Operational Amplifier Practice Test (Sample)

Study Guide

Everything you need from our exam experts!

Sample study guide. For the full version with hundreds of questions, visit:
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Introduction

Preparing for a certification exam can feel overwhelming, but with the right tools, it becomes an opportunity to build confidence, sharpen your skills, and move one step closer to your goals. At Examzify, we believe that effective exam preparation isn't just about memorization, it's about understanding the material, identifying knowledge gaps, and building the test-taking strategies that lead to success.

This guide was designed to help you do exactly that.

Whether you're preparing for a licensing exam, professional certification, or entry-level qualification, this book offers structured practice to reinforce key concepts. You'll find a wide range of multiple-choice questions, each followed by clear explanations to help you understand not just the right answer, but why it's correct.

The content in this guide is based on real-world exam objectives and aligned with the types of questions and topics commonly found on official tests. It's ideal for learners who want to:

- Practice answering questions under realistic conditions,
- Improve accuracy and speed,
- Review explanations to strengthen weak areas, and
- Approach the exam with greater confidence.

We recommend using this book not as a stand-alone study tool, but alongside other resources like flashcards, textbooks, or hands-on training. For best results, we recommend working through each question, reflecting on the explanation provided, and revisiting the topics that challenge you most.

Remember: successful test preparation isn't about getting every question right the first time, it's about learning from your mistakes and improving over time. Stay focused, trust the process, and know that every page you turn brings you closer to success.

Let's begin.

How to Use This Guide

This guide is designed to help you study more effectively and approach your exam with confidence. Whether you're reviewing for the first time or doing a final refresh, here’s how to get the most out of your Examzify study guide:

1. Start with a Diagnostic Review

Skim through the questions to get a sense of what you know and what you need to focus on. Your goal is to identify knowledge gaps early.

2. Study in Short, Focused Sessions

Break your study time into manageable blocks (e.g. 30 – 45 minutes). Review a handful of questions, reflect on the explanations.

3. Learn from the Explanations

After answering a question, always read the explanation, even if you got it right. It reinforces key points, corrects misunderstandings, and teaches subtle distinctions between similar answers.

4. Track Your Progress

Use bookmarks or notes (if reading digitally) to mark difficult questions. Revisit these regularly and track improvements over time.

5. Simulate the Real Exam

Once you're comfortable, try taking a full set of questions without pausing. Set a timer and simulate test-day conditions to build confidence and time management skills.

6. Repeat and Review

Don’t just study once, repetition builds retention. Re-attempt questions after a few days and revisit explanations to reinforce learning. Pair this guide with other Examzify tools like flashcards, and digital practice tests to strengthen your preparation across formats.

There’s no single right way to study, but consistent, thoughtful effort always wins. Use this guide flexibly, adapt the tips above to fit your pace and learning style. You've got this!

Questions

1. **Explain the basic topology of a three-op-amp instrumentation amplifier and give the gain expression in terms of R1, Rg, and the differential stage resistors.**
    - **A. Vout ≈ (R4/R3) (V2 − V1) × (1 + 2R1/Rg)**
    - **B. Vout ≈ (R2/R1) (V2 − V1) × (1 + 2R1/Rg)**
    - **C. Vout ≈ (R4/R3) (V2 + V1) × (1 + 2R1/Rg)**
    - **D. Vout ≈ (R4/R3) (V2 − V1) × (1 − 2R1/Rg)**

2. **How does a transimpedance amplifier convert current into voltage?**
    - **A. The input current is applied to the noninverting input with a resistor in the feedback path.**
    - **B. The input current is injected into the inverting input and a feedback resistor converts it to a voltage.**
    - **C. The input current is injected into the noninverting input and a feedback network converts it.**
    - **D. The output is independent of input current.**

3. **The inverting input voltage is approximately 0 V, referred to as virtual ground.**
    - **A. Absolute zero**
    - **B. Virtual ground**
    - **C. Vin**
    - **D. Vout**

4. **Define noise gain and explain its role in op-amp stability and closed-loop design.**
    - **A. Noise gain is the effective non-inverting gain seen by input-referred noise; it equals 1 + Zf/Zin for non-inverting configurations and equals the closed-loop gain for inverting configurations at low frequencies; stability depends on how the noise gain intersects the open-loop gain across frequency.**
    - **B. Noise gain is the gain of the noise amplifier.**
    - **C. Noise gain is the ratio of output noise to input signal and determines noise performance only.**
    - **D. Noise gain is the same as the open-loop gain and does not affect stability.**

5. **An ideal voltage follower has**
   - A. Infinite output impedance and zero input impedance.
   - B. Finite input impedance and finite output impedance.
   - C. Zero input impedance and infinite output impedance.
   - D. Infinite input impedance and zero output impedance.

6. **To adjust the output offset voltage of an op-amp, connect circuit inputs to**
   - A. Ground directly
   - B. Power supply
   - C. Circuit common
   - D. Output node

7. **To achieve higher accuracy when converting a PWM signal to an analog voltage, which approach is recommended?**
   - A. Using a smaller PWM frequency reduces ripple.
   - B. Increasing the sampling rate.
   - C. Employ a reconstruction filter or active averaging for higher accuracy.
   - D. Use a larger load capacitor only.

8. **A capacitor placed in parallel with the feedback resistor of an op-amp circuit causes the bandwidth to**
   - A. Decreases
   - B. Increases
   - C. No change
   - D. Undefined

9. **What limitation do conventional op-amps have compared with rail-to-rail types?**
   - A. They cannot operate on any supply.
   - B. They cannot swing input or output voltages to the supply rails.
   - C. They have zero input bias current.
   - D. They cannot be used with feedback.

10. What combination most determines the speed of recovery in a peak detector?

- **A. The diode speed, the op-amp bandwidth, and the hold capacitor size.**
- **B. Only the diode speed.**
- **C. The input impedance of the following stage.**
- **D. The color of the PCB.**

Answers

1. **A**
2. **C**
3. **B**
4. **A**
5. **D**
6. **C**
7. **C**
8. **A**
9. **B**
10. **A**

Explanations

1. **Explain the basic topology of a three-op-amp instrumentation amplifier and give the gain expression in terms of R1, Rg, and the differential stage resistors.**

   A. Vout ≈ (R4/R3) (V2 − V1) × (1 + 2R1/Rg)

   B. Vout ≈ (R2/R1) (V2 − V1) × (1 + 2R1/Rg)

   C. Vout ≈ (R4/R3) (V2 + V1) × (1 + 2R1/Rg)

   D. Vout ≈ (R4/R3) (V2 − V1) × (1 − 2R1/Rg)

The key idea is the two-stage structure: a front-end that converts the input difference into a amplified difference with gain set by the resistor that bridges the two inverting inputs, and a second stage that subtracts the two front-end outputs with a gain set by the differential stage resistor network. In the front-end, each input drives an op-amp with a feedback resistor R1 and the two inverting inputs tied together by Rg. This arrangement makes the front-end gain (for the differential signal) equal to 1 + 2R1/Rg. The outputs of these two op-amps then feed a differential amplifier in the second stage, whose gain is determined by the resistor ratio R4/R3. Multiplying the front-end differential gain by the differential-stage gain gives the overall output: Vout ≈ (R4/R3) × (V2 − V1) × (1 + 2R1/Rg). This captures why the signal is the difference between V2 and V1, scaled first by the front-end and then by the final differential stage. The other forms would misrepresent the subtraction, use the wrong resistor ratio, or place the gain factors incorrectly, which does not reflect how the three-op-amp instrumentation amplifier actually behaves.

2. **How does a transimpedance amplifier convert current into voltage?**

   A. The input current is applied to the noninverting input with a resistor in the feedback path.

   B. The input current is injected into the inverting input and a feedback resistor converts it to a voltage.

   C. The input current is injected into the noninverting input and a feedback network converts it.

   D. The output is independent of input current.

A transimpedance amplifier converts current to voltage by using an op-amp with a feedback resistor from the output back to the inverting input. The noninverting input is tied to a reference (usually ground). The op-amp’s high gain drives its output so that the inverting input sits at approximately the same voltage as the noninverting input, creating a virtual ground at the summing junction. Because of that, the input current must flow through the feedback resistor, which converts it into a voltage at the output. The output voltage equals minus the input current times the feedback resistance: Vout = -If × Rf (the sign depends on current direction). This is the essence of how a transimpedance amplifier performs current-to-voltage conversion.

3. The inverting input voltage is approximately 0 V, referred to as virtual ground.

A. Absolute zero

B. Virtual ground

C. Vin

D. Vout

Virtual ground is the idea that the inverting input of an op-amp in negative feedback sits at a voltage very close to ground, even though it isn't literally connected to ground. The non-inverting input is at ground, and the op-amp's huge gain drives its outputs so that the two inputs are nearly equal. As a result, the inverting input voltage is about 0 V, which is why we treat it as ground for signal analysis. This doesn't mean the node is a real ground conductor—the input current into the op-amp is ideally zero, so the current from Vin through the input resistor must flow through the feedback resistor to the output. That relationship gives the familiar Vout = −(Rf/Rin)·Vin for an ideal inverting amplifier. Other options don't fit because absolute zero is a temperature, while Vin and Vout are the actual input and output voltages, not the potential at the inverting input. The inverting input is the "virtual ground" region that helps simplify analysis.

4. Define noise gain and explain its role in op-amp stability and closed-loop design.

A. Noise gain is the effective non-inverting gain seen by input-referred noise; it equals 1 + Zf/Zin for non-inverting configurations and equals the closed-loop gain for inverting configurations at low frequencies; stability depends on how the noise gain intersects the open-loop gain across frequency.

B. Noise gain is the gain of the noise amplifier.

C. Noise gain is the ratio of output noise to input signal and determines noise performance only.

D. Noise gain is the same as the open-loop gain and does not affect stability.

Noise gain is the effective gain that input-referred noise experiences as it travels through the amplifier's feedback network. It represents how much of the noise at the input ends up being amplified by the closed-loop system. In a non-inverting configuration, this noise-gain value is 1 plus Zf divided by Zin, which is also the gain the circuit uses for the input-referred disturbances. In an inverting configuration, the feedback network still sets a noise-gain of 1 plus Zf/Zin, even though the actual closed-loop signal gain is Zf/Zin in magnitude; the important point is that noise gain describes how the loop treats input-referred noise, not just the desired signal. The role in stability comes from how the loop gain and phase evolve with frequency. The loop gain is the open-loop gain Aol(s) times the feedback factor β, and the noise gain is the reciprocal of β (NG = 1/β). Stability depends on where the open-loop gain crosses the noise gain as frequency increases: if the intersection occurs with insufficient phase margin, the system can become unstable or oscillate. So thinking about noise gain helps you predict stability and design the closed-loop network to ensure enough phase margin across frequencies. Other options miss this focus. Describing noise gain as merely "the gain of the noise amplifier" is too vague and ignores how feedback shapes how input noise is seen by the loop. Defining it as the ratio of output noise to input signal mixes the disturbance at the output with the actual input signal, which isn't the standard input-referred-noise view. Saying it's the same as the open-loop gain ignores the feedback action and its crucial impact on stability.

5. An ideal voltage follower has

- A. Infinite output impedance and zero input impedance.
- B. Finite input impedance and finite output impedance.
- C. Zero input impedance and infinite output impedance.
- D. Infinite input impedance and zero output impedance.

A voltage follower is meant to pass the input voltage to the output without drawing current from the source and without changing the voltage when driving a load. In an ideal version, the input impedance is infinite, so the source sees no load and its voltage stays intact. The feedback in the follower also makes the output impedance zero, so the output voltage matches the input exactly even as the load changes. That combination—infinite input impedance and zero output impedance—is what lets the follower serve as a perfect buffer. The other descriptions imply the source would be loaded or the output would sag under load, which isn't consistent with an ideal voltage follower.

6. To adjust the output offset voltage of an op-amp, connect circuit inputs to

- A. Ground directly
- B. Power supply
- C. Circuit common
- D. Output node

To null or adjust the output offset, you want the two input terminals to sit at the same potential so any remaining output is due only to the offset voltage inside the amplifier. Tying both inputs to the circuit common provides that common reference point, making the input differential effectively zero. With both inputs at the same level, you can use offset-trim provisions (if present) to dial the output back to zero. If you connect an input to the power supply, the inputs aren't forced to be equal and the amplifier may drive to a rail or behave unpredictably. Connecting to the output node would disturb the feedback behavior and won't set the inputs equal. Grounding both inputs works if ground is the same as the circuit's common reference, but the intended and reliable practice is to use the circuit common, which is the designated reference for offset adjustment.

7. To achieve higher accuracy when converting a PWM signal to an analog voltage, which approach is recommended?

A. Using a smaller PWM frequency reduces ripple.

B. Increasing the sampling rate.

C. Employ a reconstruction filter or active averaging for higher accuracy.

D. Use a larger load capacitor only.

The idea being tested is that converting a PWM signal to an accurate analog voltage hinges on removing the high-frequency switching components so the output reflects just the average value set by the duty cycle. A PWM waveform switches between 0 and V, creating a spectrum with a strong carrier at the PWM frequency and many harmonics. To achieve higher accuracy, you need a reconstruction filter that acts as a low-pass, attenuating those switching components while letting the slowly varying or DC component (the duty-cycle–scaled voltage) pass through. An active averaging approach serves the same purpose but with amplification and filtering built in, often delivering better ripple suppression and dynamic performance than a passive filter alone. This is why using a reconstruction filter or active averaging is the most effective way to improve accuracy. Lowering the PWM frequency tends to worsen ripple or push more switching energy into the passband unless you can compensate with a much higher-order filter, and simply increasing the sampling rate doesn’t inherently improve the analog value unless you perform effective digital averaging or filtering afterward. Relying on a larger load capacitor alone reduces some ripple but can slow the response and doesn’t provide proper attenuation of the high-frequency content, so it’s not as robust a solution as a dedicated reconstruction filter or averaging technique.

8. A capacitor placed in parallel with the feedback resistor of an op-amp circuit causes the bandwidth to

A. Decreases

B. Increases

C. No change

D. Undefined

A capacitor placed across the feedback resistor makes the feedback path frequency dependent, introducing a single dominant pole in the closed-loop response. In an inverting amplifier, the feedback impedance becomes Zf = Rf // 1/(jωCf), so the closed-loop gain is Vout/Vin = -Zf/Rin = -(Rf/Rin) * 1/(1 + jωRfCf). At low frequencies the gain is roughly -Rf/Rin, but as frequency increases, the capacitor provides more feedback, and the magnitude falls off roughly as 1/ω beyond the corner frequency. The corner (bandwidth) is set by ωp = 1/(RfCf), so increasing the capacitor lowers the corner frequency and thus reduces the bandwidth. In short, adding the capacitor limits how fast the circuit can respond, making the bandwidth smaller.

9. What limitation do conventional op-amps have compared with rail-to-rail types?

A. They cannot operate on any supply.

B. They cannot swing input or output voltages to the supply rails.

C. They have zero input bias current.

D. They cannot be used with feedback.

Conventional op-amps have limited input common-mode ranges and output swing; the internal transistor stages need headroom away from the supply rails, so the input voltages and the output cannot reach the rails themselves. Rail-to-rail types are designed to extend that range, allowing inputs and outputs to swing very close to both supply rails. So the key limitation being tested is that these older op-amps cannot swing input or output voltages to the supply rails. The other statements aren’t correct: op-amps require a power supply, they do work with feedback, and they do have finite input bias currents.

10. What combination most determines the speed of recovery in a peak detector?

A. The diode speed, the op-amp bandwidth, and the hold capacitor size.

B. Only the diode speed.

C. The input impedance of the following stage.

D. The color of the PCB.

Recovery speed in a peak detector comes from how quickly the stored peak on the hold capacitor can be removed when the input drops. In an active peak detector, that discharge path is set by the diode dynamics, the amplifier’s ability to respond, and how much charge is stored. If the diode is slow or has troublesome reverse recovery, the capacitor can’t release charge quickly, delaying the drop in the held peak. The amplifier’s bandwidth controls how fast the feedback loop can react to changes and pull the capacitor voltage toward the new input value; a wide bandwidth means a faster, tighter tracking during the recovery. The size of the hold capacitor directly sets how much charge is stored, so a larger capacitor requires more charge to be discharged, which slows recovery, while a smaller one allows quicker release. So, the fastest and most accurate recovery depends on the combination of diode speed, op-amp bandwidth, and hold-capacitor size. The following stage’s input impedance can influence leakage paths a bit, but it isn’t the primary determinant, and the color of the PCB has no bearing on the electrical behavior.

Next Steps

Congratulations on reaching the final section of this guide. You've taken a meaningful step toward passing your certification exam and advancing your career.

As you continue preparing, remember that consistent practice, review, and self-reflection are key to success. Make time to revisit difficult topics, simulate exam conditions, and track your progress along the way.

If you need help, have suggestions, or want to share feedback, we’d love to hear from you. Reach out to our team at hello@examzify.com.

Or visit your dedicated course page for more study tools and resources:

https://operationalamplifier.examzify.com

We wish you the very best on your exam journey. You've got this!