This print-out should have 13 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

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001 (part 1 of 4) 10.0 points

An air-filled capacitor consists of two parallel plates, each with an area of 7.8 cm^2, separated by a distance 2.8 mm. A 22 V potential difference is applied to these plates.

The permittivity of a vacuum is 8.85419×10^{-12} $C^2/N \cdot m^2$. 1 pF is equal to 10^{-12} F.

The magnitude of the electric field between the plates is

1. $E = \dfrac{1}{(V\,d)^2}$.

2. $E = \dfrac{1}{V\,d}$.

3. None of these

4. $E = \dfrac{d}{V}$.

5. $E = \left(\dfrac{d}{V}\right)^2$.

6. $E = V\,d$.

7. $E = \left(\dfrac{V}{d}\right)^2$.

8. $E = \dfrac{V}{d}$.

9. $E = (V\,d)^2$.

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002 (part 2 of 4) 10.0 points

The magnitude of the surface charge density on each plate is

1. $\sigma = \epsilon_0\,(V\,d)^2$.

2. $\sigma = \epsilon_0 \left(\dfrac{d}{V}\right)^2$.

3. None of these

4. $\sigma = \epsilon_0 \left(\dfrac{V}{d}\right)^2$.

5. $\sigma = \dfrac{\epsilon_0}{V\,d}$.

6. $\sigma = \dfrac{\epsilon_0}{(V\,d)^2}$.

7. $\sigma = \epsilon_0\,V\,d$

8. $\sigma = \dfrac{\epsilon_0\,d}{V}$.

9. $\sigma = \dfrac{\epsilon_0\,V}{d}$.

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003 (part 3 of 4) 10.0 points

Calculate the capacitance.

Answer in units of pF.

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004 (part 4 of 4) 10.0 points

Calculate plate charge; *i.e.*, the magnitude of the charge on each plate.

Answer in units of pC.

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005 10.0 points

The drift velocity of free electrons in a copper wire is 7 mm/s, resistivity is 1.71×10^{-8} $\Omega \cdot m$, and the free electron density is 8.43×10^{28} electrons/m^3.

Calculate the electric field in the conductor.

Answer in units of N/C.

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006 (part 1 of 5) 10.0 points

A current of 15 A exists in a copper (Cu) wire which has a diameter of 4 mm.

What is the current density? Each atom

of copper has one conduction band, and the average thermal speed $\sqrt{\frac{k\,T}{m}}$ of an electron is 1×10^6 m/s. The mass density of Cu is 8.92 g/cm^3, its molar mass is 63.5 g/mol, and Avogadro's number is 6.02214×10^{23} atoms/mole. The electron mass is 9.10939×10^{-31} kg, and the resistivity of copper is $1.7 \times 10^{-8}\ \Omega \cdot$ m.

Answer in units of A/m^2.

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007 (part 2 of 5) 10.0 points

What is the density of conduction electrons in copper?

Answer in units of m^{-3}.

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008 (part 3 of 5) 10.0 points

What is the drift velocity of the electrons?

Answer in units of m/s.

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009 (part 4 of 5) 10.0 points

What is the average time between collisions of the "drifting" electrons with the lattice ions?

Answer in units of s.

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010 (part 5 of 5) 10.0 points

What is their mean free path in this wire?

Answer in units of m.

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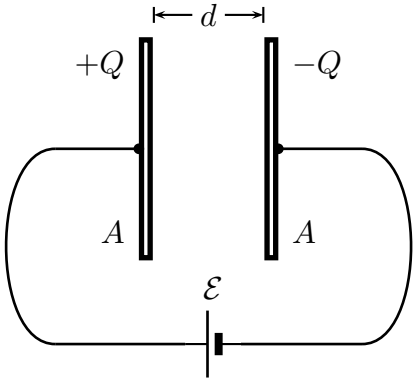
011 (part 1 of 2) 10.0 points

Consider an air-filled parallel plate capacitor with plate area A and gap width d. The plate charge is Q.



The total energy stored in the capacitor is given by

1. $U = \dfrac{Q^2}{\epsilon_0\, A\, d}$.

2. $U = \dfrac{Q^2}{2\,\epsilon_0\, A\, d}$.

3. $U = \dfrac{Q^2\, A}{\epsilon_0\, d}$.

4. $U = \dfrac{Q\, d}{\epsilon_0\, A}$.

5. $U = \dfrac{Q^2\, d}{2\,\epsilon_0\, A}$.

6. $U = \dfrac{Q}{\epsilon_0\, A\, d}$.

7. $U = \dfrac{Q\, A}{\epsilon_0\, d}$.

8. $U = \dfrac{Q}{2\,\epsilon_0\, A\, d}$.

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012 (part 2 of 2) 10.0 points

With the battery connected, fill the gap by a slab with the dielectric constant κ.

Given: $\mathcal{E} = 70$ V, $\kappa = 3.4$, $d = 0.4$ mm, and $A = 21.8$ cm^2, $\epsilon_0 = 8.85 \times 10^{-12}\, C^2/N \cdot m^2$, find the electric charge on the plate.

Answer in units of C.

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013 10.0 points

A total charge of 5.28 mC passes through a cross-sectional area of a wire in 1.5 s.

What is the current in the wire?

Answer in units of mA.