PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

ELECTROMAGNETIC INDUCTION

Jee Main 5 Years At A Glance

1. A copper rod of mass m slides under gravity on two smooth parallel rails, with separation 1 and set at an angle of θ with the horizontal. At the bottom, rails are joined by a resistance R. There is a uniform magnetic field B normal to the plane of the rails, as shown in the figure. The terminal speed of the copper rod is :

A. $\dfrac{mgR\cos\theta}{B^2l^2}$

B. $\dfrac{mgR\sin\theta}{B^2l^2}$

C. $\dfrac{mgR\tan\theta}{B^2l^2}$

D. $\dfrac{mgR\cot\theta}{B^2l^2}$

Answer: B

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2. A coil of cross-sectional area A having n turns is placed in uniform magnetic field B. When it is rotated with an angular velocity ω, the maximum e.m.f. induced in the coil will be :

A. $nBA\omega$

B. $\frac{3}{2}nBA\omega$

C. $3nBA\omega$

D. $\frac{1}{2}nBA\omega$

Answer: A

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3. In a coil of resistance 100Ω, a current is induced by changing the magnetic flux throught it as shown in the figure. The magnitude of change in flux through the coil is

A. 250 Wb

B. 275 Wb

C. 200 Wb

D. 225 Wb

Answer: A

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4. A conducting metal circular-wire-loop of radius r is placed perpendicular to a magnetic field which varies with time as $B = B_0 e^{-t/\tau}$, where B_0 and τ are constants, at time = 0. If the resistance of the loop is R then the heat generated in the loop after a long time $(t \to \infty)$ is :

A. $\frac{\pi^2 r^4 B_0^4}{2\tau R}$

B. $\frac{\pi^2 r^4 B_0^2}{2\tau R}$

C. $\frac{\pi^2 r^4 B_0^2 R}{\tau}$

D. $\frac{\pi^2 r^4 B_0^2}{\tau R}$

Answer: B

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5. When current in a coil changes from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The self - inductance of the coil is :

A. 6 H

B. 0.67 H

C. 3 H

D. 1.67 H

Answer: D

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6. A coil of circular cross - section having 1000 turns and $4cm^2$ face area is placed with its axis parallel to a magnetic field which decreases by 10^{-2}Wb m^{-2} in 0.01 s. the e.m.f induced in the coil is :

A. 400 mV

B. 200 mV

C. 4 mV

D. 0.4 mV

Answer: A

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Exercise 1 Concept Builder

1. A coil having 500 square loops each of side $10cm$ is placed normal to a magnetic flux which increase at the rate of $1.0\frac{\text{tesla}}{\text{second}}$. The induced r.m.f. in volts is

A. 0.1 V

B. 5.0 V

C. 0.5 V

D. 1.0 V

Answer: B

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2. A metal ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet

A. is equal to g

B. is less than g

C. is more than g

D. depends on the diameter of ring and length of magnet

Answer: B

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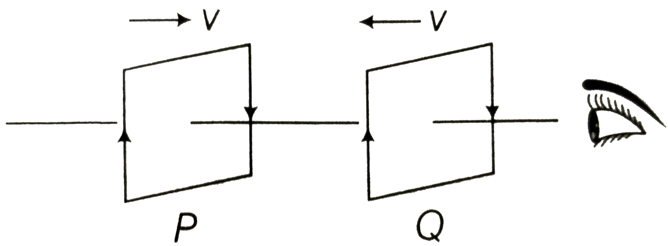
3. Two identical coils, each carrying the same current I in the clockwise direction as shown in figure, are moved towards each other with the same speed, then, the current



A. P increases while in Q decreases

B. Q increases while in P decreases

C. both P and Q increases

D. both P and Q decreases

Answer: D

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4. A rectangular coil of 20 turns and area of cross-section $25cm^2$ has a resistance of $100ohm.$ If a magnetic field which is perpendicular to the plane of the coil changes at the rate of 1000 telsa per second, the current in the coil is

A. 1A

B. 50A

C. 0.5A

D. 5A

Answer: C

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5. If the current increases from zero to 1A in 0.1 s in a coil of 5 mH then magnitude of induced emf will be

A. 0.005 volt

B. 0.5 volt

C. 0.05 volt

D. 5 volt

Answer: C

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6. A coil of insulated wire is connected to a battery. If it is connected to galvanometer, its pointer is deflected, because

A. the induced current is produced

B. the coil acts like a magnet

C. the number of turns in the coil of the galvanometer are changed

D. None of these

Answer: A

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7. The magnetic flux (in weber) linked with a coil of resistance 10Ω is varying with respect to time t $\phi = 4t^2 + 2t + 1$. Then the current in the coil at time t = 1 second is

A. 0.5A

B. 2A

C. 1.5A

D. 1A

Answer: D

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8. Two different wire loops are concentric and lie in the same plane. The current in the outer loop (I) is clockwise and increases with time. The induced current in the linner loop

A. is clockwise

B. is zero

C. is counter clockwise

D. has a direction that depends on the ration of the loop radii.

Answer: C

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9. A coil of area 100cm^2 having 50turns is perpendicular to a magnetic field of intensity 0.02T. The resistance of the coil is 2Ω. If t is removed from magnetic field in is the charge flown through the coil is:

A. 0.2 C

B. 2C

C. 0.1C

D. 1C

Answer: C

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10. Two identical circular loops of metal wire are lying on a table without touching each other. Loop A carries a current which increases with time. In response, the loop B

A. remains stationary

B. is attracted by the loop - A

C. is repelled by the loop - A

D. rotates about its CM, with CM fixed (CM is the centre of mass)

Answer: C

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11. Consider the situation shown in figure. If the switch is closed and after some time it is opened again, the closed loop will show

A. a clockwise current

B. an anticlockwise current

C. an anticlockwise current and then clockwise

D. a clockwise current and then an anticlock wise current

Answer: D

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12. A magnetic field of $2 \times 10^{-2} T$ acts at right angles to a coil of area $100 cm^2$ with 50 turns. The average emf induced in the coil is $0.1 V$, when it is removed from the field in time t. The value of t is

A. 10 s

B. 0.1 s

C. 0.01 s

D. 1s

Answer: B

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13. A rectangular coil of 100 turns and size $0.1m \times 0.05m$ is placed perpendicular to a magnetic field of 0.1 T. If the field drops to 0.05 T in 0.05 s, the magnitude of the emf induced in the coil is

A. 0.5 V

B. 1.0 V

C. 1.5 V

D. 2.0 V

Answer: A

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14. the inductance of a closed-packed coil of 400 turns is $8mH. A$ current of $5mA$ is passed through it. The magnetic flux through each turn of the coil is

A. $\frac{1}{4\pi}\mu_0 wb$

B. $\frac{1}{2\pi}\mu_0 wb$

C. $\frac{1}{3\pi}\mu_0 wb$

D. $0.4\mu_0 wb$

Answer: A

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15. The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. Then the total quantity of electric charge Q that passes any point in the circuit during the time Δt is represented by

A. $Q = R.\dfrac{\Delta\phi}{\Delta t}$

B. $Q = \dfrac{1}{R}.\dfrac{\Delta\phi}{\Delta t}$

C. $Q = \dfrac{\Delta\phi}{R}$

D. $Q = \dfrac{\Delta\phi}{\Delta t}$

Answer: C

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16. A conducting wire frame is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a constant rate. The directions of induced current in wires AB and CD are

A. B to A and D to C

B. A to B and C to D

C. A to B and D to C

D. B to A and C to D

Answer: A

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17. A coil having an area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ in a time interval t. The e.m.f. induced in the coil will be

A. $3A_0B_0/t$

B. $4A_0B_0/t$

C. $3B_0/A_0t$

D. $4A_0/B_0t$

Answer: A

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18. A horizontal telegraph wire 0.5 km long runing east and west in a part of a circuit whose resistance is 2.5Ω. The wire falls to

$g = 10.0 m / s^2$ and $B = 2 \times 10^{-5}$ weber/m^2

then the current induced in the circuit is

A. 0.7 amp

B. 0.04 amp

C. 0.02 amp

D. 0.01 amp

Answer: C

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19. A coil having n turns and resistance $R\Omega$ is connected with a galvanometer of resistance $4R\Omega$. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is

A. $-\dfrac{(W_1 - W_2)}{Rnt}$

B. $-\dfrac{n(W_2 - W_1)}{5Rt}$

C. $-\dfrac{(W_2 - W_1)}{5Rnt}$

D. $-\dfrac{n(W_2 - W_1)}{Rt}$

Answer: B

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20. Two coils X and Y are linked such that emf E is induced in Y when the current in X is changing at the rate $I'(=dI/dt)$. If a current I_0 is now made to flow through Y, the flux linked with X will be

A. $(\varepsilon/I)i$

B. $\varepsilon i I$

C. $(\varepsilon I)i$

D. iI / ε

Answer: A

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21. A circular coil and a bar magnet placed nearby are made to move in the same direction. The coil covers a distance of $1m$ in $0.5 \sec$ and the magnet a distance of $2m$ in $1 \sec$. The induced emf produced in the coil

A. zero

B. 0.5 V

C. 1V

D. 2V

Answer: A

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22. A metal conductor of length 1m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is

$0.2 \times 10^{-4} T$, then the emf developed between the two ends of hte conductor is

A. 5mV

B. $50 \mu V$

C. $5 \mu V$

D. 50 mV

Answer: B

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23. A straight conductor of length 4 m moves at a speed of 10 m/s when the conductor makes an angle of 30° with the direction of magnetic induction 0.1 T. then the induced emf is

A. 4V

B. 3V

C. 1V

D. 2V

Answer: D

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24. Two coils have a mutual inductance $0.005H$. The current changes in the first coil according to equation $I = I_0 \sin \omega t$, where $I_0 = 10A$ and $\omega = 100\pi$radian//sec`. The maximum value of e.m.f. in the second coil is

A. 2π

B. 5π

C. π

D. 4π

Answer: B

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25. A varying current in a coils charge from 10 A to zero in $0.5s$ .If the average emf induced in the coils is 220 V , the self- inductance of the coils is

A. 5 H

B. 6 H

C. 11 H

D. 12 H

Answer: C

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26. When the current in a coil changeg from 8 amperes to 2 amperes in 3×10^{-2} seconds, the e.m.f. induced in the coil is 2 volt. The self-inductance of the coil (in millihenry) is

A. 10 mH

B. 20 mH

C. 5 mH

D. 1 mH

Answer: A

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27. A coil of $N = 100$ turns and area $1cm^2$ carries a current $I = 5A$ and creates a magnetic flux $\varphi = 10^{-5} Tm^{-2}$ .The value of its inductance L will be

A. 0.05 mH

B. 0.10 mH

C. 0.15 mH

D. 0.20 mH

Answer: D

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28. In an inductance coil the current increases from zero to 6 ampere in 0.3 second by which an induced e.m.f. of 60 volt is produced in it. The value of coefficient of self-induction of coil is

A. 3 henry

B. 2 henry

C. 1 henry

D. 1.5 henry

Answer: D

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29. The mutual inductance of a pair of a coil is 0.75 H. if the current in primary coil changes from 0.5 A to 0A in 0.01 s. the average induced emf in secondary coil is

A. 25.5 V

B. 12.5 V

C. 22.5 V

D. 37.5 V

Answer: D

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30. The coefficient of self-inductance of a solenoid is $0.18mH$. If a crude of soft iron of relative permeability 900 is inserted, then the coeffcient of self-inductance will become nearly

A. 5.4 mH

B. 162 mH

C. 0.006 mH

D. 0.0002 mH

Answer: B

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31. Two coil are placed close to each other. The mutual inductance of the pair of coils depends upon.

A. relative position and orientation of the two coils

B. the materials of the wires of the coils

C. the current in the two coils

D. the rates at which currents are changing in the two coils

Answer: A

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32. A current of 2.5 A flows through a coil of inductance 5 H. The magnetic flux linked with the coil is

A. 2 Wb

B. 0.5 Wb

C. 12.5 Wb

D. Zero

Answer: C

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33. Two neighbouring coils A and B have a mutual inductance of 20 mH. The current flowing through A is given by $i = 3t^2 - 4t + 6$. The induced emf at t = 2s is

A. 160 mV

B. 200 mV

C. 260 mV

D. 300 mV

Answer: A

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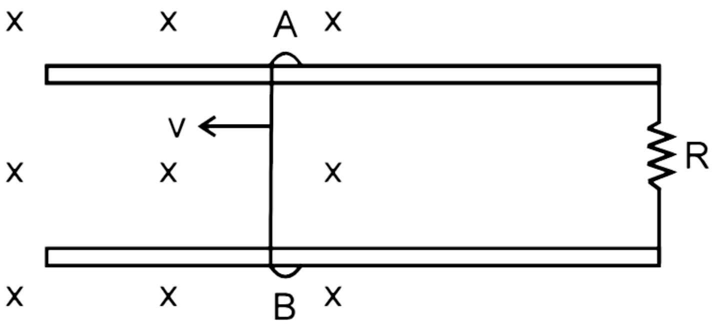
34. When the current in a coil charges from 2A to 4A in 0.05 s, emf of 8 volt is induced in the coil. The coefficient of self induction of the coil is -



A. 0.1 henry

B. 0.2 henry

C. 0.4 henry

D. 0.8 henry

Answer: B

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35. A coil is wound on a frame of rectangular cross - section. If all the linear dimensions of the frame are increased by a factor x and the number of turns per unit length of the coil remains the same, self - inductance of the coil increases by a factor of

A. x^2

B. x^3

C. x^4

D. x^5

Answer: B

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36. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area $A = 10cm^2$ and length =20cm. If one of the solenoid has 300 turns and the other 400 turns, their mutual indcutance is

A. $2.4\pi \times 10^{-5} H$

B. $4.8\pi \times 10^{-4} H$

C. $4.8\pi \times 10^{-5} H$

D. $2.4 \times 10^{-4} H$

Answer: D

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37. A copper rod of length l is rotated about one end perpendicular to the uniform magnetic field B with constant angular velocity ω. The induced e.m.f. between its two ends is

A. $\frac{1}{2}B\omega l^2$

B. $\frac{3}{4}B\omega l^2$

C. $B\omega l^2$

D. $2B\omega l^2$

Answer: A

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38. Aconductor of lengfht 0.4 m is moving with a speed of 7 m/s perpendicular to a magnetic field of intensity$0.9Wb/m^2$ .The induced emf across the coduct is

A. 1.26 V

B. 2.52 V

C. 5.04 V

D. 25.2 V

Answer: B

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39. A wire of length $1m$ is moving at a speed of $2ms^{-1}$ perpendicular to its length and a homogeneous magnetic field of $0.5T$. The ends of the wire are joined to a circuit of resistance 6Ω. The rate at which work is being done to keep the wire moving at constant speed is

A. $\frac{1}{12}W$

B. $\frac{1}{6}W$

C. $\frac{1}{3}W$

D. 1W

Answer: B

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40. Two identicaly induction coils each of inductance L joined in series are placed very close to each other such that the winding direction of one is exactly opposite to that of the other, what is the net inductance?

A. L^2

B. 2L

C. L/2

D. Zero

Answer: D

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41. A thin wire of length $2m$ is perpendicular to the xy plane. It is moved with velocity $\overrightarrow{V} = \left(2\hat{i} + 3\hat{j} + \hat{k}\right)m/s$ through a region of magnetic induction $\overrightarrow{B} = \left(\hat{i} + 2\hat{j}\right)Wb/m^2$. Then potential difference induced between the ends of the wire:

A. 1V

B. 1.5V

C. 2.5V

D. 3V

Answer: D

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42. A rectangular coil of single trun, having area A , rotates in a uniform magnetic field B with an angular velocity ω about an axis prependicular to the field. If initially the plane of the coil is perpendicular to the field, then the average induced emf when it has rotate through 90° is

A. $\dfrac{\omega BA}{\pi}$

B. $\dfrac{\omega BA}{2\pi}$

C. $\dfrac{\omega BA}{4\pi}$

D. $\dfrac{2\omega BA}{\pi}$

Answer: D

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43. The two rails of a railway track, insulated from each other and the ground, are connected to a milli voltmeter. What is the reading of the milli voltmeter when a train travels at a speed of $180 km / hours$ along the track, given that the vertical components of earth's magnitic field is $0.2 \times 10^{-4} weber / m^2$ & the rails are separated by 1 meter?

A. 10^{-2} volt

B. 10mV

C. 1 volt

D. 1mV

Answer: D

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44. In fig, CODF is a semicircular loop of a conducting wire of resistance R and radius r. It is placed in a uniform magnetic field B, which is directed into the page (perpendicular to the plane of the loop). The loop is rotated with a constant angular speed ω about an ax is passing through the centre O, and perpendicular to the page. Then the induced current in the wire loop is

A. zero

B. $B r^2 \omega / R$

C. $B r^2 \omega / 2R$

D. $B \pi r^2 \omega / R$

Answer: C

45. The mutual inductance of a pair of coils, each of N turns, is M henry. If a current of I ampere in one of the coils is brought to zero in t second, the emf induced per turn in the other coil, in volt, will be

A. $\frac{MI}{t}$

B. $\frac{NMI}{t}$

C. $\frac{MN}{It}$

D. $\frac{MI}{Nt}$

Answer: A

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46. A coil has 2000 turns and area of $70cm^2$. The magnetic field perpendicular to the plane of the coil is $0.3Wb/m^2$ and takes 0.1 sec to rotate through 180^0. The value of the induced e.m.f. will be

A. 8.4 V

B. 84 V

C. 42 V

D. 4.2 V

Answer: A

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47. When the current in a coil charges from 2A to 4A in 0.05 s, emf of 8 volt is induced in the coil. The coefficient of self induction of the coil is -

A. 0.1 henry

B. 0.2 henry

C. 0.4 henry

D. 0.8 henry

Answer: B

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48. A small square loop of wire of side l is placed inside a large square loop of wire of side $L(L > > l)$. The loops are co-planer and their centres coincide. The mutual inductance of the system is proportional to

A. $\frac{l}{L}$

B. $\frac{l^2}{L}$

C. $\frac{L}{l}$

D. $\frac{L^2}{l}$

Answer: B

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49. Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inductance will be

A. maximum in situation (a)

B. maximum in situation (b)

C. maximum in situation (c)

D. the same in all situations

Answer: A

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50. Two coils, one primary of 500 turns and one secondary of 25 turns, are wound on an iron ring of mean diameter 20 cm and cross - sectional area $12cm^2$. If the permeability of iron is 800, the mutual inductance is :

A. 0.48 H

B. 2.4 H

C. 0.12 H

D. 0.24 H

Answer: D

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51. Two circular coils, one of smaller radius r_1 and the other of very large radius r_2 are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.

A. R_1 / R_2

B. R_2 / R_1

C. R_1^2 / R_2

D. R_2^2 / R_1

Answer: D

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52. A long solenoid has 500 turns. When a current of $2A$ is passed through it, the resulting magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3} Wb$. The self-inductance of the solenoid is

A. 2.5 henry

B. 2.0 henry

C. 1.0 henry

D. 40 henry

Answer: C

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53. A metal disc of radius 100 cm is rotated at a constant angular speed of $60 rad / s$ in a plane at right angles to an external field of magnetic induction $0.05 Wb/m^2$. The emf induced between the centre and a point on the rim will be

A. 3V

B. 1.5 V

C. 6V

D. 9V

Answer: B

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54. A copper disc of radius $0.1m$ rotates about its centre with 10 revolutuion per second in a uniform magnetic field of 0.1 tesla with its plane perpendicular to the field. The emf induced across the radius of the disc is

A. $\frac{\pi}{10}$ volt

B. $\frac{2\pi}{10}$ volt

C. $\pi \times 10^{-2}$ volt

D. $2\pi \times 10^{-2}$ volt

Answer: C

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55. A square loop of side a is rotating about its diagonal with angular velocity ω in a perpendicular magnetic field $\vec{B}$. It has 10 turns. The emf induced is

A. $Ba^2\omega \sin \omega t$

B. $Ba^2\omega \cos \omega t$

C. $5\sqrt{2}Ba^2$

D. $10Ba^2\omega \sin \omega t$

Answer: D

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56. A wire loop is rotated in a uniform magnetic field about an an axis perpendicular to the field. The direction of the current induced in the loop reverses once each

A. quarter revolution

B. half revolution

C. full revolution

D. two revolutions

Answer: B

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57. In an A.C. generator, when the plane of the armature is perpendicular to the magnetic field

A. both magnetic flux and emf are maximum

B. both magnetic flux and emf are zero

C. both magnetic flux and emf are half of their respective maximum values

D. magnetic flux is maximum and emf is zero

Answer: D

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58. The pointer of a dead-beat galvanometer gives a steady deflection because

A. eddy currents are produced in the conducting frame over which the coil is wound.

B. its magnet is very strong.

C. its pointer is very light

D. its frame is made of ebonite.

Answer: A

59. If a coil made of conducting wires is rotated between poles pieces of the permanent magnet. The motion will generated a current and this device is called

A. electric motor

B. electric generator

C. electromagnet

D. All of the above

Answer: B

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60. The armature of a dc motor has 20Ω resistance It draws a currrent of 1.5 A when run by a $220V$ dc supply The value of the block emf induced in it is .

A. 150 V

B. 170 V

C. 180 V

D. 190 V

Answer: D

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61. When a metallic plate swings between the poles of a magnet

A. no effect on the plate

B. eddy currents are set up inside the plate and the direction of the current is along the motion of the plate

C. eddy currents are set up inside the plate and the direction of the current opposes the motion of the plate

D. eddy currents are set up inside the plate

Answer: C

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62. A generator has an e.m.f. of 440 Volt and internal resistance of 4000 hm. Its terminals are connected to a load of 4000 ohm. The voltage across the load is

A. 220 volt

B. 440 volt

C. 200 volt

D. 400 volt

Answer: D

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63. An AC generator of 220 V having internal resistance $r = 10\Omega$ and external resistance $R = 100\Omega$. What is the power developed in the external circuit?

A. 484 W

B. 400 W

C. 441 W

D. 369 W

Answer: B

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64. A six pole generotar with fixed field excitation developes an e.m.f. of $100V$ when operating at 1500 r.p.m. At what speed must it rotate to develop $120V$?

A. 1200 r.p.m

B. 1800 r.p.m

C. 1500 r.p.m

D. 400 r.p.m

Answer: B

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65. The number of turns in the coil of an ac genrator is 5000 and the area of the coil is $0.25m^2$. The coil is rotate at the rate of $100\text{cycles}/\text{sec}$ in a magnetic field of $0.2W/m^2$. The peak value of the emf generated is nearly

A. 786 KV

B. 440 KV

C. 220 KV

D. 1571 KV

Answer: D

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66. plane of eddy currents make an angle with the plane of magnetic lines of force equal to

A. 45°

B. 0°

C. 180°

D. 90°

Answer: B

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67. The back emf in a DC motor is maximum when,

A. the motor has picked up max speed

B. the motor has just started moving

C. the speed of motor is still on the increases

D. the motor has just been switched off

Answer: A

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68. A series would dc motor has a total resistance of 1.5 ohm. When connected across a 115 volt and running at a certain speed it draws a current of 10 A. The back emf in the motor is

A. 100 V

B. 115 V

C. 15 V

D. 1.5 V

Answer: A

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Exercise 2 Concept Applicator

1. A conducting circular loop is placed in a uniform magnetic field $0.04T$ with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at $2mm/\sec$. The induced emf in the loop when the radius is $2cm$ is

A. $4.8\pi\mu V$

B. $0.8\pi\mu V$

C. $1.6\pi\mu V$

D. $3.2\pi\mu V$

Answer: D

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2. Fig shown below represents an area $A = 0.5m^2$ situated in a uniform magnetic field B = 2.0 weber/m^2 and making an angle of 60° with respect to magnetic field.

The value of the magnetic flux through the area would be equal to

A. 2.0 weber

B. $\sqrt{3}$ weber

C. $\sqrt{3}/2$ weber

D. 0.5 weber

Answer: D

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3. A rectangular coil of single trun, having area A , rotates in a uniform magnetic field B with an angular velocity ω about an axis prependicular to the field. If initially the plane of the coil is perpendicular to the field, then the average induced emf when it has rotate through 90° is

A. $\frac{\omega B A}{\pi}$

B. $\frac{\omega B A}{2 \pi}$

C. $\frac{\omega B A}{4 \pi}$

D. $\frac{2 \omega B A}{\pi}$

Answer: D

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4. A solenoid has 2000 turns wound over a length of $0.3m$. Its cross-sectional area is equal to $1.2 \times 10^{-3} m^2$. Around its central cross-section a coil of 300 turns in wound. If an initial current of $2A$ flowing in the solenoid is reversed in $0.25s$, the emf induced in the coil is

A. $2.4 \times 10^{-4}V$

B. $2.4 \times 10^{-2}V$

C. $4.8 \times 10^{-4}V$

D. $4.8 \times 10^{-2}V$

Answer: B

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5. In a uniform magneitc field of induced B a wire in the form of a semicircle of radius r rotates about the diameter of hte circle with an angular frequency ω. The axis of rotation is perpendicular to hte field. If the total resistance of hte circuit is R, the mean power generated per period of rotation is

A. $\frac{(B\pi r\omega)^2}{2R}$

B. $\frac{(B\pi r^2\omega)^2}{8R}$

C. $\frac{B\pi r^2\omega}{2R}$

D. $\frac{(B\pi r\omega^2)^2}{8R}$

Answer: B

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6. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. An electric field is induced

A. in AD, but not in BC

B. in Bc, but not in AD

C. neither in AD nor in BC

D. in both AD and BC

Answer: D

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7. Two different coils have self-inductances $L_1 = 8mH$ and $L_2 = 2mH$. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coil is the same. At that time, the current, the induced voltage and the energy stored in the first coil are i_1, V_1 and W_1 respectively.

Corresponding values for the second coil at the same instant are i_2, V_2 and W_2 respectively. Then:

A. $\frac{i_1}{i_2} = \frac{1}{4}$

B. $\frac{i_1}{i_2} = 48$

C. $\frac{W_2}{W_1} = 4$

D. $\frac{V_2}{V_1} = \frac{1}{4}$

Answer: B

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8. A copper wire of length 40cm, diameter 2mm and resistivity $1.7 \times 10^{-8} \Omega m$ forms a square frame. If a uniform magnetic field B exists in a direction perpendicular to the plane of square frame and it changes at a steady rate $\frac{dB}{dt} = 0.02$ T/s, then find the current induced in the frame.

A. 9.3×10^{-2} amp

B. 9.3×10^{-1} amp

C. 3.3×10^{-2} amp

D. 19.3×10^{-2} amp

Answer: A

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9. A square coil of side $25cm$ having 1000 turns is rotated with a uniform speed in a magnetic field about axis perpendicular to the direction of the field. At an instant t, the e.m.f. induced in the coil is $e = 200 \sin 100\pi t$. The magnetic induction is

A. 0.50 T

B. 0.02 T

C. 0.01 T

D. 0.1 T

Answer: C

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10. A uniform magnetic field induction B is confined to a cylindrical region of radius R. The magnetic field is increasing at a constant rate of $\frac{dB}{dt}$ (tesla/second). An electron of charge e, placed at the point P on the periphery of the field experiences an acceleration.

A. $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ towards left

B. $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ towards right

C. $\frac{eR}{m}\frac{dB}{dt}$ towards left

D. Zero

Answer: A

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11. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of the figure. The magnitude of the field increases with time. I_1 and I_2 are the currents in the segments ab and cd. Then,

A. $I_1 > I_2$

B. $I_1 < I_2$

C. I_1 is in the direction ba and I_2 is in the direction cd

D. I_1 is in the direction ab and I_2 is in the direction dc

Answer: D

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12. The given assembly made of a conducting wire is rotated with a constant angular velocity ω about a vertical axis MO as shown in the figure. The magnetic field $\vec{B}$ exists vertically upwards as shown in the figure. Find the potential difference between points M and N, $|V_m - V_N|$ (only the magnitude)

A. $\frac{B\omega R^2}{2}$

B. $B\omega\frac{\pi R^2}{4}$

C. $B\omega\left(2R^2 - \frac{\pi R^2}{4}\right)$

D. Zero

Answer: A

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13. A 10-meter wire is kept in east-west direction. It is falling down with a speed of $5.0 \text{meter} / \text{second}$, perpendicular to the horizontal component of earth's magnetic field of $0.30x \times 10^{-4} \text{weber} / \text{meter}^2$. The momentary potential difference induced between the ends of the wire will be

A. 0.0015 V

B. 0.015 V

C. 0.15 V

D. 1.5 V

Answer: A

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14. A circular loop of radius 0.3 cm lies parallel to amuch bigger circular loop of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A flows through the smaller loop, then the flux linked with bigger loop is

A. 9.1×10^{-11} weber

B. 6×10^{-11} weber

C. 3.3×10^{-11} weber

D. 6.6×10^{-9} weber

Answer: A

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15. Consider the situation shown. The wire AB is sliding on fixed rails with a constant velocity. If wire AB is replaced by semi - circular wire, the magnitude of induced e.m.f. will

A. increase

B. decrease

C. remain the same

D. increase or decrease depending on whether the semi-circle buldges towards the resistance or away from it.

Answer: C

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16. A coil is wound as a transformer of rectangular cross section. If all the linear dimension of the transformer are increased by a factor 2 and the number of turns per unit length of the coil remain the same, the self-inductance increased by a factor of

A. 4

B. 8

C. 12

D. 16

Answer: B

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17. Shown in the figure is a circular loop of radius r and ressistance R. A variable magnetic field of induction $B = B_0 e^{-t}$ is established inside the coil. If the key (K) is closed, the electrical power developed right after closing the switch is equal to

A. $\dfrac{B_0^2 \pi r^2}{R}$

B. $\dfrac{B_0 10 r^3}{R}$

C. $\dfrac{B_0^2 \pi^2 r^4 R}{5}$

D. $\dfrac{B_0^2 \pi^2 r^4}{R}$

Answer: D

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18. A coil having 'n' turns and resistance $ROm \geq a$ is connected with a galvanometer of resistance $4R\Omega$. This combination is moved in time 't' seconds from a magnetic flux ϕ_1. Weber to ϕ_2 Weber. The induced current in the circuit is

A. $-\dfrac{\phi_2 - \phi_1}{5Rnt}$

B. $-\dfrac{n(\phi_2 - \phi_1)}{5Rt}$

C. $-\dfrac{(\phi_2 - \phi_1)}{Rnt}$

D. $-\dfrac{n(\phi_2 - \phi_1)}{Rt}$

Answer: B

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19. One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed v then the emf induced in the circuit in terms of B, l and v where l is the width l is the width of each tube, will be

A. zero

B. 2 Blv

C. Blv

D. $-B$

Answer: B

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20. Figure shows a conducting rod of negligible resistance that can slide on smooth U - shaped rail made of wire of resistance $1\Omega / m$. Position of the conducting rod at t = 0 is shown. A time t dependent magnetic field B = 2t tesla is switched on at t = 0.

At t = 0, when the magnetic field is switched on, the conducting rod is moved to the left at constant speed 5cm/s by some external means. The rod moves perpendicular to the rails. At t = 2s, induced emf has magnitude

A. 0.12 V

B. 0.08 V

C. 0.04 V

D. 0.02 V

Answer: B

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21. Three solenoid coils of same dimension, same number of turns and same number of layers of windings are taken. Coil 1 with inductance L_1 was would using a wire of resistance $11\Omega/m$, coil 2 with inductance L_2 was wound using the similar wire but the direction of winding was reversed in each layer, coil 3 with inductance L_3 was wound using a superconducting wire. The self-inductance of the coils L_1, L_2 and L_3 are

A. $L_1 = L_2 = L_3$

B. $L_1 = L_2, L_3 = 0$

C. $L_1 = L_3, L_2 = 0$

D. $L_1 > L_2 > L_3$

Answer: B

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22. A boat is moving due east in a region where the earth's magnetic field is $5.0 \times 10^{-5} NA^{-1}m^{-1}$ due north and horizontal. The boat carries a vertical aerial 2 m long. If the speed of the boat is $1.50ms^{-1}$, the magnitude of the induced emf in the wire of aerial is

A. 0.75 mV

B. 0.50 mV

C. 0.15 mV

D. 1 mV

Answer: C

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23. A horizontal straight wire 20 m long extending from east to west falling with a speed of $5.0 m/s$, at right angles to the horizontal component of the earth's magnetic field $0.30 \times 10^{-4} Wb/m^2$. The instantaneous value of the e.m.f. induced in the wire will be

A. 3mV

B. 4.5 mV

C. 1.5 mV

D. 6.0 mV

Answer: A

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24. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its side. A magnetic induction B constant in time and space, pointing perpendicular and into the plane at the loop exists everywhere with half the loop outside the field, as shown in figure. The induced emf is

A. zero

B. RvB

C. vBL/R

D. vBL

Answer: D

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25. The magnetic field in a region is given by $\overrightarrow{B} = B_0\left(1 + \frac{x}{a}\right)\hat{k}$. A square loop of edge length 'd' is placed with its edge along X-axis and Y-axis. The loop is moved with a constant velocity $\overrightarrow{V} = V_0 \hat{i}$. The emf induced in the loop is

A. zero

B. $v_0 B_0 d$

C. $\frac{v_0 B_0 d^3}{a^2}$

D. $\frac{v_0 B_0 d^2}{a}$

Answer: D

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26. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its side. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere. The current induced in the loop is

A. $\frac{Blv}{R}$ clockwise

B. $\frac{Blv}{R}$ anticlockwise

C. $\frac{2Blv}{R}$ anticlockwise

D. Zero

Answer: D

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27. Consider a region of cyclindrical magnetic field, changing with time at the rate x. A triangular conducting loop PQR is placed in the field such that mid point of side PQ coincides with axis of the magnetic field region. PQ = 2l, PR = 2l. Em.f induced in the sides PQ, QR, PR of the loop are

A. xl^2, 0, xl^2

B. 0, $\frac{xl^2}{2}$, $\frac{3xl^2}{2}$

C. 0, xl^2, xl^2

D. 0, $\frac{3}{2}xl^2$, $\frac{xl^2}{2}$

Answer: C

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28. A rectangular, a square , a circular and an elliptical loop, all in the $(x-y)$ plane, are moving out of a uniform magnetic field with a constant velocity $\vec{v} = v\hat{i}$. The magnetic field is directed along the negative z-axis direction. The induced emf, during the passage of these loops , out of the field region, will not remain constant for :

A. the circular and the elliptical loops.

B. only the elliptical loop

C. any of the four loops

D. the rectangular, circular and elliptical loops.

Answer: A

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29. A copper wire of length 40 cm, diameter 2mm and resistivity $1.7 \times 10^{-8} \Omega m$ form a square frame. If a uniform magnetic field B exists in a direction perpendicular to the plane of square frame and it changes at a steadyrate

$\frac{dB}{dt} = 0.02$ T/s, then find the current induced in the frame.

A. 9.3×10^{-2} amp(b)

B. 9.3×10^{-1} amp

C. 3.3×10^{-2} amp(d)

D. 19.3×10^{-2} amp

Answer: A

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