5EM

Using an Oscilloscope

1. **Preparation:**
   a) Find out what diodes do.
   b) Read about “Lissajou's figures”.
   c) See appendix 2 for some details of the cathode ray tubes found in oscilloscopes

Most oscilloscopes are “double beam” oscilloscopes. They have *two separate inputs*. One of the terminals of the supply *must* be connected to the “earthed” side of the input.

Before starting the experiment, study the controls and find out how to:

- change the brightness
- “focus” the electron beam
- change the horizontal and vertical position of the spot
- change the vertical sensitivity of the oscilloscope
- change the horizontal speed of the spot.

2. **To measure the maximum (or peak) value of an alternating voltage.**

a) Obtain a small spot in the centre of the screen.

b) Connect a low voltage (a.c.) supply to the input.

c) Measure the length of the line. Divide the length by 2, (why?) and calculate the maximum voltage using the “volts cm^{-1}” (or “volts div^{-1}”) calibration. Do this with the low voltage supply unit set to 6 V, 12 V and 24 V.

	(length of line)/2	Maximum Voltage
6 V		
12 V		
24 V		

The numbers written on the low voltage supply unit are root mean square (r.m.s.) voltages. Use your results to find the relation between the r.m.s. value and the maximum value of an a.c. supply.

v_{max} = _____

3. Estimating the Frequency of the supply

a) Obtain a thin horizontal line on the screen. Make it just bright enough to see clearly.

b) Connect the low voltage supply unit to the input and adjust the controls to give one complete “cycle” of a sine curve on the screen.

c) Using the “time cm^{-1}” (or “$time.div^{-1}$”) calibration, find the time for one alternation, T.

N.B. The “time cm^{-1}” (or “time div^{-1}”) control is called the "time-base" of the scope.

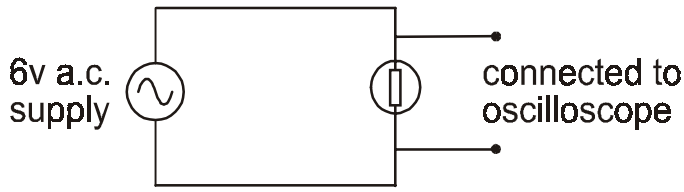
T = _____

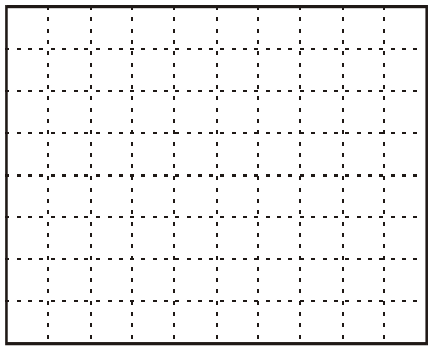
f = 1/T = _____

4. Observing the effect of a Diode and a Capacitor.

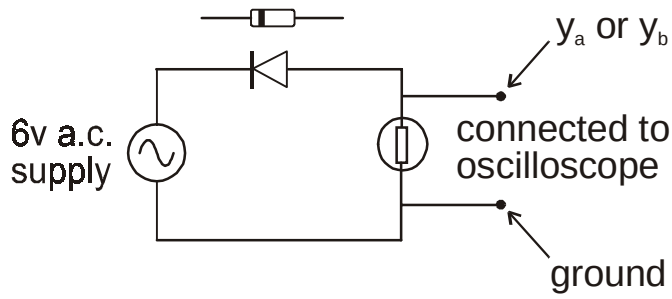
In the space of the right of each diagram, show what you saw on the screen.

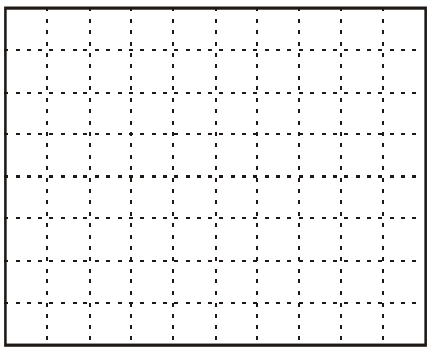
a) Without diode



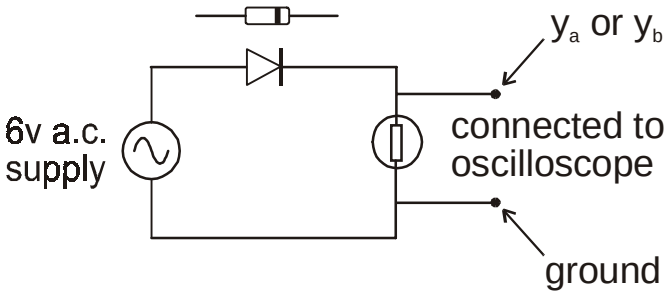


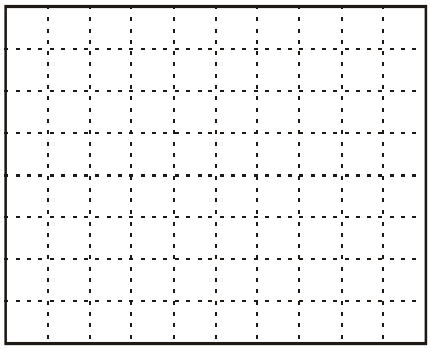
b) With diode



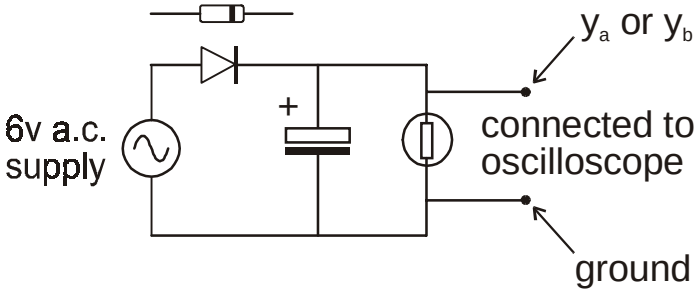


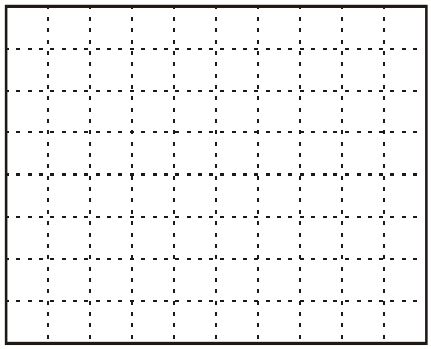
c) With diode “reversed”





d) With diode and capacitor





5. Using an Oscilloscope to compare the frequencies of two supplies of Alternating Voltage

The frequency of the main electricity supply has been measured and was found to be _____.

a) Obtain a small spot in the centre of the screen.

b) Connect a 6 V a.c. supply to the B input of the 'scope and adjust the controls to obtain a vertical line about 4 cm long. Now *switch off* the 6 V supply.

c) Connect a signal generator to input A of the 'scope and set its frequency to 50 Hz. Now make adjustments to obtain a horizontal line the same length as the vertical line in part b).

d) Switch on the 6 V supply.

e) By making *small* adjustments to the signal generator frequency it is possible to obtain a nearly stationary image on the screen.

When the image is stationary it is

either a i) _____

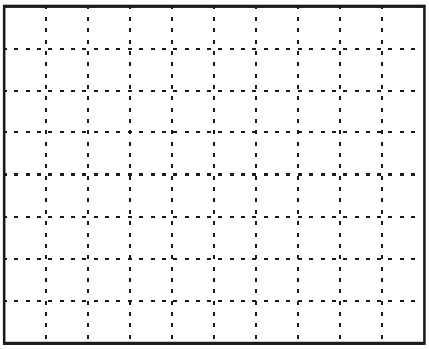
or ii) _____

or iii) _____

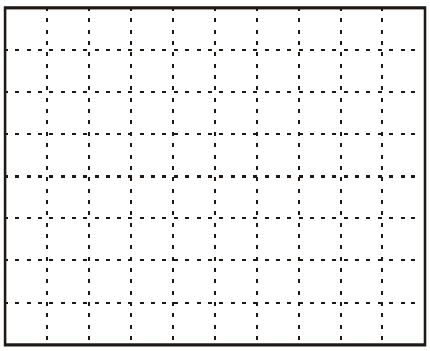
Conclusion

When the screen shows one of these shapes, we know that the frequencies of the two supplies are _____ .

Change the signal generator frequency to 100 Hz. Again, by making small adjustments try to obtain a stationary, symmetrical image on the screen. Make a sketch of what you see in the space below. Repeat for 150 Hz etc.



f (sig. gen) = 100 Hz



f (sig. gen) = 150 Hz

Conclusion

The frequency of the signal generator is given by

f (sig. gen) = 50 Hz × _____