Answers without **supporting work** or **necessary unit** will not be given full credit. If the meaning of the question isn't clear, please ask TA! You have **25mins** to complete this mini-test.

Q.1 **(a)** Prove that the power in electric circuit can be written as $P = \frac{V^2}{R}$. (**Hint**: You should prove "$P = IV$" first.) (4 point) **(b)** Figure 1. shows an electric circuit, the voltage of battery is 10 [V], two resistors are totally same, if the power in this electric circuit is 2500 [V·A]. What is the resistance of each resistor? (6 point)

$dU = dqV = \bar{I}dtV$

$\frac{dU}{dt} = \bar{I}V \rightarrow P = IV = (\frac{V}{R})V = \frac{V^2}{R}$

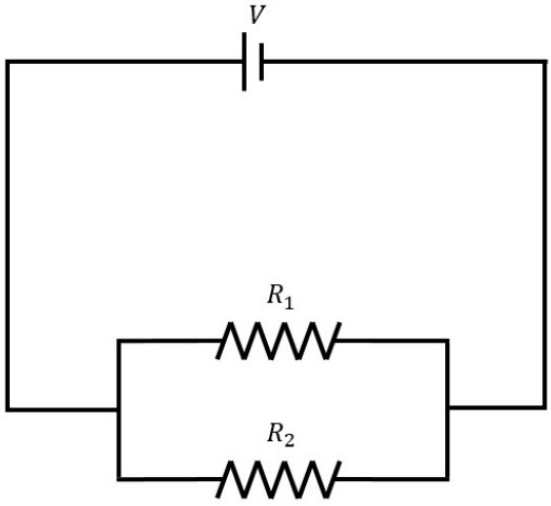

Figure 1

Q.2 Figure 2. shows a parallel-plate capacitor of plate area $A = 12\ m^2$ and plate separation $3d = 6\ m$. The left half of the gap is filled with material of dielectric constant $\kappa_1 = 5$. The top, middle and bottom of the right half are filled with materials, with the same thickness d, of permittivity constants $\varepsilon_2 = 2 \cdot \varepsilon_0$, $\varepsilon_3 = 4 \cdot \varepsilon_0$ and $\varepsilon_4 = 8 \cdot \varepsilon_0$, respectively. The vacuum permittivity is ε_0 $(F \cdot m^{-1})$. What is the capacitance? (10 points)

$C_1 = \frac{K\varepsilon_0(A/2)}{3d} = 5\varepsilon_0 F$

$C_2 = 6\varepsilon_0 F$

$C_3 = 12\varepsilon_0 F$

$C_4 = 24\varepsilon_0 F$

$C = C_1 + \frac{1}{\frac{1}{C_2}+\frac{1}{C_3}+\frac{1}{C_4}} = \varepsilon_0\left(5 + \frac{1}{\frac{1}{6}+\frac{1}{12}+\frac{1}{24}}\right) = \varepsilon_0(5+\frac{24}{7})$

$= \frac{59}{7}\varepsilon_0 F$

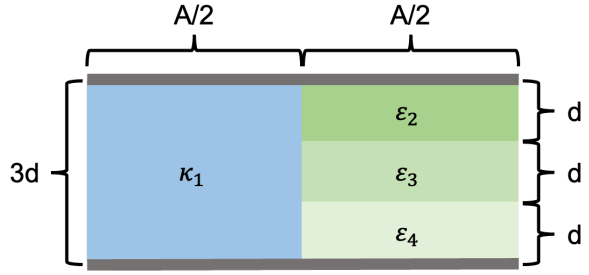

Figure 2