

Rms values, transformers and power lines

Physics grades 11-12 (A Level · IB · Class 11-12) · Test answers (mark scheme)

Award marks for method as well as for the final answer. Accept answers within rounding and follow through an earlier slip. Do not penalise a missing unit more than once in each question.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.7.5

Question 1 Defining rms (2 marks)

The rms current is the value of **steady direct current that would dissipate the same mean power** in a resistor as the alternating current.

Marking: 1 mark for steady dc equivalent, 1 mark for same mean power in a resistor.

Question 2 Peak to rms (2 marks)

$$V_{\text{rms}} = V_0 / \sqrt{2} = 340 / 1.414 = \mathbf{240 \text{ V}}.$$

Marking: 1 mark for the formula, 1 mark for the answer.

Question 3 Power in a resistor (3 marks)

$$V_{\text{rms}} = 18 / \sqrt{2} = 12.73 \text{ V}. P = V_{\text{rms}}^2 / R = 162 / 12 = \mathbf{13.5 \text{ W}}.$$

Marking: 1 mark for rms, 1 mark for $P = V^2/R$, 1 mark for the answer.

Question 4 Transformer turns (3 marks)

$$\text{a) } N_s = N_p V_s/V_p = 800 \times 11.5 / 230 = \mathbf{40 \text{ turns}}.$$

$$\text{b) } I_s = 23 / 11.5 = \mathbf{2.0 \text{ A}}; I_p = 23 / 230 = \mathbf{0.10 \text{ A}}.$$

Marking: a) 1 mark. b) 1 mark for each current.

Question 5 Why high voltage? (3 marks)

For a given power $P = VI$, a higher voltage means a **smaller current**. The heat loss in the cables is I^2R , so it falls with the square of the current. Less energy is wasted, and thinner, cheaper cables can be used. Transformers allow the voltage to be raised and lowered efficiently.

Marking: 1 mark for lower current, 1 mark for I^2R , 1 mark for reduced loss or cost.

Question 6 Reading a trace (3 marks)

a) Two cycles take 10 ms, so $T = \mathbf{5.0\ ms}$ and $f = 1/0.0050 = \mathbf{200\ Hz}$.

b) $V_{\text{rms}} = 6.0 / \sqrt{2} = \mathbf{4.2\ V}$.

Marking: a) 1 mark for T, 1 mark for f. b) 1 mark.

Question 7 Efficiency (2 marks)

Efficiency = $235 / 250 = \mathbf{94\ \%}$.

Marking: 1 mark for the ratio, 1 mark for the percentage.

Question 8 Laminated core (2 marks)

Build the core from **thin laminated sheets separated by insulation**. This breaks up the loops in which eddy currents flow, so smaller currents flow and less energy is converted to heat.

Marking: 1 mark for laminations, 1 mark for the reason.