WESTERN SYDNEY INSTITUTE OF TAFE

Mount DRUITT College

Analogue Electronics 1
(7761A / EA100)

Test #1

Time Allowed : 1 hour 30 minutes

Student Name: _____.

Instructions to Students

1. Attempt all questions.
2. Show all working and clearly indicate all answers.
3. Answers must include sufficient working to indicate that the principles of the problem have been understood.

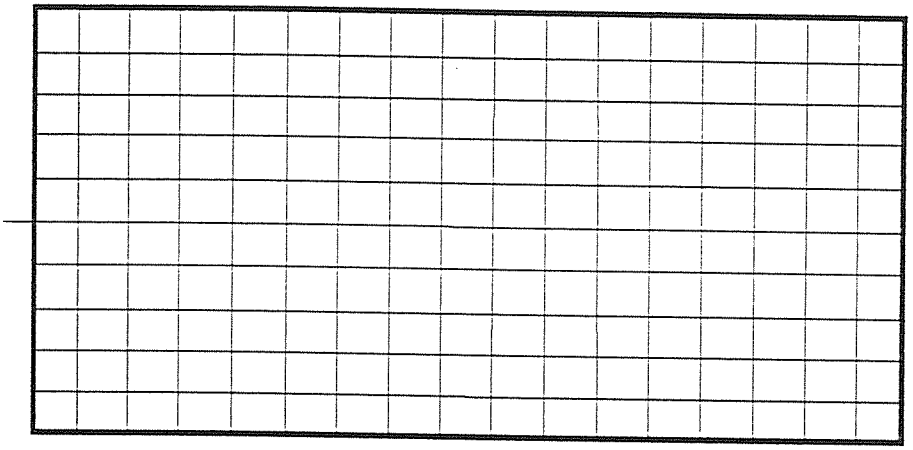
Q1. An inverting amplifier works with ±12 volt supplies. It has a gain of –10 and an input resistance of 10 kΩ. The input signal is a 500 mV peak to peak sine wave and the source has no significant internal resistance.

(a) Sketch the Op Amp circuit.

(3 Marks)

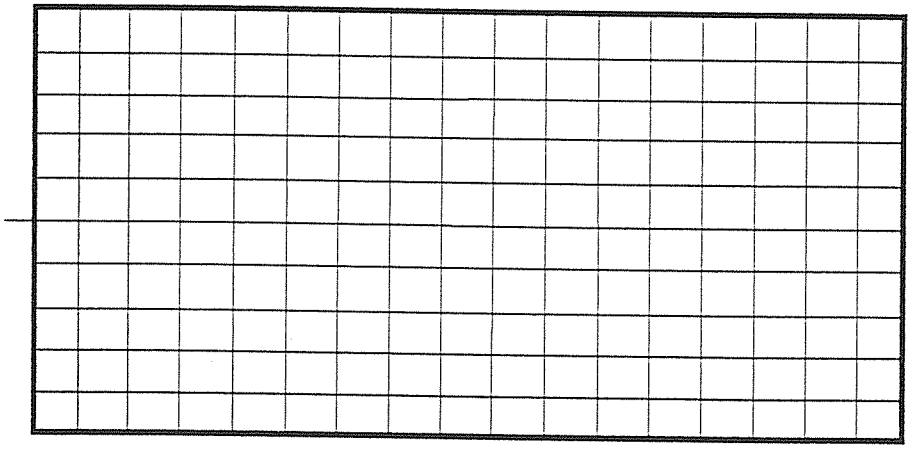
(b) Sketch the input and output voltages showing important amplitude and phase relationships.

(3 Marks)



(c) If the input was changed to 3 V_{p-p}, sketch the input and output voltages showing important amplitude and phase relationships.

(3 Marks)



(d) What would happen to the output signal if the signal source has a significant internal resistance?

(1 Mark)

QUESTION 2

Marks 10 Calculate the value of the voltages (with respect to earth) and the currents indicated in each of the following circuits. Assume that each operational amplifier is ideal but has a maximum available output swing of ± 15 V.

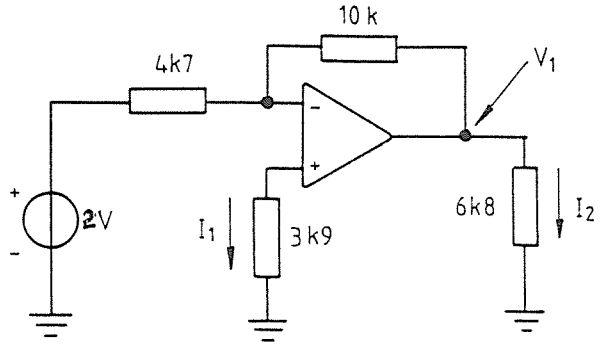


FIG. 2A

V_1 = _____ (/1)

I_1 = _____ (/1)

I_2 = _____ (/1)

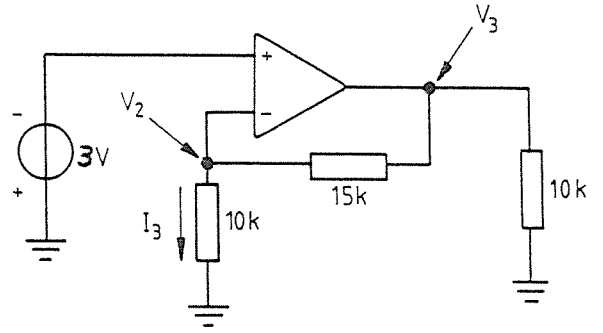


FIG. 2B

V_2 = _____ (/1)

V_3 = _____ (/1)

I_3 = _____ (/1)

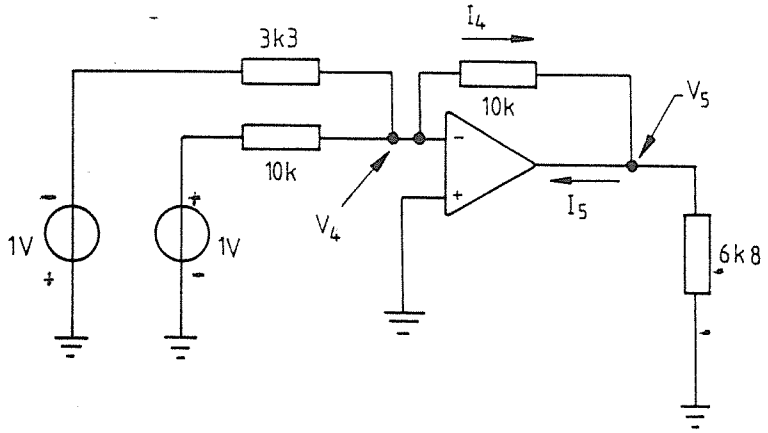


FIG. 2C

V_4 = _____ (/1)

V_5 = _____ (/1)

I_4 = _____ (/1)

I_5 = _____ (/1)

QUESTION 3

Marks (a)

4

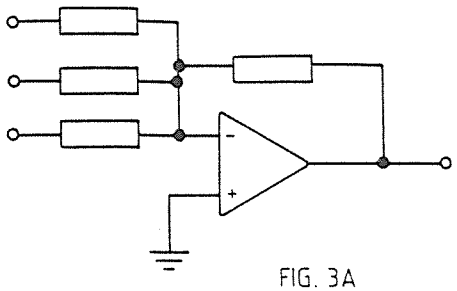


FIG. 3A

(i) What name is given to the type of circuit shown in Fig. 3A.

(/2)

(ii) State one practical application of this circuit.

(/2)

4 (b) Sketch the output waveform of the circuit of Fig. 3B if the sinusoidal waveform in Fig. 3C is applied to the input. Show the correct phase relationship of the output to the input. The operational amplifier may be assumed to be ideal but to have a maximum available output swing of $\pm$ 15 V.

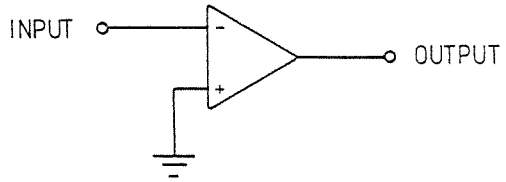


FIG. 3B

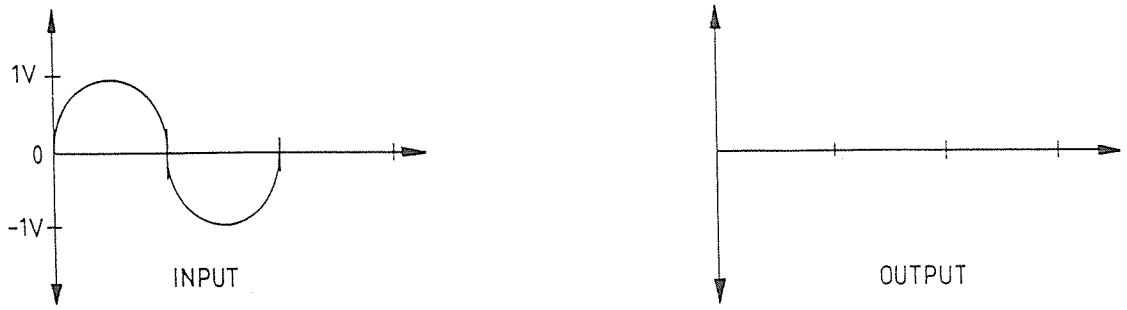


FIG 3C

(/4)

2 (c) State one reason why the circuit of Fig. 3D would not operate correctly as an amplifier.

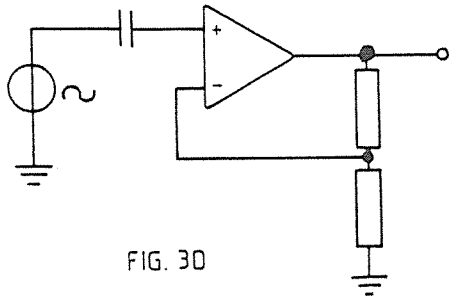


FIG. 3D

(/2)

QUESTION 4

Marks The operational amplifier used in the circuit of Fig. 4 has the following parameters :

Open Loop Voltage Gain	100 dB
Input Bias Current	100 nA
Input Offset Current	30 nA
Input Offset Voltage	1 mV
Slew Rate	0.2 V/μS
Unity Gain Bandwidth	1.5 MHz
Maximum Output Swing	±13 V

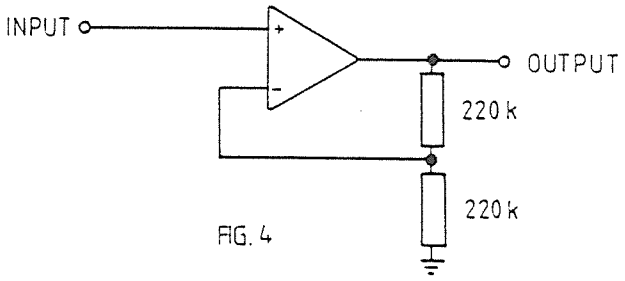


FIG. 4

2 (a) State, without performing any calculations, the effect of input bias currents on the performance of the circuit of Fig. 4.

(/2)

2 (b) Show on the circuit of Fig. 4. how the effect of input bias currents can be reduced. Calculate the value of any additional components required.

(/2)

3 (c) If a 1 Vrms, 20 kHz sinusoidal signal was connected to the input of the circuit of Fig. 4. determine whether the output waveform would show signs of slew rate distortion. You must show calculations to justify your answer.

(/3)

3 (d) The operational amplifier used in the circuit of Fig. 4. has an internal compensating capacitor.

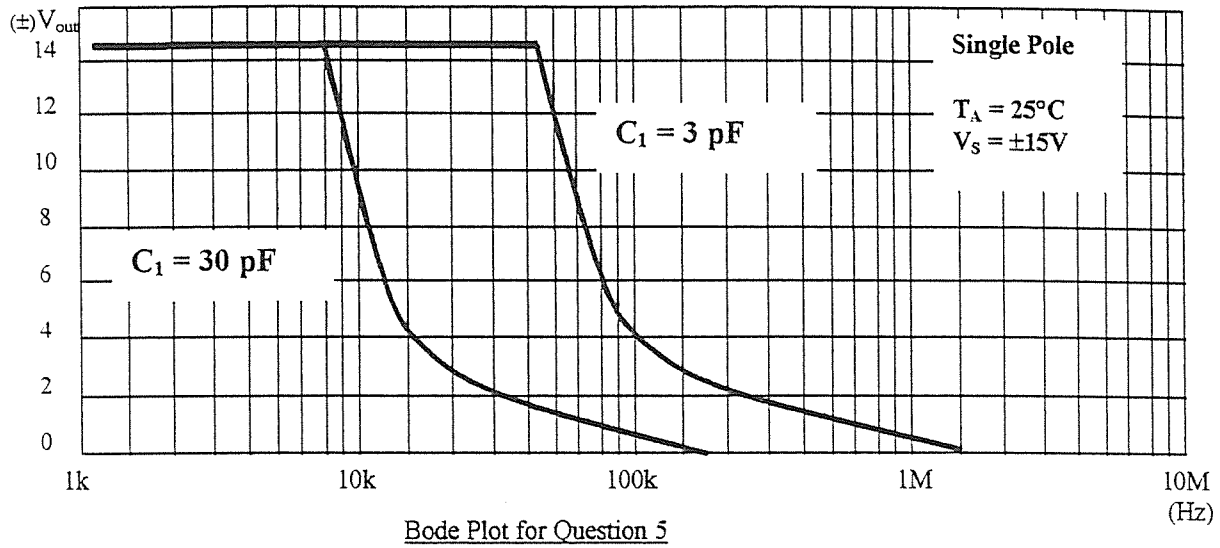
(i) Explain why a compensating capacitor is required in an operational amplifier.

(/1½)

(ii) State one effect the compensating capacitor has on the performance characteristics of the operational amplifier.

(/1½)

Q5. An Externally Compensated Op Amp has the following Output Voltage characteristics.



Bode Plot for Question 5

(a) What is the Full Power Bandwidth (**FPBW**) and Slew Rate (**SR**) of this Op Amp for C_1 = 30 pF?

(3 Marks)

(b) From the graph, determine the maximum undistorted output voltage at 300 kHz, if C_1 = 3 pF.

(2 Marks)

(c) Prove your answer to part (b) by calculation

(5 Marks)

Q6 For the circuit at Figure 3, the Op Amp has the following characteristics:

Input Offset Voltage	2 mV	Input Offset Voltage Drift	6 μV/°C
Input Offset Current	20 nA	Input Offset Current Drift	100 pA/°C
Input Bias Current	80 nA		

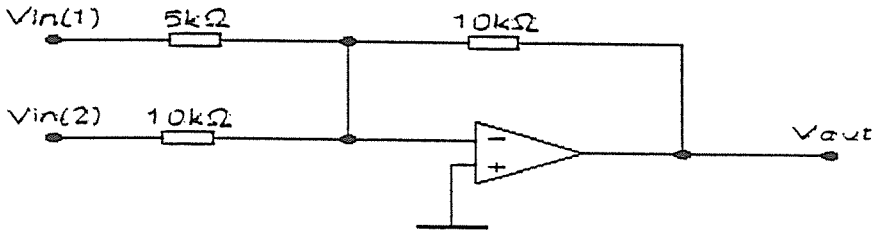


Figure 3 : Summing Amplifier

(a) Calculate the worst case DC Offset voltage at the output.

(3 Marks)

(b) If the circuit was nulled at 20 °C, calculate the output DC Offset Voltage at 70°C.

(4 Marks)

(c) If the Op Amp has a Power Supply Rejection Ratio (PSRR) of 90 dB and the Power Supply has 4 V_{p-p} Ripple, calculate the resultant output ripple.

(3 Marks)