1

90/100

EEN 360	SPRING 2008	NDU
MODERN	TEST1	ECCE DEPARTMENT
CONTROL	50 MINUTES	S.C ELMURR

NAME: ____________________

NOTE 1: OPEN BOOK, OPEN NOTES, CLOSED OLD TESTS AND SOLUTIONS.
NOTE 2: SHOW ALL WORK IN ORDER TO GET FULL CREDIT.

(1) 20
(2) 30
(3) 40

1. 20 pts: Find the inverse Laplace transform of the following function. Perform partial fraction expansion.

$$G(s) = \frac{10}{(s+1)^2(s+3)} = \frac{A}{(s+1)} + \frac{B}{(s+1)^2} + \frac{C}{s+3}$$

$$B = (s+1)^2 G(s)\Big|_{s=-1} = \frac{10}{(s+3)}\Big|_{s=-1} = \frac{10}{2} = 5$$

$$A = \left[\frac{d}{ds}\left((s+1)^2 G(s)\right)\right]_{s=-1} = \left[\frac{d}{ds}\left\{\frac{10}{(s+3)}\right\}\right]_{s=-1} = \left[\frac{-10}{(s+3)^2}\right]_{s=-1} = \frac{-10}{4} =$$

$$C = \left[(s+3)G(s)\right]_{s=-3} = \left[\frac{10}{(s+1)^2}\right]_{s=-3} = \frac{10}{4} = \frac{5}{2}$$

$$G(s) = \frac{-5/2}{(s+1)} + \frac{5}{(s+1)^2} + \frac{5/2}{s+3}$$

$$g(t) = \left[-\frac{5}{2}e^{-t} + \frac{5}{2}e^{-3t} + 5te^{-t}\right]u(t)$$

3

3. 45 pts. For the transfer function shown below, determine the value of so that the Bode magnitude plot intersects at -8 dB at w = 0.1 rad/s. Plot the magnitude and phase Bode approximations. Find the 0-db crossings and label the gain at each break frequency. Find the gain and phase margins.

$$GH(s) = \frac{Ks(s+2)^2(s+100)(s+800)^2(s+5000)}{(s+10)^2(s+40)(s+500)^2(s+1000)(s+20000)^2}$$

the ratio of the constants is:

$$\frac{128 \times 10^{10} K}{4 \; 10^{20}} = \frac{32}{10^{10}} K$$

$$20 \log\left(\frac{32K}{10^{10}}\right) = 12$$

$$\log \frac{32K}{10^{10}} = \frac{12}{20} = 0.6 \implies \log(3.2 \times 10^{-9} K) = 0.6$$

$$3.2 \times 10^{-9} K = 10^{0.6}$$

$$3.2 \times 10^{-9} K = 4$$

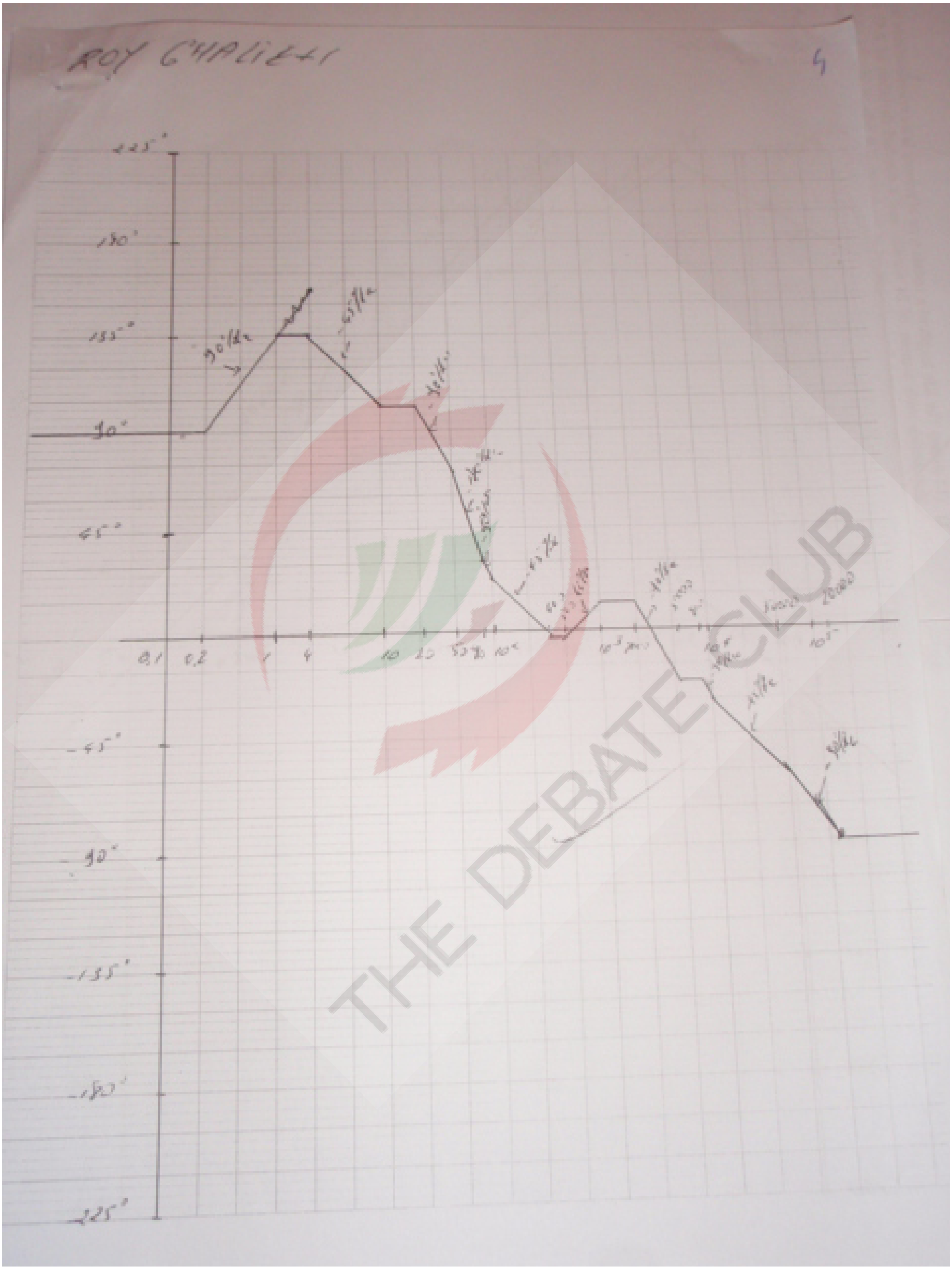
$$\boxed{K = 1.25 \times 10^{9}}$$

0 dB crossing
phase margin

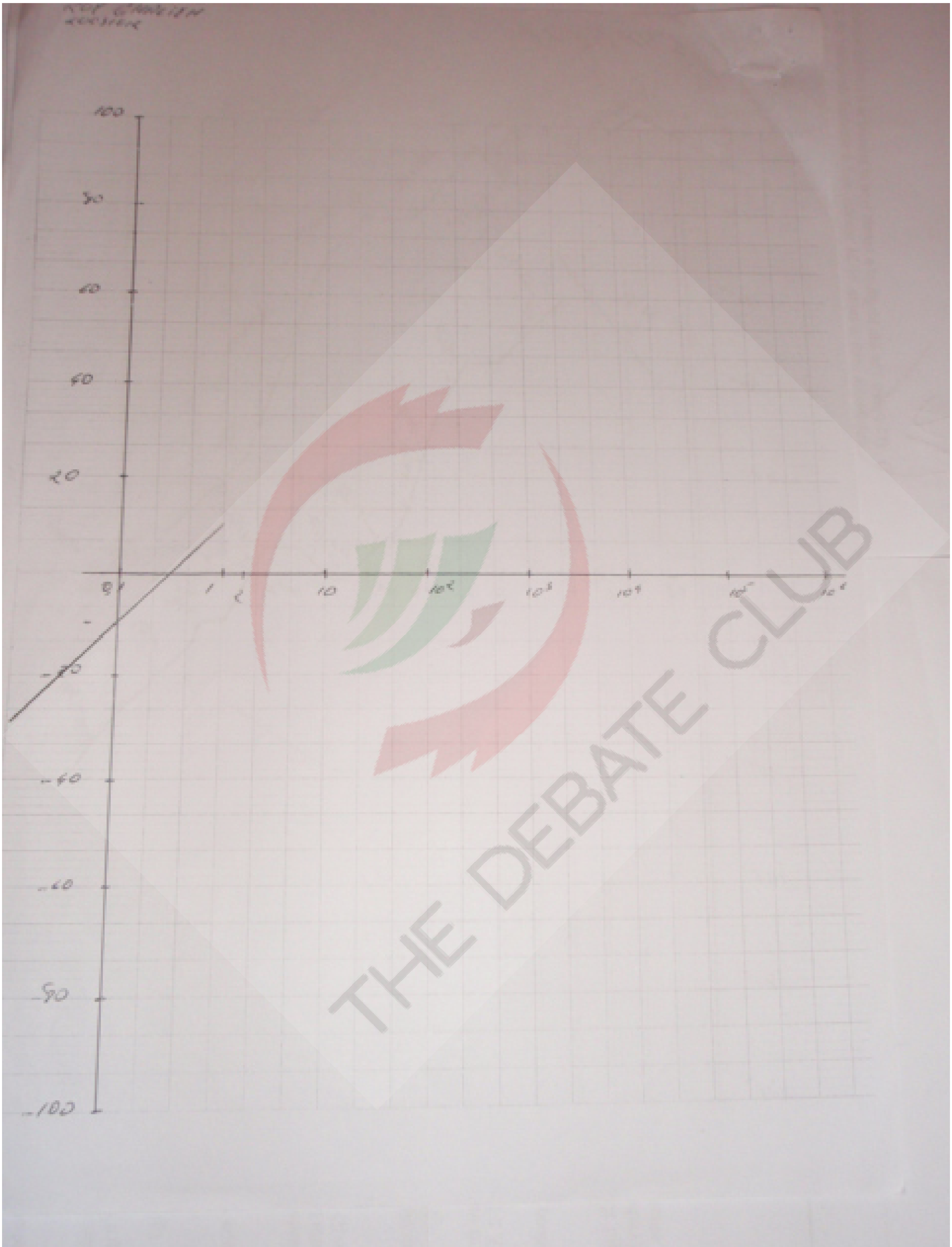
-5

In Bode form

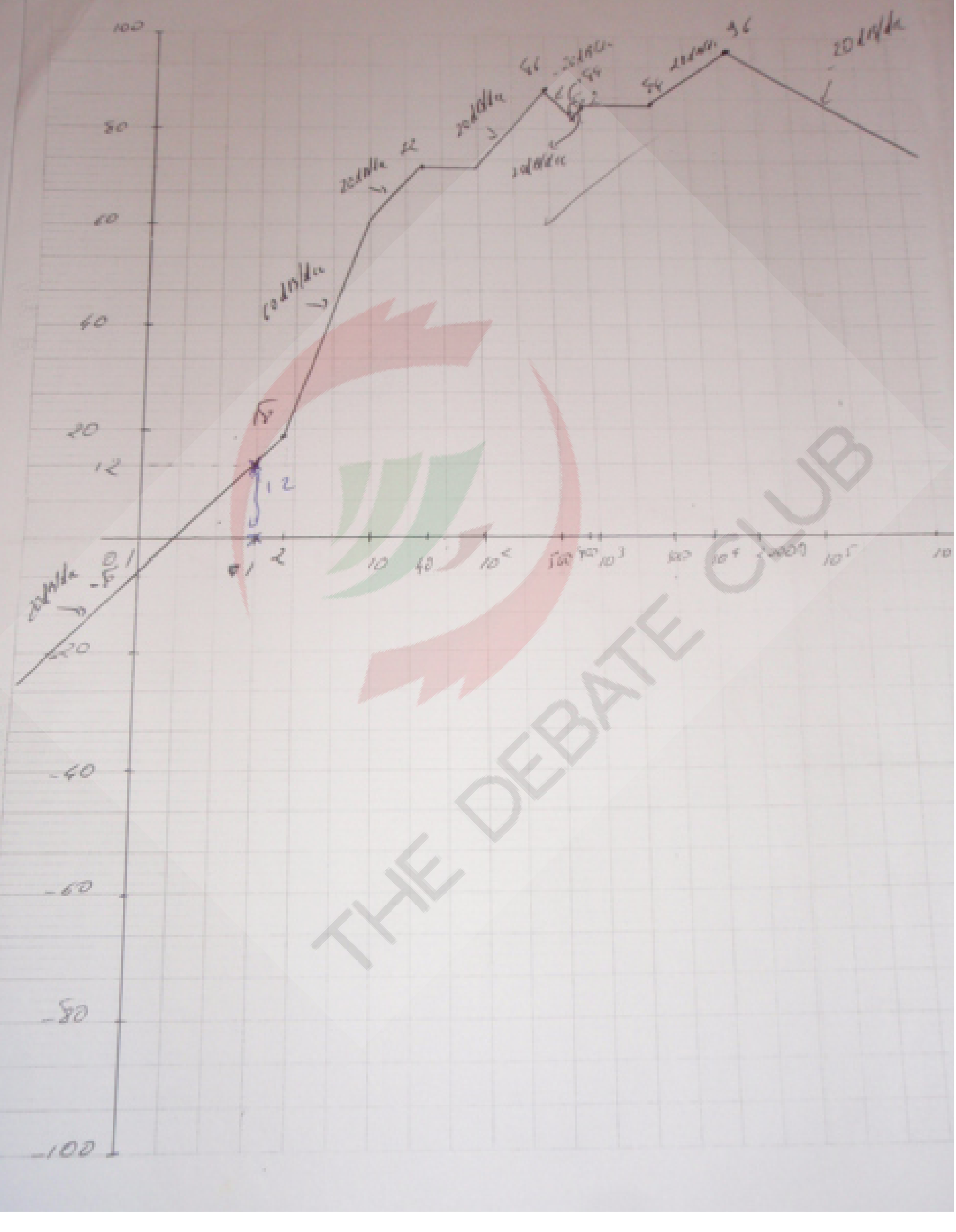
$$GH(s) = \frac{32 \times 1.25 \times 10^{9}}{10^{10}} \frac{s\left(1+\frac{s}{2}\right)^2\left(1+\frac{s}{100}\right)\left(1+\frac{s}{800}\right)^2\left(1+\frac{s}{5000}\right)}{\left(1+\frac{s}{10}\right)^2\left(1+\frac{s}{40}\right)\left(1+\frac{s}{500}\right)^2\left(1+\frac{s}{1000}\right)\left(1+\frac{s}{20000}\right)}$$



225°
180°
135°
90°
45°
-45°
-90°
-135°
-180°
-225°
0,1
0,2
1
4
10
20
20000


100
60
40
20
0.1
1
2
10
10^2
10^3
10^4
-20
-40
-100

ROY GHALIEH


100
80
60
40
20
12
-20
-40
-60
-80
-100
0.1
1
2
10
40
10^2
10^3
10^4
10^5
20dB/dec
96
94
54
12


225°
180°
135°
90°
45°
0,2
0,1
1
10
-45°
-90°
-135°
-180°
-225°