These are sample problems, and I DO NOT make any claims that they are representative of those you are going to receive on the test. However, I do suggest that you get together and LEARN how to solve them.

1. Consider a parallel plate capacitor whose plates are separated by a distance $d$, and whose surface area $= A$. You have, in your possession, 4 slabs of dielectric material. Two of these have area $A$, height $d/2$, and have a dielectric constant $\varepsilon_1$ and $\varepsilon_2$, respectively. Likewise, you have 2 more blocks each of area $A/2$ and height $d$, and permittivities $\varepsilon_1$ and $\varepsilon_2$, respectively. Assuming that both $\varepsilon_1$ and $\varepsilon_2$ are greater than $\varepsilon_0$, prove the following:

(a) If two block of the same height are placed side by side, then the effective capacitance is

$$C = \frac{A}{d} \left( \frac{\varepsilon_1 + \varepsilon_2}{2} \right)$$

(b) If the two blocks of height $d/2$ are placed on top of each other then the effective capacitance is

$$C = \frac{2A}{d} \left( \frac{\varepsilon_1 \varepsilon_2}{\varepsilon_1 + \varepsilon_2} \right)$$

2. Would you expect the dielectric constant to vary with temperature?

3. What is the dielectric constant of a conductor?

4. A capacitor has square plates each of side length $a$ making an angle of $\theta$ w.r.t each other. Show that for small $\theta$, the capacitance is given by

$$C = \frac{\varepsilon_0 a^2}{d} \left( 1 - \frac{a\theta}{d} \right)$$

5. A co-axial capacitor comprises of two dielectrics with $\varepsilon_1 = 5\varepsilon_0$ and $\varepsilon_2 = 3\varepsilon_0$ with $\varepsilon_1$ being the inner dielectric. The radius of these are 0.1, 0.2, 0.3, respectively. Find the capacitance.

6. Please see more problems on solutions to Laplace equations as well.

7. Two infinite PEC planes make a right angle w.r.t each other and lie the $x-z$ and the $x-y$ plane, respectively. Consider a dipole whose charges are separated by a distance $d$ and placed at $(a, a)$. Find the field at a point that $(b, b)$. 