NEET 2022

SOLVED PAPER

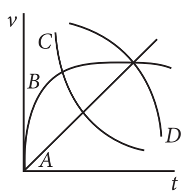
SECTION - A

1. A square loop of side 1 m and resistance 1 Ω is placed in a magnetic field of 0.5 T. If the plane of loop is perpendicular to the direction of magnetic field, the magnetic flux through the loop is
(a) 2 weber (b) 0.5 weber
(c) 1 weber (d) zero weber

2. When light propagates through a material medium of relative permittivity ε_r and relative permeability μ_r, the velocity of light, v is given by (c-velocity of light in vacuum)
(a) $v = c$ (b) $v = \sqrt{\frac{\mu_r}{\varepsilon_r}}$
(c) $v = \sqrt{\frac{\varepsilon_r}{\mu_r}}$ (d) $v = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$

3. When two monochromatic light of frequency, υ and $\frac{\upsilon}{2}$ are incident on a photoelectric metal, their stopping potential becomes $\frac{V_s}{2}$ and V_s respectively. The threshold frequency for this metal is
(a) 2υ (b) 3υ (c) $\frac{2}{3}\upsilon$ (d) $\frac{3}{2}\upsilon$

4. A spherical ball is dropped in a long column of a highly viscous liquid. The curve in the graph shown, which represents the speed of the ball (v) as a function of time (t) is



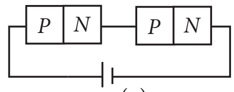
(a) A (b) B
(c) C (d) D

5. Given below are two statements :
Statement I : Biot-Savart's law gives us the expression for the magnetic field strength of an infinitesimal current element (Idl) of a current carrying conductor only.
Statement II : Biot-Savart's law is analogous to Coulomb's inverse square law of charge q, with the former being related to the field produced by a scalar source, Idl while the latter being produced by a vector source, q.
In light of above statements choose the most appropriate answer from the options given below.
(a) Both Statement I and Statement II are correct.
(b) Both Statement I and Statement II are incorrect.
(c) Statement I is correct and Statement II is incorrect.
(d) Statement I is incorrect and Statement II is correct.

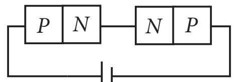
6. As the temperature increases, the electrical resistance
(a) increases for both conductors and semiconductors
(b) decreases for both conductor and semiconductors
(c) increases for conductors and but decreases for semiconductors
(d) decreases for conductors but increases for semiconductors.

7. Two resistors of resistance, 100 Ω and 200 Ω are connected in parallel in an electrical circuit. The ratio of the thermal energy developed in 100 Ω to that in 200 Ω in a given time is
(a) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1

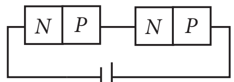
8.



(a)



(b)

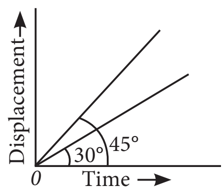


(c)

In the given circuits (a), (b) and (c), the potential drop across the two p-n junctions are equal in
(a) Circuit (a) only (b) Circuit (b) only
(c) Circuit (c) only (d) Both circuits (a) and (c)

9. The peak voltage of the ac source is equal to
(a) the value of voltage supplied to the circuit
(b) the rms value of the source
(c) $\sqrt{2}$ times the rms value of the ac source
(d) $1/\sqrt{2}$ times the rms value of the ac source.

10. The displacement-time graphs of two moving particles make angles of 30° and 45° with the x-axis as shown in the figure. The ratio of their respective velocity is



(a) $\sqrt{3}:1$ (b) 1 : 1
(c) 1 : 2 (d) $1:\sqrt{3}$

11. The angle between the electric lines of force and the equipotential surface is
(a) 0° (b) 45° (c) 90° (d) 180°

12. The dimensions $[MLT^{-2}A^{-2}]$ belong to the
(a) magnetic flux (b) self inductance
(c) magnetic permeability
(d) electric permittivity

13. If a soap bubble expands, the pressure inside the bubble
(a) decreases (b) increases
(c) remains the same
(d) is equal to the atmospheric pressure

14. The energy that will be ideally radiated by a 100 kW transmitter in 1 hour is
(a) 36×10^7 J (b) 36×10^4 J
(c) 36×10^5 J (d) 1×10^5 J

15. In half wave rectification, if the input frequency is 60 Hz, then the output frequency would be
(a) zero (b) 30 Hz (c) 60 Hz (d) 120 Hz

16. Two objects of mass 10 kg and 20 kg respectively are connected to the two ends of a rigid rod of length 10 m with negligible mass. The distance of the center of mass of the system from the 10 kg mass is
(a) $\frac{10}{3}$ m (b) $\frac{20}{3}$ m (c) 10 m (d) 5 m

17. Match List-I with List-II.

List-I (Electromagnetic waves)	**List-II (Wavelength)**
(A) AM radio waves	(i) 10^{-10} m
(B) Microwaves	(ii) 10^2 m
(C) Infrared radiations	(iii) 10^{-2} m
(D) X-rays	(iv) 10^{-4} m

Choose the correct answer from the options given below.
(a) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)
(b) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)
(c) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
(d) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)

18. An electric lift with a maximum load of 2000 kg (lift + passengers) is moving up with a constant speed of 1.5 m s^{-1}. The frictional force opposing the motion is 3000 N. The minimum power delivered by the motor to the lift in watts is (g = 10 m s^{-2})
(a) 23000 (b) 20000 (c) 34500 (d) 23500

19. In a Young's double slit experiment, a student observes 8 fringes in a certain segment of screen when a monochromatic light of 600 nm wavelength is used. If the wavelength of light is changed to 400 nm, then the number of fringes he would observe in the same region of the screen is
(a) 6 (b) 8 (c) 9 (d) 12

20. Two hollow conducting spheres of radii R_1 and R_2 ($R_1 >> R_2$) have equal charges. The potential would be
(a) more on bigger sphere
(b) more on smaller sphere
(c) equal on both the spheres
(d) dependent on the material property of the sphere.

21. In the given nuclear reaction, the element X is
$${}^{22}_{11}\text{Na} \rightarrow X + e^{+} + \upsilon$$
(a) ${}^{23}_{11}\text{Na}$ (b) ${}^{23}_{10}\text{Ne}$ (c) ${}^{22}_{10}\text{Ne}$ (d) ${}^{22}_{12}\text{Mg}$

22. The ratio of the radius of gyration of a thin uniform disc about an axis passing through its centre and normal to its plane to the radius of gyration of the disc about its diameter is
(a) 2 : 1 (b) $\sqrt{2}:1$ (c) 4 : 1 (d) $1:\sqrt{2}$

23. Let T_1 and T_2 be the energy of an electron in the first and second excited states of hydrogen atom, respectively. According to the Bohr's model of an atom, the ratio $T_1 : T_2$ is
(a) 1 : 4 (b) 4 : 1 (c) 4 : 9 (d) 9 : 4

24. A light ray falls on a glass surface of refractive index $\sqrt{3}$, at an angle 60°. The angle between the refracted and reflected rays would be
(a) 30° (b) 60° (c) 90° (d) 120°

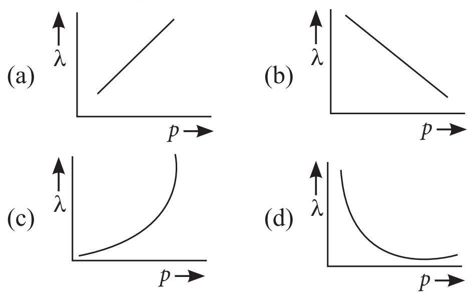
25. A copper wire of length 10 m and radius $(10^{-2}/\sqrt{\pi})$ m has electrical resistance of 10 Ω. The current density in the wire for an electric field strength of 10 V/m is
(a) 10^4 A/m^2 (b) 10^6 A/m^2
(c) 10^{-5} A/m^2 (d) 10^5 A/m^2

26. A biconvex lens has radii of curvature, 20 cm each. If the refractive index of the material of the lens is 1.5, the power of the lens is
(a) +2 D (b) +20 D (c) +5 D (d) infinity.

27. A long solenoid of radius 1 mm has 100 turns per mm. If 1 A current flows in the solenoid, the magnetic field strength at the centre of the solenoid is
(a) 6.28×10^{-2} T (b) 12.56×10^{-2} T
(c) 12.56×10^{-4} T (d) 6.28×10^{-4} T

28. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is
(a) 0.05 N/kg (b) 50 N/kg
(c) 20 N/kg (d) 180 N/kg

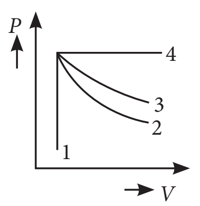
29. The graph which shows the variation of the de-Broglie wavelength (λ) of a particle and its associated momentum (p) is



30. The ratio of the distances travelled by a freely falling body in the 1st, 2nd, 3rd and 4th second
(a) 1 : 2 : 3 : 4 (b) 1 : 4 : 9 : 16
(c) 1 : 3 : 5 : 7 (d) 1 : 1 : 1 : 1

31. The angular speed of a fly wheel moving with uniform angular acceleration changes from 1200 rpm to 3120 rpm in 16 seconds. The angular acceleration in rad/s^2 is
(a) 2π (b) 4π (c) 12π (d) 104π

32. An ideal gas undergoes four different processes from the same initial state as shown in the figure below. Those processes are adiabatic, isothermal, isobaric and isochoric. The curve which represents the adiabatic process among 1, 2, 3 and 4 is



(a) 1 (b) 2 (c) 3 (d) 4

33. If the initial tension on a stretched string is doubled, then the ratio of the initial and final speeds of a transverse wave along the string is
(a) 1 : 1 (b) $\sqrt{2}:1$ (c) $1:\sqrt{2}$ (d) 1 : 2

34. Plane angle and solid angle have
(a) Units but no dimensions
(b) Dimensions but no units
(c) No units and no dimensions
(d) Both units and dimensions

35. A shell of mass m is at rest initially. It explodes into three fragments having mass in the ratio 2 : 2 : 1. If the fragments having equal mass fly off along mutually perpendicular directions with speed v, the speed of the third (lighter) fragment is
(a) v (b) $\sqrt{2}v$ (c) $2\sqrt{2}v$ (d) $3\sqrt{2}v$

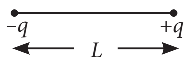
SECTION - B

Attempt any 10 questions out of 15.

36. The area of a rectangular field (in m^2) of length 55.3 m and breadth 25 m after rounding off the value for correct significant digits is
(a) 138×10^1 (b) 1382
(c) 1382.5 (d) 14×10^2

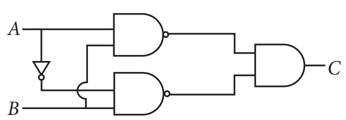
37. A big circular coil of 1000 turns and average radius 10 m is rotating about its horizontal diameter at 2 rad s^{-1}. If the vertical component of earth's magnetic field at that place is 2×10^{-5} T and electrical resistance of the coil is 12.56 Ω, then the maximum induced current in the coil will be
(a) 0.25 A (b) 1.5 A (c) 1 A (d) 2 A

38. Two point charges $-q$ and $+q$ are placed at a distance of L, as shown in the figure. The magnitude of electric field intensity at a distance $R(R >> L)$ varies as



(a) $\frac{1}{R^2}$ (b) $\frac{1}{R^3}$ (c) $\frac{1}{R^4}$ (d) $\frac{1}{R^6}$

39.



The truth table for the given logic circuit is

(a)

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

(b)

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

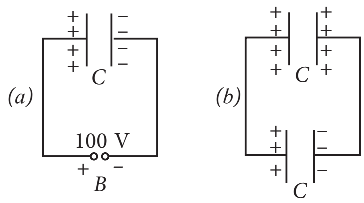
(c)

A	B	C
0	0	1
0	1	0
1	0	1
1	1	0

(d)

A	B	C
0	0	0
0	1	1
1	0	0
1	1	1

40. A capacitor of capacitance $C = 900$ pF is charged fully by 100 V battery B as shown in figure (a). Then it is disconnected from the battery and connected to another uncharged capacitor of capacitance $C = 900$ pF as shown in figure (b). The electrostatic energy stored by the system (b) is

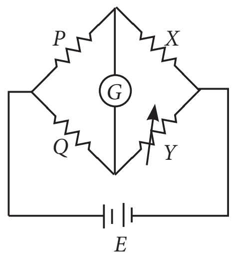


(a) 4.5×10^{-6} J (b) 3.25×10^{-6} J
(c) 2.25×10^{-6} J (d) 1.5×10^{-6} J

41. Two transparent media A and B are separated by a plane boundary. The speed of light in those media are 1.5×10^8 m/s and 2.0×10^8 m/s respectively. The critical angle for a ray of light for these two media is
(a) $\sin^{-1}(0.500)$ (b) $\sin^{-1}(0.750)$
(c) $\tan^{-1}(0.500)$ (d) $\tan^{-1}(0.750)$

42. A ball is projected with a velocity, 10 m s^{-1}, at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be
(a) zero (b) $5\sqrt{3}$ m s^{-1}
(c) 5 m s^{-1} (d) 10 m s^{-1}

43. A wheatstone bridge is used to determine the value of unknown resistance X by adjusting the variable resistance Y as shown in the figure. For the most precise measurement of X, the resistances P and Q



(a) should be approximately equal to $2X$.
(b) should be approximately equal and are small
(c) should be very large and unequal
(d) do not play any significant role

44. Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The stretching of a spring is determined by the shear modulus of the material of the spring.
Reason (R) : A coil spring of copper has more tensile strength than a steel spring of same dimensions.
In the light of the above statements, choose the most appropriate answer from the options given below :
(a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.

45. A series LCR circuit with inductance 10 H, capacitance 10 μF, resistance 50 Ω is connected to an ac source of voltage, $V = 200\sin(100t)$ volt. If the resonant frequency of the LCR circuit is υ_0 and the frequency of the ac source is υ, then
(a) $\upsilon_0 = \upsilon = 50$ Hz (b) $\upsilon_0 = \upsilon = \frac{50}{\pi}$ Hz
(c) $\upsilon_0 = \frac{50}{\pi}$ Hz, $\upsilon = 50$ Hz
(d) $\upsilon = 100$ Hz, $\upsilon_0 = \frac{100}{\pi}$ Hz

46. Two pendulums of length 121 cm and 100 cm start vibrating in phase. At some instant, the two are at their mean position in the same phase. The minimum number of vibrations of the shorter pendulum after which the two are again in phase at the mean position is

(a) 11 (b) 9 (c) 10 (d) 8

47. The volume occupied by the molecules contained in 4.5 kg water at STP, if the intermolecular forces vanish away is

(a) 5.6×10^6 m^3 (b) 5.6×10^3 m^3
(c) 5.6×10^{-3} m^3 (d) 5.6 m^3

48. Match List-I and List-II.

List-I	**List-II**
(A) Gravitational constant (G)	(i) $[L^2T^{-2}]$
(B) Gravitational potential energy	(ii) $[M^{-1}L^3T^{-2}]$
(C) Gravitational potential	(iii) $[LT^{-2}]$
(D) Gravitational intensity	(iv) $[ML^2T^{-2}]$

Choose the correct answer from the options given below.

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

49. From Ampere's circuital law for a long straight wire of circular cross-section carrying a steady current, the variation of magnetic field in the inside and outside region of the wire is

(a) uniform and remains constant for both the regions.
(b) a linearly increasing function of distance upto the boundary of the wire and then linearly decreasing for the outside region.
(c) a linearly increasing function of distance r upto the boundary of the wire and then decreasing one with $1/r$ dependence for the outside region.
(d) a linearly decreasing function of distance upto the boundary of the wire and then a linearly increasing one for the outside region.

50. A nucleus of mass number 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is

(a) 1 : 1 (b) 4 : 5 (c) 5 : 4 (d) 25 : 16

(a) $4Ia^2$ and $3Ia^2$ (b) $\sqrt{3}Ia^2$ and $3Ia^2$
(c) $3Ia^2$ and Ia^2 (d) $3Ia^2$ and $4Ia^2$

HINTS & SOLUTIONS

1. (b) : Given,
Side length of square, $l = 1$ m
Resistance, $R = 1\ \Omega$
Magnetic field, $B = 0.5$ T
The angle between the area vector and magnetic field is zero as the plane of coil is perpendicular to the magnetic field.
Magnetic flux, $\phi = BA\cos\theta$
$\phi = 0.5 \times 1 \times 1 \times \cos 0 = 0.5$ Wb

2. (d) : The velocity of light is vacuum in given by

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \quad ...(i)$$

For any medium, velocity is

$$v = \frac{1}{\sqrt{\mu_0 \mu_r \varepsilon_0 \varepsilon_r}} = \frac{1}{\sqrt{\mu_0 \varepsilon_0}\sqrt{\mu_r \varepsilon_r}}$$

Using equation (i) $v = \dfrac{c}{\sqrt{\mu_r \varepsilon_r}}$

3. (d) : Let the threshold frequency is υ_0.
By using the equation of photo electric effect, $E = h\upsilon_0 + eV_0$

Case I : $h\upsilon = h\upsilon_0 + \dfrac{eV_s}{2}$ ...(i)

Case II : $\dfrac{h\upsilon}{2} = h\upsilon_0 + eV_s$ ...(ii)

From (i) and (ii), $\dfrac{h\upsilon}{2} = \dfrac{-eV_s}{2}$ or $-h\upsilon = eV_s$

Putting in equation (i), we get

$$h\upsilon = h\upsilon_0 - \frac{h\upsilon}{2}$$

so, $\upsilon_0 = \dfrac{3}{2}\upsilon$

Practically threshold frequency cannot be greater than incident frequency. But, according to values given here most appropriate answer is (d).

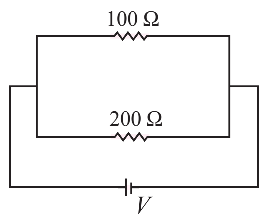
4. (b) : Initially, when the ball starts falling down, due to the force of gravity, the speed of ball increases and the viscous drag force increases also (it depends on speed $F = 6\pi\eta rv$). As the viscous force and buoyant force balances the force of gravity, the net acceleration of the ball is zero, and it starts moving with constant velocity called terminal velocity.
So, option (b) is correct.

5. (c) : Statement I is correct, but statement II is incorrect because, the magnetic field is produced by vector source Idl and the coulomb's force is produced by scalar source q.

6. (c) : The temperature coefficient of resistance (α) is positive for conductors while negative for both insulators and semiconductors.
So, as the temperature increases, the resistance of conductor increases and for semiconductors decreases.

7. (b) : The two resistances are connected in parallel, so, they both have same potential difference as V.
Heat energy is given by

$$H = \frac{V^2}{R}t$$



So, $H_1 = \dfrac{V^2}{100}t$

$H_2 = \dfrac{V^2}{200}t$

Ratio, $\dfrac{H_1}{H_2} = \dfrac{200}{100} = 2:1$

8. (d) : The potential drop across *p-n* junction diode is equal when either both are in forward biased or reversed biased. So, in circuits *(a)* and *(c)* both are in forward biased.

So, correct option is (d).

9. (c) : The relation between the peak value and the rms value is

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

so, $V_0 = \sqrt{2}\,V_{rms}$

10. (d) : The slope of displacement-time graph gives velocity

so, $v_1 = \tan 30^\circ$; $v_2 = \tan 45^\circ$

so, $\frac{v_1}{v_2} = \frac{\tan 30^\circ}{\tan 45^\circ} = \frac{1}{\sqrt{3}\times 1} = 1:\sqrt{3}$

11. (c) : The equipotential surface is always perpendicular to the electric field lines. So, the angle between the electric lines of force and the equipotential surface is 90°.

12. (c) : Dimensions of magnetic flux = $[ML^2T^{-2}A^{-1}]$

Dimensions of self inductance = $[ML^2T^{-2}A^{-2}]$

Dimensions of magnetic permeability = $[MLT^{-2}A^{-2}]$

Dimensions of electrical permittivity = $[M^{-1}L^{-3}T^4A^2]$

So, the correct option is (c).

13. (a) : The excess pressure inside a soap bubble is

$$P_i = \frac{4T}{R} + P_o$$

where, $P_i \rightarrow$ inside pressure, $P_o \rightarrow$ outside pressure

T = surface tension and R is radius.

Here, P_o, T is constant, so when R increases, P_i decreases.

So, the pressure inside the bubble decreases.

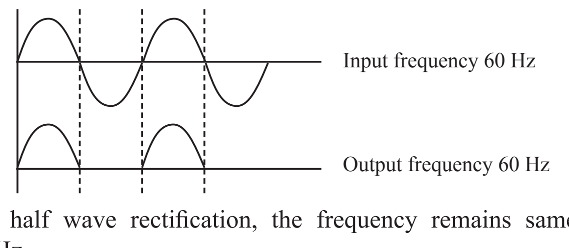
14. (a) : Power, $P = 100$ kW $= 100 \times 10^3$ W

time, $t = 1$ hr $= 3600$ s

Energy, E = power × time

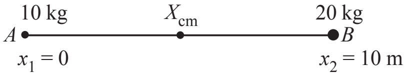
$E = 100 \times 10^3 \times 3600$; $E = 36 \times 10^7$ J

15. (c) :



For half wave rectification, the frequency remains same as 60 Hz.

16. (b) :



Masses, $m_1 = 10$ kg and $m_2 = 20$ kg

Let the distance between the two masses be, $d = 10$ m

Now, centre of mass for two particles system is written as,

$$X_{COM} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2} \quad \text{...(i)}$$

Considering point A as origin, so $B = (d, 0)$

$$X_{COM} = \left(\frac{m_1 \times 0 + m_2 d}{m_1 + m_2}\right) = \frac{m_2 d}{m_1 + m_2} ;$$

$$X_{COM} = \frac{20\text{kg} \times 10\text{m}}{10\text{kg} + 20\text{kg}} = \frac{20}{3}\text{ m}$$

17. (d) : The wavelength of AM radio waves is 10^2 m. The wavelength of microwaves ranges between 10^{-3} m to 10^{-1} m. Infrared radiations wavelength lies between 4×10^{-7} m to 7×10^{-3} m. X-rays wavelength ranges from 10^{-8} m to 10^{-12} m.

18. (c) : Given that,

Mass of lift + passengers, $m = 2000$ kg

Speed, $v = 1.5$ m/s

Frictional force, $F = 3000$ N

Power delivered, P = Force × velocity ...(i)

Force acting, $F = mg + f \Rightarrow F = 2000 \times 10 + 3000$

$F = 23000$ N

Using value of 'F' in equation (i),

$P = 23000 \times 1.5 = 34500$ W

19. (d) : As we know, wavelength of light is inversely proportional to number of fringes observed.

$\therefore \quad \lambda_1 n_1 = \lambda_2 n_2 \;\; n_2 = \frac{\lambda_1 n_1}{\lambda_2} = \frac{600 \times 8}{400} = 12$

20. (b) : The electrical potential at the surface of a hollow sphere is, $V = \frac{kq}{R}$

For sphere 1, $V_1 = \frac{kq}{R_1}$ ...(i)

For sphere 2, $V_2 = \frac{kq}{R_2}$ ...(ii)

As $R_1 >> R_2$, therefore, $V_1 << V_2$.

Hence, potential is more on smaller sphere.

21. (c) : Given that

$${}^{22}_{11}\text{Na} \rightarrow X + e^+ + \upsilon$$

To find the element X, using the law of charge conservation,

$${}^{22}_{11}\text{Na} \rightarrow {}^{22}_{10}\text{Ne} + e^+ + \upsilon$$

22. (b) : The radius of gyration of thin uniform disc of radius R about an axis passing through its centre and normal to its plane is,

$$k = \frac{R}{\sqrt{2}}$$

Radius of gyration of disc about its diametre is $k' = \frac{R}{2}$

Then, $\frac{k}{k'} = \frac{R}{\sqrt{2}} / \frac{R}{2} = \sqrt{2}:1$

23. (d) : For 1st excited state, $n = 2$

For 2nd excited state, $n = 3$ $\therefore \; \frac{T_1}{T_2} = \frac{n_2^2}{n_1^2} = \frac{3^2}{2^2} = \frac{9}{4}$

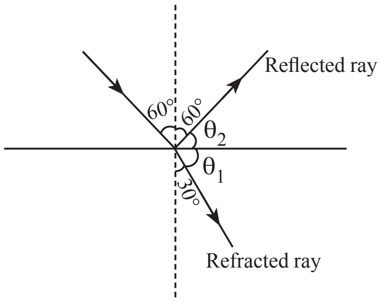
24. (c) : The refractive index of glass, $\mu = \sqrt{3}$

Angle of incidence = 60°

Let 'r' be the angle of refraction.

Now, applying Snell's law, $1 \times \sin 60^\circ = \mu \times \sin r$

$\Rightarrow \; \frac{\sqrt{3}}{2} = \sqrt{3} \times \sin r \Rightarrow \sin r = \frac{1}{2} \;\; \Rightarrow \; r = 30^\circ$



Let $\theta_1 + \theta_2$, be the angle between reflected ray and refracted ray. Hence, from figure we can say that, $\theta_1 + \theta_2 = 60° + 30° = 90°$

25. (d) : length, $l = 10$ m, radius, $r = \frac{10^{-2}}{\sqrt{\pi}}$ m

Resistance, $R = 10\ \Omega$

Electric field, $E = 10$ V/m

The current density $J = \sigma E = \frac{E}{\rho}$ ...(i)

so, $\rho = \frac{RA}{l} = \frac{10 \times \pi \times \frac{10^{-4}}{\pi}}{10} = 10^{-4}\Omega\text{m}$

From eqn. (i) ...(i)

$J = \frac{10}{10^{-4}} = 10^5$ A/m^2

26. (c) : Given, refractive index of lens = 1.5

For biconvex lens, $R_1 = +R$, $R_2 = -R$

$\therefore$ $R_1 = +20$ cm and $R_2 = -20$ cm

According to lens maker's formula,

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\therefore \frac{1}{f} = (1.5 - 1)\left(\frac{1}{20} - \frac{1}{(-20)}\right) = 0.5\left(\frac{1}{20} + \frac{1}{20}\right)$$

or $\frac{1}{f} = \frac{1}{20}$ $\Rightarrow$ $f = 20$ cm

Power of lens (in dioptre), $P = \frac{100}{\text{focal length } f \text{(in cm)}}$

$\therefore P = \frac{100}{20} = +5\text{D}$

27. (b) : Here, number of turns in the solenoid,

$n = 100/1$ mm $= 100 \times 10^3$ /m

Current in the solenoid, $I = 1$ A

Magnetic field strength at the centre of the solenoid,

$B = \mu_0 nI = 4\pi \times 10^{-7} \times 10^5 \times 1 = 12.56 \times 10^{-2}$ T

28. (b) : According to universal law of gravitation, gravitational force is

$$F = \frac{GMm}{r^2}$$

or $\frac{F}{m} = \frac{GM}{r^2}$ ...(i)

Given that, $F = 3.0$ N and $m = 60$ g $= 60 \times 10^{-3}$ kg

We know that, gravitational field intensity at point,

$I_G = \frac{GM}{r^2}$ $\therefore$ From eq. (i), we have

$I_G = \frac{F}{m} = \frac{3.0}{60 \times 10^{-3}} = 50$ N/kg

29. (d) : de-broglie wavelength, $\lambda = \frac{h}{p}$

or $\lambda \propto \frac{1}{p}$

Shape of graph is rectangular hyperbola.

Hence, curve (d) is correct option.

30. (c) : Distance travelled by a body during free fall is given by

$$S = ut + \frac{1}{2}at^2$$

Here, $u = 0$ and $a = g$ $\therefore$ $S \propto t^2$

Here, 1st second, $S_2 = Kt^2 = K$

For 2nd second, $S_2 = K(2)^2 = 4K$

For 3rd second, $S_3 = K(3)^2 = 9K$

For 4th second, $S_4 = K(4)^2 = 16K$

Distance covered in 2 seconds, $4K - K = 3K$

Distance covered in 3rd seconds, $9K - 4K = 5K$

Distance covered in 4th seconds, $16K - 9K = 7K$

$\therefore$ Ratio of distances travelled by the freely falling body will be 1 : 3 : 5 : 7

31. (b) : Initial angular speed, $\omega_0 = \frac{2\pi \times 1200}{60}$ rad s^{-1} $= 40\pi$ rad s^{-1}

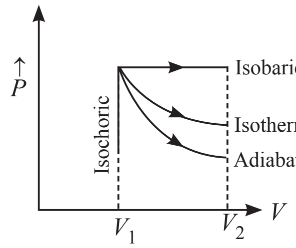
Final angular speed,

$$\omega = \frac{2\pi \times 3120}{60} \text{ rad s}^{-1} = 104\pi \text{ rad s}^{-1}$$

$\therefore$ Angular acceleration,

$$\alpha = \frac{\omega - \omega_0}{t} = \frac{104\pi - 40\pi}{16} = 4\pi \text{ rad s}^{-2}$$

32. (b) :



When a thermodynamic system undergoes a change in such a way that there is no exchange of heat with the surrounding, then the process is known as adiabatic process and the slope of adiabatic is more than isothermal.

33. (c) : Velocity of a transverse wave in a stretched string is given by

$v = \sqrt{\frac{T}{\mu}}$ ...(i)

Where T is the tension in the string and μ is the mass per unit length of the string.

If tension T is doubled, then final speed of the wave in the string will be,

$v' = \sqrt{\frac{2T}{\mu}}$ ...(ii)

From eq. (i) and (ii)

$$\frac{v}{v'} = \frac{1}{\sqrt{2}}$$

34. (a) : Plane angle and solid angle have supplementary units. Radian (rad) is the unit of plane angle and steradian (sr) is the unit of solid angle. Plane angle and solid angle are dimensionless quantities.

35. (c) : Given, mass of the shell = m

Ratio of masses of the fragments is 2 : 2 : 1.

Therefore masses of three fragments are

$$m_1 = \frac{m}{2}, m_2 = \frac{m}{2} \text{ and } m_3 = \frac{m}{4}$$

Now fragments with equal masses *i.e.*, m_1 and m_2 fly off perpendicularly with speeds $v_1 = v_2 = v$. Let the velocity of third fragment be v'.

Applying law of conservation of momentum,

$$m_1 v_1 \hat{i} + m_2 v_2 \hat{j} + m_3 \vec{v} = 0$$

$$\frac{mv}{2}\hat{i} + \frac{mv}{2}\hat{j} + \frac{m}{4}\vec{v}' = 0 \Rightarrow \vec{v}' = 2v(-\hat{i} - \hat{j})$$

$$|\vec{v}| = 2v\sqrt{(-1)^2 + (-1)^2} = 2\sqrt{2}\, v$$

36. (d) : Given, length (l) = 55.3 m

Breadth (b) = 25 m

The area of rectangular field is, $A = l \times b$

$= 55.3 \times 25 = 1382.5\ \text{m}^2 = 1.3825 \times 10^3\ \text{m}^2 \simeq 1.4 \times 10^3 = 14 \times 10^2$

37. (c) : Given, number of turns (N) = 1000

Radius (r) = 10 m

Angular velocity (ω) = 2 rad s^{-1}

Magnetic field (B) = = 2×10^{-5} T

Electrical resistance (R) = 12.56 Ω

Maximum induced emf = $N\omega AB$

Here area of the circular coil, $A = \pi r^2$

$\varepsilon = N\omega\pi r^2 B = 1000 \times 2 \times 3.14 \times (10)^2 \times 2 \times 10^{-5}$; $\varepsilon = 12.56$ V

The maximum induced current is, $i_{max} = \dfrac{\varepsilon}{R}$

$$\Rightarrow i_{max} = \frac{12.56}{12.56} = 1\text{A}$$

38. (b) : Since, $R >> L$, the given charge configuration can be treated as dipole.

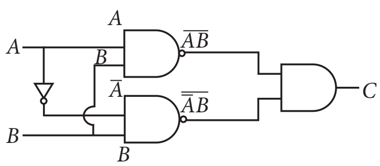
Electric field due to a dipole at any arbitrary point (R, θ) is

$$E = \frac{p}{4\pi\varepsilon_0 R^3}\sqrt{3\cos^2\theta + 1}$$

Here, $E \propto \dfrac{1}{R^3}$.

39. (c) : Output of the given circuit is

$$C = \overline{AB} + \overline{\overline{A}B}$$
$$= \overline{A} + \overline{B} + \overline{\overline{A}} + \overline{B}$$
$$= \overline{A} + \overline{B} + A + \overline{B}$$
$$\Rightarrow C = \overline{B}$$



Therefore, the correct truth table corresponding to $C = \overline{B}$ is

A	B	$C=\overline{B}$
0	0	1
0	1	0
1	0	1
1	1	0

40. (c) : Here, $C_1 = C_2 = 900$ pF

$V_1 = 100$ V, $V_2 = 0$ V

When C_1 and C_2 are joined, their common potential is given as,

$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{900 \times 100 + 900 \times 0}{1800}$$

$V = 50$ V

Electrostatic energy stored in system *(b)* is

$$U = \frac{1}{2}(C_1 + C_2)V^2 \quad U = \frac{1}{2} \times 1800 \times 10^{-12} \times 50 \times 50$$

$U = 2.25 \times 10^{-6}$ J

According to figure (*b*), charge on both the plates of capacitor is positive this is not possible.

41. (b) : For medium A, speed of light $v_A = 1.5 \times 10^8$ m/s

For medium B, speed of light $v_B = 2.0 \times 10^8$ m/s

For medium A, $n_A = \dfrac{c}{v_A} = \dfrac{3 \times 10^8}{1.5 \times 10^8} = 21$

For medium B, $n_B = \dfrac{c}{v_B} = \dfrac{3 \times 10^8}{2 \times 10^8} = 1.5$

The critical angle for a ray of light is,

$$\sin C = \frac{n_B}{n_A} \quad C = \sin^{-1}\left(\frac{1.5}{2}\right)$$

$C = \sin^{-1}$ (0.750)

42. (b) : Ball is projected with velocity, $u = 10$ m/s

Angle of projection, $\theta = 90° - 60° = 30°$

The velocity of a projectile at the highest point will be, $v = u\cos\theta$

$= 10 \times \cos 30° = 10 \times \dfrac{\sqrt{3}}{2} = 5\sqrt{3}$ m/s

43. (b) : For a balanced Wheatstone bridge, current through a galvanometer is zero.

$$\therefore \frac{P}{Q} = \frac{X}{Y}$$

Here resistances P and Q should be approximately equal and small, as it decreases error in experiment.

44. (c) : The stretching of a coiled spring is determined by its shear modulus because neither its length nor its volume changes but only the shape of the spring is changed. Elasticity of steel is more than copper.

45. (b) : Here, $L = 10$ H; $C = 10$ μF ; $R = 50$ Ω;

$V = 200 \sin (100\, t)$ V

We know that $\omega = 2\pi\upsilon \Rightarrow \upsilon = \dfrac{\omega}{2\pi}$ ...(i)

From eq. (i), $\upsilon = \frac{100}{2\pi} = \frac{50}{\pi}$ $(\because \ \omega = 100 \text{ rad/s})$

$\therefore$ Frequency, $\upsilon = \frac{50}{\pi}$ Hz

At resonance, $\upsilon_r = \upsilon_0 = \frac{1}{2\pi\sqrt{LC}}$

$= \frac{1}{2\pi\sqrt{10\times10\times10^{-6}}} = \frac{1}{2\pi\sqrt{10^{-4}}}$

$\therefore \ \upsilon_0 = \frac{1}{2\pi\times10^{-2}} = \frac{100}{2\pi} = \frac{50}{\pi}$ Hz

46. (a) : Let L_1 = 121 cm = $\frac{121}{100} = 1.21$ m

$L_2 = 100 \text{ cm} = \frac{100}{100} = 1$ m

Let T_1 = longer pendulum ; T_2 = shorter pendulum

We know, $T = 2\pi\sqrt{\frac{L}{g}} \Rightarrow T \propto \sqrt{L}$ $\frac{T_1}{T_2} \propto \sqrt{\frac{L_1}{L_2}}$ $\frac{T_1}{T_2} \propto \sqrt{\frac{1.21}{1}} = \frac{1.1}{1}$

$10\ T_1 = 11\ T_2$

10 vibrations of longer pendulum = 11 vibrations of shorter pendulum.

47. (d) : $\mu = \frac{\text{Mass of water}}{\text{Molecular weight of water}} = \frac{4.5 \text{ kg}}{18\times10^{-3} \text{ kg}} = 250$

At STP, T = 273 K and $P = 10^5$ N/m^2

From, $PV = \mu RT \Rightarrow V = \frac{\mu RT}{P}$

$V = \frac{250\times8.3\times273}{10^5}$

$V = 5.66$ m^3

48. (b) : Here, $F = G\frac{M_1M_2}{r^2}$

Gravitational constant, $G = \frac{F\times r^2}{M_1\times M_2} = [\text{M}^{-1}\text{L}^3\text{T}^{-2}]$

Gravitational potential energy, $U = \frac{-GM_1M_2}{r} = [\text{M}^1\text{L}^2\text{T}^{-2}]$

Gravitational potential, $V = -\frac{GM}{r} = [\text{M}^0\text{L}^2\text{T}^{-2}]$

Gravitational intensity, $I = \frac{GM}{r^2} = [\text{M}^0\text{L}^1\text{T}^{-2}]$

So, (A)–(ii), (B)–(iv), (C)–(i), (D) – (iii)

49. (c) : Using Ampere's circuital law

$B_{\text{in}} = \frac{\mu_0 Ir}{2\pi a^2}$, or $B_{\text{in}} \propto r$ $B_{\text{out}} = \frac{\mu_0 I}{2\pi r}$, or $B_{\text{out}} \propto \frac{1}{r}$

50. (c) : Nuclear radius, $R = R_0A^{1/3}$ ...(i)

where R_0 is a constant and A is the mass number.

From eq. (i) $R \propto A^{1/3}$

$\frac{R_1}{R_2} = \left(\frac{125}{64}\right)^{1/3}$ $\frac{R_1}{R_2} = \frac{5}{4}$