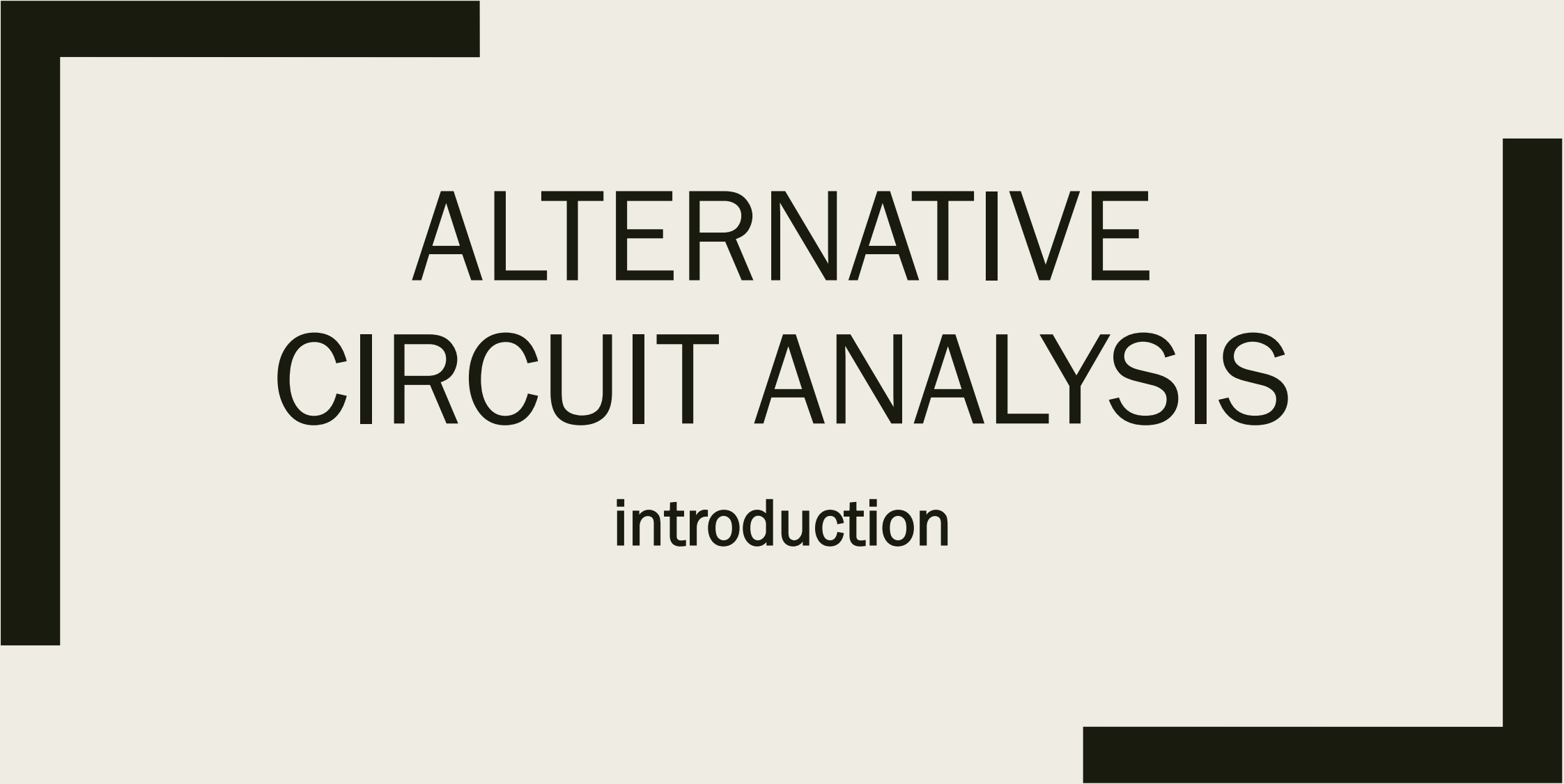


A thick black L-shaped frame is positioned on the left and bottom edges of the slide, framing the central text.

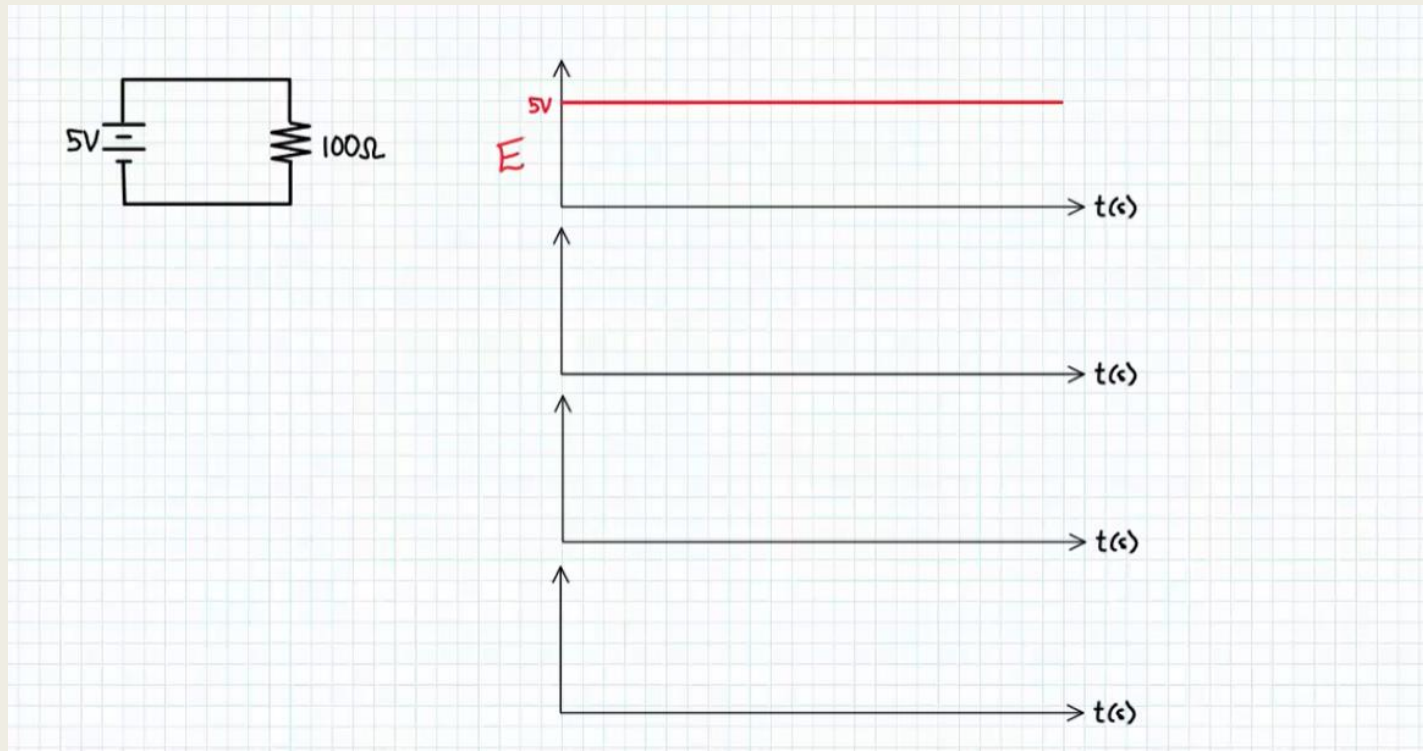
ALTERNATIVE CIRCUIT ANALYSIS

introduction

Let us analysis again a DC circuit

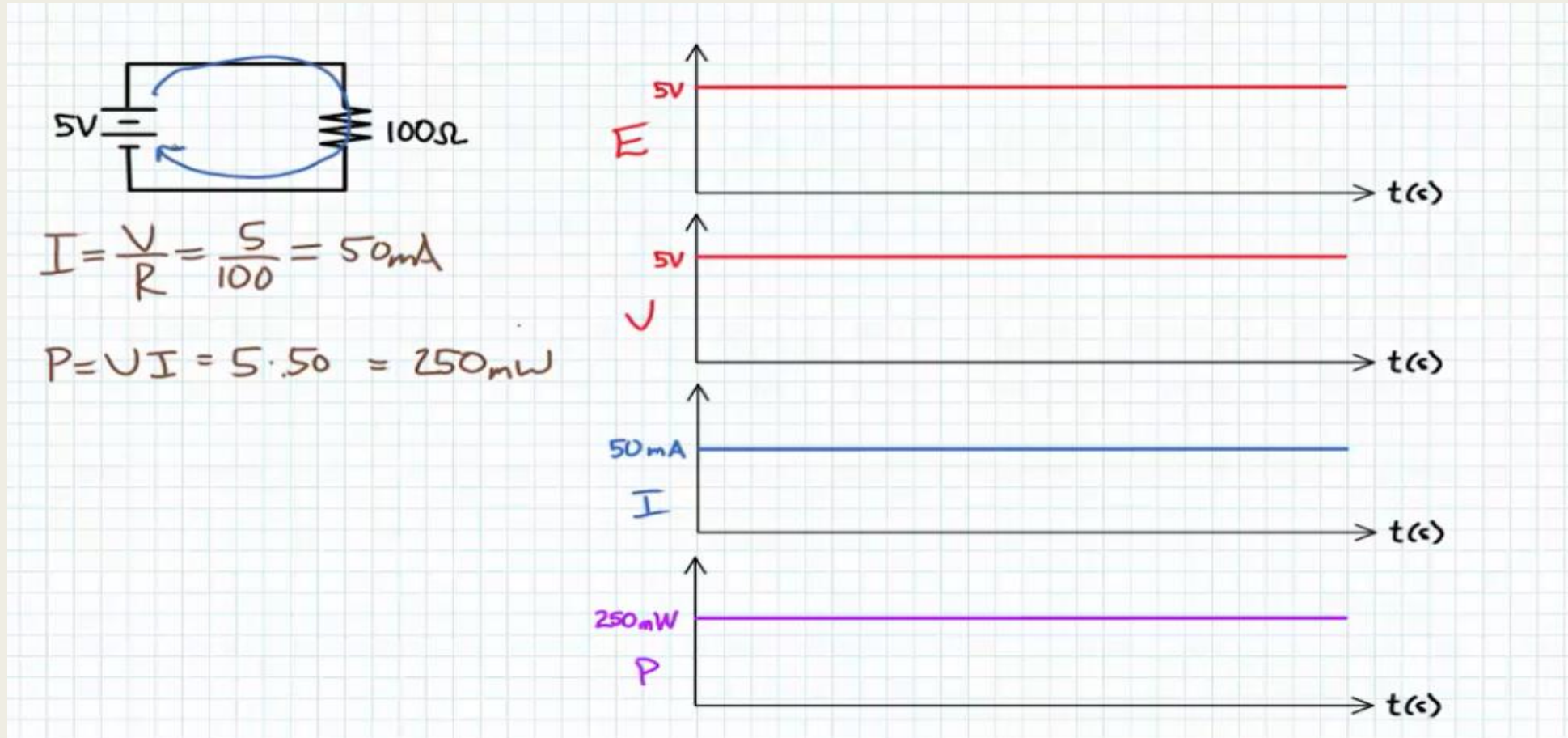
The circuit composed of D.C power supply, = 5V , a series resistance of 100 OHM
the source voltage, voltage across the resistor , current and power dissipated on
resistance.

all will shown as function of time.



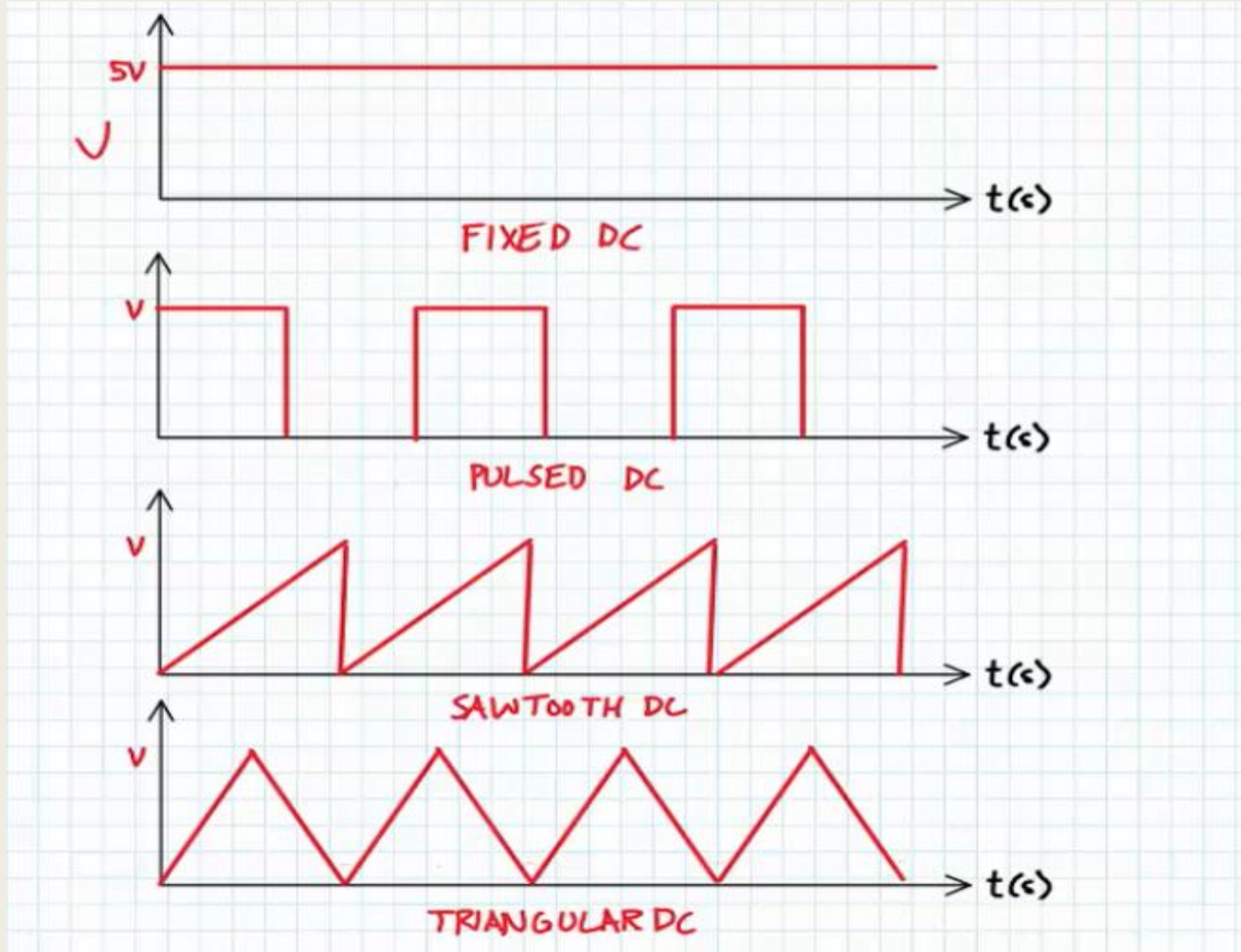
Continue

- The current through the circuit will be $I = 5 \text{ V} / 100 \text{ OHM} = 0.05 \text{ A} = 50 \text{ mA}$
- The power dissipated on resistance will be $P = V \cdot I = 5 \times 0.05 = 0.25 \text{ W} = 250 \text{ mW}$
- All these quantities are constant (not function of time)



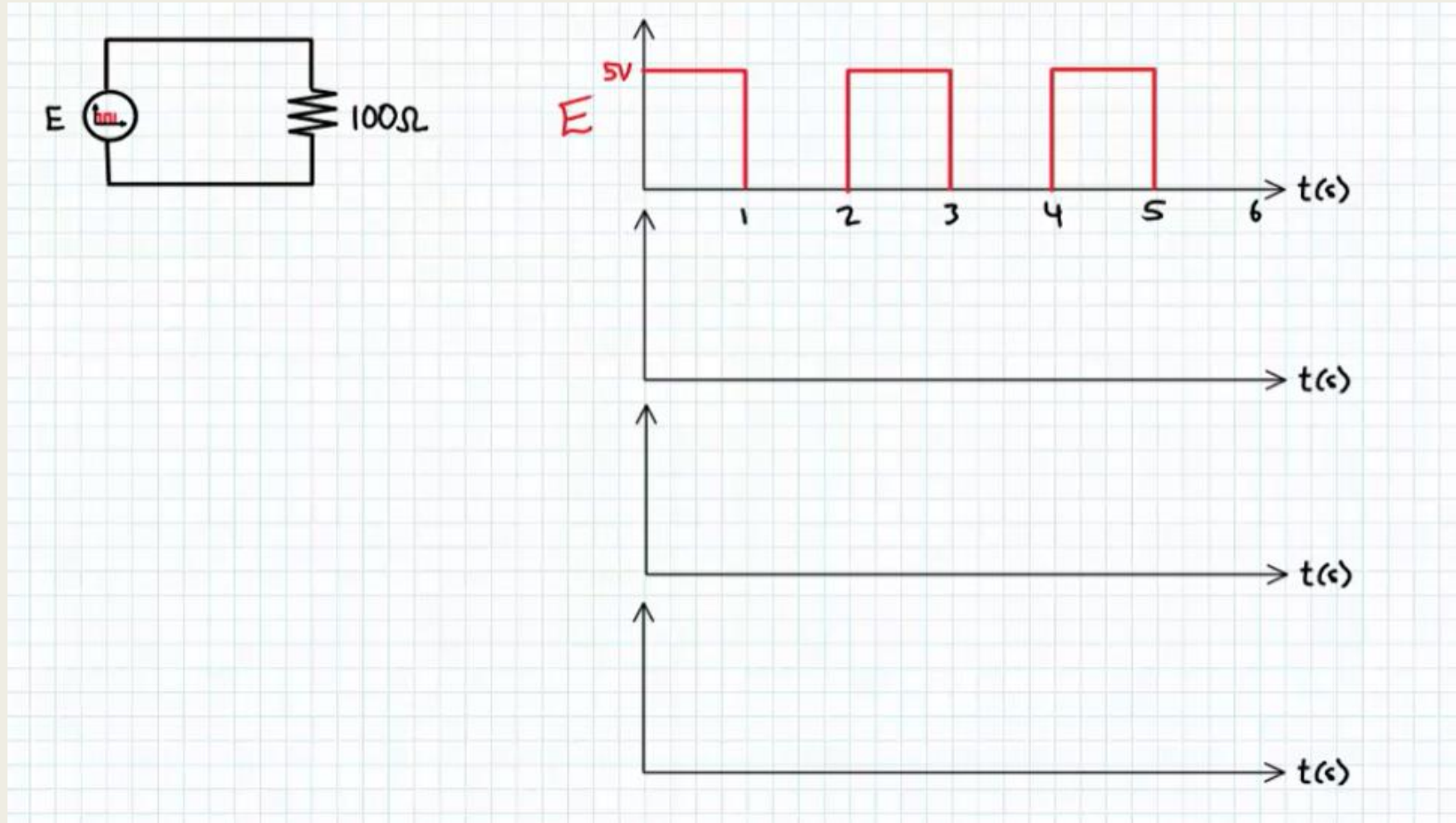
Continue

- Let us expert another type of DC signals



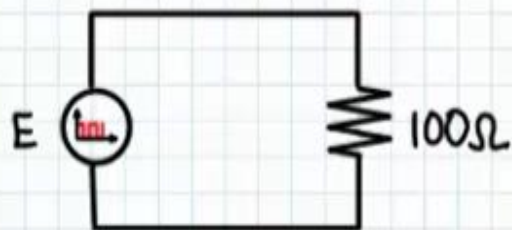
Continue

- Note that all the quantities are still DC values with one direction (Same polarity) and varied with time
- Let us tests the first type of DC voltage which known as Pulsed DC



continue

- The source voltage apply 5V for period of 1 sec. and zero V for the next sec.
- And repeats the cycle every 2 second
- The current flow in one direction(when applied voltage is 5V and no current when the source voltage is zero.
- The power will be exist for the period when there is applied voltage and no power when the voltage is zero,
- That means there is a power for one second and no power for successive second and this will repeats evert 2 seconds.
- The average power will be half the power when the voltage is 5 V
- All the quantities are DC and have one direction and varies with time (no polarity change)



$t=0 \rightarrow 1s$:

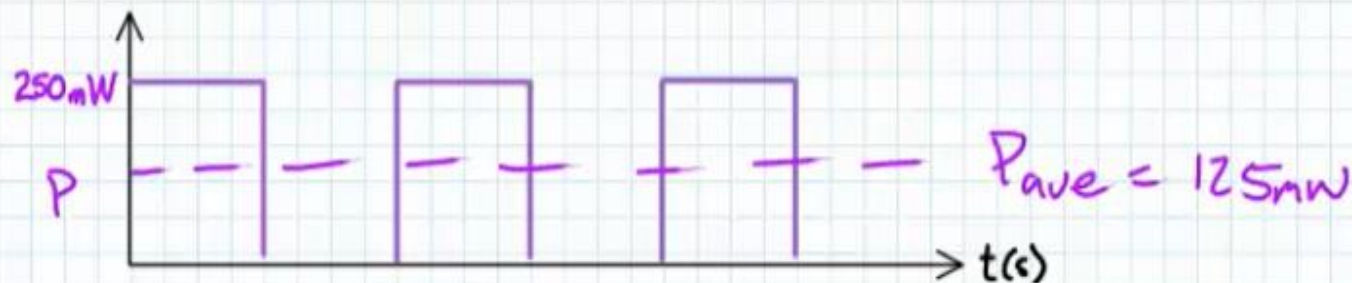
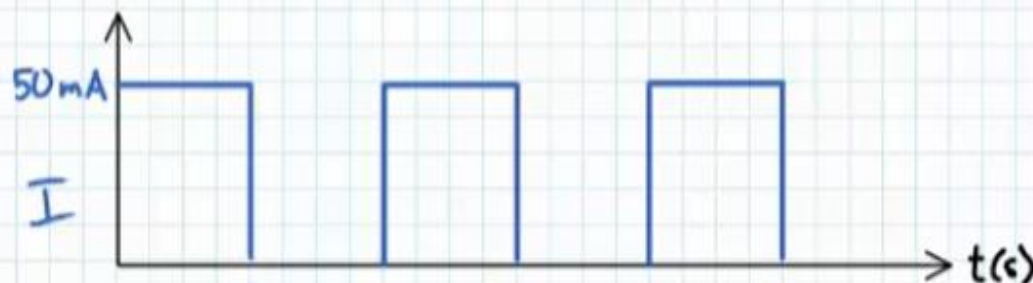
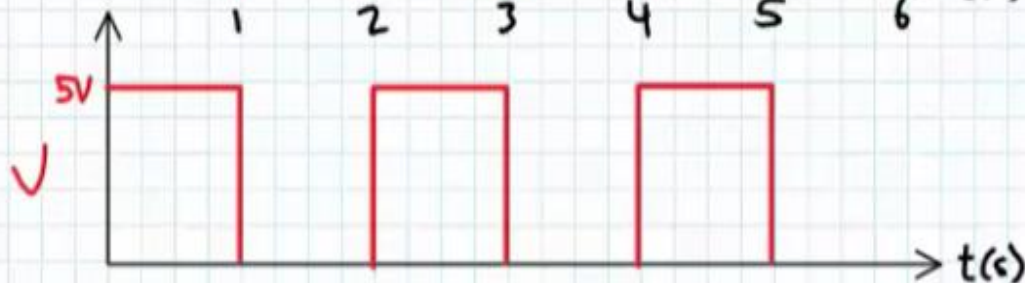
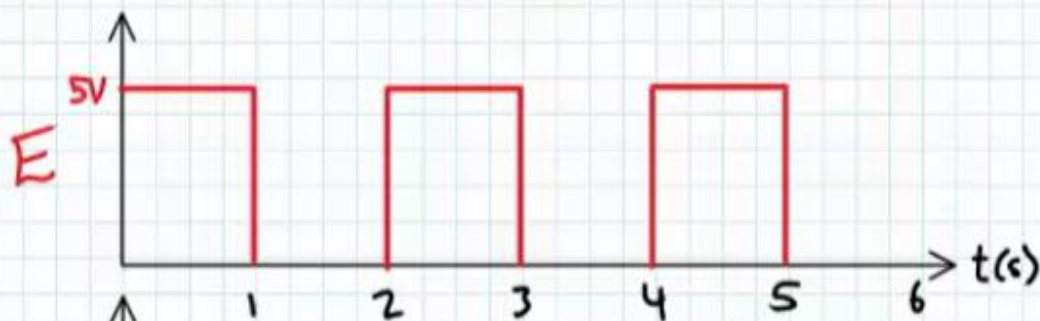
$$I = \frac{V}{R} = \frac{5}{100} = 50mA$$

$$P = VI = 5 \cdot 50 = 250mW$$

$t=1 \rightarrow 2s$:

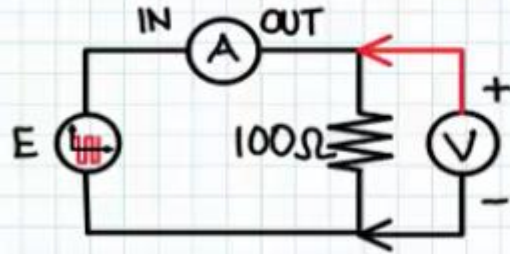
$$I = \frac{V}{R} = \frac{0}{100} = 0mA$$

$$P = VI = 0 \cdot 0 = 0mW$$



a.c circuit analysis

- Let us examine a new type of voltage which changes its magnitude and polarity with time.



$t=0 \rightarrow 1s:$

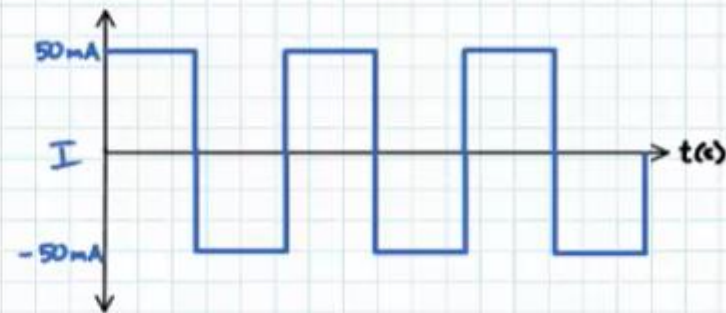
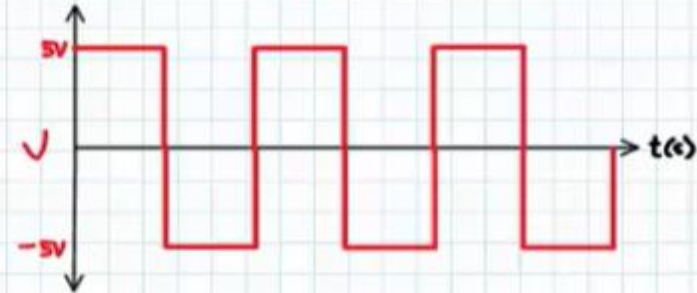
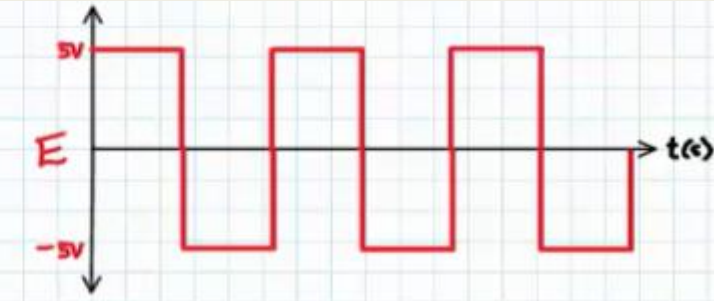
$$I = \frac{V}{R} = \frac{5}{100} = 50mA$$

$$P = VI = 5 \cdot 50 = 250mW$$

$t=1 \rightarrow 2s:$

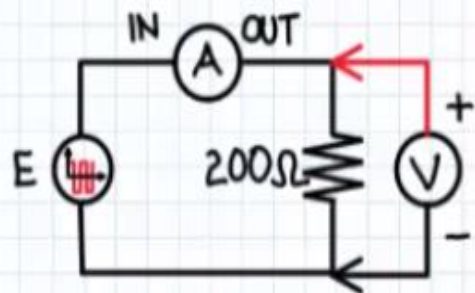
$$I = \frac{V}{R} = \frac{-5}{100} = -50mA$$

$$P = VI = -5 \cdot -50 = +250mW$$



Continue

- Now, the voltage source gives + 5V for 1 sec, and this force a current of $(5/100) \text{ A} = 0.05 \text{ A} = 50\text{mA}$
- The direction of current is from left to right.
- The power will be $P = V.I = 5 \times 0.05 = 0.25 \text{ W} = 250 \text{ mW}$
- In next second the voltage source changes its polarity and give - 5 V for 1 sec. this force a current of 50 mA but in reverse direction(from right to left).
- The power will be $P = - 5 \times - 0.05 = 0.25 \text{ W} = 250 \text{ mW}$.
- This will continue every 2 sec.



$t=0 \rightarrow 1s:$

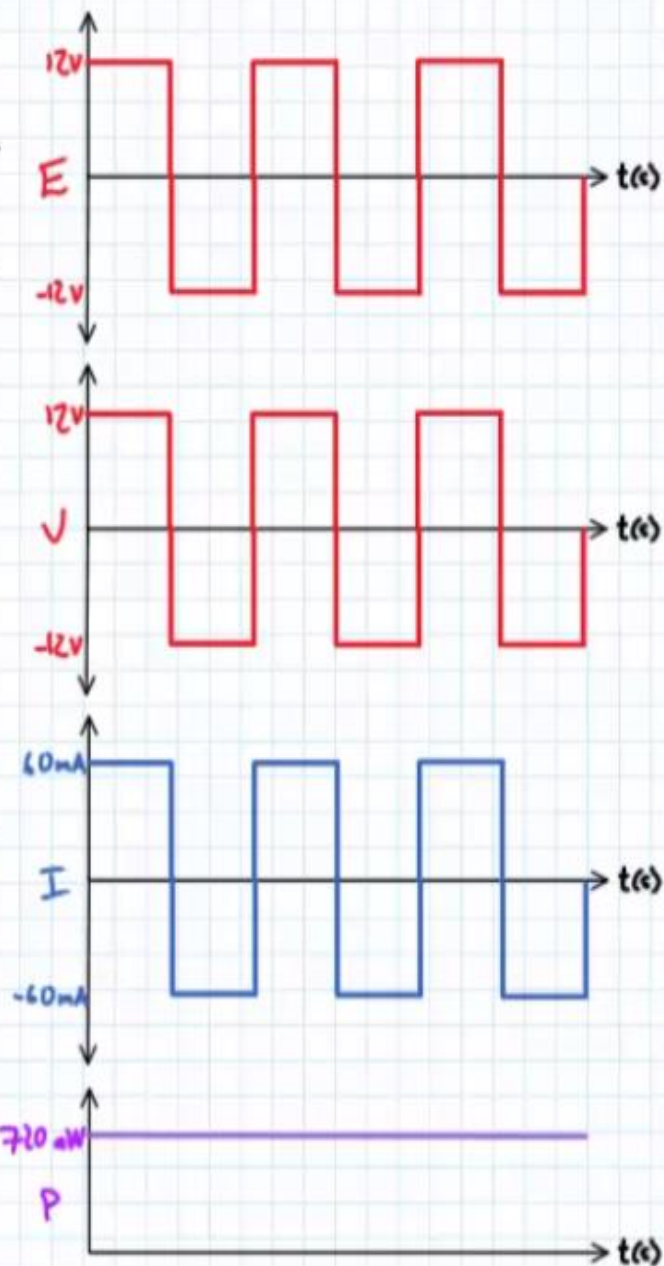
$$I = \frac{V}{R} = \frac{12}{200} = 60mA$$

$$P = VI = 12 \cdot 60 = +720mW$$

$t=1 \rightarrow 2s:$

$$I = \frac{V}{R} = \frac{-12}{200} = -60mA$$

$$P = VI = -12 \cdot -60 = +720mW$$



$$P = VI$$

$$P = I^2 R$$

$$\frac{P}{R} = I^2$$

$$\sqrt{\frac{P}{R}} = I$$

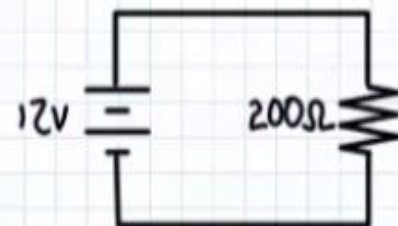
$$\sqrt{\frac{720}{200}} = 60mA$$

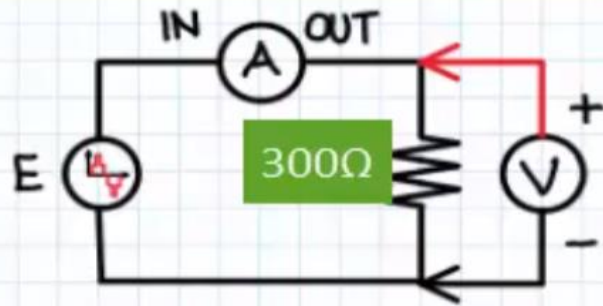
$$P = \frac{V^2}{R}$$

$$P \cdot R = V^2$$

$$\sqrt{P \cdot R} = V$$

$$\sqrt{720 \cdot 200} = 12$$





$t=0 \rightarrow 1s:$

$$I = \frac{V}{R} = \frac{0}{300} = 0mA$$

$$P = UI = 0 \cdot 0 = 0W$$

$t=1 \rightarrow 3s:$

$$I = \frac{V}{R} = \frac{30}{300} = 100mA$$

$t=4 \rightarrow 11s:$

$$I = \frac{V}{R} = \frac{-30}{300} = -100mA$$

$$P = UI = -30 \cdot 100 = -3W$$

$t=3 \rightarrow 5s:$

$$I = \frac{V}{R} = \frac{60}{300} = 200mA$$

$t=11 \rightarrow 15s:$

$$I = \frac{V}{R} = \frac{-60}{300} = -200mA$$

$$P = UI = 60 \cdot 200 = 12W$$

$$P = UI = -60 \cdot 200 = -12W$$

$t=5 \rightarrow 7s:$

$$I = \frac{V}{R} = \frac{30}{300} = 100mA$$

$t=15 \rightarrow 17s:$

$$I = \frac{V}{R} = \frac{-30}{300} = -100mA$$

$$P = UI = 30 \cdot 100 = 3W$$

$$P = UI = -30 \cdot 100 = -3W$$

$t=7 \rightarrow 9s:$

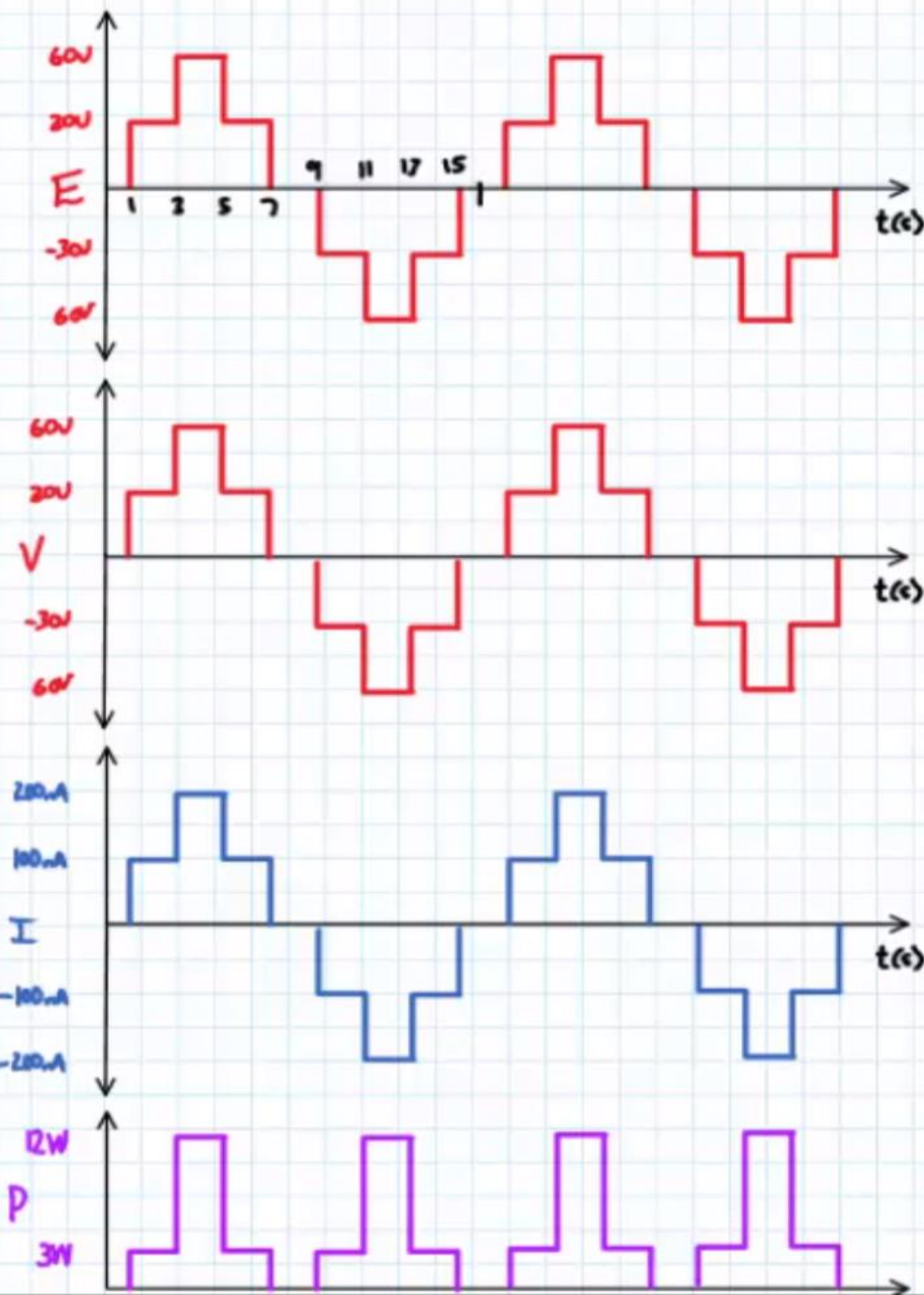
$$I = \frac{V}{R} = \frac{0}{300} = 0mA$$

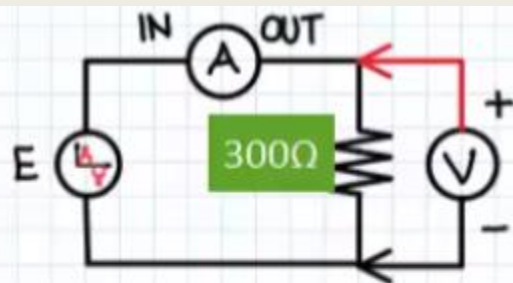
$t=17 \rightarrow 19s:$

$$I = \frac{V}{R} = \frac{0}{300} = 0mA$$

$$P = UI = 0 \cdot 0 = 0W$$

$$P = UI = 0 \cdot 0 = 0W$$





$t=0 \rightarrow 1s:$

$$I = \frac{V}{R} = \frac{0}{300} = 0mA$$

$$P = UI = 0 \cdot 0 = 0W$$

$t=1 \rightarrow 3s:$

$$I = \frac{V}{R} = \frac{30}{300} = 100mA$$

$t=4 \rightarrow 11s:$

$$I = \frac{V}{R} = \frac{-30}{300} = -100mA$$

$t=3 \rightarrow 5s:$

$$I = \frac{V}{R} = \frac{60}{300} = 200mA$$

$$P = UI = -30 \cdot 100 = -3W$$

$t=11 \rightarrow 15s:$

$$I = \frac{V}{R} = \frac{-60}{300} = -200mA$$

$$P = UI = 60 \cdot 200 = 12W$$

$t=5 \rightarrow 7s:$

$$I = \frac{V}{R} = \frac{30}{300} = 100mA$$

$$P = UI = -60 \cdot 200 = -12W$$

$t=7 \rightarrow 9s:$

$$P = UI = 30 \cdot 100 = 3W$$

$$I = \frac{V}{R} = \frac{-30}{300} = -100mA$$

$t=9 \rightarrow 17s:$

$$I = \frac{V}{R} = \frac{0}{300} = 0mA$$

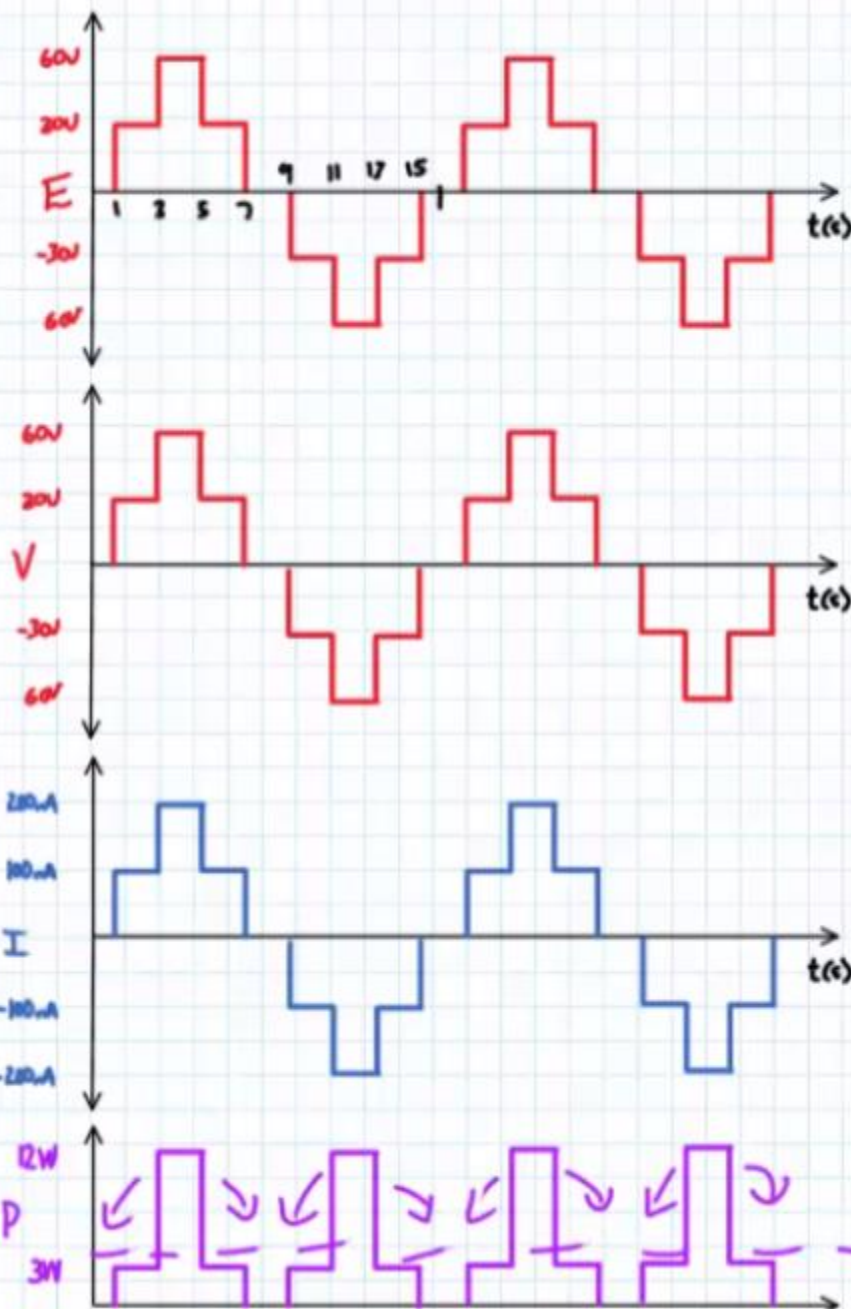
$$P = UI = -30 \cdot 100 = -3W$$

$t=17 \rightarrow 20s:$

$$P = UI = 0 \cdot 0 = 0W$$

$$I = \frac{V}{R} = \frac{0}{300} = 0mA$$

$$P = UI = 0 \cdot 0 = 0W$$



$$P = UI$$

$$P = I^2 R$$

$$\frac{P}{R} = I^2$$

$$\sqrt{\frac{P}{R}} = I$$

$$\sqrt{\frac{4.5}{300}} = 122.5mA$$

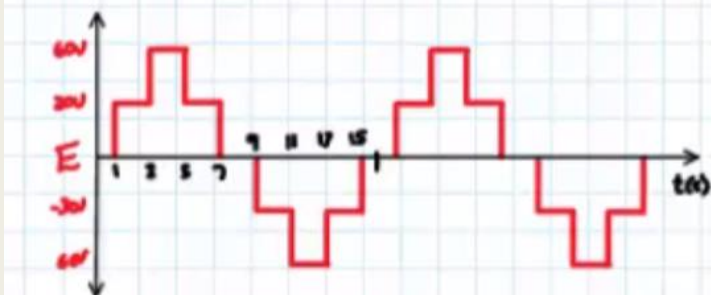
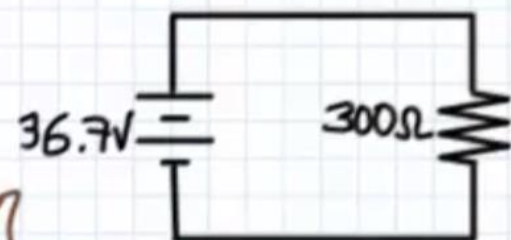
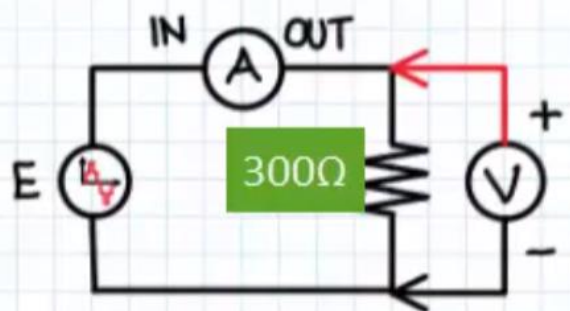
$$P = \frac{U^2}{R}$$

$$P \cdot R = U^2$$

$$\sqrt{P \cdot R} = U$$

$$\sqrt{4.5 \cdot 300} = 36.7V$$

$$P_{ave} = 4.5W$$



$$P = UI$$

$$P = I^2 R$$

$$\frac{P}{R} = I^2$$

$$\sqrt{\frac{P}{R}} = I$$

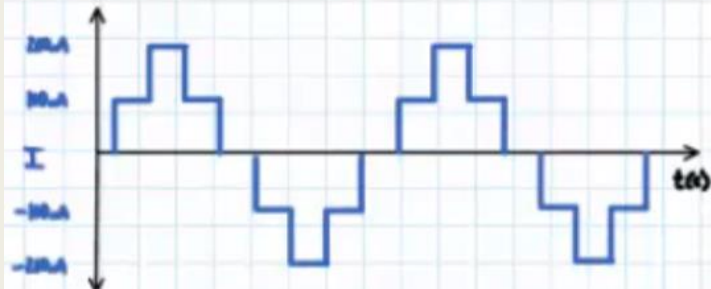
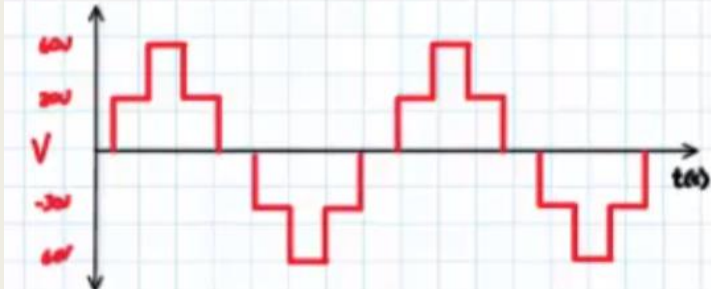
$$\sqrt{\frac{4.5}{300}} = 122.5 \text{ mA}$$

$$P = \frac{U^2}{R}$$

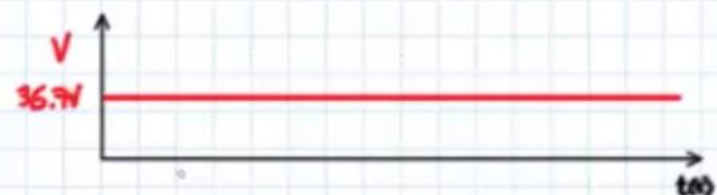
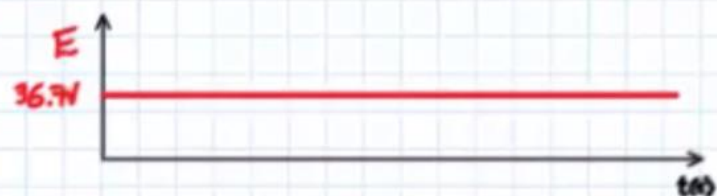
$$P \cdot R = U^2$$

$$\sqrt{P \cdot R} = U$$

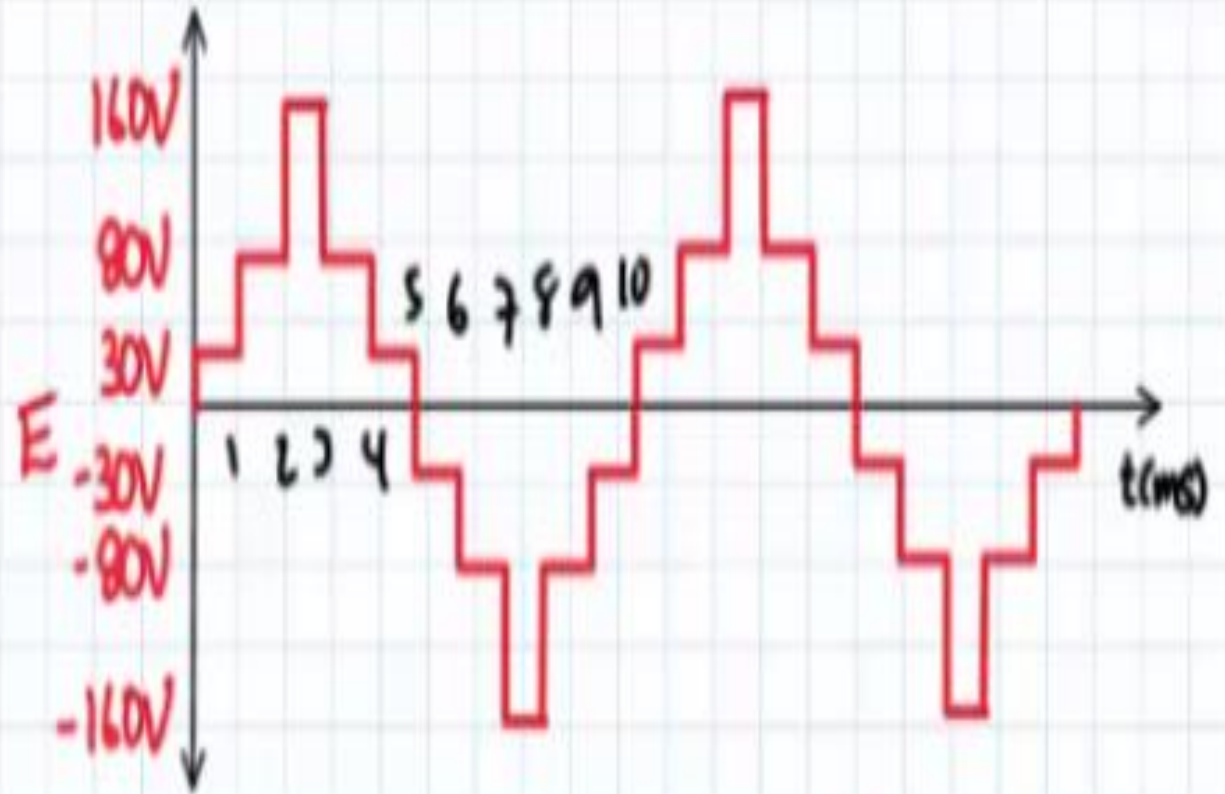
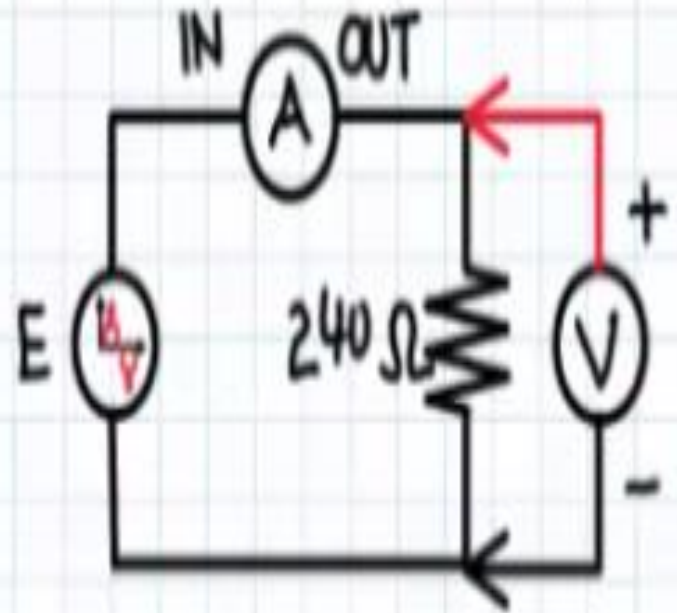
$$\sqrt{4.5 \cdot 300} = 36.7 \text{ V}$$

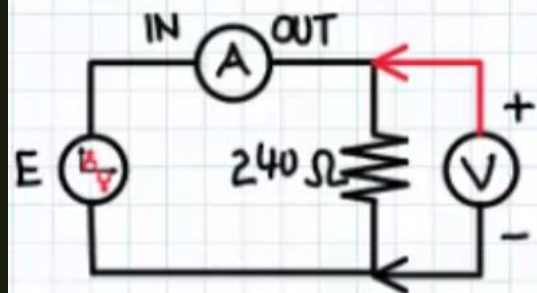


$$P_{\text{ave}} = 4.5 \text{ W}$$



Try to solve this problem





$t=0 \rightarrow 1\text{ms}$:

$$I = \frac{V}{R} = \frac{30}{240} = 125\text{mA}$$

$$P = VI = 30 \cdot 125 = 3.8\text{W}$$

$t=1-2\text{ms}$:

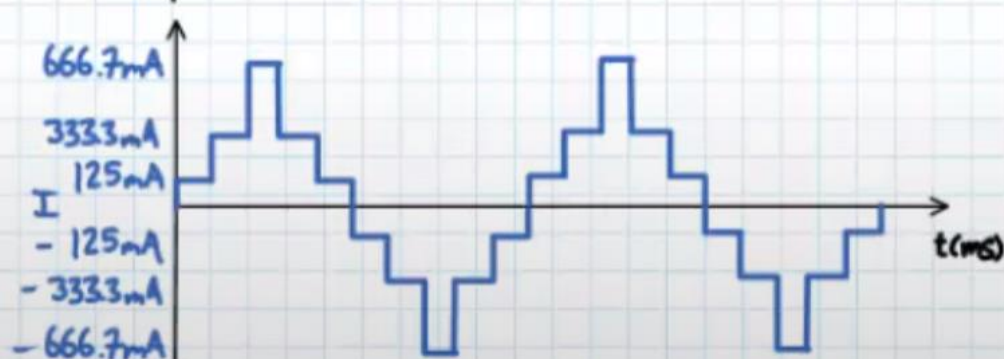
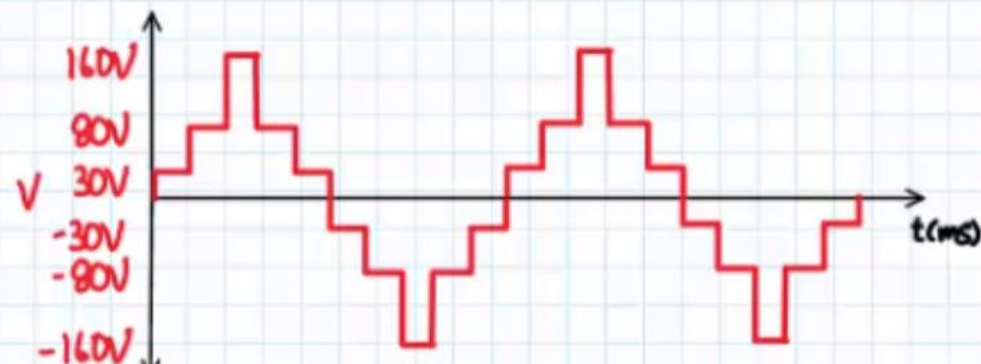
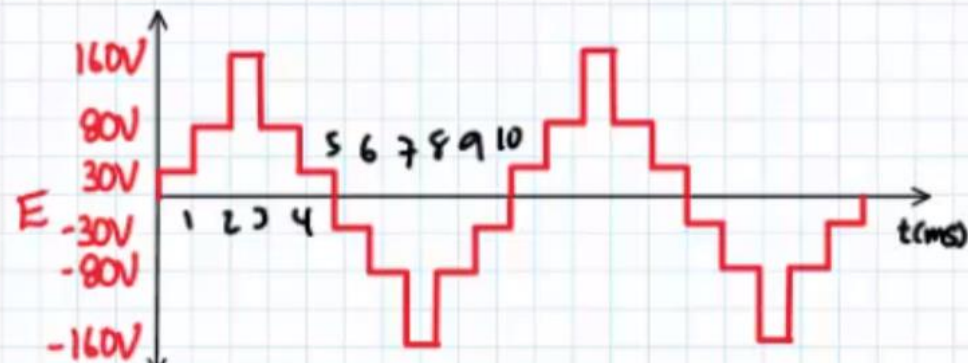
$$I = \frac{V}{R} = \frac{80}{240} = 333.3\text{mA}$$

$$P = VI = 80 \cdot 333 = 26.7\text{W}$$

$t=2-3\text{ms}$:

$$I = \frac{V}{R} = \frac{160}{240} = 666.7\text{mA}$$

$$P = VI = 160 \cdot 667 = 106.7\text{W}$$



$$P_{\text{AVE}} = 33.5\text{W}$$

$$P = VI$$

$$P = \frac{V^2}{R}$$

$$P \cdot R = V^2$$

$$\sqrt{P \cdot R} = V$$

$$\sqrt{33.5 \cdot 240} = 89.7\text{V}$$

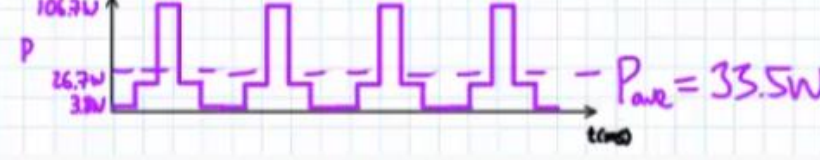
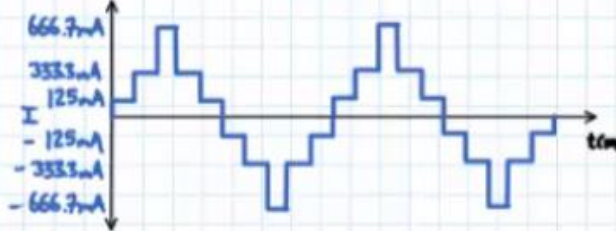
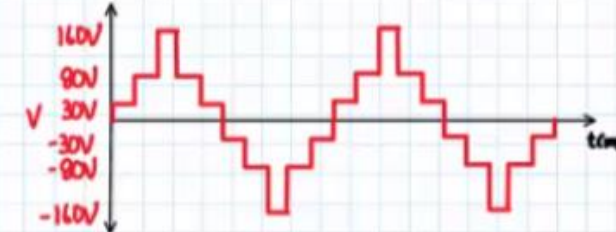
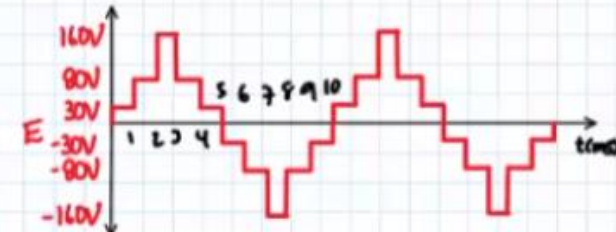
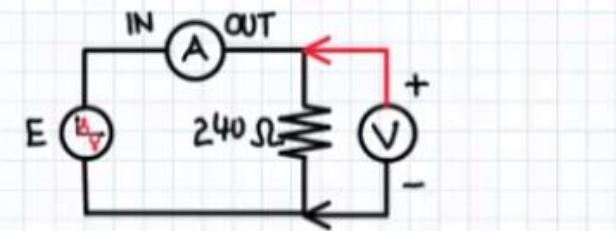
$$P = I^2 R$$

$$\frac{P}{R} = I^2$$

$$\sqrt{\frac{P}{R}} = I$$

$$\sqrt{\frac{33.5}{240}} = 373.6\text{mA}$$

Equivalent DC circuit



$$P_{AVE} = 33.5W$$

$$P = VI$$

$$P = \frac{V^2}{R}$$

$$P \cdot R = V^2$$

$$\sqrt{P \cdot R} = V$$

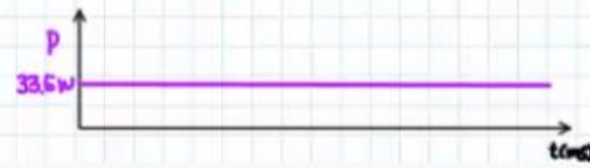
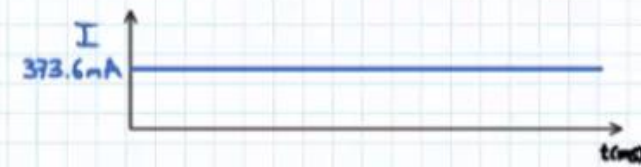
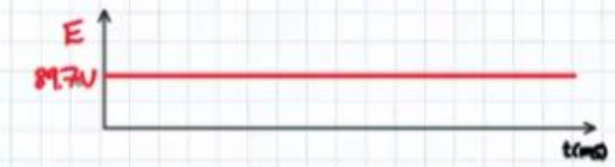
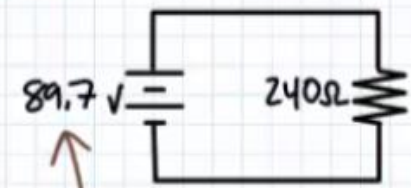
$$\sqrt{33.5 \cdot 240} = 89.7V$$

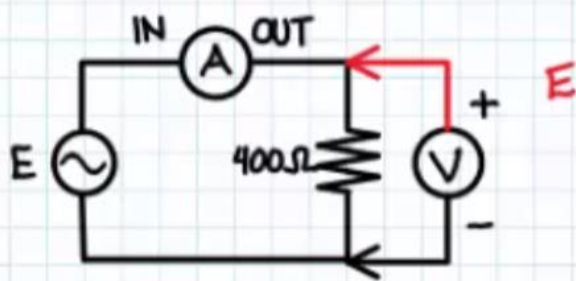
$$P = I^2 R$$

$$\frac{P}{R} = I^2$$

$$\sqrt{\frac{P}{R}} = I$$

$$\sqrt{\frac{33.5}{240}} = 373.6mA$$





$$t_1$$

$$I = \frac{V}{R} = \frac{84.9}{400} = 212.3 \text{ mA}$$

$$P = VI = 84.9 \cdot 212.3 = 18.0 \text{ W}$$

$$t_2$$

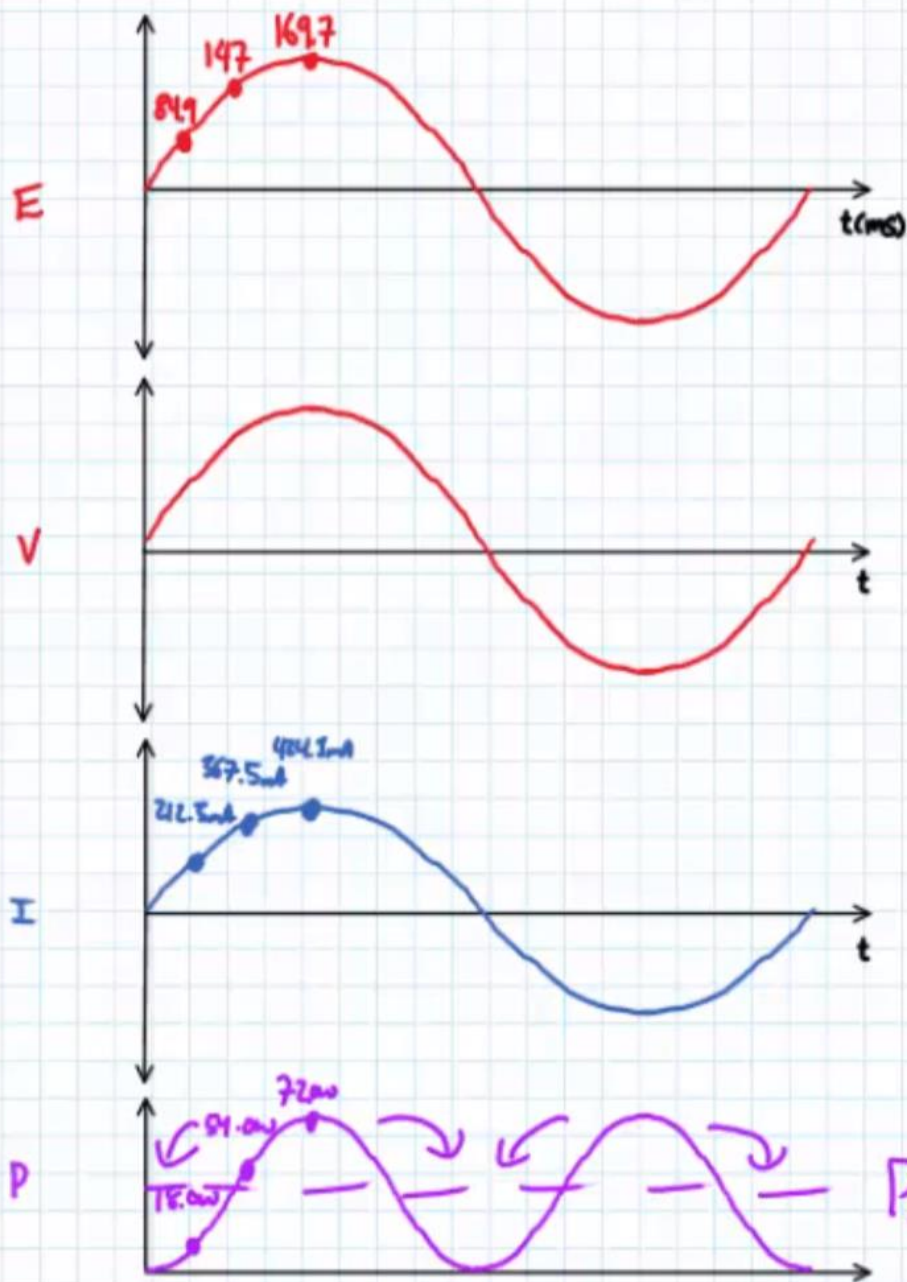
$$I = \frac{V}{R} = \frac{147}{400} = 367.5 \text{ mA}$$

$$P = VI = 147 \cdot 367.5 = 54.0 \text{ W}$$

$$t_3$$

$$I = \frac{V}{R} = \frac{169.7}{400} = 424.3 \text{ mA}$$

$$P = VI = 169.7 \cdot 424.3 = 72.0 \text{ W}$$



$$P_{\text{AVE}} = 36 \text{ W}$$

$$P = VI$$

$$P = \frac{V^2}{R}$$

$$P \cdot R = V^2$$

$$\sqrt{P \cdot R} = V$$

$$\sqrt{36 \cdot 400} = 120 \text{ V}$$

$$P = I^2 R$$

$$\frac{P}{R} = I^2$$

$$\sqrt{\frac{P}{R}} = I$$

$$\sqrt{\frac{36}{400}} = 300 \text{ mA}$$

$$P_{\text{AVE}} = 36 \text{ W}$$