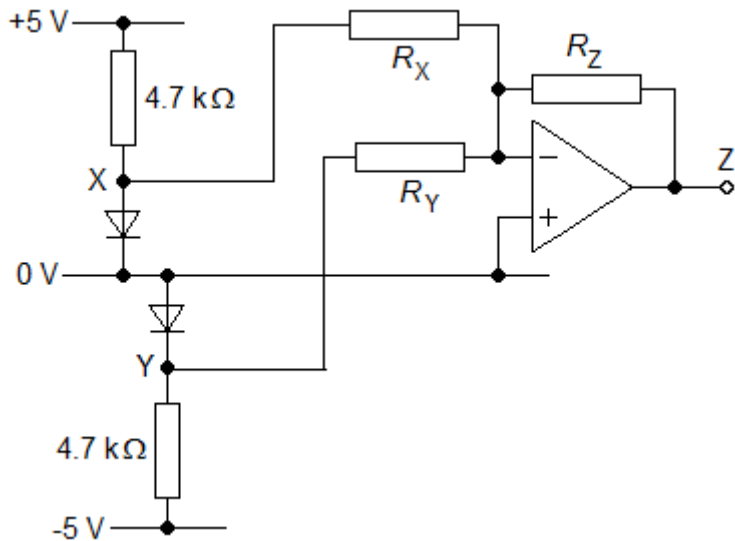


Combining signals

You are going to use a summing amplifier to combine some signals.

- 1 Assemble this circuit.
Make R_x , R_y and R_z all $22\text{ k}\Omega$.
- 2 Use a voltmeter to measure the signals at X, Y and Z.
If all is well, they should be about $+0.7\text{ V}$, -0.7 V and 0.0 V respectively.
- 3 Fill in values for the V_x and V_y columns in the table. They will be the same for every row.
- 4 Use the formula
$$-\frac{V_z}{R_z} = \frac{V_x}{R_x} + \frac{V_y}{R_y}$$
 to calculate the value expected for the signal at Z.



V_x	V_y	R_x	R_y	R_z	V_z
		$22\text{ k}\Omega$	$47\text{ k}\Omega$	$100\text{ k}\Omega$	
		$100\text{ k}\Omega$	$22\text{ k}\Omega$	$47\text{ k}\Omega$	
		$47\text{ k}\Omega$	$10\text{ k}\Omega$	$22\text{ k}\Omega$	
		$100\text{ k}\Omega$	$47\text{ k}\Omega$	$100\text{ k}\Omega$	

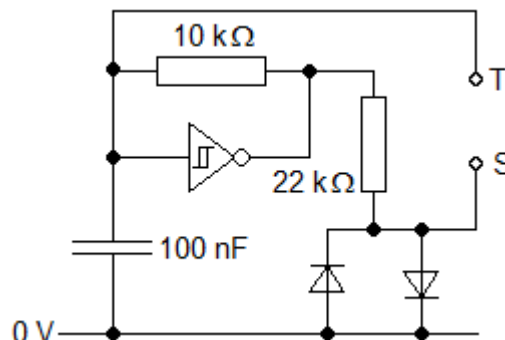
- 5 Insert resistor values given in each row of the table and measure the signal at Z.
Compare this measured value with your calculated one.

Mixing waveforms

You are going to use a summing amplifier to mix two a.c. signals.

1 Assemble this signal generator.
Run the 40106 i.c. off supply rails of ± 5 V instead of the usual +5 V and 0 V.

2 Use a double beam oscilloscope to display the signals at T and S. Both should have an amplitude of about 0.6 V, the same frequency of about 2 kHz, but different shapes.



3 Design a mixer circuit which combines the two signals as follows:

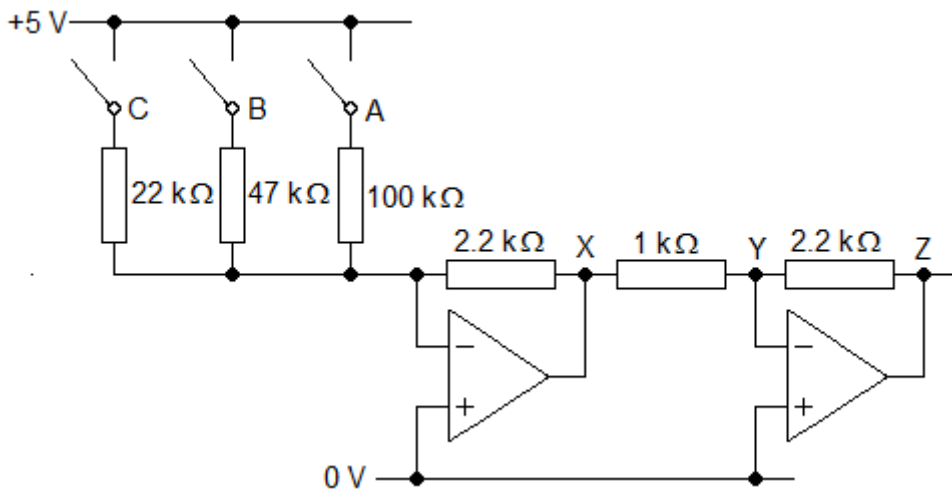
- the maximum output amplitude cannot exceed 2.5 V
- the amount of each signal mixed in can be varied from all to none

4 Assemble your mixer circuit. Use the oscilloscope to verify that it operates as required.

Digital to analogue conversion

You are going to investigate the use of a summing amplifier to produce an analogue signal from a binary word.

1 Assemble this circuit.



2 Connect a voltmeter to Z. Open all of the switches, making CBA = 000. If all is well, Z should be at 0 V. Close all of the switches (CBA = 111). This should set Z at about +1.9 V.

3 Use the circuit to complete this table.

input CBA	signal at Z
000	0.0 V
001	
010	
011	
100	
101	
110	
111	

4 Adapt the circuit as follows:

- the input is a four-bit word DCBA
- the output range is from 0.0 V to +3.2 V

Test your adapted circuit to verify that it operates as required.