

Physics 2b Quiz 4 solutions # 1

Component w/ $14\ \Omega$ resistor is rated for $P = 11\text{W}$

How much current can safely flow through?

$$P = IV, V = IR \Rightarrow P = I^2 R \Rightarrow I = \sqrt{\frac{P}{R}} = \sqrt{\frac{11\text{W}}{14\ \Omega}} = \boxed{0.89\text{A}}$$

Note: These may not be the same numerical values as appeared on your quiz. Nevertheless, the method of solution is the same. $I = \sqrt{P/R}$. Also note that, because of the wording of the question, we will also accept the answer which is lower than what you get when you calculate I using $\sqrt{P/R}$. On each test version there was one such choice.

2

Two ^{identical} capacitors in parallel have dielectrics $K_1 = 2, K_2 = 3$. We want to replace both materials with a dielectric K without changing the total capacitance. What is K ?

$$\text{Before: } C_{\text{total}} = K_1 C + K_2 C = (K_1 + K_2) C$$

$$\text{After: } C_{\text{total}} = KC + KC = 2KC$$

$$\Rightarrow 2KC = (K_1 + K_2) C$$

$$K = \frac{(K_1 + K_2)}{2} = \frac{2+3}{2} = \boxed{\frac{5}{2}}$$

Physics 2b Quiz 4 Solutions #3

Long cylindrical capacitor w/ radii $a=25\text{mm}$ and $b=100\text{mm}$.
 $V=-500\text{V}$, what is U for $L=1\text{m}$ section?

$$C = \frac{2\pi\epsilon_0 L}{\ln(b/a)} = \frac{2\pi\epsilon_0 (1\text{m})}{\ln(100/25)} = 4.01 \times 10^{-11} \mu\text{F}$$

$$U = \frac{1}{2} CV^2 = \frac{1}{2} (4.01 \times 10^{-11} \mu\text{F}) (-500\text{V})^2 = \boxed{5.0 \mu\text{J}}$$

#4

$\rho_{\text{Gold}} = 2.44 \times 10^{-8} \Omega\text{m}$, $r = 0.4\text{mm}$, $L = 20\text{cm}$, $I = 300\text{mA}$
What is P ?

$$P = IV, V = IR \Rightarrow P = I^2 R = (300 \times 10^{-3} \text{A})^2 \frac{\rho_{\text{Gold}} (0.2\text{m})}{\pi (0.4 \times 10^{-3} \text{m})^2}$$
$$= 0.87 \text{mW}$$

$\boxed{0.9 \text{mW}}$ is the closest