APPLICATION OF LOGARITHM IN ELECTRICAL CALCULATIONS

LINEAR

$$\boxed{N = b^{x} \longrightarrow \log_{b} N = x}$$

$$N = 10^{x} \longrightarrow \log_{10} N = x$$

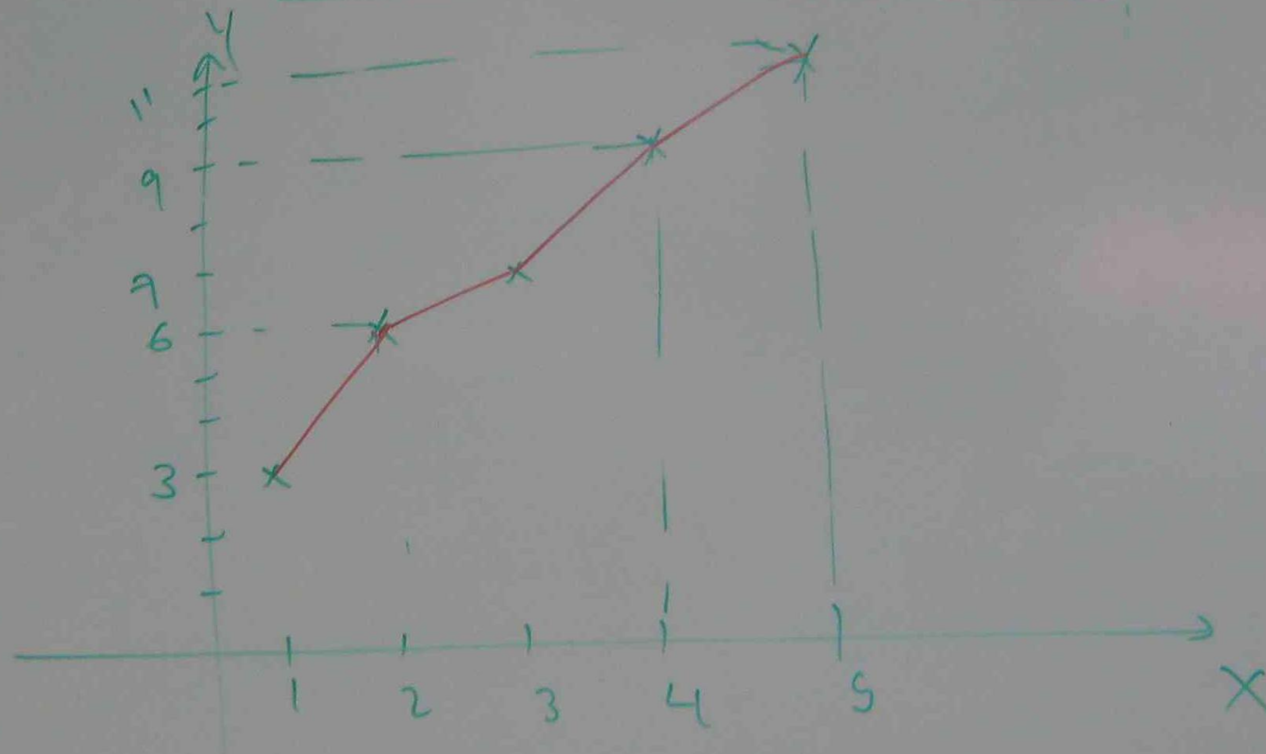
$$N = e^{x} \longrightarrow \log_{e} N = x \longrightarrow \ln N = x$$

$$\log_{e} N = 2.303 \log_{10} N$$

$$\boxed{\ln N = 2.303 \log_{10} N}$$

LINEAR GRAPH

X	1	2	3	4	5
Y	3	6	7	9	11

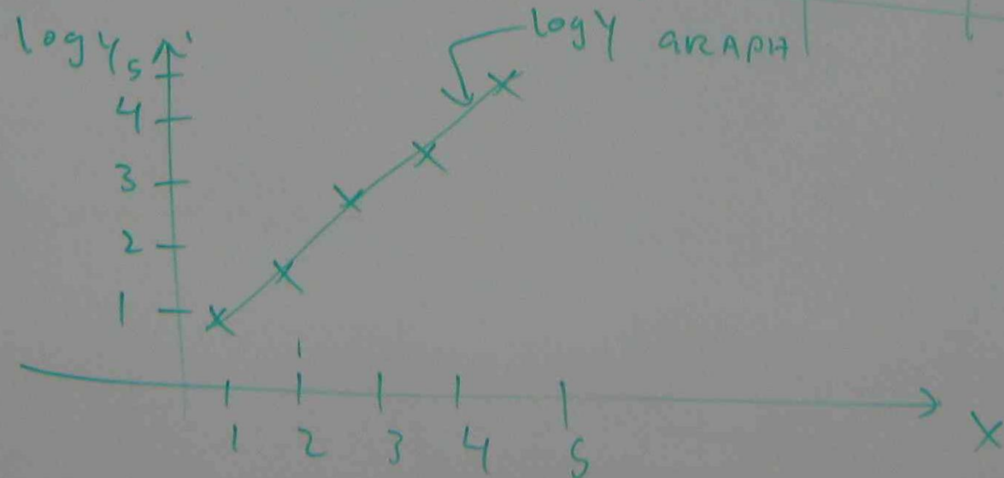


Log GRAPH

X	1	2	3	4	5
Y	10	100	1000	10000	100000

X	1	2	3	4	5
log Y	log10 = 1	log100 = 2	log1000 = 3	log10000 = 4	log100000 = 5

X



IN ELECTRONICS SIGNAL SYSTEMS, THE RANGE OF FREQUENCIES IS TOO WIDE.

LOG GRAPH IS APPLIED TO PLOT SUCH VERY WIDE FREQUENCIES.

PROPERTIES OF LOGARITHMS

$$\log_{10} 1 = 0 \longrightarrow 10^0 = 1$$

$$\log_b N^n = n \log_b N$$

$$\log_b N + \log_b M = \log_b MN$$

$$\log_b N - \log_b M = \log_b \frac{N}{M}$$

$$\log_b N = \frac{\log_{10} N}{\log_{10} b}$$

XPRESSIONS.

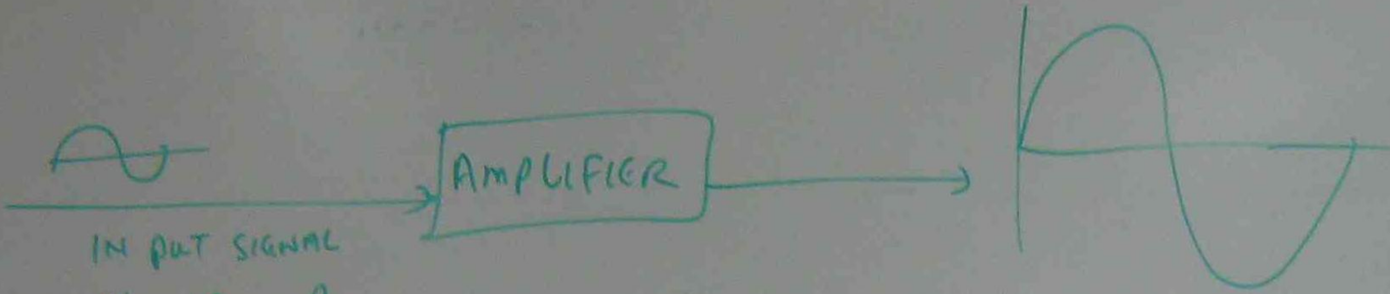
(240)

(d) $\log_{10} \frac{1\times10^{4}}{1\times10^{-4}} = \log_{10}\frac{10^4}{10^{-4}} = \log_{10}10^4 - \log_{10}10^{-4} = 4\log_{10}10 - (-4)\log_{10}10$

$= 4 + 4 = 8$

$\boxed{\log_{10}10 = 1}$

(e) $\log_{10}10^4 = 4\log_{10}10 = 4\times1 = 4$



IN PUT SIGNAL

V_1, I_1, P_1

OUT PUT SIGNAL

V_2, I_2, P_2

POWER GAIN = $10 \log_{10} \frac{P_2}{P_1}$ (DECIBELS dB)

VOLTAGE GAIN = $20 \log_{10} \frac{V_2}{V_1}$ (DECIBEL → dB)

CURRENT GAIN = $20 \log_{10} \frac{I_2}{I_1}$

pb

FIND THE VOLTAGE GAIN IN dB OF A SYSTEM WHERE THE APPLIED SIGNAL IS 2mV AND THE OUTPUT VOLTAGE IS 1.2V

$V_1 = 2\,mV$ $\boxed{\text{AMPLIFIER}}$ $V_2 = 1.2V$

$= 2 \times 10^{-3}\, V$

$$\text{VOLTAGE GAIN} = 20 \log_{10} \frac{V_2}{V_1} = 20 \log_{10} \frac{1.2}{2\times10^{-3}}$$

$$= 20 \log_{10} \frac{1.2\times10^{3}}{2} = 20 \log_{10} 0.6\times10^{3}$$

$$= 20 \log_{10} 600$$

$$= 55.56\ dB$$

Pb IF A SYSTEM HAS A VOLTAGE GAIN OF 36 dB, FIND THE APPLIED VOLTAGE IF THE OUT PUT VOLTAGE IS 6.8V.

$$\text{VOLTAGE GAIN} = 20 \log_{10} \frac{V_2}{V_1}$$

$$36 = 20 \log_{10} \frac{6.8}{V_1}$$

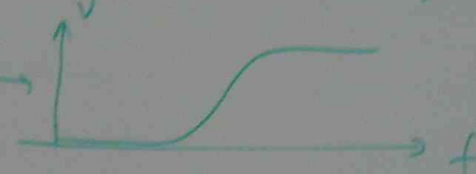
$$1.8 = \log_{10} \frac{6.8}{V_1}$$

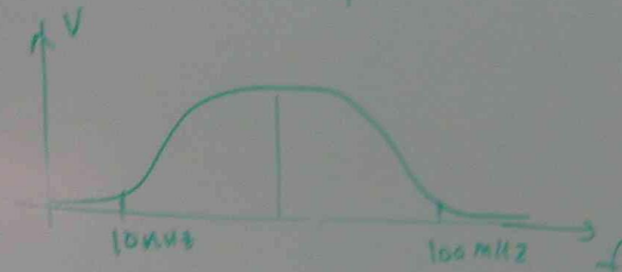
$$10^{1.8} = \frac{6.8}{V_1} \longrightarrow V_1 = \frac{6.8}{10^{1.8}} = \frac{6.8}{63.095} = 0.107\,V$$

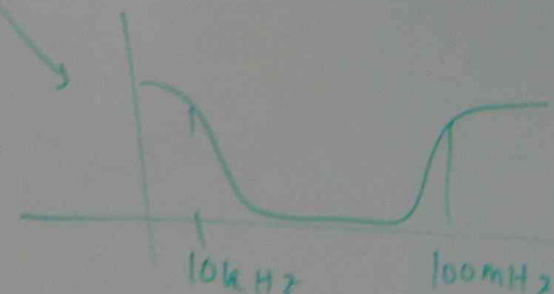
APPLICATION OF LOGARITHMIC GRAPHS

FILTERS

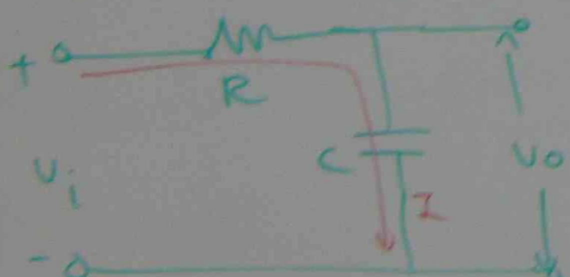
- LOW PASS
- HIGH PASS
- BAND PASS
- BAND STOP







low pass filter



$$V_i = I \times Z = I \times \sqrt{R^2 + X_c^2}$$

$$V_o = I \times X_c$$

$$A_v = \frac{V_o}{V_i} = \frac{I X_c}{I\sqrt{R^2+X_c^2}} = \frac{X_c}{\sqrt{R^2+X_c^2}}$$

pb

SOLVE $(y+x^4)\,dx - x\,dy = 0$

$$y\,dx + x^4\,dx - x\,dy = 0$$

$$\underbrace{y\,dx - x\,dy}_{} + x^4\,dx = 0$$

INTEGRATING FACTOR $\frac{1}{x^2}$

$$\frac{1}{x^2}\left(y\,dx - x\,dy\right) + \frac{1}{x^2}x^4\,dx = 0$$

$$\frac{y\,dx - x\,dy}{x^2} + x^2\,dx = 0$$

$$-\frac{xdy+ydx}{x^2} = -\left(\frac{xdy-ydx}{x^2}\right)$$

$$-\left(\frac{xdy-ydx}{x^2}\right)+x^2dx=0$$

$$-d\left(\frac{y}{x}\right)+x^2dx=0$$

$$\int -d\left(\frac{y}{x}\right)+\int x^2dx=\int 0 = 0$$

$$-\frac{y}{x}+\frac{x^{2+1}}{2+1}=0$$

$$-\frac{y}{x}+\frac{x^3}{3}=0$$

pb SOLVE $(x^3 + xy^2 - y)dx + x\,dy = 0$

$$x^3dx + xy^2dx - y\,dx + x\,dy = 0$$

$$x^3dx + xy^2dx - (y\,dx - x\,dy) = 0$$

$$x\,dx(x^2+y^2) - (y\,dx - x\,dy) = 0$$

DIVIDED BY (x^2+y^2)

$$\frac{x\,dx(x^2+y^2)}{(x^2+y^2)} - \frac{(y\,dx - x\,dy)}{x^2+y^2} = 0$$

$$x\,dx - \frac{(y\,dx - x\,dy)}{x^2+y^2} = 0$$

$$x\,dx - \frac{(-x\,dy + y\,dx)}{x^2+y^2} = 0$$

$$x\,dx + \frac{(x\,dy - y\,dx)}{x^2+y^2} = 0$$

$$x\,dx + d\tan^{-1}\frac{y}{x} = 0$$

$$\int x\,dx + \int d\tan^{-1}\frac{y}{x} = \int 0$$

$$\frac{x^{1+1}}{1+1} + \tan^{-1}\frac{y}{x} + c = 0$$

$$\frac{x^2}{2} + \tan^{-1}\frac{y}{x} = c$$