Set #5 - for Thursday, November 6

Read

HR&K, Vol. 2	Ch. 30 (attention to examples)
Purcell	Ch. 3, Sects. 3.6 – 3.8
Feynman Vol. 2	Ch. 6, 8

Solve

From HR&K

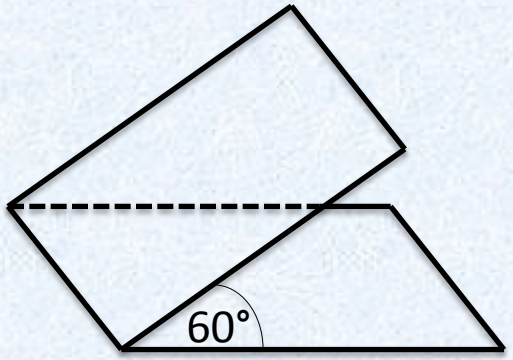
Ch. 30 Exercise 27, 37; Problems 4, 8, 10

From Purcell

Ch. 1 Problems 1.82

Ch. 3 Problems 3.41, 3.58, 3.68

Problem 1(Extra Credit). Describe images of a charge that is placed between two semi-infinite conducting planes. The planes start from the same line and make a dihedral angle 60°.



Problem 2. Show $\vec{\nabla}\cdot\left(\phi\vec{A}\right)=\left(\vec{\nabla}\phi\right)\cdot\vec{A}+\phi\vec{\nabla}\cdot\vec{A}$

Problem 3. Evaluate (a) $\int_0^5 \sin 3x\cdot\delta(3-x)dx$ (b) $\int_0^\infty e^x\cdot\delta(x^2-1)dx$ (c) $x^2\dfrac{d^2\delta(x)}{dx^2}$

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Problem 4. Calculate the amount of electrostatic energy in a sphere of radius R and charge Q uniformly distributed through
a) its volume
b) Its surface.
Use the two different methods below:

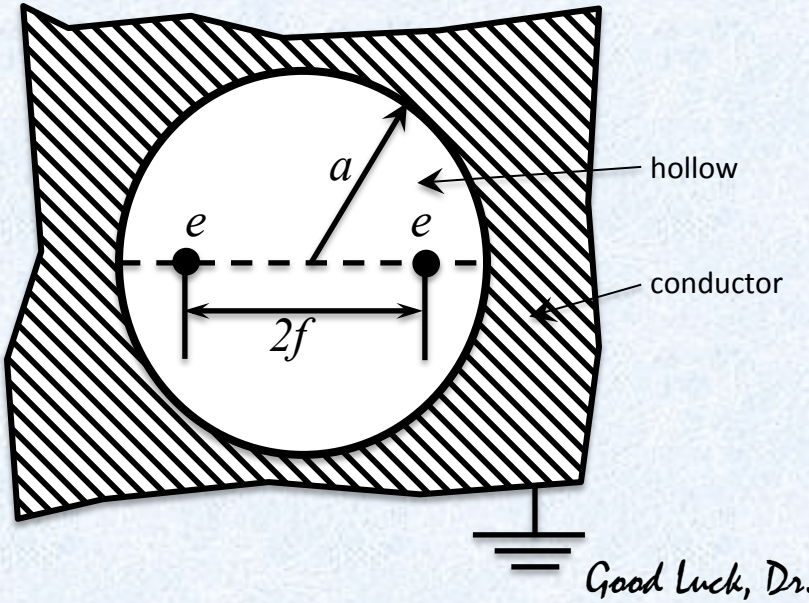
Method (I): $$U = \frac{1}{2}\int \rho V d^3r \text{ or } U = \frac{1}{2}\sum q_i V_i$$

Method (II): $$U = \frac{1}{2}\varepsilon_0 \int E^2 d^3r$$

Assume this sphere is an electron of mass 9.11×10^{-31} kg. Find the classical electron radius for each distribution of charges.

Problem 5. Within the spherical hollow, radius a, of a grounded conductor, equal point-charges e are placed at equal distances f from the center, on the same diameter, as shown in the figure below. Show that each charge is acted on by a force equal to

$$F = k_C e^2 \left[\frac{4a^3 f^3}{\left(a^4 - f^4\right)^2} + \frac{1}{4f^2} \right]$$



Good Luck, Dr. B