Subject: **CHEMISTRY, MATHEMATICS & PHYSICS**

Paper Code: **JEE_ Main_ Sample Paper - V**

Duration: 3 hours

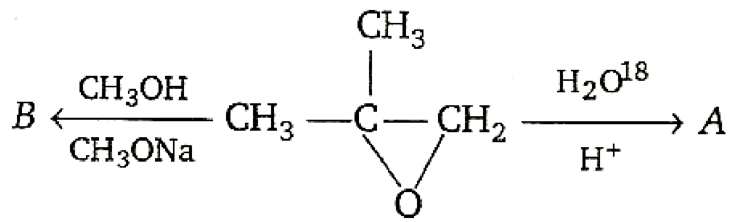
Maximum Marks: 360

General Instructions:

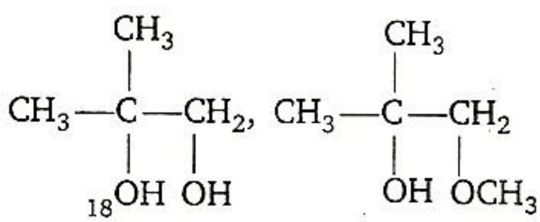
1. Immediately fill in the particulars on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The test is of **3 hours duration.**
3. The Test Booklet consists of **90** questions. The maximum marks are **360.**
4. There are **three** parts in the question paper A, B, C consisting of **Chemistry, Mathematics** and **Physics** having 30 questions in each part of equal weight age. Each question is allotted **4 (four)** marks for correct response.
5. Candidates will be awarded marks as stated above in instruction No. 4 for correct response of each question. (1/4) (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
6. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 5 above.

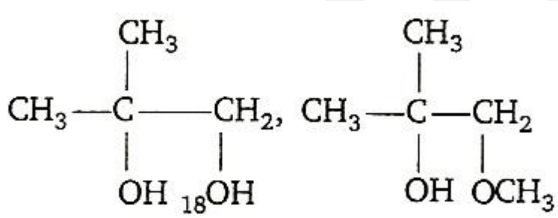
PART – A - CHEMISTRY

1)



A and B are

a) 

b) 

c) Both (a) and (b) are correct
d) None of the above is correct

2) Statement I: pH of 10 M HCl aqueous solution is less than 1.
Statement II: pH is, negative logarithm of [H^+] concentration.
   a) Statement I is true; Statement II is true; Statement II is not the correct explanation for statement I.

b) Statement I is true; Statement II is false.
c) Statement I isfalse; Statement II is true.
d) Statement I is true; Statement II is true; Statement II is the correct explanation for statement I.

3) Correct order of bond energy is
a) $N_2 > N_2^+ > N_2^- > N_2^{2-}$
b) $N_2^2 > N_2^- > N_2^{2-} > N_2$
c) $N_2 > N_2^+ = N_2^- > N_2^{2-}$
d) $N_2^- > N_2 = N_2^+ > N_2^{2-}$

4) The correct order of dipole moment is
a) $CH_4 < NF_3 < NH_3 < H_2O$
b) $NF_3 < CH_4 < NH_3 < H_2O$
c) $NH_3 < NF_3 < CH_4 < H_2O$
d) $H_2O < NH_3 < NF_3 < CH_4$

5) The pH of 0.10 M NH_3 solution is [Given $K_b = 1.8 \times 10^{-5}$; log 1.35 = 0.13]
a) 1
b) 12.87
c) 11.13
d) 1.35

6)
$$\underset{\text{(glucose derivative)}}{A} + HIO_4 \longrightarrow 3HCOOH + HCHO + CHO-COOH$$

A is

a) gluconic acid
b) glucaric acid
c) glucitol
d) glucouronic acid

7) $N_0/2$ atoms of X (g) are converted into X^+ (g) by energy E. $N_0/2$ atoms of X(g) are converted into X^- (g) by energy E_2. Hence, ionisation potential and electron affinity of X (g) are

a) $\frac{2E_1}{N_0}, \frac{2(E_1 - E_2)}{N_0}$
b) $\frac{2E_1}{N_0}, \frac{2E_2}{N_0}$
c) $\frac{(E_1 - E_2)}{N_0}, \frac{2E_2}{N_0}$
d) None is correct

8) A hydrogen electrode X was placed in a buffer solution of sodium acetate and acetic acid in the ratio a:b and another hydrogen electrode Y was placed in a buffer solution of sodium acetate and acetic acid in the ratio b:a. If reduction potential values for two cells are found to be E_1 and E_2 respectively w.r.t. standard hydrogen electrode, the pK_a values of the acid can be given as

a) $\frac{E_1 - E_2}{0.118}$

b) $-\frac{E_1 + E_2}{0.118}$

c) $\frac{E_1}{E_2} X\, 0.118$

d) $\frac{E_2 - E_1}{0.118}$

9) A square planar complex is formed by hybridization of which atomic orbitals ?

a) s, P_x, P_y, P_z, d_{yz}
b) s, P_x, P_y, $d_{x^2-y^2}$
c) s, P_x, P_y, d_{z^2}
d) s, P_x, P_z, d_{xy}

10) For the dissolution of solid solute in liquid solvent the proper dissociation of ionic crystal and then, solvation (sheath formation around ions) are quite required. For the spontaneous dissolution

a) U (Lattice energy) = $\Delta H_{solvation}$ (Solvation energy)
b) U <$\Delta H_{solvation}$
c) U >$\Delta H_{solvation}$
d) both lattice energy and solvation energy is not concerned for spontaneity

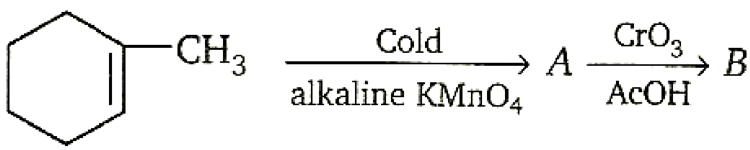
11) Which of the following express correct relation of the cell potential (E_3) for the cell reaction, which is actually overall cell reaction on adding two half cell reactions, whose potentials are respectively E_1 and E_2

a) $E_3 = E_1 + E_2$

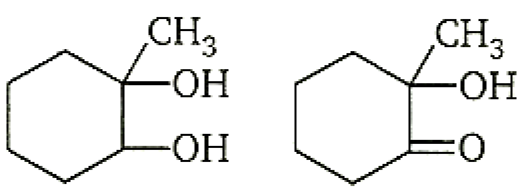
b) $E_3 = \frac{(n_1E_1 + n_2 + E_2)}{n_3}$

c) $E_3 = \frac{(E_1 + E_2)}{n_3}$

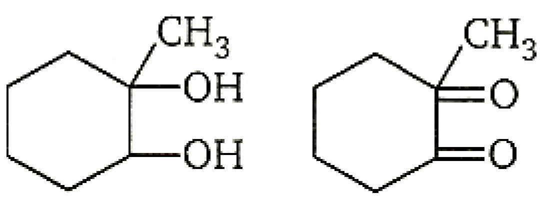
d) $E_3 = nE_1 + nE_2$



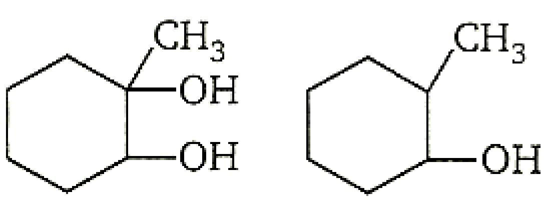
12) A and B are, respectively



a)



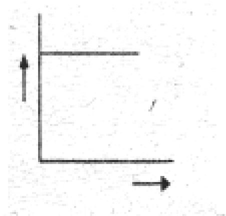
b)

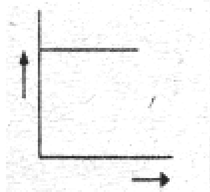


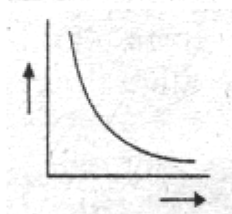
c)

d) No formation of A and B

13) Which one of the following graph verifies the Boyle's law?

a) 

b) 

c) 

d) All of these.

14) What is the decreasing order of strength of the bases OH^-, $N\bar{H}_2$, H – C $\equiv C^-$, CH_3^-

a) $C\bar{H}_3 > N\bar{H}_2 > H - C \equiv \overset{\Theta}{C} > OH^-$

b) $H - C \equiv \overset{\Theta}{C} > C\bar{H}_3 > N\bar{H}_2 > OH^-$

c) $OH^- > N\bar{H}_2 > H - C \equiv \overset{\Theta}{C} > C\bar{H}_3$

d) $N\bar{H}_2 > H - C \equiv \overset{\Theta}{C} > OH^- > C\bar{H}_3$

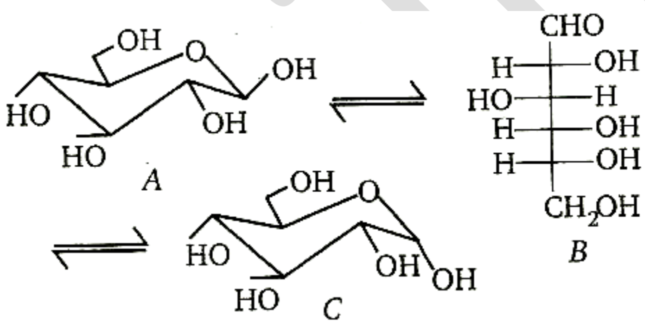
15) Oxidation number of (S) in H_2SO_3 is

a) 5
b) 10
c) 6
d) 8

16) Thermal stability of alkaline earth metal carbonates decreases in the order

a) $BaCO_3 > SrCO_3 > CaCO_3 > MgCO_3$
b) $BaCO_3 > SrCO_3 > MgCO_3 > CaCO_3$
c) $CaCO_3 > SrCO_3 > MgCO_3 > BaCO_3$
d) $MgCO_3 > CaCO_3 > SrCO_3 > BaCO_3$

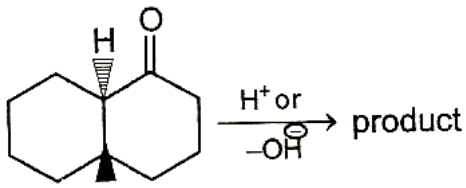
17)



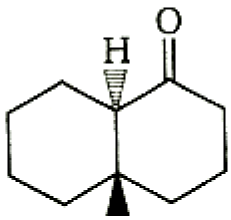
Which of the following is correct about A, B and C?

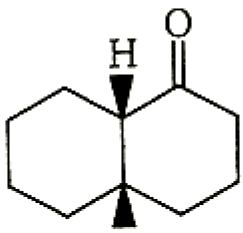
a) A, B and C are anomers
b) A, Band C are metamers
c) Only A and Care anomers
d) None of the above

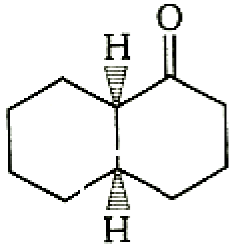
18)



Product is

a) 

b) 

c) 

d) Both (a) and (b)

19) In the reaction sequence

$$X \xrightarrow{Ca(OH)_2} Y \xrightarrow[\text{distillation}]{\text{Dry}} \text{Acetone} \xrightarrow[H_2SO_4]{\text{Conc.}} Z;$$

a) CH_3CHO, aldol, phorone
b) HCOOH, $CHCOO)_2$ Ca, mesityl oxide
c) CH_3COOH, $(CH_3COO)_2$ Ca, mesityl oxide
d) CH_3COOH, $(CH_3COO)_2$ Ca, pinacol

Below given 3 questions are based on the Paragraph given. First read the paragraph and then answer the questions:-

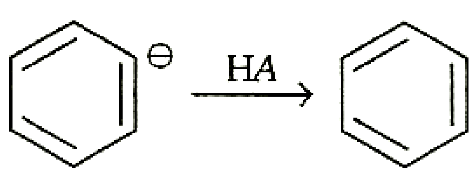
Paragraph

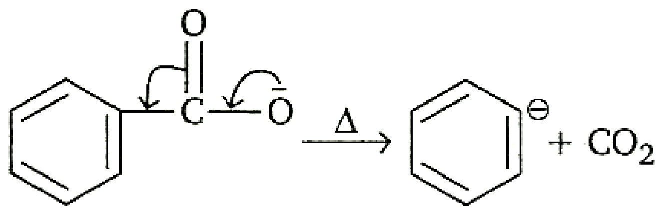
The decarboxylation of aromatic acids is most often carried out by heating with Cu-quinoline

$$ArCOOH \xrightarrow{Cu-quinoline} ArH + CO_2$$

Cuprous salts of aromatic acids, actually undergoes decarboxylation. However, two other methods can be used with certain substrates.

Method 1: Salt of acid, $ArCOO^-$ is heated (SEl)

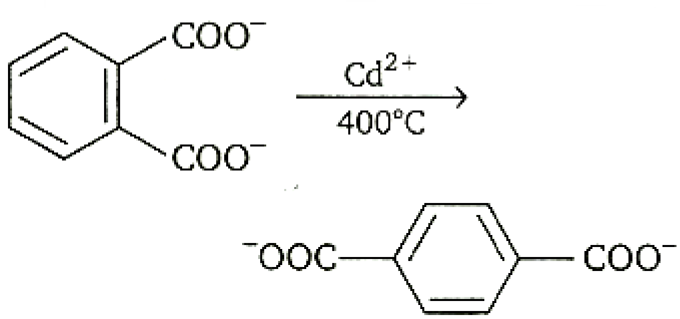
Step II :


Step I : 

Method II : Carboxylic acid is heated with a strong acid, often sulphuric acid.

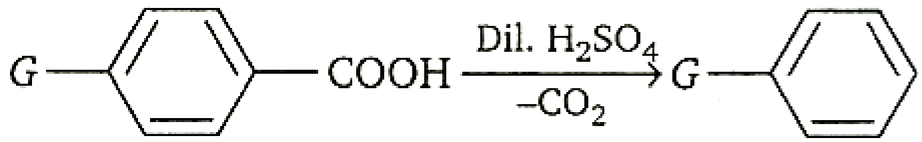
$$ArCOOH \xrightarrow{H^+} Ar^+\!\!<^{COOH}_{H} \xrightarrow{-H^+} Ar\!<^{COO^-}_{H} \xrightarrow{-CO_2} ArH + CO_2$$

Decarboxylation takes place by the arenium ion mechanism, with H^+ electrophile. Evidently, the order of electro fugal ability is $CO_2 > H^+ > COOH^+$. Rearrangements are also known to take place. For example, when the phthalate ion is heated with catalytic amount of cadmium, the terephthalate ion is produced.



In a similar process, potassium benzoate heated with cadmium salts disproportionate. The rearrangement is named as 'Henkel rearrangement'.

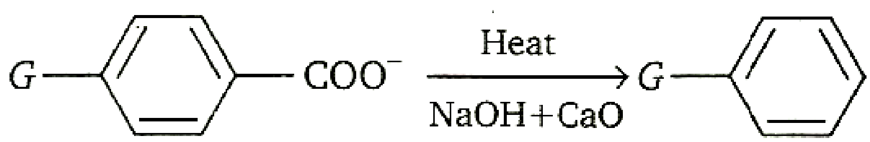
20)



Mark out the correct order of - G (functional group) according to their ease to facilitate the decarboxylation reaction.

a) $-NO_2 > -CHO > -H > -Cl > -CH_3$
b) $-CH_3 > -H > -Cl > -CHO > -NO_2$
c) $-CH_3 > -Cl > -H > -NO_2 > -CHO$
d) $-CHO > -NO_2 > -H > -CH3 > -Cl$

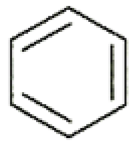
21)

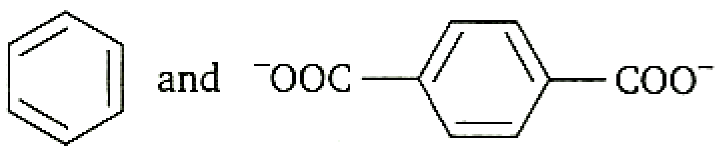


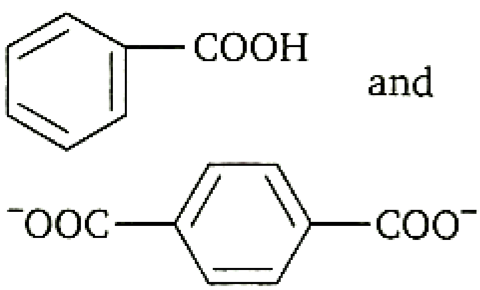
Mark out the correct order of -G (functional group) according to their ease to facilitate the decarboxylation reaction.

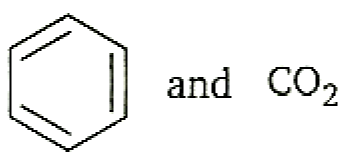
a) $-OCH_3 > -NO_2 > -F > -H > -CH_3$
b) $-NO_2 > -F > -H > -CH_3 > -OCH_3$
c) $-NO_2 > -F > -OCH_3 > -H > -CH_3$
d) $-OCH_3 > -CH_3 > -H > -F > -NO_2$

22) In the 'Henkel reaction' when potassium benzoate is heated with cadmium salts, the products are

a) 

b) 

c) 

d) 

23) The mechanism for the reaction is given below.

$$2P + Q \rightarrow S + T$$
$$P + Q \rightarrow R + S \quad (slow)$$
$$A + R \rightarrow U \quad (fast)$$

The rate law expression for the reaction is

a) R = k $[P]^2[Q]$
b) R = k [P] [Q]

c) R = k [A] [R]
d) R = k $[P]^2$

Below given 3 questions are based on the Paragraph given. First read the paragraph and then answer the questions:-

Paragraph

Properties, whose values depend only the concentration of solute particles in solution and not on the identity of the solute, are called colligative properties. There may be change in number of moles of solute due to ionization or association hence these properties are also affected. Number of moles of the product is related to degree of ionization or association by Vant Hoff factor 'i'.

Given by $i = [1 + (n-1)\alpha]$ *for dissociation and*

$$i = \left[1 + \left(\frac{1}{n} - 1\right)\alpha\right] \text{ for association}$$

where n is the no. of products (ions or molecules) obtained per mole of the reactant. A dilute solution contains't' moles of solute X in 1kg of solvent with molal elevation constant Kb. The solute dimerises in the solution according to the following equation. The degree of association is α.

$$2X \rightleftharpoons X_2$$

24) The Van't Hoff factor will be [if we start with one mole of X]

a) $i = 1-2\alpha$
b) $i = 1-\alpha/2$
c) $i = 1 + \alpha/2$
d) $i = 1 + \alpha$

25) The colligative properties observed will be

a) $\Delta P_{obs} > \Delta P_{actual}$
$\Delta T_{obs} > \Delta Tb_{actual}$
$\Delta Tf_{obs} > \Delta Tf_{actual}$

b) $\Delta P_{obs} = \Delta P_{actual}$
$\Delta T_{obs} = \Delta Tb_{actual}$
$\Delta Tf_{obs} = \Delta Tf_{actual}$

c) $\Delta P_{obs} < \Delta P_{actual}$
$\Delta T_{obs} < \Delta Tb_{actual}$
$\Delta Tf_{obs} < \Delta Tf_{actual}$

d) $\Delta P_{obs} \geq \Delta P_{actual}$

$\Delta T_{obs} = \Delta Tb_{actual}$

$\Delta Tf_{obs} < \Delta Tf_{actual}$

26) The equilibrium constant for the process can be expressed as

a) $K = \dfrac{K_b \dfrac{t}{\Delta t_b}}{1 - \dfrac{K_b t}{\Delta T_f}}$

b) $K = \dfrac{K_b\left(K_b t - \Delta T_b\right)}{\left[2\Delta T_b - K_b t\right]^2}$

c) $K = \dfrac{2(K_b t - \Delta T_b / \Delta T_b)}{2t\left[1 - \dfrac{2\left(K_b t - \Delta t_b\right)^2}{\Delta T_b}\right]}$

d) $K = \dfrac{\Delta Tb_{obs}}{\Delta Tf_{obs}}$

27) For $NH_4HS(s) \rightleftarrows NH_3(g) + H_2S(g)$, if K_p = 64 atm^2, equilibrium pressure of mixture is

a) 8 atm

b) 16 atm

c) 64 atm

d) 4 atm

28) The decreasing order of catenation of group 16 elements is

a) O> S > Se> Te
b) S>O>Se>Te
c) S> Se >O> Te
d) O > S> Te> Se

29) The type of hybridisation and possible geometry of tetrafluorides of members of oxygen family are

a) sp^3d, Irregular tetrahedral
b) Sp^3, tetrahedral
c) dsp^2, square planar
d) d^2sp^3, octahedral

30) Reaction of Br_2 on ethylene in presence ofNaCl gives the compound as major product is

a) $Br\text{-}CH_2\text{-}CH_2\text{-}Br$
b) $Cl\text{-}CH_2\text{-}CH_2\text{-}Br$
c) $ClCH_2\text{-}CH_2Cl$
d) NaCH=CHNa

PART – B - PHYSICS

31) The equation of plane progressive wave motion is y = a sin2$\pi/\lambda(vt-x)$. Velocity of particle is –

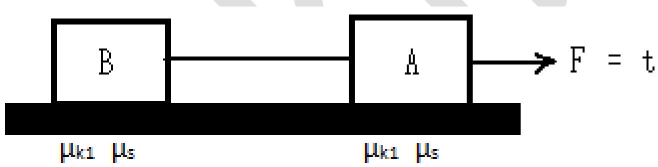
a) $y\frac{dv}{dx}$

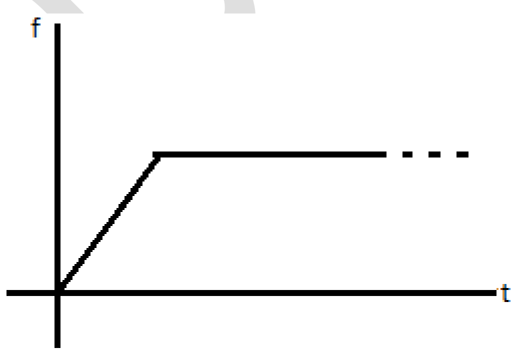
b) $v\frac{dy}{dx}$

c) $-y\frac{dv}{dx}$

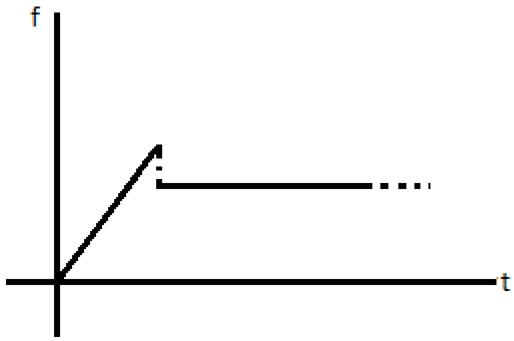
d) $-v\frac{dy}{dx}$

32) A force F = t is applied to a black A as shown in figure, where t is time in seconds. The force is applied at t = 0 seconds when the system was at rest. Which of the following graph correctly gives the frictional force between A and horizontal surface as a function of time t. [Assume that at t = 0, tension in the string connecting the two blocks is zero].

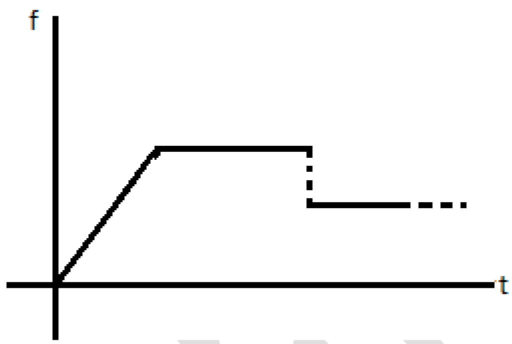




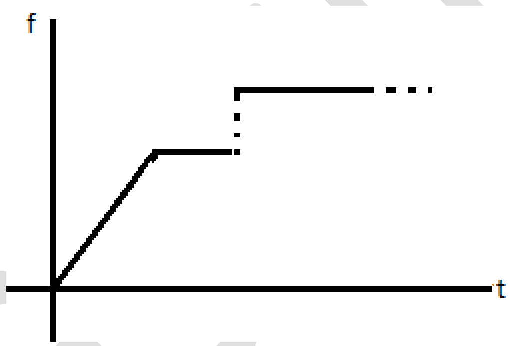
A



B c

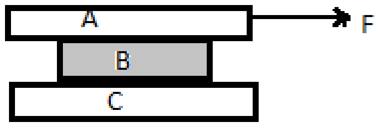


C



D

33) Given m_A = 20kg, m_B = 10kg, m_C = 20kg. Between A and B μ_1 = 0.3, between B and C μ_2 = 0.3 and between C and ground μ_3 = 0.1. The least horizontal force F to start the motion of any part of the system of three blocks resting upon one another as shown in figure is (g = 10m/s^2)



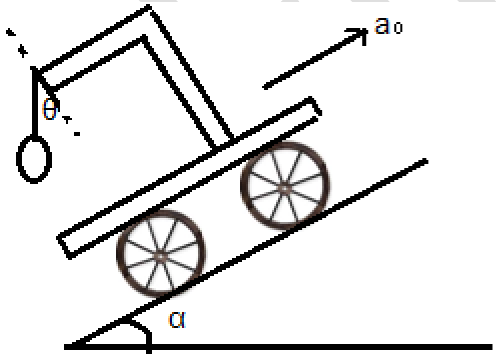
A 60N

B 90N

C 80N

D 50N

34) A pendulum of mass m hangs from a support fixed to a trolley. The direction of the string when the trolley rolls up a plane of inclination α with acceleration a_0 is



A $\theta = \tan^{-1}\alpha$

B $\theta = \tan^{-1}(a_0/g)$

C $\theta = \tan^{-1}(g/a_0)$

D $\theta = \tan^{-1}(a_0 + g\sin\alpha/g\cos\alpha)$

35) A uniform chain of length L and mass M is lying on a smooth table and one-third of its length is hanging vertically down over the edge of the table. If g is acceleration due to gravity, the work required to pull the hanging part on to the table is

A MgL

B MgL/3

C MgL/9

D MgL/18

36) A body of mass m_0 is placed on a smooth horizontal surface. The mass of the body is decreasing exponentially with disintegration constant λ. Assuming that the mass is ejected backwards with a relative velocity u. If initially the body was at rest, the speed of body at time t is

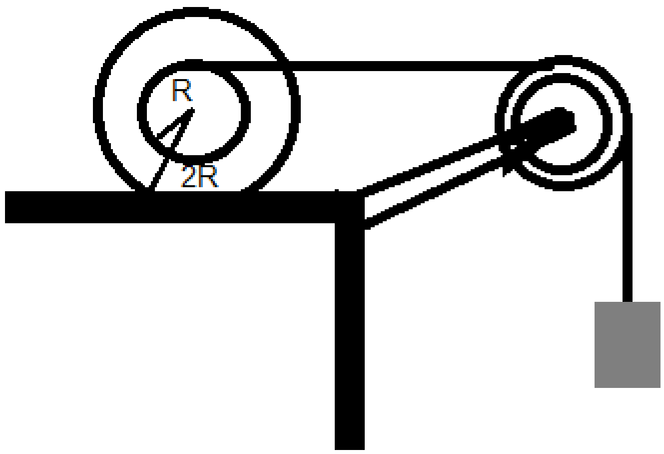
A $ue^{\lambda t}$

B $u\lambda t$

C $ue^{-\lambda t}$

D $u(1-e^{-\lambda t})$

37) In the figure shown mass of both, the special body and block is m. Moment of inertia of the spherical body about centre of mass is $2mR^2$. The spherical body rolls on the horizontal surface. There is no slipping at any surfaces in contact. The ratio of kinetic energy of the spherical body to that of block is



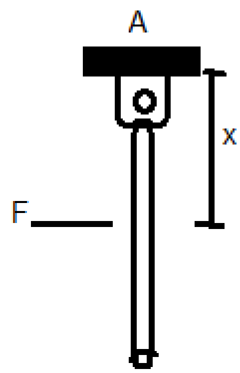
A ¾

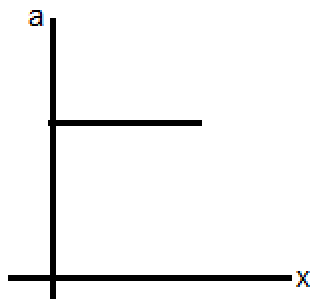
B 1/3

C 2/3

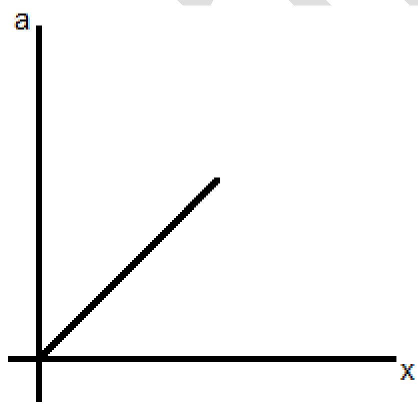
D ½

38) A rod of mass m and length l is hinged at one of its end A as shown in figure. A force F is applied at a distance x from A. The acceleration of centre of mass (a) varies with x as



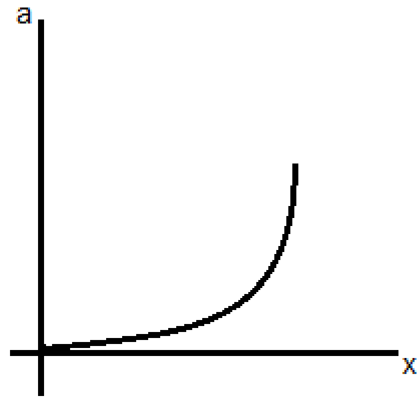


A

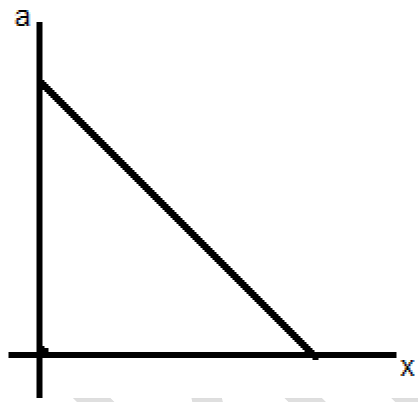


B

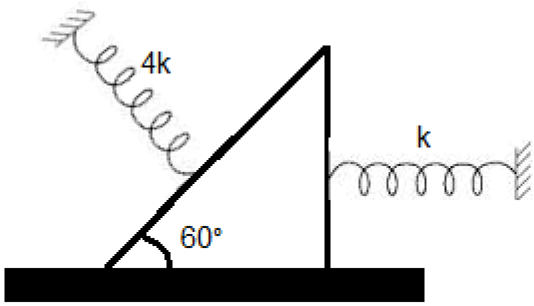
C



D



39) A smooth wedge of mass m and angle of inclination 60^o rests unattached between two springs of spring constant k and 4k, on a smooth horizontal plane, both springs in the unexpended position. The time period of small oscillations of the wedge (Assuming that the springs are constrained to get compressed along their length) equals –



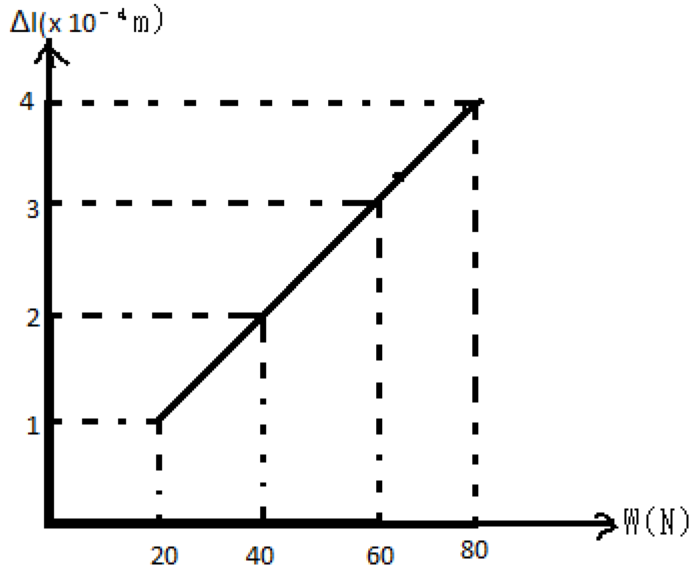
A $\pi\left(1+\frac{1}{2}\right)\sqrt{\frac{m}{k}}$

B $\pi\left(1+\frac{1}{\sqrt{3}}\right)\sqrt{\frac{m}{k}}$

C $\pi\left(1+\frac{2}{\sqrt{3}}\right)\sqrt{\frac{m}{k}}$

D None of the above

40) The adjacent graph shown the extension (Δl) of a wire of length 1m suspended from the top of a roof at one end and with a load W connected to the other end. If the cross-sectional area of the wire is 10^{-6} m^2, calculate from the graph the Young's modulus of the material of the wire.



s

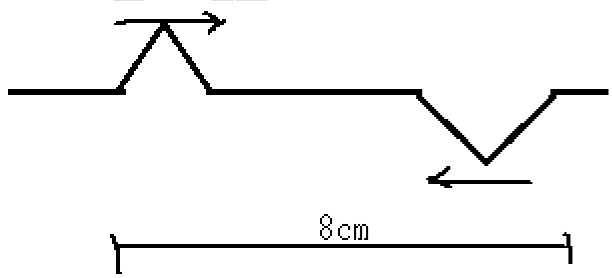
A $2 \times 10^{11} N/m^2$

B $2 \times 10^{-11} N/m^2$

C $3 \times 10^{12} N/m^2$

D $2 \times 10^{13} N/m^2$

41) Two pulses in a stretched string, whose centers are initially 8cm, apart, are moving towards each other as shown in the figure. The speed of each pulse is 2cm/s. After 2s the total energy of the pulses will be



A 0

B purely kinetic

C purely potential

D partly kinetic and partly potential

42) A closed organ pipe of length L and an open organ pipe contain gases of densities ρ_1 and ρ_2 respectively. The compressibility of gases is equal in both the pipes. Both the pipes are vibrating in their first overtone with same frequency. The length of the open organ pipe is

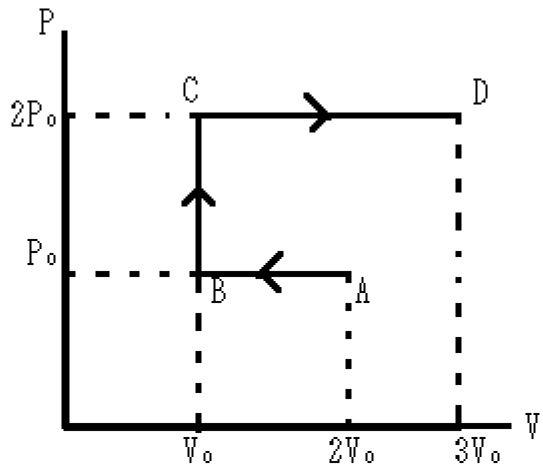
A L/3

B 4L/3

C $4L/3 \sqrt{\frac{\rho_1}{\rho_2}}$

D $4L/3 \sqrt{\frac{\rho_2}{\rho_1}}$

43) P-V diagram of an ideal gas is as shown in figure. Work done by the gas in the process ABCD is



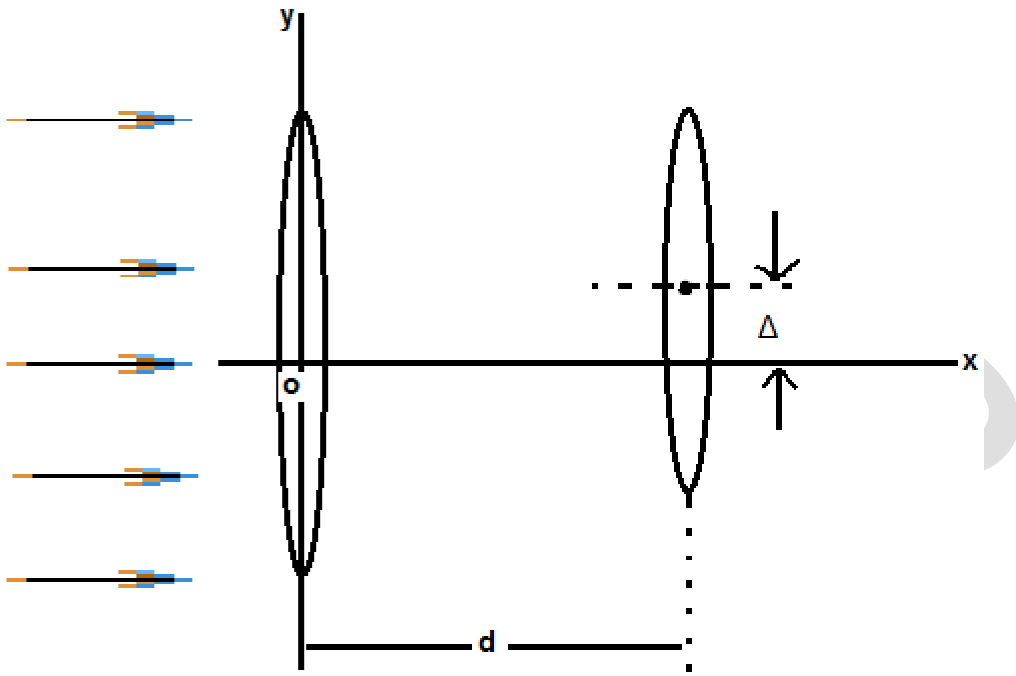
A $4P_0V_0$

B $2P_0V_0$

C $3P_0V_0$

D P_0V_0

44) Two thin convex lenses of focal length f_1 and f_2 are separated by a horizontal distance d (where $d < f_1$, $d < f_2$) and their centers are displaced by a vertical separation Δ as shown in figure.



Taking the origin of coordinates, O, at the centre of the first lens, the x and y-coordinates of the focal point of this lens system, for a parallel beam of rays coming from the left, are given by

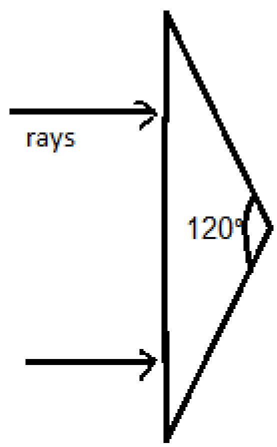
A $x = \frac{f_1 f_2}{f_1 + f_2}, y = \Delta$

B $x = \frac{f_1(f_2 + d)}{f_1 + f_2 - d}, y = \frac{\Delta}{f_1 + f_2}$

C $x = \frac{f_1 f_2 + d(f_1 - d)}{f_1 + f_2 - d}, y = \frac{\Delta(f_1 - d)}{f_1 + f_2 - d}$

D $x = \frac{f_1 f_2 + d(f_1 - d)}{f_1 + f_2 - d}, y = 0$

45) An isosceles prism of angle 120^o has a refractive index 1.44. Two parallel rays of monochromatic light entre the prism parallel to each other in air as shown. The rays emerging from the opposite face



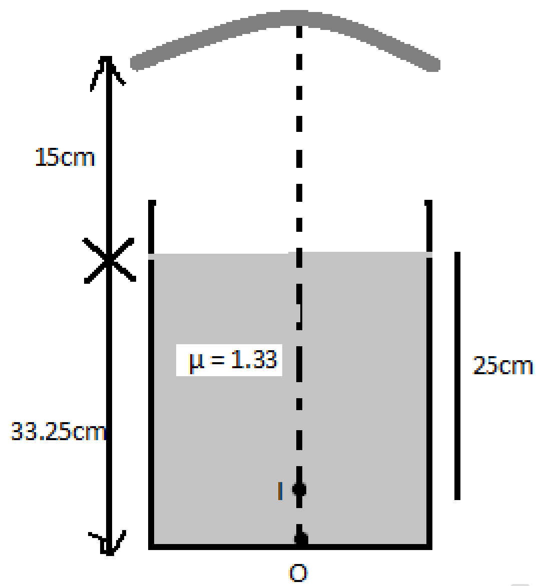
A are parallel to each other

B are diverging

C make an angle $2[\sin^{-1}(0.72) - 30^o]$ with each other

D make an angle $2\sin^{-1}(0.72)$with each other

46) A container is filled with water ($\mu = 1.33$) up to a height of 33.25cm. A concave mirror is placed 15cm above the water level and the image of an object placed at the bottom is formed 25cm below the water level. The focal length of the mirror is



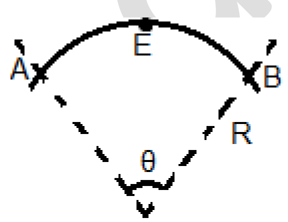
A 10cm

B 15cm

C 20cm

D 25cm

47) Figure shows an electric line of force which curves along a circular arc. The magnitude of electric field intensity is same at all points on this curve and is equal to E. If the potential at A is V, then the potential at B is:



A V – Erθ

B $V - E2R \sin\theta/2$

C $V + ER\theta$

D $V + 2ER \sin\theta/2$

48) Two point dipoles $p\hat{k}$ & $p/2\hat{k}$ are located at (0, 0, 0) & (1m, 0, 2m) respectively. The resultant electric field due to the two dipoles at the point (1m, 0, 0) is:

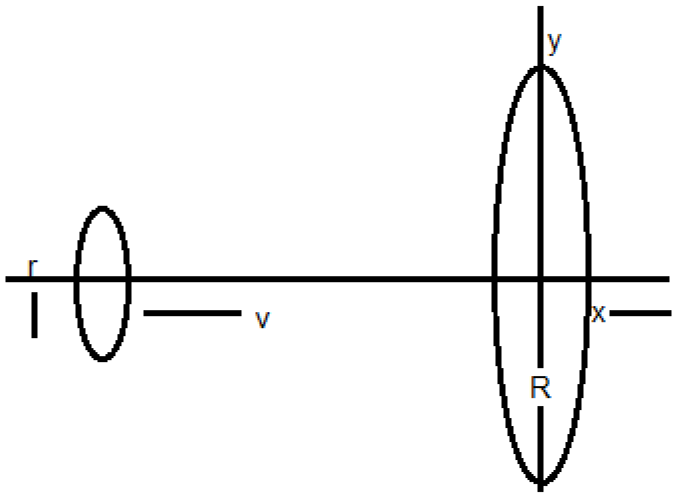
A $9p/32\pi\epsilon_0\hat{k}$

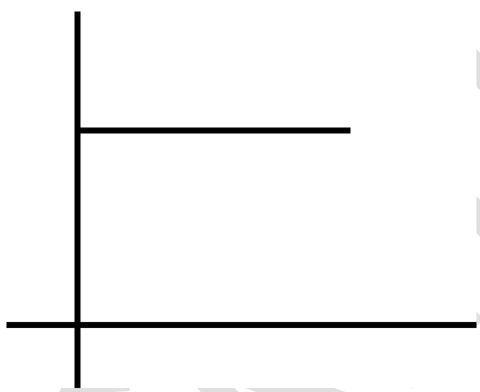
B $-7p/32 \quad \pi\epsilon_0\hat{k}$

C $7p/32\pi\epsilon_0\hat{k}$

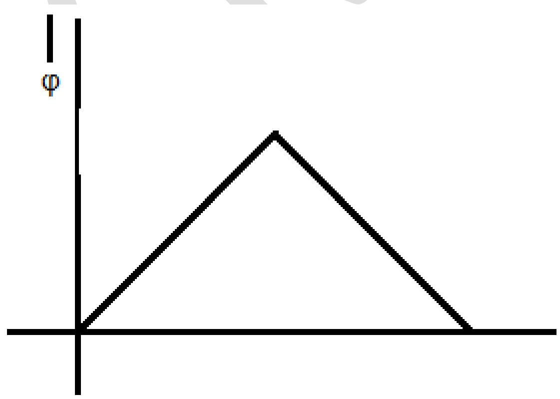
D None of these

49) A ring of radius R is placed in the plane with its centre at origin and its axis along the x-axis and having uniformly distributed positive charge. A ring of radius r (<<R) and coaxial with the larger ring is moving along the axis with constant velocity then the variation of electrical flux (ϕ) passing through the smaller ring with position will be represented by:

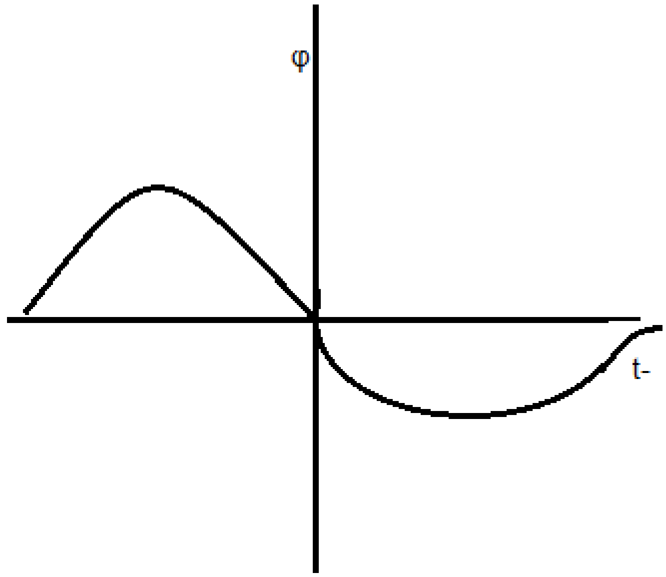


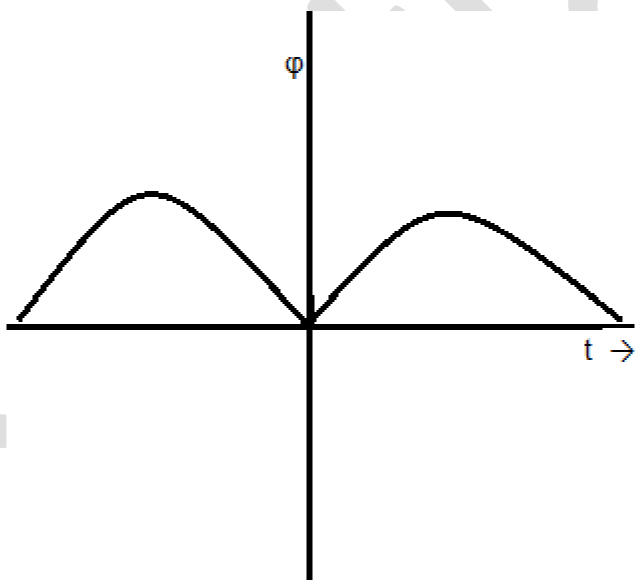


A



B

C 

D 

50) Electrical potential 'v' in space as a function of co-ordinates is given by, v = 1/x + 1/y + 1/z. Then the electric field intensity at (1, 1, 1) is given by:

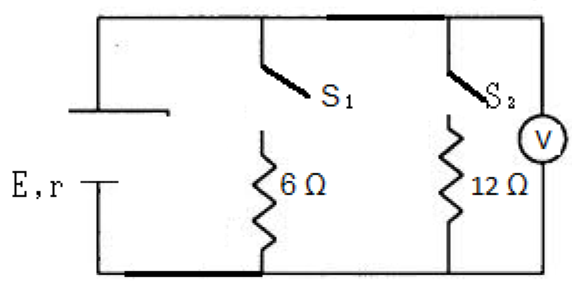
A $-\left(\hat{i}+\hat{j}+\hat{k}\right)$

B $\hat{i}+\hat{j}+\hat{k}$

C 0

D $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$

51) In the circuit shown in figure when switch S_1 is closed and S_2 is open, the ideal voltmeter shows a reading 18V. When switch S_2 is closed and S_1 is open, the reading of the voltmeter is 24V. When S_1 and S_2 both are closed the voltmeter reading will be



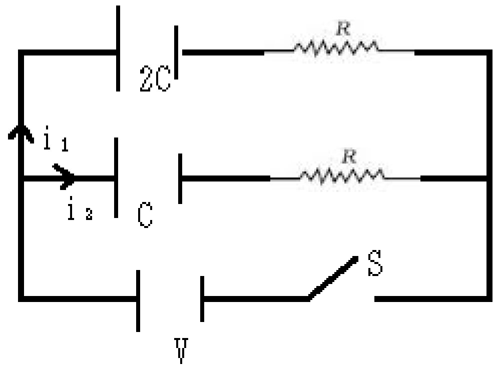
A 14.4V

B 20.6V

C 24.2V

D 10.8V

52) In the circuit shown in figure switch S is closed at time t = 0. Let i_1 and i_2 be the currents at any finite time t then the ratio i_1/i_2



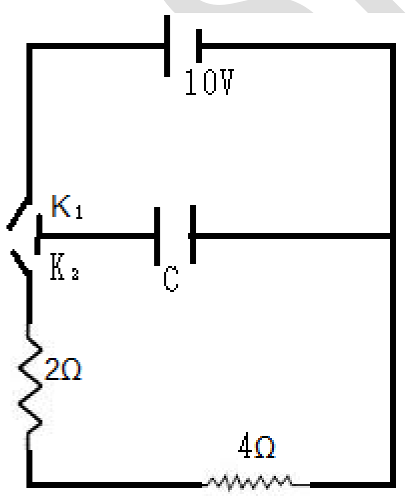
A is constant

B increases with time

C decreases with time

D first increases and then decreases

53) A capacitor of capacitance 3µF is first charged by connecting it across a 10V battery by closing key K_1. Then it is allowed to get discharged through 2Ω and 4Ω resistors by closing the key K_2. The total energy dissipated in the 4Ω resistor is equal to



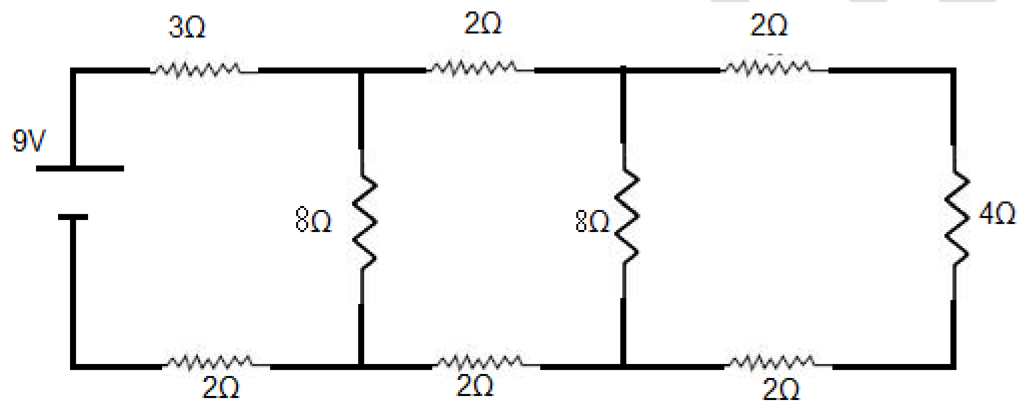
A 0.5mJ

B 0.05mJ

C 0.1mJ

D None of these

54) In the circuit shown in the figure, the current through



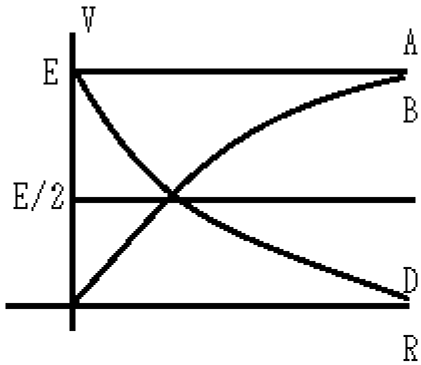
A the 3Ω resistor is 0.50A

B the 3Ω resistor is 0.25A

C the 4Ω resistor is 0.50A

D the 4Ω resistor is 0.25A

55) A cell of emf E having an internal resistance ‘r’ is connected to an external resistance R. The potential difference ‘v’ across the resistance R varies with R as shown by the curve:



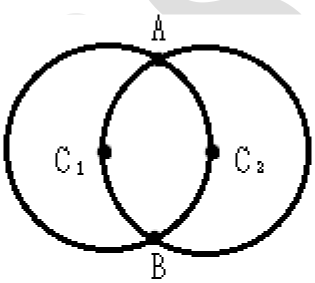
A A

B B

C C

D D

56) Two circular rings of identical radii and resistance of 36Ω each are placed in such a way that they cross each other's centre C_1 and C_2 as shown in figure. Conducting joints are made at intersection points A and B of the rings. An ideal cell of emf 20volts is connected across AB. The power delivered by cell is



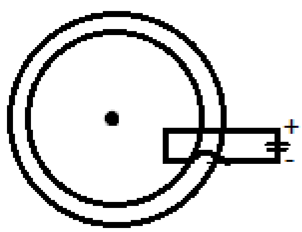
A 80watt

B 100watt

C 120watt

D 200watt

57) A spherical shell, made of material of electrical conductivity 109/π (Ω-m)-1, has thickness 20 cm and radius 1m. A potential difference is applied between the inner and outer surface of the shell. The resistance offered by the shell is equal to –



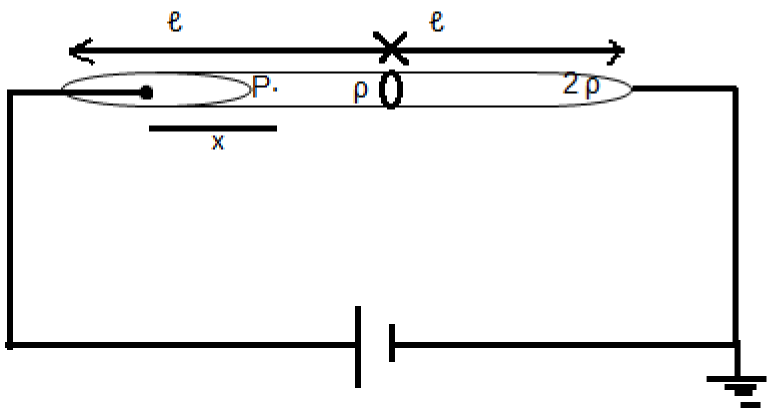
A $5\pi \times 10^{-12}\Omega$

B $2.5 \times 10^{-11}\Omega$

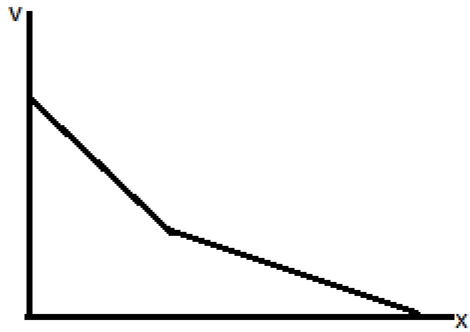
C $5 \times 10^{-12}\Omega$

D $5 \times 10^{-11}\Omega$

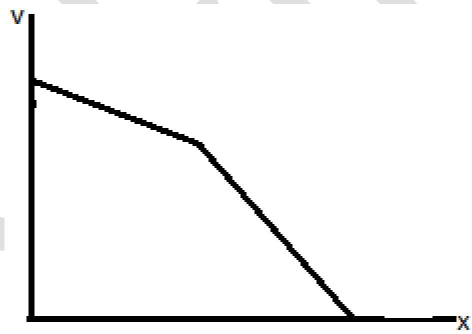
58) Two cylindrical rods of same cross-section area and same length are connected in series to an ideal cell as shown. The resistivity of left rod is ρ and that or right rod is 2ρ. Then the variation of potential at any point P distant x from left end of combined rod system is given by.



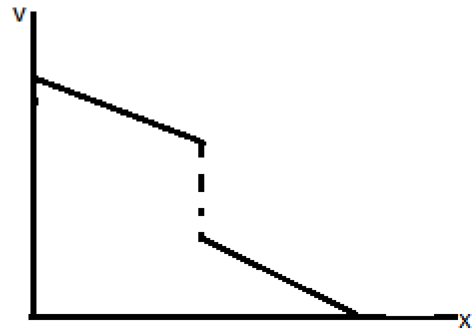
A



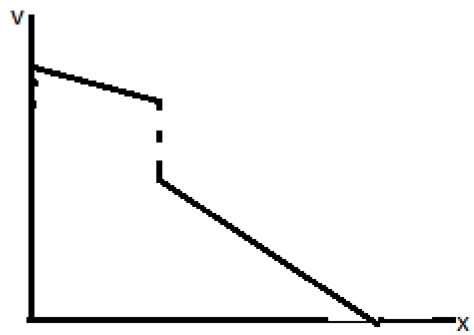
B



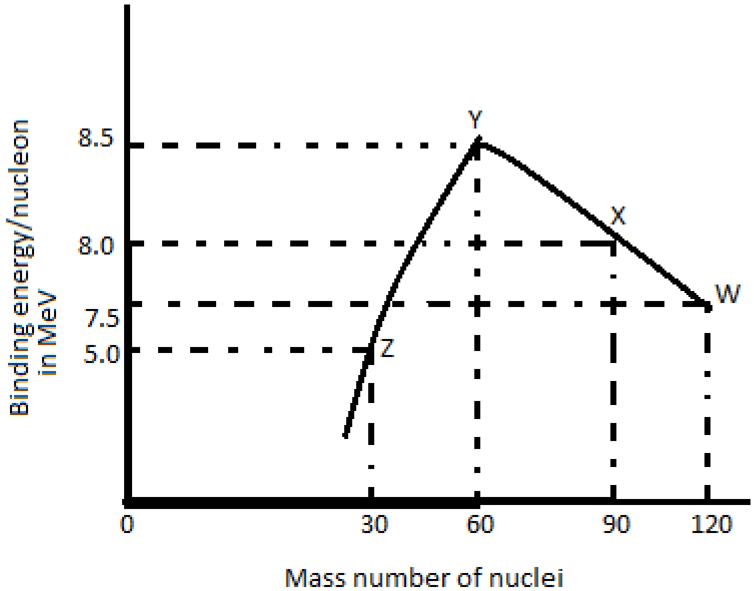
C



D



59) Binding energy per nucleon versus mass number cure for nuclei is shown in figure. W, X, Y and Z are four nuclei indicated on the curve. The process that would release energy is



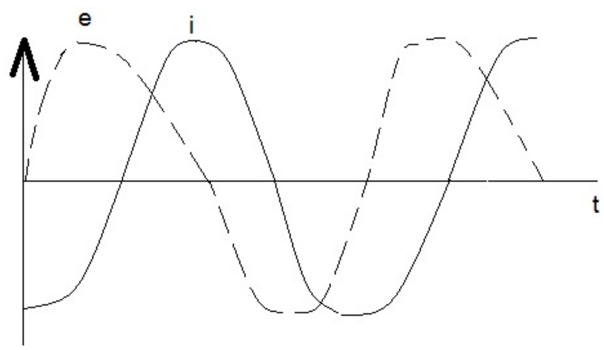
A $Y \rightarrow 2Z$

B $W \rightarrow X + Z$

C $W \rightarrow 2Y$

D $X \rightarrow Y + Z$

60) When an AC source of emf $e = E_0 \sin(100t)$ is connected across a circuit, the phase difference between the emf e and the current i in the circuit is observed to be $\pi/4$ ahead, as shown in the diagram. If the circuit consists possibly only of R – C or R – L or L – C in series, find the relationship between the two elements:



A R = 1kΩ, C = 10μF

B R = 1kΩ, C = 1μF

C R = 1kΩ, L = 10H

D R = 1kΩ, L = 1H

PART – C – MATHEMATICS

61) If $\log_{0.3}(x - 1) < \log_{0.09}(x - 1)$, then x lies in the interval

a) $(2, \infty)$
b) (1, 2)
c) (-2,-1)
d) None of these

62) The inequality $|z - 4| < |z - 2|$ represents the region given by

a) $Re(z) \geq 0$
b) $Re(z) < 0$
c) $Re(z) > 0$
d) None of these

63) If from any point P on the circle $x^2 + y^2 + 2gx + 2fy + c = 0$, tangents are drawn to the circle $x^2 + y^2 + 2gx + 2fy + c\sin^2\alpha + (g^2 + f^2)\cos^2\alpha = 0$, then angle between the tangents is

a) α
b) 2α
c) $\frac{\alpha}{2}$
d) None of these

64) The function $f(\theta) = \frac{d}{d\theta}\int_0^\theta \frac{dx}{1-\cos\theta\cos x}$ satisfies

a) $\frac{df}{d\theta} + 2f(\theta)\cot\cot\theta = 0$
b) $\frac{df}{d\theta} - 2f(\theta)\cot\theta = 0$
c) $\frac{df}{d\theta} + 2f(\theta) = 0$
d) $\frac{df}{d\theta} - 2f(\theta) = 0$

65) The integer just greater than $(\sqrt{3} + 1)^{2m}$ contains

a) 2^{m+2} as a factor
b) 2^{m+1} as a factor
c) 2^{m+3} as a factor
d) None of these

66) The function

$f(x) = \sqrt{\cos(\sin x)} + sin^{-1}\left(\frac{1+x^2}{2x}\right)$ is defined for

a) x $\in$ {-1, 1}
b) x $\in$ [-1,1]
c) x $\in$ R
d) x $\in$ (-1, 1)

67) The set of all values of x for which log (1 + x) $\leq$ x is

a) $(0, \infty)$
b) $(-1, \infty)$
c) (-1, 0)
d) None of these

68) The equation of the tangent to the curve y = (2x -1) $e^{2(1-x)}$ at the point of its maximum, is

a) y - 1 = 0
b) x - 1 = 0
c) x + y - 1 = 0
d) x - y + 1 = 0

69) If P(x, y, z) is a point on the line segment joining Q(2, 2, 4) and R (3, 5, 6) such that the projections of $\overrightarrow{\mathbf{OP}}$ on coordinate axes are $\frac{13}{5}, \frac{19}{5}, \frac{26}{5}$ respectively, then P divides QR in the ratio

a) 1: 2
b) 3 : 2
c) 2: 3
d) 1: 3

70) If f(x) = $\sin^2 x + \sin^2\left(\mathbf{x} + \frac{\pi}{3}\right)$ + cos x cos (x + $\frac{\pi}{3}$) and g $\left(\frac{5}{4}\right)$ = 1, then g of (x) is equal to

a) 0
b) 1
c) sin 1°
d) None of these

71) The centre of the circle passing through the point (0, 1) and touching the curve y = x_2 at point (2, 4) is

a) $\left(-\frac{16}{5}, \frac{27}{10}\right)$
b) $\left(-\frac{16}{7}, \frac{53}{10}\right)$
c) $\left(-\frac{16}{5}, \frac{53}{10}\right)$
d) None of these

72) The inequalities y(-1)$\geq$-4,y(1)$\leq$0and y (3)$\geq$5 are known to hold for y =ax^2+bx+c then the least value of 'a' is

a) -1/4
b) -1/3
c) ¼
d) 1/8

73) If $x^2 + y^2 + z^2 = r^2$, then

$\text{Tan}^{-1}\left(\frac{xy}{zr}\right) + \tan^{-1}\left(\frac{yz}{xr}\right) + \tan^{-1}\left(\frac{xz}{yr}\right)$ is equal to

a) π
b) $\frac{\pi}{2}$
c) 0
d) None of these

74) The series of natural numbers is divided into groups as follows; (1), (2, 3), (4, 5, 6,), (7, 8, 9, 10) and so on. Find the sum of the numbers is the nth groups is

a) $\frac{1}{2}[n(n^2+1)]$
b) $\frac{n(n^2+1)}{4}$
c) $\frac{2n(n+1)}{3}$
d) $\frac{n^2(n+1)}{2}$

75) If four dice are thrown together, then the probability that the sum of the numbers appearing on them is 13, is

a) 35/216
b) 25/216
c) 35/324
d) 25/324

76) In a triangle the angles are in AP and the lengths of the two larger sides are 10 and 9 respectively, then the length of the third side can be

a) $5 + \sqrt{6}$
b) 0.7
c) $15 - \sqrt{6}$
d) None of these

77) The roots of the cubic equation $(z+\alpha\beta)^3 = \alpha^3, \alpha \neq 0$ represent the vertices of a triangle of sides of length

a) $\frac{1}{\sqrt{3}}|\alpha\beta|$
b) $\sqrt{3}|\alpha|$
c) $\sqrt{3}|\beta|$
d) $\frac{1}{\sqrt{3}}|\alpha|$

78) Suppose $f : R \to R$ is a differentiable function and $f(1)$ = 4. Then, the value of $\lim_{x\to 1}\int_4^{f(x)} \frac{2t}{x-1} dtis$

a) $8f'(1)$
b) $4f'(1)$
c) $2f'(1)$
d) $f'(1)$

79) If [x] denotes the greatest integer less than or equal to x, then

$\lim_{n\to\infty} \frac{[1^2 x]+[2^2 x]+[3^2 x]+\dots+[n^2 x]}{n^3}$ is equal to

a) $\frac{x}{2}$
b) $\frac{x}{3}$
c) $\frac{x}{6}$
d) 0

80) Let $f(x) = x^n$, n being a non-negative integer. The value of n for which the equality $f'(x+y) = f'(x) + f'(y)$ is valid ∀ x, y > 0, is
a) 0
b) 1
c) 3
d) None of these

81) $\sum_{m=1}^{n} tan^{-1}\left(\frac{2m}{m^4+m^2+2}\right)$ is equal to
a) $\tan^{-1}\left(\frac{n^2+n}{n^2+n+2}\right)$
b) $\tan^{-1}\left(\frac{n^2+n+2}{n^2+n}\right)$
c) $\tan^{-1}\left(\frac{n^2-n}{n^2-n+2}\right)$
d) None of the above

82) All possible two factors product are formed from numbers 1, 2, ……., 200. The number of factors out of the total obtained which are multiple of 5, is

a) 5040
b) 7180
c) 8150
d) None of these

83) The vector $\hat{i} + x\hat{j} + 3\hat{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\hat{i}$ + (4x - 2) $\hat{j}$ + 2$\hat{k}$. The value of x is

a) $-\frac{2}{3}$
b) $\frac{1}{3}$
c) $\frac{2}{3}$
d) None of these

84) The equation | z - i| +| z +i| =k, k > 0, can represent an ellipse, if k^2 is

a) < 1
b) < 2
c) > 4
d) None of these

85) If A_1 is the area of the parabola $y^2 = 4ax$ lying between vertex and the latus rectum and A_2 is the area between the latus rectum and the double ordinate x = 2a, then A_1 / A_2 is equal to

a) $(2\sqrt{2} - 1)$
b) $\frac{1}{7}(2\sqrt{2} + 1)$
c) $\frac{1}{7}(2\sqrt{2} - 1)$

d) None of these

86) In aΔ ABC, $\angle$ B = 90° and b + a = 4, the area of the triangle is the maximum, when $\angle$C is

a) $\frac{\pi}{4}$

b) $\frac{\pi}{6}$

c) $\frac{\pi}{3}$

d) None of these

87) An elevator starts with m passengers and stops at n floors (m$\leq$ n). The probability that no two passengers alight at the same floor, is

a) $\frac{{}^nP_m}{m^n}$

b) $\frac{{}^nP_m}{n^m}$

c) $\frac{{}^nC_m}{m^n}$

d) $\frac{{}^nC_m}{m^n}$

88) If y =sin mx then the value of $\begin{vmatrix} y & y_1 & y_2 \\ y_3 & y_4 & y_5 \\ y_6 & y_7 & y_8 \end{vmatrix}$ (where suffixes of y shows the order of derivative 0) is-

a) Independent of x but dependent on m

b) Dependent of x but independent of m

c) Dependent on both m and x

d) Independent of m and x

89) Let g(x) = tan$^{-1}|x| - \cot^{-1}|x|$, $\neq 0 \neq 0 \neq 0$

F(x) = $\frac{[x]}{[x+1]}$ {x}, h(x) = |g(f(x))|, where {x} denotes fractional part and [x] denotes the integral part then which of the following holds good

a) h is continuous at x=0

b) h is discontinuous at x=0

c) h(0^-)=$\frac{\pi}{2}$

d) h(0^+)=-$\frac{\pi}{2}$

90) Let a_n be the nth term of an A.P. if,then the common difference of the A.P. is-

a) $\alpha - \beta$

b) $\beta - \alpha$

c) $\frac{\alpha - \beta}{2}$

d) None of these