InkPhysics

QUESTION WORKBOOK

Transformers

Magnetic fields · Year 13

AQA 3.7.5.6 · OCR A 6.3.3(f)(i)

18 questions · 48 marks

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SECTION A · Warm-up

A1 Explain how a transformer transfers energy from its primary coil to its secondary coil. [2]

A2 A transformer has 1000 turns on its primary coil and 100 turns on its secondary coil. The primary voltage is 230 V. Calculate the secondary voltage. [2]

A3 A transformer has fewer turns on its secondary coil than on its primary coil. State whether it is a step-up or a step-down transformer. [1]

A4 Explain why a transformer produces no output when its primary coil is connected to a steady dc supply. [2]

A5 State two causes of energy loss in a real transformer. [2]

A6 A phone charger contains a transformer that steps 230 V down to 5.0 V. Calculate the turns ratio N_p:N_s. [2]

SECTION B · Standard

B1 A transformer steps 240 V down to 12 V. The primary coil has 2000 turns. Calculate the number of turns on the secondary coil. [2]

B2 An ideal transformer has a primary voltage of 230 V and draws a primary current of 2.0 A. The secondary voltage is 23 V. Calculate the power transferred and the secondary current. [3]

B3 A transformer has an input power of 500 W and a useful output power of 450 W. Calculate its efficiency. [2]

B4 An ideal step-up transformer raises 230 V to 1150 V. The secondary current is 0.40 A. Calculate the primary current. [2]

B5 Explain what eddy currents are, why they waste energy in a transformer, and how the design of the core reduces them. [3]

B6 The alternating flux in a transformer core links every turn of both coils. Explain why the induced emf per turn is the same for both coils, and how this leads to the transformer equation $V_s/V_p = N_s/N_p$. [3]

B7 A student tests a transformer with four meters. The primary takes 0.26 A at 230 V; the secondary delivers 4.6 A at 11.5 V. Calculate the efficiency of the transformer and the power dissipated inside it. [4]

SECTION C · Stretch

C1 A power of 100 kW is transmitted along a cable of resistance 5.0 Ω. Calculate the power lost in the cable when the transmission voltage is 10 kV, and when it is 100 kV. Comment on the results. [4]

C2 A transformer is 96% efficient. The primary coil takes 5.0 A at 230 V and the secondary output is at 46 V. Calculate the input power, the output power and the secondary current. [3]

C3 Explain why electrical energy is transmitted across the National Grid at very high voltage. [3]

C4 A garden lighting system needs an rms supply of between 11.5 V and 12.5 V, taken from the 230 V mains. Three transformers are available.
T1: 1000 primary turns, 52 secondary turns
T2: 1000 primary turns, 60 secondary turns
T3: 750 primary turns, 30 secondary turns
Deduce which transformer, if any, is suitable. [4]

C5 An ideal transformer steps the 230 V mains down with a turns ratio of 10:1. The secondary is connected to a 4.6 Ω resistor. Calculate the secondary voltage, the secondary current and the primary current. [4]