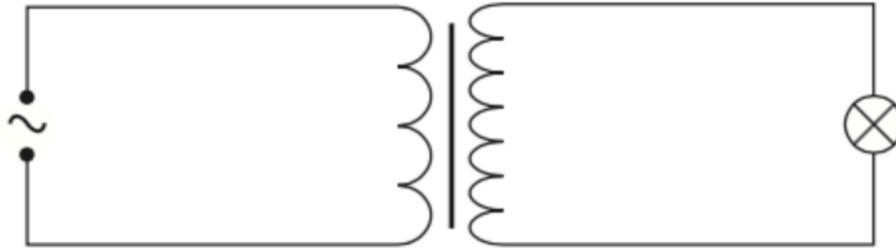


1

The primary coil of a step-up transformer is connected to a source of alternating pd. The secondary coil is connected to a lamp.



Which line, **A** to **D**, in the table correctly describes the ratios of flux linkages and currents through the secondary coil in relation to the primary coil?

|          | Secondary magnetic flux linkage<br>Primary magnetic flux linkage | Secondary current<br>Primary current |
|----------|------------------------------------------------------------------|--------------------------------------|
| <b>A</b> | $< 1$                                                            | $< 1$                                |
| <b>B</b> | $> 1$                                                            | $< 1$                                |
| <b>C</b> | $> 1$                                                            | $> 1$                                |
| <b>D</b> | $< 1$                                                            | $> 1$                                |

(Total 1 mark)

2

A lamp rated at 12 V 60 W is connected to the secondary coil of a step-down transformer and is at full brightness. The primary coil is connected to a supply of 230 V. The transformer is 75% efficient.

What is the current in the primary coil?

- A** 0.25 A
- B** 0.35 A
- C** 3.75 A
- D** 5.0 A

3

A transformer has 1150 turns on the primary coil and 500 turns on the secondary coil.

The primary coil draws a current of 0.26 A from a 230 V ac supply. The current in the secondary coil is 0.50 A. What is the efficiency of the transformer?

- A** 42%
- B** 50%
- C** 84%
- D** 100%

(Total 1 mark)

4

Which one of the following statements concerning power losses in a transformer is **incorrect**?

Power losses can be reduced by

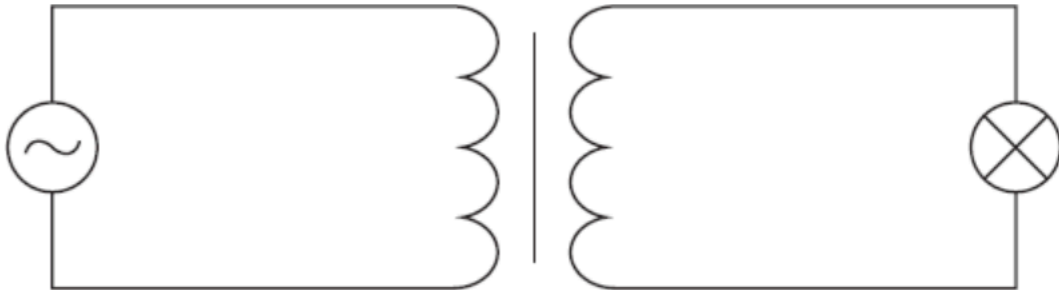
- A** laminating the core.
- B** using high resistance windings.
- C** using thick wire.
- D** using a core made of special iron alloys which are easily magnetised.

(Total 1 mark)

5

A transformer with 3000 turns in its primary coil is used to change an alternating pd from an rms value of 240 V to an rms value of 12 V.

When a 60 W, 12 V lamp is connected to the secondary coil, the lamp lights at normal brightness and a rms current of 0.26 A passes through the primary coil.



Which line, **A** to **D**, in the table gives correct values for the number of turns on the secondary coil and for the transformer efficiency?

|          | number of turns on the secondary coil | efficiency |
|----------|---------------------------------------|------------|
| <b>A</b> | 150                                   | 96%        |
| <b>B</b> | 60 000                                | 96%        |
| <b>C</b> | 150                                   | 90%        |
| <b>D</b> | 60 000                                | 90%        |

(Total 1 mark)

6

Which one of the following would **not** reduce the energy losses in a transformer?

- A** using thinner wire for the windings
- B** using a laminated core instead of a solid core
- C** using a core made from iron instead of steel
- D** using a core that allows all the flux due to the primary coil to be linked to the secondary coil

(Total 1 mark)

7

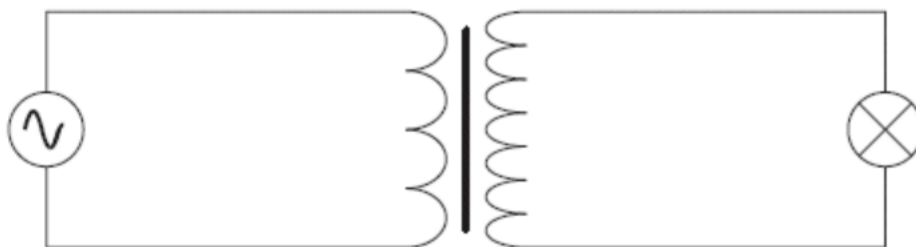
Which one of the following is **not** a cause of energy loss in a transformer?

- A good insulation between the primary and secondary coil
- B induced currents in the soft iron core
- C reversal of magnetism in the soft iron core
- D resistances in the primary and secondary coil

(Total 1 mark)

8

The primary coil of a step-up transformer is connected to a source of alternating pd. The secondary coil is connected to a lamp.



Which line, **A** to **D**, in the table correctly describes the flux linkage and current through the secondary coil in relation to the primary coil?

|          | <u>secondary magnetic flux linkage</u><br><u>primary magnetic flux linkage</u> | <u>secondary current</u><br><u>primary current</u> |
|----------|--------------------------------------------------------------------------------|----------------------------------------------------|
| <b>A</b> | >1                                                                             | <1                                                 |
| <b>B</b> | <1                                                                             | <1                                                 |
| <b>C</b> | >1                                                                             | >1                                                 |
| <b>D</b> | <1                                                                             | >1                                                 |

(Total 1 mark)

9

A transformer has 1200 turns on the primary coil and 500 turns on the secondary coil. The primary coil draws a current of 0.25 A from a 240 V ac supply. If the efficiency of the transformer is 83%, what is the current in the secondary coil?

- A 0.10 A
- B 0.21 A
- C 0.50 A
- D 0.60 A

**10**

A 230 V, 60 W lamp is connected to the output terminals of a transformer which has a 200 turn primary coil and a 2000 turn secondary coil. The primary coil is connected to an ac source with a variable output pd. The lamp lights at its normal brightness when the primary coil is supplied with an alternating current of 2.7 A.

What is the percentage efficiency of the transformer?

- A** 3%
- B** 10%
- C** 97%
- D** 100%

(Total 1 mark)

**11**

- (a) Explain what is meant by the term *magnetic flux linkage*. State its unit.

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(2)

- (b) Explain, in terms of electromagnetic induction, how a transformer may be used to step down voltage.

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(4)

- (c) A minidisc player is provided with a mains adapter. The adapter uses a transformer with a turns ratio of 15:1 to step down the mains voltage from 230 V.

- (i) Calculate the output voltage of the transformer.

(2)

- (ii) State **two** reasons why the transformer may be less than 100% efficient.

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(2)

(Total 10 marks)

12

A transformer is required to produce an r.m.s. output of  $2.0 \times 10^3$  V when it is connected to the 230 V r.m.s. mains supply. The primary coil has 800 turns.

- (a) Calculate the number of turns required on the secondary coil, assuming the transformer is ideal.

(2)

- (b) The transformer suffers from *eddy current* losses.

- (i) Explain how *eddy currents* arise.

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(4)

- (ii) State the feature of transformers designed to minimise eddy currents.

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(1)

(Total 7 marks)

13

Which one of the following statements is the main reason for operating power lines at high voltage?

- A Transformers are never perfectly efficient.
- B High voltages are required by many industrial users of electricity.
- C Electrical generators produce alternating current.
- D For a given amount of transmitted power, increasing the voltage decreases the current.

(Total 1 mark)

Mark schemes

|    |                                                                                                                                                                                                                                |                          |     |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----|
| 1  | B                                                                                                                                                                                                                              |                          | [1] |
| 2  | B                                                                                                                                                                                                                              |                          | [1] |
| 3  | C                                                                                                                                                                                                                              |                          | [1] |
| 4  | B                                                                                                                                                                                                                              |                          | [1] |
| 5  | A                                                                                                                                                                                                                              |                          | [1] |
| 6  | A                                                                                                                                                                                                                              |                          | [1] |
| 7  | A                                                                                                                                                                                                                              |                          | [1] |
| 8  | A                                                                                                                                                                                                                              |                          | [1] |
| 9  | C                                                                                                                                                                                                                              |                          | [1] |
| 10 | C                                                                                                                                                                                                                              |                          | [1] |
| 11 | (a) product of flux and number of turns<br>Wb or equivalent                                                                                                                                                                    | B1<br>C1                 | (2) |
|    | (b) changing primary magnetic field due to alternating voltage<br>(applied to primary)<br>varying flux links with secondary<br>induced emf $\Sigma$ rate of change of flux linkage<br>$N_S < N_P$ so less voltage on secondary | B1<br><br>B1<br>B1<br>C1 | (4) |
|    | (c) (i) equation or correct substitution<br>15.3 V                                                                                                                                                                             | C1<br>A1                 | (2) |

- (ii) <100% flux linkage / flux leakage / copper losses / iron losses / hysteresis losses **not** just “heating” or “heat loss”

B2

(2)

[10]

12

(a)  $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

C1

7000 (6960)

A1

(2)

- (b) (i) changing magnetic field

B1

emf or changing magnetic field is in the core

B1

e.m.f. induced (due to changing magnetic field) not back emf

B1

current flows as core is made from a conducting material

B1

(4)

- (ii) laminated core

B1

(1)

[7]

13

D

[1]