BioE 1310 - Review 4 - Op Amps 1/16/2017

Instructions: On the Answer Sheet, enter your 2-digit ID number (with a leading 0 if needed) in the boxes of the ID section. *Fill in the corresponding numbered circles.* Answer each of the numbered questions by filling in the corresponding circles in the numbered question section. Print your name in the space at the bottom of the answer sheet. Sign here stating that you have neither given nor received help.

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your signature

1. Which of the following are properties of the ideal operation amplifier?

I - Infinite input impedance.
II - Perfectly linear internal amplification.
III - Infinite gain.
IV - Zero output impedance.

A. I, II and III

B. I and III

C. All of them

D. I, III, and IV

E. II, III and IV

2. The following are true regarding hysteresis as applied in our lab about thermoregulation *except*, (or all are true).

A. It was brought about by tying a resistor from the output of the comparator to the center point of the resistor divider.

B. All are true.

C. It decreases the frequency at which the heater turns on and off.

D. It represents a form of positive feedback, in which, once the heater begins to turn on or off, it is encouraged to turn *all the way* on or off.

E. It provides for two different set-points for the comparator.

3. Which of the following is (are) true about comparators vs. operation amplifiers (op amps) as used in our labs.

I - Comparators generally give a true/false output whereas op amps generally give an output voltage at some intermediate value.
II - Comparators often use a single-sided power supply, whereas op amps are usually configured with plus-and-minus power supplies.
III - Op amps have infinite input impedance, whereas comparators have zero input impedance.
IV - Both have enormous internal gain.

A. I, II and III

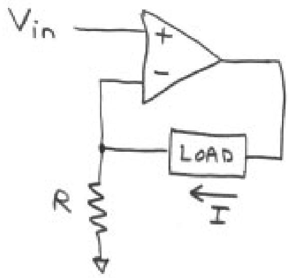
B. All of them

C. II, III and IV

D. I and II

E. I, II, and IV

4. Assuming that $V_{in} = 3$ V and $R = 600\Omega$, what is the current I through the load?



A. 200 A

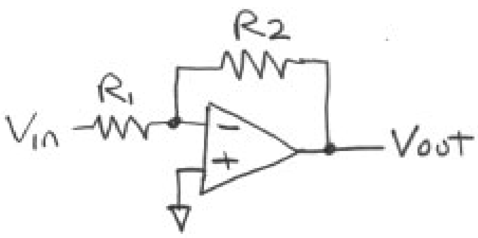
B. 200 ma

C. 5 mA

D. .05 A

E. Cannot be determined.

5. If $R_2 = 150\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 0.3$V, what voltage would you expect at V_{out}?



A. 0.2V

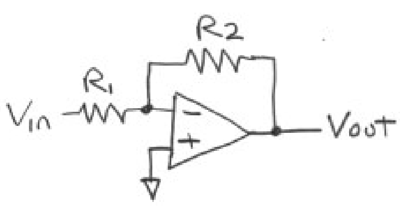
B. 4.5V

C. -185.5mV

D. -4.5V

E. 185.5mV

6. If $R_2 = 100\text{K}\Omega$, $R_1 = 5\text{K}\Omega$, $V_{in} = 0.25$V, what voltage would you expect at V_{out}?



A. 5.0V

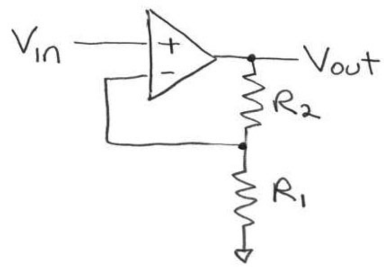
B. -0.25V

C. -238mV

D. -5.0V

E. 238mV

7. What is the voltage V_{out}, if $R_1 = 100\Omega$, $R_2 = 200\Omega$, and $V_{in} = 1.5V$?



A. 3V

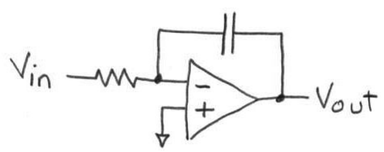
B. 0.5V

C. 4.5V

D. 0V

E. 1V

8. What is the voltage V_{out} after 1 second, if V_{out} begins at 0V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = 1V$?



A. -0.25V

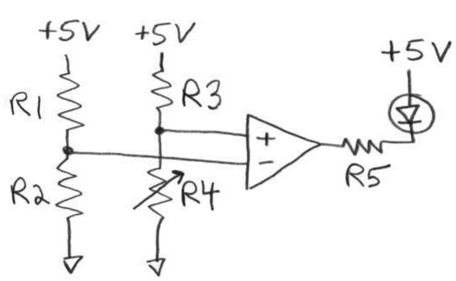
B. 4V

C. Cannot be determined.

D. 1V

E. -1V

9. What value must variable resistor R_4 be adjusted to for the comparator to be just at the point of turning on, or off, the LED in the following circuit, if $R_1 = 100\ \Omega$, $R_2 = 200\ \Omega$, $R_3 = 300\ \Omega$, and $R_5 = 250\ \Omega$?



A. 150 Ω

B. 400 Ω

C. Cannot be determined from the information given.

D. 300 Ω

E. 600 Ω

10. The following are true about feedback *except* (or all are true).

A. Negative feedback can be used with an operational amplifier (op amp) to hold a “virtual ground” at zero volts.

B. Hysteresis is a form of positive feedback.

C. Positive feedback can be used to reinforce a particular state and make it stable and distinct from another possible state for a given system.

D. All are true.

E. Negative feedback can be used to make a system unstable and thus produce oscillation.

11. Which of the following are properties of the ideal operation amplifier?

I - The (+) input is always at “virtual ground”.
II - Infinite input impedance.
III - Infinite gain.
IV - Zero output impedance.

A. I and III

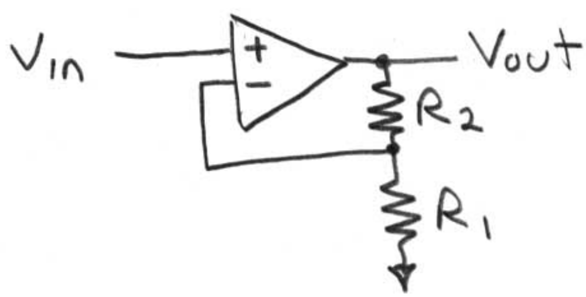
B. I, II and III

C. II, III and IV

D. I, III, and IV

E. All of them

12. Assuming that $V_{in} = 3$ V, $R_2 = 200\Omega$, $R_1 = 100\Omega$, what is V_{out}?



A. 9 V

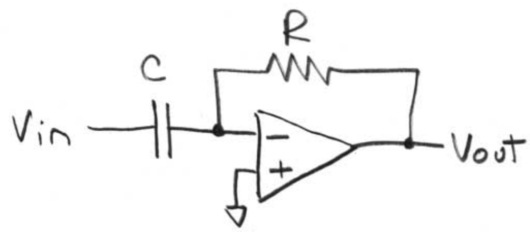
B. 4.5 V

C. 2 V

D. None of the other answers is correct.

E. 1 V

13. The following circuit



A. is a differentiator.

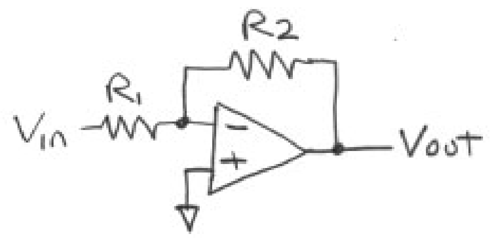
B. is an integrator.

C. is a peak detector.

D. is non-linear.

E. performs a logarithm.

14. If $R_2 = 50\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 0.3\text{V}$, which of the following is (are) true?



I - $V_{out} = -1.5V$.
II - The negative input will be a "virtual ground".
III - No current will run through R_2.

A. I and III

B. II and III

C. I and II

D. I

E. II

15. The following are true about comparators and operational amplifiers, *except*

A. Comparators tend to be used to determine which input is higher, and often have positive feedback (hysteresis) added to prevent chatter when the inputs are very close in value.

B. They both can generally be modeled to have infinite input impedance.

C. Op amps circuits tend to be designed with negative feedback, in which an implicit equation is solved by having the output do what it must to keep the inputs equal.

D. Op amps are generally modeled to have infinite gain, whereas comparators are not.

E. Op amps tend to be used with dual (+ and −) power supplies, whereas comparators are often used with a single (+) power supply.

16. Which of the following are properties of the ideal operation amplifier?

I - Infinite input impedance.
II - Infinite output impedance.
III - Infinite gain.

A. II and III

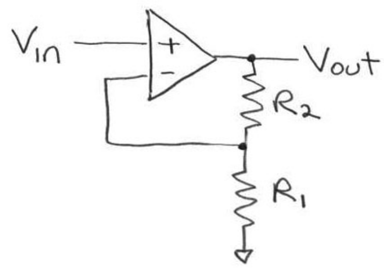
B. I and III

C. Only I

D. I and II

E. I, II, and III

17. What is the voltage V_{in} that would produce 5 V at V_{out}, if $R_1 = 200$ KΩ and $R_2 = 300$ KΩ?



A. 7.5 V

B. 2 V

C. 3.33 V

D. 3 V

E. 12.5 V

18. The following are true regarding hysteresis as applied in our lab about thermoregulation *except*, (or all are true).

A. It represents a form of positive feedback, in which, once the heater begins to turn on or off, it is encouraged to turn *all the way* on or off.

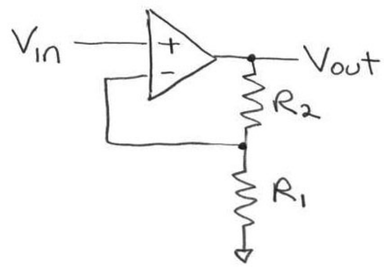
B. It is present in standard old electromechanical thermostats in the form of a little heating element that changes the effective set-point.

C. It provides for two different set-points for the comparator.

D. All are true.

E. It *increases* the frequency at which the heater turns on and off, increasing what is known as “chatter”.

19. What is the voltage V_{out}, if $R_1 = 200\Omega$, $R_2 = 100\Omega$, and $V_{in} = 2$V?



A. 0V

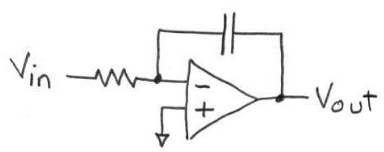
B. 4.5V

C. 1V

D. 0.5V

E. 3V

20. What is the voltage V_{out} after 1 second, if V_{out} begins at 0V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = -4V$?



A. -0.25V

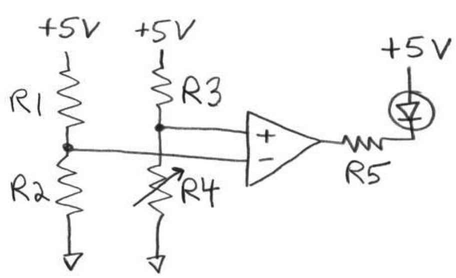
B. Cannot be determined.

C. 1V

D. 4V

E. -1V

21. Which is true about the following circuit?



A. The diode is used to prevent current from leaving the comparator.

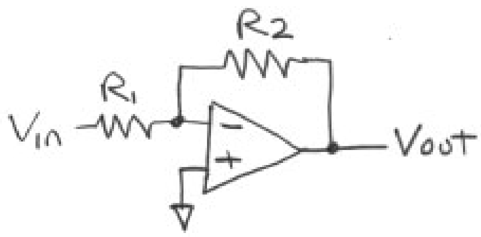
B. It contains a Wheatstone bridge.

C. None of the other statements is true.

D. It uses hysteresis.

E. R_5 provides negative feedback.

22. If $R_2 = 30\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 1\text{V}$, which of the following is (are) true?



I - $V_{out} = -3V$.
II - The negative input of the Op Amp will be at 0 volts.
III - The magnitude of the current through R_1 is the same as through R_2.

A. II and III

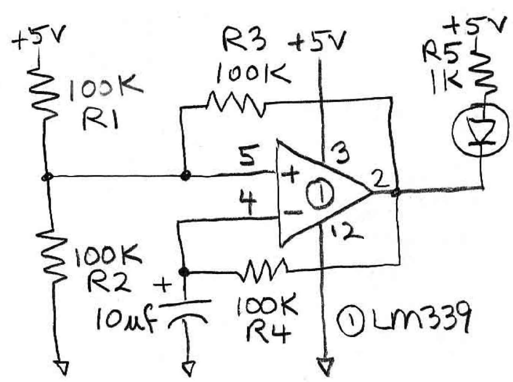
B. I

C. I, II, and III

D. I and II

E. I and III

23. The circuit below shows an oscillator used in one of the labs. The waveforms generated at pins 5, 4, and 2 of the comparator are as follows:



A. 5-square, 4-triangle, 2-triangle

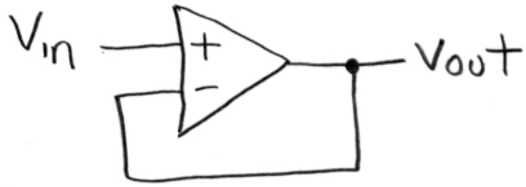
B. 5-triangle, 4-triangle, 2-square

C. 5-square, 4-square, 2-triangle

D. 5-triangle, 4-square, 2-square

E. 5-square, 4-triangle, 2-square

24. The following are true about the the circuit below *except* (or all are true).



A. It puts practically no load on input voltage V_{in}.

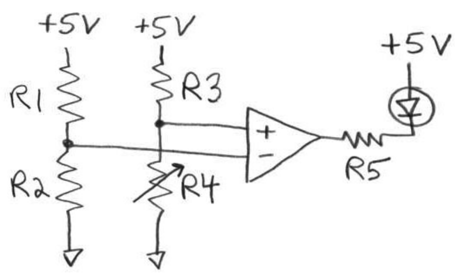
B. It is an example of positive feedback.

C. All are true.

D. It produces an output voltage V_{out} that is practically identical to the voltage seen at V_{in}.

E. This is commonly called a "buffer".

25. What value must variable resistor R_4 be adjusted to for the comparator to be just at the point of turning the LED on, or off, in the following circuit, if $R_1 = 100\ \Omega$, $R_2 = 300\ \Omega$, $R_3 = 600\ \Omega$, and $R_5 = 200\ \Omega$?



A. 300 Ω

B. 600 Ω

C. 1800 Ω

D. 400 Ω

E. 200 Ω

26. Which of the following are properties of the ideal operation amplifier?

I - Infinite input impedance.
II - Zero output impedance.
III - Infinite gain.

A. I and II

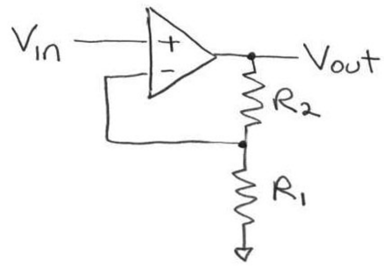
B. II and III

C. I, II, and III

D. I and III

E. Only III

27. If $R_1 = 100\Omega$, $R_2 = 200\Omega$, and $V_{in} = 2V$, the following are true *except* (or all are true)?



A. This is a non-inverting amplifier circuit.

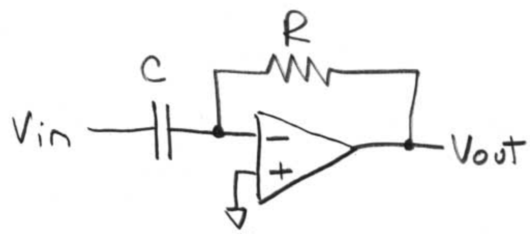
B. $V_{out} = 3V$.

C. If the op amp is considered to be ideal, V_{out} will not change, no matter how much current a load may draw from the output of the circuit.

D. The circuit puts virtually no load on V_{in}.

E. All are true

28. Given the following circuit, the following statements are true *except* (or all are true)



A. Given a DC voltage at V_{in} the voltage on the capacitor will continue to increase at a constant rate forever (or until it reaches the positive power supply).

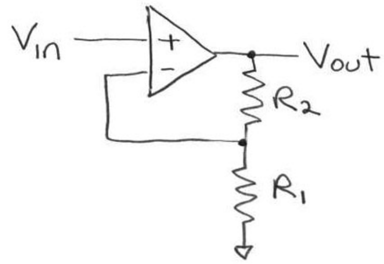
B. The current through the capacitor is proportional to the derivative of the input voltage, and that current passes through the resistor as well (because it cannot go into the op amp).

C. It employs a virtual ground.

D. All are true.

E. It is a differentiator.

29. If $R_1 = 200\Omega$, $R_2 = 100\Omega$, and $V_{in} = 2$V, and assuming an ideal op amp, the following are true *except* (or all are true)?



A. V_{out} will not change, no matter how much current a load may draw from the output of the circuit.

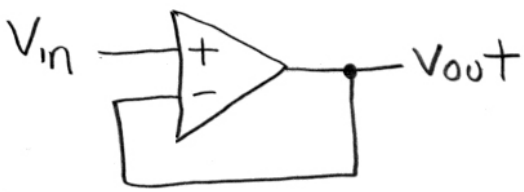
B. The circuit puts virtually no load on V_{in}.

C. All are true

D. The + and − inputs of the amplifier will be equal.

E. $V_{out} = 3$V.

30. The following are true about the the circuit below *except* (or all are true).



A. It puts practically no load on input voltage V_{in}.

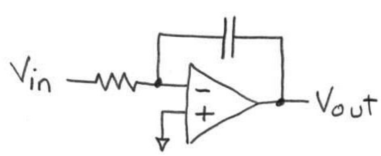
B. It produces an output voltage V_{out} that is practically identical to the voltage seen at V_{in}.

C. All are true.

D. It is an example of negative feedback.

E. This is commonly called a "buffer", because it can protect an input voltage that does not itself have much current to give.

31. What is the voltage V_{out} after 2 seconds, if V_{out} begins at 0V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = -4V$?



A. -2V

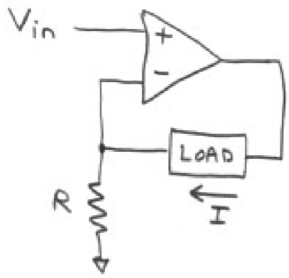
B. -0.5V

C. 1V

D. 8V

E. 2V

32. Assuming that $V_{in} = 5$ V and $R = 500\Omega$, what is the current I through the load?



A. 400 ma

B. 400 A

C. .1 A

D. 10 mA

E. Cannot be determined.

33. The following are true regarding to the conventions of drawing schematics used in our course *except*, (or all are true).

A. Lines that cross each require a dot to signify that they connect, otherwise they do not connect.

B. All are true.

C. Positive to negative voltage tends to flow from top to bottom.

D. Integrated circuits have their pin numbers *inside* the symbol boundary and their pin functions *outside* the symbol boundary.

E. Signals tend to flow from left to right, except for feedback, which may flow from right to left.

34. As seen in this course, the following are true regarding properly designed systems comprised of subsystems, assuming the signals between subsystems carry information in the form of a voltage, *except*, (or all are true).

A. The subsystems should have high input impedance.

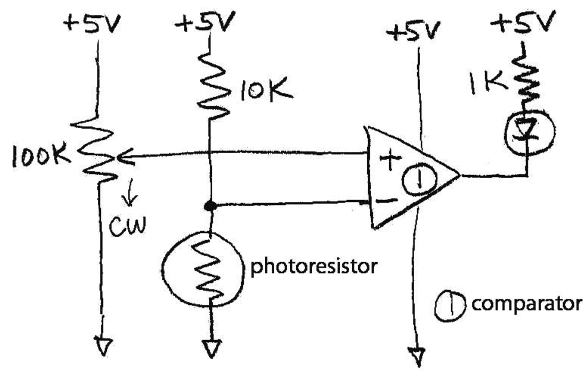
B. A subsystem should have complete control of its output, whose voltage should not be influenced (loaded) by the connections to the inputs of other systems.

C. All are true.

D. The subsystems should have low output impedance.

E. A subsystem should always have a linear relationship between its input and output.

35. For the circuit below, the following are true *except* (or all are true)



A. The circuit utilizes a Wheatstone bridge.

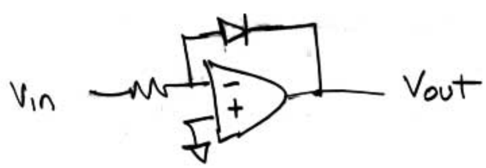
B. Although the comparator may be an open-collector device, the circuit can still function since the LED is tied to +5V by the 1K resistor.

C. Given proper adjustment of the potentiometer, increasing the amount of light hitting the photoresistor will cause the LED to turn *off*.

D. Turning the potentiometer clockwise (CW) will lower the voltage on the (+) input of the comparator.

E. All are true.

36. For the schematic below, which of the following is true?



A. V_{out} is a logarithmic function of V_{in}

B. V_{out} is an exponential function of V_{in}

C. The circuit is an integrator.

D. The circuit is a differentiator.

E. The circuit is a peak detector.

37. Common Mode Rejection Ration (CMRR) is defined by the equations below, given that the individual gains A_1 and A_2 for the (+) and (−) inputs are not necessarily equal. Which of the following is *false* (or all are true)?

$$V_{out} = A_1 V_{in(+)} - A_2 V_{in(-)}$$

$$CMRR = \left| \frac{1}{2} \frac{A_1 + A_2}{A_1 - A_2} \right|$$

A. All are true.

B. Noise tends to be "common-mode", meaning in-phase, especially if the wires connecting the sensor are twisted together so that they pass through the same space and pick up the same varying magnetic fields.

C. It is useful in predicting how well an operational amplifier will reject noise.

D. To accomplish a high CMRR, a signal should be configured as differential, i.e., the voltages should be exactly out-of-phase.

E. In a perfect operational amplifier, the CMRR should be ∞.

38. Common Mode Rejection Ration (CMRR) is defined by the equations below, given that the individual gains A_1 and A_2 for the (+) and (−) inputs are not necessarily equal. Which of the following is *false* (or all are true)?

$$V_{out} = A_1 V_{in(+)} - A_2 V_{in(-)}$$

$$CMRR = \left| \frac{1}{2} \frac{A_1 + A_2}{A_1 - A_2} \right|$$

A. It is useful in predicting how well an operational amplifier will reject noise.

B. All are true.

C. To accomplish a high CMRR, a signal should be configured as differential, i.e., the voltages should be exactly out-of-phase.

D. In a perfect operational amplifier, the CMRR should be zero.

E. Noise tends to be "common-mode", meaning in-phase, especially if the wires connecting the sensor are twisted together so that they pass through the same space and pick up the same varying magnetic fields.

39. As seen in this course, the following are true regarding properly designed systems comprised of subsystems, assuming the signals between subsystems carry information in the form of a voltage, *except*, (or all are true).

A. A subsystem should have low output impedance, that is, it should act like as much like a perfect voltage source as possible.

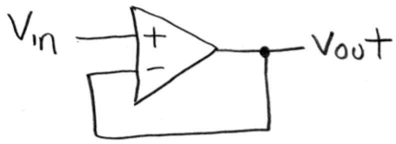
B. A subsystem should have high input impedance, that is, it should sense voltage at the input while drawing minimal current.

C. An output of one stage should not be effected by the inputs of subsequent stages to which it is connected.

D. Assuming no feedback between subsystems, information flows only in one direction, making each subsystem only dependent on other subsystems upstream.

E. All are true.

40. The following are true about the the circuit below *except* (or all are true).



A. It produces an output voltage V_{out} that is practically identical to the voltage seen at V_{in}.

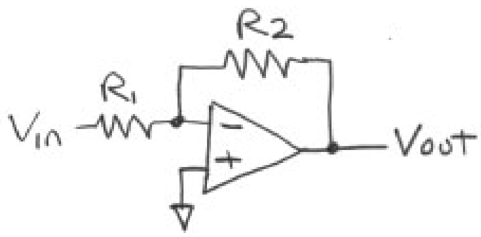
B. This is commonly called a *voltage follower.*

C. It makes use of a virtual ground.

D. All are true.

E. It puts practically no load on input voltage V_{in}, because there is practically no current going into the Op Amp.

41. Assuming a perfect Op Amp, if $R_2 = 10\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 3\text{V}$, which of the following is (are) true?



I - $V_{out} = -3V$.
II - The negative input of the Op Amp will be at 0 volts.
III - The magnitude of the current through R_1 is the same as through R_2.

A. I, II, and III

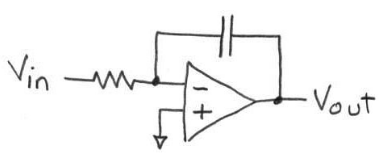
B. I and II

C. I and III

D. II and III

E. I

42. What is the voltage V_{out} after 1 second, if V_{out} begins at 2V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = -2V$?



A. 4V

B. -4V

C. -6V

D. 0V

E. 6V

43. The following are true regarding hysteresis as applied in our lab about thermoregulation *except*, (or all are true).

A. It *decreases* the frequency at which the heater turns on and off, decreasing what is known as "chatter".

B. All are true.

C. It is present in standard old electromechanical thermostats in the form of a little heating element that changes the effective set-point.

D. It provides for two different set-points for the comparator.

E. It represents a form of positive feedback, in which, once the heater begins to turn on or off, it is encouraged to turn *all the way* on or off.

44. The following are true regarding the conventions of drawing schematics used in our course *except*, (or all are true).

A. Integrated circuits have their pin numbers *outside* the symbol boundary and their pin functions *inside* the symbol boundary.

B. Positive to negative voltage tends to flow from top to bottom.

C. All are true.

D. Signals tend to flow from left to right, except for feedback, which may flow from right to left.

E. Lines that cross each require a dot to signify that they connect, otherwise they do not connect.

45. Common Mode Rejection Ration (CMRR) is defined by the equations below, given that the individual gains A_1 and A_2 for the (+) and (−) inputs are not necessarily equal. Which of the following is *false* (or all are true)?

$$V_{out} = A_1 V_{in(+)} - A_2 V_{in(-)}$$

$$CMRR = \left| \frac{1}{2} \frac{A_1 + A_2}{A_1 - A_2} \right|$$

A. In a perfect operational amplifier, the CMRR should be ∞.

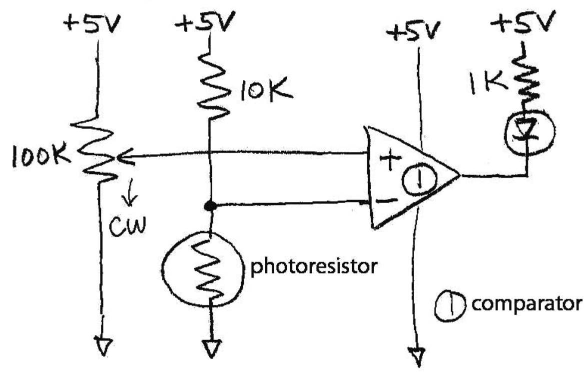
B. It is useful in predicting how well an operational amplifier will reject noise.

C. The signal should be "common-mode", with the (+) and (-) inputs of the amplifier going up and down in phase, but the signal must be so much stronger than the noise that the signal will not be significantly corrupted.

D. All are true.

E. Noise tends to be "common-mode", meaning in-phase, especially if the wires connecting the sensor are twisted together so that they pass through the same space and pick up the same varying magnetic fields.

46. For the circuit below, the following are true *except* (or all are true)



A. Although the comparator may be an open-collector device, the circuit can still function since the LED is tied to +5V by the 1K resistor.

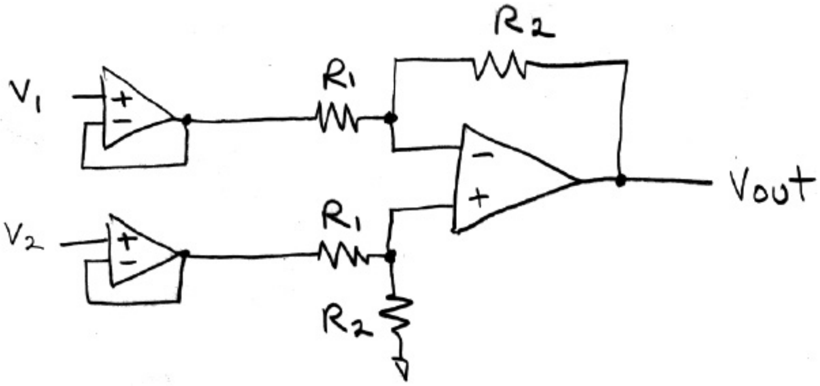
B. All are true.

C. Given proper adjustment of the potentiometer, increasing the amount of light hitting the photoresistor will cause the LED to turn *off*.

D. The circuit utilizes a Wheatstone bridge.

E. Turning the potentiometer clockwise (CW) will raise the voltage on the (+) input of the comparator.

47. Which is true about the following circuit?



A. This is a summer.

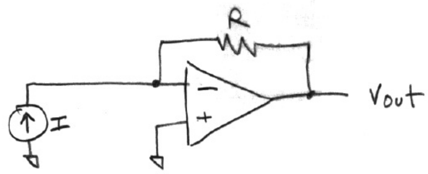
B. This is a Differential Amplifier, sometimes called an “Instrumentation” Amplifier.

C. The input impedance for V_1 and V_2 are both R_1.

D. This is a differentiator.

E. This is an integrator.

48. Regarding the following circuit (assuming a perfect Op Amp), the following are true *except* (or all are true).



A. The output impedance of the circuit is zero.

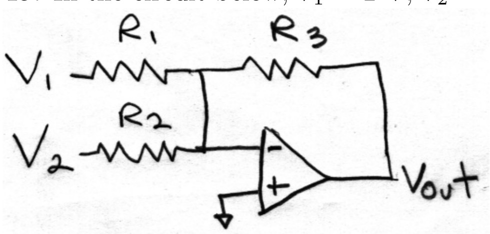
B. The voltage at the negative input of the Op Amp is zero.

C. $V_{out} = -IR$.

D. All are true.

E. All of the current I passes through the resistor.

49. In the circuit below, $V_1 = 2$ V, $V_2 = 3$ V, $R_1 = R_2 = R_3 = 3$ KΩ, what is V_{out}?



A. 5 V.

B. None of the other answers is correct.

C. -1 V.

D. -5 V.

E. 1 V.

50. The following are true about H-Bridge circuits *except*

A. They contain two op amps configured as (1) a voltage follower (buffer) and (2) an inverting amplifier with a gain of 1.

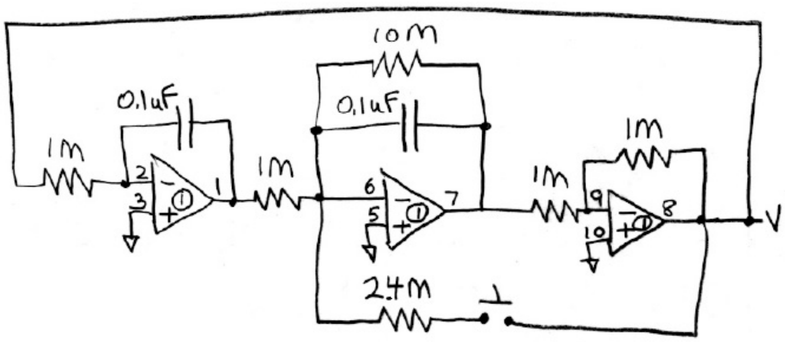
B. The audio amplifier integrated circuit we used in the lab consists of one.

C. They provide two outputs with voltages that move in opposite directions in response to a given change in the input voltage.

D. They provide an ability to move current in either direction through a load.

E. Since they contain op amps, they require both positive and negative power supplies.

51. The following are true about the circuit shown below, discussed in class, and built in the lab *except* (or all are true)



A. All are true.

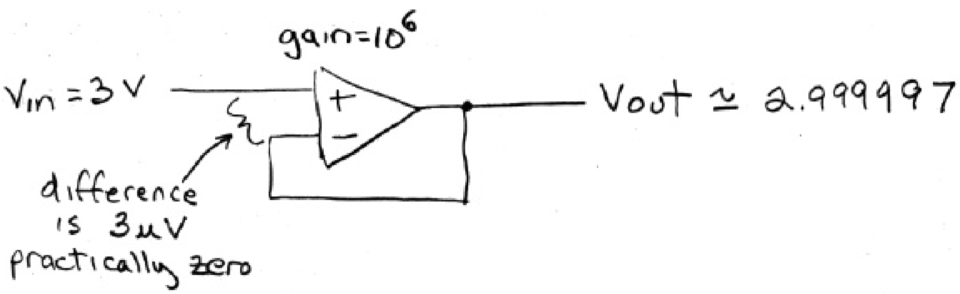
B. The negative input of each op amp is a virtual ground.

C. It contains two integrators and an inverter all built into a loop, whose solution is a sinusoid.

D. Its output can change amplitude along both positive and negative first order exponentials.

E. It provides the solution to a second order differential equation.

52. The following are true about the figure below, discussed in class *except*



A. It shows how the voltage between the inputs of a real op amp with feedback is not actually zero, but rather very small.

B. It is an example of negative feedback.

C. The current available at V_{out} is many orders of magnitude greater than the current drawn from V_{in}.

D. It demonstrates a voltage follower, otherwise known as a buffer.

E. It assumes an ideal op amp.

53. The following are true about a real (non-ideal) op amp *except*

A. The output impedance, though not zero, is very low, up to a rated maximum current for the particular op amp.

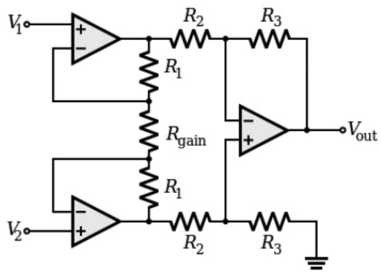
B. The open loop (no external feedback) gain is not actually infinite, but is very high at low frequencies, falling with increasing frequency to 1 (unity gain) at some high frequency.

C. When the (+) and (−) inputs are equal, the output voltage is not precisely 0 V.

D. The common mode rejection ratio (CMRR) cannot be determined, since only ideal op amps have a CMRR.

E. The input current, though generally very small, is not truly zero.

54. The following are true about the figure below, discussed in class, *except*



A. It shows a differential amplifier, also known as an "instrumentation" amplifier.

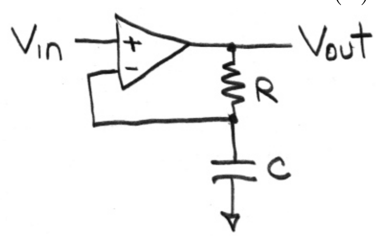
B. Assuming ideal op amps, it provides infinite input impedance.

C. Assuming perfect op amps and perfectly matched pairs of resistors, R_1, R_2, and R_3, it provides infinite common mode rejection ratio (CMRR).

D. Assuming ideal op amps, it provides infinite gain.

E. As opposed to some differential amplifiers, the gain of this circuit may be controlled by a singled resistor value.

55. The transfer function $H(\omega)$ for the following circuit is



A. 1

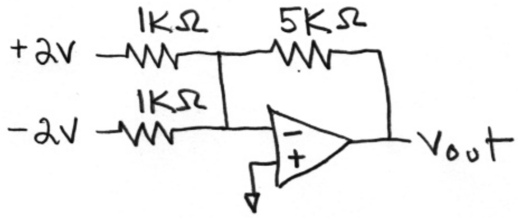
B. $\frac{1}{RC}$

C. $1 + j\omega RC$

D. $j\omega RC$

E. $\frac{1}{1+j\omega RC}$

56. What is V_{out} for the following circuit?



A. 0 V

B. 20 V

C. -20 V

D. -10 V

E. 10 V

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BioE 1310 - Review 4 - Op Amps 1/16/2017
Answer Sheet - Correct answer is A for all questions

1. Which of the following are properties of the ideal operation amplifier?

I - Infinite input impedance.
II - Perfectly linear internal amplification.
III - Infinite gain.
IV - Zero output impedance.

A. I, III, and IV

B. I, II and III

C. II, III and IV

D. I and III

E. All of them

Explanation: All but II. The gain is virtually infinite, but can be very non-linear. Linearity is supplied by the external components.
[*circuits0025.mcq*]

2. The following are true regarding hysteresis as applied in our lab about thermoregulation *except*, (or all are true).

A. All are true.

B. It provides for two different set-points for the comparator.

C. It decreases the frequency at which the heater turns on and off.

D. It was brought about by tying a resistor from the output of the comparator to the center point of the resistor divider.

E. It represents a form of positive feedback, in which, once the heater begins to turn on or off, it is encouraged to turn *all the way* on or off.

Explanation: See lab.
[*circuits0026.mcq*]

3. Which of the following is (are) true about comparators vs. operation amplifiers (op amps) as used in our labs.

I - Comparators generally give a true/false output whereas op amps generally give an output voltage at some intermediate value.
II - Comparators often use a single-sided power supply, whereas op amps are usually configured with plus-and-minus power supplies.
III - Op amps have infinite input impedance, whereas comparators have zero input impedance.
IV - Both have enormous internal gain.

A. I, II, and IV

B. I, II and III

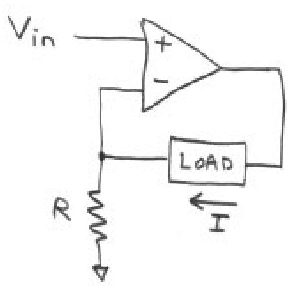
C. II, III and IV

D. I and II

E. All of them

Explanation: Comparators have infinite input impedance and very high gain, just like op amps.
[*circuits0027.mcq*]

4. Assuming that $V_{in} = 3$ V and $R = 600\Omega$, what is the current I through the load?



A. 5 mA

B. .05 A

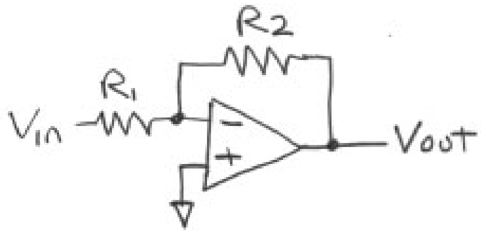
C. 200 ma

D. 200 A

E. Cannot be determined.

Explanation: This is a voltage to current converter, or "current source". Assuming the inputs to the op amp are the same voltage, I = V_{in} / R.
[*circuits0029.mcq*]

5. If $R_2 = 150\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 0.3\text{V}$, what voltage would you expect at V_{out}?



A. -4.5V

B. 4.5V

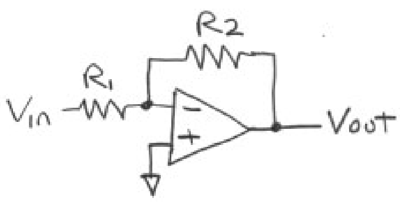
C. 0.2V

D. 185.5mV

E. -185.5mV

Explanation: $V_{out} = -V_{in}\frac{R_2}{R_1}$
[*circuits0031.mcq*]

6. If $R_2 = 100\text{K}\Omega$, $R_1 = 5\text{K}\Omega$, $V_{in} = 0.25\text{V}$, what voltage would you expect at V_{out}?



A. -5.0V

B. 5.0V

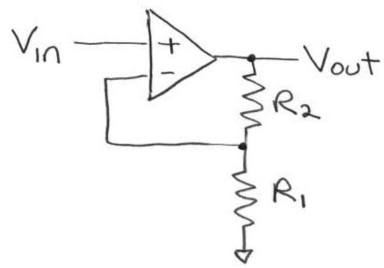
C. -0.25V

D. 238mV

E. -238mV

Explanation: $V_{out} = -V_{in}\frac{R_2}{R_1}$
[*circuits0042.mcq*]

7. What is the voltage V_{out}, if $R_1 = 100\Omega$, $R_2 = 200\Omega$, and $V_{in} = 1.5V$?



A. 4.5V

B. 0.5V

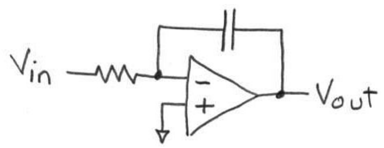
C. 1V

D. 3V

E. 0V

Explanation: $V_{out} = \frac{R_1+R_2}{R_1} V_{in}$
[*circuits0046.mcq*]

8. What is the voltage V_{out} after 1 second, if V_{out} begins at 0V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = 1V$?



A. -1V

B. 4V

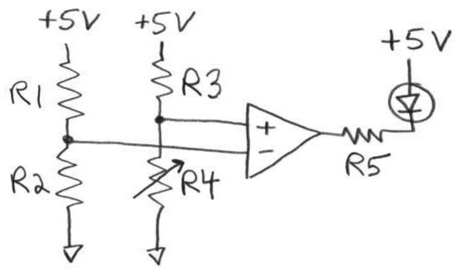
C. -0.25V

D. 1V

E. Cannot be determined.

Explanation: $V_{out} = -\frac{1}{RC} \int V_{in} dt$
[*circuits0048.mcq*]

9. What value must variable resistor R_4 be adjusted to for the comparator to be just at the point of turning on, or off, the LED in the following circuit, if $R_1 = 100\ \Omega$, $R_2 = 200\ \Omega$, $R_3 = 300\ \Omega$, and $R_5 = 250\ \Omega$?



A. 600 Ω

B. 150 Ω

C. 300 Ω

D. 400 Ω

E. Cannot be determined from the information given.

Explanation: The voltages at the (+) and (−) inputs of the comparator are equal when $\frac{R_1}{R_2} = \frac{R_3}{R_4}$
[*circuits0051.mcq*]

10. The following are true about feedback *except* (or all are true).

A. All are true.

B. Positive feedback can be used to reinforce a particular state and make it stable and distinct from another possible state for a given system.

C. Negative feedback can be used to make a system unstable and thus produce oscillation.

D. Negative feedback can be used with an operational amplifier (op amp) to hold a "virtual ground" at zero volts.

E. Hysteresis is a form of positive feedback.

Explanation: These are all true.
[*circuits0056.mcq*]

11. Which of the following are properties of the ideal operation amplifier?

I - The (+) input is always at "virtual ground".
II - Infinite input impedance.
III - Infinite gain.
IV - Zero output impedance.

A. II, III and IV

B. I, II and III

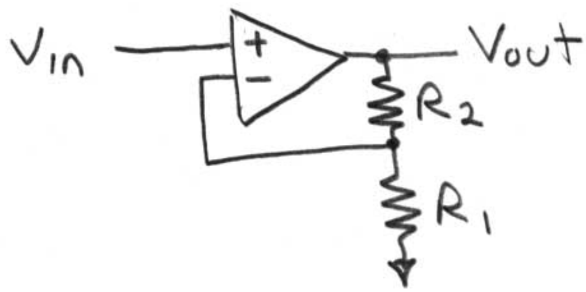
C. I, III, and IV

D. I and III

E. All of them

Explanation: All but I. The (+) input should be equal to the (-) input in a properly biased op amp circuit, but that voltage doesn't necessarily have to be ground (although it is in many circuits).
[*circuits0099.mcq*]

12. Assuming that $V_{in} = 3$ V, $R_2 = 200\Omega$, $R_1 = 100\Omega$, what is V_{out}?



A. 9 V

B. 2 V

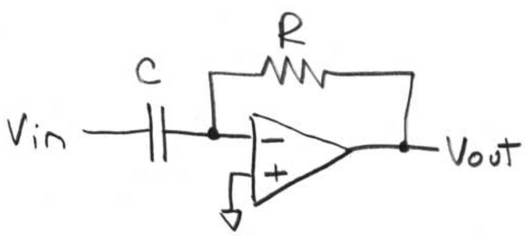
C. 1 V

D. 4.5 V

E. None of the other answers is correct.

Explanation: This is a non-inverting amplifier. Solve by setting the inputs of the op amp to the same voltage, and you basically have an implicit version of a voltage divider: $V_{out} = V_{in}\frac{R_2+R_1}{R_1}$.
[*circuits0101.mcq*]

13. The following circuit



A. is a differentiator.

B. is an integrator.

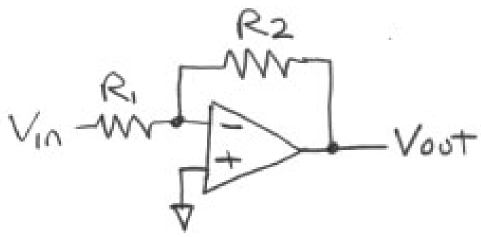
C. performs a logarithm.

D. is a peak detector.

E. is non-linear.

Explanation: This is a differentiator. The negative input is a virtual ground. The current through the capacitor is proportional to the derivative of the input voltage, and that current passes through the resistor as well (because it cannot go into the op amp) indicating that the output voltage must be proportional to that current (although negative). Differentiation, capacitors, and resistors, are all linear.
[*circuits0102.mcq*]

14. If $R_2 = 50\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 0.3\text{V}$, which of the following is (are) true?



I - $V_{out} = -1.5V$.
II - The negative input will be a "virtual ground".
III - No current will run through R_2.

A. I and II

B. II

C. I

D. II and III

E. I and III

Explanation: $V_{out} = -V_{in}\frac{R_2}{R_1}$. The same current will run through R_2 as R_1. The inputs to the op amp will be equal, i.e., at ground.
[*circuits0107.mcq*]

15. The following are true about comparators and operational amplifiers, *except*

A. Op amps are generally modeled to have infinite gain, whereas comparators are not.

B. They both can generally be modeled to have infinite input impedance.

C. Comparators tend to be used to determine which input is higher, and often have positive feedback (hysteresis) added to prevent chatter when the inputs are very close in value.

D. Op amps circuits tend to be designed with negative feedback, in which an implicit equation is solved by having the output do what it must to keep the inputs equal.

E. Op amps tend to be used with dual (+ and −) power supplies, whereas comparators are often used with a single (+) power supply.

Explanation: Both operational amplifiers and comparators are modeled to have infinite gain. The fact that an comparator can accurately compare, means that it must have very high gain so that the two compared voltages can be very close.
[*circuits0110.mcq*]

16. Which of the following are properties of the ideal operation amplifier?

I - Infinite input impedance.
II - Infinite output impedance.
III - Infinite gain.

A. I and III

B. I and II

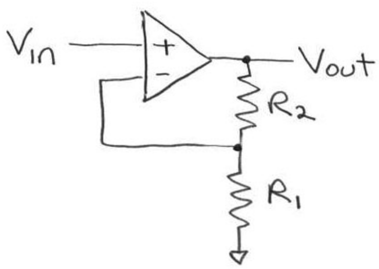
C. II and III

D. I, II, and III

E. Only I

Explanation: II is not true; the ideal op amp has *zero* output impedance.
[*circuits0116.mcq*]

17. What is the voltage V_{in} that would produce 5 V at V_{out}, if $R_1 = 200$ KΩ and $R_2 = 300$ KΩ?



A. 2 V

B. 3 V

C. 7.5 V

D. 3.33 V

E. 12.5 V

Explanation: $V_{out} = \frac{R_1+R_2}{R_1} V_{in}$, $V_{in} = \frac{R_1}{R_1+R_2} V_{out}$
[*circuits0118.mcq*]

18. The following are true regarding hysteresis as applied in our lab about thermoregulation *except*, (or all are true).

A. It *increases* the frequency at which the heater turns on and off, increasing what is known as "chatter".

B. It provides for two different set-points for the comparator.

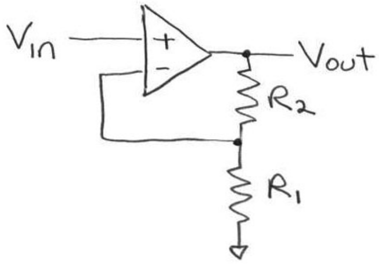
C. All are true.

D. It is present in standard old electromechanical thermostats in the form of a little heating element that changes the effective set-point.

E. It represents a form of positive feedback, in which, once the heater begins to turn on or off, it is encouraged to turn *all the way* on or off.

Explanation: See lab. It actually *decreases* chatter.
[*circuits0166.mcq*]

19. What is the voltage V_{out}, if $R_1 = 200\Omega$, $R_2 = 100\Omega$, and $V_{in} = 2$V?



A. 3V

B. 0.5V

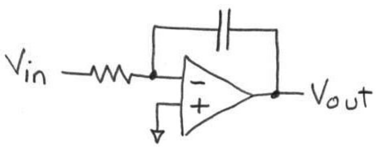
C. 1V

D. 4.5V

E. 0V

Explanation: $V_{out} = \frac{R_1+R_2}{R_1} V_{in}$
[*circuits0167.mcq*]

20. What is the voltage V_{out} after 1 second, if V_{out} begins at 0V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = -4V$?



A. 4V

B. -1V

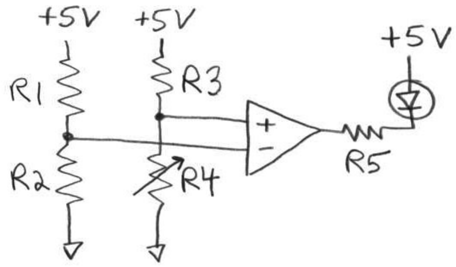
C. -0.25V

D. 1V

E. Cannot be determined.

Explanation: $V_{out} = -\frac{1}{RC} \int V_{in} dt$
[*circuits0168.mcq*]

21. Which is true about the following circuit?



A. It contains a Wheatstone bridge.

B. It uses hysteresis.

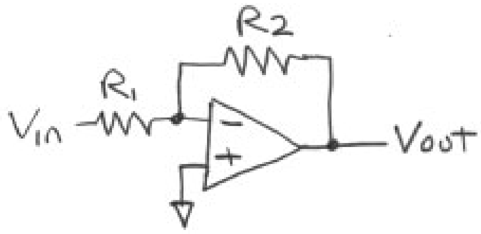
C. R_5 provides negative feedback.

D. The diode is used to prevent current from leaving the comparator.

E. None of the other statements is true.

Explanation: It uses a Wheatstone bridge (the four resistors to the left of the op amp). The voltages at the (+) and (−) inputs of the comparator are equal when $\frac{R_1}{R_2} = \frac{R_3}{R_4}$. R_5 is present simply to limit the current to the LED.
[*circuits0169.mcq*]

22. If $R_2 = 30\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 1\text{V}$, which of the following is (are) true?



I - $V_{out} = -3V$.
II - The negative input of the Op Amp will be at 0 volts.
III - The magnitude of the current through R_1 is the same as through R_2.

A. I, II, and III

B. I and II

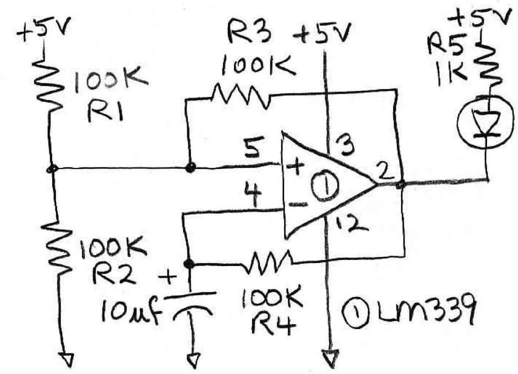
C. I

D. II and III

E. I and III

Explanation: $V_{out} = -V_{in}\frac{R_2}{R_1}$. The same current will run through R_2 as R_1. The inputs to the op amp will be equal, i.e., at ground.
[*circuits0185.mcq*]

23. The circuit below shows an oscillator used in one of the labs. The waveforms generated at pins 5, 4, and 2 of the comparator are as follows:



A. 5-square, 4-triangle, 2-square

B. 5-square, 4-triangle, 2-triangle

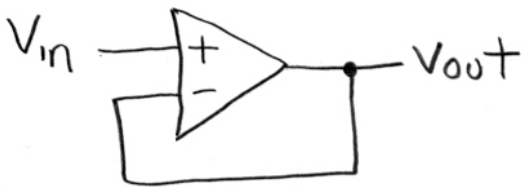
C. 5-triangle, 4-square, 2-square

D. 5-triangle, 4-triangle, 2-square

E. 5-square, 4-square, 2-triangle

Explanation: The capacitor at pin 4 charges and discharges, creating a triangle wave. The comparator goes from +5 to ground creating a square wave both at pin 2 and (a smaller one) at pin 5.
[*circuits0190.mcq*]

24. The following are true about the the circuit below *except* (or all are true).



A. It is an example of positive feedback.

B. This is commonly called a “buffer”.

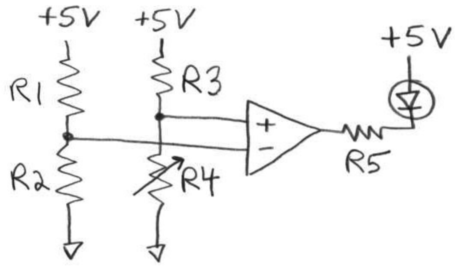
C. It puts practically no load on input voltage V_{in}.

D. It produces an output voltage V_{out} that is practically identical to the voltage seen at V_{in}.

E. All are true.

Explanation: This is example of *negative* rather than *positive* feedback.
[*circuits0224.mcq*]

25. What value must variable resistor R_4 be adjusted to for the comparator to be just at the point of turning the LED on, or off, in the following circuit, if $R_1 = 100\ \Omega$, $R_2 = 300\ \Omega$, $R_3 = 600\ \Omega$, and $R_5 = 200\ \Omega$?



A. 1800 Ω

B. 200 Ω

C. 300 Ω

D. 400 Ω

E. 600 Ω

Explanation: The voltages at the (+) and (−) inputs of the comparator are equal when $\frac{R_1}{R_2} = \frac{R_3}{R_4}$
[*circuits0225.mcq*]

26. Which of the following are properties of the ideal operation amplifier?

I - Infinite input impedance.
II - Zero output impedance.
III - Infinite gain.

A. I, II, and III

B. I and II

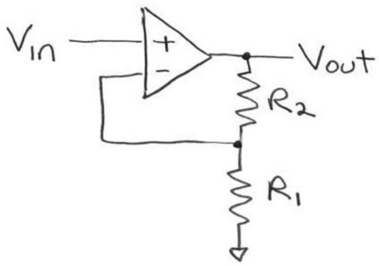
C. II and III

D. I and III

E. Only III

Explanation: All are true.
[*circuits0226.mcq*]

27. If $R_1 = 100\Omega$, $R_2 = 200\Omega$, and $V_{in} = 2$V, the following are true *except* (or all are true)?



A. $V_{out} = 3$V.

B. If the op amp is considered to be ideal, V_{out} will not change, no matter how much current a load may draw from the output of the circuit.

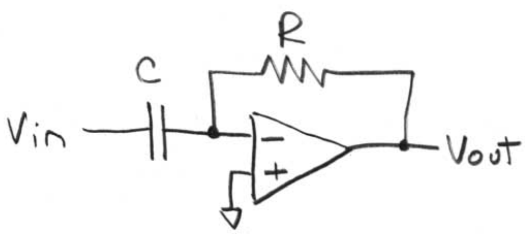
C. This is a non-inverting amplifier circuit.

D. The circuit puts virtually no load on V_{in}.

E. All are true

Explanation: $V_{out} = \frac{R_1+R_2}{R_1} V_{in}$. so $V_{out} = 6$V.
[*circuits0227.mcq*]

28. Given the following circuit, the following statements are true *except* (or all are true)



A. Given a DC voltage at V_{in} the voltage on the capacitor will continue to increase at a constant rate forever (or until it reaches the positive power supply).

B. It is a differentiator.

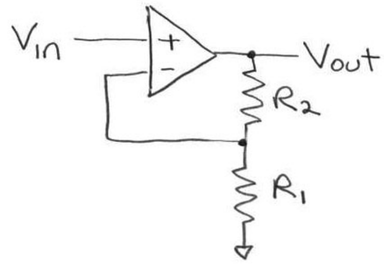
C. It employs a virtual ground.

D. The current through the capacitor is proportional to the derivative of the input voltage, and that current passes through the resistor as well (because it cannot go into the op amp).

E. All are true.

Explanation: This is a differentiator. The negative input is a virtual ground. Answer A describes the voltage on a capacitor in the integrator configuration, not the differentiator.
[*circuits0228.mcq*]

29. If $R_1 = 200\Omega$, $R_2 = 100\Omega$, and $V_{in} = 2$V, and assuming an ideal op amp, the following are true *except* (or all are true)?



A. All are true

B. V_{out} will not change, no matter how much current a load may draw from the output of the circuit.

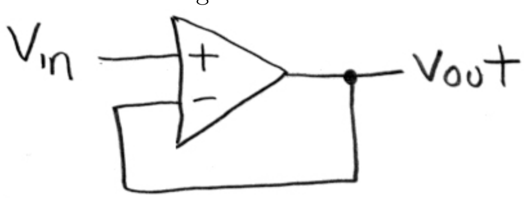
C. $V_{out} = 3$V.

D. The circuit puts virtually no load on V_{in}.

E. The + and − inputs of the amplifier will be equal.

Explanation: $V_{out} = \frac{R_1+R_2}{R_1} V_{in}$.
[*circuits0273.mcq*]

30. The following are true about the the circuit below *except* (or all are true).



A. All are true.

B. This is commonly called a "buffer", because it can protect an input voltage that does not itself have much current to give.

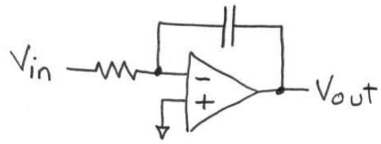
C. It puts practically no load on input voltage V_{in}.

D. It produces an output voltage V_{out} that is practically identical to the voltage seen at V_{in}.

E. It is an example of negative feedback.

Explanation: This is example of *negative* rather than *positive* feedback.
[*circuits0274.mcq*]

31. What is the voltage V_{out} after 2 seconds, if V_{out} begins at 0V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = -4V$?



A. 8V

B. -2V

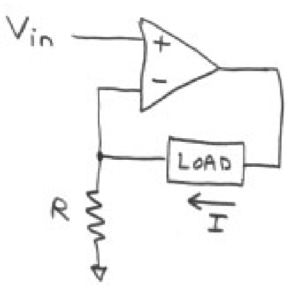
C. -0.5V

D. 2V

E. 1V

Explanation: $V_{out} = -\frac{1}{RC}\int V_{in}dt$
[*circuits0275.mcq*]

32. Assuming that $V_{in} = 5$ V and $R = 500\Omega$, what is the current I through the load?



A. 10 mA

B. .1 A

C. 400 ma

D. 400 A

E. Cannot be determined.

Explanation: This is a voltage to current converter, or "current source". Assuming the inputs to the op amp are the same voltage, I = V_{in} / R.
[*circuits0276.mcq*]

33. The following are true regarding to the conventions of drawing schematics used in our course *except*, (or all are true).

A. Integrated circuits have their pin numbers *inside* the symbol boundary and their pin functions *outside* the symbol boundary.

B. Positive to negative voltage tends to flow from top to bottom.

C. Signals tend to flow from left to right, except for feedback, which may flow from right to left.

D. Lines that cross each require a dot to signify that they connect, otherwise they do not connect.

E. All are true.

Explanation: Integrated circuits have their pin numbers *outside* the symbol boundary and their pin functions *inside* the symbol boundary.
[*circuits0304.mcq*]

34. As seen in this course, the following are true regarding properly designed systems comprised of subsystems, assuming the signals between subsystems carry information in the form of a voltage, *except*, (or all are true).

A. A subsystem should always have a linear relationship between its input and output.

B. The subsystems should have low output impedance.

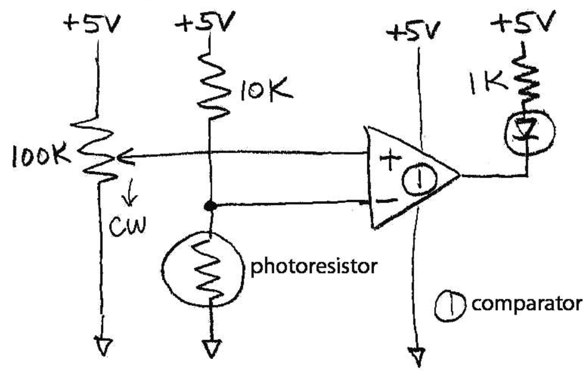
C. The subsystems should have high input impedance.

D. All are true.

E. A subsystem should have complete control of its output, whose voltage should not be influenced (loaded) by the connections to the inputs of other systems.

Explanation: We have certainly seen many properly designed sub-systems in this course that are not linear.
[*circuits0305.mcq*]

35. For the circuit below, the following are true *except* (or all are true)



A. All are true.

B. Although the comparator may be an open-collector device, the circuit can still function since the LED is tied to +5V by the 1K resistor.

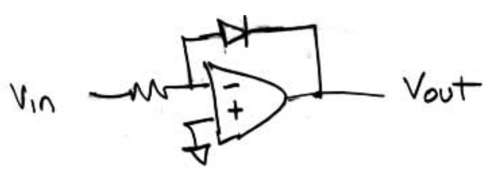
C. Given proper adjustment of the potentiometer, increasing the amount of light hitting the photoresistor will cause the LED to turn *off*.

D. Turning the potentiometer clockwise (CW) will lower the voltage on the (+) input of the comparator.

E. The circuit utilizes a Wheatstone bridge.

Explanation: All are true.
[*circuits0306.mcq*]

36. For the schematic below, which of the following is true?



A. V_{out} is a logarithmic function of V_{in}

B. The circuit is a peak detector.

C. The circuit is an integrator.

D. The circuit is a differentiator.

E. V_{out} is an exponential function of V_{in}

Explanation: The diode has an exponential relation between voltage and current, which when inserted into the feedback portion of the circuit yields a logarithmic behavior for the circuit.
[*circuits0308.mcq*]

37. Common Mode Rejection Ration (CMRR) is defined by the equations below, given that the individual gains A_1 and A_2 for the (+) and (−) inputs are not necessarily equal. Which of the following is *false* (or all are true)?

$$V_{out} = A_1 V_{in(+)} - A_2 V_{in(-)}$$

$$CMRR = \left| \frac{1}{2} \frac{A_1 + A_2}{A_1 - A_2} \right|$$

A. All are true.

B. It is useful in predicting how well an operational amplifier will reject noise.

C. Noise tends to be "common-mode", meaning in-phase, especially if the wires connecting the sensor are twisted together so that they pass through the same space and pick up the same varying magnetic fields.

D. To accomplish a high CMRR, a signal should be configured as differential, i.e., the voltages should be exactly out-of-phase.

E. In a perfect operational amplifier, the CMRR should be ∞.

Explanation:
[*circuits0313.mcq*]

38. Common Mode Rejection Ration (CMRR) is defined by the equations below, given that the individual gains A_1 and A_2 for the (+) and (−) inputs are not necessarily equal. Which of the following is *false* (or all are true)?

$$V_{out} = A_1 V_{in(+)} - A_2 V_{in(-)}$$

$$CMRR = \left| \frac{1}{2} \frac{A_1 + A_2}{A_1 - A_2} \right|$$

A. In a perfect operational amplifier, the CMRR should be zero.

B. It is useful in predicting how well an operational amplifier will reject noise.

C. Noise tends to be "common-mode", meaning in-phase, especially if the wires connecting the sensor are twisted together so that they pass through the same space and pick up the same varying magnetic fields.

D. To accomplish a high CMRR, a signal should be configured as differential, i.e., the voltages should be exactly out-of-phase.

E. All are true.

Explanation: In a perfect operational amplifier, the CMRR should be ∞.
[*circuits0326.mcq*]

39. As seen in this course, the following are true regarding properly designed systems comprised of subsystems, assuming the signals between subsystems carry information in the form of a voltage, *except*, (or all are true).

A. All are true.

B. A subsystem should have low output impedance, that is, it should act like as much like a perfect voltage source as possible.

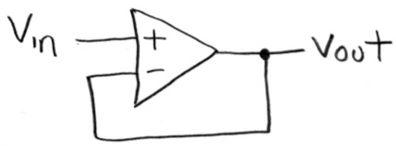
C. A subsystem should have high input impedance, that is, it should sense voltage at the input while drawing minimal current.

D. Assuming no feedback between subsystems, information flows only in one direction, making each subsystem only dependent on other subsystems upstream.

E. An output of one stage should not be effected by the inputs of subsequent stages to which it is connected.

Explanation: All are true.
[*circuits0335.mcq*]

40. The following are true about the the circuit below *except* (or all are true).



A. It makes use of a virtual ground.

B. This is commonly called a *voltage follower*.

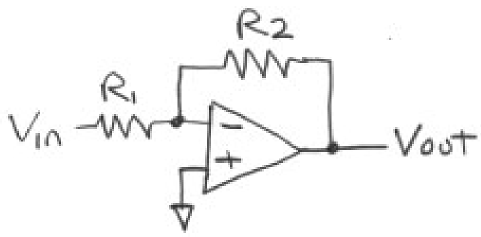
C. It puts practically no load on input voltage V_{in}, because there is practically no current going into the Op Amp.

D. It produces an output voltage V_{out} that is practically identical to the voltage seen at V_{in}.

E. All are true.

Explanation: A virtual ground must have one of the inputs to the Op Amp tied to ground.
[*circuits0337.mcq*]

41. Assuming a perfect Op Amp, if $R_2 = 10\text{K}\Omega$, $R_1 = 10\text{K}\Omega$, $V_{in} = 3\text{V}$, which of the following is (are) true?



I - $V_{out} = -3V$.
II - The negative input of the Op Amp will be at 0 volts.
III - The magnitude of the current through R_1 is the same as through R_2.

A. I, II, and III

B. I and II

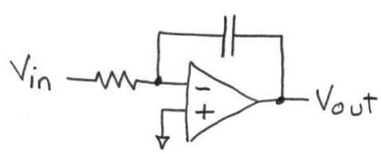
C. I

D. II and III

E. I and III

Explanation: $V_{out} = -V_{in}\frac{R_2}{R_1}$. The same current will run through R_2 as R_1. The inputs to the op amp will be equal, i.e., at ground.
[*circuits0338.mcq*]

42. What is the voltage V_{out} after 1 second, if V_{out} begins at 2V, the resistor is $1M\Omega$, the capacitor is $1\mu F$, and $V_{in} = -2V$?



A. 4V

B. -4V

C. -6V

D. 0V

E. 6V

Explanation: $V_{out} = -\frac{1}{RC}\int V_{in}dt$, keeping in mind that the initial value for V_{out} is 2V.
[*circuits0339.mcq*]

43. The following are true regarding hysteresis as applied in our lab about thermoregulation *except*, (or all are true).

A. All are true.

B. It provides for two different set-points for the comparator.

C. It *decreases* the frequency at which the heater turns on and off, decreasing what is known as "chatter".

D. It is present in standard old electromechanical thermostats in the form of a little heating element that changes the effective set-point.

E. It represents a form of positive feedback, in which, once the heater begins to turn on or off, it is encouraged to turn *all the way* on or off.

Explanation: See lab.
[*circuits0340.mcq*]

44. The following are true regarding the conventions of drawing schematics used in our course *except*, (or all are true).

A. All are true.

B. Positive to negative voltage tends to flow from top to bottom.

C. Signals tend to flow from left to right, except for feedback, which may flow from right to left.

D. Lines that cross each require a dot to signify that they connect, otherwise they do not connect.

E. Integrated circuits have their pin numbers *outside* the symbol boundary and their pin functions *inside* the symbol boundary.

Explanation: All are true.
[*circuits0341.mcq*]

45. Common Mode Rejection Ration (CMRR) is defined by the equations below, given that the individual gains A_1 and A_2 for the (+) and (−) inputs are not necessarily equal. Which of the following is *false* (or all are true)?

$$V_{out} = A_1 V_{in(+)} - A_2 V_{in(-)}$$

$$CMRR = \left| \frac{1}{2} \frac{A_1 + A_2}{A_1 - A_2} \right|$$

A. The signal should be "common-mode", with the (+) and (-) inputs of the amplifier going up and down in phase, but the signal must be so much stronger than the noise that the signal will not be significantly corrupted.

B. It is useful in predicting how well an operational amplifier will reject noise.

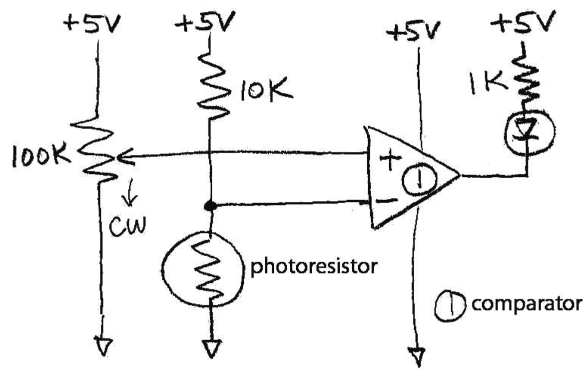
C. Noise tends to be "common-mode", meaning in-phase, especially if the wires connecting the sensor are twisted together so that they pass through the same space and pick up the same varying magnetic fields.

D. All are true.

E. In a perfect operational amplifier, the CMRR should be ∞.

Explanation: To accomplish a high CMRR, a signal should be configured as differential, i.e., the voltages should be exactly out-of-phase. The point is that the signal is often not much stronger than the noise, and the differential amplifier is used to separate them.
[*circuits0362.mcq*]

46. For the circuit below, the following are true *except* (or all are true)



A. Turning the potentiometer clockwise (CW) will raise the voltage on the (+) input of the comparator.

B. Although the comparator may be an open-collector device, the circuit can still function since the LED is tied to +5V by the 1K resistor.

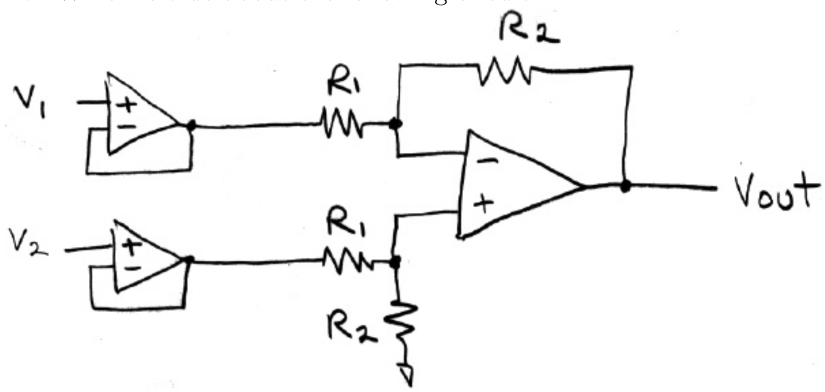
C. Given proper adjustment of the potentiometer, increasing the amount of light hitting the photoresistor will cause the LED to turn *off*.

D. All are true.

E. The circuit utilizes a Wheatstone bridge.

Explanation: Turning the potentiometer clockwise (CW) will lower the voltage on the (+) input of the comparator.
[*circuits0363.mcq*]

47. Which is true about the following circuit?



A. This is a Differential Amplifier, sometimes called an "Instrumentation" Amplifier.

B. The input impedance for V_1 and V_2 are both R_1.

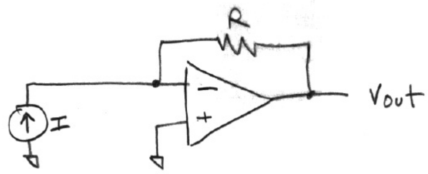
C. This is an integrator.

D. This is a differentiator.

E. This is a summer.

Explanation: The input impedance for V_1 and V_2 are both essentially infinite, because of the buffers.
[*circuits0390.mcq*]

48. Regarding the following circuit (assuming a perfect Op Amp), the following are true *except* (or all are true).



A. All are true.

B. The voltage at the negative input of the Op Amp is zero.

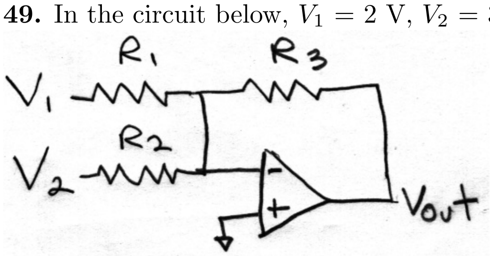
C. $V_{out} = -IR$.

D. All of the current I passes through the resistor.

E. The output impedance of the circuit is zero.

Explanation: This is a current-to-voltage converter. The output impedance of a perfect Op Amp is zero, and so the resistance R has no effect on that output impedance, being essentially in parallel with 0 Ω.
[*circuits0391.mcq*]

49. In the circuit below, $V_1 = 2$ V, $V_2 = 3$ V, $R_1 = R_2 = R_3 = 3$ KΩ, what is V_{out}?



A. -5 V.

B. 5 V.

C. 1 V.

D. -1 V.

E. None of the other answers is correct.

Explanation: This is a summer (inverting). The currents from each input, determined by ohms law for the particular input resistor and voltage, sum independently at the virtual ground and continue on through R_3, so $V_{out} = -(\frac{R_3}{R_1}V_1 + \frac{R_3}{R_2}V_2)$.
[*circuits0394.mcq*]

50. The following are true about H-Bridge circuits *except*

A. Since they contain op amps, they require both positive and negative power supplies.

B. The audio amplifier integrated circuit we used in the lab consists of one.

C. They contain two op amps configured as (1) a voltage follower (buffer) and (2) an inverting amplifier with a gain of 1.

D. They provide two outputs with voltages that move in opposite directions in response to a given change in the input voltage.

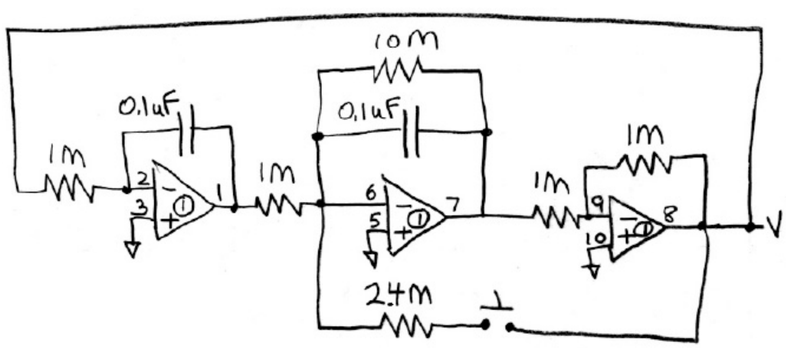
E. They provide an ability to move current in either direction through a load.

Explanation: The provide an ability to move current in either direction through a load, *without* requiring both positive and negative power supplies.

Alternate acceptable answer: BCDE

Errata: Answer A should say, "Since it contains op amps, the circuit as a whole requires both positive and negative power supplies." Otherwise, Answer A could mean the op amps themselves require positive and negative power supplies, which they could be seen as having. So all answers could be considered true, and credit is given for any answer.
[*circuits0444.mcq*]

51. The following are true about the circuit shown below, discussed in class, and built in the lab *except* (or all are true)



A. All are true.

B. The negative input of each op amp is a virtual ground.

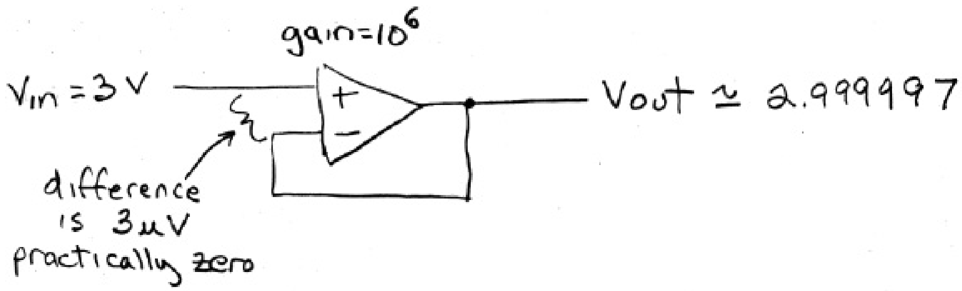
C. It provides the solution to a second order differential equation.

D. It contains two integrators and an inverter all built into a loop, whose solution is a sinusoid.

E. Its output can change amplitude along both positive and negative first order exponentials.

Explanation:
[*circuits0445.mcq*]

52. The following are true about the figure below, discussed in class *except*



A. It assumes an ideal op amp.

B. It demonstrates a voltage follower, otherwise known as a buffer.

C. It shows how the voltage between the inputs of a real op amp with feedback is not actually zero, but rather very small.

D. The current available at V_{out} is many orders of magnitude greater than the current drawn from V_{in}.

E. It is an example of negative feedback.

Explanation: It assumes a *real* op amp, with large (10^6) but not infinite gain. Even so, Answer D is still true.
[*circuits0446.mcq*]

53. The following are true about a real (non-ideal) op amp *except*

A. The common mode rejection ratio (CMRR) cannot be determined, since only ideal op amps have a CMRR.

B. The input current, though generally very small, is not truly zero.

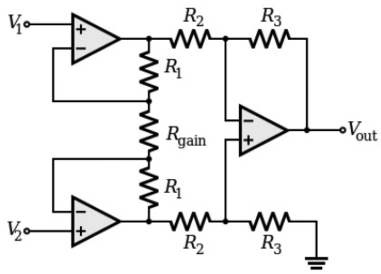
C. The open loop (no external feedback) gain is not actually infinite, but is very high at low frequencies, falling with increasing frequency to 1 (unity gain) at some high frequency.

D. The output impedance, though not zero, is very low, up to a rated maximum current for the particular op amp.

E. When the (+) and (−) inputs are equal, the output voltage is not precisely 0 V.

Explanation: Perfect op amps have an infinite CMRR, whereas real op amps have a finite CMRR.
[*circuits0447.mcq*]

54. The following are true about the figure below, discussed in class, *except*



A. Assuming ideal op amps, it provides infinite gain.

B. It shows a differential amplifier, also known as an "instrumentation" amplifier.

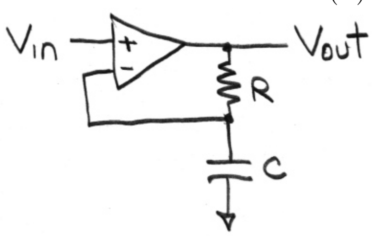
C. As opposed to some differential amplifiers, the gain of this circuit may be controlled by a singled resistor value.

D. Assuming ideal op amps, it provides infinite input impedance.

E. Assuming perfect op amps and perfectly matched pairs of resistors, R_1, R_2, and R_3, it provides infinite common mode rejection ratio (CMRR).

Explanation: Even assuming perfect op amps, it provides a *finite* gain. That is how it differs from a single ideal op amp.
[*circuits0448.mcq*]

55. The transfer function $H(\omega)$ for the following circuit is



A. $1 + j\omega RC$

B. $j\omega RC$

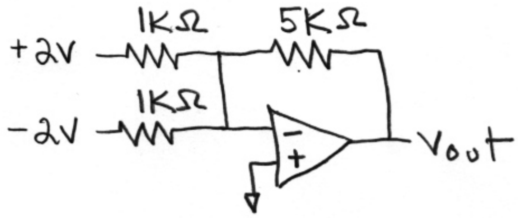
C. $\frac{1}{1+j\omega RC}$

D. $\frac{1}{RC}$

E. 1

Explanation: Since this is a standard non-inverting amplifier based on an impedance divider, the transfer function $H(\omega) = \frac{R+\frac{1}{j\omega c}}{\frac{1}{j\omega c}} = 1 + j\omega RC$.
[*circuits0468.mcq*]

56. What is V_{out} for the following circuit?



A. 0 V

B. 10 V

C. -10 V

D. 20 V

E. -20 V

Explanation: The current entering the virtual ground through the top input resistor will be completely removed through the bottom input resistor, leaving no current to flow through the feedback resistor. Therefore V_{out} will be at ground. See slide for the Inverting Adder for relevant equations.
[*circuits0469.mcq*]