Teacher notes
Topic B

Sometimes wrong methods give the right answer!

Question 35 from May 2021, Paper 1 TZ1 asks:

A resistor designed for use in a direct current (dc) circuit is labelled “50W, 2Ω”. The resistor is connected in series with an alternating current (ac) power supply of peak potential difference 10V. What is the average power dissipated by the resistor in the ac circuit?

A. 25W

B. 35W

C. 50W

D. 100 W

The answer is A.

A lot of students got this answer by finding the current in the DC circuit: $P = RI^2$ so $I = \sqrt{\frac{P}{R}} = \sqrt{\frac{50}{2}} = 5.0 \text{ A}$. They then used this value of the current in the AC circuit to get a peak power of $P = RI^2 = 50 \text{ W}$ and so an average power of 25 W which is the correct answer.

But the method is wrong. There is no reason why the current is the same in both cases.

The correct method would be to say that the peak power in the AC circuit is $P = \frac{V^2}{R} = \frac{10^2}{2.0} = 50 \text{ W}$ and so an average of 25 W. But why do the two methods both give the correct answer? It is just a coincidence of numbers.

Suppose the question said the lamp was rated as “100 W at 4.0 Ω” and the peak value of the voltage in the AC circuit was 10 V.

Using the wrong method we would get:

$I = \sqrt{\frac{P}{R}} = \sqrt{\frac{100}{4}} = 5.0\ \text{A}$. Using this current in the AC circuit would give a peak power of $P = RI^2 = 100\ \text{W}$ and an average of 50 W.

Using the correct method the peak power would be $P = \frac{V^2}{R} = \frac{10^2}{4.0} = 25\ \text{W}$ and so an average of 12.5 W.

The two methods give different answers when the numbers are changed.