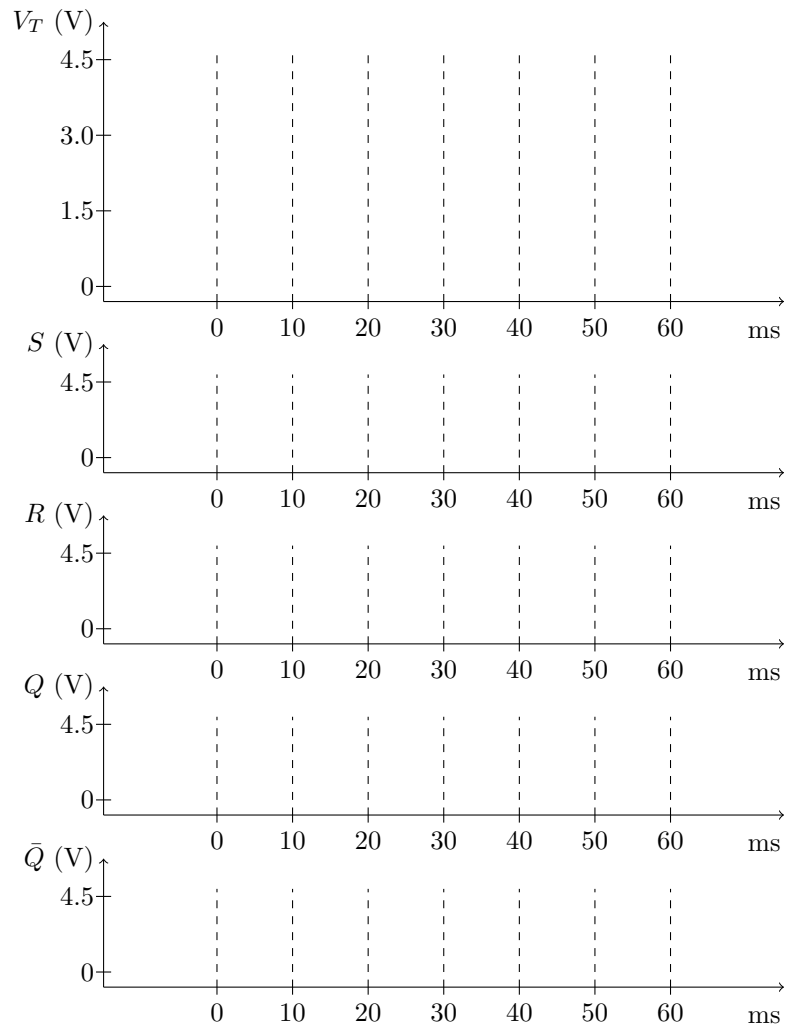
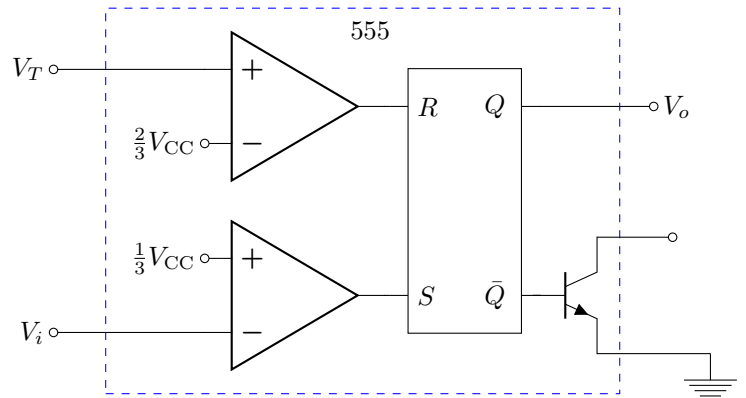
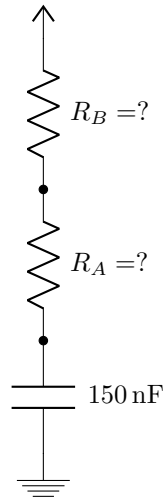


Instructions:

- This quiz lasts 30 minutes. Answer all questions (on both sides of the sheet)
- You may have a 8.5" × 11" sheet of notes and a non-network-connected calculator

Q1a: A 555 timer circuit is shown, with voltage supplies of $V_{CC} = 4.5\text{ V}$ and ground. Are components are ideal.

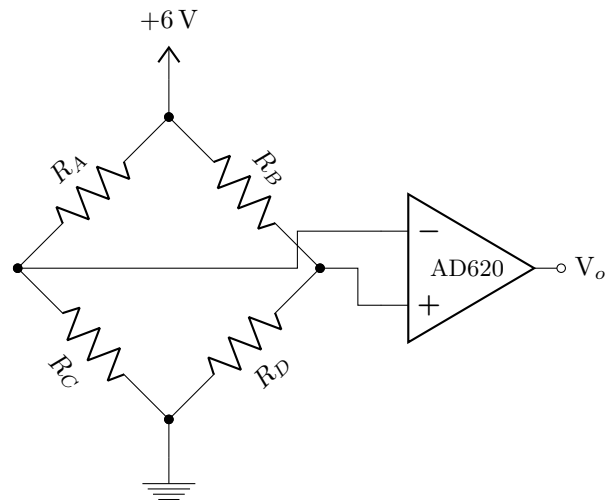
- (10 marks) It is required that the circuit function as an astable oscillator with output low- and high-periods of 20 ms and 30 ms, respectively. To make this happen, draw appropriate connections and select resistors R_A and R_B .
- (10 marks) At time $t = 0$, $V_T = 0$. Sketch graphs of V_T , S , R , Q , and \bar{Q} on the axes indicated.



Q2a: Using strain gauges with an instrumentation amplifier which is initially ideal:

- (10 marks) Two strain gauges are used to measure a horizontal beam being bent downwards at one end.
 - Sketch the layout of this scenario.
 - Indicate where the two strain gauges are placed (and in what orientation).
 - Indicate whether each resistance increases, decreases or stays approximately constant when the beam is loaded.

- (10 marks) Resistors $R_A = R_C = 10\text{ k}\Omega$, and the strain gauges have unloaded values of $R_B = R_D = 10\text{ k}\Omega$. When loaded, R_B changes by +10% and R_D changes by -5%. What is V_o if
 - the amplifier has common-mode and difference gains: $A_d = 100$ and $A_{cm} = 0$.
 - the amplifier has common-mode and difference gains: $A_d = 100$ and $A_{cm} = 0.1$.

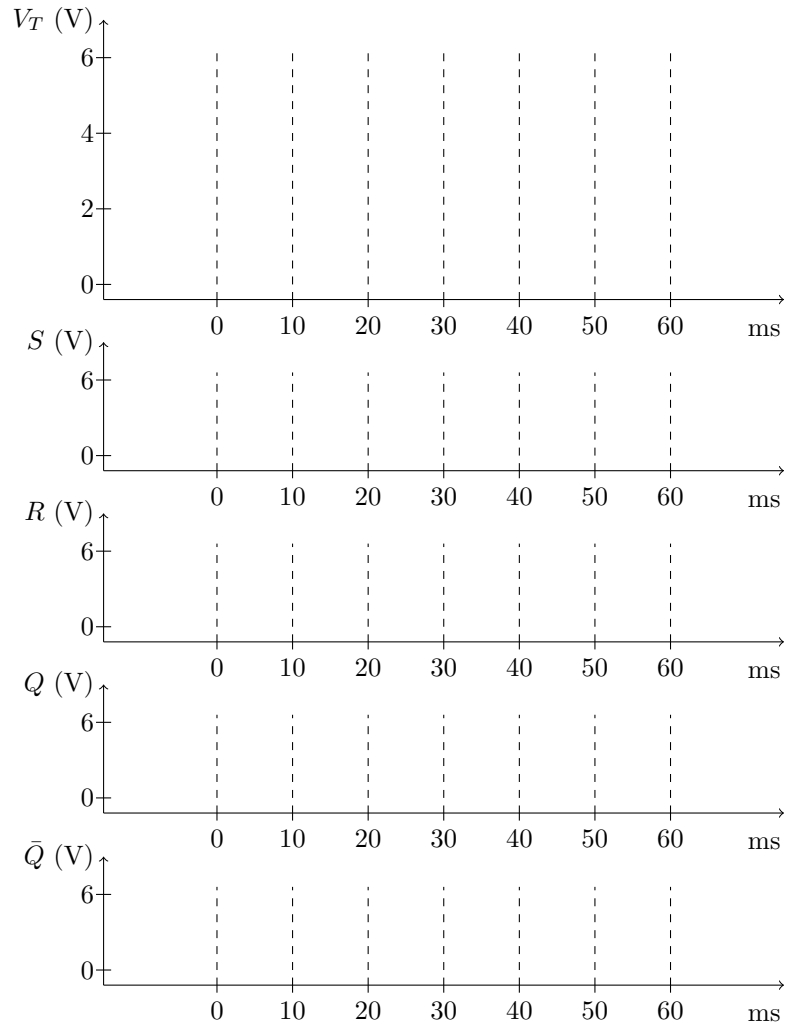
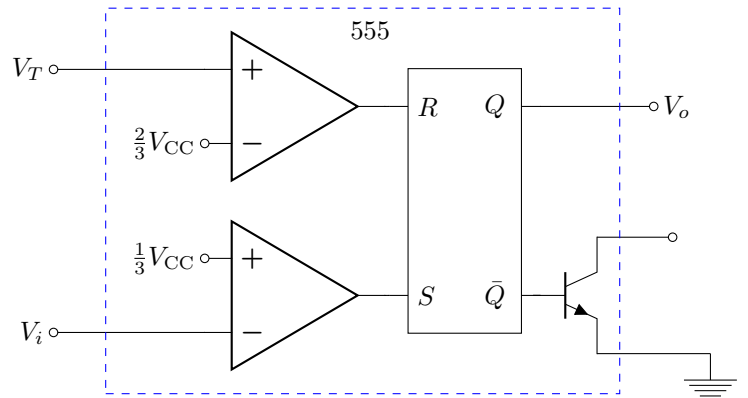
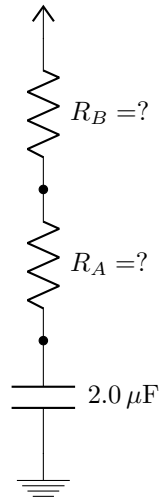


Instructions:

- This quiz lasts 30 minutes. Answer all questions (on both sides of the sheet)
- You may have a 8.5" × 11" sheet of notes and a non-network-connected calculator

Q1b: A 555 timer circuit is shown, with voltage supplies of $V_{CC} = 6\text{ V}$ and ground. Are components are ideal.

1. (10 marks) It is required that the circuit function as an astable oscillator with output low- and high-periods of 10 ms and 20 ms, respectively. To make this happen, draw appropriate connections and select resistors R_A and R_B .
2. (10 marks) At time $t = 0$, $V_T = 0$. Sketch graphs of V_T , S , R , Q , and \bar{Q} on the axes indicated.



Q2b: Using strain gauges with an instrumentation amplifier which is initially ideal:

- (10 marks) Two strain gauges are used to measure a vertical beam fixed at the bottom while being compressed from the top.
 - Sketch the layout of this scenario.
 - Indicate where the two strain gauges are placed (and in what orientation).
 - Indicate whether each resistance increases, decreases or stays approximately constant when the beam is loaded.

- (10 marks) Resistors $R_A = R_C = 2.0\text{ k}\Omega$, and the strain gauges have unloaded values of $R_B = R_D = 2.0\text{ k}\Omega$. When loaded, R_B changes by -10% and R_D changes by -1% . What is V_o if
 - the amplifier has common-mode and difference gains: $A_d = 100$ and $A_{cm} = 0$.
 - the amplifier has common-mode and difference gains: $A_d = 100$ and $A_{cm} = 0.1$.

