21 AC power and r.m.s. – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
power	功率			
root-mean-square	均方根			

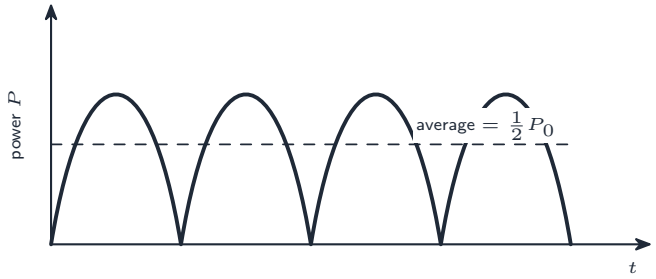
Recall

An alternating current still delivers **power** 功率 to a resistor, even though it keeps reversing.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

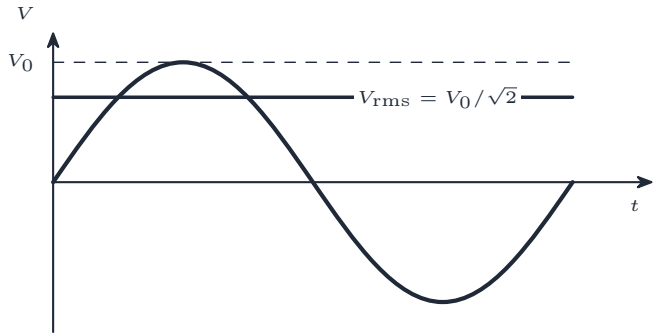
1 Power pulses



The power $P = I^2R$ is always positive (squaring removes the sign), so it pulses up and down. Its average is *half* the peak power.

Worked example. If the power in a resistor peaks at 100 W during the cycle, its average over the whole cycle is $\frac{1}{2} \times 100 = 50$ W — that average is what heats the resistor.

2 The r.m.s. value



The **root-mean-square** 均方根 (r.m.s.) value is the steady d.c. value that would give the same average power: $V_{\text{rms}} = V_0/\sqrt{2}$.

Worked example. A mains supply has peak voltage $V_0 = 340$ V. Its r.m.s. value is $V_{\text{rms}} = V_0/\sqrt{2} = 340/1.41 \approx 240$ V — the value usually quoted for the mains.

Watch out: the voltage printed on the mains (e.g. "230 V") is the r.m.s. value, *not* the peak. The peak is about $\sqrt{2}$ times bigger. Always use r.m.s. values in power calculations.

Practice

Try these in order.

21.1 Why is the power always positive, even though the current reverses? [1]

21.2 The average power is what fraction of the peak power? [1]

21.3 What does the *r.m.s.* value of an a.c. represent? [1]

21.4 Write V_{rms} in terms of the peak V_0. [1]

21.5 The peak voltage is 340 V. Find the r.m.s. voltage. [2]

21.6 An a.c. supply and a d.c. supply light identical bulbs equally brightly. Explain what this tells you about the r.m.s. value of the a.c. compared with the d.c. value. [2]

21.7 Challenge. A mains supply is labelled "230 V". Explain why the actual peak voltage is higher than this, and find it ($V_0 = V_{\text{rms}}\sqrt{2}$). [2]