1. An ideal transformer , rated at $6.6\ \text{kW}$, is used to step up an alternating voltage having peak value of $220\ \text{V}$ to $4.4\ \text{kV}$. If the primary coil has $1,000$ turns, find the current rating of the secondary coil.

A. $3.5\ \text{A}$

B. $1.5\ \text{A}$ ✓

C. $5.5\ \text{A}$

D. $8.5\ \text{A}$

Power supplied at primary coil is given by,

$$P_{\text{input}} = \mathcal{E}_P i_P = 6.6 \times 10^3\ \text{W}$$

$$\Rightarrow i_P = \frac{6.6 \times 10^3}{220} = 30\ \text{A}$$

Now, for an ideal transformer,

$$\frac{i_P}{i_S} = \frac{N_S}{N_P} = \frac{\mathcal{E}_S}{\mathcal{E}_P}$$

$$\Rightarrow i_S = \frac{\mathcal{E}_P}{\mathcal{E}_S} \times i_P = \frac{220}{4400} \times 30 = 1.5\ \text{A}$$

Hence, option (B) is the correct answer.

2. An ideal transformer has 50 turns in its primary winding and 25 turns in its secondary winding. If the current in the secondary winding is $4\ \text{A}$, what will be the current in the primary winding, when a $200\ \text{V}$ alternating voltage is applied across the primary?

A. $3\ \text{A}$

B. $1\ \text{A}$

C. $2\ \text{A}$

D. $4\ \text{A}$

Using the ideal transformer equation, we have,

$$\frac{\mathcal{E}_S}{\mathcal{E}_P}=\frac{N_S}{N_P}=\frac{i_P}{i_S}$$

$$\Rightarrow \mathcal{E}_S=\frac{N_S}{N_P}\times \mathcal{E}_P$$

$$\Rightarrow \mathcal{E}_S=\frac{25}{50}\times 200=100\ \text{V}$$

Also,

$$\mathcal{E}_S i_S=\mathcal{E}_P i_P$$

$$\therefore i_P=\frac{\mathcal{E}_S i_S}{\mathcal{E}_P}=\frac{100\times 4}{200}=2\ \text{A}$$

Hence, option (C) is the correct answer.

3. A transformer is used to light a $140\ \text{W}, 24\ \text{V}$ lamp from $240\ \text{V}$ AC mains. The current in mains cable is $0.7\ \text{A}$, find the efficiency (approximate value) of transformer.

A. 50%

B. 76%

C. 83%

D. 91%

Resistance of the lamp,

$$R=\frac{\mathcal{E}_S^2}{P}=\frac{24^2}{140}\approx 4.11\ \Omega$$

Current in secondary coil is,

$$i_S=\frac{\mathcal{E}_S}{R}=\frac{24}{4.11}=5.84\ \mathrm{A}$$

Power at primary coil is,

$$P_{\text{input}}=\mathcal{E}_P i_P=240\times 0.7=168\ \mathrm{W}$$

Power at secondary coil is,

$$P_{\text{output}}=\mathcal{E}_S i_S=24\times 5.84=140.16\ \mathrm{W}$$

Now, efficiency of the transformer is,

$$\eta=\frac{P_{\text{output}}}{P_{\text{input}}}\times 100$$

$$\Rightarrow \eta=\frac{140.16}{168}\times 100\approx 83\%$$

Hence, option (C) is the correct answer.

4. The transformer ratio in the step-up transformer is

- ✗ **A.** equal to 1.
- ✓ **B.** greater than 1.
- ✗ **C.** less than 1.
- ✗ **D.** less than 0.

We know that, transformer ratio is given by,

$$k=\frac{N_S}{N_P}=\frac{\mathcal{E}_S}{\mathcal{E}_P}$$

For a step-up transformer, $\mathcal{E}_S>\mathcal{E}_P$

$$\Rightarrow k>1$$

Hence, option (B) is the correct answer.

5. In a transformer, there are $10,000$ turns in primary coil and $25,000$ turns in secondary coil. An alternating voltage, $\mathcal{E} = 50\sin(\pi t)$ is applied across the primary coil. Find the peak voltage across the secondary coil, in ideal conditions.

A. 175 V

B. 100 V

C. 125 V

D. 225 V

Using the transformer equation, we have,

$$\frac{\mathcal{E}_S}{\mathcal{E}_P} = \frac{N_S}{N_P}$$

$$\Rightarrow \mathcal{E}_S = \frac{N_S}{N_P} \times \mathcal{E}_P = \frac{25,000}{10,000} \times 50 = 125 \text{ V}$$

Hence, option (C) is the correct answer.

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