2)

a) $V_{o,rms} = \frac{V_m}{\sqrt{2}}\sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}} = V_{rms}\sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}}$

$V_m = 120\sqrt{2}$ $\quad \alpha = 45° \rightarrow V_{o,rms} = 114.4\ V$; $I_{o,rms} = \frac{V_{o,rms}}{R} = \frac{114.4}{20} = 5.72\ A$

b) $P = \frac{V_{o,rms}^2}{R} = \frac{114.4^2}{20} = 655\ W$

c) $pf = \frac{P}{S} = \frac{P}{V_{rms} I_{rms}} = \frac{655}{(120)(5.72)} = 0.953$

d) $I_{avg,SCR} = \frac{V_m}{2\pi R}(1 + \cos\alpha) = \frac{120\sqrt{2}}{2\pi(20)}(1 + \cos 45°) = 2.30\ A$

$I_{rms,SCR} = \frac{I_{o,rms}}{\sqrt{2}} = \frac{5.72}{\sqrt{2}} = 4.05\ A$

e) $I_{1,rms} \cong 0.92\left[\frac{120}{20}\right] = 5.53\ A$

$THD_I = \frac{\sqrt{I_{rms}^2 - I_{1,rms}^2}}{I_{1,rms}} = \frac{\sqrt{5.72^2 - 5.53^2}}{5.53} = 0.26 = 26\%$

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5)

For $P = 200\ W$, $V_{o,rms} = \sqrt{PR} = \sqrt{200(40)} = 89.4\ V$

Using Eq. 5-3,

$89.4 - 120\sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}} = 0 \longrightarrow \alpha = 1.48\ rad = 85°$

$pf = \frac{P}{S} = \frac{P}{V_{rms} I_{rms}} = \frac{200}{(120)(89.4/40)} = 0.75 = 75\%$.

For $P = 400\ W$, $V_{o,rms} = \sqrt{PR} = \sqrt{400(40)} = 126\ V$

Since $126\ V > 126\ V$ of the source, $400\ W$ is not possible.

The maximum power available is $\frac{120^2}{40} = 360\ W$. The pf is 1.0 for 360 W.

8) $R = \frac{V^2}{P} = \frac{120^2}{100} = 144\,\Omega$

a) $P = 75\,W : V_{rms} = \sqrt{(144)(75)} = 103.9\,V$

From Fig. 5-3, $\alpha = 1.16\ rad = 66.2°$

b) $P = 25\,W : V_{rms} = \sqrt{(144)(25)} = 60\,V$

From Fig. 5-3, $\alpha = 1.99\ rad = 114°$

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10) $v_o(\omega t) = V_m \sin \omega t$ for $\alpha_1 < \omega t < \pi$ and for $\pi + \alpha_2 < \omega t < 2\pi$

$$V_{o.rms} = \sqrt{\frac{1}{2\pi}\left[\int_{\alpha_1}^{\pi} (V_m \sin\omega t)^2 d(\omega t) + \int_{\pi+\alpha_2}^{2\pi} (V_m \sin \omega t)^2 d(\omega t)\right]}$$

$$= V_m \sqrt{\frac{1}{2} - \frac{\alpha_1 + \alpha_2}{4\pi} + \frac{\sin(2\alpha_1) + \sin(2\alpha_2)}{8\pi}}$$

$$V_{o.rms} = \frac{V_m}{\sqrt{2}} \sqrt{1 - \frac{\alpha_1 + \alpha_2}{2\pi} + \frac{\sin(2\alpha_1) + \sin(2\alpha_2)}{4\pi}}$$

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13) Using Eq. 5-9,

$Z = 15.0\,\Omega \quad \theta = 0.646\ rad; \quad \omega t = 0.754$

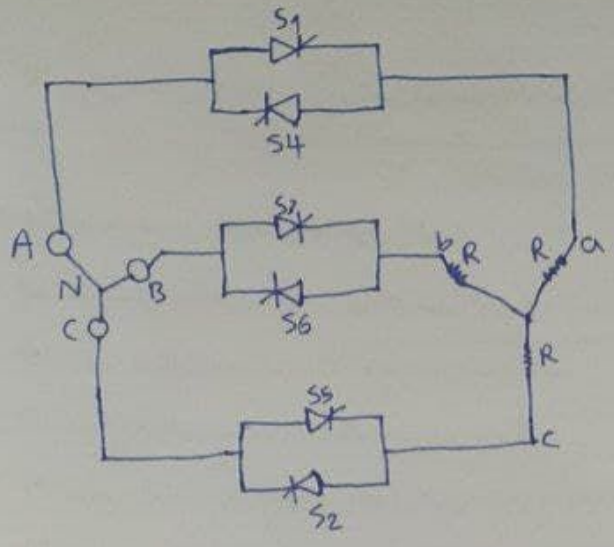
$i(\omega t) = 11.3 \sin(\omega t - 0.646) - 15.8 e^{-\omega t / 0.754}$ A

$\alpha = 115° = 2.01\ rad, \beta = 3.681\ rad = 211°$

$I_{rms} = 2.95\,A$

ب) ولتاژ خروجی با اتصال ستاره در زاویه آتش 45، 60، 105 با بار اهمی، و تنها ولتاژ ورودی سه فاز 380 ومقاومت 20 اهم اگر باشد، V_{rms} و ضریب تست؟

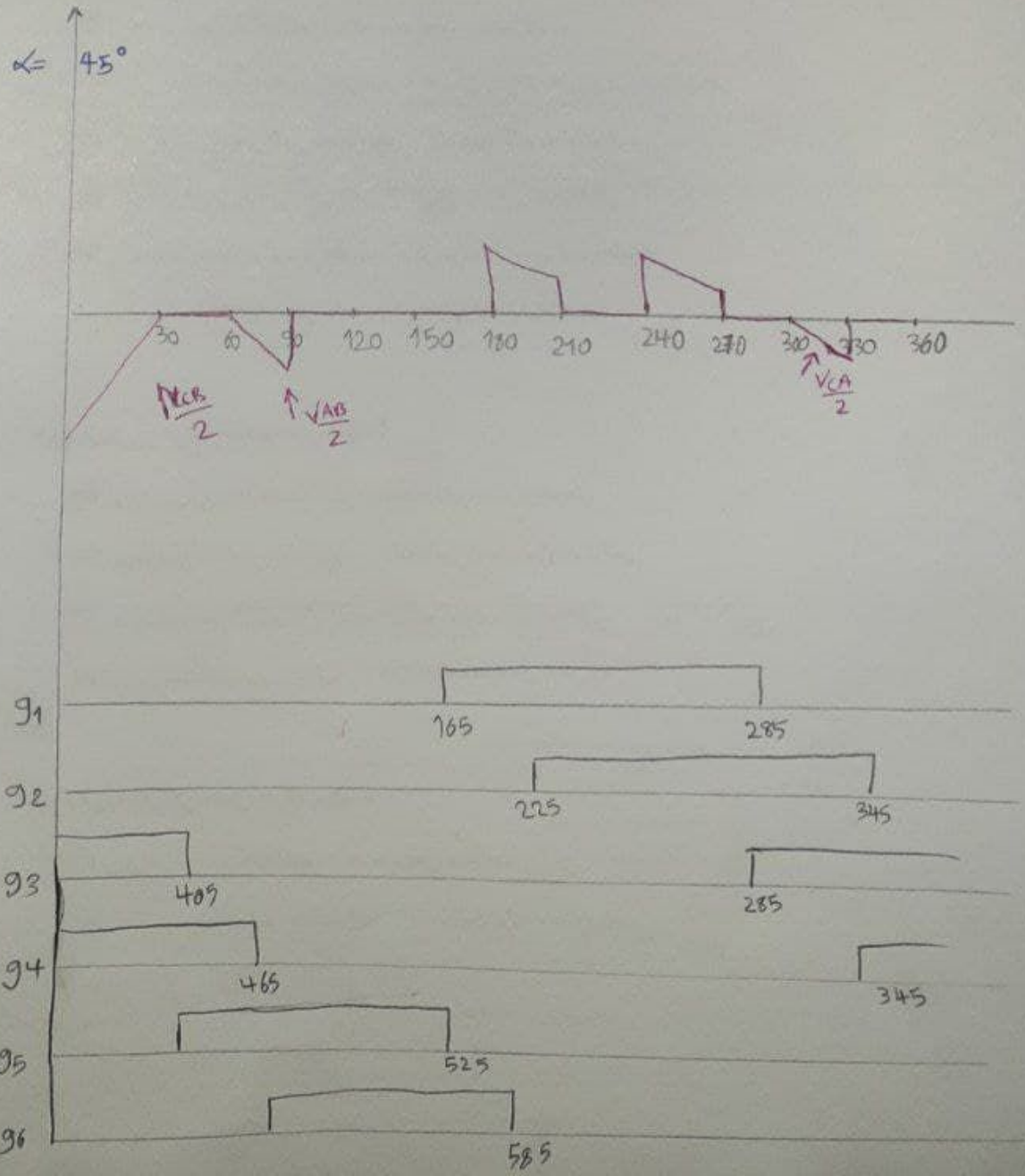
$R = 20\Omega$



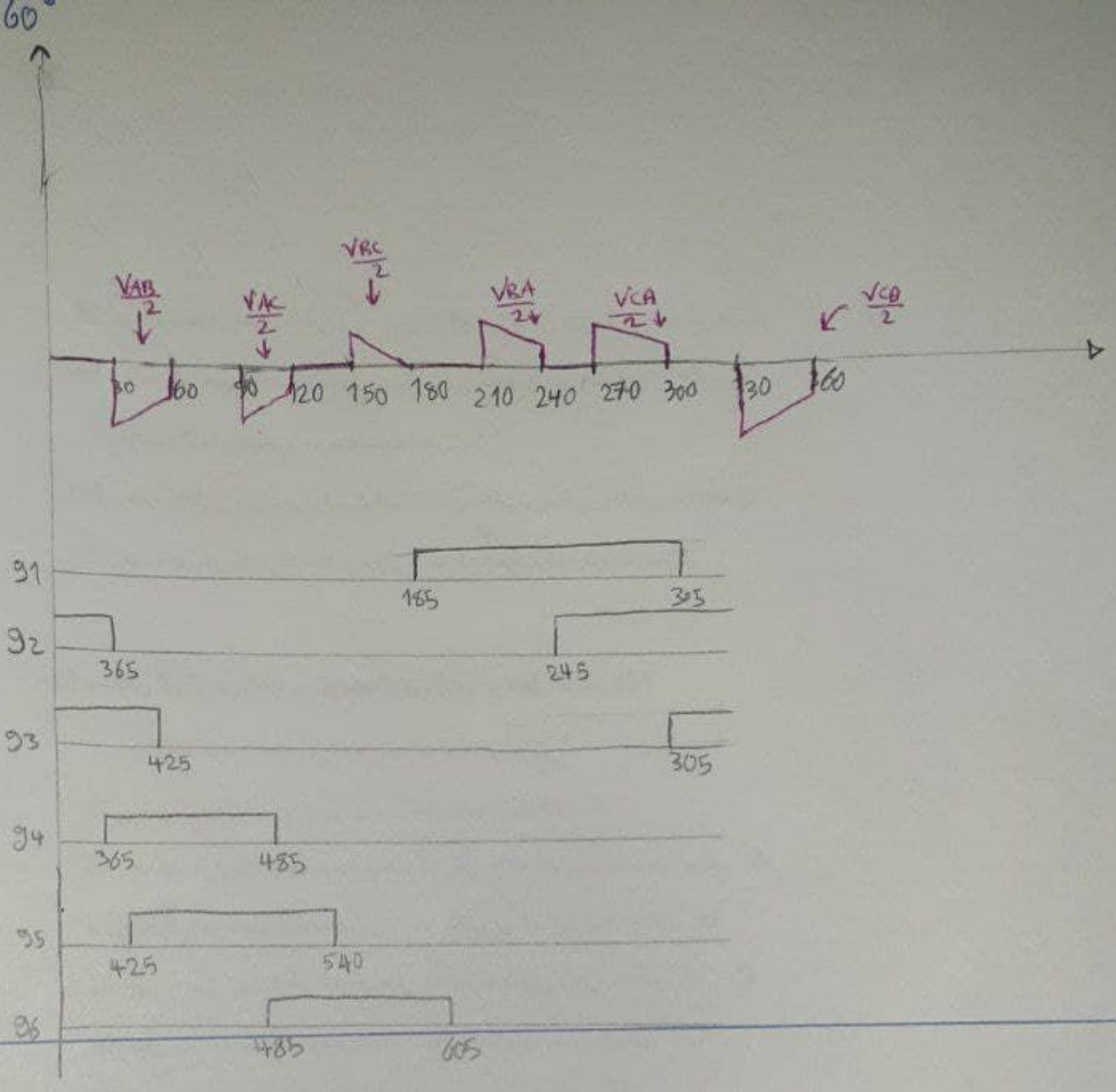
1) اگر یک تریستور روشن باشد ← V_0 صفر

2) اگر دو تریستور روشن باشد ← $\frac{V_{BC}}{2}$ V_0

3) اگر سه تریستور روشن باشد ← V_B



$\alpha = 60°$



$\alpha = 105°$