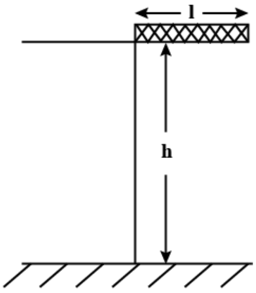
# DIWALI HOME WORK

**1.** A rectangular solid box of length 0.3 m is held horizontally, with one of its sides on the edge of a platform of height 5 m. When released, it slips off the table in a very short time $t = 0.01$ s, remaining essentially horizontal. The angle by which it would rotate when it hits the ground will be (in radians) close to:




(A) 0.3 (B) 0.02 (C) 0.28 (D) 0.5

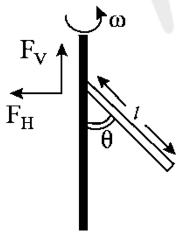
**2.** A person of mass M is, sitting on a swing of length L and swinging with an angular amplitude $q_0$. If the person stands up when the swing passes through its lowest point the work done by him, assuming that his center of mass moves by a distance l (l<< L), is close to:

(A) Mgl (B) $Mgl\,(1+\theta_0^2)$ (C) $Mgl\left(1+\frac{\theta_0^2}{2}\right)$ (D) $Mgl\,(1-\theta_0^2)$

**3.** In a car race on straight road, car A takes a time t less than car B at the finish and passes finishing point with a speed ' V more than that of car B. Both the cars start from rest and travel with constant acceleration $a_1$ and $a_2$ respectively. Then ' V is equal to:

(A) $\frac{a_1+a_2}{2}t$ (B) $\frac{2a_1a_2}{a_1+a_2}t$ (C) $\sqrt{2a_1a_2}t$ (D) $\sqrt{a_1a_2}t$

**4.** A uniform rod of length ' l ' is pivoted at one of its ends on a vertical shaft of negligible radius. When the shaft rotates at angular speed ω the rod makes an angle θ with it (see figure). To find θ equate the rate of change of angular momentum (direction going into the paper) $\frac{ml^2}{12}\omega^2\sin\theta\cos\theta$ about the centre of mass (CM) to the torque provided by the horizontal and vertical forces $F_H$ and $F_v$ about the CM. The value of θ is then such that




(A) $\cos\theta = \frac{g}{1\omega^2}$ (B) $\cos\theta = \frac{2g}{31\omega^2}$ (C) $\cos\theta = \frac{g}{21\omega^2}$ (D) $\cos\theta = \frac{3\,g}{21\omega^2}$

**5.** Moment of inertia of a cylinder of mass M, length L and radius R about an axis passing through its centre and perpendicular to the axis of the cylinder is $I = M\left(\frac{R^2}{4}+\frac{L^2}{12}\right)$. If such a cylinder is to be made for a given mass of a material, the ratio L/R for it to have minimum possible I is

(A) $\sqrt{\frac{2}{3}}$ (B) $\frac{2}{3}$ (C) $\frac{3}{2}$ (D) $\sqrt{\frac{3}{2}}$

**6.** If $R_E$ be the radius of Earth, then the ratio between the acceleration due to gravity at a depth ' $r$ ' below and a height ' $r$ ' above the earth surface is:(Given: $r < R_E$ )

(A) $1-\frac{r}{R_E}-\frac{r^2}{R_E^2}-\frac{r^3}{R_E^3}$ (B) $1+\frac{r}{R_E}+\frac{r^2}{R_E^2}+\frac{r^3}{R_E^3}$ (C) $1+\frac{r}{R_E}-\frac{r^2}{R_E^2}-\frac{r^3}{R_E^3}$ (D) $1+\frac{r}{R_E}-\frac{r^2}{R_E^2}+\frac{r^3}{R_E^3}$

**7.** If $Y, K$ and $\eta$ are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters.

(A) $Y=\frac{9K\eta}{3K-\eta} N/m^2$ (B) $Y=\frac{9K\eta}{2\eta+3K} N/m^2$ (C) $K=\frac{Y\eta}{9\eta-3Y} N/m^2$ (D) $\eta=\frac{3YK}{9K+Y} N/m^2$

**8.** Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

**Assertion A:** Body ' P ' having mass M moving with speed ' u ' has head-on collision elastically with another body

' Q ' having mass ' m ' initially at rest. If $m \ll M$, body ' Q ' will have a maximum speed equal to ' 2u ' after collision.

**Reason R :** During elastic collision, the momentum and kinetic energy are both conserved. In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both A and R are correct and R is the correct explanation of A

(B) A is not correct but R is correct

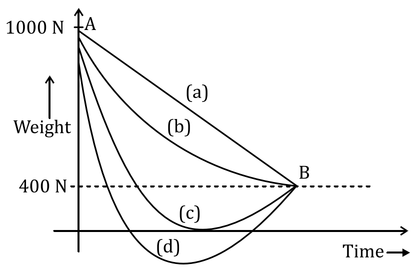
(C) A is correct but R is not correct

(D) Both A and R are correct but R is NOT the correct explanation of A

**9.** A boy reaches the airport and finds that the escalator is not working. He walks up the stationary escalator in time $t_1$. If he remains stationary on a moving escalator then the escalator takes him up in time $t_2$. The time taken by him to walk up on the moving escalator will be:

(A) $t_2-t_1$ (B) $\frac{t_1 t_2}{t_2-t_1}$ (C) $\frac{t_1+t_2}{2}$ (D) $\frac{t_1 t_2}{t_2+t_1}$

**10.** A person whose mass is 100 kg travels from Earth to Mars in a spaceship. Neglect all other objects in sky and take acceleration due to gravity on the surface of the Earth and Mars as $10 m/s^2$ and $4 m/s^2$ respectively, Identify from the below figures, the curve that fits best for the weight of the passenger as a function of time.




(A) (a) (B) (c) (C) (d) (D) (b)

**11.** A mass M hangs on a massless rod of length l which rotates at a constant angular frequency. The mass M moves with steady speed in a circular path of constant radius. Assume that the system is in steady circular motion with constant angular velocity $\omega$. The angular momentum of M about point A is $L_A$ which lies in the positive z direction and the angular momentum of M about point B is $L_B$. The correct statement for this system is:

(A) $L_A$ is constant, both in magnitude and direction

(B) $L_B$ is constant in direction with varying magnitude

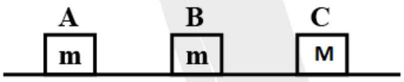
(C) $L_A$ and $L_B$ are both constant in magnitude and direction

(D) $L_B$ is constant, both in magnitude and direction

**12.** In the experiment of Ohm's law, a potential difference of 5.0 V is applied across the end of a conductor of length 10.0 cm and diameter of 5.00 mm. The measured current in the conductor is 2.00 A. The maximum permissible percentage error in the resistivity of the conductor is:

(A) 3.0 (B) 3.9 (C) 7.5 (D) 8.4

**13.** Three blocks A, B and C are lying on a smooth horizontal surface, as shown in the figure. A and B have equal masses, m while C has mass M. Block A is given an initial speed v towards B due to which it collides with B perfectly inelastically. The combined mass collides with C, also perfectly inelastically. $\frac{5^{th}}{6}$ of the initial kinetic energy is lost in whole process. What is value of M/m ?




(A) 3 (B): 4 (C) 2 (D) 5

**14.** A particle of mass m is dropped from a height h above the ground. At the same time another particle of the same mass is thrown vertically upwards from the ground with a speed of $\sqrt{2gh}$. If they collide head-on completely inelastically, the time taken for the combined mass to reach the ground, in units of $\sqrt{\frac{h}{g}}$ is

(A) $\sqrt{\frac{1}{2}}$ (B) $\sqrt{\frac{3}{4}}$ (C) $\frac{1}{2}$ (D) $\frac{1}{2}$

**15.** A particle of mass m is projected with a speed u from the ground at an angle $\theta = \frac{\pi}{3}$ w.r.t. horizontal ( x-axis). When it has reached its maximum height, it collides completely inelastically with another particle of the same mass and velocity $u\hat{i}$. The horizontal distance covered by the combined mass before reaching the ground is

(A) $\frac{5}{8}\frac{u^2}{g}$ (B) $\frac{3\sqrt{2}}{4}\frac{u^2}{g}$ (C) $\frac{3\sqrt{3}}{8}\frac{u^2}{g}$ (D) $2\sqrt{2}\frac{u^2}{g}$

**16.** Mass per unit area of a circular disc of radius a depends on the distance r from its centre as $\sigma(r) = A + Br$. The moment of inertia of the disc about the axis, perpendicular to the plane and passing through its centre is:

(A) $2\pi a^4\left(\frac{A}{4}+\frac{B}{5}\right)$ (B) $\pi a^4\left(\frac{A}{4}+\frac{aB}{5}\right)$ (C) $2\pi a^4\left(\frac{A}{4}+\frac{aB}{5}\right)$ (D) $2\pi a^4\left(\frac{aA}{4}+\frac{B}{5}\right)$

**17.** A satellite of mass $m$ is launched vertically upwards with an initial speed $u$ from the surface of the earth. After it reaches height $R(R =$ radius of the earth ), it ejects a rocket of mass $\frac{m}{10}$ so that subsequently the satellite moves in a circular orbit. The kinetic energy of the rocket is ( $G$ is the gravitational constant; $M$ is the mass of the earth):

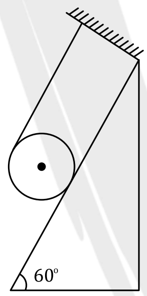
(A) $5m\left(u^2-\frac{119}{200}\frac{GM}{R}\right)$ (B) $\frac{3m}{8}\left(u+\sqrt{\frac{5GM}{6R}}\right)^2$ (C) $\frac{m}{20}\left(u-\sqrt{\frac{2GM}{3R}}\right)^2$ (D) $\frac{m}{20}\left(u^2+\frac{113}{200}\frac{GM}{R}\right)$

**18.** A rubber ball is released from a height of 5 m above the floor. 1- bounces back repeatedly, always rising to $\frac{81}{100}$ of the height through which if falls. Find the average speed of the ball.

(Take $g = 10\ ms^{-2}$ )

(A) $3.50\ ms^{-1}$ (B) 2.0. ms (C) $2.50\ ms^{-1}$ (D) 14k. 0 ms

**19.** A solid cylinder of mass $m$ is wrapped with an inextensible lightstring and, is placed on a rough inclined plane as shown in the figure. The frictional force acting between the cylinder and the inclined plane is:



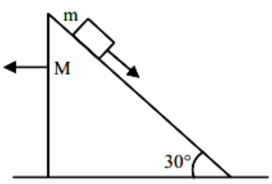

[The coefficient of static friction, $\mu_s$, is 0.4]

(A) 0 (B) 5mg (C) $\frac{7}{2}$mg (D) $\frac{mg}{5}$

**20.** A block of mass m slides on the wooden wedge, which in turn slides backward on the horizontal surface. The acceleration of the block with respect to the wedge is:

Given $m = 8$ kg, $M = 16$ kg

Assume all the surfaces shown in the figure to be frictionless.




(A) $\frac{2}{3}$ g (B) $\frac{4}{3}$ g (C) $\frac{6}{5}$ g (D) $\frac{3}{5}$ g

**21.** A body is projected vertically upwards from the surface of earth with a velocity sufficient enough to carry it to infinity. The time taken by it to reach height $h$ is s.

(A) $\sqrt{\frac{2R_e}{g}}\left[\left(1+\frac{h}{R_e}\right)^{\frac{3}{2}}-1\right]$
(B) $\frac{1}{3}\sqrt{\frac{R_e}{2g}}\left[\left(1+\frac{h}{R_\theta}\right)^{\frac{3}{2}}-1\right]$
(C) $\sqrt{\frac{R_e}{2g}}\left[\left(1+\frac{h}{R_e}\right)^{\frac{3}{2}}-1\right]$
(D) $\frac{1}{3}\sqrt{\frac{2R_e}{g}}\left[\left(1+\frac{h}{R_\theta}\right)^{\frac{3}{2}}-1\right]$

**22.** Water droplets are coming from an open tap at a particular rate. The spacing between a droplet observed at $4^{\text{th}}$ second after its fall to the next droplet is 34.3 m. At what rate the droplets are coming from the tap? (Take $g=9.8\ \mathrm{m/s^2}$ )

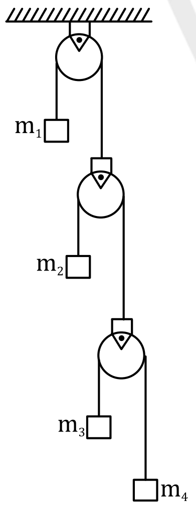
(A) 1 drop /7 seconds
(B) 3 drops /2 seconds
(C) 2 drops / second
(D) 1 drop / second

**23.** A body of mass M moving at speed $V_0$ collides elastically with a mass ' m ' at rest. After the collision, the two masses move at angles $\theta_1$ and $\theta_2$ with respect to the initial direction of motion of the body of mass M. The largest possible value of the ratio M/m, for which the angles $\theta_1$ and $\theta_2$ will be equal, is:

(A) 4
(B) 2
(C) 1
(D) 3

**24.** Suppose you have taken a dilute solution of oleic acid in such a way that its concentration becomes $0.01\ \mathrm{cm^3}$ of oleic acid per $\mathrm{cm^3}$ of the solution. Then you make a thin film of this solution (monomolecular thickness) of area $4\ \mathrm{cm^2}$ by considering 100 spherical drops of radius $\left(\frac{3}{40\pi}\right)^{\frac{1}{3}}\times 10^{-3}$ cm. Then the thickness of oleic acid layer will be $x\times 10^{-14}$ m. Where x is

**25.** In the arrangement shown in figure $a_1, a_2, a_3$ and $a_4$ are the accelerations of masses $m_1, m_2, m_3$ and $m_4$ respectively. Which of the following relation is true for this arrangement?

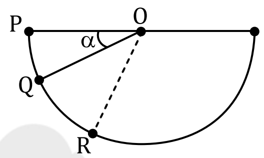


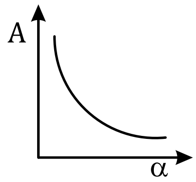

(A) $4a_1+2a_2+a_3+a_4=0$
(B) $a_1+4a_2+3a_3+a_4=0$
(C) $a_1+4a_2+3a_3+2a_4=0$
(D) $2a_1+2a_2+3a_3+a_4=0$

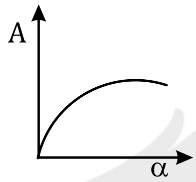
**26.** If ρ is the density and η is coefficient of viscosity of fluid which flows with a speed v in the pipe of diameter d, the correct formula for Reynolds number $R_\theta$ is:

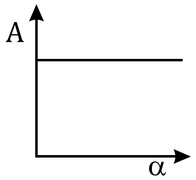
(A) $R_e = \frac{\eta d}{\rho v}$ (B) $R_e = \frac{\rho v}{\eta d}$ (C) $R_e = \frac{\rho v d}{\eta}$ (D) $R_\theta = \frac{\eta}{\rho v d}$

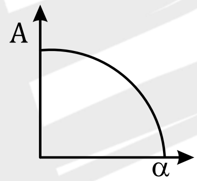
**27.** A ball is released from rest from point P of a smooth semi-spherical vessel as shown in figure. The ratio of the centripetal force and normal reaction on the ball at point Q is A while angular position of point Q is a with respect to point P. Which of the following graphs represent the correct relation between A and α when ball goes from Q to R ?



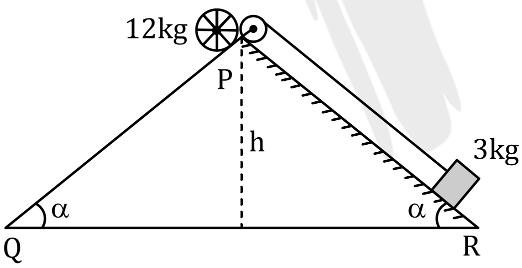

(A)



(B)



(C)



(D)



**28.** A rolling wheel of 12 kg is on an inclined plane at position *P* and connected to a mass of 3 kg through a string of fixed length and pulley as shown in figure. Consider *PR* as friction free surface. The velocity of centre of mass of the wheel when it reaches at the bottom of of the inclined plane PQ will be $\frac{1}{2}\sqrt{xgh}$ m/s. The value of x is



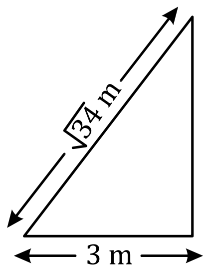

**29.** A silver wire has a mass $(0.6 \pm 0.006)$g, radius $(0.5 \pm 0.005)$mm and length $(4 \pm 0.04)$cm. The maximum percentage error in the measurement of its density will be

(A) 4% (B) 3% (C) 6% (D) 7%

**30.** A pendulum of length 2 m consists of a wooden bob of mass 50 g. A bullet of mass 75 g is fired towards the stationary bob with a speed v. The bullet emerges out of the bob with a speed $\frac{v}{3}$ and the bob just completes the vertical circle. The value of v is $ms^{-1}$. (if $g = 10\ m/s^2$ ).

**31.** A $\sqrt{34}$ m long ladder weighing 10 kg leans on a frictionless wall. Its feet rest on the floor 3 m away from the wall as shown in the figure. If $F_f$ and $F_w$ are the reaction forces of the floor and the wall, then ratio of $F_w/F_f$ will be:

(Use $g = 10\ m/s^2$ )




(A) $\frac{6}{\sqrt{110}}$ (B) $\frac{3}{\sqrt{113}}$ (C) $\frac{3}{\sqrt{109}}$ (D) $\frac{2}{\sqrt{109}}$

**32.** An object of mass 5 kg is thrown vertically upwards from the ground. The air resistance produces a constant retarding force of 10 N throughout the motion. The ratio of time of ascent to the time of descent will be equal to [Use $g = 10\ ms^{-2}$].

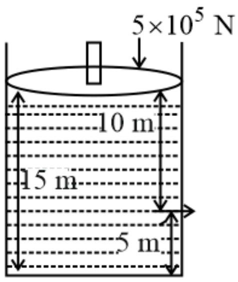
(A) 1: 1 (B) $\sqrt{2}:\sqrt{3}$ (C) $\sqrt{3}:\sqrt{2}$ (D) 2: 3

**33.** A metre scale is balanced on a knife edge at its centre. When two coins, each of mass 10 g are put one on the top of the other at the 10.0 cm mark the scale is found to be balanced at 40.0 cm mark. The mass of the metre scale is found to be $x \times 10^{-2}$ kg. The value of $x$ is

**34.** Two cylindrical vessels of equal cross-sectional area 16 $cm^2$ contain water upto heights 100 cm and 150 cm respectively. The vessels are interconnected so that the water levels in them become equal. The work done by the force of gravity during the process, is [Take, density of water = $10^3\ kg/m^3$ and $g = 10\ ms^{-2}$ ]

(A) 0.25 J (B) 1: 1 (C) 8 J (D) 12 J

**35.** Consider a cylindrical tank of radius 1 m is filled with water. The top surface of water is at 15 m from the bottom of the cylinder. There is a hole on the wall of cylinder at a height of 5 m from the bottom. A force of $5 \times 10^5$ N is applied an the top surface of water using a piston. The speed of efflux from the hole will be: (given atmosphere pressure $P_A = 1.01 \times 10^5$ Pa, density or water $\rho_w = 1000\ kg/m^3$ and gravitational acceleration $g = 10\ m/s^2$ )




(A) 11.6 m/s (B) 10.8 m/s (C) 17.8 m/s (D) 14.4 m/s

**36.** The magnetic field of an electromagnetic wave is given by:

$$\bar{B} = 1.6 \times 10^{-6} \cos(2 \times 10^{7} z + 6 \times 10^{18} t)(2\hat{i} + \hat{j}) \frac{Wb}{m^2}$$

The associated electric field will be:

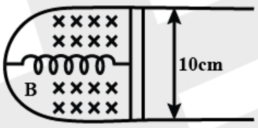
(A) $\bar{E} = 4.8 \times 10^{2} \cos(2 \times 10^{7} z + 6 \times 10^{15} t)(-\hat{i} + 2\hat{j}) \frac{V}{m}$

(B) $\bar{E} = 4.8 \times 10^{2} \cos(2 \times 10^{7} z - 6 \times 10^{15} t)(2\hat{i} + \hat{j}) \frac{V}{m}$

(C) $\bar{E} = 4.8 \times 10^{2} \cos(2 \times 10^{7} z - 6 \times 10^{15} t)(-2j + i) \frac{V}{m}$

(D) $\bar{E} = 4.8 \times 10^{2} \cos(2 \times 10^{7} z + 6 \times 10^{15} t)(\hat{i} - 2)) \frac{V}{m}$

**37.** A thin strip 10 cm long is on a U-shaped wire of negligible resistance and it is connected to a spring of spring constant $0.5 Nm^{-1}$ (see figure). The assembly is kept in a uniform magnetic field of 0.1 T. If the strip is pulled from its equilibrium position and released, the number of oscillations it performs before its amplitude decreases by a factor of $e$ is N. If the mass of the strip is 50 grams, its resistance $10\Omega$ and air drag negligible, $N$ will be close to

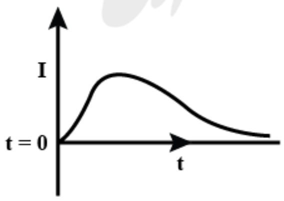


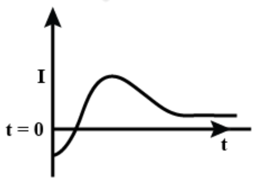

(A) 1000 (B) 5000 (C) 50000 (D) 10000

**38.** In a conductor, if the number of conduction electrons per unit volume is $8.5 \times 10^{28}\ m^{-3}$ and mean free time is 25 fs (femto second), it's approximate resistivity is ($m_e = 9.1 \times 10^{-31}$ kg)

(A) $10^{-5} \Omega m$ (B) $10^{-6} \Omega m$ (C) $10^{-7} \Omega m$ (D) $10^{-8} \Omega m$

**39.** A very long solenoid of radius R is carrying current $1(t) = kte^{-xt} (k > 0)$, as a function of time $(t \geq 0)$. Counter clockwise current is taken to be positive. A circular conducting coil of radius 2R is placed in the equatorial plane of the solenoid and concentric with the solenoid. The current induced in the outer coil is correctly depicted, as a function of time, by:

(A)



(B)
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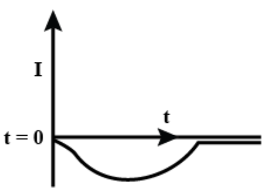


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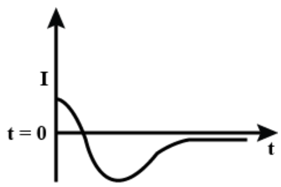



**40.** The magnetic field of a plane electromagnetic wave is given by:

$\bar{B} = \bar{B}_0 \hat{i}[\cos(kz - wt) + B_1 \hat{j} \cos(kz + wt)$

where $B_0 = 3 \times 10^{-5}$T and $B_1 = 2 \times 10^{-6}$ T.

The rms value of the force experienced by a stationary charge $Q = 10^{-4}$C at $z = 0$ is closest to:

(A) 0.6 N (B) 0.9 N (C) $3 \times 10^{-2}$ N (D) 0.1 N

**41.** A uniformly charged ring of radius 3a and total charge q is placed in xy-plane centred at origin. A point charge q is moving towards the ring along the z-axis and has speed v at z = 4a. The minimum value of v such that it crosses the origin is:

(A) $\sqrt{\frac{2}{m}}\left(\frac{1}{15}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$ (B) $\sqrt{\frac{2}{m}}\left(\frac{1}{5}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$

(C) $\sqrt{\frac{2}{m}}\left(\frac{4}{15}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$ (D) $\sqrt{\frac{2}{m}}\left(\frac{2}{15}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$

**42.** The electric field of a plane electromagnetic wave is given by $\bar{E} = E_0\hat{i}\cos(kz)\cos(\omega t)$

The corresponding magnetic field $\vec{B}$ is then given by:

(A) $\vec{B} = \frac{E_0}{C}\hat{j}\sin(kz)\cos(\omega t)$ (B) $\vec{B} = \frac{E_0}{C}\hat{j}\cos(kz)\sin(\omega t)$

(C) $\vec{B} = \frac{E_0}{C}\hat{j}\sin(kz)\sin(\omega t)$ (D) $\vec{B} = \frac{E_0}{C}\dot{k}\sin(kz)\cos(\omega t)$

**43.** A current of 5 A passes through a copper conductor (resistivity $= 1.7 \times 10^{-8}\Omega$m ) of radius of cross-section 5 mm. Find the mobility of the charges if their drift velocity is $1.1 \times 10^{-3}$ m/s.

(A) 1.3 $m^2$Ns (B) 1.8 $m^2$Ns (C) 1.5 $m^2$Ns (D) 1.0 $m^2$Ns

**44.** Given below in the left column are different modes of communication using the kinds of waves given in the right column.

| | |
|---|---|
| A. Optical Fiber Communication | P. Ultrasound |
| B. Radar | d. Infrared Light |
| C. Sonar | R. Microwaves |
| D. Mobile Phones | S. Radio Waves |

From the options given below, find the most appropriate match between entries in the left and the right column.

(A) A-Q, B-S, C-P, D-R (B) A-Q, B-S, C-R, D-P

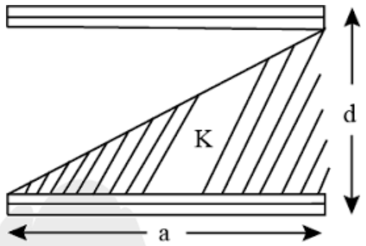
(C) A-S, B-Q, C-R, D-P (D) A-R, B-P, C-S, D-Q

**45.** A moving coil galvanometer, having a resistance G, produces full scale deflection when a current $I_g$ flows through it. This galvanometer can be converted into (i) an ammeter of range 0 to $I_0(I_0 > I_g)$ by connecting a shunt resistance $R_A$ to it and (ii) into a voltmeter of range 0 to V(V = G lo) by connecting a series resistance $R_V$ to it. Then,

(A) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{I_0 - I_g}\right)^2$ (B) $R_A R_V = G^2\left(\frac{I_g}{I_0 - I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_0 - I_g}{I_g}\right)^2$

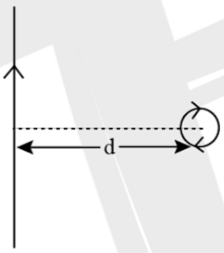
(C) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \frac{I_g}{(I_0 - I_g)}$ (D) $R_A R_V = G^2\left(\frac{(I_0 - I_g)}{I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{(I_0 - I_g)}\right)^2$

**46.** A parallel plate capacitor is made of two square plates of side a, separated by a distance $d(d < a)$. The lower triangular portion is filled with a dielectric of dielectric constant $K$, as shown in the figure. Capacitance of this capacitor is




(A) $\frac{K\varepsilon_0 a^2}{d(K-1)}\ln K$ (B) $\frac{K\varepsilon_0 a^2}{d}\ln K$ (C) $\frac{K\varepsilon_0 a^2}{2d(K+1)}$ (D) $\frac{1}{2}\frac{K\varepsilon_0 a^2}{d}$

**47.** An infinitely long current carrying wire and a small current carrying loop are in the plane of the paper as shown. The radius of the loop is a and distance of its centre from the wire is d(d >> a). If the loop applies a force F on the wire then:




(A) $F = 0$ (B) $F \propto \left(\frac{a}{d}\right)^2$ (C) $F \propto \left(\frac{a}{d}\right)$ s (D) $F \propto \left(\frac{a^2}{d^2}\right)$

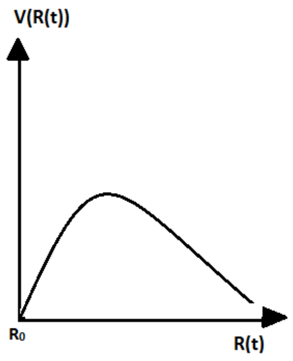
**48.** At some location on earth the horizontal component of earth's magnetic field is $18 \times 10^{-6}$ T. At this location, magnetic needle of length 0.12 m and pole strength 1.8Am is suspended irom its mid-point using a thread, it makes 45° angie with horizontal in equilibrium. To keep this needle horizontal, the vertical force that should be applied at one of its ends is:

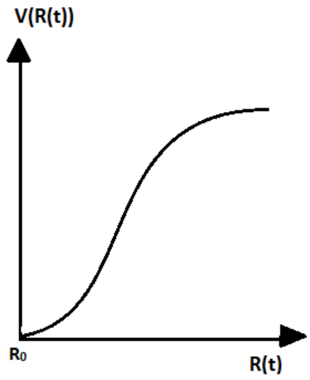
(A) $1.3 \times 10^{-5}$ N (B) $18.10^{-5}$ N (C) $6.5 \times 10^{-5}$ N (D) $3.6 \times 10^{-5}$ N

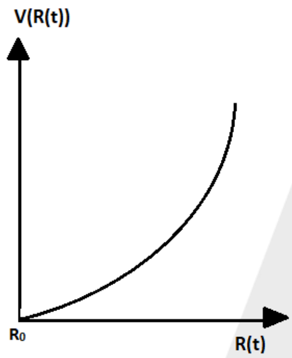
**49.** An electromagnetic wave of intensity $50 W/m^2$ enters in a medium of refractivo index ' n ' without any loss. The ratio of the magnitudes of electric fields, and the ratio of the magnitudes of magnetic fields of the wave before and after entering into the medium are respectively. given by

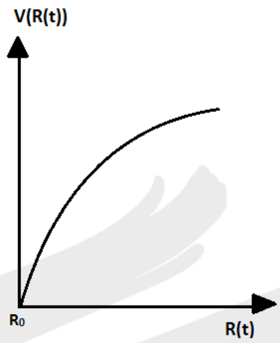
(A) $\left(\frac{1}{\sqrt{n}}, \sqrt{n}\right)$ (B) $\left(\sqrt{n}, \frac{1}{\sqrt{n}}\right)$ (C) $\left(\frac{1}{\sqrt{n}}, \frac{1}{\sqrt{n}}\right)$ (D) $(\sqrt{n}, \sqrt{n})$

**50.** There is a uniform spherically symmetric surface charge density at a distance $R_0$ from the origin. The charge distribution is initially at rest and starts expanding because of mutual repulsion. The figure that represents best the speed V(R(t)) of the distribution as a function of its instantaneous radius R(t) is

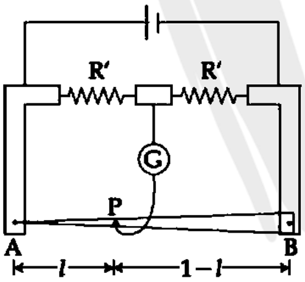
(A) 


(B) 


(C) 


(D) 


**51.** In a meter bridge, the wire of length 1 m has a non-uniform cross-section such that, the variation $\frac{dR}{dl}$ of its resistance R with length l is $\frac{dR}{dl} \propto \frac{1}{\sqrt{l}}$. Two equal resistances are connected as shown in the figure. The galvanometer has zero deflection when the jockey is at point P. What is the length AP?




(A) 0.2 m (B) 0.35 m (C) 0.25 m (D) 0.3 m

**52.** A light wave is incident normally on a glass slab of refractive index 1.5. If 4% of light gets reflected and the amplitude of the electric field of the incident light is 30V/m, then the amplitude of the electric field for the wave propogating in the glass medium will be

(A) 6 V/m (B) 10 V/m (C) 24 V/m (D) 30 V/m

**53.** A long solenoid of radius R carries a time (t) – dependent current $I(t) = 10t(1-t)$. A ring of radius 2R is placed coaxially near its middle. During the time interval the induced current ($I_R$) and the induced EMF($V_R$) in the ring change as:

(A) Direction of $I_R$ remains unchanged and $V_R$ is zero at $t = 0.25$

(B) Direction of $I_R$ remains unchanged and $V_R$ is maximum at $t = 0.5$

(C) At $t = 0.5$ direction of $I_R$ reverses and $V_R$ is zero

(D) At $t = 0.25$ direction of $I_R$ reverses and $V_R$ is maximum

**54.** The electric field of a plane electromagnetic wave is given by $\vec{E} = E_0 \frac{\hat{i}+\hat{j}}{\sqrt{2}} \cos(kz + \omega t)$

At $t = 0$, a positively charged particle is at the point $(x, y, z) = \left(0, 0, \frac{\pi}{k}\right)$. If its instantaneous velocity at $(t = 0)$ is $v_0\hat{k}$, the force acting on it due to the wave is:

(A) Antiparallel to $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

(B) Zero

(C) Parallel to $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

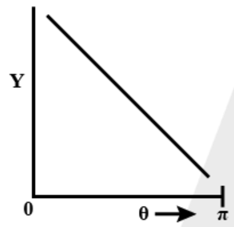
(D) Parallel to $\hat{k}$

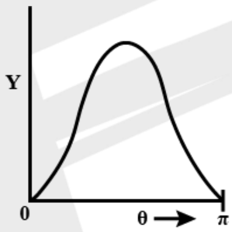
**55.** The graph which depicts the results of Rutherford gold foil experiment with α-particle is

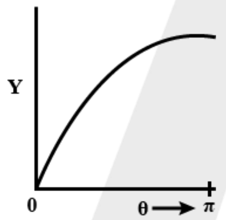
θ : Scattering angle

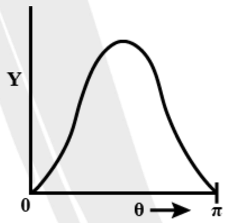
Y: Number of scattered α-particles detected

(Plots are schematic and not to scale)

(A)



(B)



(C)



(D)



**56.** The electric fields of two plane electromagnetic plane waves in vacuum are given by

$\bar{E}_1 = E_0\hat{j}\cos(\omega t - kx)$ and $\bar{E}_2 = E_0\hat{k}\cos(\omega t - ky)$

At $t = 0$, a particle of charge q is at origin with a velocity $\vec{v} = 0.8c\hat{j}$ ( c is the speed of light in vaccum). The instantaneous force experienced by the particle is:

(A) $E_0q(0.4\hat{i} - 3\hat{j} + 0.8\hat{k})$

(B) $E_0q(-0.8\hat{i} + \hat{j} + \hat{k})$

(C) $E_0q(0.8\hat{i} + \hat{j} + 0.2\hat{k})$

(D) $E_0q(0.8\hat{i} - \hat{j} + 0.4\hat{k})$

**57.** A plane electromagnetic wave is propagating along the direction $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$, with its polarization along the direction $\hat{k}$. The correct form of the magnetic field of the wave would be (here $B_0$ is an appropriate constant)

(A) $B_0 \frac{\hat{i}-\hat{j}}{\sqrt{2}} \cos \left(\omega t - k\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$ (B) $B_0 \hat{k} \cos \left(\omega t - k\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$

(C) $B_0 \frac{\hat{i}+\hat{j}}{\sqrt{2}} \cos \left(\omega t - k\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$ (D) $B_0 \frac{\hat{j}-\hat{i}}{\sqrt{2}} \cos \left(\omega t + k\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$

**58.** A plane electromagnetic wave, has frequency of $2.0 \times 10^{10}$ Hz and its energy density is $1.02 \times 10^{-8}\ \mathrm{J/m^3}$ in vacuum. The amplitude of the magnetic field of the wave is close to $\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \frac{\mathrm{Nm^2}}{\mathrm{C^2}}\right.$ and speed of light $= 3 \times 10^8\ \mathrm{ms^{-1}}$)

(A) 190nT (B) 160nT (C) 150nT (D) 180nT

**59.** Magnetic materials used for making permanent magnets (P) and magnets in a transformer (T) have different properties of the following, which property best matches for the type of magnet required?

(A) T : Large retentivity, small coercivity (B) P : Large retentivity, large coercivity

(C) P : Small retentivity, large coercivity (D) T : Large retentivity, large coercivity

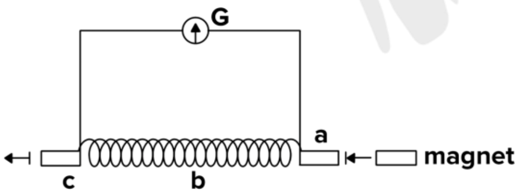
**60.** The fractional change in the magnetic field intensity at a distance ' $r$ ' from centre on the axis of current carrying coil of radius ' $a$ ' to the magnetic field intensity at the centre of the same coil is: (Take $r < a$ ).

(A) $\frac{3}{2}\frac{r^2}{a^2}$ (B) $\frac{2}{3}\frac{a^2}{t^2}$ (C) $\frac{2}{3}\frac{r^2}{a^2}$ (D) $\frac{3}{2}\frac{a^2}{r^2}$

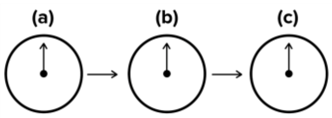
**61.** A paramagnetic sample shows a net magnetisation of 6Am when it is placed in an external magnetic field of 0.4 T at a temperature of 4 K. When the sample is placed in an external magnetic field of 0.3 T at a temperature of 24 K, then the magnetisation will be

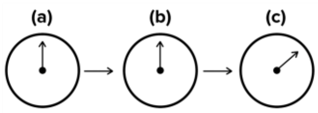
(A) 1 A/m (B) 0.75Am (C) 4 A/m (D) 2.25Am

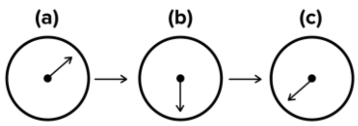
**62.** A small bar magnet is moved through a coil at constant speed from one end to the other. Which of the following series of observations will be seen on the galvanometer G attached across the coil?

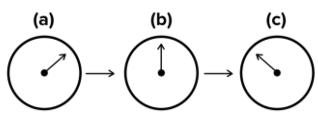



Three positions shown describe: (a) the magnet's entry (b) magnet is completely inside and (c) magnet's exit.

(A) 


(B) 


(C) 


(D) 

**63.** The correct match between the entries in column I and column II are

| | I | | II |
|---|---|---|---|
| | Radiation | | Wavelength |
| (a) | Microwave | (i) | 100 m |
| (b) | Gamma rays | (ii) | $10^{-15}$ m |
| (c) | A.M. radio waves | (iii) | $10^{-10}$ m |
| (d) | $X$ = rays | (iv) | $10^{-3}$ m |

(A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(B) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)
(C) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
(D) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

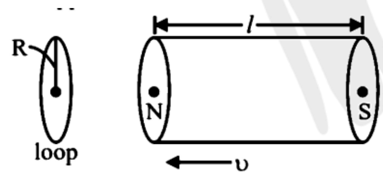
**64.** An electron is constrained to move along the $y$-axis with a speed of 0.1c ( c is the speed of light) in the presence of electromagnetic wave, whose electric field is $\vec{E} = 30\hat{j}\sin(1.5 \times 10^7 t - 5 \times 10^{-2} x)$ V/m. The maximum magnetic force experienced by the electron will be (given $c = 3 \times 10^8\ ms^{-1}$ and electron charge $= 1.6 \times 10^{-19}$C )

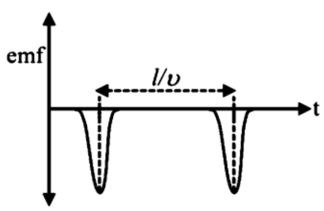
(A) $4.8 \times 10^{-19}$ N
(B) $2.4 \times 10^{-18}$ N
(C) $3.2 \times 10^{-18}$ N
(D) $1.6 \times 10^{-19}$ N

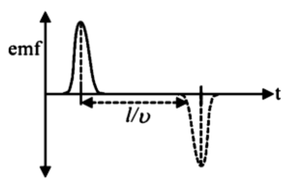
**65.** A circuit to verify Ohm's law uses ammeter and voltmeter in series or parallel connected correctly to the resistor. In the circuit

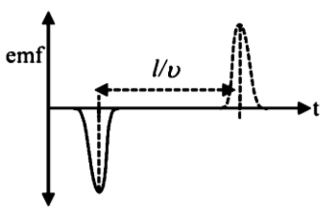
(A) Ammeter is always connected in series and voltmeter in parallel
(B) Both ammeter and voltmeter must be connected in parallel
(C) Ammeter is always used in parallel and voltmeter is series
(D) Both ammeter and voltmeter must be connected in series

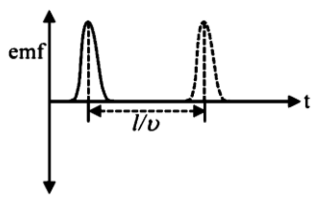
**66.** A bar magnet is passing through a conducting loop of radius R with velocity v. The radius of the bar magnet is such that it just passes through the loop. The induced e.m.f. in the loop can be represented by the approximate curve:




(A) 


(B) 


(C) 


(D) 

**67.** Choose the incorrect statement:

(a) The electric lines of force entering into a Gaussian surface provide negative flux.

(b) A charge ' q ' is placed at the centre of a cube. The flux through all the faces will be the same.

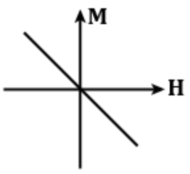
(c) In a uniform electric field net flux through a closed Gaussian surface containing no net charge, is zero.

(d) When electric field is parallel to a Gaussian surface, it provides a finite non-zero flux.

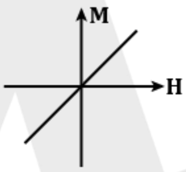
Choose the most appropriate answer from the options given below:

(A) (d) Only
(B) (c) and (d) Only
(C) (a) and (c) Only
(D) (b) and (d) Only

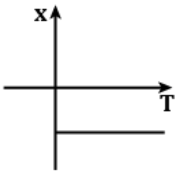
**68.** Following plots show Magnetization (M) vs Magnetising field (H) and Magnetic susceptibility $\chi$ vs Temperature (T) graph:



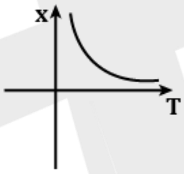

(a)




(b)




(c)




(d)

Which of the following combination will be represented by a diamagnetic material?

(A) (a), (d)
(B) (b), (c)
(C) (b), (d)
(D) (a), (c)

**69.** Electric field of a plane electromagnetic wave propagating through a non-magnetic medium is given by $E = 20\cos(2 \times 10^{10} t - 200x) V/m$. The dielectric constant of the medium is equal to: (Take $\mu_r = 1$)

(A) $\frac{1}{3}$
(B) 9
(C) 3
(D) 2

**70.** A soft ferromagnetic material is placed in an external magnetic field. The magnetic domains:

(A) decrease in size and changes orientation.

(B) may increase or decrease in size and change its orientation.

(C) increase in size but no change in orientation.

(D) have no relation with external magnetic field

**71.** In a ferromagnetic material, below the curie temperature, a domain is defined as:

(A) a macroscopic region with randomly oriented magnetic dipoles.

(B) a macroscopic region with consecutive magnetic dipoles oriented in opposite direction.

(C) a macroscopic region with saturation magnetization.

(D) a macroscopic region with zero magnetization.

**72.** Choose the correct option

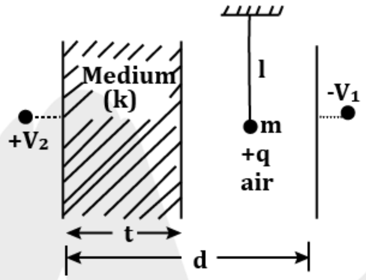
(A) True dip is always equal to apparent dip.

(B) True dip is not mathematically related to apparent dip.

(C) True dip is less than the apparent dip

(D) True dip is always greater than the apparent dip.

**73.** A simple pendulum of mass ' m ', length ' l and charge ' +q ' suspended in the electric field produced by two conducting parallel plates as shown. The value of deflection of pendulum in equilibrium position will be



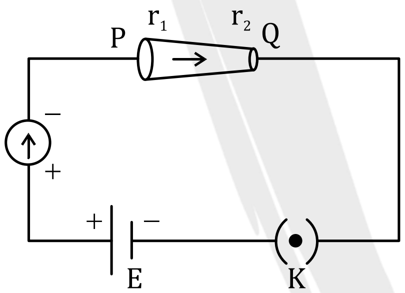

(A) $\tan^{-1}\left[\frac{q}{mg}\times\frac{C_2(V_2-V_1)}{(C_1+C_2)(d-t)}\right]$

(B) $\tan^{-1}\left[\frac{q}{mg}\times\frac{C_1(V_2-V_1)}{(C_1+C_2)(d-t)}\right]$

(C) $\tan^{-1}\left[\frac{q}{mg}\times\frac{C_1(V_1+V_2)}{(C_1+C_2)(d-t)}\right]$

(D) $\tan^{-1}\left[\frac{q}{mg}\times\frac{C_2(V_1+V_2)}{(C_1+C_2)(d-t)}\right]$

**74.** In the given figure, a battery of emf E is connected across a conductor PQ of length l and different area of cross-sections having radii $r_1$ and $r_2 (r_2 < r_1)$.




Choose the correct option as one moves from P to Q

(A) All of these

(B) Electron current decreases

(C) Electric field decreases

(D) Drift velocity of electron increases

**75.** Which of the following statements are correct?

(A) Electric monopoles do not exist whereas magnetic monopoles exist.

(B) Magnetic field lines due to a solenoid at its ends and outside cannot be completely straight and confined.

(C) Magnetic field lines are completely confined within a toroid.

(D) Magnetic field lines inside a bar magnet are not parallel.

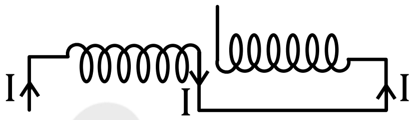
(E) $x = -1$ is the condition for a perfect diamagnetic material, where x is its magnetic susceptibility.

Choose the correct answer from the options given below:

(A) (C) and (E) only
(B) (B) and (C) only
(C) (B) and (D) only
(D) (A) and (B) only

**76.** The peak electric field produced by the radiation coming from the 8 W bulb at a distance of 10 m is $\frac{x}{10}\sqrt{\frac{\mu_0 c}{\pi}}\frac{V}{m}$. The efficiency of the bulb is 10% and it is a point source. The value of x is

**77.** Two coils of self inductance $L_1$ and $L_2$ are connected in series combination having mutual inductance of the coils as $M$. The equivalent self inductance of the combination will be:




(A) $\frac{1}{L}+\frac{1}{L_2}+\frac{1}{M}$
(B) $L_1+L_2+M$
(C) $L_1+L_2+2M$
(D) $L_1+L_2-2M$

**78.** If electric field intensity of a uniform plane electromagnetic wave is given as

$E=-301.6\sin(kz-\omega t)\hat{a}_x+452.4\sin(kz-\omega t)\hat{a}_y\frac{V}{m}$.

Then, magnetic intensity ' H ' of this wave in $Am^{-1}$ will be :

[Given: Speed of light in vacuum $c=3\times10^8\ ms^{-1}$, Permeability of vacuum $\mu=4\pi\times10^{-7}NA^{-2}$ ]

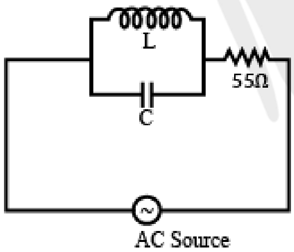
(A) $+0.8\sin(kz-\omega t)\hat{a}_y+0.8\sin(kz-\omega t)\hat{a}_x$.

(B) $+1.0\times10^{-6}\sin(kz-\omega t)\hat{a}_y+1.5\times10^{-6}(kz-\omega t)\hat{a}_x$

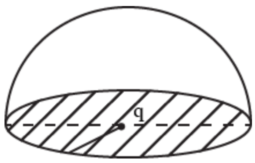
(C) $-0.8\sin(kz-\omega t)\hat{a}_y-1.2\sin(kz-\omega t)\hat{a}_x$

(D) $-1.0\times10^{-6}\sin(kz-\omega t)\hat{a}_y-1.5\times10^{-6}\sin(kz-\omega t)\hat{a}_x$

**79.** A 110 V, 50 Hz, AC source is connected in the circuit (as shown in figure). The current through the resistance 55Ω, at resonance in the circuit, will be A.




**80.** If a charge $q$ is placed at the centre of a closed hemispherical non-conducting surface, the total flux passing through the flat surface would be:

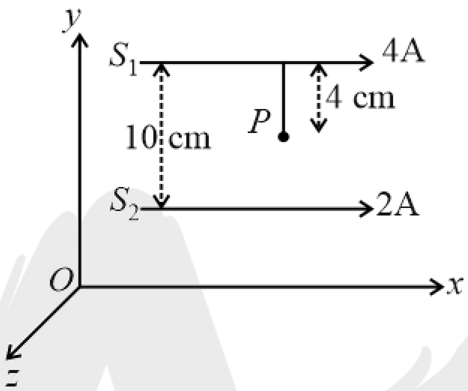



(A) $\frac{q}{\varepsilon_0}$
(B) $\frac{q}{2\varepsilon_0}$
(C) $\frac{q}{4\varepsilon_0}$
(D) $\frac{q}{2\pi\varepsilon_0}$

**81.** Two long parallel conductors $S_1$ and $S_2$ are separated by a distance 10 cm and carrying currents of 4 A and 2 A respectively. The conductors are placed along x-axis in $X-Y$ plane. There is a point P located between the conductors (as shown in figure).

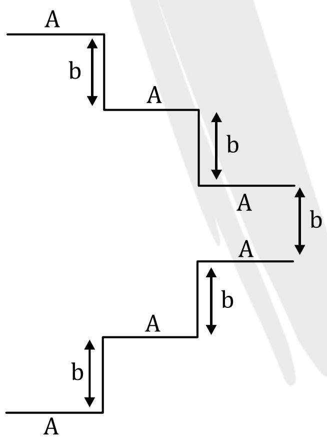
A charge particle of $3\pi$ coulomb is passing through the point P with velocity $\vec{v} = (2\hat{i} + 3\hat{j})$m/s; where $\hat{i}$ and $\hat{j}$ represents unit vector along x&y axis respectively.

The force acting on the charge particle is $4\pi \times 10^{-5}(-x\hat{i} + 2\hat{j})$N. The value of x is:



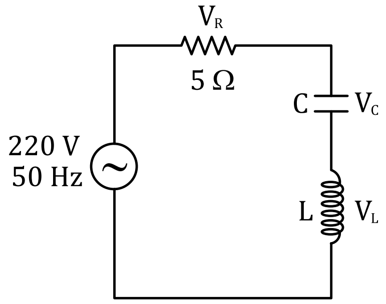

(A) 2 (B) 1 (C) 3 (D) -3

**82.** A parallel plate capacitor is made up of stair like structure with a plate area A of each stair and that is connected with a wire of length b, as shown in the figure. The capacitance of the arrangement is $\frac{x}{15}\frac{\varepsilon_0 A}{b}$, the value of x is?

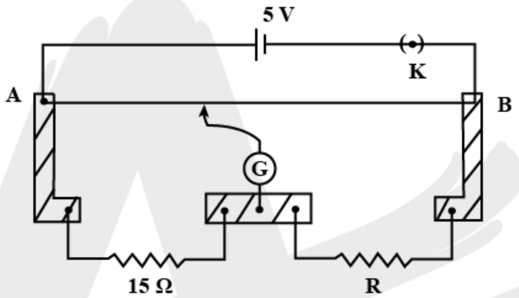



**83.** A cell, shunted by a $8\Omega$ resistance, is balanced across a potentiometer wire of length 3 m. The balancing length is 2 m when the cell is shunted by $4\Omega$ resistance. The value of internal resistance of the cell will be $\Omega$.

**84.** In the given circuit, the magnitude of $V_L$ and $V_C$ are twice that of $V_R$. Given that $f = 50$ Hz, the inductance of the coil is $\frac{1}{K\pi}$mH. The value of K is (Answer to nearest integer)




**85.** A meter bridge setup is shown in the figure. It is used to determine an unknown resistance $R$ using a given resistor of 15Ω. The galvanometer (G) shows null deflection when tapping key is at 43 cm mark from end $A$. If the end correction for end $A$ is 2 cm, then the determined value of $R$ will be Ω.




**86.** Two coils require 20 minutes and 60 minutes respectively to produce same amount of heat energy when connected separately to the same source. If they are connected in parallel arrangement to the same source; the time required to produce same amount of heat by the combination of coils, will be min.

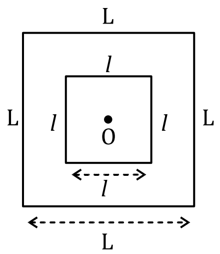
**87.** A plane electromagnetic waves travels in a medium of relative permeability 1.61 and relative permittivity 6.44. If magnitude of magnetic intensity is $4.5 \times 10^{-2}\,\mathrm{Am^{-1}}$ at a point, what will be the approximate magnitude of electric field intensity at that point?

(Given: Permeability of free space $\mu_0 = 4\pi \times 10^{-7}\,\mathrm{NA^{-2}}$, speed of light in vacuum $c = 3 \times 10^8\ \mathrm{ms^{-1}}$ )

(A) $16.96\,\mathrm{Vm^{-1}}$ (B) $2.25 \times 10^{-2}\,\mathrm{Vm^{-1}}$

(C) $8.48\,\mathrm{Vm^{-1}}$ (D) $6.75 \times 10^{6}\,\mathrm{Vm^{-1}}$

**88.** A small square loop of wire of side f is placed inside a large square loop of wire L(L ≫ l). Both loops are, coplanar and their centres coincide at point O as shown in figure. The mutual inductance of the system is:

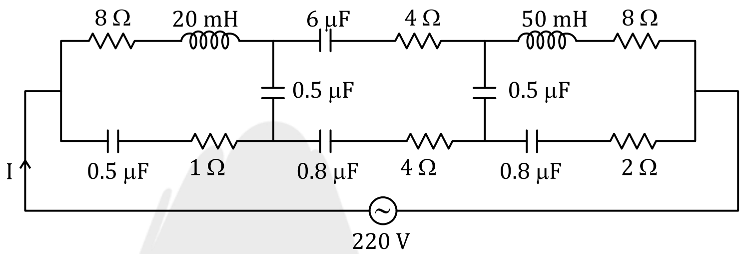


(A) $\frac{2\sqrt{2}\mu_0 L^2}{\pi/}$ (B) $\frac{\mu_0 l^2}{2\sqrt{2}\pi L}$ (C) $\frac{2\sqrt{2}\mu_0 l^2}{\pi L}$ (D) $\frac{\mu_0 L^2}{2\sqrt{2}\pi/}$

**89.** Two uniformly charged spherical conductors A and B of radii 5 mm and 10 mm are separated by a distance of 2 cm. If the spheres are connected by a conducting wire, then in equilibrium condition, the ratio of the magnitude of the electric fields at the surface of the sphere A and B will be

(A) 1: 2 (B) 2: 1 (C) 1: 1 (D) 1: 4

**90.** The effective current I in the given circuit at very high frequencies will be ______ A.



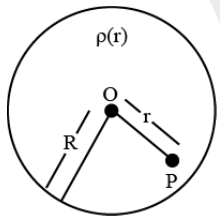

**91.** A conducting circular loop is placed in $X - Y$ plane in presence of magnetic field $\vec{B} = (3t^3\hat{j} + 3t^2\hat{k})$ in SI unit. If the radius of the loop is 1 m, the induced emf in the loop, at time $t = 2$ s is $n\pi V$. The value of n is

**92.** A capacitor of capacitance 500μF is charged completely using a dc supply of 100 V. It is now connected to an inductor of inductance 50mH to form an LC circuit. The maximum current in the LC circuit will be A.

**93.** A spherically symmetric charge distribution is considered with charge density varying as

$$\rho(r) = \begin{cases} \rho_0\left(\frac{3}{4} - \frac{r}{R}\right) & \text{for } r \leq R \\ \text{zero} & \text{for } r > R \end{cases}$$

Where, $r(r < R)$ is the distance from the centre O (as shown in figure) The electric field at point P will be




(A) $\frac{\rho_0 r}{4\varepsilon_0}\left(\frac{3}{4} - \frac{r}{R}\right)$ (B) $\frac{\rho_0 r}{3\varepsilon_0}\left(\frac{3}{4} - \frac{r}{R}\right)$ (C) $\frac{\rho_0 r}{4\varepsilon_0}\left(1 - \frac{r}{R}\right)$ (D) $\frac{P_0 r}{5\varepsilon_0}\left(1 - \frac{r}{R}\right)$

**94.** Diameter of the objective lens of a telescope is 250 cm. For light of wavelength 600 nm. coming from a distant object, the limit of resolution of the telescope is close to:

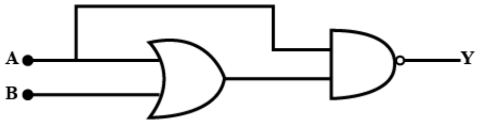
(A) $1.5 \times 10^{-7}$rad (B) $3.0 \times 10^{-7}$rad

(C) $2.0 \times 10^{-7}$rad (D) $4.5 \times 10^{-7}$rad

**95.** A system of three polarizers $P_1, P_2, P_3$ is set up such that the pass axis of $P_3$ is crossed with respect to that of $P_1$. The pass axis of $P_2$ is inclined at $60^\circ C$ to the pass axis of $P_3$. When a beam of unpolarized light of intensity

(A) 1.80 (B) 5.33 (C) 10.67 (D) 16.00

**96.** The truth table for the circuit given in the fig. is:




(A)

| A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

(B)

| A | B | Y |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

(C)

| A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

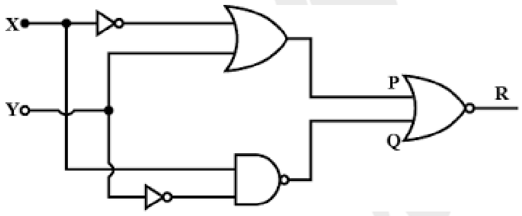
(D)

| A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

**97.** Mobility of electrons in a semiconductor is defined as the ratio of their drift velocity to the applied electric field. If, for an $n$-type semiconductor, the density of electrons is $10^{19}\ m^{-3}$ and their mobility is $1.6\ m^2/(V.s)$ then the resistivity of the semiconductor (since it is an n-type semiconductor contribution of holes is ignored) is close

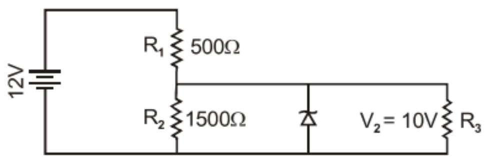
(A) $2\Omega m$ (B) $0.2\Omega m$ (C) $0.4\Omega m$ (D) $4\Omega m$

**98.** To get output ' 1 ' at $R$, for the given logic gate circuit the input values must be



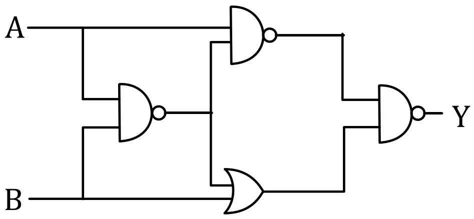

(A) $X = 1, Y = 1$ (B) $X = 0, Y = 0$ (C) $X = 1, Y = 0$ (D) $X = 0, Y = 1$

**99.** In the given circuit the current through Zener Diode is close to




(A) 6.7 mA (B) 0.0 mA (C) 4.0 mA (D) 6.0 mA

**100.** The output of the given logic circuit is:




(A) $A\bar{B} + \bar{A}B$ (B) $A\bar{B}$ (C) $AB + \overline{AB}$ (D) $\bar{A}B$

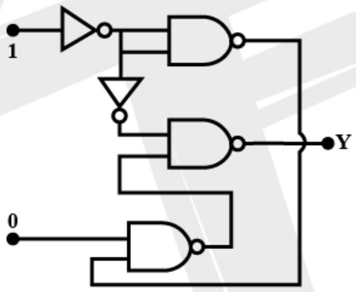
**101.** Visible light of wavelength $6000 \times 10^{-8}$ cm falls normally on a single slit and produces a diffraction pattern. It is found that the second diffraction minimum is at 60° from the central maximum. If the first minimum is produced at $\theta_1$, then $\theta_1$ is close to

(A) 25° (B) 30° (C) 20° (D) 45°

**102.** A polarizer-analyzer set is adjusted such that the intensity of light coming out of the analyser is just 10% of the original intensity. Assuming the polarizer - analyser set does not absorb any light, the angle by which the analyser need to be rotated further to reduced the output intensity to be zero, is

(A) 71.6° (B) 45° (C) 90° (D) 18.4°

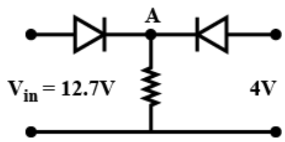
**103.** In the given circuit, value of Y is



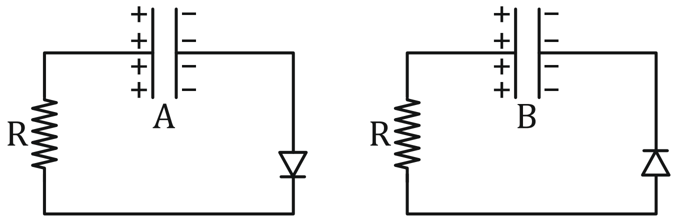

(A) Toggles between 0 and 1 (B) = 0

(C) 1 (D) Will not execute

**104.** Both the diodes used in the circuit shown are assumed to be deal and have negligible resistance when these are forward biased. Built in potential in each diode is: 0.7 V. For the input voltages shown in the figure, the voltage (in Volts) at point A is



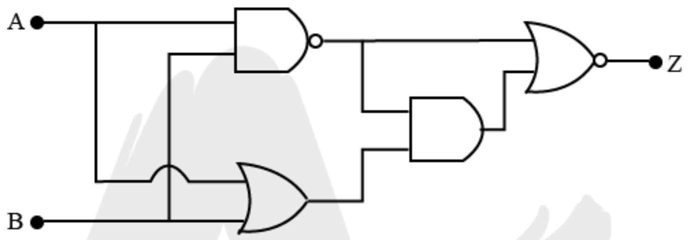

**105.** Two identical capacitors A and B, charged to the same potential 5 V are connected in two different circuits as shown below at time t = 0. If the charge on capacitors A and B at time t = CR is $Q_A$ and $Q_B$ respectively, then (Here e is the base of natural logarithm)




(A) $Q_A = \frac{CV}{2}, Q_B = \frac{VC}{e}$  (B) $Q_A = VC, Q_B = CV$

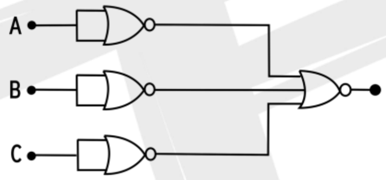
(C) $Q_A = \frac{CV}{e}, Q_B = \frac{VC}{2}$  (D) $Q_A = VC, Q_B = \frac{VC}{e}$

**106.** In the following digital circuit, what will be the output at ' Z ', when the input (A, B) are (1,0), (0,0), (1,1), , (0,1)




(A) 1,1,0,1  (B) 0,0,1,0  (C) 1,0,1,1  (D) 0,1,0,0

**107.** Identify the operation performed by the circuit given below.

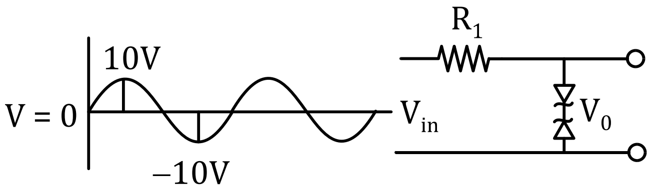


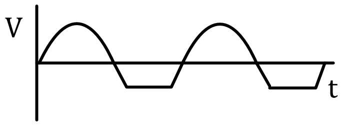

(A) AND  (B) NOT  (C) NAND  (D) OR

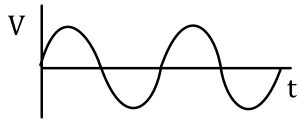
**108.** A beam of plane polarised light of large cross-sectional area and uniform intensity of $3.3 Wm^{-2}$ falls normally on a polariser (cross sectional area $3 \times 10^{-4}$ $m^2$ ) which rotates about its axis with an angular speed of 31.4 rad/s. The energy of light passing through the polariser per revolution, is close to

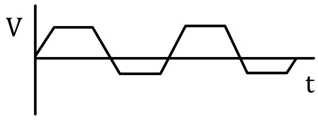
(A) $1.0 \times 10^{-5}$ J  (B) $1.0 \times 10^{-4}$ J  (C) $5.0 \times 10^{-4}$ J  (D) $1.5 \times 10^{-4}$ J

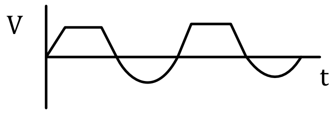
**109.** Take the breakdown voltage of the zener diode used in the given circuit as 6 V. For the input voltage shown in figure below, the time variation of the output voltage is (Graphs drawn are schematic and not to scale)




(A)


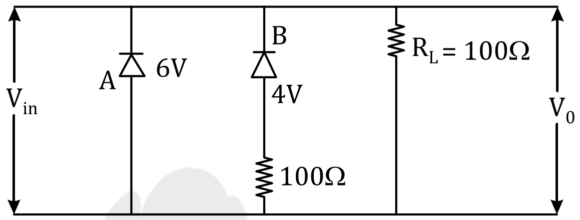

(B)


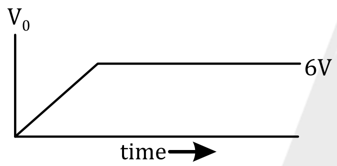
(C) 

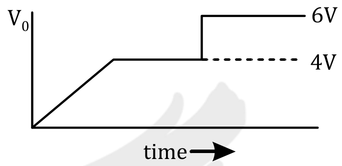

(D) 

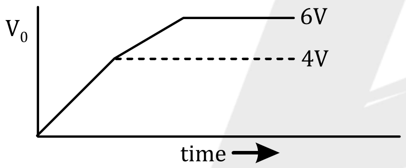

**110.** Two Zener diodes ( A and B ) having breakdown voltages of 6 V and 4 V respectively, are connected as shown in the circuit below. The output voltage $V_0$ variation with input voltage linearly increasing with time, is given by $\left(V_{input} = 0\text{ V at } t = 0\right)$

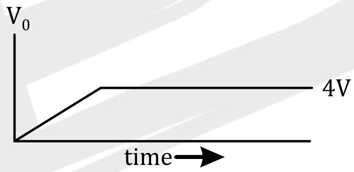
(figures are qualitative)




(A) 


(B) 


(C) 


(D) 


**111.** With increasing biasing voltage of a photodiode, the photocurrent magnitude

(A) Increases initially and after attaining certain value, it decreases

(B) Increases linearly

(C) Increases initially and saturates finally

(D) Remains constant

**112.** Given the masses of various atomic particles $m_p = 1.0072\text{u}, m_n = 1.0087\text{u}, m_e = 0.000548\text{u}$, where $\rho \equiv$ proton, $n \equiv$ neutron, $e \equiv$ electron, $\hat{v} \equiv$ antineutrino and $d \equiv$ deuteron. Which of the following process is allowed by momentum and energy conservation?

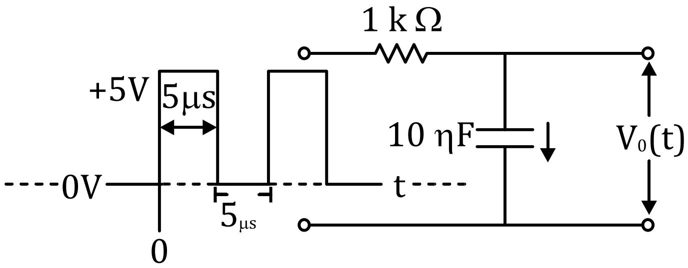
(A) $n + n \rightarrow$ deuterium atom (electron bound to the nucleus)

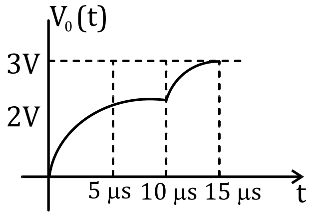
(B) $n + p \rightarrow d + \gamma$

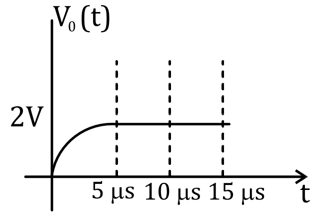
(C) $p \rightarrow n + e^+ + \bar{v}$

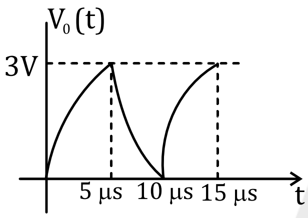
(D) $e^+ + e^- \rightarrow \gamma$

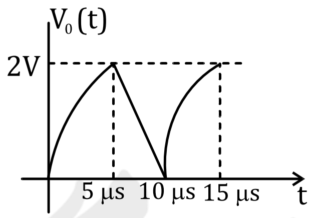
**113.** For the given input voltage waveform $V_{in}(t)$, the output voltage waveform $V_0(t)$, across the capacitor is correctly depicted by



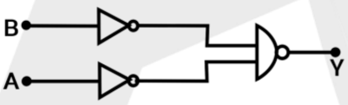

(A)


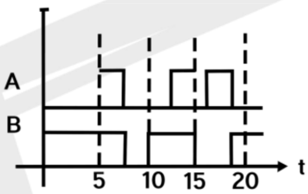

(B)


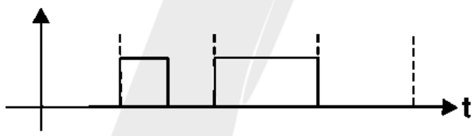

(C)


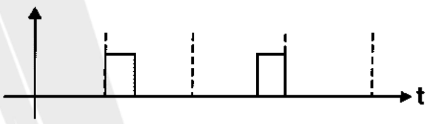

(D)


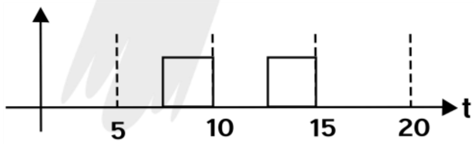

**114.** Identify the correct output signal Y in the given combination of gates (as shown) for the given inputs A and B.

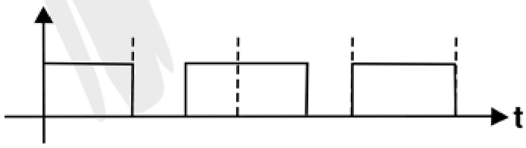


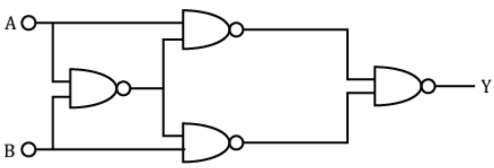

(A)



(B)



(C)



(D)



**115.** Four NOR gates are connected as shown in figure. The truth table for the given figure is:




(A)

| A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

(B)

| A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

(C)

| A | B | Y |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

(D)

| A | B | Y |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

**116.** **Statement I:** By doping silicon semiconductor with pentavalent material, the electrons density increases.

**Statement II:** The n-type semiconductor has net negative charge.

In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both statement I and statement II are true

(B) Both statement l and statement II are false

(C) Statement I is true but statement II is false

(D) Statement I is false but statement II is true

**117.** In a photoelectric experiment, increasing the intensity of incident light:

(A) Increases the frequency of photons incident and the K.E. of the ejected electrons remains unchanged.

(B) Increases the frequency of photons incident and increases the K.E. of the ejected electrons.

(C) Increases the number of photons incident and also increases the K.E. of the ejected electrons.

(D) Increases the number of photons incident and the K.E. of the ejected electrons remains unchanged.

**118.** **Statement I:** To get a steady dc output from the pulsating voltage received from a full wave rectifier we can connect a capacitor across the output parallel to the load $R_L$.

**Statement II:** To get a steady dc output from the pulsating voltage received from a full wave rectifier we can connect an inductor in series with $R_L$.

In the light of the above statements, choose the most appropriate answer from the options given below:

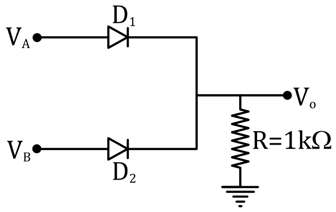
(A) Both statement I and statement II are true

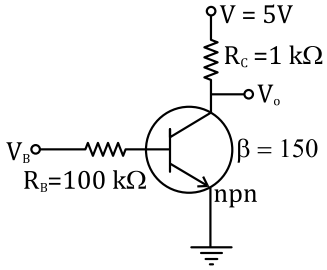
(B) Statement I is false but statement II is true

(C) Both statement I and statement ll are false

(D) Statement I is true but statement II is false

**119.** If $V_A$ and $V_B$ are the input voltages (either 5 V or 0 V ) and $V_O$ is the output voltage then the two gates represented in the following circuits (A) and (B) are:

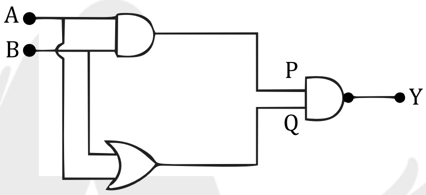



(A) NAND and NOR Gate (B) AND and OR Gate

(C) OR and NOT Gate (D) AND and NOT Gate

**120.** In the following logic circuit the sequence of the inputs A, B are (0,0), (0,1), (1,0) and (1,1). The output Y for this sequence will be:




(A) 0,1,0,1 (B) 0,0,1,1 (C) 1,0,1,0 (D) 1,1,1,0

## Answer key

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** | (D) | **2.** | (B) | **3.** | (D) | **4.** | (D) | **5.** | (D) | **6.** | (C) | **7.** | (C) |
| **8.** | (A) | **9.** | (D) | **10.** | (B) | **11.** | (A) | **12.** | (B) | **13.** | (B) | **14.** | (D) |
| **15.** | (C) | **16.** | (C) | **17.** | (A) | **18.** | (C) | **19.** | (D) | **20.** | (A) | **21.** | (D) |
| **22.** | (D) | **23.** | (D) | **24.** | 25 | **25.** | (A) | **26.** | (C) | **27.** | (C) | **28.** | 03 |
| **29.** | (A) | **30.** | 10 | **31.** | 3 | **32.** | (B) | **33.** | 06 | **34.** | (B) | **35.** | (C) |
| **36.** | (A) | **37.** | (B) | **38.** | (D) | **39.** | (B) | **40.** | (A) | **41.** | (D) | **42.** | (C) |
| **43.** | (D) | **44.** | (A) | **45.** | (A) | **46.** | (A) | **47.** | (B) | **48.** | (C) | **49.** | (B) |
| **50.** | (D) | **51.** | (C) | **52.** | (C) | **53.** | (C) | **54.** | (A) | **55.** | (D) | **56.** | (C) |
| **57.** | (A) | **58.** | (B) | **59.** | (B) | **60.** | (A) | **61.** | (B) | **62.** | (D) | **63.** | (B) |
| **64.** | (A) | **65.** | (A) | **66.** | (C) | **67.** | (A) | **68.** | (D) | **69.** | (B) | **70.** | (B) |
| **71.** | (C) | **72.** | (C) | **73.** | (D) | **74.** | (D) | **75.** | (C) | **76.** | 02 | **77.** | (D) |
| **78.** | (C) | **79.** | 0 | **80.** | (B) | **81.** | (C) | **82.** | 23 | **83.** | 8 | **84.** | 0 |
| **85.** | 19 | **86.** | 15 | **87.** | (C) | **88.** | (C) | **89.** | (B) | **90.** | 44 | **91.** | 12 |
| **92.** | 10 | **93.** | (C) | **94.** | (B) | **95.** | (C) | **96.** | (D) | **97.** | (C) | **98.** | (C) |
| **99.** | (B) | **100.** | (B) | **101.** | (A) | **102.** | (D) | **103.** | (B) | **104.** | 12 | **105.** | (D) |
| **106.** | (B) | **107.** | (A) | **108.** | (B) | **109.** | (C) | **110.** | (C) | **111.** | (C) | **112.** | (B) |
| **113.** | (A) | **114.** | none | **115.** | (A) | **116.** | (C) | **117.** | (D) | **118.** | (A) | **119.** | (C) |
| **120.** | (D) | | | | | | | | | | | | |