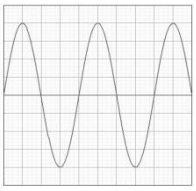
Monitoring and measuring alternating current

Alternating current → The electrons flow in one direction before changing to flow in the _____ way.
Direct current → Electrons flow in _____ direction only.

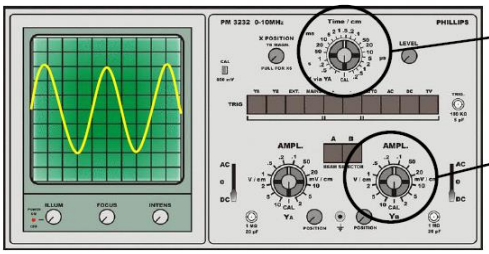
An oscilloscope shows a trace on a screen of how a voltage varies with time.



a.c. waveform

d.c. waveform

Measuring frequency and peak voltage



Time-base – this controls the time setting

Y-gain – this controls the

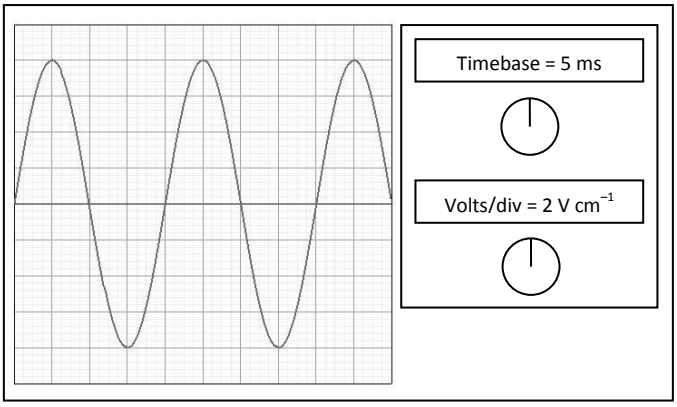
The **frequency** of an a.c. signal is calculated from its _____. This is the time for _____ complete cycle of the current as it moves in one direction then the other, so we measure the horizontal distance on the screen between crests.

The **peak voltage** is calculated by measuring the _____ of the wave.
Peak voltage = boxes up x Y Gain

The period is calculated by measuring the _____ of the wave.
Period = boxes along x time Base

Worked example

Calculate (i) the frequency and (ii) the peak voltage of the waveform shown on the CRO screen below. Each box on the CRO screen has a side of length 1 cm.



Switching off the time base

If the time base is switched off, the a.c. signal will not spread along the *x*-axis. However, the voltage variation will continue to oscillate up and down, meaning a _____ _____ line will be displayed on the screen.

Finding an average voltage

$$V_{\text{rms}} = \frac{1}{\sqrt{2}} V_{\text{peak}} \quad \text{and} \quad I_{\text{rms}} = \frac{1}{\sqrt{2}} I_{\text{peak}}$$

Example: A transformer is labelled with a primary coil of 230 V_{rms} and a secondary coil of 12 $V_{rms.}$ What is the peak voltage which would occur in the secondary?

Important notes:

1. Readings on meters that measure a.c. are rms values, not peak values.
   e.g. a multimeter switched to a.c. mode will display rms values.

2. For power calculations involving a.c. always use rms values:

$$P = I_{\text{rms}} V_{\text{rms}} = I_{\text{rms}}^2 \; R = \frac{V_{\text{rms}}^2}{R}$$

3. The mains supply is usually quoted as 230 V a.c. This is of course 230 V rms. The peak voltage rises to approximately 325 V. This voltage is dangerous, therefore electrical insulation must be provided to withstand this peak voltage.