CET – PHYSICS – 2010

VERSION CODE: B – 2

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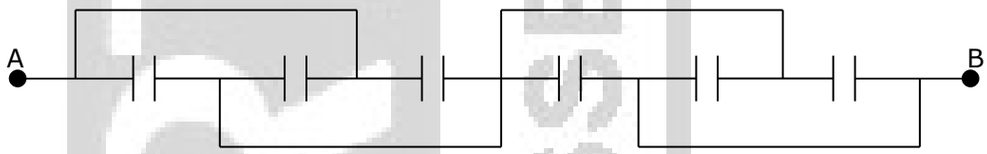
1. All capacitors used in the diagram are identical and each is of capacitance C. Then the effective capacitance between the point A and B is ……

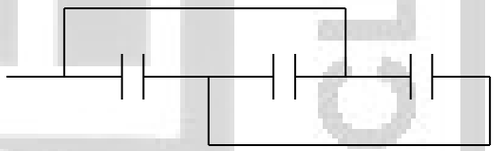


a) 1.5 C b) 6 C c) C d) 3 C

Ans: (a)

Capacitors are in parallel

$C_p = 3C$



Another such circuit in series

$\therefore C_{AB} = \frac{C_P}{2} = 1.5\ C$

2. Two identical conducting balls A and B have positive charges q_1 and q_2 respectively. But $q_1 \neq q_2$. The balls are brought together so that they touch each other and then kept in their original positions. The force between them is …….

a) less than that before the balls touched

b) greater than that before the balls touched

c) same as that before the balls touched

d) zero

Ans: (b)

When two charged spheres are brought in contact they attain equal charge = $\frac{q_1 + q_2}{2}$

For a given total charge $q_1 + q_2$, the force between the charges is maximum when charges are equal

3. Red light of wavelength 625 nm is incident normally on an optical diffraction grating with 2×10^5 lines / m. Including central principal maxima, how many maxima may be observed on a screen which is far from the grating?

a) 15 b) 17 c) 8 d) 16

Ans: (b)

$\frac{\sin\theta}{N} = n\lambda$

For maximum number of diffraction maxima $\theta = 90^\circ$

$$n = \frac{1}{\lambda N} = \frac{1}{6.25 \times 10^{-7} \times 2 \times 10^{5}} = 8$$

$\therefore$ Number of maxima = 2n + 1 = 2×8+ 1 = 17

4. A battery of e.m.f. E has an internal resistance 'r'. A variable resistance R is connected to the terminals of the battery. A current I is drawn from the battery. V is the terminal P.D. If R alone is gradually reduced to zero, which of the following best describes I and V?

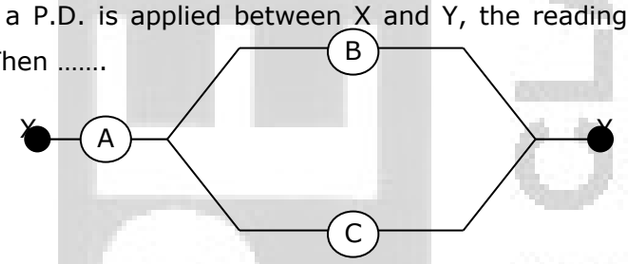
a) I approaches zero, V approaches E
b) I approaches E/r, V approaches zero
c) I approaches E/r, V approaches E
d) I approaches infinity, V approaches E

Ans: (b)

$I = \frac{E}{R + r}$ when R decreases to 0, $I = \frac{E}{r}$

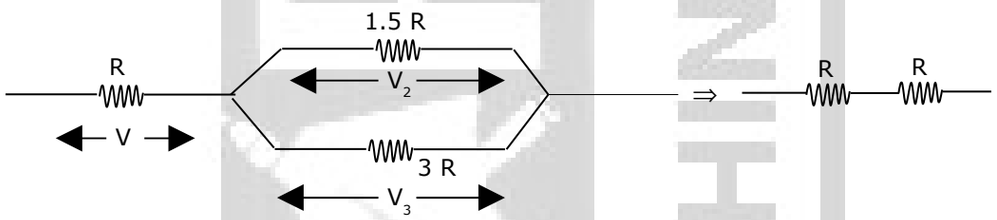
V = IR when R decreases to 0, V = 0

5. Three voltmeters A, B and C having resistances R, 1.5 R and 3R respectively are used in a circuit as shown. When a P.D. is applied between X and Y, the reading of the voltmeters are V_1, V_2 and V_3 respectively. Then …….



a) $V_1 = V_2 = V_3$
b) $V_1 < V_2 = V_3$
c) $V_1 > V_2 > V_3$
d) $V_1 > V_2 = V_3$

Ans: (a)



Since resistance are equal, pd across them is same

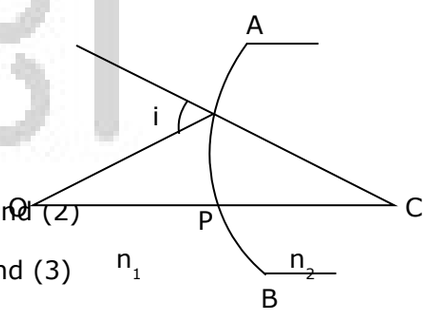
6. A point object O is kept at a distance of OP = u. The radius of curvature of the spherical surface APB is CP = R. The refractive index of the media are n_1 and n_2 which are as shown in the diagram. Then,

1) if $n_1 > n_2$, image is virtual for all values of 'u'

2) if $n_2 = 2n_1$, image is virtual when R > u

3) the image is real for all values of u, n_1 and n_2

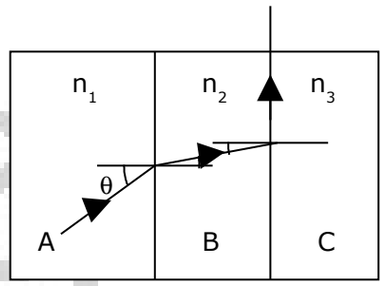
Here, the correct statement/s is/are ……



a) only (2)
b) both (1) and (2)
c) only (1)
d) (1), (2) and (3)

Ans: (b)

7. A, B and C are the parallel sided transparent media of refractive index n_1, n_2 and n_3 respectively. They are arranged as shown in the figure. A ray is incident at an angle θ on the surface of separation of A and B which is as shown in the figure. After the refraction into the medium B, the ray grazes the surface of separation of the media B and C. Then, sin θ = ……



a) $\frac{n_3}{n_1}$

b) $\frac{n_1}{n_3}$

c) $\frac{n_2}{n_3}$

d) $\frac{n_1}{n_2}$

Ans: (a)

$n_1 \sin\theta = n_3 \sin 90^\circ$

$\sin\theta = \frac{n_3}{n_1}$

8. A boat has green light of wavelength λ = 500 nm on the mast. What wavelength would be measured and what colour would be observed for this light as seen by a diver submerged in water by the side of the boat? Given n_w = 4/3.

a) Green of wavelength 376 nm
b) Red of wavelength 665 nm
c) Green of wavelength 500 nm
d) Blue of wavelength 376 nm

Ans: (a)

$n = \frac{\lambda_a}{\lambda_m}$

$\lambda_m = \frac{550}{4/3}$ = 376 nm

9. Two beams of red and violet colours are made to pass separately through a prism of A = 60°. In the minimum deviation position the angle of refraction inside the prism will be

a) greater for red colour
b) equal but not 30° for both the colours
c) greater for violet colour
d) 30° for both the colours

Ans: (d)

A = 2r for minimum deviation

$r = \frac{60^0}{2}$ = 30°

10. The focal length of a plano convex lens is 'f' and its refractive index is 1.5. It is kept over a plane glass plate with its curved surface touching the glass plate. The gap between the lens and the glass plate is filled by a liquid. As a result, the effective focal length of the combination becomes 2f. Then the refractive index of the liquid is …….

a) 1.5 b) 2 c) 1.25 d) 1.33

Ans: (c)

For plano convex lens $f = \frac{R}{(n-1)}$

$R = 0.5\ f$

$\frac{1}{2f} = \frac{1}{f} + \frac{1}{f_\ell} \Rightarrow \frac{1}{f_\ell} = -\frac{1}{2f} \Rightarrow f_\ell = -2f$

$f_\ell = \frac{R}{(n_\ell - 1)} \Rightarrow -2f = \frac{-0.5f}{n_\ell - 1}$

$n_\ell - 1 = 0.25 \Rightarrow n_\ell = 1.25$

11. Two simple harmonic motions are represented by $y_1 = 5\ [\sin 2\pi t + \sqrt{3}\ \cos 2\pi t]$ and $y_2 = 5 \sin\left(2\pi t + \frac{\pi}{4}\right)$. The ratio of their amplitude is ……..

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

Ans: (b)

$A_1 = \sqrt{5^2 + (5\sqrt{3})^2} = 10$

$A_2 = 5$

$\frac{A_1}{A_2} = \frac{2}{1}$

12. A bat flies at a steady speed of 4 ms^{-1} emitting a sound of $f = 90 \times 10^3$ Hz. It is flying horizontally towards a vertical wall. The frequency of the reflected sound as detected by the bat will be ……..

(Take velocity of sound in air as 330 ms^{-1}).

a) 88.1×10^3 Hz b) 87.1×10^3 Hz c) 92.1×10^3 Hz d) 89.1×10^3 Hz

Ans: (c)

$f^{\prime} = \left(\frac{v + v_s}{v - v_s}\right) f = \left(\frac{330 + 4}{330 - 4}\right) 90 \times 10^3 = 92.1 \times 10^3$ Hz

13. A closed organ pipe and an open organ pipe of same length produce 2 beats / second while vibrating in their fundamental modes. The length of the open organ pipe is halved and that of closed pipe is doubled. Then, the number of beats produced per second while vibrating in the fundamental mode is …….

a) 2 b) 6 c) 8 d) 7

Ans: (d)

$f_o - f_c = 2$ but $f_o = 2f_C$ (when lengths are same)

$\therefore f_c = 2$ Hz and $f_o = 4$ Hz

$f_o^{\prime} = 8$ Hz, when l is halved

$f_c^{\prime} = 1$ Hz, when l is doubled $\therefore f_o^{\prime} - f_c^{\prime} = 7$

$f_s^{\prime} - f_c^{\prime} = 7$

14. A uniform wire of length L, diameter D and density P is stretched under a tension T. The correct relation between its fundamental frequency 'f', the length L and the diameter D is ……..

a) $f \propto \frac{1}{LD}$ b) $f \propto \frac{1}{L\sqrt{D}}$ c) $f \propto \frac{L}{D^2}$ d) $f \propto \frac{1}{LD^2}$

Ans: (a)

$f = \frac{1}{2L}\sqrt{\frac{T}{m}} = \frac{1}{2L}\sqrt{\frac{T}{\rho \pi D^2}} \therefore f \propto \frac{1}{LD}$

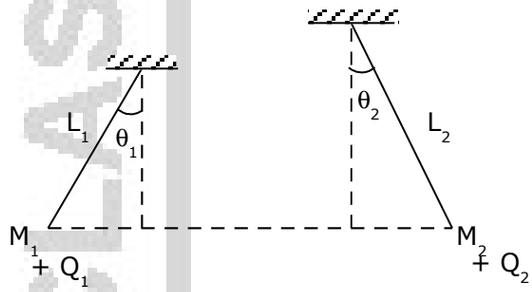
15. Two small spheres of masses M_1 and M_2 are suspended by weightless insulating threads of lengths L_1 and L_2. The spheres carry charges of Q_1 and Q_2 respectively. The spheres are suspended such that they are in level with one another and the threads are inclined to the vertical at angles of θ_1 and θ_2 as shown. Which one of the following conditions is essential, if $\theta_1 = \theta_2$?

a) $M_1 \neq M_2$, but $Q_1 = Q_2$

b) $M_1 = M_2$

c) $Q_1 = Q_2$

d) $L_1 = L_2$



Ans: (b)

$\tan \theta = \frac{F}{Mg}$

F is same on both the charges; θ is same only if M is equal

16. The wavelength of the light used in Young's double slit experiment is λ. The intensity at a point on the screen where the path difference is $\frac{\lambda}{6}$ is I. If I_0 denotes the maximum intensity, then the ratio of I and I_0 is …….

a) 0.866 b) 0.5 c) 0.707 d) 0.75

Ans: (d)

$\phi = \frac{2\pi}{\lambda} x = \frac{2\pi}{\lambda} \times \frac{\lambda}{6} = \frac{\pi}{3} = 60°$

$I = I_o \cos^2 (\phi/2)$

$\frac{I}{I_0} = \cos^2 (30°) = \left(\frac{\sqrt{3}}{2}\right)^2 = \frac{3}{4} = 0.75$

17. What is the minimum thickness of a thin film required for constructive interference in the reflected light from it? Given: R. I of the film = 1.5, wavelength of light incident on the film = 600 nm

a) 100 nm b) 300 nm c) 50 nm d) 200 nm

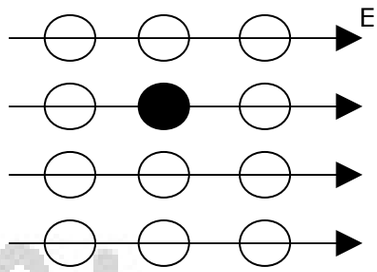
Ans: (a)

$2nt \cos (r) = (2m + 1) \frac{\lambda}{2}$

$2 \times 1.5 \times t \cos (0°) = (2 (0) + 1) \frac{\lambda}{2}$

$3t = \frac{\lambda}{2}$ or $t = \frac{\lambda}{6} = \frac{600\,nm}{6} = 100$ nm

18. There is a uniform electric field of intensity E which is as shown. How many labelled points have the same electric potential as the fully shaded point?



a) 2

b) 3

c) 8

d) 11

Ans: (b)

Take vertical plane through the shaded circle, which is equilpotential ($\because$ lines of force and equipotential surface are perpendicular)

19. Critical angle for certain medium is $\sin^{-1}(0.6)$. The polarizing angle of that medium is ……..

a) $\tan^{-1}[1.5]$ b) $\sin^{-1}[0.8]$ c) $\tan^{-1}(1.6667)$ d) $\tan^{-1}[0.6667]$

Ans: (c)

$C = \sin^{-1}(0.6)$

$\text{Sin}(C) = 0.6$

$n = \frac{1}{\sin(C)} = \frac{1}{0.6}$

$\theta_p = \tan^{-1}(n) = \tan^{-1}(1/0.6) = \tan^{-1}(1.6667)$

20. Electromagnetic wave consists of periodically oscillating electric and magnetic vectors ……

a) in mutually perpendicular planes but vibrating with a phase difference of π

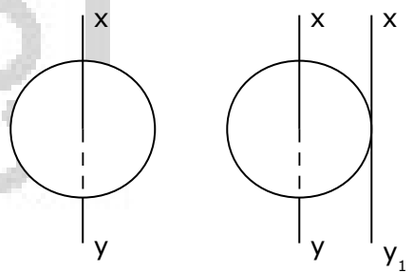
b) in mutually perpendicular planes but vibrating with a phase difference of $\pi/2$

c) in randomly oriented planes but vibrating in phase

d) in mutually perpendicular planes but vibrating in phase

Ans. (d)

21. The moment of inertia of a circular disc of radius 2 m and mass 1 kg about an axis passing through the centre of mass but perpendicular to the plane of the disc is 2 kgm^2. Its moment of inertia about an axis parallel to this axis but passing through the edge of the disc is …… (see the given figure)



a) 8 kgm^2

b) 4 kgm^2

c) 10 kgm^2

d) 6 kgm^2

Ans: (d)

Apply parallel axis theorem

$I = I_C + Md^2$

$= 2 + (1)(2)^2 = 6 \text{ kg m}^2$

22. An astronaut on a strange planet find that acceleration due to gravity is twice as that on the surface of earth. Which of the following could explain this?

a) Both the mass and radius of the planet are half as that of earth

b) Radius of the planet is half as that of earth, but the mass is the same as that of earth.

c) Both the mass and radius of the planet are twice as that of earth

d) Mass of the planet is half as that of earth, but radius is same as that of earth

Ans: (a)

$g = \frac{GM}{R^2}$

If $M^{l} = \frac{M}{2}$ and $R = \frac{R}{2}$ then $g^{l} = \frac{G\left(\frac{M}{2}\right)}{\left(\frac{R}{2}\right)^2} = \frac{2GM}{R^2} = 2g$

23. Which of the following substances has the highest elasticity?

a) sponge b) steel c) rubber d) copper

Ans: (b)

24. Three liquids of equal masses are taken in three identical cubical vessels A, B and C. Their densities are P_A, P_B and P_C respectively. But $P_A < P_B < P_C$. The force exerted by the liquid on the base of the cubical vessel is ……

a) maximum in vessel C b) minimum in vessel C

c) the same in all the vessels d) maximum in vessel A

Ans: (c)

25. Water is in streamline flow along a horizontal pipe with nonuniform cross-section. At a point in the pipe where the area of cross-section is 10 cm^2, the velocity of water is 1 ms^{-1} and the pressure is 2000 Pa. The pressure at another point where the cross-sectional area is 5 cm^2 is ……..

a) 4000 Pa b) 2000 Pa c) 1000 Pa d) 500 Pa

Ans: (d)

$A_1 v_1 = A_2 v_2$

$10 \times 1 - 5 \times v_2$

$v_2 = 2m/s$

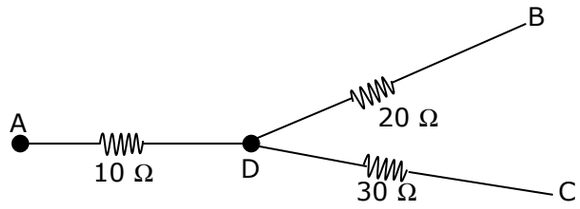
$\frac{P_1}{\rho} + \frac{v_1^2}{2} = \frac{P_2}{\rho} + \frac{v_2^2}{2}$

$\frac{2000}{1000} + \frac{1^2}{2} = \frac{P_2}{1000} + \frac{2^2}{2}$

$2.5 = \frac{P_2}{1000} + 2$

$P_2 = 500$ Pa

26. In the circuit given here, the points A, B and C are 70 V, zero, 10 V respectively. Then



a) the point D will be at a potential of 60 V

b) the point D will be at a potential of 20 V

c) currents in the paths AD, DB and DC are in the ratio of 1 : 2 : 3

d) currents in the paths AB, DB and DC are in the ratio of 3 : 2 : 1 **[printing error in this option]**

NO ANSWER

According to KCL, $I_1 = I_2 + I_3$

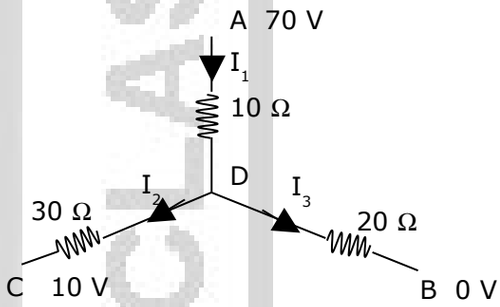
$$\frac{V_A - V_D}{10} = \frac{V_D - 0}{20} + \frac{V_D - V_C}{30}$$

Or $70 - V_D = \frac{V_D}{2} + \frac{V_D - 10}{3}$

$6(70 - V_D) = 3V_D + 2(V_D - 10)$

$420 - 6V_D = 3V_D + 2V_D - 20$

$440 = 11 V_D \Rightarrow V_D = 40V$



Now $I_1 = \frac{70 - 40}{10} = 3A$

$I_2 = \frac{40 - 0}{20} = 2A$

$I_3 = \frac{40 - 10}{30} = 1A$

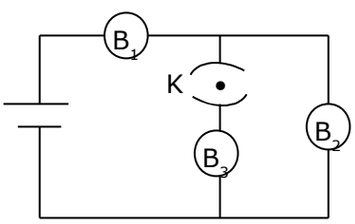
27. B_1, B_2 and B_3 are the three identical bulbs connected to a battery of steady e.m.f. with key K closed. What happens to the brightness of the bulbs B_1 and B_2 when the key is opened?

a) Brightness of the bulbs B_1 increases and that of B_2 decreases.

b) Brightness of the bulbs B_1 and B_2 increases

c) Brightness of the bulb, B_1 decreases and that of B_2 increases.

d) Brightness of the bulbs B_1 and B_2 decreases.



Ans: (c)

28. Magnetic field at the centre of a circular coil of radius R due to current I flowing through it is B. The magnetic field at a point along the axis at distance R from the centre is ……

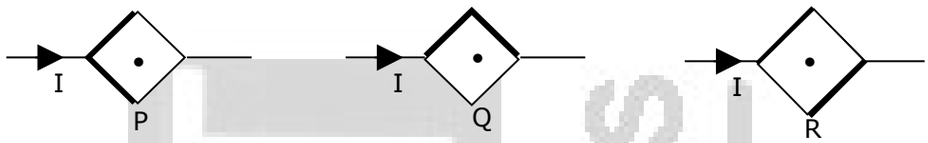
a) $\frac{B}{2}$ b) $\frac{B}{4}$ c) $\frac{B}{\sqrt{8}}$ d) $\sqrt{8}\,B$

Ans: (c)

$B_A = \frac{B_C}{\sqrt{8}}$ if $x = R$

29. Two thick wires and two thin wires, all of same material and same length, form a square in three different ways P, Q and R as shown in the figure. With correct connections shown, the magnetic field due to the current flow, at the centre of the loop will be zero in case of ……

a) Q and R only b) P only c) P and Q only d) P and R only



Ans: (d)

Resistance of the two branches are identical in P & R

30. There is a uniform magnetic field directed perpendicular and into the plane of the paper. An irregular shaped conducting loop is slowly changing into a circular loop in the plane of the paper. Then ……

a) current is induced in the loop in the anti-clockwise direction

b) current is induced in the loop in the clockwise direction

c) AC is induced in the loop

d) no current is induced in the loop

Ans: (a)

Use Fleming's right hand rule

31. The dimensions of 'resistance' are same as those of ……. where h is the Planck's constant, e is the charge.

a) $\frac{h^2}{e^2}$ b) $\frac{h^2}{e}$ c) $\frac{h}{e^2}$ d) $\frac{h}{e}$

Ans: (c)

$$R = \frac{V}{I} = \frac{W}{QI} = \frac{ML^2T^{-2}}{A^2T}$$

$$R = ML^2T^{-3}A^{-2}$$

$$\frac{h}{e^2} = ML^2T^{-3}A^{-2}$$

32. A train is moving slowly on a straight track with a constant speed of 2 ms^{-1}. A passenger in that train starts walking at a steady speed of 2 ms^{-1} to the back of the train in the opposite direction of the motion of the train. So to an observer standing on the platform directly in front of that passenger, the velocity of the passenger appears to be …….

a) 4 ms^{-1} b) 2 ms^{-1}

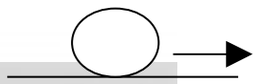
c) 2 ms^{-1} in the opposite direction of the train d) zero

Ans: (d)

Distance covered by train in one second is equal to distance covered by passenger in one second in opposite direction.

33. A ball rests upon a flat piece of paper on a table top. The paper is pulled horizontally but quickly towards right as shown. Relative to its initial position with respect to the table, the ball ……

(1) remains stationary if there is no friction between the paper and the ball



(2) moves to the left and starts rolling backwards, i.e. to the left if there is a friction between the paper and the ball

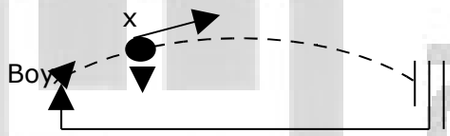
(3) moves forward, i.e. in the direction in which the paper is pulled

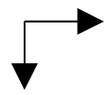
Here, the correct statement/s is/are ……..

a) both (1) and (2) b) only (3) c) only (1) d) only (2)

Ans: (a)

34. A boy throws a cricket ball from the boundary to the wicket-keeper. If the frictional force due to air cannot be ignored, the forces acting on the ball at the position X are represented by …….



a)  b)  c)  d) 

Ans: (c)

Resistance of air is acting in opposite direction to motion of the body.

35. If the linear momentum of a body is increased by 50%, then the kinetic energy of that body increases by ……..

a) 100% b) 125% c) 225% d) 25%

Ans: (b)

$$\frac{K_2}{K_1} = \frac{P_2^{\,2}}{P_1^{\,2}} = \left[\frac{150}{100}\right]^2 = \frac{9}{4}$$

$$100\left(\frac{K_2}{K_1} - 1\right) = \left(\frac{9}{4} - 1\right) x\,100$$

$$\left[\frac{K_2 - K_1}{K}\right] x\,100 = \frac{5}{4} x\,100 = 125\%$$

36. The temperature of a gas contained in a closed vessel of constant volume increases by 1°C when the pressure of the gas is increased by 1%. The initial temperature of the gas is ……

a) 100 K b) 273° C c) 100° C d) 200 K

Ans: (a)

$P \propto T$

$$100 x \frac{dp}{P} = \frac{dT}{T} x\,100$$

$1 = \frac{1}{T} \times 100$

$T = 100K.$

37. A motorboat covers a given distance in 6 hours moving downstream on a river. It cover the same distance in 10 hours moving upstream. The time it takes to cover the same distance in still water is …….

a) 9 hours b) 7.5 hours c) 6.5 hours d) 8 hours

Ans: (b)

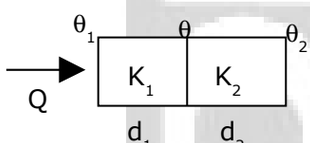
Total time of journey in stillwater.

$t = \frac{2t_1t_2}{t_1 + t_2} = \frac{2 \times 6 \times 10}{16} = \frac{120}{16} = 7.5 \text{ hrs}$

38. Two slabs are of the thicknesses d_1 and d_2. Their thermal conductivities are K_1 and K_2 respectively. They are in series. The free ends of the combination of these two slabs are kept at temperatures θ_1 and θ_2. Assume $\theta_1 > \theta_2$. The temperature θ of their common junction is …….

a) $\frac{K_1\theta_1 + K_2\theta_2}{\theta_1 + \theta_2}$ b) $\frac{K_1\theta_1 d_1 + K_2\theta_2 d_2}{K_1 d_2 + K_2 d_1}$ c) $\frac{K_1\theta_1 d_2 + K_2\theta_2 d_1}{K_1 d_2 + K_2 d_1}$ d) $\frac{K_1\theta_1 + K_2\theta_2}{K_1 + K_2}$

Ans: (c)



$K_1\left[\frac{\theta_1 - \theta}{d_1}\right] = K_2\left[\frac{\theta - \theta_2}{d_2}\right]$

$Q = \frac{K_1\theta_1 d_2 + K_2\theta_2 d_1}{K_1 d_2 + K_2 d_1}$

39. Hot water cools from 60°C to 50°C in the first 10 minutes and to 42°C in the next 10 minutes. Then the temperature of the surroundings is …….

a) 20°C b) 30°C c) 15°C d) 10°C

Ans: (d)

$\frac{d\theta}{dt} \propto \left[\frac{\theta_i + \theta_f}{2} - \theta_s\right]$

$1 = [55 - x]\, k$

$K = 1/[55 - x]$

$\frac{8}{10} = [46 - x] \times \frac{1}{55 - x}$

$x = 10° C$

40. The efficiency of Carnot's heat engine is 0.5 when the temperature of the source is T_1 and that of sink is T_2. The efficiency of another Carnot's heat engine is also 0.5. The temperature of source and sink of the second engine are respectively …….

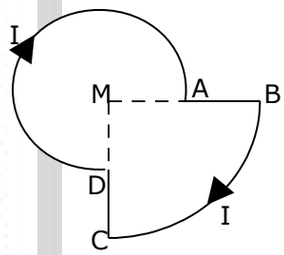
a) $2T_1, 2T_2$ b) $2T_1, \frac{T_2}{2}$ c) $T_1 + 5, T_2 - 5$ d) $T_1 + 10, T_2 - 10$

Ans: (a)

$$\eta = 1 - \frac{T_2}{T_1}$$

Efficiency remains same when both T_1 and T_2 are increased by same factor

41. A current I is flowing through the loop. The direction of the current and the shape of the loop are as shown in the figure. The magnetic field at the centre of the loop is $\frac{\mu_0 I}{R}$ times ……. (MA = R, MB = 2R, ∠DMA = 90°)



a) $\frac{5}{16}$, but out of the plane of the paper

b) $\frac{5}{16}$, but into the plane of the paper

c) $\frac{7}{16}$, but out of the plane of the paper

d) $\frac{7}{16}$, but into the plane of the paper

Ans: (d)

$$B = \frac{\mu_0 I}{4\pi r}[\theta \text{ in rad}]$$

$$B_1 = \frac{\mu_0 I}{4\pi r} \times \frac{3\pi}{2} = \frac{3\mu_0 I}{8r}$$

$$B_2 = \frac{\mu_0 I}{4\pi(2R)} \times \frac{\pi}{2} = \frac{\mu_0 I}{16r}$$

$$B_1 + B_2 = \frac{7}{16}\frac{\mu_0 I}{r}$$

42. An ideal choke draws a current of 8A when connected to an AC supply of 100 V, 50 Hz. A pure resistor draws a current of 10 A when connected to the same source. The ideal choke and the resistor are connected in series and then connected to the AC source of 150 V, 40 Hz. The current in the circuit becomes ……

a) $\frac{15}{\sqrt{2}}$ A b) 8 A c) 18 A d) 10 A

Ans: (a)

$$R = \frac{100}{10} = 10\Omega$$

$$X_L = \frac{100}{8} = 12.5 = 2\pi fL$$

$$L = 0.04 \text{ henry}$$

$$X_L' = 2\pi f' L \approx 10\ \Omega$$

$$Z' = \sqrt{R^2 + x_L'^2} = 10\sqrt{2}$$

$$I = \frac{150}{10\sqrt{2}} = \frac{15}{\sqrt{2}} A$$

43. The spectrum of an oil flame is an example for …….

a) line emission spectrum b) continuous emission spectrum

c) line absorption spectrum d) band emission spectrum

Ans: (b)

44. According to Einstein's photoelectric equation, the graph of K.E. of the photoelectron emitted from the metal versus the frequency of the incident radiation gives a straight line graph, whose slope ……..

a) depends on the intensity of the incident radiation

b) depends on the nature of the metal and also on the intensity of incident radiation

c) is same for all metals and independent of the intensity of the incident radiation

d) depends on the nature of the metal

Ans: (c)

Slope = h, Planck's constant

45. An electron is moving in an orbit of a hydrogen atom from which there can be a maximum of six transitions. An electron is moving in an orbit of another hydrogen atom from which there can be a maximum of three transitions. The ratio of the velocity of the electron in these two obrits is …….

a) $\frac{1}{2}$ b) $\frac{2}{1}$ c) $\frac{5}{4}$ d) $\frac{3}{4}$

Ans: (d)

Number of transitions = $\frac{n(n-1)}{2} = 6 \Rightarrow n = 4$

$\frac{n'(n'-1)}{2} = 3 \Rightarrow n' = 3$

$\frac{V}{V'} = \frac{n'}{n} = \frac{3}{4}$

46. γ_1 is the frequency of the series limit of Lyman series, v_2 is the frequency of the first line of Lyman series and γ_3 is the frequency of the series limit of the Balmer series. Then …….

a) $\gamma_1 - \gamma_2 = \gamma_3$ b) $\gamma_1 = \gamma_2 - \gamma_3$ c) $\frac{1}{\gamma_2} = \frac{1}{\gamma_1} + \frac{1}{\gamma_3}$ d) $\frac{1}{\gamma_1} = \frac{1}{\gamma_2} + \frac{1}{\gamma_3}$

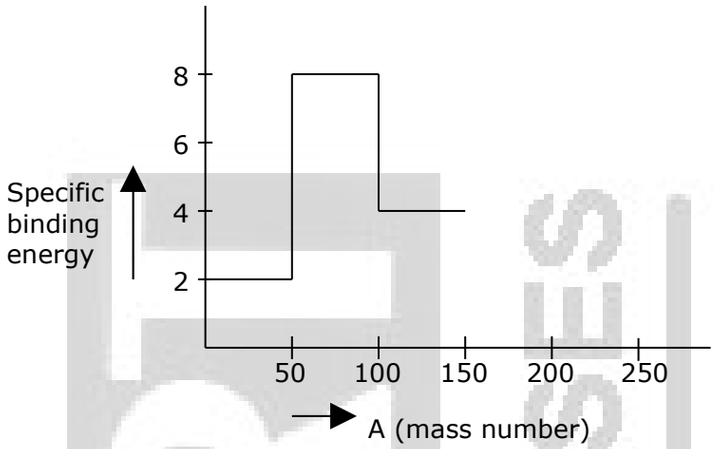
Ans: (a)

$\gamma = RC\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\gamma_1 = RC\left[1 - \frac{1}{\infty}\right] = RC$ $\gamma_2 = RC\left[1 - \frac{1}{4}\right] = \frac{3RC}{4}$

$\gamma_3 = RC\left[\frac{1}{4} - \frac{1}{\infty}\right] = \frac{RC}{4} \Rightarrow \gamma_1 - \gamma_2 = \gamma_3$

47. Assume the graph of specific binding energy versus mass number is as shown in the figure. Using this graph, select the correct choice from the following.



a) Fusion of two nuclei of mass number lying in the range of $100 < A < 200$ will release energy.

b) Fusion of two nuclei of mass number lying in the range of $51 < A < 100$ will release energy.

c) Fusion of two nuclei of mass number lying in the range of $1 < A < 50$ will release energy.

d) Fission of the nucleus of mass number lying in the range of $100 < A < 200$ will release energy when broken into two fragments.

Ans: (b)

48. Pick out the correct statement from the following.

a) Energy released per unit mass of the reactant is less in case of fusion reaction

b) Packing fraction may be positive or may be negative

c) Pu^{239} is not suitable for a fission reaction

d) For stable nucleus, the specific binding energy is low

Ans: (b)

49. A radioactive sample S_1 having the activity A_1 has twice the number of nuclei as another sample S_2 of activity A_2. If $A_2 = 2A_1$, then the ratio of half life of S_1 to the half life of S_2 is

a) 4 b) 2 c) 0.25 d) 0.75

Ans: (a)

Activity $A \propto \frac{N}{T}$

$$\frac{T_1}{T_2} = \frac{N_1}{N_2} \times \frac{A_2}{A_1} = \frac{2N_2}{N_2} \times \frac{2A_1}{A_1} = \frac{4}{1}$$

50. When a neutron is disintegrated to give a β-particle, ……

a) a neutrino alone is emitted b) a proton and neutrino are emitted

c) a proton alone is emitted d) a proton and an antineutrino are emitted

Ans: (d)

$N \rightarrow P + \beta + v$

51. The forbidden energy gap in Ge is 0.72 eV. Given, hc = 12400 eV - $\overset{\circ}{A}$. The maximum wavelength of radiation that will generate an electron hole pair is ……

a) 172220 $\overset{\circ}{A}$ b) 172.2 $\overset{\circ}{A}$ c) 17222 $\overset{\circ}{A}$ d) 1722 $\overset{\circ}{A}$

Ans: (c)

$E = \frac{12400}{\lambda}$ (eV)

$\lambda = \frac{12400}{0.72} = 17220\ \overset{\circ}{A}$

52. Pick out the statement which is NOT correct.

a) At a low temperature, the resistance of a semiconductor is very high.

b) Movement of holes is restricted to the valence band only

c) Width of the depletion region increases as the forward bias voltage increases in case of a N – P junction diode.

d) in a forward bias condition, the diode heavily conducts.

Ans: (c)

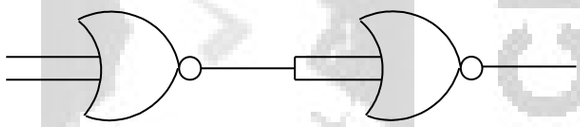
53. In a given direction, the intensities of the scattered light by a scattering substance for two beams of light are in the ratio of 256 : 81. The ratio of the frequency of the first beam to the frequency of the second beam is ……

a) 64 : 127 b) 1 : 2 c) 64 : 27 d) 2 : 1

NO ANSWER

$\frac{I_1}{I_2} = \left(\frac{f_1}{f_2}\right)^4 \Rightarrow \frac{f_1}{f_2} = \left(\frac{I_1}{I_2}\right)^{1/4} = \frac{(256)^{1/4}}{(81)^{1/4}} = \frac{4}{3}$

54. Identify the logic operation performed by the circuit given here



a) OR b) NOR c) NOT d) NAND

Ans: (a)

$Y = \overline{A + B}$ $Y' = \overline{\overline{A + B}} = A + B$

55. The de-Broglie wavelength of the electron in the ground state of the hydrogen atom is …….. (radius of the first orbit of hydrogen atom = 0.53 A)

a) 1.67 $\overset{\circ}{A}$ b) 3.33 $\overset{\circ}{A}$ c) 1.06 $\overset{\circ}{A}$ d) 0.53 $\overset{\circ}{A}$

Ans: (b)

$\lambda = \frac{2\pi r}{n} = \frac{2 \times 3.14 \times 0.53}{1} = 3.33\ \overset{\circ}{A}$

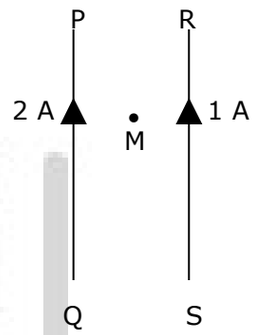
56. PQ and RS are long parallel conductors separated by certain distance. M is the midpoint between them (see the figure). The net magnetic field at M is B. Now, the current 2A is switched off. The field at M now becomes ……..

a) 2 B

b) B

c) $\frac{B}{2}$

d) 3 B



Ans: (b)

$B_R = B_1 - B_2 = 2B - B = B$

If $2B = 0$, $B_R = B$

57. An electron enters the space between the plates of a charged capacitor as shown. The charge density on the plate is σ. Electric intensity in the space between the plates is E. A uniform magnetic field B also exists in that space perpendicular to the direction of E. The electron moves perpendicular to both $\vec{E}$ and $\vec{B}$ without any change in direction.

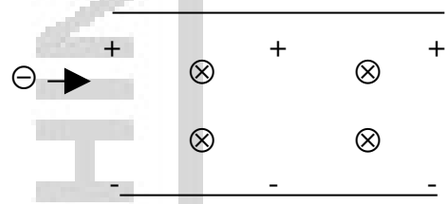
The time taken by the electron to travel a distance ℓ in the space is …….

a) $\frac{\sigma \ell}{\epsilon_o B}$

b) $\frac{\sigma B}{\epsilon_o \ell}$

c) $\frac{\epsilon_o \ell B}{\sigma}$

d) $\frac{\epsilon_o \ell}{\sigma B}$



Ans: (c)

$qE = q\,vB$

$v = \frac{E}{B} = \frac{\sigma}{\epsilon_o B}$ $(\because E = \frac{\sigma}{\epsilon_o})$

$t = \frac{\ell}{v} = \frac{\ell}{\frac{\sigma}{\epsilon_0 B}} = \frac{\epsilon_o \ell B}{\sigma}$

58. In a series resonant R – L – C circuit, the voltage across R is 100 V and the value of R = 1000 Ω. The capacitance of the capacitor is 2 x 10^{-6} F; angular frequency of AC is 200 rad s^{-1}. Then the P.D. across the inductance coil is ……..

a) 100 V b) 40 V c) 250 V d) 400 V

Ans: (c)

$$I = \frac{V}{R} = \frac{100}{1000} = 0.1 \text{ A}$$

$$V_L = V_C = \frac{I}{WC} = \frac{0.1}{200 \times 2 \times 10^{-6}} \times = 250 \text{ V}$$

59. A capacitor and an inductance coil are connected in separate AC circuits with a bulb glowing in both the circuits. The bulb glows more brightly when ……

a) an iron rod is introduced into the inductance coil

b) the number of turns in the inductance coil is increased

c) separation between the plates of the capacitor is increased

d) a dielectric is introduced into the gap between the plates of the capacitor

Ans: (d)

$$I = \frac{V}{\sqrt{R^2 + X_L{}^2}} \text{ and } I = \frac{V}{\sqrt{R^2 + X_C{}^2}}$$

60. A horizontal metal wire is carrying an electric current from the north to the south. Using a uniform magnetic field, it is to be prevented from falling under gravity. The direction of this magnetic field should be towards the ……..

a) north b) south c) east d) west

Ans: (c)

Using Flemings left hand rule