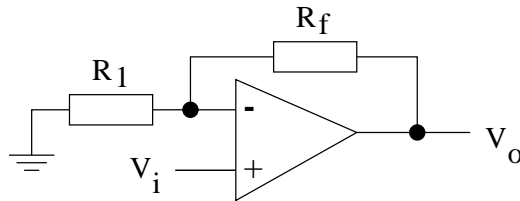


Question 1.

- (a) Draw an op-amp **integrator**.
- (b) Derive the input-output relationship for the following non-inverting op-amp.



Question 2.

- (a) Name three (3) properties of a waveform that can be measured on a CRO.
- (b) What is the purpose of **blanking** of the electron beam?
- (c) What does ALT do?
- (d) What happens on the CHOP setting?
- (e) At **low** frequencies is it better to use ALT or CHOP? Why?

Question 3.

- (a) Define **accuracy**.
- (b) Define **precision**.
- (c) Define **repeatability**.
- (d) Name a circuit that performs a **null** measurement.
- (e) What causes **parallax** reading error?

Question 4.

- (a) What kind of AC bridge is suitable for measuring **capacitors**?
- (b) Draw a Wheatstone bridge with $R_1 = 500 \Omega$, $R_2 = 100 \Omega$, R_3 varying from $2 \text{ k}\Omega$ to $20 \text{ k}\Omega$, and R_X is the unknown resistor.
- (c) Calculate the range of values of R_X that the bridge of (b) can measure.
- (d) What is the metric prefix for ten to the power of **negative twelve** (-12)?
- (e) What is the name of the metric prefix for ten to the power of **nine** (9)?

Question 5.

- (a) Describe **amplitude modulation** (AM).
- (b) Describe **frequency modulation** (FM).
- (c) What is **multi-path propagation**?
- (d) **Why** do we need a **carrier** wave?
- (e) Why do mobile phones sometimes fail to operate inside buildings?

Question 6.

- (a) $V_T = \frac{kT}{q}$: what are the name and value of the constant **k** in that formula?
- (b) What is the value and meaning of **q** in the formula of part (a)?
- (c) What unit is **T** measured in?
- (d) $I_c = I_0 \exp\left(\frac{V}{V_T}\right)$: name an electronic device to which this formula applies.
- (e) At **27** degrees Celsius (a mild summer's day) what is the value of V_T ?

Question 7.

- (a) Give one (1) use for an **isolation** amplifier.
- (b) Define **voltage drift** in an op-amp.
- (c) Define **common mode gain**.
- (d) List five (5) properties of a **real** op-amp.
- (e) **Instrumentation amplifiers** reduce what two (2) problems of simpler differential op-amp circuits?

Question 8.

- (a) Name two (2) types of **white** noise.
- (b) Name two (2) types of **pink** noise.
- (c) **AC meters** are suited to measuring the RMS voltage of what shape of waveform?
- (d) Draw a **three-bit ripple** counter.
- (e) Why is a ripple counter **not** a suitable design when there are a large number of bits?

Question 9.

- (a) What is the **Peltier** effect in a thermocouple?
- (b) State the **sampling** theorem.
- (c) Sketch the distorted waveform that results from passing a **square** wave through a **low** pass filter.
- (d) What is the purpose of the **voltage controlled oscillator** (VCO) in a **spectrum analyser**?
- (e) Draw a picture showing how you would make a **bandstop** filter from a lowpass and a high-pass filter.

Question 10.

- (a) List **two** (2) indoor **sources** of **capacitive** (electric) interference.
- (b) Name the four (4) classes of device in the **GPIB** standard.
- (c) Define **total harmonic distortion**.
- (d) Give the formula for **quality factor** Q in terms of a circuit's **resonant frequency** f_r and **bandwidth** B .
- (e) A **sweep generator** can be used to measure a resonant circuit's **frequency response**. If we use a **high** sweep rate, what **undesired** effect can occur?