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IIT-JEE-Mathematics-Screening–2001

SCREENING

Time : Three hours   Max. Marks : 100

Notations :
R : set of real numbers.
[x] : the greatest integer $\leq$ x.

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1. Let f:R→R be a function defined by (x)=max { x, x^3 }. The set of all points where is NOT differentiable is:
(A) {-1, 1 }
(B) {-1, 0 }
(C) {0, 1 }
(D) {-1, 0, 1 }

2. Let f:(0,∞)→R and $F(x)=\int_0^x f(t)dt$. If $F(x^2) = x^2 (1+x)$, then f(4)equals:
(A) 5/4
(B) 7
(C) 4
(D) 2

3. The left hand derivative of f(x)=[x] sin(πx) at x=k,k an integer, is:
(A) $(-1)^k (k-1)\pi$
(B) $(-1)^{(k-1)} (k-1)\pi$
(C) $(-1)^k k\pi$
(D) $(-1)^{(k-1)} k\pi$

4. If $f(x)=x e^{(x(1-x))}$, then f(x) is:

(A) Increasing on [-1/2 ,1]
(B) Decreasing on R
(C) Increasing on R
(D) Decreasing on [-1/2 ,1]

5. $\lim_{x\to 0} \sin(\pi \cos^2 x) / x^2$

(A) $-\pi$
(B) π
(C) $\pi/2$

(D) 1

6. The triangle formed by the tangent to the curve $f(x)= x^2+ bx-b$ at the point

(1, 1)and the coordinate axes, lies in the first quadrant. If its area is 2, then the value of b is:
(A) -1
(B) 3
(C) -3
(D) 1

7. Let g(x)=1+x-[x] and

$$f(x) = \begin{cases} -1, & x < 0 \\ 0, & x = 0 \\ 1, & x > 0 \end{cases}$$

Then for all x,f[g(x)] is equal to:
(A) x
(B) 1
(C) f(x)
(D) g(x)

8. If f:[1,∞) is given by f(x)=x+1/x then f^{-1} (x) equals :

(A) $(x+\sqrt{(x^2-4)})/2$
(B) $x/1+x^2$
(C) $(x-\sqrt{(x^2-4)})/2$
(D) $1+\sqrt{(x^2-4)}$

9. The domain of definition of $f(x)= (\log_2 (x+3))/(x^2+3x+2)$ is:

(A) R\{-1, -2}
(B) (-2, ∞)
(C) R/{-1,-2,-3}
(D) (-3, ∞)\{-1, -2}

10. The equation of the common tangent touching the circle $(x-3)^2+ y^2= 9$ and the parabola $y^2=4x$ above the x-axis is :

(A) $\sqrt{3}$ y=3x+1
(B) $\sqrt{3}$ y=-(x+3)
(C) $\sqrt{3}$ y=x+3
(D) $\sqrt{3}$ y=-(3x+1)

11. The value of $\int_{-\pi}^{\pi} (\cos^2 x / 1+a^x)\, dx$, a>0, is

(A) π
(B) $a\pi$
(C) $\pi/2$
(D) 2π

12. Let AB be a chord of the circle $x^2+y^2=r^2$ subtending a right angle at the

centre. Then the locus of the centroid of the triangle PAB as P moves on the circle is:
(A) A parabola
(B) A circle
(C) An ellipse
(D) A pair of straight lines

13. The number of integer values of m, for which the x-coordinate of the point of intersection of the lines $3x+4y=9$ and $y=mx+1$ is also an integer, is :
(A) 2
(B) 0
(C) 4
(D) 1

14. The equation of the directrix of the parabola $y^2+4y+4x+2=0$ is:
(A) $x=-1$
(B) $x=1$
(C) $x=-3/2$
(D) $x=3/2$

15. Let α and β be the roots of $x^2-x+p=0$ and γ and δ be the roots of $x^2-4x+q=0$.

if $\alpha,\beta,\gamma,\delta$ are in G.P. then the integral values of P and q respectively, are:
(A) -2, -32
(B) -2, 3
(C) -6, 3
(D) -6, -32

16. In the binomial expansion of $(a-b)^n$, $n\geq5$, the sum of the 5^{th} and 6^{th} terms is zero. Then a/b equals:
(A) (n-5)/6
(B) (n-4)/5
(C) 5/(n-4)
(D) 6/(n-5)

17. Let $f(x)=(1+b^2)\,x^2+2bx+1$ and let m(b) be the minimum value of f(x). As b varies, the range of m(b) is:
(A) [0, 1]
(B) [0,1/2]
(C) [1/2,1]

(D) [0, 1]

18. The number of distinct roots of

$$\begin{vmatrix} \sin x & \cos x & \cos x \\ \cos x & \sin x & \cos x \\ \cos x & \cos x & \sin x \end{vmatrix} = 0 \text{ in the interval } -\frac{\pi}{4} \le x \le \frac{\pi}{4} \text{ is:}$$

(A) 0
(B) 2
(C) 1
(D) 3

19. Let E={1,2,3,4} and F={1,2}. Then the number of onto functions from E to F is:
(A) 14
(B) 16
(C) 12
(D) 8

20. Let T_n denote the number of triangles which can be formed using the vertices of a regular polygon of n sides. If $T_{n+1} - T_n = 21$, then n equals:
(A) 5
(B) 7
(C) 6
(D) 4

21. The complex numbers z_1,z_2,and z_3,satisfying $(z_1 - z_3)/(z_2 - z_3) = (1-i\sqrt{3})/2$ are the vertices of a triangle which is :
(A) Of area zero
(B) Right-angled isosceles
(C) Equilateral
(D) Obtuse-angled isosceles

22. If the sum of the first 2n terms of the A.P. 2,5,8,……………, is equal to the sum of the first n terms of the A.P.57,59,61,…..,then n equals:
(A) 10
(B) 12
(C) 11
(D) 13

23. Let z_1 and z_2 be nth roots of unity which subtend a right angle at the origin. Then n must be of the form:
(A) 4k+1
(B) 4k+2
(C) 4k+3
(D) 4k

24. Let the positive numbers a,b,c,d be in A.P. Then abc, abd, acd, bcd are:
(A) NOT in A.P./G.P/H.P.
(B) In A.P
(C) In G.P
(D) In H.P

25. Let f(x) = αx/(x+1), x ≠ -1. Then for what value of α is f[f(x)]=x:
(A) √2
(B) - √2
(C) 1
(D) -1

26. If $If\ \vec{a},\ \vec{b}, and\ \vec{c}\ are\ unit\ vectors, then$
$|\vec{a} - \vec{b}|^2 + |\vec{b} - \vec{c}|^2 + |\vec{c} - \vec{a}|^2$

does not exceed :
(A) 4
(B) 9
(C) 8
(D) 6

27. Which of the following functions is differentiable at x=0 :
(A) cos(|x|)+|x|
(B) cos(|x|)-|x|
(C) sin(|x|)+|x|
(D) sin(|x|)-|x|

28. The number of solutions of $\log_4 (x-1)=\log_2 (x-3)$ is :
(A) 3
(B) 1
(C) 2
(D) 0

29. Let $\vec{a} = \vec{i} - \vec{k}, \vec{b} = x\vec{i} + \vec{j} + (1-x)\vec{k}\ and\ \vec{c} = y\vec{i} + x\vec{j} + (1 + x - y)\vec{k}$.
Then $[\vec{a}, \vec{b}, \vec{c}]$ depends on :

(A) Only x
(B) Only y
(C) Neither x nor y
(D) Both x and y

30. Area of the parallelogram formed by the lines y =mx, y =mx +1 , y =nx and y = nx +1

equals:
(A) $|m+n|/(m-n)^2$
(B) $2/|m+n|$
(C) $1/|m+n|$
(D) $1/|m-n|$

31. Let PQ and RS be tangents at the extremities of the diameter PR of a circle of radius r. If PS and RQ intersect at a point X on the circumference of the circle, then 2r equals :
(A) $\sqrt{(PQ.RS)}$
(B) $(PQ+RS)/2$
(C) $(2PQ.RS)/(PQ+RS)$
(D) $\sqrt{((PQ^2+RS^2)/2)}$

32. A man from the top of a 100 metres high tower sees a car moving towards the tower at an angle of depression of 300. After some time, the angle of depression becomes 600. The distance (in metres) travelled by the car during this time is :
(A) $100\sqrt{3}$
(B) $(200\sqrt{3})/3$
(C) $(100\sqrt{3})/3$
(D) $200\sqrt{3}$

33. If $\alpha+\beta = \pi/2$ and $\beta+\gamma = \alpha$, then $\tan \alpha$ equals:
(A) $2(\tan \beta + \tan \gamma)$
(B) $\tan \beta + \tan \gamma$
(C) $\tan \beta + 2\tan \gamma$
(D) $2 \tan \beta + \tan \gamma$

34. $\sin^{-1}(x-x^2/2 + x^3/4 - \ldots) + \cos^{-1}(x^2 - x^4/2 + x^6/4 - \ldots) = \pi/2$ for $0<|x|<\sqrt{(2,)}$ then x equals :
(A) ½
(B) 1
(C) -1/2
(D) -1

35. The maximum value of $(\cos \alpha_1).(\cos \alpha_2). \ldots.. (\cos \alpha_n)$, under the restrictions $0 \leq \alpha_1,\alpha_2,\ldots\ldots,\alpha_n \leq \pi/2$ and $(\cot \alpha_1).(\cot \alpha_2). \ldots.. (\cot \alpha_n)=1$ is:

(A) $1/2^{n/2}$
(B) $1/2^n$
(C) $1/2n$
(D) 1

IIT-JEE-Chemistry-Screening–2001

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Screening

Time : Two hours Max. Marks : 100

Instructions
Use the values of the constants as given below:
Planck's constant, h = 6.626 x 10^{-34} Js
Atomic Numbers: Cr = 24, Mn =25, Fe = 26, Co=27, Pt=78

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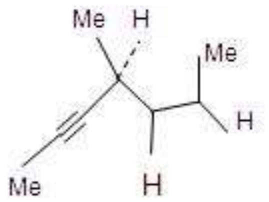
1. In thermodynamics, a process is called reversible when:
(a) Surroundings and system change into each other
(b) There is no boundary between system and surroundings
(c) The surroundings are always in equilibrium with the system
(d) The system changes into the surroundings spontaneously

2. The root mean square velocity of an ideal gas at constant pressure varies with density (d) as :
(a) d^2
(b) d
(c) √d
(d) 1/√d

3. In a solid 'AB' having the NaCl structure, 'A' atoms occupy the corners of the cubic unit cell. If all the face-centered atoms along one of the axes are removed, then the resultant stoichiometry of the solid is:
(a) AB_2
(b) A_2B
(c) A_4B_3
(d) A_3B_4

4. The wavelength associated with a golf ball weighing 200g and moving at a speed of 5 m/h is of the order :
(a) 10^{-10}m
(c) 10^{-20}m
(d) 10^{-30}m
(e) 10^{-40}m

5. Hydrogenation of the adjoining compound in the presence of poisoned palladium catalyst gives :



(a) An optically active compound
(b) An optically inactive compound
(c) A racemic mixture
(d) A diastereomeric mixture

6. 1-Propanol and 2-Propanol can be best distinguished by :
(a) Oxidation with alkaline $KMnO_4$ followed by reaction with Fehling solution
(b) Oxidation with acidic dichromate followed by reaction with Fehling solution
(c) Oxidation by heating with copper followed by reaction with Fehling solution
(d) Oxidation with concentrated H_2SO_4 followed by reaction with Fehling solution

7. The reaction of propene with HOCl proceeds via the addition of :
(a) H^+ in the first step
(b) Cl^+ in the first step
(c) OH^- in the first step
(d) Cl^+ and OH^- single step

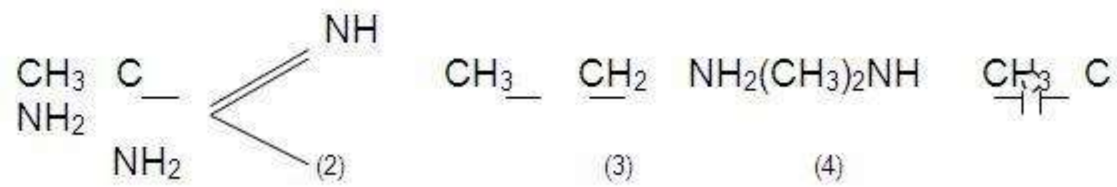
8. An SN_2 reaction at an asymmetric carbon of a compound always gives :
(a) An enantiomer of the substrate
(b) A product with opposite optical rotation
(c) A mixture of diastereomers
(d) A single steroisomer

9. The quantum numbers +1/2 and -1/2 for the electron spin represent :
(a) Rotation of the electron in clockwise and anticlockwise direction respectively
(b) Rotation of the electron in anticlockwise and clockwise direction respectively
(c) Magnetic moment of the electron pointing up and down respectively
(d) Two quantum mechanical spin states which have no classical analogue

10. Which one of the following statements is false :
(a) Work is state function
(b) Temperature is a state function
(c) Change in the state is completely defined when the initial and final stated are specified
(d) Work appears at the boundary of the system

11. An aqueous solution of 6.3 g oxalic acid dehydrate is made up to 250ml> the volume of 0.1N NaOH required to completely neutralize 10ml of this solution is :
(a) 40ml
(b) 20ml
(c) 10ml
(d) 4ml

12. The correct order of basicities of the following compounds is :



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

13. The number of isomers for the compound with molecular formula C_2 BrClFI is:
(a) 3
(b) 4
(c) 5
(d) 6

14. In the presence of peroxide, hydrogen chloride and hydrogen iodide do not give anti-Markovnikov addition to alkenes because :
(a) Both are highly ionic
(b) One is oxidising and the other is reducing
(c) One of the steps is endothermic in both the cases
(d) All the steps are exothermic in both the cases

15. The compound that will react most readily with NaOH to form methanol is :
(a) $(CH_3)_4$ N^+ I^-

(b) CH_3 OCH_3
(c) $(CH_3)_3$ S^+ I^-

(d) $(CH_3)_3$ Cl

16. A mixture of benzaldehyde and formaldehyde on heating with aqueous NaOH solution gives :
(a) Benzyl alcohol and sodium formate
(b) Sodium benzoate and methyl alcohol
(c) Sodium benzoate and sodium formate
(d) Benzyl alcohol and methyl alcohol

17. The correct order of equivalent conductance at infinite dilution of LiCl,NaCl and KCl is:
(a) LiCl>NaCl> KCl
(b) KCl>NaCl> LiCl
(c) NaCl>KCl>LiCl
(d) LiCl>KCl>NaCl

18. At constant temperature, the equilibrium constant (KP) for the decomposition reaction $N_2 O_4$ $2NO_2$ is expressed by $K_P=4x^2 P/(1-x^2)$, where P= pressure,

x = extent of decomposition. Which one of the following statements is true:
(a) K_P increases with increase of P
(b) K_P increases with increase of x
(c) K_P increases with decrease of x
(d) K_P remains constant with change in P and x

19. If 'I' is the intensity of absorbed light and 'C' is the concentration of AB for the photochemical process AB+hv → AB* , the rate of formation of AB* is directly proportional to :
(a) C
(b) I
(c) I^2
(d) C.I

20. Saturated solution of KNO_3 is used to make 'salt-bridge' because :
(a) Velocity of K^+ is greater than that of NO_3^-
(b) Velocity of NO_3^- is greater than that of K^+
(c) Velocities of both K^+ and NO_3^- are nearly the same
(d) KNO_3 is highly soluble in water.

21. For a sparingly soluble salt APBq , the relationship of its solubility product (LS) with its solubility (S) is :
(a) $L_S=S^{(p+q)}.p^p.q^q$
(b) $L_S=S^{(p+q)}.p^q.q^p$
(c) $L_S=S^{pq}.p^p.q^q$
(d) $L_S=S^{pq}.p.q^{(p+q)}$

22. The correct order of acidity is :
(a) $HClO < HClO_2 < HClO_3 < HClO_4$
(b) $HClO_4 < HClO_3 < HClO_2 < HCLO$
(c) $HClO < HClO_4 < HClO_3 < HClO_2$
(d) $HClO_4 < HClO_2 < HClO_3 < HClO$

23. The reaction, $3ClO^-_{(aq)} \rightarrow ClO^-_{3(aq)} + 2Cl^-_{(aq)}$ is an example of :
(a) Oxidation reaction
(b) Reduction reaction
(c) Disproportionate reaction
(d) Decomposition reaction

24. The number of s-s bonds in sulphur trioxide timer (S_3O_9) is :
(a) Three
(b) Two
(c) One

(d) Zero

25. The common features among the species CN^-, CO and NO^+ are :
(a) Bond order three and isoelectronic
(b) Bond order three and weak field ligands
(c) Bond order two and acceptors
(d) Isoelectronic and weak field ligands.

26. The chemical composition of 'slag' formed during the smelting process in the extraction of copper is :
(a) Cu_2O + FeS
(b) $FeSiO_3$
(c) $CuFeS_2$
(d) Cu_2S + FeO

27. In the standardization of $Na_2S_2O_3$ using $K_2Cr_2O_7$ by iodometry, the equivalent weight of $K_2Cr_2O_7$ is:
(a) (molecular weight)/2
(b) (molecular weight)/6
(c) (molecular weight)/3
(d) Same as molecular weight

28. The complex ion which has no 'd' electrons in the central metal atom is :
(a) $[MnO_4]^-$
(b) $[Co(NH_3)_6]^{3+}$
(c) $[Fe(CN)_6]^{3-}$
(d) $[Cr(H_2O)_6]^{3+}$

29. The set representing the correct order of first ionization potential is :
(a) K>Na>Li
(b) Be>Mg>Ca
(c) B>C>N
(d) Ge>Si>C

30. The correct order of hybridization of the central atom in the following species NH3, $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is:

(a) dsp_2,dsp_3,sp_2 and sp_3
(b) sp_3,dsp_2,dsp_3,sp_2
(c) dsp_2,sp_2,sp_3,dsp_3
(d) dsp_2,sp_3,sp_2,dsp_3

The questions below (31-35) consist of an '**Assertion**' in column 1 and the '**Reason**' in column 2. Use the following key to choose the appropriate answer.
(a) If both assertion and reason are CORRECT, and reason is the CORRECT explanation of the assertion.

(b) If both assertion and reason are CORRECT, but reason is NOT the CORRECT explanation of the assertion.
(c) If assertion is CORRECT, but reason is INCORRECT.
(d) If assertion is INCORRECT, but reason is CORRECT.

Assertion (column 1)	Reason (column 2)
31. Dimethylsulphide is commonly used for the reduction of an ozonide of an alkene to get the carbonyl compounds.	It reduces the ozonide giving water soluble dimethyl sulphoxide and excess of it evaporates.
32. Addition of bromine to trans-2-butene yields meso-2, 3-dibromobutane.	Bromine addition to an alkene is an electrophilic addition.
33. Between $SiCl_4$ and CCl_4, only $SiCl_4$ reacts with water.	$SiCl_4$ is ionic and CCl_4 is covalent.
34. strongly acidic solutions, aniline becomes more reactive towards electrophilic reagents.	The amino group being completely protonated in strongly acidic solution, the lone pair of electrons of the nitrogen is no longer available for resonance.
35. In any ionic solid (MX) with Schottky defects, the number of positive and negative ions are same.	Equal numbers of cation and anion vacancies are present.

IIT-JEE-Physics-Screening–2001

SCREENING

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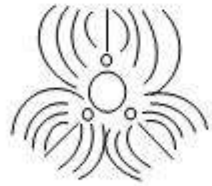
1. Three positive charges of equal value q are placed at the vertices of an equilateral triangle. The resulting lines of force should ne sketched as in :

(A)

(B)

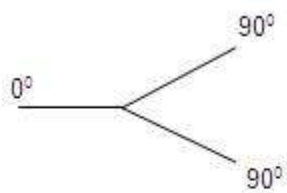


(C)

(D)

2. When a block of iron floats in mercury at 00C, a fraction k1 of its volume is submerged, while at the temperature 600 C, a fraction k2 is seen to be submerged. If the coefficient of volume expansion of iron γ_{Fe} and that of mercury is γ_{Hg}, then the ratio k1 / k2 can be expressed as :
(A) $(1+60\ \gamma_{Fe})/(1+60\ \gamma_{Hg})$
(B) $(1-60\ \gamma_{Fe})/(1+60\ \gamma_{Hg})$
(C) $(1+60\ \gamma_{Fe})/(1-60\ \gamma_{Hg})$
(D) $(1+60\ \gamma_{Hg})/(1+60\ \gamma_{Fe})$

3. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at 0°C and 90°C respectively. The temperature of the junction of the three rods will be:



(A) 45°C
(B) 60°C
(C) 30°C
(D) 20°C

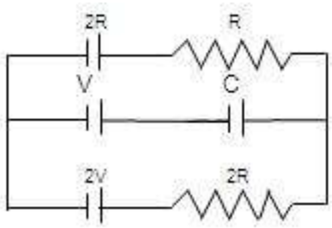
4. In a given process of an ideal gas, dW = 0 and dQ <0.Then for the gas :
(A) The temperature will decrease
(B) The volume will increase
(C) The pressure will remain constant
(D) The temperature will increase

5. The electron emitted in beta radiation originates from :
(A) Inner orbits of atoms
(B) Free electrons existing in nuclei
(C) Decay of a neutron in a nucleus

(D) Photon escaping from the nucleus

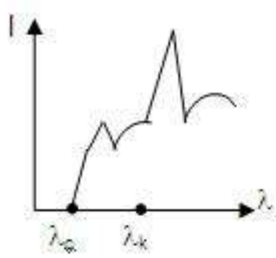
6. The transition from the state n = 4 to n =3 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition :
(A) 2→1
(B) 3→2
(C) 4→2
(D) 5→4

7. In the given circuit with steady current the potential drop across the capacitor must be :



(A) V
(B) V/2
(C) V/3
(D) 2V/3

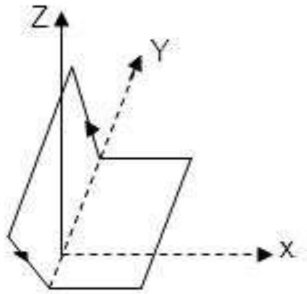
8. The intensity of X- Rays from a Coolidge tube is plotted against wavelength λ as shown in the figure. The minimum wavelength found is λ_c and the wavelength of the kC line is λ_K. As the accelerating voltage is increased :



(A) $\lambda_K - \lambda_c$ increases
(B) $\lambda_K - \lambda_c$ decreases
(C) λ_K increases
(D) λ_K decreases

9. Two beams of light having intensities I and 4 I interfere to produce a fringe pattern on a screen. The phase difference between the beans is π/2at point A and π at point B. Then the difference between the resultant intensities at A and B is :
(A) 2 I
(B) 4 I
(C) 5 I
(D) 7 I

10. A non –planar loop of conducting wire carting a current I is placed as shown in the figure. Each of the straight sections of the loop is of length 2a. The magnetic field due to this loop at the point P (a,0,a) points in the direction :



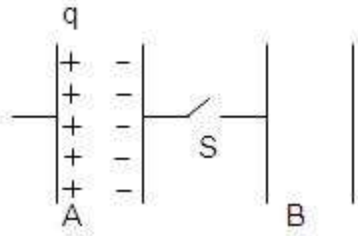
(A) 1/√2 (-ĵ+k)
(B) 1/√3 (-ĵ+k+ î)
(C) 1/√3 (i+ĵ+k)
(D) 1/√2 (î+k)

11. A particle executes simple harmonic motion between X= - A and X= + A. The time taken for it to go from 0 to A/2 is T1 and to go from A/ 2 to A is T2. Then :
(A) $T_1 < T_2$
(B) $T_1 > T_2$
(C) $T_1 = T_2$
(D) $T_1 = 2 T_2$

12. In a Young's double slit experiment, 12 fringes are observed to be formed in a certain segment of the screen when light of wavelength 600nm is used. If the wavelength of light is changed to 400nm, number of fringes observed in the same segment of the screen is given by :
(A) 12
(B) 18
(C) 24
(D) 30

13. A quantity X is given by ϵ_0 L ΔV/Δt where ϵ_0 is the permittivity of free space. L is a length, ΔV is a potential difference and 8k is a time interval. The dimensional formula for X is same as that of :
(A) Resistance
(B) Charge
(C) Voltage
(D) Current

14. Consider the situation shown in the figure. The capacitor A has a charge q on it whereas B is uncharged. The charge appearing on the capacitor B a long time after the switch is closed is :

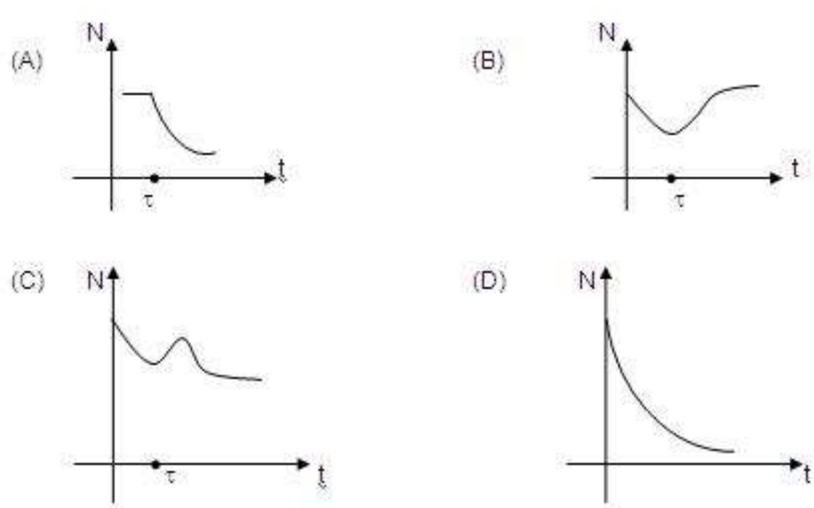


(A) Zero
(B) q/2
(C) q
(D) 2q

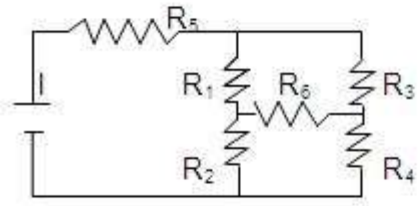
15. A uniform electric field pointing in positive X-direction exists in a region. Let A be the origin, B be the point on the x-axis at x=+1 cm and C be the point on the y-axis at y= +1 cm. Then the potentials at the potentials at the points A, B and C satisfy :
(A) $V_A < V_B$
(B) $V_A > V_B$
(C) $V_A < V_c$
(D) $V_A > V_c$

16. A coil having N turns is wound tightly in the form of spiral with inner and outer radii and b respectively. When a current passes through the coil, the magnetic field at the centre is:
(A) $(\mu_0 NI)/b$
(B) $(2\mu_0 NI)/a$
(C) $(\mu_0 NI)/(2(b-a))$ ln b/a
(D) $(\mu_0 I^N)/(2(b-a))$ ln b/a

17. A radioactive sample consists of two distinct species having equal number of atoms initially. The mean life of one species is τ and that of the other is 5τ. The decay products in both cases are stable. A plot is made of the total number of radioactive nuclei as a function of time. Which of the following figures best represents the form of this plot :

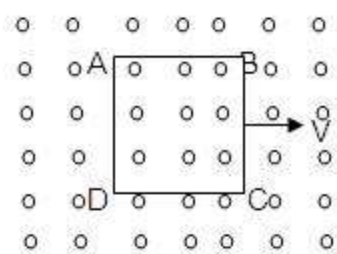


18. In the given circuit, it is observed that the current I is independent of the value of the resistance R_6 .The resistance values must satisfy :



(A) R_1 R_2 R_5= R_3 R_4 R_6
(B) 1/(R_5)+ 1/R_6 = 1/(R_1+ R_2)+1/(R_3+ R_4)
(C) R_1 R_4 = R_2 R_3
(D) R_1 R_3= R_2 R_4

19. A metallic square loop ABCD is moving in its own plane with velocity V in a uniform magnetic field perpendicular to its plane s shown in the figure, Electric field is induced :

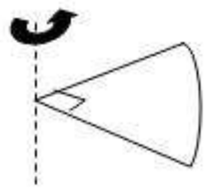


(A) in AD, but not in BC
(B) in BC, but not in AD
(C) neither in AD nor in BC
(D) in both AD and BC

20. A simple pendulum has a time period T_1 when on the earth's surface, and T_2 when taken to a height R above the earth's surface where R is the radius of the earth. The value of T_2/T_1 is :
(A) 1
(B) √2
(C) 4
(D) 2

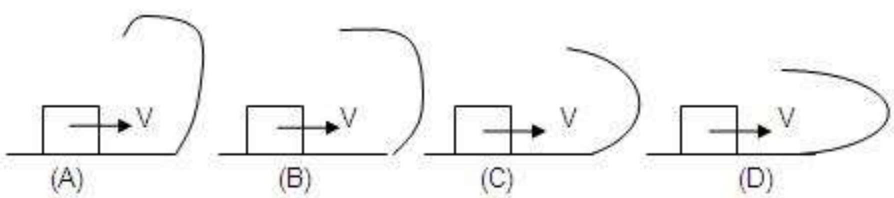
21. Two particles of masses ma and m2 in projectile motion have velocities vectors v_1 < v_2 respectively at time t=0. They collide at time t_0. Their velocities become v'_1 and v'_2 at time $2t_0$ while still moving in air. The value of $|(m_1 v'_1+ m_2v'_2) - (m_1 v_1+ m_2v_2)|$ is:
(A) Zero
(B) $(m_1 + m_2) gt_0$
(C) $2(m_1 + m_2) gt_0$
(D) $1/2(m_1 + m_2) gt_0$

22. One quarter section is cut from a uniform circular disc of radius R. This section has a mass M. It is made to rotate about a line perpendicular to is its plane and passing through the centre of the original disc. Its moment of inertia about the axis of rotation is :



(A) 1/2 MR^2
(B) 1/4 MR^2
(C) 1/8 MR^2
(D) $\sqrt{2}MR^2$

23. A small block is shot into each of the four tracks as shown below. Each of the tracks rises to the same height. The speed with which the block enters the track is the same in all cases. At the highest point of the track the normal reaction is maximum in :



24. A ray of light passes through four transparent media with refractive indices $\mu 1$, $\mu 2$, $\mu 3$ and $\mu 4$ as shown in the figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, we must have :
(A) $\mu 1 = \mu 2$
(B) $\mu 2 = \mu 3$
(C) $\mu 3 = \mu 4$
(D) $\mu 4 = \mu 1$

25. A given ray of light suffers minimum deviation in an equilateral prism P. Additional prism Q and R of identical shape and of the same material as P are now added as shown in the figure. The ray will suffer :
(A) Greater deviation
(B) No deviation
(C) Same deviation as before
(D) Total internal refection.

26. A wire of length L and 3 identical cells of negligible internal resistances are connected in series. Due to the current, the temperature of the wire is raised by ΔT in a time t. A number N of similar cells is now connected in series with a wire of the same material and cross-section but of

length 2L. The temperature of the wire is raised by the same amount ΔT in the same time. The value of N is :
(A) 4
(B) 6
(C) 8
(D) 9

27. An insect crawls up a hemispherical surface very slowly (see the figure). The coefficient of friction between the surface and the insect is 1/3. If the line joining the centre of the hemispherical surface to the insect makes an angle α wit the vertical, the maximum possible value of is α given by:
(A) cot α = 3
(B) tan α =3
(C) sec α=3
(D) cosec α=3

28. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by:
(A) $\sqrt{2}$ Mg
(B) $\sqrt{2}$ mg
(C) $\sqrt{((M+m)^2+m^2} g)$
(D) $\sqrt{((M+m)^2+M^2} g)$

29. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be:
(A) 0^0
(B) 30^0
(C) 45^0
(D) 60^0

30. The ends of a stretched wire of length L are fixed at x =0 and x =L. In one experiment the displacement of the wire is y_1= A sin(πx/L) sin ωt and energy is E_1 and in other experiment its displacement is y_2= A sin(2πx/L) sin 2ωt and energy is E_2 . Then :
(A) $E_2=E_1$
(B) $E_2=2E_1$
(C) $E_2=4E_1$
(D) $E_2=16E_1$

31. P-V plots for two gases during adiabatic processes are shown in the figure. Plots 1 and 2 should correspond respectively to :
(A) He and O_2
(B) O_2 and He
(C) He and Ar
(D) O_2 and N_2

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

(A) Zero
(B) Purely kinetic
(C) Purely potential
(D) Partial kinetic and partly potential

33. A hemispherical portion of radius R. The volume of the remaining cylinder is V and mass M. It is suspended by a string in a liquid of density ρ where it stays vertical. The upper surface of the cylinder is at a depth h below the liquid surface. The force on the bottom of the cylinder by the liquid is:

(A) Mg
(B) Mg -Vρg
(C) Mg +$\pi R^2 h$ ρg
(D) ρg(V + $\pi R^2 h$)

34. Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively and the trajectories are as shown in the figure. Then :

(A) $m_A v_A < m_B v_B$
(B) $m_A v_A > m_B v_B$
(C) $m_A < m_B$ and $v_A < v_B$
(D) $m_A = m_B$ and $v_A = v_B$

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

(A) Maximum in situation (a)
(B) Maximum in situation (b)
(C) Maximum in situation (c)
(D) The same in all situations