

TUTORIAL 1 Op-Amps & Other Monsters

Question 1

You have a heater which is nominally 3kW, plugged into a mains socket. Model it. What is the current drawn?

If you live close to the distribution transformer, the voltage may be 10% higher. Calculate the current drawn and the power rating of the heater.

Likewise at the end of the line, where it may be 10% less.

Question 2

Do the above for a 100W bulb.

At 25c/kWh, compare the cost of running the heater, and the bulb for six hours a day for a month.

Comment on the adage: “Turn off the light”.

Comment on the percentage increase/decrease in power.

Comment on the life of a light bulb, and the length of time taken to toast a standard slice of bread. (Toaster is nominally 800W).

Question 3

Duhva power station consists of 6 “sets” of 600MW generator units. Assume (incorrectly) that the output voltage is the domestic supply voltage, and that the output resistance of the station is 1mΩ. Calculate the fault current.

Attach your light bulb to Duhva. How much power flows?

What about Maximum Power Transfer?

Assume you have used ordinary twin-flex to feed your light bulb. This is usually rated at about 5A. Assume this ruptures at 20A. What is the maximum power you can get out of Duhva on twin-flex? Into what load?

What about Maximum Power Transfer?

Question 4

Just Ginger Screeches into a Microphone. Into an open circuit, his tonsils can generate 1mV.

Assuming his tonsils allow him to generate a single, pure tone, sketch the waveform.

What is “ground”?

Why?

Assuming you continued your studies at the University of Cape Town, would the “ground” be the same? Why?

The microphone output resistance is about 100Ω.

Plug the Mike into an op-amp based inverting amplifier with an input resistance of 10kΩ, and a gain of 10, suitably powered up from a split-supply. What is the output swing achieved?

Design an amplifier with a gain of ten, but whose input obeys the Maximum Power Transfer principle. What is the output swing achieved?

Which amp would you use?

Sketch the output if your microphone were connected as follows:

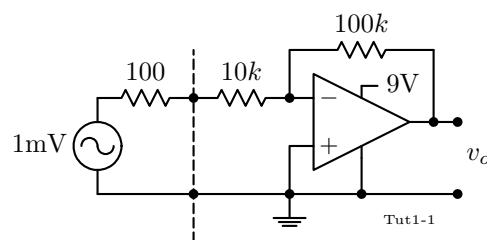


Figure 1: Microphone connected to inverting amplifier.

How would you re-design the circuit?

Question 5

Problems in text:

2.2 [1001V/V]; 2.6 [G = 0.9 to 1.1]; 2.8; 2.9; 2.12 [76.8 V/V]; 2.22 [-8V/V]; 2.24; 2.25; 2.37 [-1.5V];

2.41; 2.46; 2.55; 2.58; 2.62; 2.82 [250kHz]; 2.86;
2.87; 2.95.