PHYSICS

BOOKS - CENGAGE PHYSICS

ELECTROMAGNETIC INDUCTION

Worked Example

1. A transformer lowers emf from 220 V to 12 V. If the number of turns in primary is 8800, how many turns are there in secondary coil?

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2. An emf applied to a primary coil is 210 V. If the number of turns in primary coil is 200 and that in secondary coil is 20, then find out the output voltage. Name the type of the transformer.

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3. A step-up transformer operates on a 220-V AC line and supplies a load current of 6 A. The ratio of the primary to secondary turns is 1:12. Find the current in the primary, voltage in the secondary, and output power, given that the efficiency of the transformer is 70%.

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Mandatory Exercise Exercise Set I

1. What happens when the north pole of a magnet is moved towards the face of a coil connected to a galvanometer?

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2. What happens when the north pole of a magnet is moved away from the coil connected to a galvanometer? (draw appropriate labelled diagrams)

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3. What is the difference between a DC generator and an AC generator?

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4. Name a device which converts mechanical energy into electrical energy. On which principle does it work?

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5. What are the energy losses in an actual transformer?

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Mandatory Exercise Exercise Set Ii

1. Electromagnetic induction was discovered by

A. Oersted

B. Maxwell

C. Thomson

D. Faraday

Answer: D

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2. Direction of induced current produced by motion of a conductor in a magnetic field is given by

A. Fleming's right-hand rule

B. Fleming's left-hand rule

C. Clock rule

D. Faraday's rule

Answer: A

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3. Which of the following involves electromagnetic induction?

A. A rod charged with electricity

B. An electric current producing a magnetic field

C. The relative motion between a magnet and a coil producing an electric current

D. A magnetic field exerting a force on a current carrying wire

Answer: C

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4. You have a coil and a bar magnet. You can produce an electric current by moving

A. the magnet, but not the coil

B. the coil, but not the magnet

C. either the magnet or the coil

D. neither the magnet nor the coil

Answer: C

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5. A coil rotates in a magnetic field

A. in a motor, but not in a generator

B. in a generator, but not in a motor

C. neither in a motor nor in a generator

D. in a motor as well as a generator

Answer: B

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6. A commutator changes the direction of current in the coil of

A. a DC motor

B. a DC motor and an AC generator

C. a DC motor and a DC generator

D. an AC generator

Answer: C

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7. What is the SI unit of magnetic flux?

A. Tesla

B. Weber

C. Henry

D. Ampere

Answer: B

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8. How much current is flowing when a magnet is kept stationary inside a solenoid?

A. 1A

B. 10A

C. 0.1A

D. 0A

Answer: D

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9. Faraday's third law is also known as

A. Newton's Law

B. Coulomb's Law

C. Neumann's Law

D. Ampere's Law

Answer: C

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10. Galvanometer is a device that can measure

A. current

B. potential difference

C. resistance

D. induced emf

Answer: A

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11. How does flux change in a solenoid when a magnet is moved away from the solenoid?

A. Increase

B. Decrease

C. Remain same

D. Cannot determine

Answer: B

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12. Lenz' law is in accordance with the law of

A. Conservation of mass

B. Conservation of energy

C. Conservation of charge

D. Conservation of momentum

Answer: B

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13. Lenz' law is explained on the basis of

A. inertia of rest

B. inertia of motion

C. moment of inertia

D. electromagnetic inertia

Answer: D

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14. According to Fleming's right hand rule, which finger points towards the direction of field?

A. Thumb

B. Forefinger

C. Central finger

D. Ring finger

Answer: B

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15. Which finger is used to denote the direction of motion of conductor in Fleming's right hand rule?

A. Thumb

B. Forefinger

C. Little finger

D. Central finger

Answer: A

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16. ___finger indicates the direction of induced current in Fleming's right hand rule.

A. Thumb

B. Little finger

C. Central finger

D. Ring finger

Answer: C

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17. Name the type of current that is induced on the surface of a metallic solid when moved in a non-uniform magnetic field.

A. Eddy current

B. Metallic current

C. Surface current

D. Induced current

Answer: A

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18. Which of the following parts is absent in an AC generator?

A. Armature

B. Slip rings

C. Split rings

D. Brush

Answer: C

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19. In polyphase generators, there are multiple numbers of

A. field magnet

B. armature

C. slip rings

D. all of these

Answer: C

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20. For a step down transformer

A. $N_p > N_s$

B. $N_p < N_s$

C. $N_p = N_s$

D. $N_p \geq N_s$

Answer: A

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21. Which is not possible for a transformer?

A. $E_p I_p = E_s I_s$

B. $E_p I_p < E_s I_s$

C. $E_p I_p > E_s I_s$

D. all are possible

Answer: B

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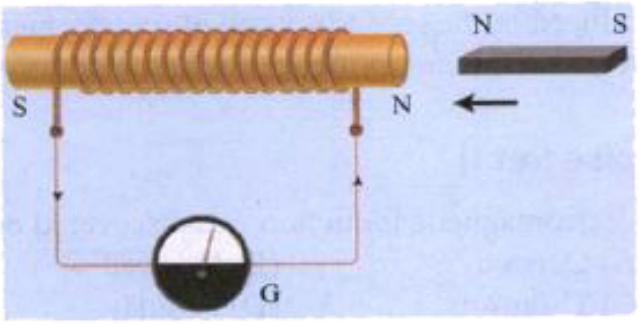
Mandatory Exercise Exercise Set Iii

1. The bar magnet is placed along the axis of the solenoid as shown in figure. When the magnet is stationary (v = 0), galvanometer

shows



A. deflection to the right

B. deflection to the left

C. no deflection

D. depends on the temperature

Answer: C

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2. The direction of the induced current is given by

A. Lenz's law

B. Fleming's right-hand rule

C. Faraday's first law

D. Faraday's second law

Answer: A::B

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3. Following are the applications of electromagnetic induction:

A. Electric generator

B. Transformers

C. Electric bulb

D. Dynamo

Answer: A::B

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4. The strength of the induced current depends on

A. the number of turns in the coil

B. cross-sectional area of the coil

C. strength of the magnetic filed

D. speed of rotation of the coil

Answer: A::B::C::D

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5. 'The induced emf and current persist as long as the magnetic flux is changing. This is the statement for

A. Faraday's second law

B. Lenz's law

C. Faraday's first law

D. Laplace's law

Answer: A

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6. Case 1: Number of field lines through an area decreases from 100 to 99 in 10 seconds Case II: Number of field lines through an area decreases from 10 to 0 in 1 second In which case will the induced emf be higher?

A. Case I

B. Case II

C. Same in both

D. Data insufficient

Answer: B

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7. The current due to time varying magnetic flux linked within a closed circuit is known as

A. magnetic current

B. heat current

C. induced current

D. all of these

Answer: C

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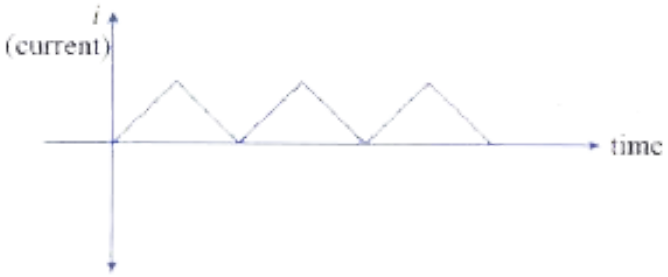
8. Current varies with time as shown in the graph



This current is

A. DC

B. AC

C. changing from DC to AC

D. can't predict

Answer: A

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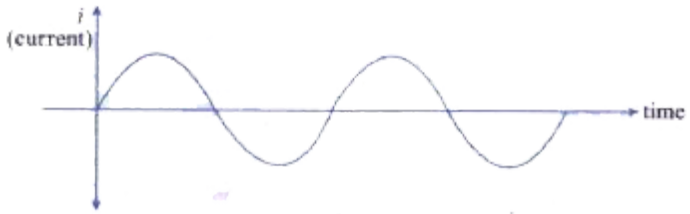
9. Current varies with time as shown in the graph



The current is

A. AC

B. DC

C. changing from DC to AC

D. can't predict

Answer: A

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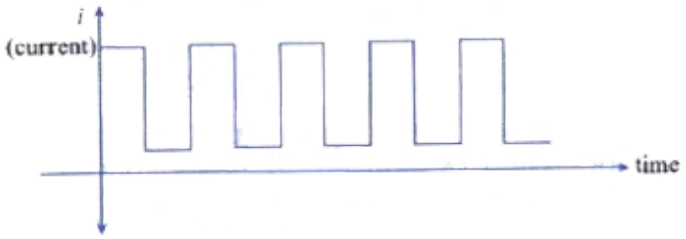
10. Current varies with time as shown in the graph



The current is

A. AC with changing magnitude

B. AC with constant magnitude

C. DC with changing magnitude

D. DC with constant magnitude

Answer: C

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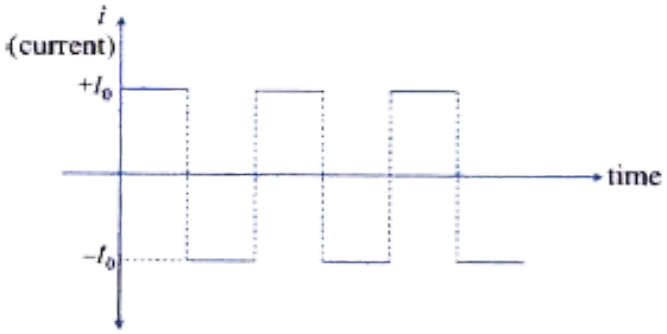
11. Current varies with time as shown in the graph



Current is

A. AC with changing magnitude

B. AC with constant magnitude

C. DC with changing magnitude

D. DC with constant magnitude

Answer: B

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12. The number of turns in the primary circuit is 1000 and the number of turns in the secondary circuit is 2000. If the input voltage is 220V. Then what is the output voltage?

A. 110

B. 220

C. 440

D. 880

Answer: C

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13. We want to construct a transformer that decreases the voltage 4 times. If the number of turns in the secondary coil is 1680. What must be the number of turns in primary coil?

A. 420

B. 840

C. 3360

D. 6720

Answer: D

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14. A transformer is used to light a 60 W and 110 V lamp from 220 V mains. If the main current is 1.5 A, what is the efficiency of the transformer?

A. 0.1818

B. 0.3191

C. 0.7523

D. 0.8327

Answer: A

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15. A 110 V input is supplied to a transformer. The output circuit has a current of 4 A at 220

V. If the efficiency of the transformer is 60%.

What is the current in the primary circuit?

A. 6.67A

B. 12.23 A

C. 13.34 A

D. 16.73 A

Answer: C

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16. The current in the primary circuit and secondary circuit of a transformer are 20 A and 4 A respectively. If the number of turns in primary coil is 560. What is the number of turns in secondary circuit if the transformer has 100% efficiency?

A. 112

B. 280

C. 1120

D. 2800

Answer: D

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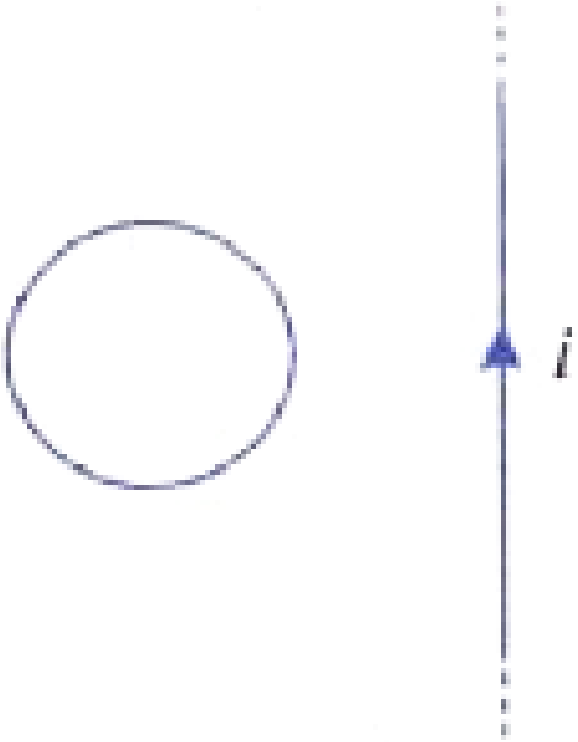
17. A loop and an infinite wire are placed side by side as shown in the figure. If the current I in the wire is increased then the induced

current in the loop is



A. clockwise

B. anticlockwise

C. zero

D. cannot determine

Answer: A

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Mandatory Exercise Exercise Set Iv

1. Match the following:

A	B
(1) Electromagnetic induction	(a) The magnitude of induced emf is directly proportional to the rate of change of magnetic flux associated with the circuit.
(2) Magnetic flux	(b) The induced emf and current persist as long as the magnetic flux is changing.
(3) Faraday's first law of electromagnetic induction	(c) The induced emf drives an induced current in such a direction as to oppose the change responsible for its production.
(4) Faraday's second law of electromagnetic induction	(d) Phenomenon in which a time-varying magnetic flux linked with a closed circuit induces a current in it.
(5) Faraday's third law of electromagnetic induction	(e) Number of magnetic lines of force passing through a given area normally.
(6) Lenz's law	(f) Whenever there is a change in magnetic flux associated with a closed circuit, an emf is induced and a current flows in the circuit.

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Challenging Exercise

1. A transformer inside the power supply for a portable CD player has 500 turns in the primary coil. It supplies an emf of amplitude 6.8 V when plugged into the usual sinusoidal household emf of amplitude 170 V. (a) How many turns does the secondary coil have? (b) If the current drawn by the CD player has amplitude 1.5 A, what is the amplitude of the current in the primary?

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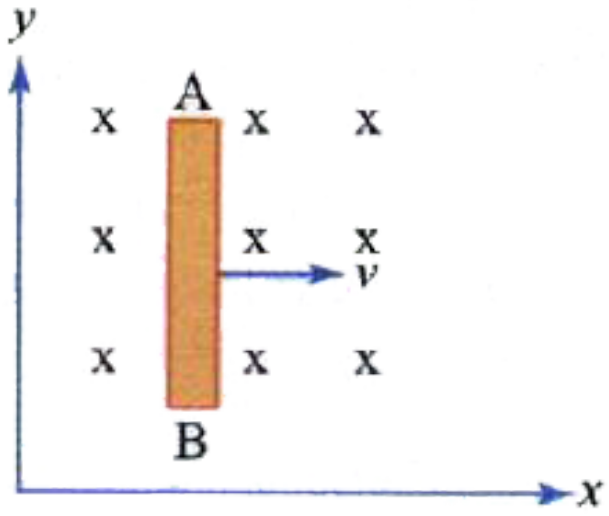
2. A conducting rod AB moves parallel to x-axis in a uniform magnetic field pointing perpendicular and into the plane of paper. The end A of the rod



A. gets positively charged

B. gets negatively charged

C. remains neutral

D. gets positively charged first and then negatively charged

Answer:

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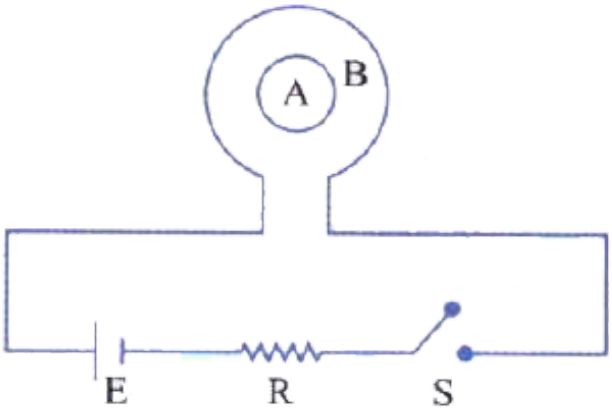
3. A closed circular wire loop A lies in the plane D larger loop B which is connected to the battery as shown in figure. What is the direction of current induced in the loop A when the switch S is closed?



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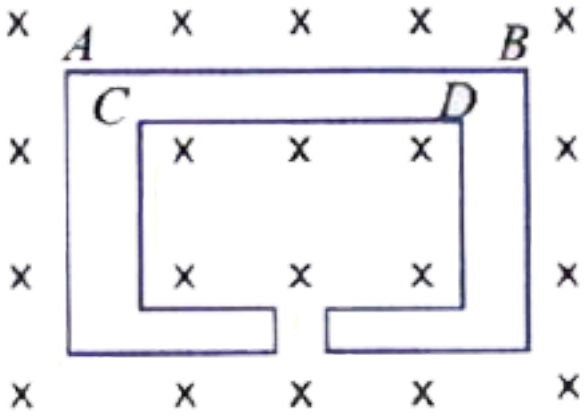
Olympiad And Ntse Level Exercises

1. A wire is bent to form the double loop shown in figure. There is a uniform magnetic field directed into the plane of the loop. If the magnitude of this field is decreasing, current will flow from:



A. A to B and C to D

B. B to A and D to C

C. A to B and D to C

D. B to A and C to D

Answer: C

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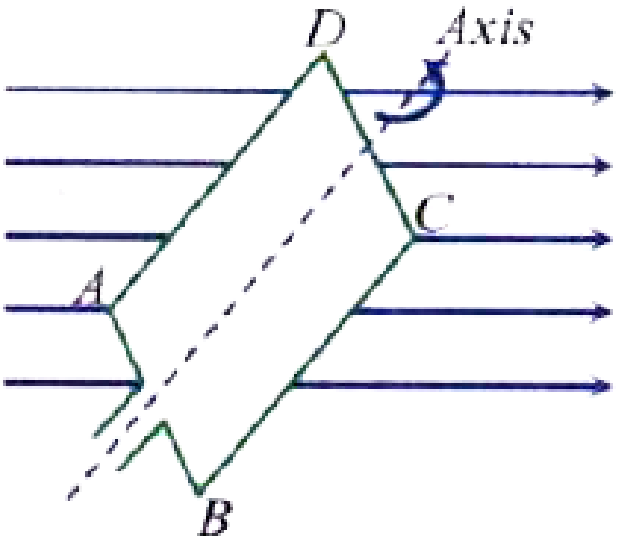
2. A rectangular coil ABCD is rotated anticlockwise with a uniform angular velocity about the axis shown in diagram below. The

axis of rotation of the coil as well as the magnetic field B are horizontal. The induced e.m.f. in the coil would be maximum when



A. The plane of the coil is horizontal

B. The plane of the coil makes an angle of

45° with the magnetic field

C. The plane of the coil is at right angles to the magnetic field

D. The plane of the coil makes an angle of 30° with the magnetic field

Answer: A

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3. Which of the following statements is incorrect?

A. Both ac and dc dynamo have a field magnet

B. Both ac and dc dynamo have an armature

C. Both ac and dc dynamo convert mechanical energy into electrical energy

D. Both ac and dc dynamo have slip rings

Answer: D

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4. In a transformer 220 ac voltage is increased to 2200 volts. If the number of turns in the secondary are 2000, then the number of turns in the primary will be

A. 200

B. 100

C. 50

D. 20

Answer: A

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5. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an ac supply of 120 V and the current flowing in it is 10 A. The voltage and the current in the secondary are

A. 240 V, 5 A

B. 240 V, 10 A

C. 60 V, 20 A

D. 120 V, 20 A

Answer: A

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6. A transformer is employed to reduce 220 V to 11 V. The primary draws a current of 5 A and the secondary 90 A. The efficiency of the transformer is

A. 0.2

B. 0.4

C. 0.7

D. 0.9

Answer: D

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7. In a step-up transformer the turn ratio is 1:10. A resistance of 200 ohm connected across the secondary is drawing a current of 0.5 A. What is the primary voltage and current?

A. 50 V, 1 amp

B. 10 V, 5 amp

C. 25 V, 4 amp

D. 20 V, 2 amp

Answer: B

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8. A transformer with efficiency 80% works at 4 kW and 100 V. If the secondary voltage is 200

V, then the primary and secondary currents are respectively

A. 40 A, 16 A

B. 16 A, 40 A

C. 20 A, 40 A

D. 40 A, 20 A

Answer: A

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9. Read the assertion and reason carefully to mark the correct option.

Assertion: An aircraft flies along the meridian, the potential at the ends of its wings will be the same.

Reason: Whenever there is change in the magnetic flux e.m.f. induces.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: D

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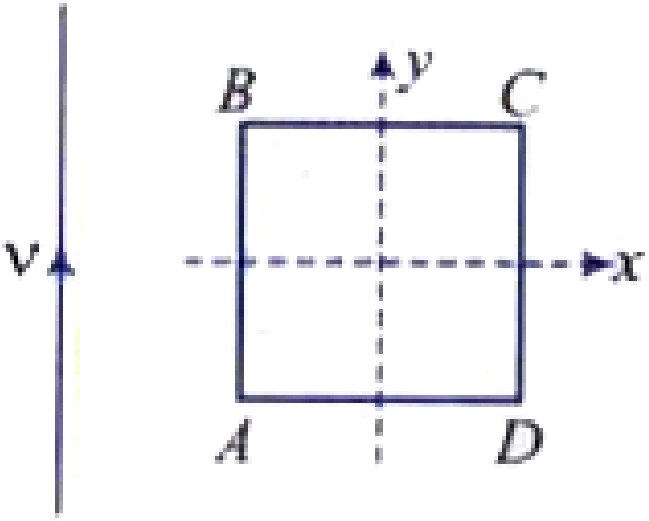
10. A long current carrying wire and a loop made of conducting wire are placed in x-y plane, such that long wire is parallel to y axis. Column I is regarding some changes made in the position of loop and column II indicates the resulting effects.


B
y
C
V
x
A
D

Column I		Column II	
(p)	If loop is moved away from the wire while keeping it in x-y plane.	(a)	Current is induced in the loop in anticlockwise direction
(q)	If loop is moved towards the wire while keeping it in x-y plane.	(b)	Current is induced in the loop in clockwise direction
(r)	If loop is rotated about x axis, then just after this	(c)	No emf is induced in the loop
(s)	If loop is rotated about y axis, then just after this	(d)	The wire will attract or repel the loop

Codes

(A) (p - b,d) (q - a,d) (r - c) (s - c)

(B) (p - a,d) (q - a,d) (r - b) (s - c)

(C) (p - b,d) (q - a,c) (r - b) (s - c)

(D) (p - b,c) (q - a,c) (r - d) (s - d)

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