

Physics 2401 Summer 2, 2008
Exam II

$e = 1.60 \times 10^{-19} \text{ C}$, $m(\text{electron}) = 9.11 \times 10^{-31} \text{ kg}$, $\epsilon_0 = 8.845 \times 10^{-12} \text{ C}^2/\text{Nm}^2$,

$k_e = 9.0 \times 10^9 \text{ Nm}^2/\text{C}^2$, $m(\text{proton}) = 1.67 \times 10^{-27} \text{ kg}$. $n = \text{nano} = 10^{-9}$, $\mu = \text{micro} = 10^{-6}$, $m = \text{milli} = 10^{-3}$

Put your answers on the orange scantron which you brought. There is only one correct answer for each questions. All questions are weighted equally.

1. A $30\text{-}\mu\text{F}$ capacitor is charged to 80 V and then connected across an initially uncharged capacitor of unknown capacitance C . If the final potential difference across the $30\text{-}\mu\text{F}$ capacitor is 20 V , determine C .

- a. $60 \mu\text{F}$
- b. $75 \mu\text{F}$
- c. $45 \mu\text{F}$
- d. $90 \mu\text{F}$
- e. $24 \mu\text{F}$

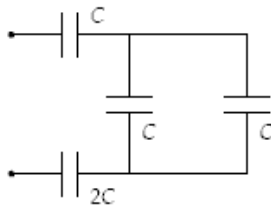
2. A parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0 , it has charge of magnitude Q_0 on its plates. It is then disconnected from the battery and the plates are pulled apart to a separation $2d$ without discharging them. After the plates are $2d$ apart, the magnitude of the charge on the plates and the potential difference between them are

- a. $\frac{1}{2}Q_0, \frac{1}{2}V_0$
- b. $Q_0, \frac{1}{2}V_0$
- c. Q_0, V_0
- d. $Q_0, 2V_0$
- e. $2Q_0, 2V_0$

3. A parallel plate capacitor is connected to a battery and charged. It remains connected to the battery as a piece of dielectric material with dielectric constant K is inserted between the plates. When the material is inserted, the stored energy in the capacitor

a) stays the same b) increases c) decreases

4. Determine the equivalent capacitance of the combination shown when $C = 12 \text{ pF}$.

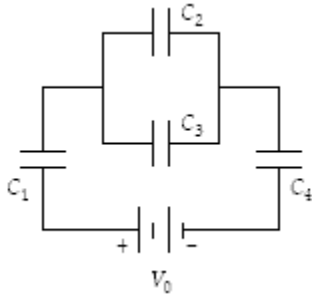


- a. 48 pF
- b. 12 pF
- c. 24 pF
- d. 6.0 pF
- e. 59 pF

5. An uniform electric field of magnitude 15 V/m exists in a region of space. The energy in the electric field in a cubical volume with sides 2.8 m long is, in nJ,

- a) 22 b) 11 c) 1.5 d) 43 e) 3.0

6. Determine the energy stored by C_4 when $C_1 = 20 \mu\text{F}$, $C_2 = 10 \mu\text{F}$, $C_3 = 14 \mu\text{F}$, $C_4 = 30 \mu\text{F}$, and $V_0 = 45 \text{ V}$.



- a. 3.8 mJ
b. 2.7 mJ
c. 3.2 mJ
d. 2.2 mJ
e. 8.1 mJ

7. Light bulb A is rated at 60 W and light bulb B is rated at 100 W . Both are designed to operate at 110 V . Which statement is correct?

- a. The 60 W bulb has a greater resistance and greater current than the 100 W bulb.
b. The 60 W bulb has a greater resistance and smaller current than the 100 W bulb.
c. The 60 W bulb has a smaller resistance and smaller current than the 100 W bulb.
d. The 60 W bulb has a smaller resistance and greater current than the 100 W bulb.
e. We need to know the resistivities of the filaments to answer this question.

8. A resistor is hooked up to a battery with a constant potential difference. If we cool the resistor using liquid nitrogen,

- a) the current increases b) the current decreases c) the current is unchanged

9. A small bulb is rated at 7.5 W when operated at 125 V . Its resistance (in ohms) is

- a. 0.45.
b. 7.5.
c. 17.
d. 940.
e. 2100.

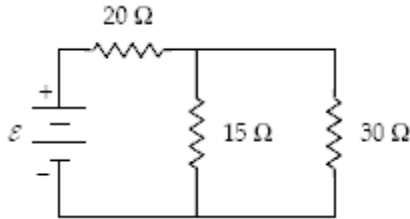
10. An Ohmic material is one in which

- a) the drift velocity is proportional to the electric field
b) the number of charge carriers is constant
c) the drift velocity is independent of electric field
d) a) and c)
e) a) and b)

11. A resistor of unknown resistance and a $15\text{-}\Omega$ resistor are connected across a 20-V emf in such a way that a 2.0 A current is observed in the emf. What is the value of the unknown resistance?

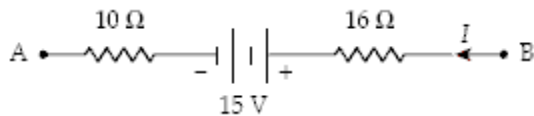
- a. $75\ \Omega$
- b. $12\ \Omega$
- c. $7.5\ \Omega$
- d. $30\ \Omega$
- e. $5.0\ \Omega$

12. What is the current in the $15\text{-}\Omega$ resistor when $\varepsilon = 9.0\text{ V}$?



- a. 0.20 A
- b. 0.30 A
- c. 0.10 A
- d. 0.26 A
- e. 0.60 A

13. What is the potential difference $V_B - V_A$ when $I = 0.50\text{ A}$ in the circuit segment shown below?



- a. $+28\text{ V}$
- b. $+2.0\text{ V}$
- c. -28 V
- d. -2.0 V
- e. $+18\text{ V}$

14. A capacitor in a single-loop RC circuit is charged to 85% of its final potential difference in 2.4 s . What is the time constant for this circuit?

- a. 1.5 s
- b. 1.3 s
- c. 1.7 s
- d. 1.9 s
- e. 2.9 s

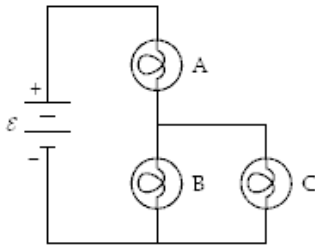
15. If 480 C pass through a $4.0\text{-}\Omega$ resistor in 10 min , what is the potential difference across the resistor?

- a. 3.6 V
- b. 2.8 V
- c. 2.4 V
- d. 3.2 V
- e. 5.0 V

16. A fully charged capacitor acts like
 a) a resistanceless wire (short circuit) b) an infinite resistance (open circuit)

17. In a loop in a closed circuit, the sum of the currents entering a junction equals the sum of the currents leaving a junction because
 a. the potential of the nearest battery is the potential at the junction.
 b. there are no transformations of energy from one type to another in a circuit loop.
 c. capacitors tend to maintain current through them at a constant value.
 d. current is used up after it leaves a junction.
 e. charge is neither created nor destroyed at a junction.

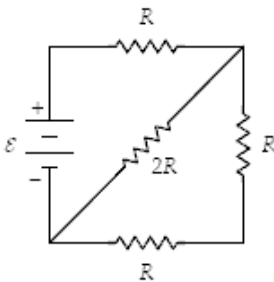
18. The circuit below contains three 100 watt light bulbs. The emf $\varepsilon = 110 \text{ V}$. Which light bulb(s) is(are) the brightest?



a. A
 b. B
 c. C
 d. B and C
 e. All three are equally bright.

19. A voltmeter
 a) should be connected in series and have a small internal resistance
 b) should be connected in parallel and have a small internal resistance
 c) should be connected in series and have a large internal resistance
 d) should be connected in parallel and have a large internal resistance

20. At what rate is thermal energy being generated in the $2R$ -resistor when $\varepsilon = 12 \text{ V}$ and $R = 3.0 \Omega$?



a. 12 W
 b. 24 W
 c. 6.0 W
 d. 3.0 W
 e. 1.5 W

