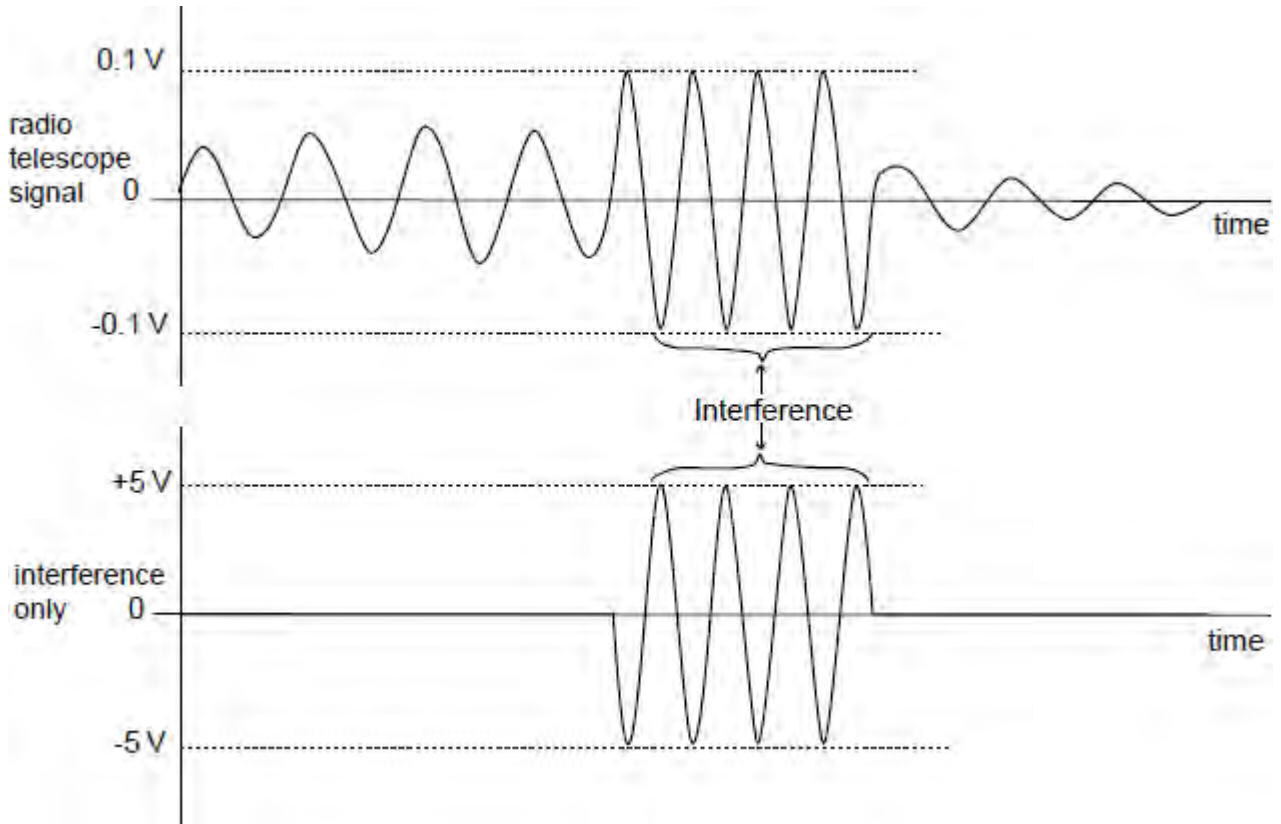


Q1. A radio telescope suffers interference from local industrial equipment. To reduce the interference it is decided to combine the radio telescope output signal with the signal from a receiver that receives only the interference. The two signals are shown below.



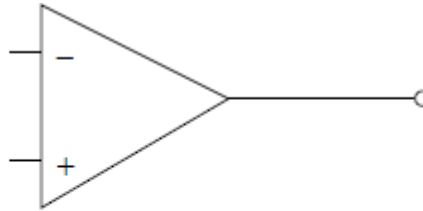
Before the signals are combined, the interference signals must have the same amplitude. This is achieved by amplifying the radio telescope signal.

(a) (i) Calculate the voltage gain needed from this amplifier.

.....

(3)

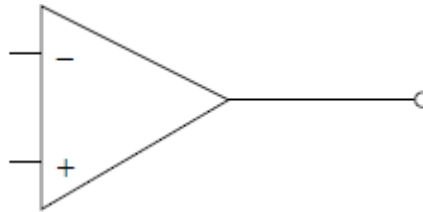
(ii) It is decided to use a non-inverting amplifier where the voltage gain can be adjusted from 11 to approximately 100. Complete the circuit diagram for the non-inverting amplifier and include suitable values for the resistors.



(3)

(b) The amplified radio telescope signal and the interference signal are added together with a summing amplifier.

(i) Complete the circuit diagram below for a summing amplifier and include suitable values for the resistors.



(3)

(ii) Explain how adding the two signals reduces the interference signal in the output.

.....

(2)

(Total 11 marks)

Q2.(a) The demodulator stage in a radio receiver has an output voltage of 10 mV but can only deliver a very small current. This stage is then connected to an af amplifier.

(i) Explain why the af amplifier should have a high input resistance.

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.....

(1)

(ii) What type of op-amp based circuit should be used for the af amplifier?

.....

(1)

(iii) The voltage gain of the af amplifier is to be 28.
Draw a suitable circuit in the space below.
Choose and calculate suitable values for the resistors.
Label these components with their correct values on your diagram and label the input and output connections to the circuit.

(5)

(iv) Calculate, using data given earlier in this question the output signal voltage from this circuit.

.....

(2)

(b) The op-amp IC used has a gain-bandwidth product of 1 MHz.
Calculate the bandwidth of this af circuit and comment on its suitability for this application.

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(3)

- (c) The amplified audio signal is then fed to a push-pull output stage using two MOSFETs. Draw a suitable circuit in the space below, label the p-channel and n-channel MOSFETs.

(4)
(Total 16 marks)