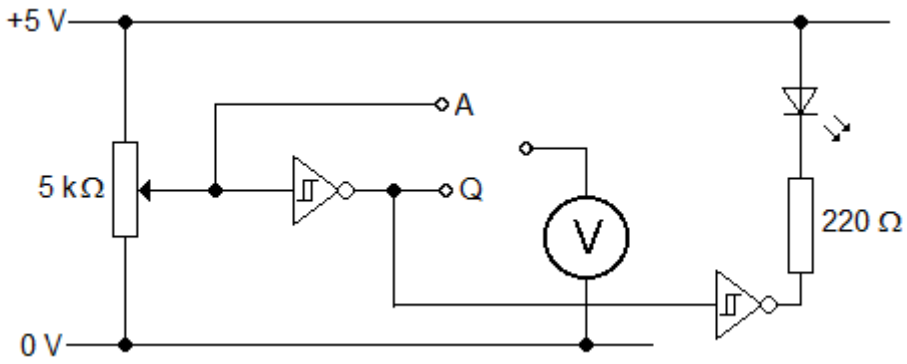
Schmitt trigger NOT gates

You are going to find the transfer characteristic of a Schmitt trigger NOT gate.

1 Assemble the circuit shown below. Note the use of a spare Schmitt trigger NOT gate to act as a driver.

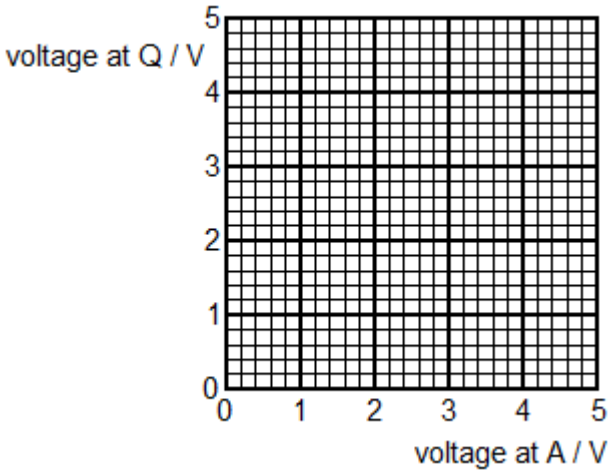


2 Connect the voltmeter to A. Rotate the potentiometer. If all is well, the signal at Q should go low when A is high and vice versa.

3 Carefully determine the voltage at A required to make Q

- fall from high to low
- rise from low to high.

4 Use your observations to draw a graph on the axes below to show how Q changes as A is swept from 0 V to +5 V.

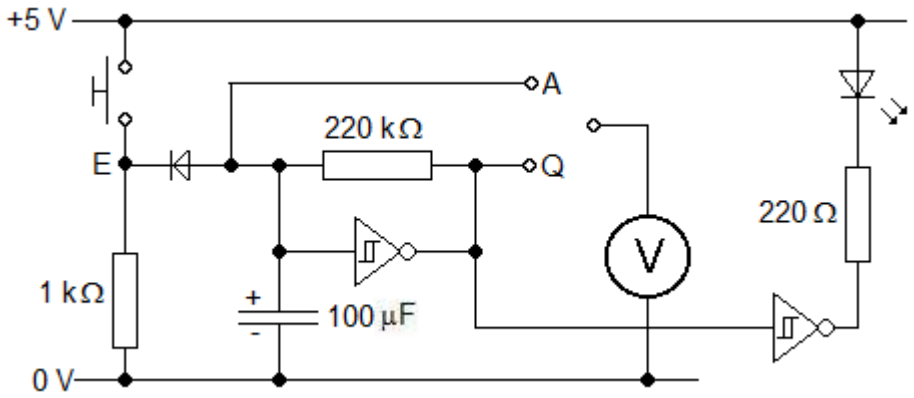


5 On the same axes, draw another graph to show the changes in Q as A is swept from +5 V to 0 V.

Relaxation Oscillator

You are going to assemble a relaxation oscillator and investigate its behaviour.

1 Assemble the circuit shown below. Note the use of a spare Schmitt trigger NOT gate to act as a driver.



2 Press the switch. If all is well, the LED should go off and on at intervals of about 5 s.

3 Connect the voltmeter to A. Press the switch to raise E high. Verify that A shows the capacitor charging and discharging between the trip points of the Schmitt trigger NOT gate as Q swaps between high and low.

4 Verify that releasing the switch to make E low forces Q to go high immediately.

5 Use a stopwatch to time ten cycles of oscillation at Q. Hence obtain a value for the period *T* of the oscillator. Compare it with the value calculated from 0.5*RC*.

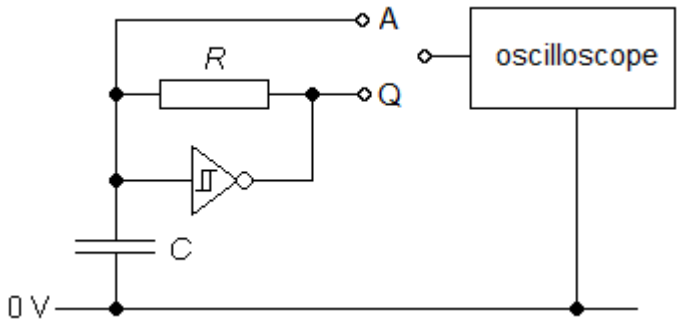
6 Measure the values of *T* for the values of *R* and *C* given in the table below.

R	***C***	***T***	**0.5*RC***
220 kΩ	100 µF		11 s
100 kΩ	100 µF		
47 kΩ	1000 µF		
470 kΩ	10 µF		

Fast oscillators

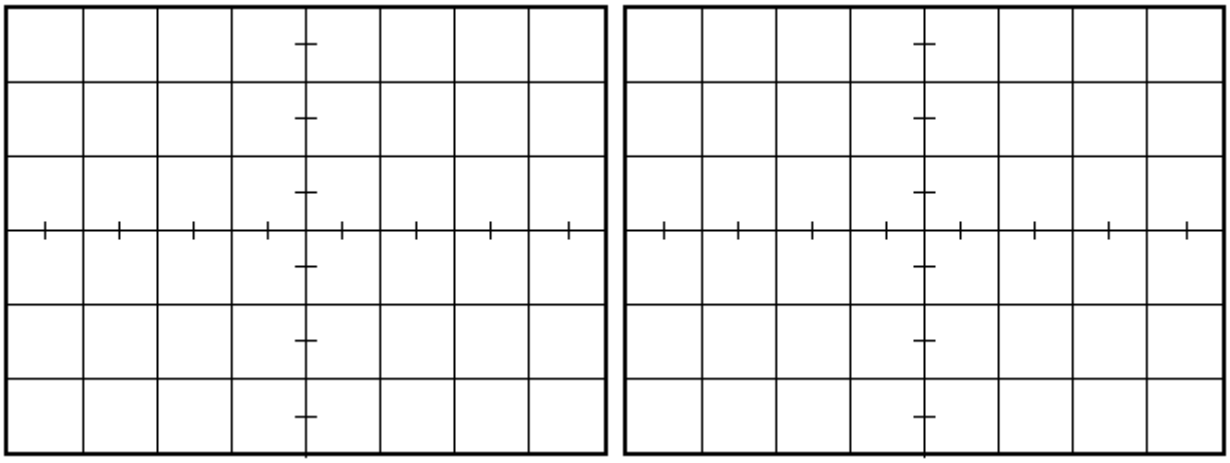
You are going to assemble a relaxation oscillator and investigate its behaviour with an oscilloscope.

1 Assemble the circuit opposite.
Use R = 22 kΩ and C = 100 nF.



2 Set the timebase and vertical amplifier of the oscilloscope to 0.2 ms/div and 1 V/div, with 0 V at the bottom of the screen.

3 Study the signals at A and Q. Sketch their traces on the screens drawn below.



3 Use the oscilloscope to measure the period T of the oscillator. Compare it with the value calculated from 0.5RC.

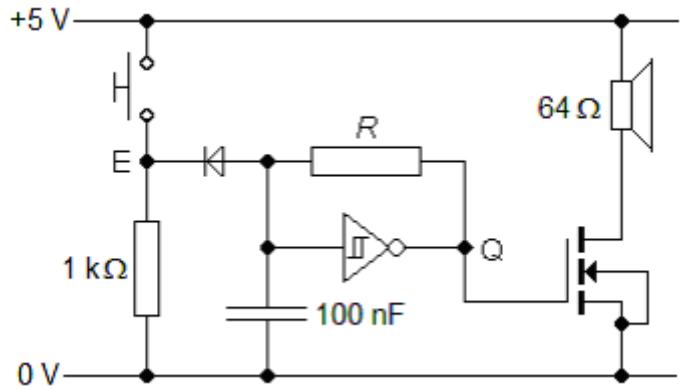
4 Measure the values of T for the values of R and C given in the table below. Calculate a value for the frequency f of the oscillator from $f = 1/T$.

R	***C***	***T***	**0.5*RC***	***f***
22 kΩ	100 nF		1.1 ms	
100 kΩ	100 nF			
47 kΩ	10 nF			
47 kΩ	1 nF			

Light-to-sound converter

You are going to assemble and test a system which has an interesting audible output.

1 Assemble the circuit shown below. Start with R = 10 kΩ.



2 Use an oscilloscope to investigate the signal at Q when E is pulled high.

3 Investigate the effect of replacing the feedback resistor with an LDR.

4 Design and assemble a second oscillator which has a frequency of 1 Hz. Use its output to control the first oscillator.