

## TAP 123-4: Questions on alternating current

1. The mains ac supply in some countries is 110 V r.m.s at 50 Hz (sinusoidal).
  - (a) What is the peak value of voltage?
  - (b) What is the peak-to-peak value of voltage?
  - (c) How long does one cycle of this ac supply last?
  - (d) A 100 W lamp is designed for use with 110 V ac What is the resistance of its filament?
  
2. Which will light a lamp more brightly, 12 V peak ac or 12 V steady dc? Explain.
  
3. UK mains ac has an r.m.s. value of 230 V and a frequency of 50 Hz. Sketch a graph of voltage against time for one cycle of this ac and include values for peak voltage and time period on the axes.
  
4. What is the ratio of powers delivered by 20 V dc and 20 V peak ac to the same load?

### Answers and Worked Solutions

1. (a)  $110 \times \sqrt{2} = 155.6 \text{ V}$   
(b)  $2 \times 155.6 = 311 \text{ V}$   
(c)  $1 / 50 \text{ Hz} = 0.02\text{s}$   
(d)  $P = V^2/R$   $R = 110^2/100 = 121\Omega$
  
2.  $12 \text{ V}$  peak ac is equivalent to  $12/\sqrt{2} \text{ V} = 8.5 \text{ V}$  dc equivalent. So  $12 \text{ V}$  peak to peak is dimmer.
  
3.  $230 \times \sqrt{2} \text{ V} = 325\text{V}$ , so graph varies between  $+ 325 \text{ V}$  and  $-325 \text{ V}$ .  
One time period =  $1 / 50 \text{ Hz} = 0.02\text{s}$
  
4.  $P = V^2/R$  so the ratio of powers is ratio of voltages squared.  $20 \text{ V}$  peak ac is equivalent to  $20/\sqrt{2} \text{ V}$  dc i.e.  $14.14 \text{ V}$  so dc power / ac power =  $20^2/14.14^2 = 2$   
or  
dc  $V^2 / (\text{ac peak} / \sqrt{2})^2 = (\sqrt{2})^2 = 2$