Cube Charge

(a) Charge is distributed throughout the volume of a dielectric cube with charge density $\rho = \beta z^2$, where z is the height from the bottom of the cube, and where each side of the cube has length L. What is the total charge inside the cube? Do this problem in two ways as both a single integral and as a triple integral.

(b) On a different cube: Charge is distributed on the surface of a cube with charge density $\sigma = \alpha z$ where z is the height from the bottom of the cube, and where each side of the cube has length L. What is the total charge on the cube? Don't forget about the top and bottom of the cube.

2 Curvilinear coordinate drawings

(a) Using the conventions from class for cylindrical and spherical coordinates, draw each of the surfaces below *by hand*:

 (a) $\phi = \frac{\pi}{3}$
 (b) $\theta = \frac{3\pi}{4}$

(b) Using the conventions from class for cylindrical and spherical coordinates, draw each of the following vectors *by hand* at the indicated point.

 (a) $\hat{\boldsymbol{\phi}}$ at the point where $s = 2$, $\phi = \frac{\pi}{3}$, and $z = 0$.
 (b) $\hat{\boldsymbol{\theta}}$ at the point where $r = 1$, $\theta = \frac{3\pi}{4}$, and $\phi = \frac{\pi}{2}$.

3 Exponential and Logarithm Identities

Make sure that you have memorized the following identities and can use them in simple algebra problems:

$$e^{u+v} = e^u\, e^v$$
$$\ln uv = \ln u + \ln v$$
$$u^v = e^{v \ln u}$$

4 Derivative Rules

Make sure that you have memorized or can quickly find the derivative of all of the common transcendental functions: powers, trigonometric functions (especially sine and cosine), exponential, logarithms. Make sure that you can use these rules, even when the argument has parameters in it, e.g. $\sin kx$. Also, make sure you can use the chain rule.

5 Basic Calculus: Practice Exercises

Determine the following derivatives and evaluate the following integrals, all by hand. You should also learn how to check these answers on Wolfram Alpha.

(a) $\frac{d}{du}\left(u^2 \sin u\right)$

(b) $\frac{d}{dz}\left(\ln(z^2 + 1)\right)$

(c) $\displaystyle\int v \cos(v^2)\, dv$

(d) $\displaystyle\int v \cos v\, dv$