Transformer calculations and energy balance

Student activity • observation and reasoning

YEAR 11 / LESSON 88 / PHYSICS ONLY

The question

How do voltage and current change without creating extra power?

Solve original ideal-transformer calculations and identify when real losses change the answer.

Equipment

- Booklet and calculator

Paper calculations only. No transformer, mains circuit or high-voltage apparatus is operated.

Course coverage: Physics only: 6.19P–6.20P. Voltage/turns ratio and ideal power balance.

Plan, model or apparatus sketch

Draw labelled coils, field directions, motion and circuit connections as relevant.

Method and reasoning

Read the whole sequence before starting

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1. Label primary and secondary quantities. Write Vp/Vs = Np/Ns and state that the ideal transformer model is being used.

2. For Vp = 12 V, Np = 600 and Ns = 150, calculate Vs. Classify the transformer as step-up or step-down.

3. If its secondary current is 2.0 A, calculate output power and the ideal primary current using VpIp = VsIs.

4. For a second ideal transformer with Vp = 6.0 V, Np = 100, Ns = 300 and Ip = 0.60 A, calculate Vs and Is.

5. For a separately specified real transformer taking 20 W and delivering 16 W, calculate efficiency and the power transferred to unwanted stores. Do not apply ideal equal-power assumptions to this case.

6. Explain transmission losses using a stated cable resistance and P loss = I^2R qualitatively: for the same useful transferred power, increasing voltage reduces current and cable heating.

Cleanup

- Retain calculations and return calculators.

Record your evidence

Blank spaces are for your own work

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Reference and task data

All numerical values are original practice data. The first ideal case gives 3.0 V, 6.0 W and 0.50 A primary current. The second gives 18 V and 0.20 A secondary current. These are paper calculations, not apparatus instructions.

Case	Known quantities	Calculation / result
First: Vs		
First: power and Ip		
Second: Vs and Is		
Real: efficiency and loss		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Find Vs in the first case.

2. Find its output power.

3. Find its ideal primary current.

4. Find Vs and Is in the second case.

5. Find the real example's efficiency and loss.

6. Why can higher output voltage accompany lower output current?