1. Resistors of values 8.0Ω, 12.0Ω, and 24.0Ω are connected in parallel across a fresh battery. Which resistor dissipates the greatest power?

(1) the 8.0-Ω resistor
(2) the 12.0-Ω resistor
(3) the 24.0-Ω resistor
(4) All dissipate the same power when in parallel.
(5) The 8.0-Ω and 12.0-Ω resistors dissipate the same power.

2. A series $RC$ circuit has a time constant of 1.0 s. The battery has a voltage of 50 V and the maximum current just after closing the switch is 500 mA. The capacitor is initially uncharged. What is the charge on the capacitor 2.0 s after the switch is closed?

(1) 0.43 C  (2) 0.66 C  (3) 0.86 C  (4) 0.99 C  (5) 0.22 C

3. A proton and a deuteron are moving with equal velocities perpendicular to a uniform magnetic field. A deuteron has the same charge as the proton but has twice its mass. The ratio of the acceleration of the proton to that of the deuteron is:

(1) 2.  (2) 1.  (3) 0.5.  (4) There is no acceleration in this case.  (5) none of these

4. There is a current $I$ flowing in a clockwise direction in a square loop of wire that is in the plane of the paper. If the magnetic field $B$ is toward the right, and if each side of the loop has length $L$, then the net magnetic torque acting on the loop is:

(1) $IBL^2$.  (2) $IBL$.  (3) $2IBL$.  (4) zero.  (5) $2IBL^2$. 

Useful Constants:

<table>
<thead>
<tr>
<th>$K = 9 \times 10^9 \text{Nm}^2/C^2$</th>
<th>$\epsilon_0 = 8.85 \times 10^{-12} \text{C}^2/(\text{Nm}^2)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{V}=\text{volt}$</td>
<td>$\text{N}=\text{newton}$</td>
</tr>
<tr>
<td>$k=\text{kilo}=10^3$</td>
<td>$\text{pico}=10^{-12}$</td>
</tr>
<tr>
<td>$\mu=\text{micro}=10^{-6}$</td>
<td>$g = 9.8 \text{m/s}^2$</td>
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5. Two long parallel wires 20 cm apart carry currents of 5.0 A and 8.0 A in the same direction. Is there any point between the two wires where the magnetic field is zero?

(1) yes, 7.7 cm from the 5-A wire
(2) yes, 12 cm from the 5-A wire
(3) yes, midway between the wires
(4) no such solution is possible
(5) yes, 9.1 cm from the 5-A wire

6. A coaxial cable consists of a thin insulated straight wire carrying a current of 2.00 A surrounded by a cylindrical conductor carrying a current of 3.50 A in the opposite direction. The cylindrical conductor has a radius of 0.420 cm. What is the magnitude of the magnetic field (in microtesla, \(\mu\)T) outside of the cylindrical conductor 2.00 cm from the central wire?

(1) 15  (2) 20  (3) 30  (4) 40  (5) 50

7. Two parallel wires are separated by 0.25 m. Wire A carries 5.0 A and Wire B carries 10 A, both currents in the same direction. The force (in \(\mu\)N, micro-newton) on 0.80 m of Wire A is:

(1) 32.  (2) 26.  (3) 16.  (4) 10.  (5) 45.

8. A 14.0-g conducting rod of length 1.30 m is free to slide downward between two vertical rails without friction. The rails are connected to an 8.00\(\Omega\) resistor, and the entire apparatus is placed in a 0.430 T uniform magnetic field. Ignore the resistance of the rod and rails. What is the terminal velocity of the rod?

(1) 3.52 m/s  (2) 3520 m/s  (3) 1.97 m/s  (4) 1965 m/s  (5) none of these

9. An ideal transformer supplies 100 kW of power to a 120 V circuit. If the input voltage is 10,000 V, what is the input current?

(1) 10.0 A  (2) 1.2 mA  (3) 120 A  (4) 240 A  (5) 830 A

10. A copper pipe is held vertically and a magnet is dropped down the pipe. The magnet is oriented with the north pole down. What direction do the eddy currents flow as viewed from above the pipe? If a copper bar of approximately the same size and weight is dropped down the tube, will it fall faster or slower?

(1) CW above the magnet and CCW below the magnet; copper bar will fall faster
(2) CCW above the magnet and CW below the magnet; copper bar will fall slower
(3) CW above the magnet and CCW below the magnet; copper bar will fall slower
(4) CCW above the magnet and CW below the magnet; copper bar will fall faster
(5) none of the other answers is correct

11. If the number of turns is tripled for an inductor of fixed length and fixed cross-sectional area, what happens to its inductance?

(1) it becomes 9 times the original value
(2) it triples
(3) it stays the same
(4) it decreases by a factor of 3
(5) it decreases by a factor of 9
12. A series LR circuit includes a 9.0 V battery, a resistance of 0.500Ω, and an inductance of 0.800 H. What is the greatest energy stored by the inductor after the switch is closed?

(1) 130 J (2) 13.0 mJ (3) 33.0 mJ (4) 65.0 J (5) 33.0 J

13. A circuit breaker trips when the rms current exceeds 20.0 A. How many 15.0-W lightbulbs can run on this circuit without tripping the breaker? (The voltage is 120 V rms.)

(1) 160 (2) 320 (3) 80 (4) 400 (5) none of these

14. Plane polarized light of intensity $I_0$ is sent through a polarizer rotated 45° clockwise to the original plane of polarization and then through a second polarizer rotated 45° counter-clockwise measured from the original plane of polarization. What is the transmitted intensity?

(1) 0 (2) 0.50$I_0$ (3) 0.35$I_0$ (4) 0.25$I_0$ (5) 0.71$I_0$

15. How fast would you have to drive in order to see a red light as green? Assume $\lambda = 630$ nm for red and $\lambda = 530$ nm for green.

(1) $5.1 \times 10^7$ m/s (2) $5.1 \times 10^6$ m/s (3) $5.1 \times 10^5$ m/s (4) $5.1 \times 10^4$ m/s (5) none of these