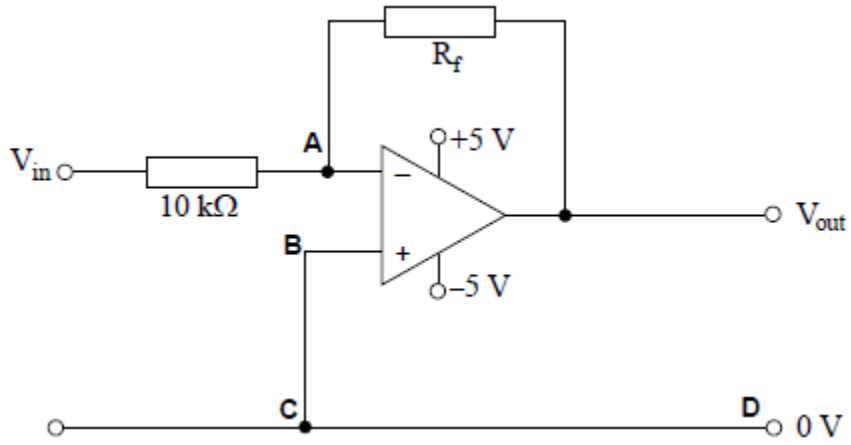
Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.

Figure 1 shows an inverting op-amp amplifier subsystem.

Figure 1



(a) (i) Write in the box the letter that corresponds to the virtual earth point in **Figure 1**.

(1)

(ii) Explain the meaning of the term **virtual earth point**.

_____

_____

(2)

(iii) State the input resistance of this amplifier subsystem.

_____

(1)

(b) Calculate the value of R_f needed to give the amplifier subsystem a voltage gain of − 47.

_____

_____

(3)

(c) The amplifier subsystem in part **(b)** is used to increase the signal voltage from an electric

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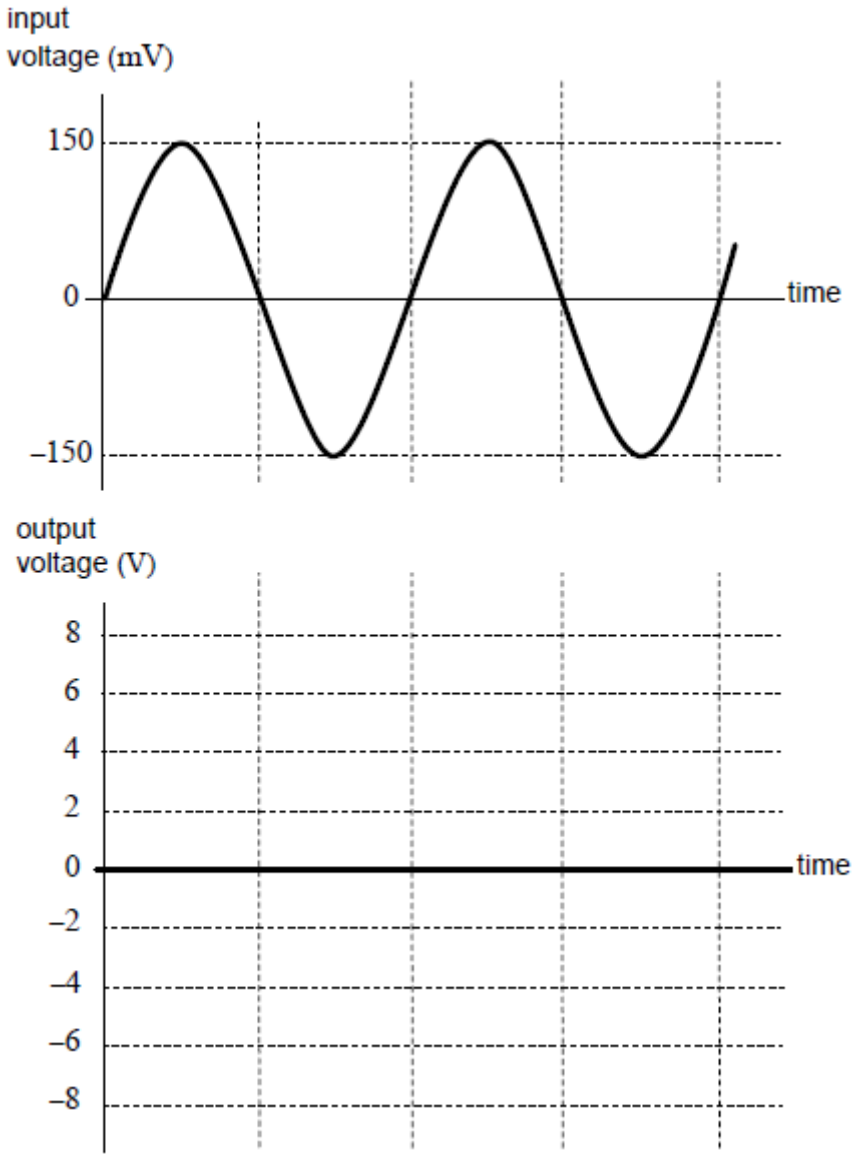
guitar.

The voltage from the guitar to the amplifier input is shown in **Figure 2**.

Draw onto the lower part of **Figure 2** the output signal from the amplifier subsystem.

Figure 2



(4)

(Total 11 marks)

Q2.

According to semiconductor theory, the forward voltage across a silicon diode increases linearly with temperature, so long as the current through the diode remains constant.

When a current of 1 mA passes through a particular diode, a student measures a forward voltage of 0.619 V at 0 °C and 0.718 V at 100 °C.

(a) Show, using a calculation, that the change in voltage per °C is approximately 10^{-3} V / °C.

_____

_____

(1)

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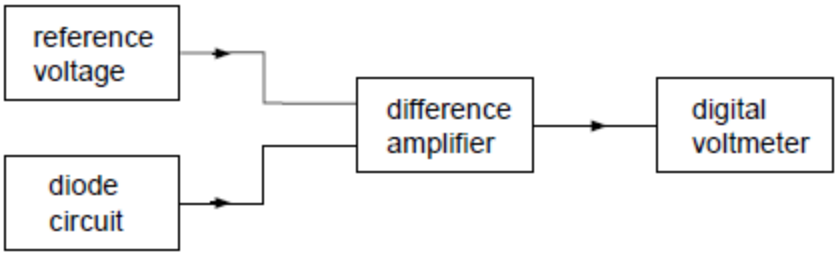
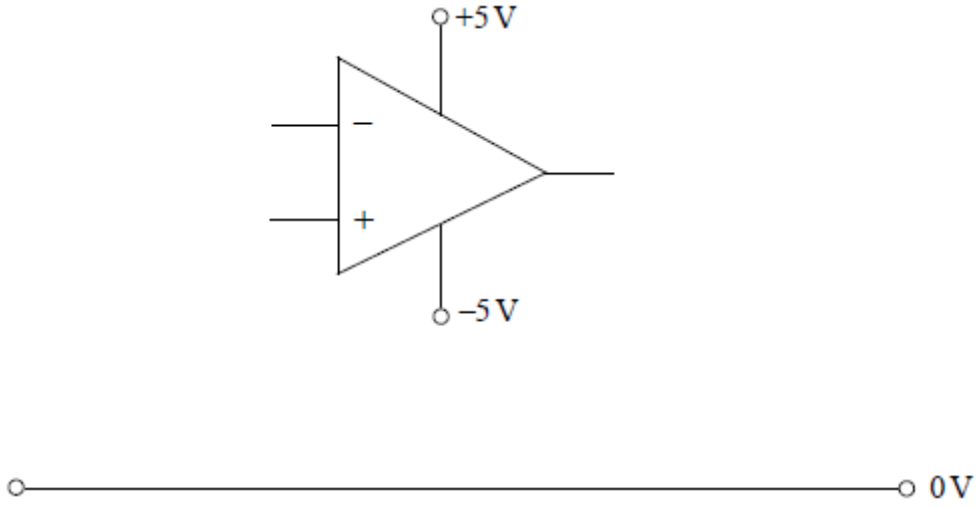
(b) The student decides to use this diode for a room thermometer project and devises the system diagram in **Figure 1**.

Figure 1



Complete the circuit diagram in **Figure 2** for a difference amplifier by adding **four** resistors.

Figure 2



(4)

(c) The output display for the room thermometer is a 0 to 5 V digital voltmeter that represents temperatures from 0 °C to 50 °C.
Show, using a calculation, that the difference amplifier needs to have a voltage gain of 100.

_____

_____

_____

(3)

(d) The student uses 15 kΩ input resistors in his difference amplifier.
Calculate the value that both the other resistors must have to produce a voltage gain of 100.

_____

_____

_____

(3)
(Total 11 marks)

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