

Name _____

Class _____

Date _____

By the end of this worksheet I can...

- ☐ identify inverting, non-inverting, summing, difference and comparator op-amp circuits
- ☐ calculate gain and output voltage, including saturation at about 85% of supply
- ☐ design an op-amp circuit with suitable resistor values
- ☐ describe how a comparator switches an output

I DO**Worked example** Read how a full-mark answer is built

The same amplifier (gain -10) now has $V_{in} = 1.5\text{ V}$. Supply $\pm 12\text{ V}$.

1 Calculate V_{out} , taking the supply into account. (2 marks)**Full-mark answer** each ✓ is one mark

$-10 \times 1.5 = -15\text{ V}$, which is beyond the supply ✓. The op-amp saturates at about 85% of 12 V , so $V_{out} \approx -10.2\text{ V}$ ✓.

Why marks are not awarded

" $V_{out} = -15\text{ V}$ "

0 marks: ignores saturation.

WE DO**Guided practice** Use the starters and word bank to help you

An inverting amplifier has $R_{in} = 4.7\text{ k}\Omega$ and $R_f = 47\text{ k}\Omega$. $V_{in} = 0.35\text{ V}$. Supply $\pm 12\text{ V}$.

2 Calculate V_{out} . (2 marks)**Sentence starters**

One ... is ..., which means ...

Another ... is ..., so ...

Word bank

Tip: 2 marks = 2 separate, developed points.

YOU DO**On your own** No notes. Check your answers afterwards.**3 Quick check: tick one box for each.**

- a) Which configuration is used as a buffer?
☐ Summing amplifier ☐ Voltage follower ☐ Comparator ☐ Inverting amplifier
- b) On a 12 V supply, an op-amp saturates at about...
☐ 12 V ☐ 0.7 V ☐ 6 V ☐ 10.2 V
- c) $R_f = 100\text{ k}\Omega$, $R_{in} = 10\text{ k}\Omega$, $V_{in} = 0.2\text{ V}$ (inverting). V_{out} is...
☐ -2 V ☐ 2 V ☐ 0.02 V ☐ -0.2 V
- d) A comparator output goes high when...
☐ $V_- > V_+$ ☐ Both are equal ☐ $V_+ > V_-$ ☐ Supply is off

4 Key terms: write the letter of the matching description next to each term.

- | | | |
|----------------------------|-------|--|
| 1. Inverting amplifier | _____ | A $V_{out} = (R_f/R_1) \times (V_2 - V_1)$ |
| 2. Non-inverting amplifier | _____ | B $V_{out} = (1 + R_f/R_1) \times V_{in}$ |
| 3. Summing amplifier | _____ | C Output high when $V_+ > V_-$, otherwise low. |
| 4. Difference amplifier | _____ | D $V_{out} = -R_f \times (V_1/R_1 + V_2/R_2 + \dots)$ |
| 5. Voltage follower | _____ | E $V_{out} = V_{in}$; used as a buffer. |
| 6. Comparator | _____ | F $V_{out} = -(R_f/R_{in}) \times V_{in}$ |

A non-inverting amplifier must have a gain of 11. $R_{in} = 1\text{ k}\Omega$.

5 Calculate R_f . (2 marks)

A summing amplifier has inputs of 0.2 V and 0.5 V, each through 10 k Ω , with $R_f = 22\text{ k}\Omega$.

6 Calculate V_{out} . (2 marks)

A difference amplifier has $V_1 = 2.4\text{ V}$, $V_2 = 3.0\text{ V}$, $R_1 = 10\text{ k}\Omega$ and $R_f = 33\text{ k}\Omega$ (balanced).

7 Calculate V_{out} . (2 marks)

Check and reflect

Mark your answers with the answer sheet. Go back to the checklist on the site and re-rate each “I can” statement above. Which one still needs work?
