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Solutions - PHYS 212 Exam 2 - Practice Test

1A
The uniformly distributed charge can be thought of as a point charge located at the center of the sphere. According the equation for electric potential of a point charge, the potential decreases as the distance form the point increases. Thus the closer to the center you are, the greater the potential will be, and so we pick answer choice A.

2E
The only equation relating potential energy and electric potential is $\Delta V = \Delta U/q$.
This means to calculate the change in potential energy, we need to multiply ΔV with q. Note that in this particular problem, q represents the negative charge that is moved from the x-axis to the y-axis.
The change in electric potential, ΔV, is a scalar quantity that is essentially only interested in the fixed point charge and its distance, r, where we measure the potential. In this particular problem, the initial and final locations of the moving charge are the same distance from the fixed charge, thus the potential at each location is identical. This means that the change in potential as the negative charge moves from its initial to its final location is zero, and thus the change in potential energy is also zero.

3D
This scenario is indicative of a positive point charge, which decreases in field strength the further you are from it. The potential of such a point charge will also decrease as you move away from the charge, and thus answer D is the appropriate choice.

4D
This type of problem needs a little visualization before trying to solve. <u>Any electric field moving through the yz plane is actually headed along the x-axis</u>. Once we can see that, we can calculate the specific flux using the equation $\Phi = EA = (24)(2) = 48$.
Note that we use the x-component for the electric field, 24i N/C.

5B
The answer choice differ in the way they express the distance form the point Y, to any place on the rod, given by the position, x. Essentially, we can think of the dashed line as the distance we are trying to express, which we can calculate using Pythagorean theory: where the distance along the x-axis is given by L-x, the distance along the y-axis is given by y, and the vector distance will then be: $(L - x)^2 + (y)^2$
Thus we choose answer choice B as it is the only option that expresses the distance from the rod to point Y in this correct format.

6E
The most effective use of Gauss' Law is that the total flux through an enclosed surface is given by total internal charge, q, divided by the constant ε_0. Since we are not given the total charge, we can substitute for it using q = λL, where the charge density, λ, is q/L. Thus we can pick answer choice E to represent the total flux.

7C
For any conducting spherical shell, the inside surface will have the same charge as the point charge inside the sphere but will have the opposite sign. Thus the inner surface must be -5μC. However, since the +5μC inside the sphere is not located at the center, the charge will not be uniformly distributed along the inner surface.
Another rule for conducting spherical shells, is that the sum of the inner and outer surface charges must equal the excess charge of the sphere.
So we get:

Inner + Outer = Excess

-5μC + Outer = +3μC

Outer = +8μC

The outer surface charge will be uniformly distributed, unlike the inner surface charge, and thus we pick answer choice C.

8B
Positive charges always move in the direction of the electric field. The resulting motion always moves the positive charge from a region of higher to potential to one of lower potential, and so its electric potential energy decreases accordingly.

9 (not on test)
The circuit deals with resistors, which are not on this exam, however, if we replace each resistor with a 30 F capacitor, the equivalent capacitance is 75 F. (Note that the top-right capacitor has zero charge since the current can bypass it entirely when completing its loop, and therefore is not included in the calculation of equivalent capacitance).

10D
Using the equation for capacitance, area is proportional to C, while distance is inversely proportional to C. Thus we want large area, and small distance to maximize C. In addition, the presence of a dielectric also increases C.