Name: **TRR**

PHYS 102 CA 15/16-1

Solutions 15–24

15. $q = e = 1.6 \times 10^{-19}\ C$
 $E = 3.0\ N/C$
 $x = 15\ cm = 0.15\ m$
 $\theta = 90°$, $\cos(\theta) = \cos(90°) = 0$
 no need to substitute
 $W = F x \cos(\theta) = qEx \cos(\theta) = 0$

16. $\Delta V = 9.0\ V$
 $\Delta x = 4.0\ mm = 0.004\ m$
 We saw for a constant E field that
 $\Delta V = -E_x \Delta x$
 sign only indicates higher or lower potential so we ignore it here
 $E = \dfrac{\Delta V}{\Delta x} = \dfrac{9.0\ V}{0.004\ m} = 2.3 \times 10^3\ V/m$
 the units V/m are fine be we can show that

 $$\frac{V}{m} = \frac{J/C}{m} = \frac{N\,m/C}{m} = \frac{N/C}{1} = N/C$$

17. Consider $\Delta V = -E_x \Delta x$ and $W = q\Delta V$
 If a positive charge is moved in the direction of the E field, it is moved to a lower potential (that is what the negative sign says), to less potential energy per unit charge and the work is negative. Thus a when a positive charge moved against the E field, the field does positive work on it; and when a negative charge is moved with the E field, positive work is done on it.

18. $\Delta V = 9.0\ V$
 $q = 20\ mC = 2.0 \times 10^{-2}\ C$
 Now $W = -q(V_B - V_A)$, the minus sign shows energy lost by the battery, work delivered is + so
 $W = q\Delta V = (2.0 \times 10^{-2}\ C)(9.0 V) = 1.8 \times 10^{-1}\ J$

19. $r = 0.15\ m$
 $q = 6.0\ \mu C = 6.0 \times 10^{-6}\ C$
 $k_e = 8.99 \times 10^9\ Nm^2/C^2$
 $\Delta V = k_e \dfrac{q}{r} = (8.99 \times 10^9\ Nm^2/C^2)\dfrac{6.0 \times 10^{-6}\ C}{0.15\,m} =$
 $3.6 \times 10^5\ Nm/C = 3.6 \times 10^5\ J/C$

20. In the equation
 $C \equiv \dfrac{q}{\Delta V}$, the capacitance is fixed by the geomtry so if ΔV is increased, more charge must flow onto the capacitor plates.

21. $C = 20\ \mu F = 2.0 \times 10^{-5}\ F$
 $\Delta V = 1000\ V$
 $C \equiv \dfrac{q}{\Delta V} \Rightarrow q = C\,\Delta V = (2.0 \times 10^{-5}\ F)(1000\ V) =$
 $2.0 \times 10^{-2}\,FV$; note that $FV = \left(\dfrac{C}{V}\right)(V) = C$

22. The answer is A. Look at the figure showing capacitors in series. The net effect of connecting capacitors in series is to increase the plate separation that reduces the capacitance of the series, thus the equivalent capacitance is less than any of the individual capacitances.

 A. $C_{eq} < C_1$

23. The answer is A.
 $A = 1.0\ m^2$
 $\kappa = 3.7$
 $d = 1.0\ mm = 0.001\ m$
 $\Delta V = 5000\ V$
 $\varepsilon_0 = 8.85 \times 10^{-12}\ F/m$
 $C = \kappa \dfrac{\varepsilon_0 A}{d} = (3.7)\dfrac{(8.85 \times 10^{-12}\ F/m)(1.0\ m^2)}{0.001\,m}$
 $PE_C = \tfrac{1}{2} C (\Delta V)^2 = \tfrac{1}{2}\kappa \dfrac{\varepsilon_0 A}{d}(\Delta V)^2 =$
 $\tfrac{1}{2}(3.7)\dfrac{(8.85 \times 10^{-12}\ F/m)(1.0\ m^2)}{0.001\,m}(5000\ V)^2 =$
 $0.41\ J$

24. The answer is 42