1. (12 points total) Circle the best answer to each of the following questions. Your answers need not be justified, and no partial credit will be awarded.

4 pts per question

A. In which of the following respects is a classical method of analysis inferior to an instrumental method of analysis? (Assume a skilled chemist is performing all analyses.)
(a) The accuracy of the results.
(b) The precision of the results.
(c) The dynamic range of the technique.
(d) The time required for the analysis.
(e) None of the above.

B. Which of the following statements about electronics is true?
(a) The internal resistance of an ideal current source is zero.
(b) The usefulness of a voltage follower circuit is related to the high output impedance of the operational amplifier.
(c) Adjusting the knob on a variac changes the variable resistance of a voltage divider.
(d) The intrinsic gain $A$ of an operational amplifier remains constant over time.
(e) Statements (a), (b), (c), and (d) are all false.

C. Which of the following statements about optical sources is false?
(a) A high pressure sodium lamp has broader lines than a low-pressure sodium lamp.
(b) In a quantum-mechanical transition, the natural line width is inversely proportional to the lifetime of the excited state.
(c) In order to produce light, a hollow cathode lamp requires an initial discharge to ionize the inert gas inside the lamp.
(d) Near infrared radiation (0.70 µm to 2.5 µm) excites vibrational overtones in molecules.
(e) The source in a fluorescence instrument is coaxial with the wavelength selector and detector.

2. (8 points) Discuss one advantage and one disadvantage of narrowing the analytical bandwidth of a measurement that employs operational amplifier circuits.

Advantages:
1. Lower Johnson and shot noise $\frac{V_{th}}{\sqrt{N}}$ $\Rightarrow$ higher precision
2. Op-amp circuits: $(A_f)$ constant so $\Delta f = \text{higher gain} \Rightarrow \text{higher signal}$

Disadvantages:
1. May lose information (if we don't know at what freg the data are being transmitted)
2. Since $\text{rise time} \propto \frac{1}{\Delta f}$, slower response time $\Rightarrow \text{distortion of signal}$

-1 significance of slower rise time not discussed