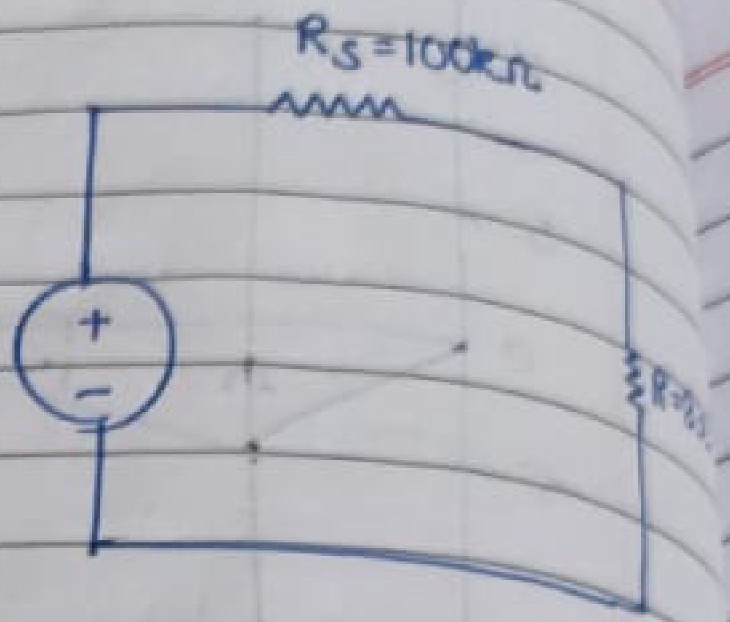
Tut-08

1)

(a) $V_s(p-p) = 20mV$

$$V_{rms} = \frac{\overset{10mV}{\cancel{V_{(p-p)}}}}{2\sqrt{2}} = \frac{10mV}{2\sqrt{2}} = \frac{\overset{10}{\cancel{5mV}}}{\sqrt{2}}$$



$$P = I_{rms}^2 \times R$$

$$= \left(\frac{10\times10^{-3}}{\sqrt{2}\times(100\times10^{3})}\right)^2 \times 8 = 4\times10^{-14} mW$$

$$P = 4\times10^{-14} mW$$

(b) $R_i = 100k\Omega$

$P_{out} = 4W$

$$P_{out} = \frac{V_{out}^2}{R_{out}^2} = 4$$

$$V_{out} = \sqrt{4\times8} = \sqrt{32}\ \text{Volt}$$

$$\cancel{V_{in}} = \cancel{I_{rms}\times R_i} = \frac{10\times10^{-3}}{\sqrt{2}} \times 100\times10^{3}\times 8 = \frac{1000\times8}{\sqrt{2}}$$

$$= \frac{8000}{\sqrt{2}}$$

$$\text{gain} = A_v = \frac{V_{out}}{V_{in}} = \frac{\sqrt{32}}{8000}\times\sqrt{2}$$

$V_{in} = I_{rms} \times R_i$

$= \frac{\cancel{10\times10^{-3}}}{\cancel{\sqrt{2}}} \cancel{\times10^5} \times 9\cancel{05}$

$\cancel{V_{in}} = \cancel{\frac{10^3}{\sqrt{2}}} = \left(\frac{\cancel{10\times10^{-3}}}{\sqrt{2}} \times \right.$

$\cancel{A_V = \frac{V_{out}}{V_{in}}} =$

$V_{in} = I_{rms} \times R_i = \frac{V_{rms}}{2R_i} \times R_i = \frac{V_{rms}}{2} = \frac{5\times10^{-3}}{\sqrt{2}}$ V

$A_v = \frac{V_{out}}{V_{in}} = \frac{\sqrt{32}}{5\times10^{-3}} \times \sqrt{2} = 1600$

b)

(c) (i) V_{out} $V_{in} = \frac{V_{rms}}{R_j + R_i} \times R_i$

$R_i = 10^4 \Omega$

$V_{in} = \frac{10\times10^{-3}}{(10^4+10^5)\sqrt{2}} \times 10^4 = \frac{1}{1100\sqrt{2}}$

$A_V = \frac{\sqrt{32}\times\sqrt{2}}{\cancel{100}} \times 1100 = 8800$

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$1M\Omega = 10^6$

(ii)

$$V_{in} = \frac{V_{rms}}{(R_s + R_i)} \times R_i = \frac{10 \times 10^{-3}}{(10^5 + 10^6)\sqrt{2}} \times 10^6 = \cancel{\frac{1}{10100\sqrt{2}}}$$

$$A_v = \frac{V_o}{V_i} = \cancel{\sqrt{32} \times \sqrt{2} \times 10100} = \cancel{808000} \quad 880$$

(d) $$A_p = \frac{P_o}{P_i} = \frac{V_o^2}{R_o} \times \frac{R_i}{V_i^2} = \left(\frac{V_o}{V_i}\right)^2 \times \frac{R_i}{R_o}$$

$$A_p = A_v^2 \times \frac{R_i}{R_o}$$

(i) $R_i = 100k\Omega$

$A_v =$

$$A_p = (1600)^2 \times \frac{100 \times 10^3}{8} = 3.2 \times 10^{10}$$

(ii) $R_i = \cancel{10k\Omega}$

$$A_p = (8800)^2 \times \frac{10^4}{8} = 9.68 \times 10^{10}$$

(iii) $$A_p = (\cancel{808000}\ 880)^2 \times \frac{10^6}{8} = \cancel{8.16 \times 10^{13}}\ \cancel{9.68 \times 10}$$

9.68×10^{10}

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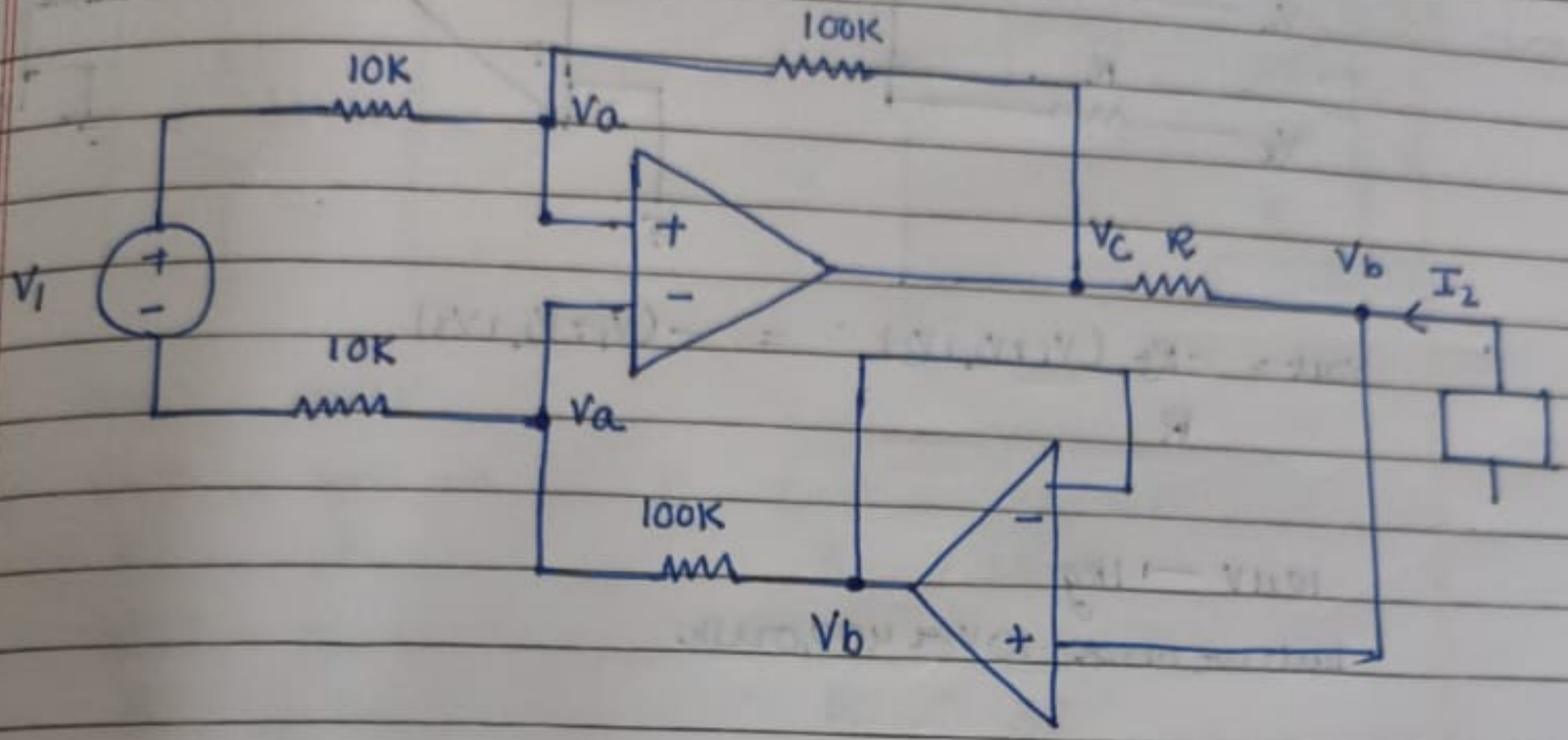
$$V_2 = \frac{21}{2} \times \left(\frac{V_{13} + V_{14}}{2} \right) - 10(V_{11} + V_{12})$$



$$\frac{V_a + V_1 - V_a}{20K} + \frac{V_a - V_b}{100K} = 0$$

$$10V_1 + 2V_a - 2V_b = 0 \quad -(1)$$

$$\frac{V_b - V_a}{100K + R} + \cancel{V_b} + I_2 = 0$$

$$V_b - V_a = -I_2 \times (100K + R)$$

$$2(V_a - V_b) = 2I_2(100K + R)$$

$$\boxed{10V_1 = -2I_2(100K + R)}$$

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$$\frac{V_a + V_1 - V_a}{20K} + \frac{V_a - V_b}{\underset{5}{100K}} = 0$$

$$5V_1 + V_a - V_b = 0 \quad -(1)$$

$$\frac{V_a - V_1 - V_a}{20K} + \frac{V_a - V_c}{100K} = 0$$

$$-5V_1 + V_a - V_c = 0 \quad -(2)$$

$$\frac{V_b - V_c}{R} - I_2 = 0$$

$$V_b - V_c - I_2R = 0 \quad -(3)$$

(2) − (1)

$$(-5V_1 + V_a - V_c) - (5V_1 + V_a - V_b) = 0$$

$$-10V_1 + \cancel{V_a} - V_c - \cancel{V_a} + V_b = 0$$

$$-10V_1 + V_b - V_c = 0$$

$$-10V_1 + I_2R = 0 \qquad \boxed{I_2R = 10V_1}$$