(a)

$$dU = dq \times V \quad \ldots \mathbf{1}$$

$$dU = \frac{dq}{dt} \times dt \times V \quad \ldots \mathbf{1}$$

$$P = \frac{dU}{dt} = \frac{dq}{dt} \times V = I \times V \quad \ldots \mathbf{1}$$

$$R \equiv \mathrm{V/I}\,,\mathrm{I} = \mathrm{V/R} \quad \ldots \mathbf{0.5}$$

$$P = I \times V = \frac{V^2}{R} \quad \ldots \mathbf{0.5}$$

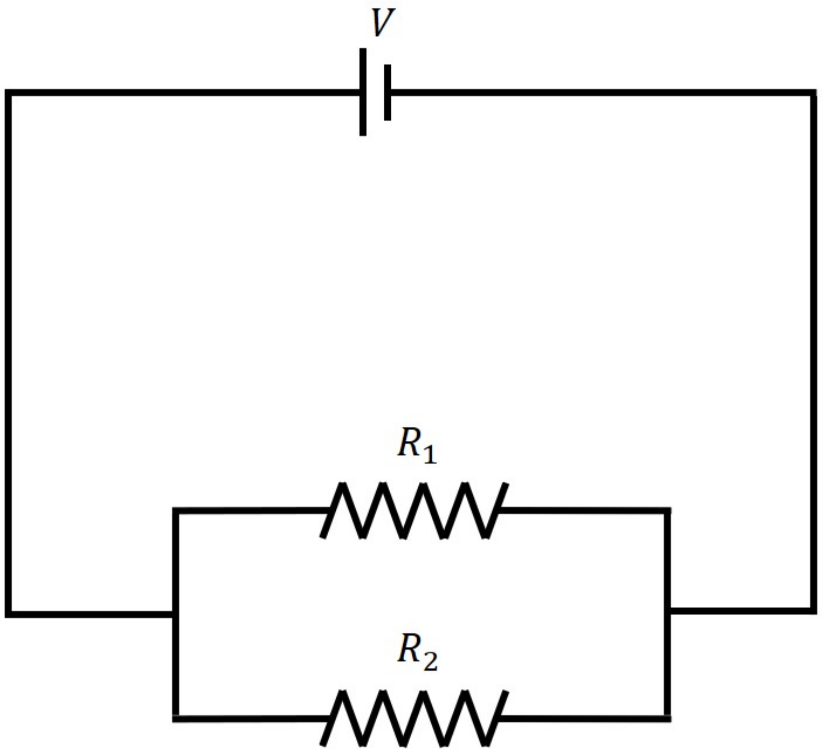
(b)

$$P = \frac{V^2}{R} \quad \ldots \mathbf{1}$$

$$R = \frac{10^2}{2500} = 0.04\ (\Omega) \quad \ldots \mathbf{1}$$

$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{0.04} \quad \ldots \mathbf{2}$$

$$R_1 = R_2 = 0.08\ (\Omega) \quad \ldots \mathbf{2}$$



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)

$$C_1 = \frac{(\kappa_1 \varepsilon_0)\cdot(A/2)}{3d} = \frac{(5\varepsilon_0)\cdot(12/2)}{6} = 5\varepsilon_0\ F \quad (2)$$

$$C_2 = \frac{\varepsilon_2 \cdot (A/2)}{d} = \frac{(2\varepsilon_0)\cdot(12/2)}{2} = 6\varepsilon_0\ F \quad (2)$$

$$C_3 = \frac{\varepsilon_3 \cdot (A/2)}{d} = \frac{(4\varepsilon_0)\cdot(12/2)}{2} = 12\varepsilon_0\ F \quad (2)$$

$$C_4 = \frac{\varepsilon_4 \cdot (A/2)}{d} = \frac{(8\varepsilon_0)\cdot(12/2)}{2} = 24\varepsilon_0\ F \quad (2)$$

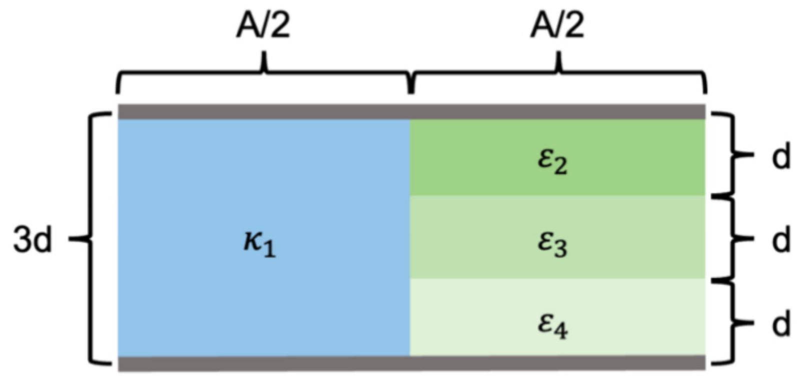


Figure 2

$$C = 5\varepsilon_0 + \frac{1}{\frac{1}{6\varepsilon_0} + \frac{1}{12\varepsilon_0} + \frac{1}{24\varepsilon_0}} = \varepsilon_0 \cdot \left(5 + \frac{24}{4+2+1}\right) = \frac{59}{7}\varepsilon_0\ F \ * \quad (2)$$