1. a) Emitter follower — allows load to have large current without drawing a large current from a source.

b) quiescently, \( V_B = \frac{R_2}{R_1 + R_2} \cdot V_{cc} = \frac{50}{95} \cdot 15 \ V = 7.9 \ V \)

so \( V_E = V_B - 0.6 \ V = 7.3 \ V \)

\( V_c = V_{cc} = 15 \ V \)

which makes \( I_E = \frac{7.3}{5} \ V = 1.46 \ mA \)

and \( I_E = I_c = 1.6 \ mA \)

Finally, \( V_c = +15 \ V \)

c) \( 10X \) rule applied to biasing network: biasing network "sees" 5 \( k \)

load resistor as \( h_{FE} \ R_E = 500 \ k \)

since the Thévenin equivalent of the biasing network (voltage divider) is \( 45 \ k / 50 \ k \), or \( \frac{1}{\frac{45}{45} + \frac{1}{50}} = 24 \ k \), the load is \( > 10X \) source \( V \)

d) In this circuit, \( V_E \) has to be between 0 \( V \) (\( V_{EE} \)) and 14.8 \( V \) (\( V_{cc} \geq 0.2 \ V \)). This corresponds to \( V_B \) between 0.6 \( V \) and 15.4 \( V \).

since \( V_B \) sits quiescently (with \( V_{in} = 0 \)) at 7.9 \( V \), \( V_{in} \) can swing down 0.6 \( V - 7.9 \ V = -7.3 \ V \) and up 15.4 - 7.9 = 7.5 \( V \).

e) The 45 \( k \) and 50 \( k \) resistors form a voltage divider that holds the base (and therefore the emitter) far enough above ground that an input signal that swings positive and negative can keep the transistor turned on. These resistors would not be needed if a dual supply (\( +V \ + -V \)) were available for \( V_{cc} + V_{EE} \).
2. a) Common-emitter amplifier, produces voltage as well as current gain

b) quiescently, \( V_B = \frac{R_2}{R_1 + R_2} V_C = \frac{15k}{115k} (15V) = 2.0 \text{ V} \)
\[ \text{so } \ V_E = V_B - 0.6 = 1.4 \text{ V} \]

which makes \( I_E = \frac{V_E}{R_E} = \frac{1.4V}{4k} = 0.35 \text{ mA} \rightarrow I_C = 0.35 \text{ mA} \)

\( I_B = I_C / h_{FE} = 0.0035 \text{ mA} \)

and then \( V_C = 15 - (20k)(0.35 \text{ mA}) = 8 \text{ V} \)

c) voltage gain = \(-R_C / R_E = -20k / 4k = -5 \)

d) quiescent \( V_{CE} = 8 - 1.4 = 6.6 \text{ V} > 0.2 \text{ V}, \text{ so we are in the active region where } h_{FE} \approx 100 \)

e) with \( V_{in} = 0.5 \text{ V} \) amplitude at 10 kHz,
expected \( V_{out} = -5 \times 0.5 \text{ V} = -2.5 \text{ V} \)

or 2.5 V amplitude at 10 kHz

the output is inverted, and is offset by 8 V (the quiescent \( V_C \))

f) with \( V_{in} = 3.0 \text{ V} \) amplitude at 10 kHz, we'd expect
\( V_{out} = -15 \text{ V} \) amplitude

but \( V_{out} \) can only swing \( 15 - 8 = 7 \text{ V up} \)

and \( 8 - 0.2 = 7.8 \text{ V down} \)

so the output signal will clip or saturate at about \( \pm 7.8 \text{ V} \)