2. In each circuit in Fig. 1, either the value of v or i is not known

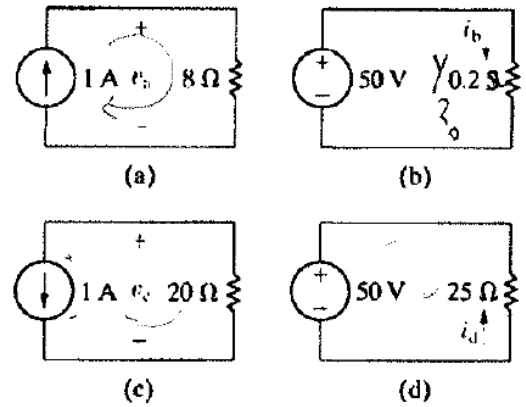


Figure 1

a) Calculate the values of v_a, i_b, v_c, and i_d. Units are important for all questions.

0.5 Answer:	$V_a = 1 \times 8 = 8V$ $I_b = \frac{50}{10.2} = 10A$ $V_c = -1 \times 20 = -20V$ $I_d = \frac{-50}{25} = -2A$

b) Determine the power dissipated in each resistor. $0V$ V^2/R I^2R

0.5 Answer:	(a) $V_a \times I = 8 \times 1 = 8W$ (b) $50 \times \frac{50}{10} = 500W$ (c) $-1 \times -20 = 20W$ (d) $-2 \times -50 = 100W$

7. The variable resistor R in the circuit in Fig. 6 is adjusted until i_0 equals 20 mA Find the value of R.

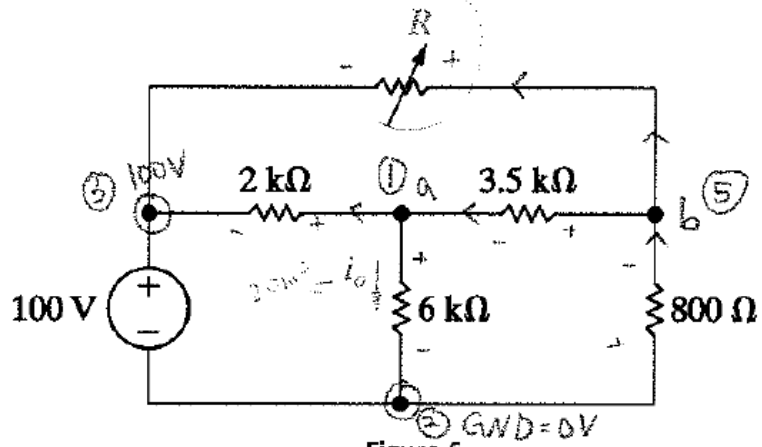


Figure 6

④ Set polarity

Answer:

④ $i_0 = 20mA = \frac{(a-0)}{6k} \Rightarrow a = 120V$

⑤

⑥ KCL at a

$\frac{a-100}{2k} + i_0 = \frac{b-a}{3.5k} \Rightarrow b = 225V$

⑦ KCL at b ⑧ ⑨ ⑩ ⑪

$\frac{b-100}{R} + \frac{b-0}{3.5k} = \frac{0-225}{800}$

$R = -411.92\ \Omega$

an active component

8. Find (a) i_o (b) i_1, and (c) i_2 in the circuit in Fig.7

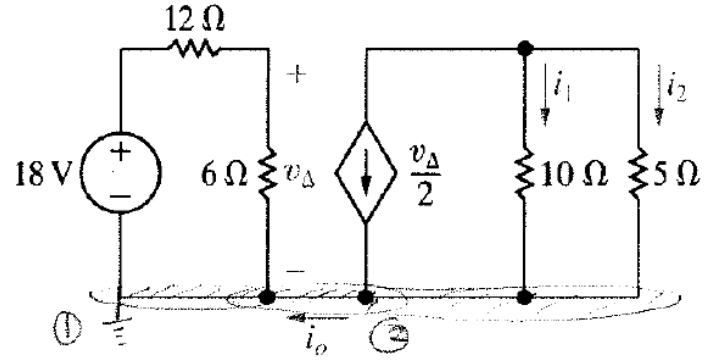


Figure 7

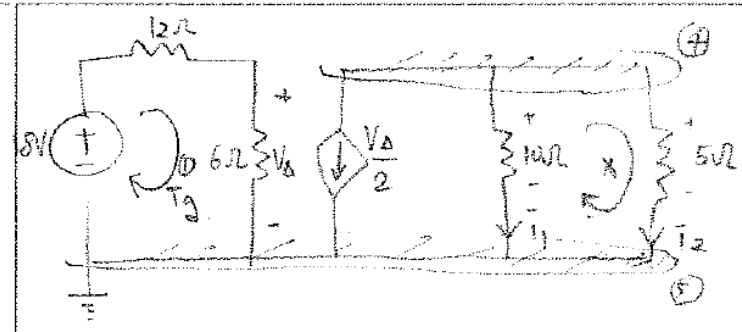
(a) Answer

0.3

$I_o = 0A$, ∵ no current can exist in a single node.

(b) Answer

0.3



① $i_1 = \frac{18V}{(12+6)\Omega} = 1A$

② $V_\Delta = 18 \times \frac{6}{12+6} = 6V$

③ $\frac{V_\Delta}{2} = 3A$

⑥ KVL at X loop.

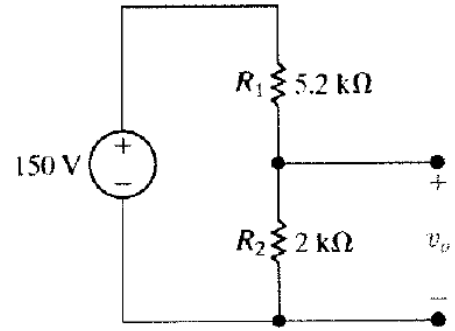
$5i_2 = 10i_1$

⑦ KCL at ⑤ node

6 $-\frac{2V_\Delta}{2} + i_1 + i_2 = 0$. ∴ $i_1 = -1A$

$i_2 = -2A$

4. Refer to the following circuit to answer following questions



a) Calculate the output voltage v_0 for the voltage divider circuit

0.4

Answer:

$$V_o = 150 \times \frac{2k}{(5.2+2)k} = 41.66V$$

b) Calculate the net current flowing through the circuit

0.3

Answer:

$$\bar{I} = \frac{150V}{(5200+2000)} = 20.8\,mA = 0.0208\,A$$

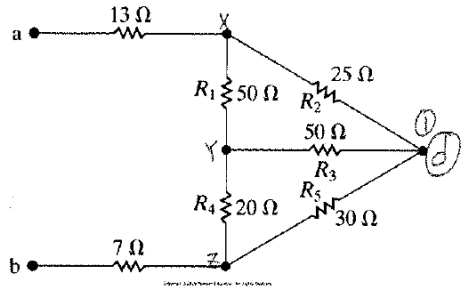
c) Calculate the total power of this circuit in the absence of R1, if the existing voltage source is replaced by a similar source of 100V.

0.3

Answer:

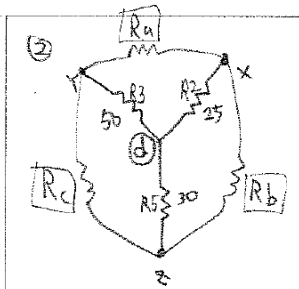
$$P = VI = V^2/R = \frac{(100)^2}{2000} = 5W$$

5-6. Refer to the following circuit to answer following questions



5. Find the equivalent resistance R_{ab} in the circuit by using a Y-to-Δ transformation involving the resistors R2, R3, and R5.

Answer:

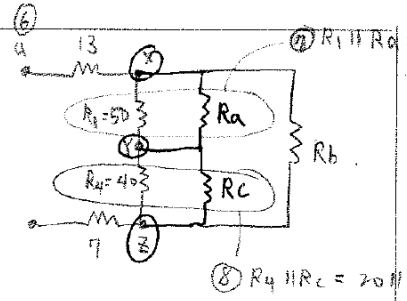


[Note that R1, R4 are not considered in this calculation]

③ $R_a = \frac{(25\times50+50\times30)+(30\times25)}{30} = 116.6\Omega$

④ $R_b = \frac{3500}{50} = 70\Omega$

⑤ $R_c = \frac{21500}{25} = 140\Omega$



⑥ $R_1 \parallel R_a = 50 \parallel 116.6$

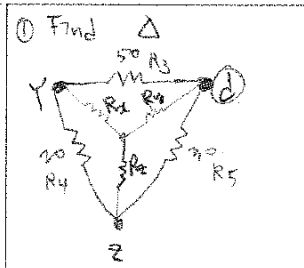
⑧ $R_4 \parallel R_c = 20 \parallel 140$

⑨ $(⑦ + ⑧) \parallel R_b = 30\Omega$

⑩ $R_{ab} = 13 + 30 + 7 = 50\Omega$

6. Repeat (a) using a Δ -to-Y transformation involving resistors R3, R4, and R5.

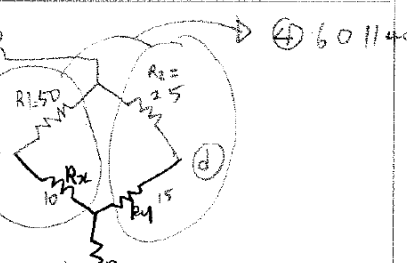
Answer:



② $R_{2c} = \frac{50\times30}{50+20+30} = 10\Omega$

$R_y = \frac{50\times20}{100} = 15\Omega$

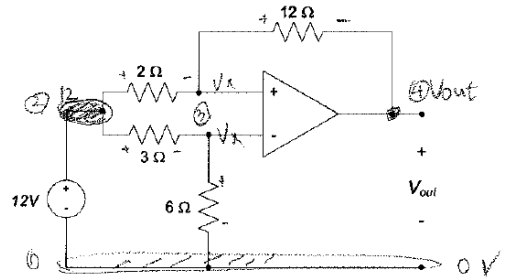
$R_z = \frac{20\times30}{100} = 6\Omega$



④ $60 \parallel 40 = 24\Omega$

⑤ $R_{ab} = 13 + 24 + 6 + 7 = 50\Omega$

1. For the circuit shown, find V_{out}.



Answer:

① KCL at ③ → V⁻ → Vx V⁻ → 0 →

$\frac{12-V_x}{3} = \frac{V_x}{6}$

$24 - 2V_x = V_x$

$3V_x = 24$

$V_x = 8[V]$

② KCL at V^+

$\frac{12 - V_x}{2} = \frac{V_x - V_{out}}{12}$

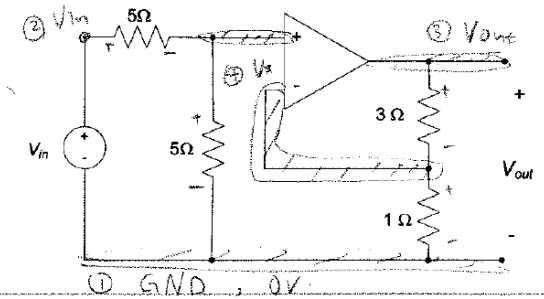
$2 = \frac{8 - V_{out}}{12}$

$-V_{out} = 24 - 8$

$= 16$

$V_{out} = -16[V]$

2. For the circuit shown, find the relationship between V_{out} and V_{in}.



Answer:

③ KCL at V^+

$\frac{V_{in} - V_x}{5} = \frac{V_x}{5}$

$2V_x = V_{in}$

$V_x = \frac{1}{2} V_{in}$

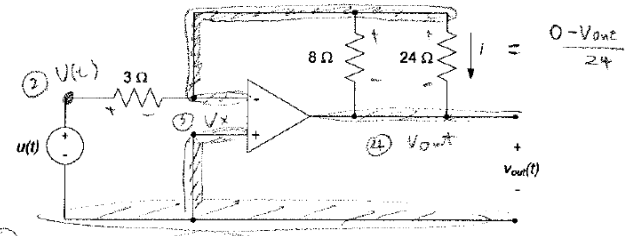
④ Voltage divider at V^-

$V_x = V_{out} \cdot \frac{1}{3+1}$

⑤ $\frac{1}{4} V_{out} = \frac{1}{2} V_{in}$

⑧ $V_{out} = 2V_{in}$.

3. For the circuit below, determine:



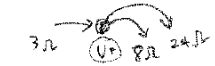
a) The current, *i*, and voltage v_{out} if *u(t) = 4V*

Answer:

④ at $V^+ = 0V$

$\therefore V^- = 0 = V_x$

⑤ KCL at $V^+ = 0$



$$\frac{u(t)-0}{3} = \frac{0-V_{out}}{8} + \frac{0-V_{out}}{24}$$ (×24)

$8u(t) = -3V_{out} - V_{out}$

$2u(t) = -V_{out}$

if $u(t) = 4V$

$V_{out} = -8[V]$

$\bar{I} = \frac{-V_{out}}{24} = \frac{8}{24} = \frac{1}{3}[A]$

① GND = 0V

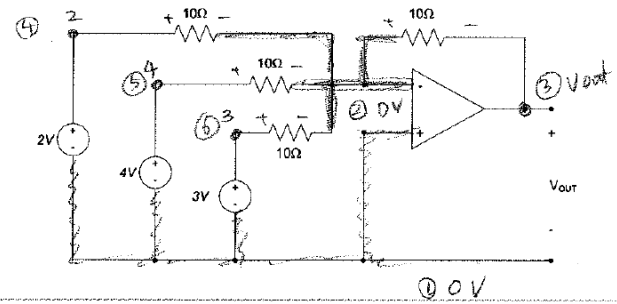
b) The current, *i*, and voltage v_{out} if *u(t) = 2cos(5t)*

Answer:

$V_{out} = -2u(t) = -4\cos(5t)$ [V]

$\bar{I} = \frac{-(-4\cos(5t))}{24\Omega} = \frac{1}{6}\cos(5t)$ [A]

4. For the circuit shown, find V_{out}.



Answer:

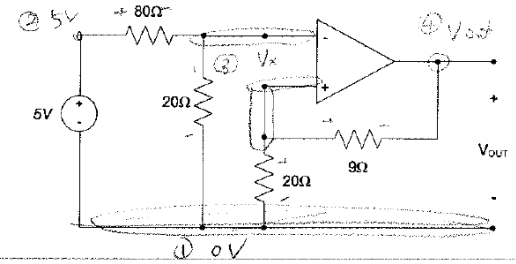
① KCL at V^-

$$\frac{2-0}{10} + \frac{4-0}{10} + \frac{3-0}{10} = \frac{0-V_{out}}{10}$$

$-V_{out} = 2+4+3 = 9$

$V_{out} = -9$ [V]

5. For the circuit shown, find V_{out}.



Answer:

⑤ at V⁻

$\frac{5-V_x}{80} = \frac{V_x}{20}$

$5 - V_x = 4V_x$

$5V_x = 5$

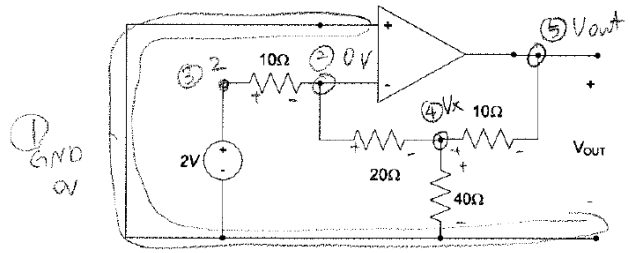
$V_x = 1$

⑥ at V+

$V_x = 1 = V_{out} \times \frac{20}{20+9} = \frac{20}{29} V_{out}$

$V_{out} = \frac{29}{20}$ [V]

6. For the circuit shown, find V_{out}.



Answer:

⑥ KCL at V⁻

$\frac{2-0}{10} = \frac{0-V_x}{20}$ ×20

$4 = -V_x$

$V_x = -4$ [V].

⑪ KCL at Vx

$\frac{0-V_x}{20} = \frac{V_x - V_{out}}{10} + \frac{V_x}{40}$

$\frac{-(-4)}{5} = \frac{-4-V_{out}}{10} + \frac{-4}{10}$

$\left(\frac{1}{5} = \frac{-4-V_{out}}{10} - \frac{1}{10}\right)$ ×10

$2 = -4 - V_{out} - 1$

$V_{out} = -4 - 1 - 2 = -7$ [V]