

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) $\hat{\phi}$ at the point where $s = 2$, $\phi = \frac{\pi}{3}$, and $z = 0$.
 - (b) $\hat{\theta}$ 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:

$$\begin{aligned}e^{u+v} &= e^u e^v \\ \ln uv &= \ln u + \ln v \\ u^v &= e^{v \ln u}\end{aligned}$$

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

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

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

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