Section 1 Multiple choice questions:

Q1a. If you want to adjust the peak value of a sinusoidal signal from a signal generator, which knob should you use?

Amplitude knob
Voltage offset knob
Duty cycle knob
Frequency knob

Q1b. If you want to adjust the frequency of a sinusoidal signal from a signal generator, which knob should you use?

Frequency range
Frequency knob
Voltage offset knob
Duty cycle knob

Q2a. If a square wave signal is integrated by four times, what will the waveshape be?

Near sinusoidal
Square
Triangular
Pulsating

Q2b. If a square wave signal is differentiated by four times, what will the waveshape be?

Pulsating
Near sinusoidal
Square
Triangular

Q3a. If a 500Hz square wave signal is measured by a multimeter, do you think the reading is accurate?

No
Yes

Q3b. If a 500Hz sinusoidal wave signal is measured by a multimeter, do you think the reading is accurate?

Yes
No

Q4a. What is the fundamental frequency of the waveform $v(t)=10\sin(1000\pi t)+2\cos(2000\pi t)$?

a. 500Hz
b. 1kHz
c. 2kHz
d. 4kHz

Q4b. What is the fundamental frequency of the waveform $v(t)=10\sin(1000\pi t)+2\cos(3000\pi t)$?

a. 1kHz
b. 1.5kHz
c. 500Hz
d. Not periodic

Q5a. Which of the following properties do buffer amplifiers have?

a. High input resistance
b. Low output resistance
c. Low input resistance
d. High output resistance

Q5b. Which of the following properties do you need to consider for sensors?

a. Output resistance
b. Output voltage
c. Output current
d. Input resistance

Q6a. A lead acid battery has no-load voltage of 12V and output resistance of 10mΩ. If it is connected to a 10Ω load, what is the terminal voltage?

a. 11.988V
b. 12.000V
c. 12.012V
d. 11.881V

Q6b. A lead acid battery has no-load voltage of 12V and output resistance of 10mΩ. If it is connected to a 10Ω load, what is the output current?

a. 1.1988A
b. 1.2A
c. 1.2012A
d. 1.1881A

Q7a. If a battery has the output characteristic of $v_b = 14 - 0.03 i_b$, where v_b is the battery voltage and i_b is the battery current, respectively. Determine the open-circuit voltage.

14V
13.7V
14.03V
13.97V

Q7b. If a battery has the output characteristic of $v_b = 14 - 0.03 i_b$, where v_b is the battery voltage and i_b is the battery current, respectively. Determine the battery voltage if the output current is 10A.

13.7V
14V
14.03V
13.97V

Q8a. What is the average voltage of the signal $v(t) = -10 + 5\cos(1000\pi t)\,\text{V}$?

-10V
-5V
+5V
+10V

Q8b. What is the peak value of the signal $v(t) = -10 + 5\cos(1000\pi t)\,\text{V}$?

-5V
-10V
+5V
+10V

Q9a. What are the pins for I2C communication on Microbit?

a. pin 19 for SCL and pin 20 for SDA
b. pin 19 for SDA and pin 20 for SCL
c. pin 18 for SCL and pin 19 for SDA
d. pin 18 for SDA and pin 19 for SCL

Q9b. What are the pins for Analog input if LED display is used at the same time?

a. pins 0, 1, 2
b. pins 1, 2, 3
c. pins 2, 3, 4
d. pins 1, 2, 4

Q10a. Which of the following statement(s) is/are correct?

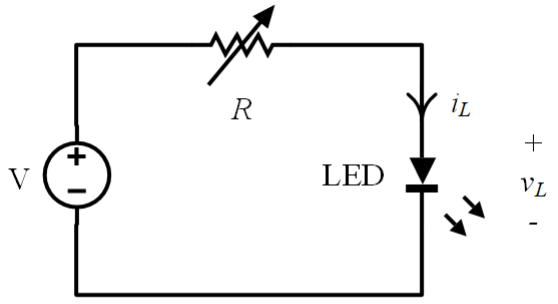
The output voltage of an electronic system can be higher than the input voltage.
The output current of an electronic system can be higher than the input current.
The output power of an electronic system can be higher than the input power.
The output resistance of an electronic system can be higher than the input resistance.

Q10b. Which of the following statement(s) is/are correct?

The frequency of the output of an electronic system can be higher than the frequency of the input.
The ideal output resistance of an electronic system is zero.
The ideal input resistance of an electronic system is zero.
The output voltage of an electronic system can be kept unchanged even if the input voltage is changed.

Section 2 Long questions

Question 2(a)
Fig. 1 shows a circuit that can control the brightness of an LED. The current-voltage characteristic of the different LEDs is given.



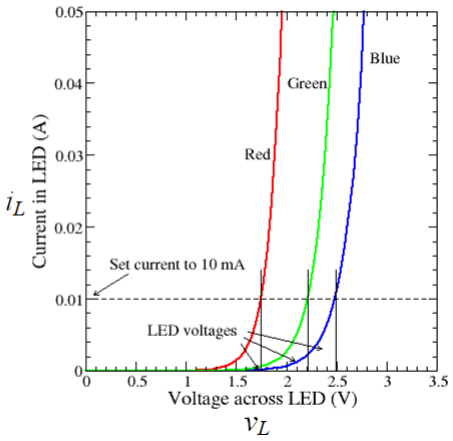


Fig. 1

(a) Express i_L in terms of V, R, and v_L. (1 mark)

Ans.: $i_L = (V - v_L)/R$

(b) Based on (a), explain how the operating point is determined graphically. (1 mark)

Draw the straight line using the function derived in part (a). The intersection point of the straight line and the LED characteristic is the operating point that gives the LED voltage and LED current. [Other reasonable answers are acceptable.]

(c) What is the minimum value of V to turn on a green LED? (1 mark)

1.5V

(d) Discuss two methods that can control the brightness of an LED. (1 mark)

Control the supply voltage or the value of the resistor.

(e) Suggest two methods that can dim three LEDs with fixed resistor(s) (1 mark)

1) Three separate circuits connected to the same are used to control individual LEDs so that the currents of the three circuits can be controlled or
2) The LEDs can be connected in series to share the same current.

[Other reasonable answers are acceptable.]

Question 2(b)

Fig. 1 shows a circuit that can control the brightness of an LED. The current-voltage characteristic of the different LEDs is given.

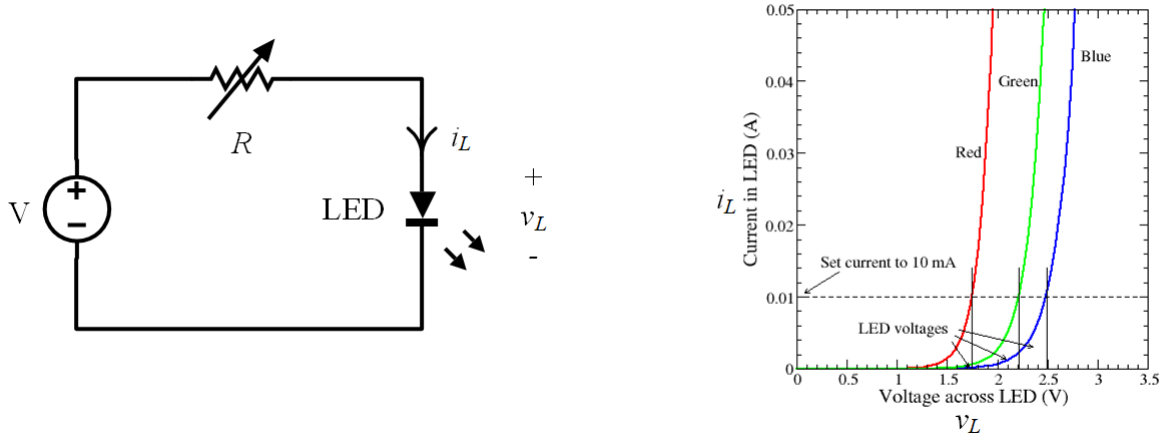


Fig. 1

(a) Express i_L in terms of V, R, and v_L. (1 mark)

Ans.: $i_L = (V - v_L)/R$

(b) Based on (a), discuss how the operating point can be determined graphically. (1 mark)

Draw the straight line using the function derived in part (a). The intersection point of the straight line and the LED characteristic is the operating point that gives the LED voltage and LED current. [Other reasonable answers are acceptable.]

(c) Suggest how the brightness of the blue LED can be controlled. (1 mark)

Change the values of *R and V*.

(d) Suggest how the brightness of an LED can be controlled by a Microbit board. (1 mark)

By changing the pulsewidth of the PWM signal, the average value of V, and thus the brightness, can be controlled. [Other reasonable answers are acceptable.]

(e) Suggest two methods that can dim three LEDs with fixed resistor(s) (1 mark)

1) Three separate circuits connected to the same are used to control individual LEDs so that the currents of the three circuits can be controlled or
2) The LEDs can be connected in series to share the same current.

[Other reasonable answers are acceptable.]