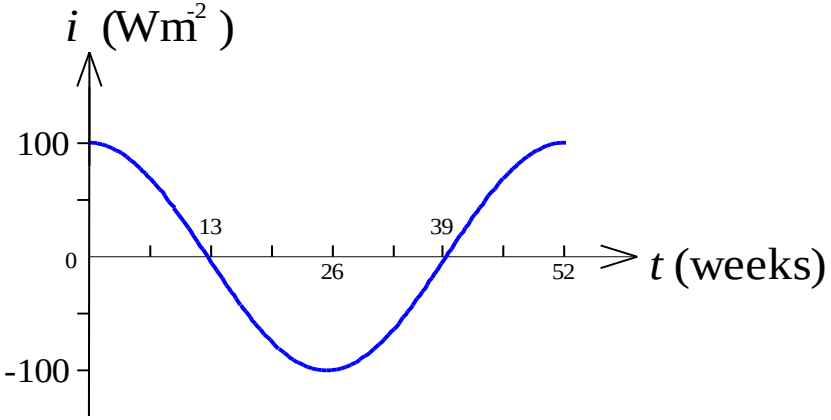
10 Solar Thermal Modelling

The annual amount of incoming solar energy varies depending on the latitude and season. A graph of the deviation from the mean solar intensity during the year, at a latitude of 34° S, is plotted as a function of weeks of the year below (with week 0 being summer solstice).



Temperature deviations from the mean value throughout the year are given by:

$$T = 8\cos\left(\frac{2\pi(t-13)}{52}\right) \ ^\circ\text{C}$$

where the time t is measured in weeks.

a) Sketch the solar intensity deviation (i) and the temperature deviation (T) on the same horizontal axis (ωt expressed in degrees), but with different vertical axes.

b) What is the period, the angular frequency, and the frequency in Hertz of the waveforms?

c) Which waveform lags the other waveform in time?

d) What is the phase angle of the temperature deviation with respect to the solar intensity deviation?

e) At the instant the solar intensity deviation is $35\ \text{Wm}^{-2}$ and decreasing with increasing time, what is the instantaneous value of the temperature deviation?

f) What would be the phasor representation of T and i?

10.2