What is an Operational Amplifier?

Worksheet

An op-amp amplifies the difference between its inputs; with feedback its gain is set by external resistors, e.g. Vout = (Rf/Rin)Vin for the inverting configuration.

$$V_{out} = A(V_+ - V_-)$$

Questions

1. An ideal op-amp has input impedance:

A) Zero
B) Infinite
C) 1 k
D) Negative

2. The inverting amplifier gain formula is:

A) Rf/Rin
B) Rf/Rin
C) 1 + Rf/Rin
D) Rin/Rf

3. The non-inverting amplifier gain formula is:

A) Rf/Rin
B) Rf/Rin
C) 1 + Rf/Rin
D) 1 Rf/Rin

4. In an inverting amplifier, the output is:

A) In phase with the input
B) 180 out of phase with the input
C) 90 shifted
D) There is no output

5. An inverting amplifier has Rf = 10 k, Rin = 1 k and Vin = 0.5 V. Find Vout.

6. A non-inverting amplifier has Rf = 20 k, Rin = 5 k and Vin = 1 V. Find Vout.

7. An op-amp has open-loop gain A = 100,000 and inputs V+ = 2.0001 V, V = 2 V. Find Vout.

8. Define: What is an op-amp?

9. Define: What are the ideal op-amp assumptions?

10. Define: Formula for inverting amplifier gain?

Answer Key

1. B) Infinite - Ideal op-amps draw essentially no input current, implying infinite input impedance.
2. B) Rf/Rin - The inverting configuration gain is Av = Rf/Rin, with a sign inversion.
3. C) 1 + Rf/Rin - Non-inverting gain is always at least 1: Av = 1 + Rf/Rin.
4. B) 180 out of phase with the input - The inverting configuration flips the sign, producing a 180 phase shift.
5. Vout = (Rf/Rin)Vin = (10/1)0.5 = 5 V
6. Gain = 1 + Rf/Rin = 1 + 20/5 = 5 Vout = 5 1 = 5 V
7. Vout = A(V+ V) = 100000 0.0001 = 10 V (would saturate near the supply rail in practice)
8. A high-gain differential voltage amplifier IC with two inputs and one output.
9. Infinite open-loop gain, infinite input impedance, and zero output impedance.
10. Av = Rf/Rin.