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MM2EMD

Worksheet 4 – MM2EMD Analog electronics and operation amplifiers.

Q1. Draw the full equivalent circuit of an operation amplifier and label all inputs,outputs, resistors and voltage sources.

Q2. What resistance can one assume the inputs and outputs of an opp-amp have? Redraw the equivalent circuit taking these assumptions into account.

Q3. Explain the difference between an analog and digital signal.

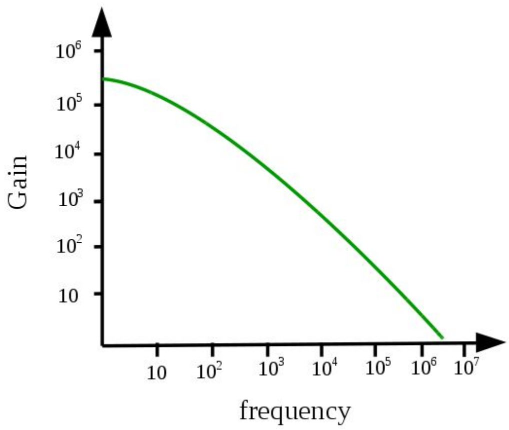
Q4. Draw the diagram for an inverting amplifier and write down the full equation relating the input voltage and output voltage. What can we assume about the gain for most op-amps? Using this assumption simplify the equation.

Q5. An inverting amplifier circuit has a feedback resistor with a resistance of 100 Ohms, and a input resistance of 10 Ohms. Calculate the gain of the the inverting amplifier circuit assuming the open loop gain, A is >>1.

Q6. Name three uses for an op-amp.

Q7. Explain in words why we can't use an op-amp with no feedback?

Q8. If an inverting amplifier had a feedback resistance of 200 Ohms, and an input resistance of 1 Ohm how much would a 1kHz sin wave be amplified by? Use the open loop gain plot below to solve this question.



Q9. Draw the circuit diagram for a summing amplifier and write down the equation relating the inputs to the outputs. What assumptions must be made for this equation to hold?

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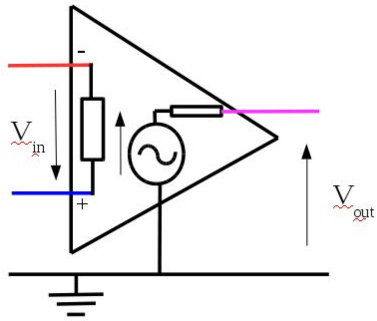
Answers

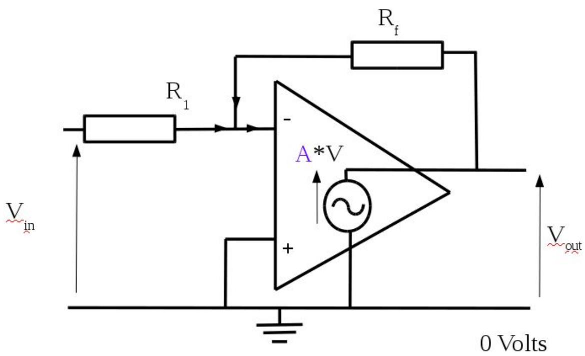
Q1.



Q2. One can assume that the input resistance to an op-amp is infinite and the output resistance is 0.

Q3. Digital signals can only take the value of 0 or 1, analog signals can take any value.

Q4.



$$G=\frac{V_{\text{out}}}{V_{\text{in}}}=\frac{-R_f A}{[R_r(A+1)+R_f]}$$

If A>>1

$$G=\frac{V_{\text{out}}}{V_{\text{in}}}=-\frac{R_f}{R_1}$$

Q5.

$$G=\frac{V_{\text{out}}}{V_{\text{in}}}=-\frac{R_f}{R_1}$$

Therefore G=-100/10= -10

Q6. Amplifier, adder and as a filter.

Q7. The negative feedback from an op-amp reduces the over all gain to a usable level. If no feedback resistor is used you would encounter the following problems:
1. Gain would be non-linear as a function of frequency and introduce distortion into any signal you wanted to amplify.
2. The gain would be so high that the circuit would saturate and any output would be chopped.

Q8.

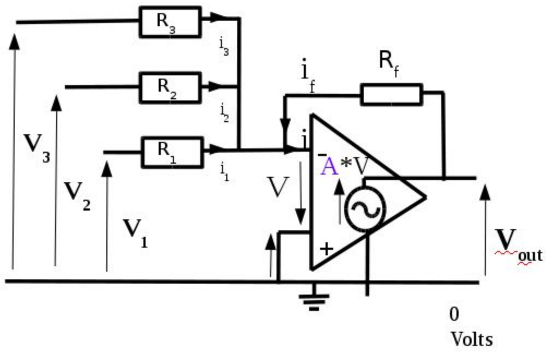
$$G=\frac{V_{\text{out}}}{V_{\text{in}}}=\frac{-R_f A}{[R_1(A+1)+R_f]}$$

@ 1kHz A=1x10^4.

Rf=200 Ohm
R1=1 Ohm

Therefore
G=-196.06

Q9.



$$V_{out}=-\sum V_{\text{in}}$$

For this equation to be valid the following conditions must be met

$$R_f=R_1+R_2+R_3$$

and

$$R_1=R_2=R_3$$
must be true.