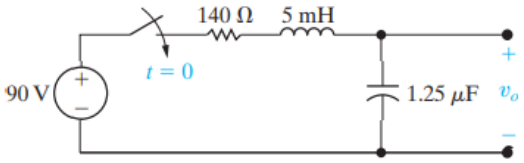
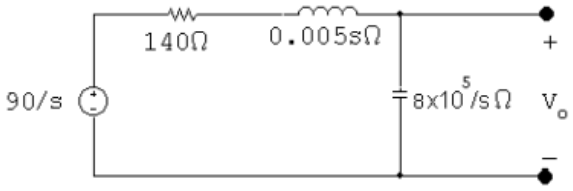
Solution of Homework-04 ENGR 117

5 Questions 20 points each

Q-1 Find V_o and v_o in the circuit shown below if the initial energy is zero and the switch is closed at t=0. Also find the transfer function and identify the poles and zeros for this circuit. (Use circuit transform method)





$$V_o = \frac{(90/s)(8 \times 10^5/s)}{140 + 0.005s + (8 \times 10^5/s)}$$

$$= \frac{144 \times 10^8}{s(s^2 + 28{,}000s + 16 \times 10^7)}$$

$$= \frac{144 \times 10^8}{s(s + 8000)(s + 20{,}000)}$$

$$= \frac{K_1}{s} + \frac{K_2}{s + 8000} + \frac{K_3}{s + 20{,}000}$$

$$K_1 = \frac{144 \times 10^8}{16 \times 10^7} = 90$$

$$K_2 = \frac{144 \times 10^8}{(-8000)(12{,}000)} = -150$$

$$K_3 = \frac{144 \times 10^8}{(-12{,}000)(-20{,}000)} = 60$$

$$V_o = \frac{90}{s} - \frac{150}{s + 8000} + \frac{60}{s + 20{,}000}$$

$$v_o(t) = [90 - 150e^{-8000t} + 60e^{-20{,}000t}]u(t)\ \text{V}$$

$H(s) = \frac{V0}{Vi}$ = $\frac{144 \times 10^8}{s(s + 8000)(s + 20{,}000)}$ divided by 90/s

$$H(s) = \frac{1.6 \times 10^8}{(s + 8000)(s + 20{,}000)}$$

No Zeros

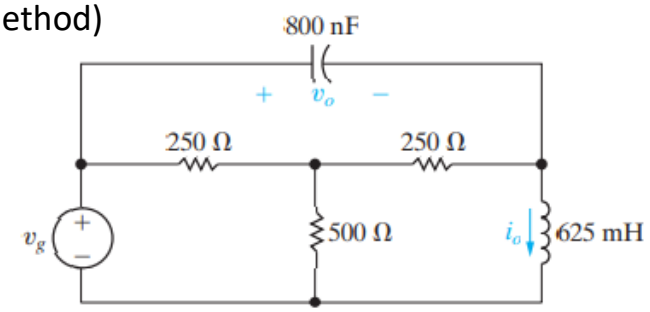
2 Poles: -8000 and -20000

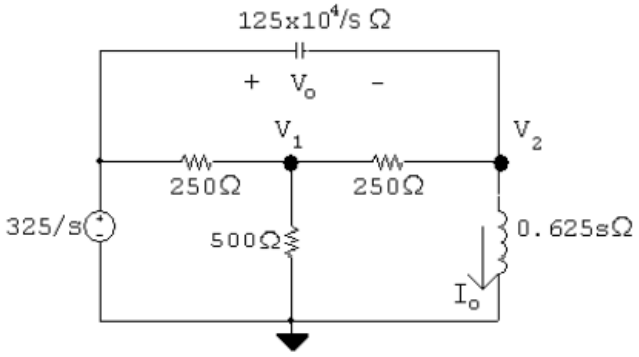
Q-2 There is no energy stored in the circuit shown below at the time the voltage source is turned on. (Use circuit transform method)

vg = 325u(t) V.

a) Find V_o and I_o

b) Find v_o and i_o





$$\frac{V_1 - 325/s}{250} + \frac{V_1}{500} + \frac{V_1 - V_2}{250} = 0$$

$$\frac{V_2}{0.625s} + \frac{V_2 - V_1}{250} + \frac{(V_2 - 325/s)s}{125 \times 10^4} = 0$$

Thus,

$$5V_1 - 2V_2 = \frac{650}{s}$$

$$-5000sV_1 + (s^2 + 5000s + 2 \times 10^6)V_2 = 325s$$

$$\Delta = \begin{vmatrix} 5 & -2 \\ -5000s & s^2 + 5000s + 2 \times 10^6 \end{vmatrix} = 5(s + 1000)(s + 2000)$$

$$N_2 = \begin{vmatrix} 5 & 650/s \\ -5000s & 325s \end{vmatrix} = 1625(s + 2000)$$

$$V_2 = \frac{N_2}{\Delta} = \frac{1625(s + 2000)}{5(s + 1000)(s + 2000)} = \frac{325}{s + 1000}$$

$$V_o = \frac{325}{s} - \frac{325}{s + 1000} = \frac{325{,}000}{s(s + 1000)}$$

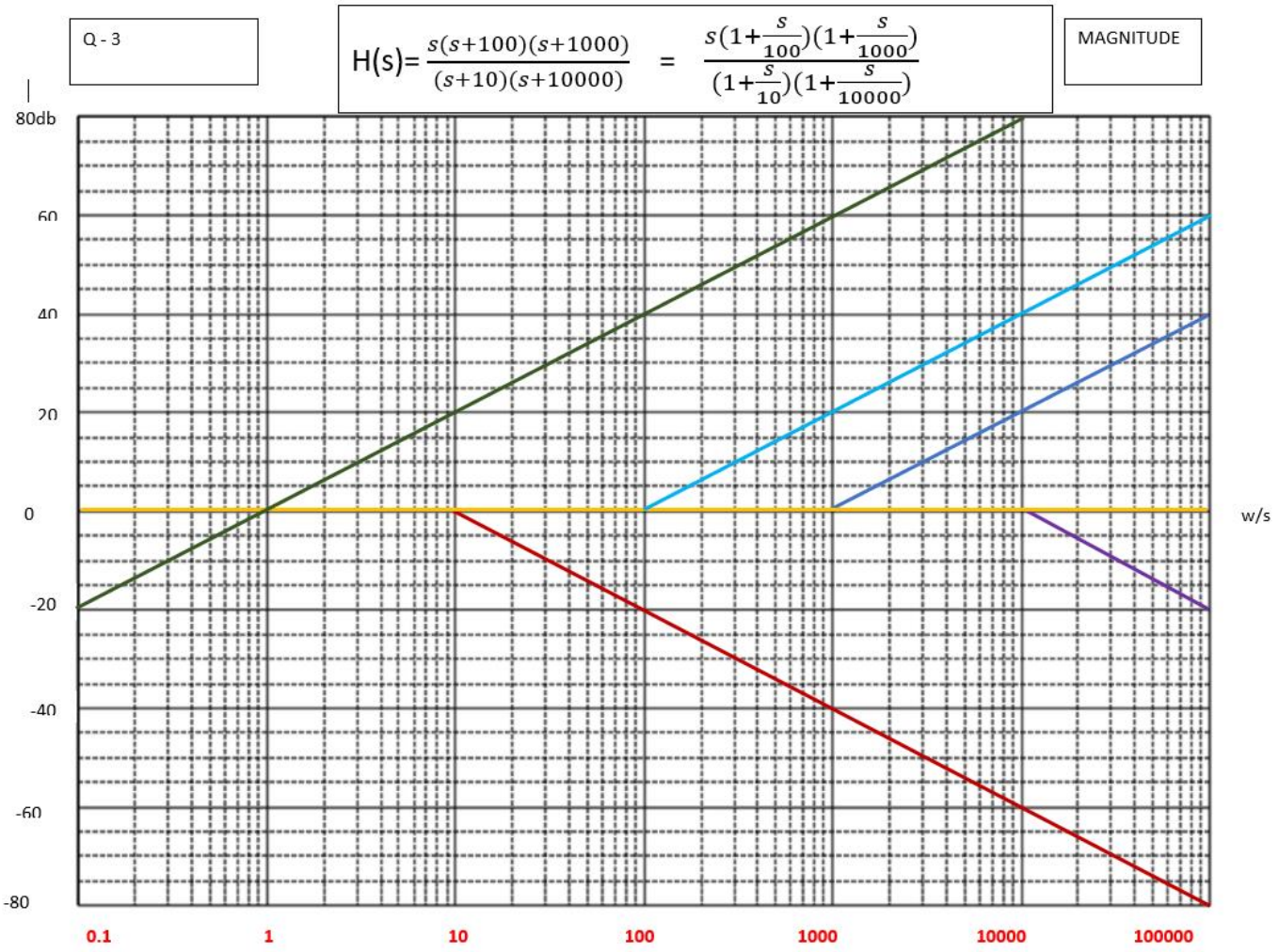
$$I_o = \frac{V_2}{0.625s} = \frac{520}{s(s + 1000)} = \frac{0.52}{s} - \frac{0.52}{s + 1000}$$

[b] $v_o(t) = (325 - 325e^{-1000t})u(t)\,\text{V}$

$i_o(t) = (520 - 520e^{-1000t})u(t)\,\text{mA}$

Q-3 Draw the magnitude and phase Bode diagram for the following transfer function.

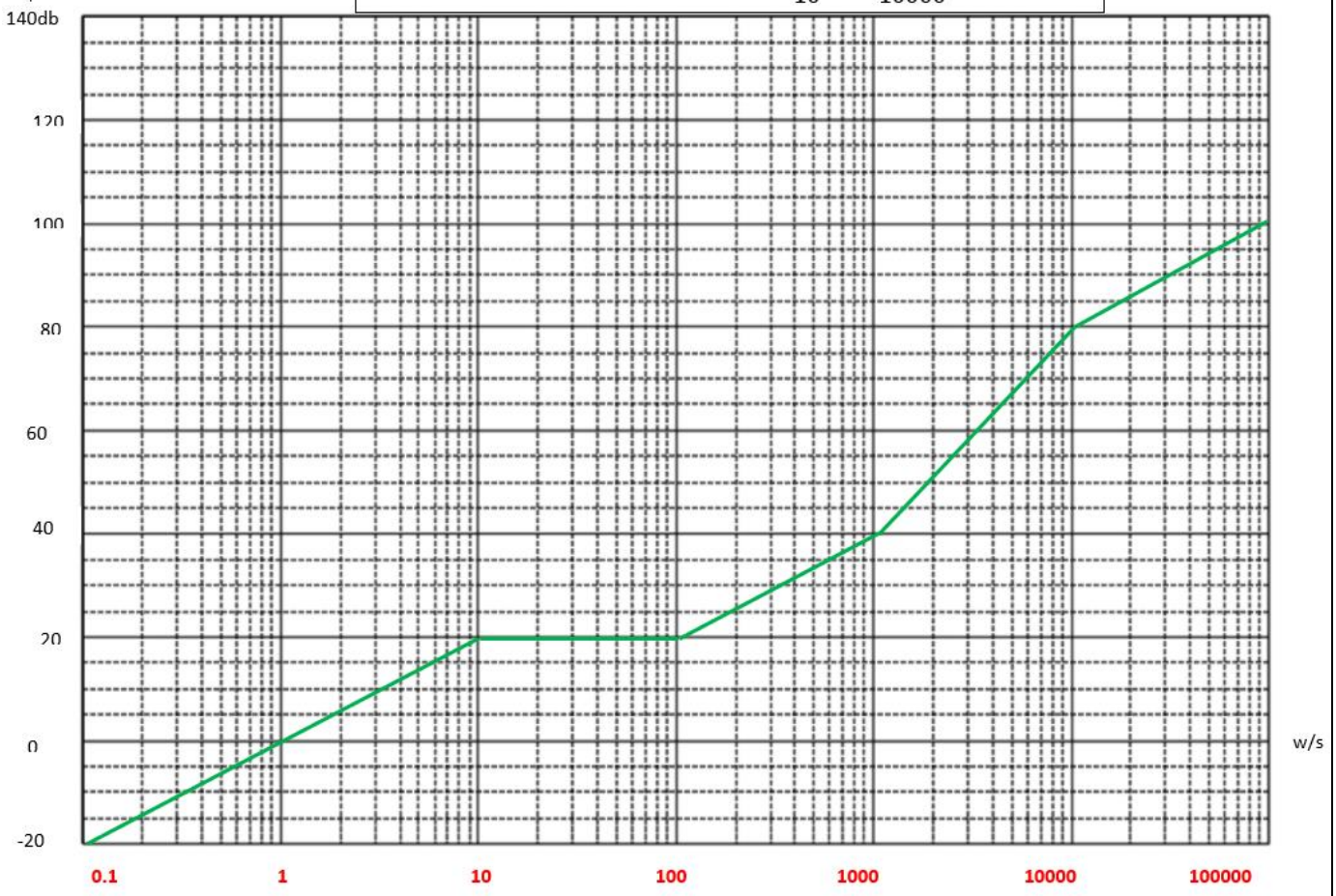
$$H(s) = \frac{s(s+100)(s+1000)}{(s+10)(S+10000)}$$



Q - 3

$$H(s)=\frac{s(s+100)(s+1000)}{(s+10)(s+10000)} = \frac{s(1+\frac{s}{100})(1+\frac{s}{1000})}{(1+\frac{s}{10})(1+\frac{s}{10000})}$$

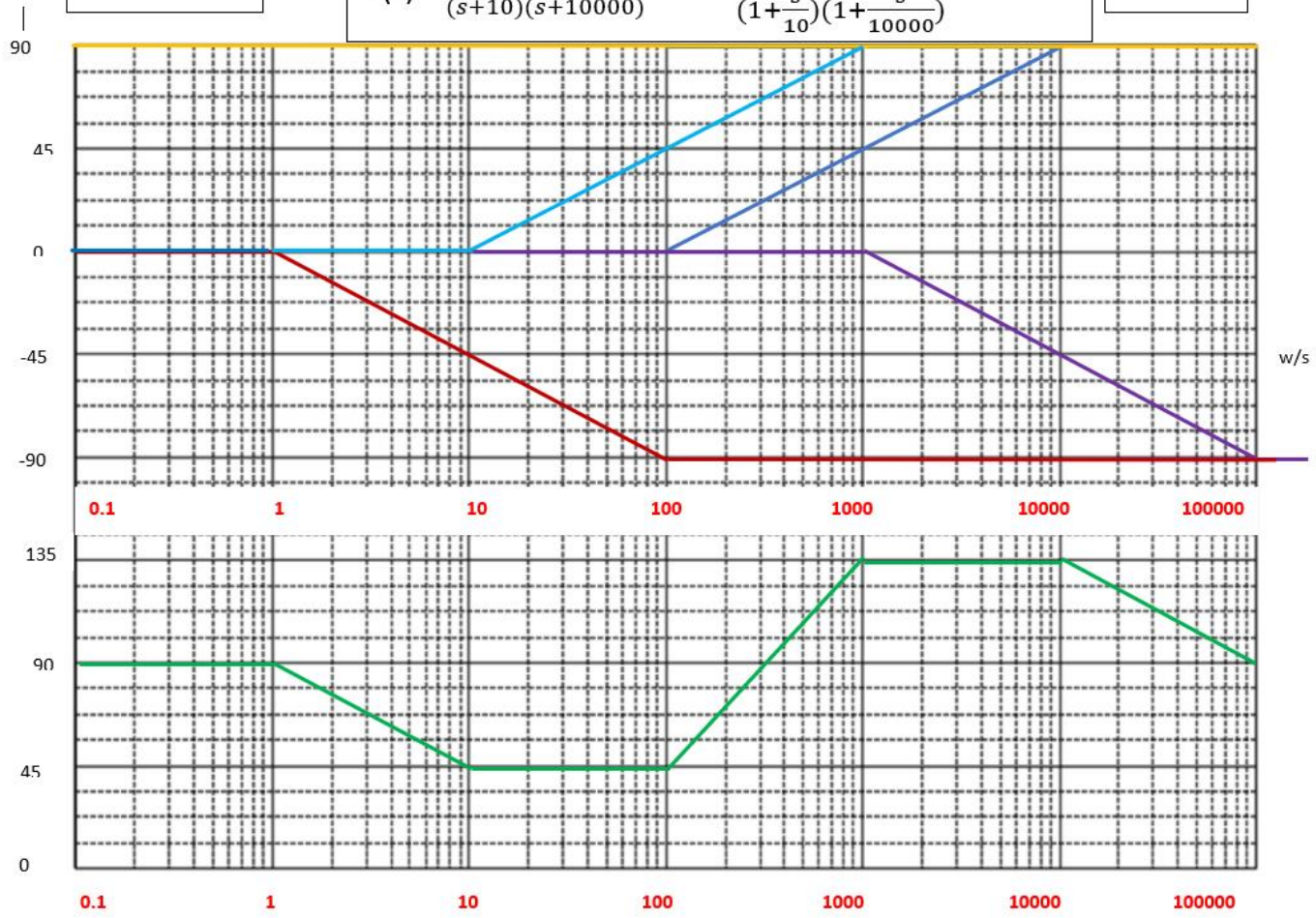
MAGNITUDE



Q - 3

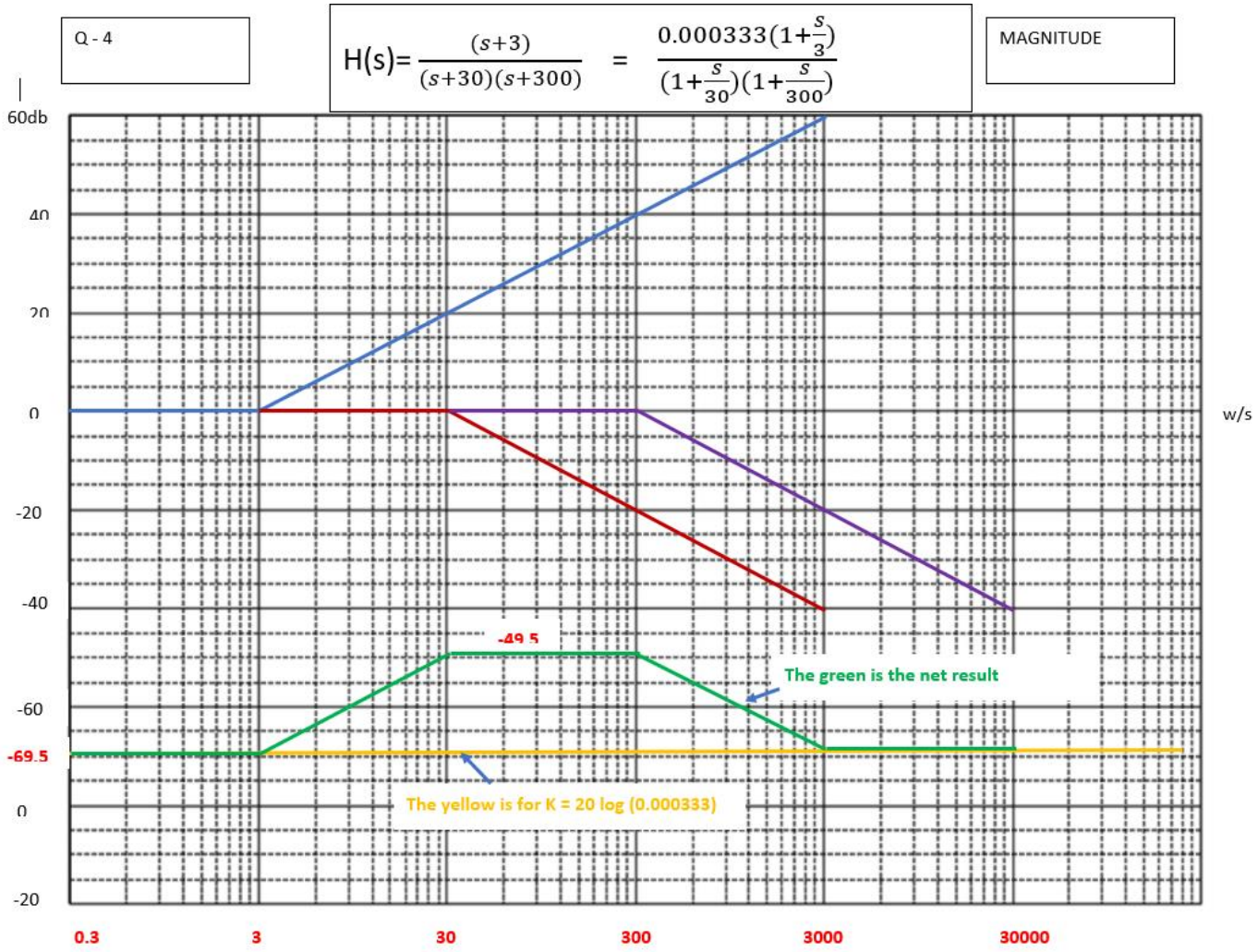
$$H(s)=\frac{s(s+100)(s+1000)}{(s+10)(s+10000)} = \frac{s(1+\frac{s}{100})(1+\frac{s}{1000})}{(1+\frac{s}{10})(1+\frac{s}{10000})}$$

PHASE



Q-4 Draw the magnitude and phase Bode diagram for the following transfer function.

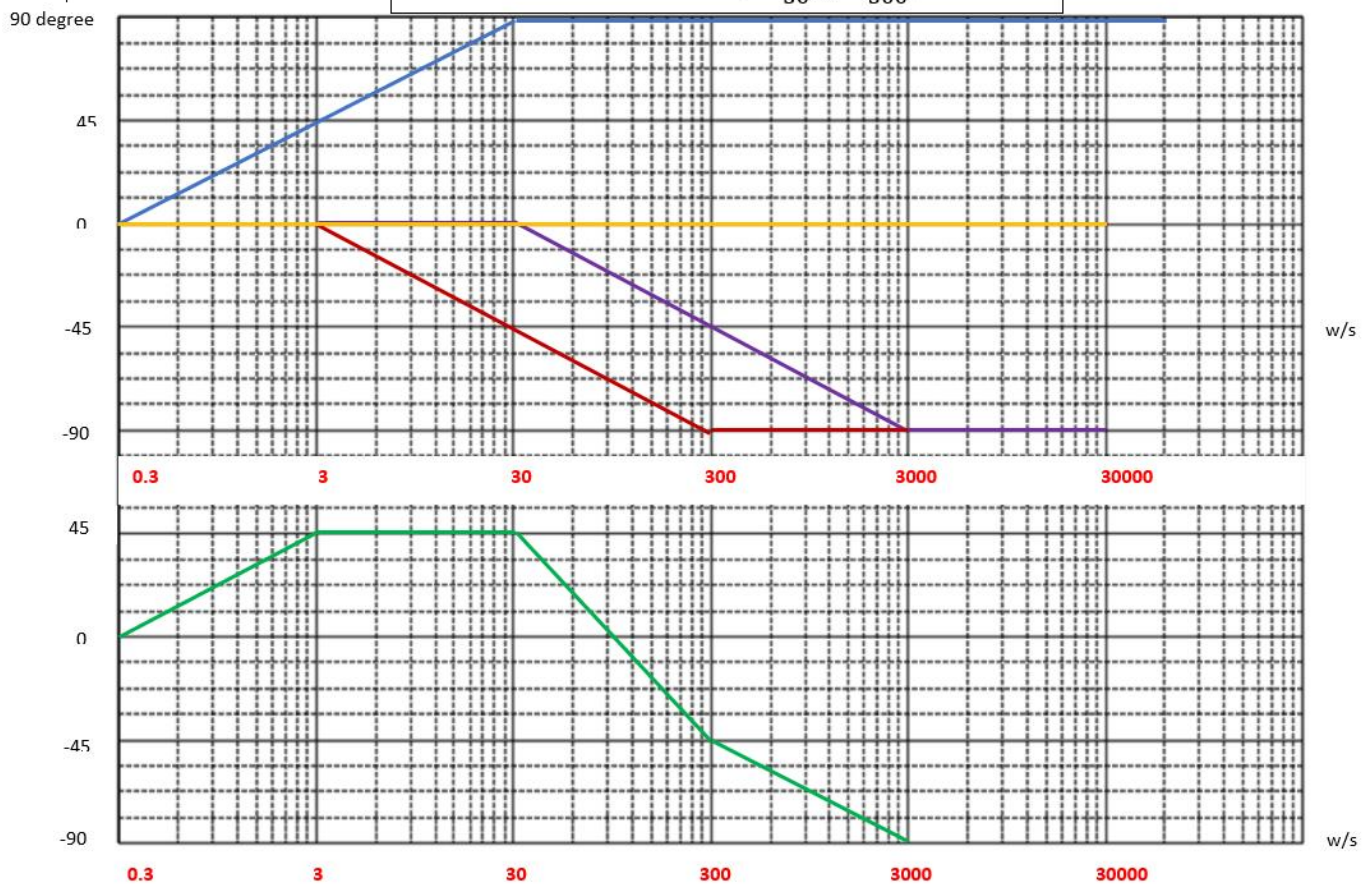
$$H(s) = \frac{(s+3)}{(s+30)(S+300)}$$



Q - 4

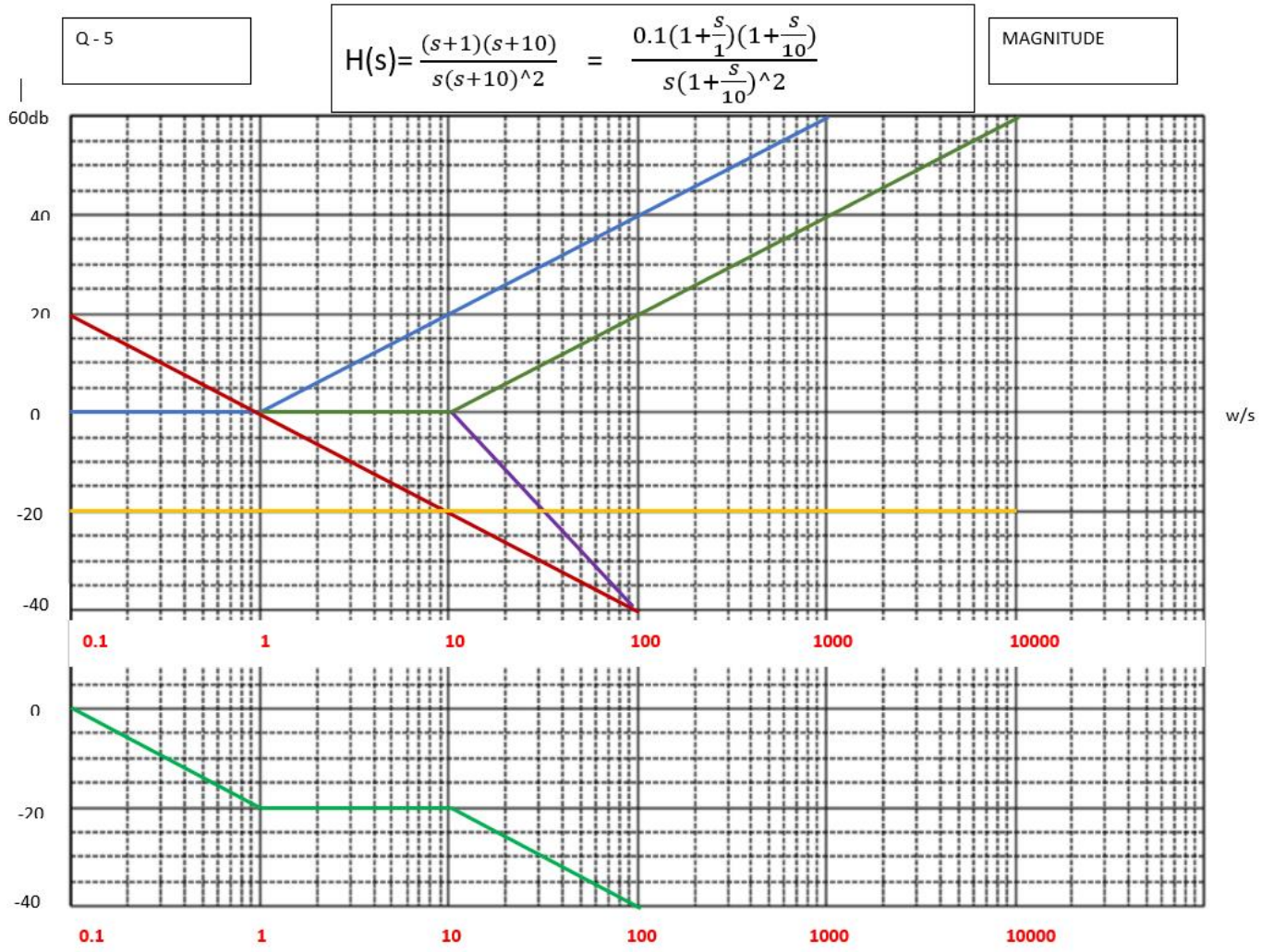
$$H(s)=\frac{(s+3)}{(s+30)(s+300)} = \frac{0.000333\left(1+\frac{s}{3}\right)}{\left(1+\frac{s}{30}\right)\left(1+\frac{s}{300}\right)}$$

Phase



Q-5 Draw the magnitude and phase Bode diagram for the following transfer function.

$$H(s) = \frac{(s+1)(s+10)}{s(s+10)^2}$$



Q - 5

$$H(s)=\frac{(s+1)(s+10)}{s(s+10)^2}=\frac{0.1\left(1+\frac{s}{1}\right)\left(1+\frac{s}{10}\right)}{s\left(1+\frac{s}{10}\right)^2}$$

Phase