Q1

b) Find v_b first by applying voltage divider rule given that R_3 and R_4 are in series.

c) I_3 can be found by considering the voltage across R_1. $I_3 = I_F$ because $I_1 = 0$. Last, v_o can be found by considering the voltage drop across R_2.

Q2

a) Applying nodal analysis at non-inverting input:

$$\frac{10mV - V^+}{4k} = \frac{V^+}{6k} + \frac{V^+}{12k}$$ (Bear in mind there is no current going into the op amp)

b) Applying nodal analysis at inverting input:

$$\frac{10mV - V^-}{6k} + \frac{v_o - V^-}{12k} = \frac{V^-}{4k}$$ (Bear in mind there is no current going into the op amp)

And the value of V^- is already known from the previous part.

Q3

b) Note that i_4 is the sum of the i_3 and the current in the 100 kΩ resistor.

c) i_5 can be found by considering the voltage drop across the 50 kΩ resistor, which equals v_{o2}. Note that the 100 kΩ and 50 kΩ resistors are in series, allowing us to apply voltage divider rule to find v_o.

Q4

Note that first stage is a summing amplifier with v_i and v_o as inputs:
If we define V_1 as the output of this stage, then:
$V_1 = -10/5 * v_i - 10/4 * v_o$

The second stage is a non-inverting amplifier with V_1 as input:
Therefore, $v_o = (1 + 10/2)*V_1$

Q5

a) With $V_S = 1.2$ V, the corresponding output (a negative voltage) would be over the saturation limit. So it will be limited by V_S^-.

b) Two features of the graph that should be highlighted:
- The line around the origin (where V_S is small) has a slope equal to the gain. As implied by the negative sign of the closed loop gain, the slope of the line should be negative.

- Once the curve reaches +5V or -5V, it should be horizontal to represent saturation.