

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: (10 marks) Describe two facts about Canada's classification system for medical devices (two sentences each). (e.g. What the levels are, criteria used to assess a device)

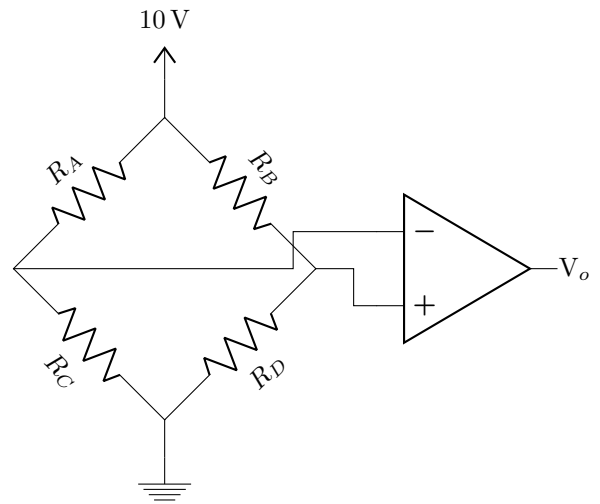
Q2a: (10 marks) Multiple measurements of a strain gauge sensor yield the following values (at right)

Length (mm)	10.0	10.0	10.0	10.5	10.5	10.5
Resistance (Ω)	81.0	80.0	79.0	89.5	89.5	91.0

- Estimate the sensitivity of this sensor (with units)
- Explain one situation in which it's useful to have a sensitive strain gauge (1 sentence)

Q3a: (20 marks) In the circuit at right, $R_A = R_B = R_C = 100\ \Omega$. R_D is a strain gauge which is currently at $101\ \Omega$. The amplifier is an AD620 instrumentation amplifier with a gain set to 100. The amplifier has a CMRR of 60 dB.

- (a) What is $V_d = V_+ - V_-$?
- (b) What is $V_{cm} = \frac{1}{2}(V_+ + V_-)$?
- (c) What is V_o ?
- (d) Why is high CMRR important for this circuit?



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: (10 marks) From a regulation point of view, what is the key difference between a “medical device” and a consumer product (such as health / lifestyle wearables products). Briefly explain (two sentences) and give one example.

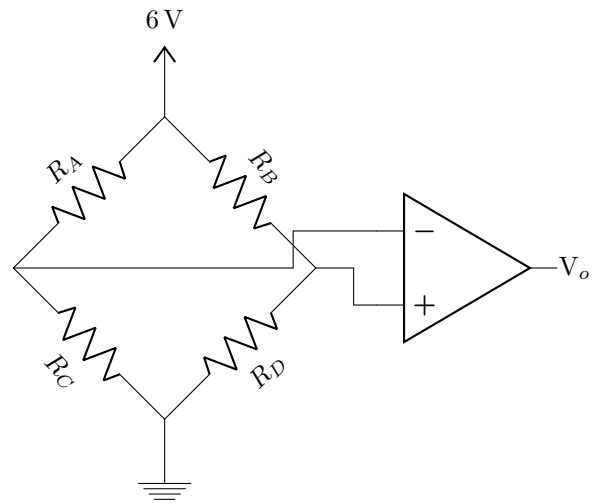
Q2b: (10 marks) Multiple measurements of a thermistor sensor yield the following values (at right)

Temperature ($^{\circ}\text{C}$)	30.0	30.0	30.0	30.5	30.5	30.5
Resistance (Ω)	41.0	40.0	39.0	59.5	59.5	61.0

- Estimate the sensitivity of this sensor (with units)
- Explain one situation in which it's useful to have a sensitive thermistor (1 sentence)

Q3b: (20 marks) In the circuit at right, $R_A = R_B = R_C = 200\ \Omega$. R_D is a strain gauge which is currently at $201\ \Omega$. The amplifier is an AD620 instrumentation amplifier with a gain set to 100.

- What is $V_d = V_+ - V_-$?
- What is $V_{cm} = \frac{1}{2}(V_+ + V_-)$?
- What CMRR is required so that the contribution of V_{cm} to V_o is $100\times$ less than the contribution of V_d ?



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

Q1c: (10 marks) Describe two facts about Canada's classification system for medical devices (two sentences each). (e.g. What the levels are, criteria used to assess a device)

Q2c: (10 marks) Multiple measurements of a strain gauge sensor yield the following values (at right)

Length (mm)	10.0	10.0	10.0	10.5	10.5	10.5
Resistance (Ω)	81.0	80.0	79.0	89.5	89.5	91.0

- Explain how would you estimate the precision of this sensor (numerical values and one sentence)?
- What is the difference between accuracy and precision for this sensor (one sentence)?

Q3c: (20 marks) In the circuit at right, $R_A = R_B = R_C = 2\text{ k}\Omega$. R_D is a strain gauge which starts at $2\text{ k}\Omega$. The amplifier is an AD620 instrumentation amplifier with a gain set to 100, and infinite CMRR.

- What is V_o under no strain?
- What is V_o when an applied strain makes $R_D = 2.01\text{ k}\Omega$?
- What is the sensitivity (in $\Delta V/\Delta\Omega$)?

