Given $A_1 = \dfrac{A_0}{1+\frac{s}{\omega_0}}$ and $K = 1$,

the loop gain is $T = KA_1 = \dfrac{A_0}{1+\frac{s}{\omega_0}}$.

Find ω_{ax} by setting $|T| = 1$

$$\therefore \left| \frac{A_0}{1+j\frac{\omega}{\omega_0}} \right| = 1$$

$$A_0 = \left| 1 + j\frac{\omega}{\omega_0} \right| = \sqrt{1^2 + \left(\frac{\omega}{\omega_0}\right)^2}$$

$$A_0^2 - 1 = \left(\frac{\omega}{\omega_0}\right)^2$$

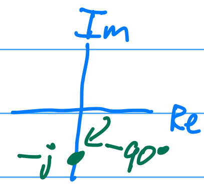
If $A_0^2 \gg 1$ then $A_0^2 \approx \left(\frac{\omega}{\omega_0}\right)^2$

$$\therefore \omega_{ax} = A_0 \omega_0$$

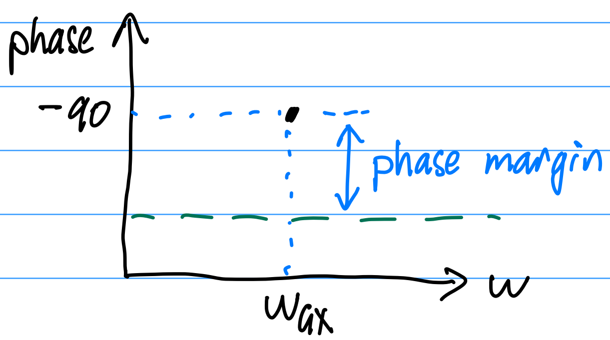
At this freq, $T = \dfrac{A_0}{1+\left(\frac{j\omega_{ax}}{\omega_0}\right)} = \dfrac{A_0}{1+\left(\frac{jA_0\cancel{\omega_0}}{\cancel{\omega_0}}\right)}$

Since A_0 is large, $|jA_0| \gg 1$

$$\therefore T \approx \frac{A_0}{jA_0} = \frac{1}{j} = -j.$$



$$\therefore \angle T = -90°.$$



$\therefore$ Phase margin

$= -90 - (-180)$

$= 90°.$