1a) $V_a = V_b = 2 \times \frac{90}{90+10} = 1.8V$ //

b) $I_3 = I_f = \frac{1-1.8}{10k} = 0.08mA$ //

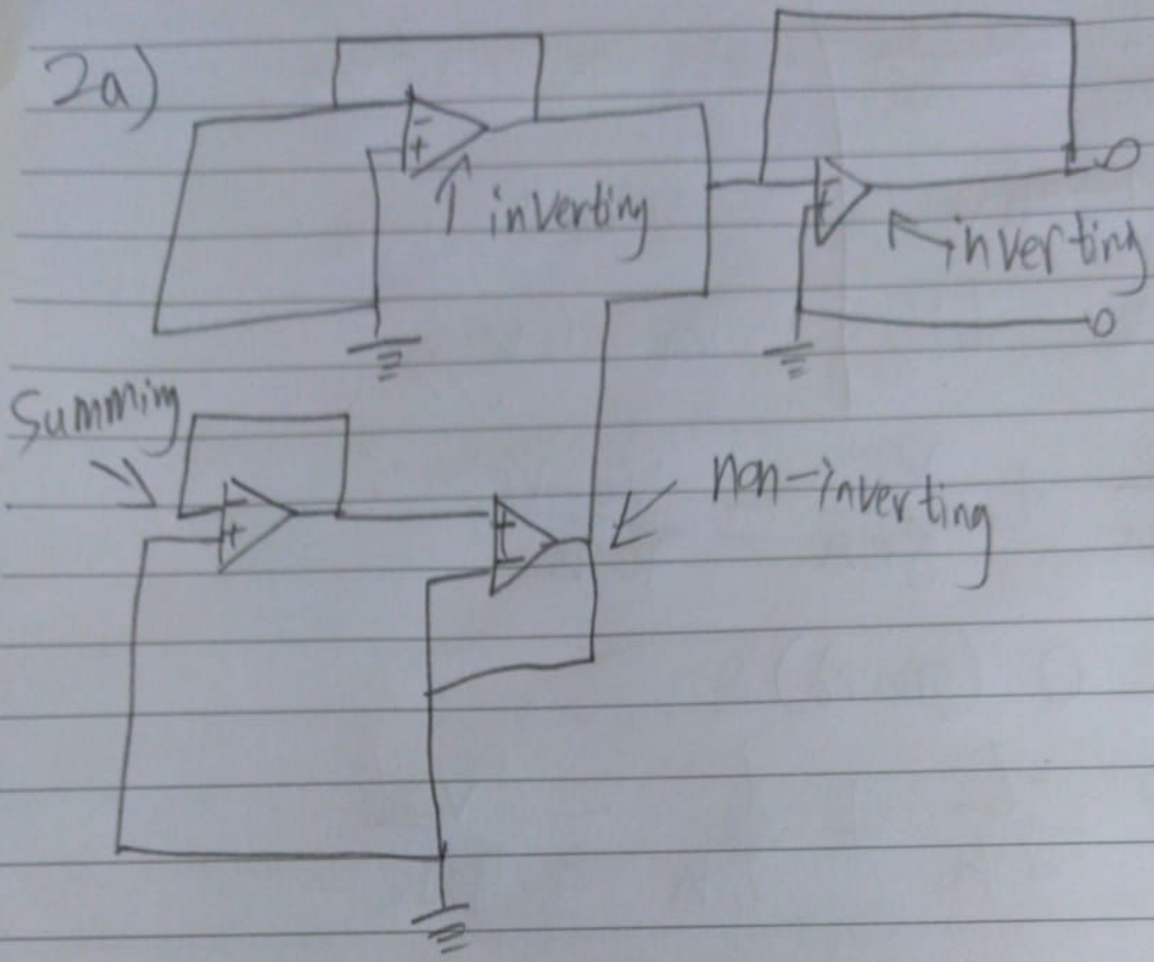
$\frac{1.8-|V_o|}{90k} = -0.08$

$|V_o| = 9V$

$V_o = -9V$ //

Date

2a)



No.

Date

2. b $\frac{1.5}{5k} = \frac{|V_1|}{20k}$

$|V_1| = 6V$

$V_1 = -6V$ //

$V_3 = V_2 = 2.25V$ //

$V_3 = V_4 \cdot \frac{30k}{30k+50k}$

$V_4 = 6V$ //

$$\frac{V_1}{40k} + \frac{V_4}{80k} = \frac{V_0 - V_5}{100k}$$

$\because V_5 = 0$ (ground)

$$\frac{-6}{40k} + \frac{6}{80k} = \frac{V_0}{100k}$$

$$V_0 = -7.5V$$

c) unchanged due to the currents being 0 at the resistors affected.

No.

Date . .

3.a) $$\frac{V_1}{\left(\frac{\frac{R}{j\omega C_1}}{R+\frac{1}{j\omega C_1}}\right)} + \frac{V_i}{R} = 0$$

$$V_1 = -\frac{V_i}{1+j\omega C_1 R}$$

$$\frac{V_1}{R+\frac{1}{j\omega C_2}} + \frac{V_2}{R} = 0$$

$$V_2 = -\frac{V_1 R}{R+\frac{1}{j\omega C_2}}$$

$$\frac{V_2}{R_i} + \frac{V_0}{R_f} = 0$$

$$V_0 = -\frac{R_f}{R_i} \cdot V_2$$

$$V_0 = \left(-\frac{R_f}{R_i}\right)\left(-V_1\right)\left(\frac{R}{R+j\omega C_2}\right)$$

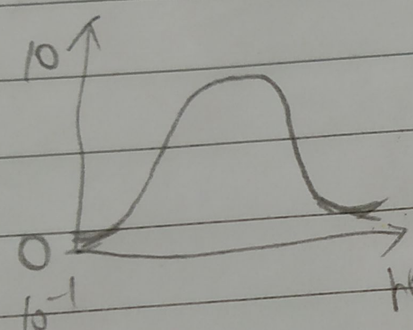
$$V_0 = \left(-\frac{R_f}{R_i}\right)\left(\frac{V_i}{1+j\omega C_1 R}\right)\left(\frac{j\omega C_2 R}{1+j\omega C_2 R}\right)$$

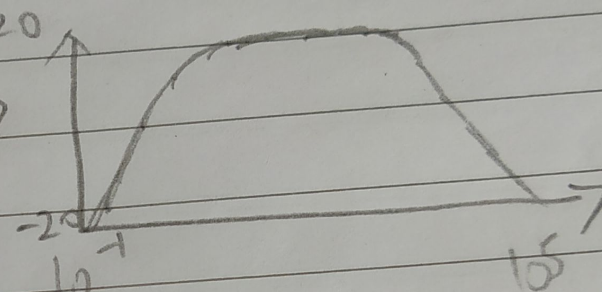
$$\frac{V_0}{V_i} = -\frac{R_f}{R_i}\left(\frac{1}{1+j\omega C_1 R}\right)\left(\frac{j\omega C_2 R}{1+j\omega C_2 R}\right)$$

3b) $\frac{V_o}{V_i} = -\frac{R_f}{R_i}\left(\frac{1}{1+\frac{j\omega}{\omega_1}}\right)\left(\frac{\frac{j\omega}{\omega_2}}{1+\frac{j\omega}{\omega_2}}\right)$

$\because$ First part of circuit is a 1st order low pass filter
$\because$ Second circuit is a 1st order high pass filter

$\because$ If $\omega_2 < \omega_1$





$\therefore$ Still a band pass with different magnitudes

c) $\frac{V_o}{V_i} = -\frac{R_f}{R_i}\left(\frac{1}{1+\frac{j\omega_0}{\omega_1}}\right)\left(\frac{\frac{j\omega_0}{\omega_2}}{1+\frac{j\omega_0}{\omega_2}}\right)$

$\frac{V_o}{V_i} = -\frac{R_f}{R_i}\left(\frac{1}{1+\frac{j\sqrt{\omega_1\omega_2}}{\omega_1}}\right)\left(\frac{j\omega_1\omega_2}{1+\frac{j\omega_1\omega_2}{\omega_2}}\right)$

When $\omega_0 = 0$, $\omega_0 = \infty$