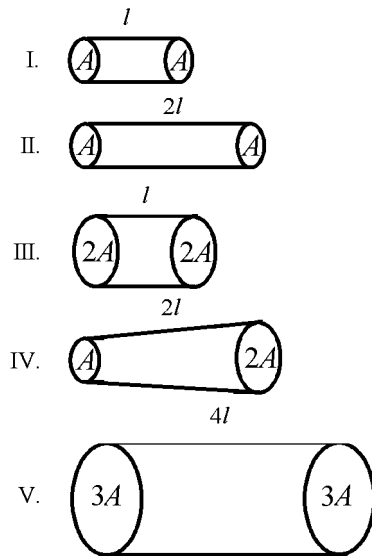Base your answers to questions **1** through **3** on the 5 resistors shown below, which are all made of material with the same resistivity.

I. l A — A

II. $2l$ A — A

III. l $2A$ — $2A$

IV. $2l$ A — $2A$

V. $4l$ $3A$ — $3A$

1. Which resistor has the greatest resistance?

   A) I

   B) II

   C) III

   D) IV

   E) V

2. Which resistor has the least resistance?

   A) I

   B) II

   C) III

   D) IV

   E) V

3. Which two resistors have the same resistance?

   A) I and II

   B) II and III

   C) I and III

   D) I and IV

   E) IV and V

4. What is the electric field for a parallel-plate capacitor?

   A) $\sigma/2\varepsilon_0$

   B) σ/ε_0

   C) $2\sigma/\varepsilon_0$

   D) $-\sigma/2\varepsilon_0$

   E) $-\sigma/\varepsilon_0$

5. What is the ratio of Q to $\mathcal{C}V$ for any capacitor?

   A) C

   B) E

   C) K
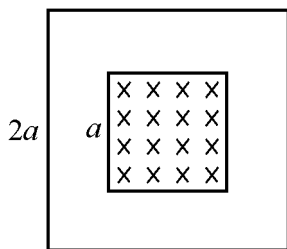
   D) ε_0

   E) d

6. A coaxial cable of length l consists of a solid conducting cylinder of radius a, which carries a linear charge density of $+\lambda$, concentric with an outer cylindrical shell of radius b, which carries a linear charge density of $-\lambda$. What is the capacitance of a coaxial cable?

   A) $\varepsilon_0 l \ln(b/a)$

   B) $\pi\varepsilon_0 l \ln(b/a)$

   C) $2\pi\varepsilon_0 l \ln(b/a)$

   D) $\pi\varepsilon_0 /l\ln(b/a)$

   E) $2\pi\varepsilon_0 /l\ln(b/a)$

7. A spherical conducting shell of radius a, carrying a charge of $+Q$, is concentric with an outer spherical shell of radius b carrying a charge of $-Q$. What is the capacitance of this capacitor?

A) Zero

B) $a/4\mathbf{p}\varepsilon_0$

C) $a/2\mathbf{p}\varepsilon_0$

D) $2\mathbf{p}\varepsilon_0 a$

E) $4\mathbf{p}\varepsilon_0 a/(\frac{1}{a} - \frac{1}{0})$

8. All of the following are true about spherical capacitors **EXCEPT**

A) The electric field outside the outer sphere is zero

B) The electric field between the two spheres is determined only by the charge on the outer sphere

C) The electric field points radially towards the center of the spheres

D) The potential difference between the two spheres is the negative integral of the electric field

E) The capacitance is equal to the charge divided by the potential difference

9. All of the following are true about cylindrical capacitors **EXCEPT**

A) The electric field outside the cylinder is zero

B) The electric field between the two cylinders is determined by only the charge on the inner cylinder

C) The electric field will point radially toward the central axis of the cylinders

D) The potential difference between the two cylinders is the negative derivative of the electric field

E) The capacitance is equal to the charge divided by the potential difference

10. A spherical capacitor has an inner radius R_1 and an outer radius R_2. A cylindrical capacitor also has an inner radius R_1 and an outer radius R_2. What is the relationship between the capcitances of these capacitors?

A) The spherical capacitor has a greater capacitance than the cylindrical capacitor.

B) The spherical capacitor has the same capacitance as the cylindrical capacitor.

C) The spherical capacitor has a smaller capacitance than the cylindrical capacitor.

D) Both capacitors must have a capacitance of zero.

E) The answer cannot be determined from this information.

11. Which of the following will make the electrical resistance of a material known as a superconductor suddenly decrease to essentially zero?

A) Expose it to sufficiently high levels of electromagnetic radiation.

B) Drawing it into a wire with a sufficiently large cross sectional area.

C) Placing it in a sufficiently strong magnetic field.

D) Applying a sufficiently high voltage to it.

E) Lowering the temperature past a certain threshold.

12. A cylindrical resistor of constant resistivity dissipates a power P when attached to a battery with potential V. If the resistor was replaced with one with twice the radius and twice the length the power dissipated would be

A) $\frac{1}{4}P$

B) $\frac{1}{2}P$

C) P

D) $2P$

E) $4P$

13. The resistance of a wire can be increased by increasing which of the following?

   A) The length of the wire

   B) The diameter of the wire

   C) The current in the wire

   D) The potential difference across the wire

   E) None of the above

14. Wires *A* and *B* are made of the same material. Wire *A* has 4 times the resistance of Wire *B*. Which of the following statements about the wires are most likely true?

   A) Wire *A* has a cross-sectional area 4 times that of Wire *B* and the same length as Wire *B*.

   B) Wire *A* has a cross-sectional area 2 times that of Wire *B* and a length 2 times that of Wire *B*.

   C) Wire *A* has a cross-sectional area half that of Wire *B* and is half the length of Wire *B*.

   D) Wire *A* has a cross-sectional area half that of Wire *B* and the same length as Wire *B*.

   E) Wire *A* has a cross-sectional area half that of Wire *B* and is 2 times the length of Wire *B*.

15. A wire with a circular cross-sectional area has a resistance *R*. A circular wire of the same material has a cross-sectional radius twice that of the first wire. The resistance of the second wire is

   A) $\frac{R}{4}$

   B) $\frac{R}{2}$

   C) R

   D) 2R

   E) 4R

16. If the length of a copper wire with resistance *R* is reduced by half, then the resistance of the wire will be

   A) $\frac{1}{4}R$

   B) $\frac{1}{2}R$

   C) R

   D) $2R$

   E) $4R$

17. A manufacturer recommends that the longer the extension cord used with an electric drill, the thicker (heavier gauge) the extension cord should be. This recommendation is made because the resistance of a wire varies

   A) directly with length and inversely with cross-sectional area

   B) inversely with length and directly with cross-sectional area

   C) directly with both length and cross-sectional area

   D) inversely with both length and cross-sectional area

   E) inversely with length, and remains constant with cross sectional area

18. Base your answer to the following question on the diagram below of two square loops of the same wire, one with side length a and side length $2a$. A uniform magnetic field B directed into the page is contained within the area enclosed by the square of side a.

The total resistance of the wire loop with side a is R. What is the resistance of the wire loop with side $2a$?

A) $\frac{R}{4}$

B) $\frac{R}{2}$

C) R

D) $2R$

E) $4R$

19. Which of the following materials is a conductor?

Material	Resistivity (Ω m)
Copper	1.7×10^{-8}
Glass	10^{12}
Quartz	5×10^{16}

A) Copper

B) Glass

C) Quartz

D) Glass and Quartz

E) None are conductors

20. If the resistance of 10 m of a certain type of wire is R, what is the resistance of a 25 m of that same wire?

A) $0.016R$

B) $0.4R$

C) R

D) $2.5R$

E) $6.25R$

21. Two concentric metal spheres are used to make a capacitor. The inner sphere has radius R_1 and the outer sphere has radius R_2. If the seperation of the plates, d, is very small compared to the radii of the spheres, then what is the capacitance?

A) $4\mathbf{p}\varepsilon_0 R_1^2$

B) $4\mathbf{p}\varepsilon_0 R_2^2$

C) $4\mathbf{p}\varepsilon_0 R_1^2/d$

D) $4\mathbf{p}\varepsilon_0 R_2^2/d$

E) $\mathbf{p}\varepsilon_0 (R_1 + R_2)^2/d$

Answer Key
Non-Plate Capacitors MC Questions [Mar 28, 2011]

1. ___B___

2. ___C___

3. ___E___

4. ___B___

5. ___A___

6. ___C___

7. ___E___

8. ___B___

9. ___B___

10. ___E___

11. ___E___

12. ___B___

13. ___A___

14. ___E___

15. ___A___

16. ___B___

17. ___A___

18. ___D___

19. ___A___

20. ___D___

21. ___E___

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

15. _____

16. _____

17. _____

18. _____

19. _____

20. _____

21. _____