HOMEWORK – 1 (HINTS).

Chapter-24.

==========

4. A solid nonconducting sphere (radius = 12 cm) has a charge of uniform density (30 nC/m^3) distributed throughout its volume. Determine the magnitude of the electric field 15 cm from the center of the sphere.

   a. 22 N/C
   b. 49 N/C
   c. 31 N/C
   d. 87 N/C
   e. 26 N/C

==========
HINTS:
==========

Strategy:

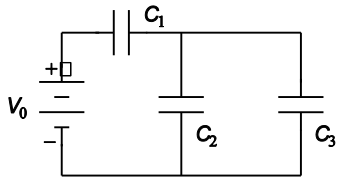
First, calculate the total charge of the sphere: $q = \sigma \times$ (Volume of the sphere-R=12cm). The field E will be the same if the total charge is concentrated in the center of the sphere.

Use the Gauss Law: $E \times$ (Area-of-sphere-radius-R=15 cm) = q / ε_0.

Finally, solve for E.

Ch. 26==========

7. Determine the energy stored in C_2 when C_1 = 15 μF, C_2 = 10 μF, C_3 = 20 μF, and V_0 = 18 V.



a. 0.72 mJ
b. 0.32 mJ
c. 0.50 mJ
d. 0.18 mJ
e. 1.60 mJ

==========
HINTS:
==========

Strategy:

Determine the total charge on each plate for two fragments (C_1) and (C_{23} = made of C_2 and C_3 connected in parallel). Determine the total capacitance C_{tot} of C_1 and C_{23} fragments connected in series. The total charge Q can be determined from $C_{tot} = Q/V_0$.

Q is the charge on C_1 and $Q = Q_2 + Q_3$ (Q2=charge on C2 and Q3 = charge on C3).

We also know that: $V_0 = V_1 + V_{23}$, (V_{23} = the potential difference across C_2 or C_3), V_1 = the potential difference across C_1.

Determine V_1 from Q and C_1, and then V_{23}.

Finally, solve for the potential energy stored in C_2 capacitor: $U_2 = 1/2\ C_2\ V_{23}^2$.

8. A 30-μF capacitor is charged to an unknown potential V_0 and then connected across an initially uncharged 10-μF capacitor. If the final potential difference across the 10-μF capacitor is 20 V, determine V_0.

a. 13 V
b. 27 V
c. 20 V
d. 29 V
e. 60 V

==========
HINTS:
==========

Strategy:

Use the conservation law of the total electric charge.

Before the connection (initial-situation):
Q(initial) = $C_1 \times V_0$,
(Here, C_1 = 30-μF)

After the connection: Q(final) = $C_1 \times V_f$ + $C_2 \times V_f$.
(Here, C_1 = 30-μF , C_2 = 10-μF , V_f= 20 V)

Charges must be preserved: Q(initial) = Q(final).
Finally, solve for V_0.