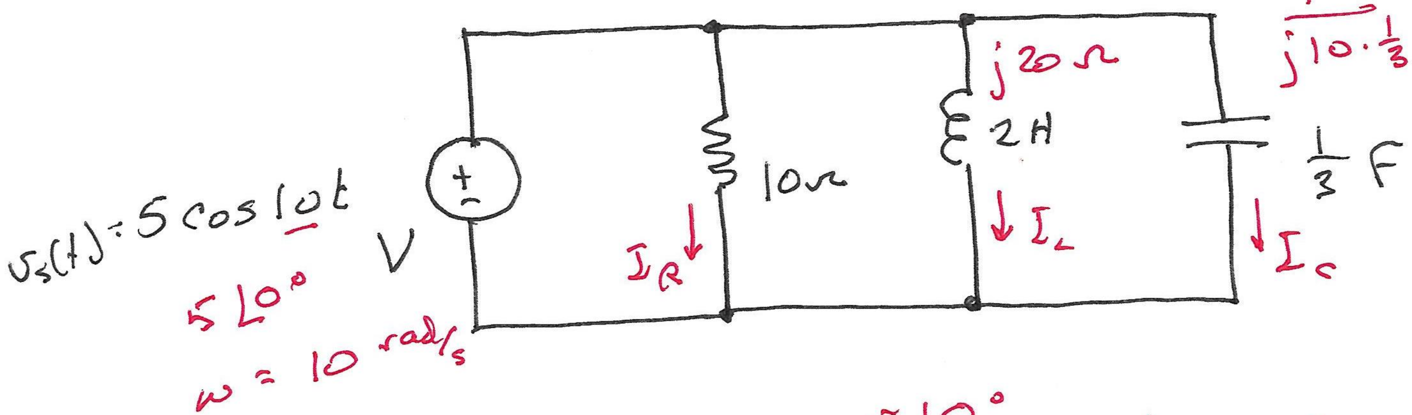
Phasor Diagram

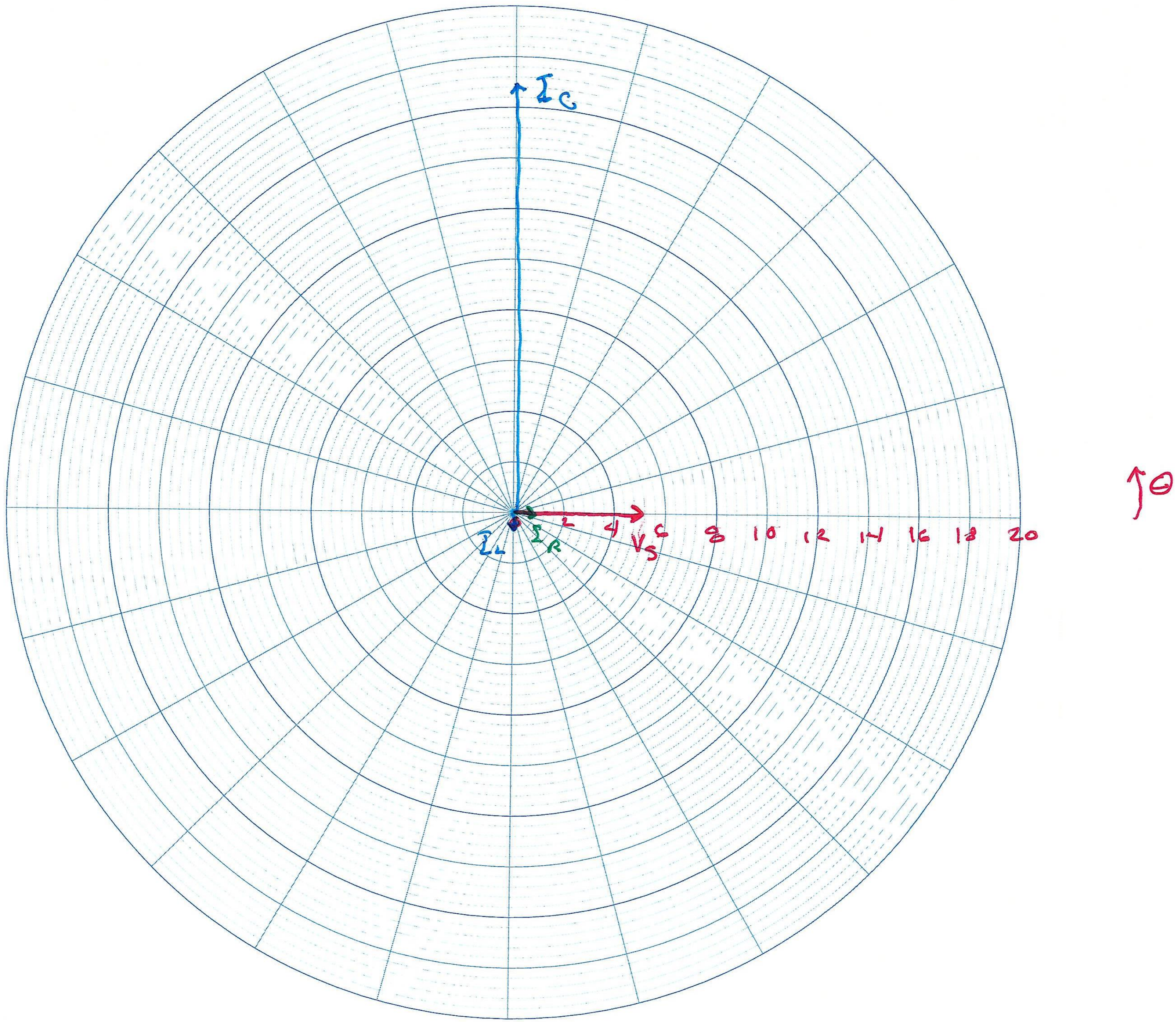


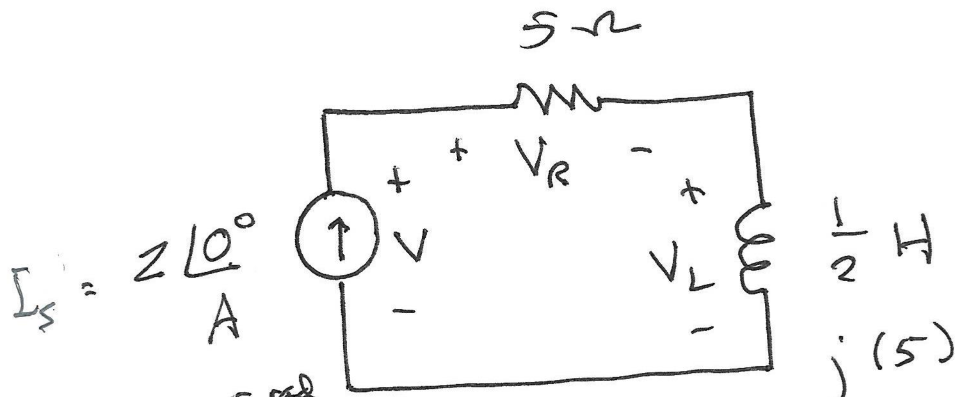
$$\frac{1}{j10\cdot\frac{1}{3}} = -j0.3\ \Omega$$
$$= 0.3\angle -90^\circ$$

$$I_R = \frac{5\angle 0^\circ}{10} = \frac{1}{2}\angle 0^\circ$$

$$I_L = \frac{5\angle 0^\circ}{j20} = \frac{5\angle 0^\circ}{20\angle 90^\circ} = \frac{1}{4}\angle -90^\circ$$

$$I_C = \frac{5\angle 0^\circ}{0.3\angle -90^\circ} = \frac{50}{3}\angle 90^\circ = 16.67\angle 90^\circ$$


I_C
I_L
I_R
V_S
2 4 6 8 10 12 14 16 18 20
$\uparrow \theta$



$\omega = 5 \frac{\text{rad}}{\text{s}}$

$i_s(t) = 2\cos(5t)$ A

$j(5)(\tfrac{1}{2})$

$= j2.5$

$= 2.5\angle 90^\circ$

$V_R = (5\,\Omega)(2\angle 0^\circ)$

$= 10\angle 0^\circ$

$V_L = (2.5\angle 90^\circ)(2\angle 0^\circ)$

$= 5\angle 90^\circ$

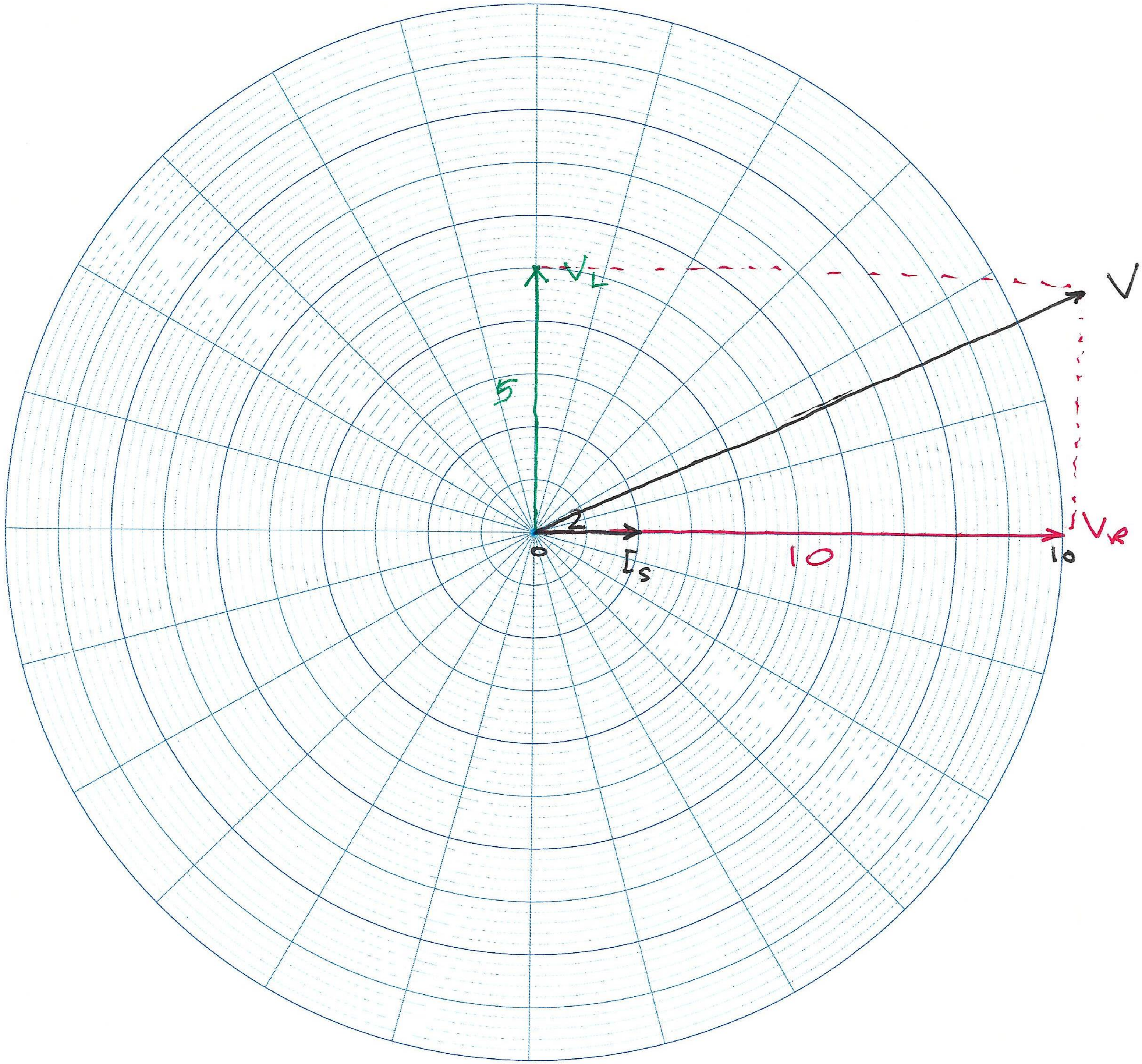
$$V = V_R + V_L$$

$$= 10\angle 0^\circ + 5\angle 90^\circ$$

$$= 10 + j5$$

$$= \sqrt{100 + 25}\ \angle \tan^{-1}\tfrac{5}{10}$$

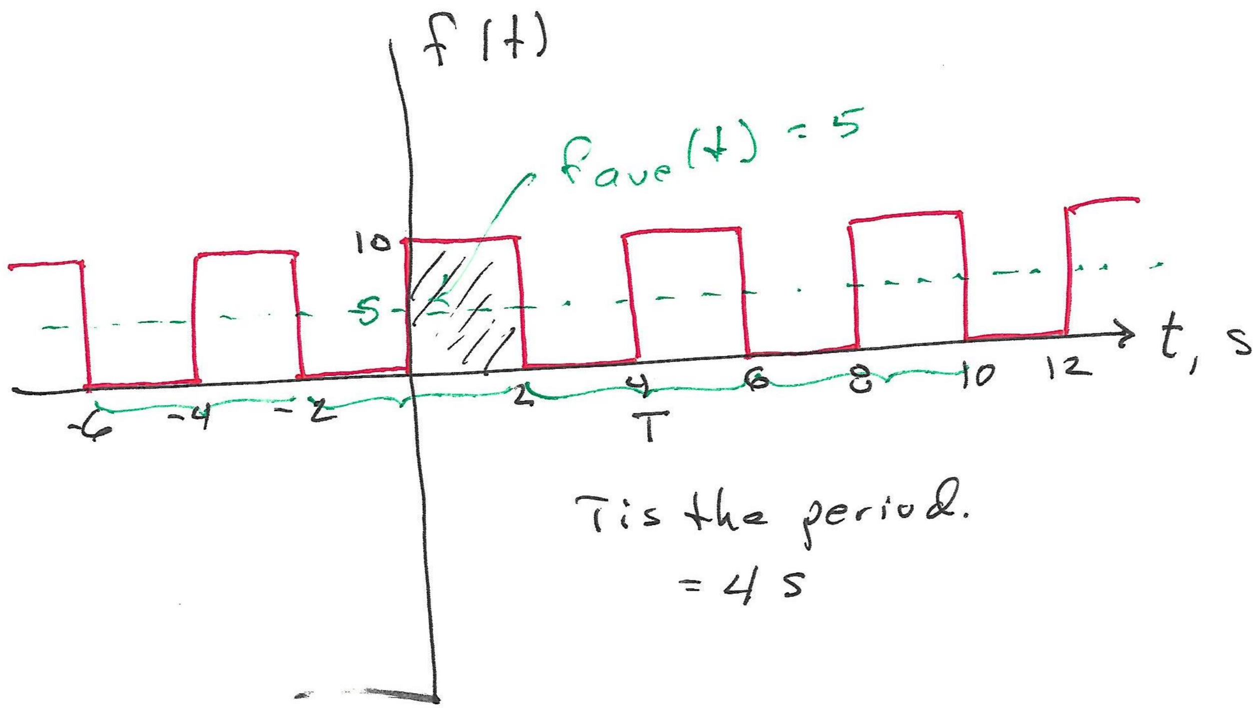
$$\approx 11\angle 26.6^\circ \text{ V}$$



V
V_L
5
2
0
I_s
10
10
V_R

Periodic $\Rightarrow$ There is some T for which

$$f(t_0) = f(t_0 \pm nT)$$



T is the period.
$= 4$ s

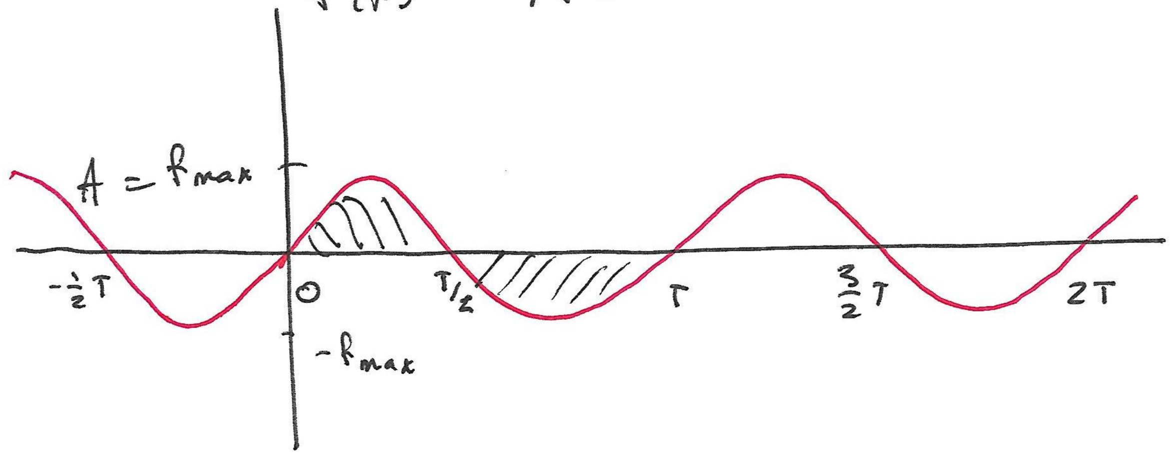
$$f_{ave}(t) = \frac{1}{T}\int_{t_0}^{t_0+T} f(t)\,dt$$

$$= \frac{1}{4}\underbrace{\int_{0}^{4} f(t)\,dt}_{10 \times 2}$$

$$= \frac{1}{4}\cdot 10\cdot 2$$

$$= 5$$

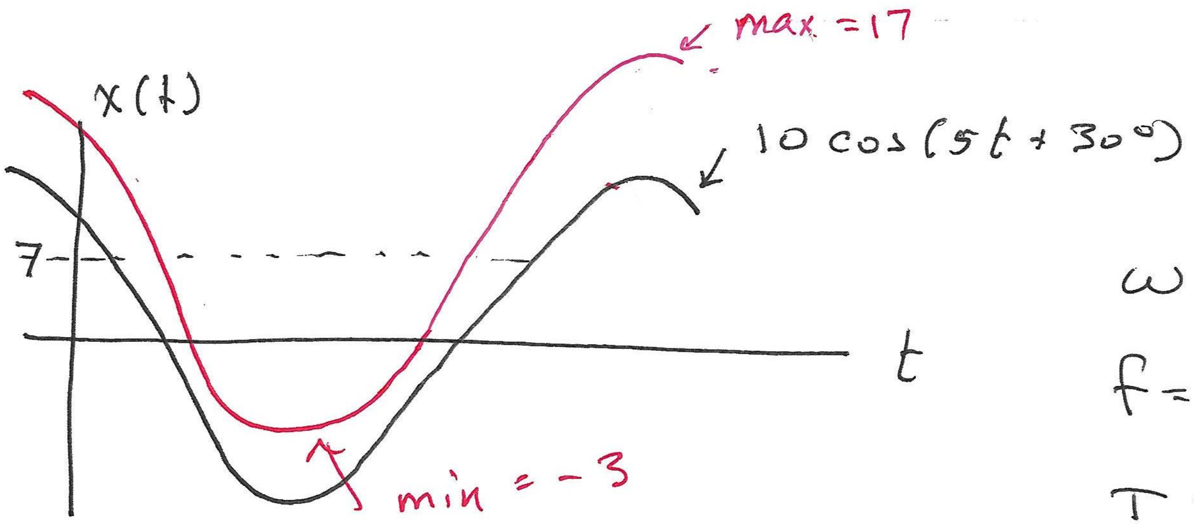
$f(t) = A\sin(\omega t + \theta)$



$f_{ave} = 0$

What is the average value of

$x(t) = 10\cos(5t + 30°) + 7$



$\omega = 5$

$f = \dfrac{\omega}{2\pi}$

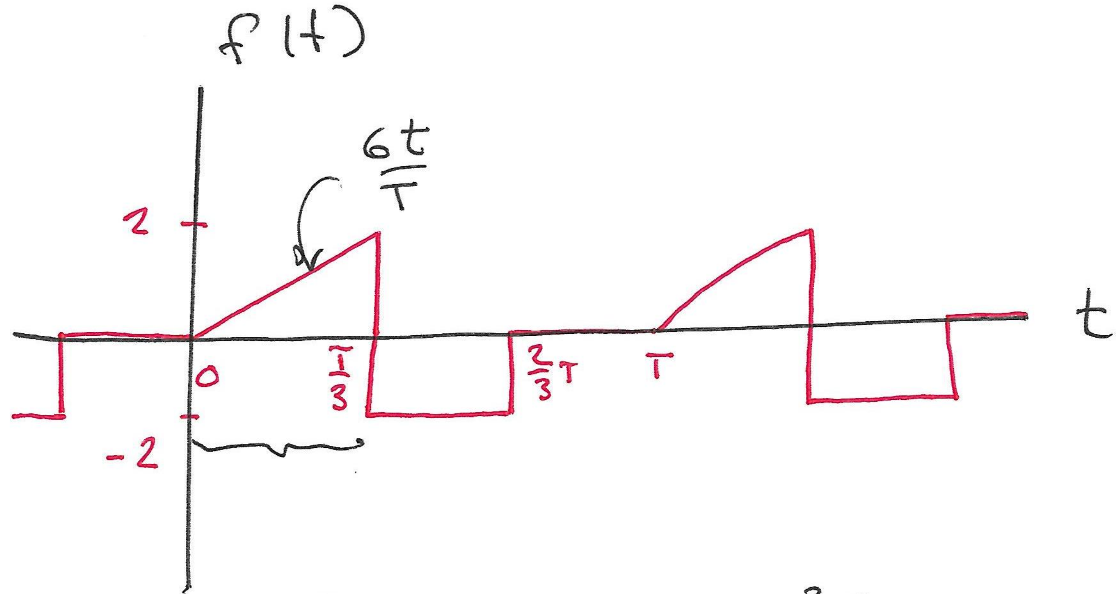
$T = \dfrac{1}{f} = \dfrac{2\pi}{\omega}$

$$x_{ave} = \frac{5}{2\pi} \int_0^{T = \frac{2\pi}{5}} [10\cos(5t + 30^\circ) + 7]\, dt$$

$$= \frac{5}{2\pi} \left[\int_0^T \underbrace{10\cos(5t + 30^\circ)\, dt}_{0} + \int_0^T 7\, dt \right]$$

$$= \frac{1}{T}\, 7T$$

$$= 7$$



$$f_{ave} = \frac{1}{T}\left[\int_0^{T/3} \frac{6}{T} t\, dt + \int_{T/3}^{\frac{2}{3}T} (-2)\, dt + \int_{\frac{2}{3}T}^{T} 0\, dt\right]$$

$$= \frac{1}{T}\left[\frac{3t^2}{T}\Big|_0^{T/3} - 2t\Big|_{T/3}^{2T/3} + 0\right]$$

$$= \frac{1}{T}\left[\frac{3}{T}\left(\frac{T^2}{3^2} - 0\right) - 2\left(\frac{2T}{3} - \frac{T}{3}\right)\right]$$

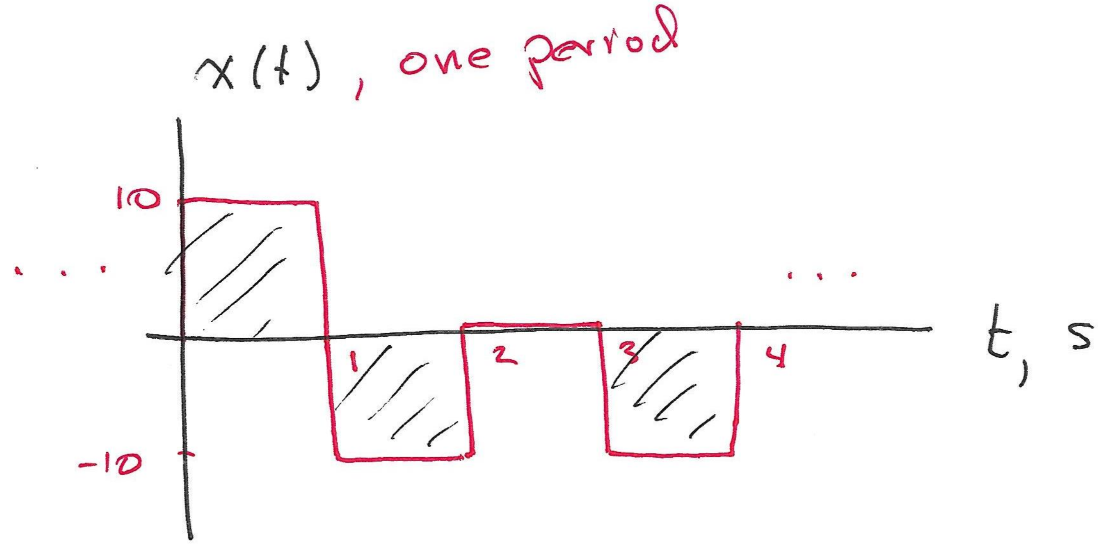
$$= \frac{1}{T}\left[\frac{T}{3} - 2\left(\frac{T}{3}\right)\right] = -\frac{1}{3}$$

Average $\equiv$ Mean

rms = root mean square

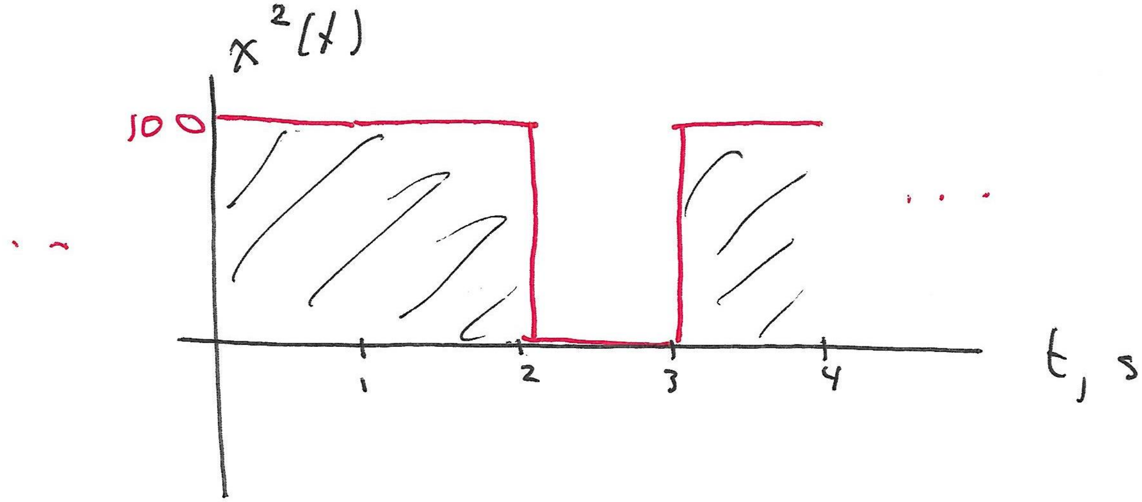
To find the rms value of $x(t)$

$$x_{rms} = \sqrt{\frac{1}{T}\int_0^T x^2(t)\,dt}$$



$$T = 4\,s$$

$$x_{ave} = \frac{1}{4}\int_0^4 x(t)\,dt = \frac{1}{4}\left[10 - 10 + 0 - 10\right] = -2.5$$



$$x_{rms} = \sqrt{\frac{1}{4}\underbrace{\int_0^4 x^2(t)\, dt}_{300}}$$

$$= \sqrt{75}$$

$$= 5\sqrt{3}$$