Student ID:_____ Student Name:_____

1) For the circuit in Fig 1, assuming the op amp is ideal, and given that $R_2 = R_4 = 90$ kΩ.
$R_1 = R_3 = 10$ kΩ, $v_1 = 1$ V and $v_2 = 2$ V, **3 marks**

a) Find v_a and v_b;

b) Find I_3, I_F and v_o.

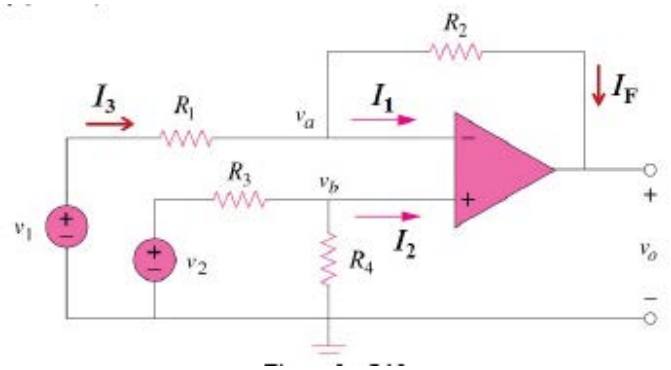

Fig 1

2) With reference to the circuit in Fig 2, assuming all op amps to be ideal, **4 marks**

a) Identify the type of amplifier circuit associated with each of the op amps (label next to the op amp);

b) Find V_1, V_2, V_3, V_4, V_5, and v_o

c) Find v_o again if all the 10 kΩ resistors were reduced to 2 kΩ.

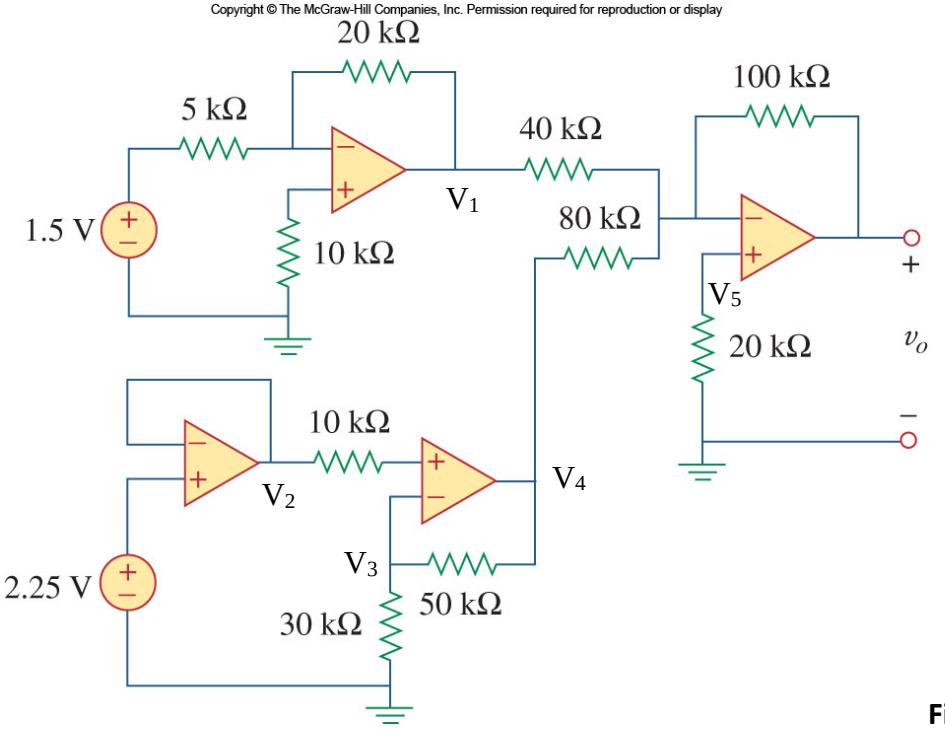

Fig 2

3 **3 marks**

a) Prove that transfer function of the filter shown in Fig 3 is:

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

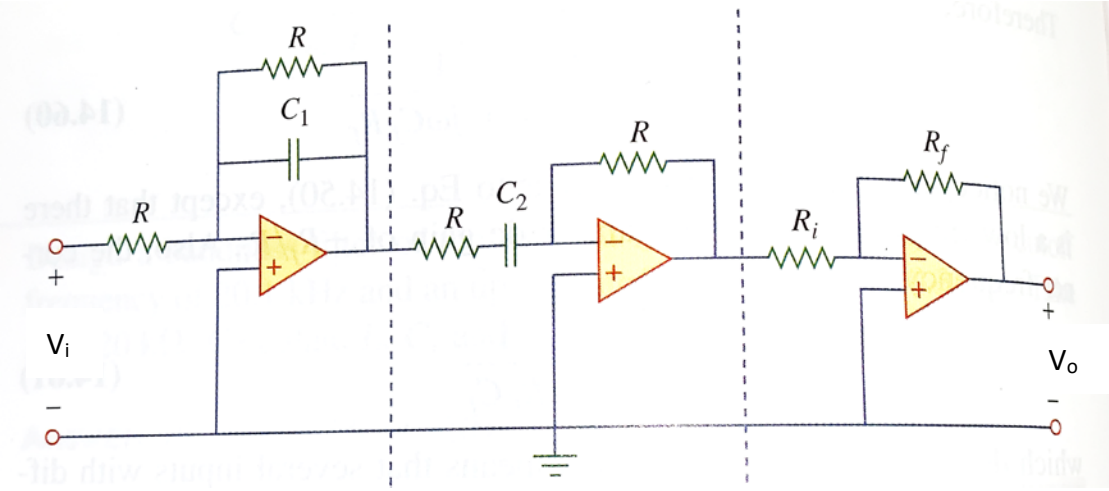

Fig 3

b) Define $\omega_1 = \frac{1}{RC_1}$ and $\omega_2 = \frac{1}{RC_2}$. If $\omega_2 < \omega_1$, is the filter in Fig 3 a low-pass, high-ass, bandpass or bandstop filter?

c) At the center frequency $\omega_o = \sqrt{\omega_1 \omega_2}$, what is the magnitude of the transfer function $\left|\frac{V_o}{V_i}\right|$?