

**Exam III review.**

**RII-1** How many ohms in a coulomb?

- A) one gazillion      B) one coullion      C) 17      D) None of these
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Answer: None of these. Ohm is unit of resistance. Coulomb is unit of charge.

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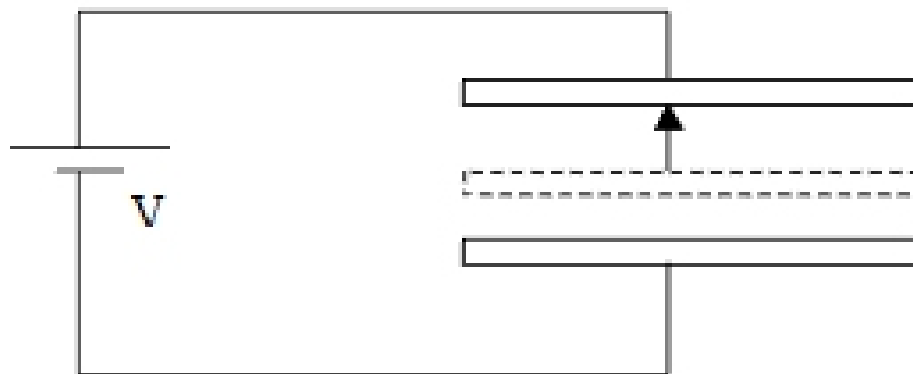
**RII-2** Does the capacitance of a capacitor depend on the charge  $Q$  on the capacitor?

- A) Yes      B) No      C) Depends on the type of capacitor.
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Answer: No. The capacitance of a capacitor is fixed by its size and shape.  $C = Q / V$  is a constant ratio for a given capacitor: if  $Q$  increases,  $V$  increases so that the ration  $Q / V$  remains constant.

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**RII-3** A capacitor is attached to a battery which maintains a constant voltage  $V$  across the capacitor plates. While the battery is attached, the plates are moved further apart. The energy stored in the capacitor..



- A) increased.  
B) decreased.  
C) remained constant.

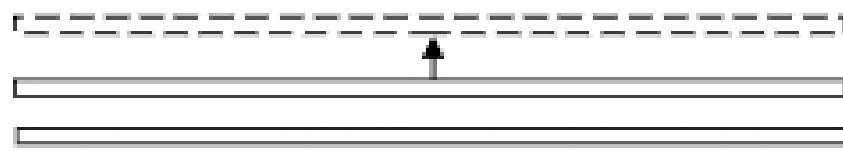
Hint:  $U = (1/2)QV = (1/2)Q^2/C = (1/2) CV^2$

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Answer:  $V$  is fixed by the battery.  $Q$  is not fixed, since charge can go on or off the plates through the attached wires. Use  $U = (1/2) CV^2$ .  $C$  decreases,  $V$  constant, so  $U$  decreases. (Both the battery and the external agent do work, so work arguments are not easy to apply in this case.)

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**RII-4** A charged capacitor is isolated (so no charge can get on or off). The plates of the capacitor are slowly pulled apart.



After the plates are pulled apart a bit, the electric field between the plates  
A) increased B) decreased C) remained constant

The voltage difference between the plates..

A) increased B) decreased C) remained constant

The capacitance ..

A) increased B) decreased C) remained constant

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Answers: The E-field stays constant, because E due to large plane of charge is constant, independent of distance from plane.

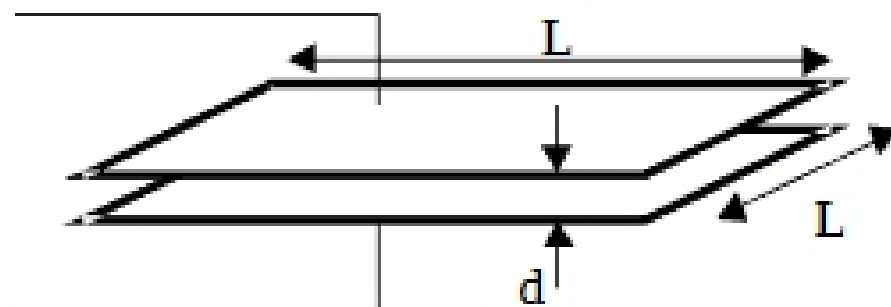
The voltage difference increases since  $\Delta V = E d$  (E is constant, d increases)

The capacitance decreased. We can see this either from  $C = Q / V$  (Q stayed constant, V increases) or from  $C = \epsilon_0 A / d$  (d increased)

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**RII-5** A parallel-plate capacitor has square plates of edge length L, separated by a distance d. A second capacitor is made with L doubled and d decreased by a factor of 2. By what factor is the capacitance of the new capacitor increased?

A) 1 B) 2 C) 4 D) 16 E) None of these



Answer: 2.  $C = \epsilon_0 A / d$ . A increased by factor of 4, so ratio A / d increased by factor of 2.

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**RII-6** A copper wire and an aluminum wire both have the same dimensions (same length, same cross-sectional area).

Which one statement is true?

- A) Both wires have the same resistance  $R$  and the same resistivity  $\rho$ .
  - B) The wires have different resistances and different resistivities.
  - C) The wires have the same resistance but different resistivities.
  - D) The wires have different resistances but the same resistivity.
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Answer: The wires have different resistances and different resistivities.  $R = \rho L / A$  Different materials have different resistivity  $\rho$ . Same  $L$ , same  $A$ , different  $\rho$ 's, so different  $R$ 's

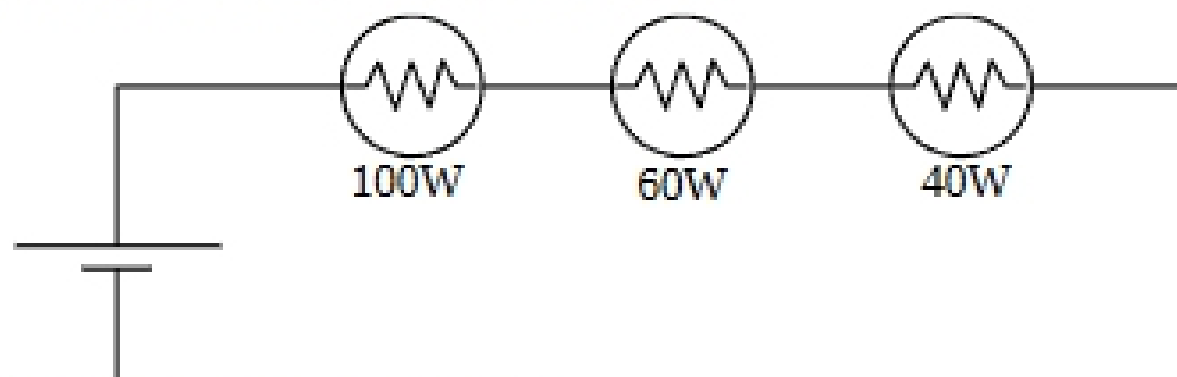
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**RII-7** Which has higher resistance ?

- A) 100 W bulb
  - B) 60 W bulb
- Hint:  $P = IV = I^2R = V^2/R$

Answer: 60 W bulb has higher  $R$ . All light bulbs are meant to be used at constant voltage  $V = 120 \text{ VAC}$ . So use  $P = V^2 / R$ .

**RII-8** Consider the following circuit containing three ordinary household light bulbs, a 100W light bulb, a 60W bulb, and a 40W bulb.



Which one statement is true?

- A) The 100W bulb will be brightest.
  - B) The 60W bulb will be brightest.
  - C) The 40W bulb will be brightest.
  - D) All the light bulbs glow with the same brightness.
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Answer: the 40W bulb is brightest! (Since it has the largest  $R$ ). In comparing the power (or brightness) of two light bulbs, you must first be clear whether the current or the voltage is the same for the two. It makes all the difference. If the two bulbs are in series, then the current is the same, and according to  $P = I^2 R$ , the higher resistance bulb has more power, and is brighter. But if the bulbs are in parallel, then the voltage is the same, and then according to  $P = V^2 / R$ , the larger resistance bulb has less power, and is dimmer.

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