IIT-JEE-Physics-Screening–2000

SCREENING

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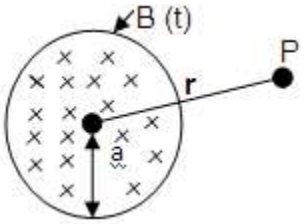
1. Electrons with energy 80keV are incident on the tungsten target of an X-Ray tube. K-shell electrons of tungsten have -72.5keV energy. X-rays emitted by the tube contain only.
(A) a continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of ~0.155 Å.
(B) A continuous X-ray spectrum (Bremsstrahlung) with all wavelengths.
(C) The characteristic X-ray spectrum of tungsten.
(D) A continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of ~0.155 Å and the characteristic X-ray spectrum of tungsten.

2. A uniform but time varying magnetic field B (t) exists in a circular region of radius a and is directed into the plane of the paper as shown. The magnitude of the induced electric field at point P at a distance r from the center of the circular region

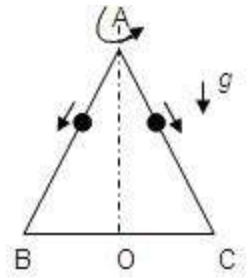
(A) Is zero
(B) Decreases as 1/r
(C) Increases as r
(D) Decreases as $1/r^2$



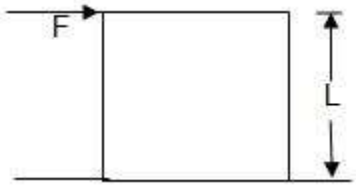
3. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth 4y from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then, R is equal to
(A) $L/\sqrt{2\pi}$
(B) $2\pi L$
(C) L
(D) $L/2\pi$

4. An equilateral triangle ABC formed from a uniform wire has two small identical beads initially located at A. The triangle is set rotating about the vertical axis AO. Then the beads are released from rest simultaneously and allowed to slide down; One along AB and the other along AC as shown. Neglecting frictional effects, the quantities that are conserved as beads slides down are

(A) Angular velocity and total energy (Kinetic and potential)
(B) Total angular momentum and total energy
(C) Angular momentum and moment of inertia About the axis of rotation
(D) Total angular momentum and moment of Inertia about the axis f rotation



5. A cubical block of side L rests on a rough horizontal surface with coefficient of friction μ. A horizontal force F is applied on the block as shown. If the coefficient of friction is sufficiently high so that the block does not slide before toppling, the minimum force required to topple the block is



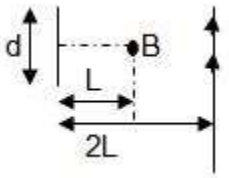
(A) Infinitesimal
(B) mg/4
(C) mg/2
(D) mg(1-μ)

6. Imagine an atom made up of proton and a hypothetical particle of double the mass of the electron but having the same charge as the electron. Apply the Bohr atom model and consider all possible transitions of this hypothetical particle to the first excited level. The longest wavelength photon that will be emitted has wavelength λ (given in terms of the Rydberg constant R for the hydrogen atom) equal to
(A) 9/5R
(B) 36/5R
(C) 18/5R
(D) 4/R

7. A monoatomic ideal gas, initially at temperature T_1, is enclosed in a cylinder fitted with a friction piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the lengths of the gas column before and after expansion respectively, then T_1 / T_2 is given by
(A) $(L_1 / L_2)^{2/3}$
(B) (L_1 / L_2)
(C) L_2 / L_1
(D) $(L_2 / L_1)^{2/3}$

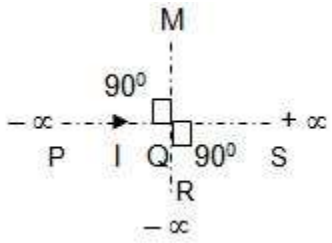
8. A point source of light B placed at a distance L in front of the centre of a mirror of width d, hangs vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance 2L from it as shown. The greatest distance over which he can see the image of the

light source in the mirror is

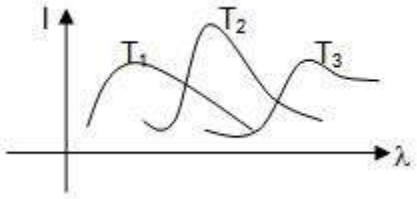


(A) d/2
(B) d
(C) 2d
(D) 3d

9. An infinitely long conductor PQR is bent to form a right angle as shown. A current I flows through PQR. The magnetic field due to this current at the point M is H1. Now, another infinitely long straight conductor QS is connected to Q so that the current is I/2 in QR as well as in QS, the current in PQ remaining unchanged. The magnetic field at M is now H2.The ratio of H1/H2 is given by



10. The plots of intensity versus wavelength for three black bodies at temperatures T1, T2 and T3 respectively are as shown. Their temperatures are such that



(A) $T_1 > T_2 > T_3$
(B) $T_1 > T_3 > T_2$
(C) $T_2 > T_3 > T_1$
(D) $T_3 > T_2 > T_1$

11. A train moves towards a stationary observer with speed 34 m/s. The train sounds a whistle and its frequency registered by the observer is F_1. If the train's speed is reduced to 17 m/s, the frequency registered is F_2. If the speed of sound is 340 m/s then f_1/ f_2 is
(A) 18 / 19
(B) 1 / 2
(C) 2

(D) 19 / 18

12. A particle of charge q and mass m moves in a circular orbit of radius r with angular speed ω. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on
(A) ω and q
(B) ω, q and m
(C) q and m
(D) ω and m

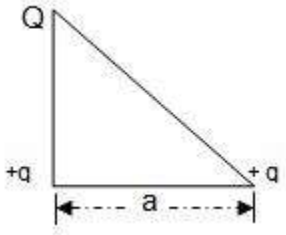
13. The dimension of (1/2) $Є_0 E^2$ (Є0 : permittivity of free space; E : electric field) is
(A) MLT^{-1}
(B) ML^2T^{-2}
(C) $ML^{-1}T^{-2}$
(D) ML^2T^{-1}

14. In a compound microscope, the intermediate image is
(A) Virtual, erect and magnified
(B) Real, erect and magnified
(C) Real, inverted and magnified
(D) Virtual, erect and reduced

15. The period of oscillation of a simple pendulum of length L suspended from the roof of the vehicle which moves without friction, down an inclined plane of inclination α, is given by
(A) $2\pi\sqrt{(L/g\cos\alpha)}$
(B) $2\pi\sqrt{(L/g\sin\alpha)}$
(C) $2\pi\sqrt{(L/g)}$
(D) $2\pi\sqrt{(L/g\tan\alpha)}$

16. In a double slit experiment instead of taking slits of equal widths, one slit is made twice as wide as the other, then in the interference pattern
(A) The intensities of both the maxima and minima increases
(B) The intensity of maxima increases and the minima has zero intensity
(C) The intensity of maxima decreases and that of minima increases
(D) The intensity of maxima decreases and the minima has zero intensity

17. Three charges Q, +q and –q are p;aced at the vertices of a right angle triangle (isosceles triangle) as shown. The net electrostatic energy of the configuration is zero if Q is equal to



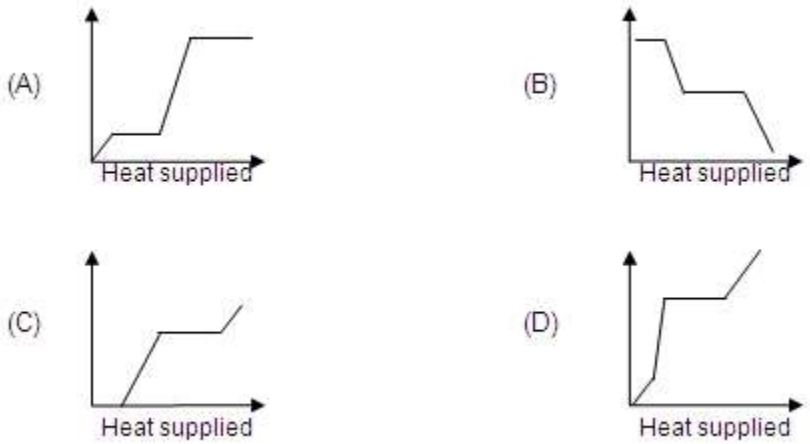
(A) $(-q)/(1+\sqrt{2})$
(B) $(-2q)/(2+\sqrt{2})$

(C) -2q
(D) +q

18. A long horizontal road has a bead which can slide along its length and is initially placed at a distance L from one end A of the rod. The rod is set in angular motion about A with a constant angular acceleration. If the coefficient of friction between the rod and the bead is μ, and gravity is neglected, then the time after which the bead starts slipping is
(A) $\sqrt{(\mu/\alpha)}$
(B) $\mu/\sqrt{\alpha}$
(C) $1/\sqrt{\mu\alpha}$
(D) Infinitesimal

19. Starting with the same initial conditions, an ideal gas expands from volume V1 to V2 in three different ways, the work done by the gas is W1 if the process is purely isothermal, W2 if purely isobaric and W3 if purely adiabatic, then
(A) W2> W1> W3
(B) W2> W3 >W1
(C) W1 >W2 >W3
(D) W1 >W3 >W2

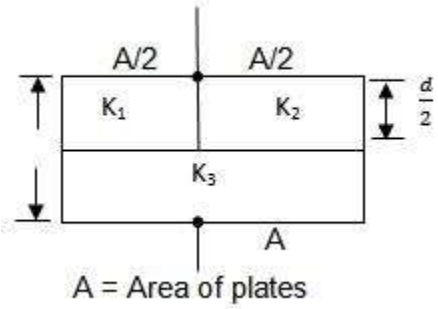
20. A block of ice at -100C is slowly heated ahs converted to steam at 1000C. Which of the following curves represents the phenomenon qualitatively?



21. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the + x direction and a magnetic field along the + z direction then
(A) Positive ions deflect towards +y direction and negative ions towards –y direction
(B) All ions deflect towards +y direction
(C) All ions deflect towards – y direction
(D) Positive ions deflect towards –y direction and negative ions towards +y direction

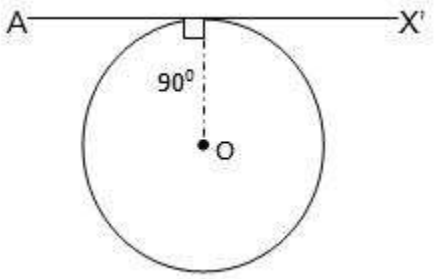
22. Two radioactive materials X_1 and X_2 have decay constants 10λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_2 to that of X_2 will be 1/e after a time
(A) $1/10\lambda$
(B) $1/11\lambda$
(C) $11/10\lambda$
(D) $1/9\lambda$

23. A parallel plate capacitor of area A, plate separation d and capacitance C is filled with three different dielectric materials having dielectric constants k_1, k_2 and k_3 as shown. If a single dielectric material is to be used to have the same capacitance C in this capacitor then its dielectric constant k is given by



(A) $1/k = 1/k_1 + 1/k_2 + 1/(2k_3)$
(B) $1/k = 1/(k_1 + k_2) + 1/(2k_3)$
(C) $k = (k_1 k_2)/(k_1 + k_2) + 2k_3$
(D) $k = (k_1 k_3)/(k_1 + k_2) + (k_2 k_3)/(k_2 + k_2)$

24. A thin wire of length L and uniform linear mass density p is bent into a circular loop with centre at O as shown. The moment of inertia of the loop about the axis XX' is

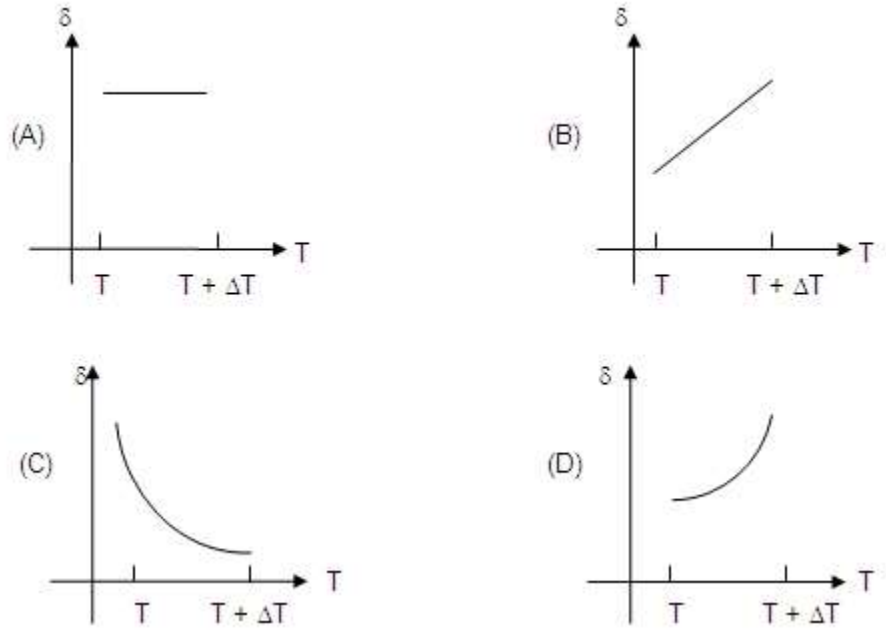


(A) $(pL^3)/(8\pi^2)$
(B) $(pL^3)/(16\pi^2)$
(C) $(5pL^3)/(16\pi^2)$
(D) $(3pL^3)/(8\pi^2)$

25. The electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following statements is true
(A) Its kinetic energy increases and its potential and total energy decreases
(B) Its kinetic energy decreases, potential energy increases and its total energy remains the same

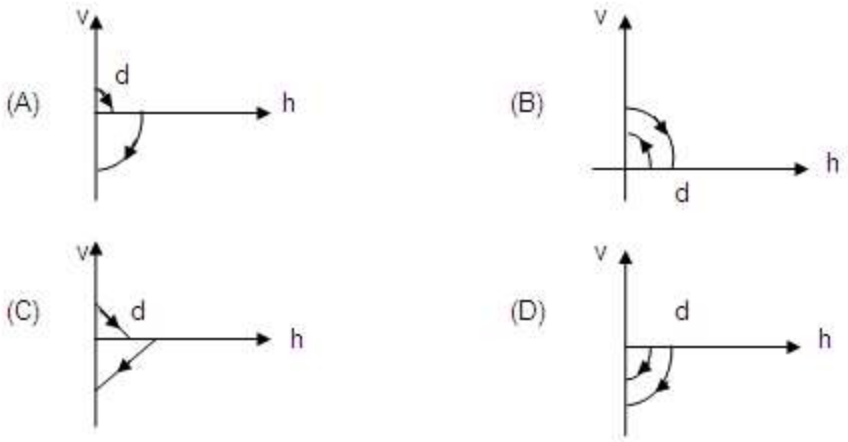
(C) Its kinetic and total energy decreases and its potential energy increases
(D) Its kinetic , potential and total energy decreases

26. An ideal gas is initially at temperature T and volume V. Its volume is increased by ΔV due to an increase in temperature ΔT, pressure remaining constant. The quantity $\delta = \Delta V/V\Delta T$ varies with temperature as



27. A wind-powered generator converts wind energy into electrical energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed V, the electrical power output will be proportional to
(A) v
(B) v^2
(C) v^3
(D) v^4

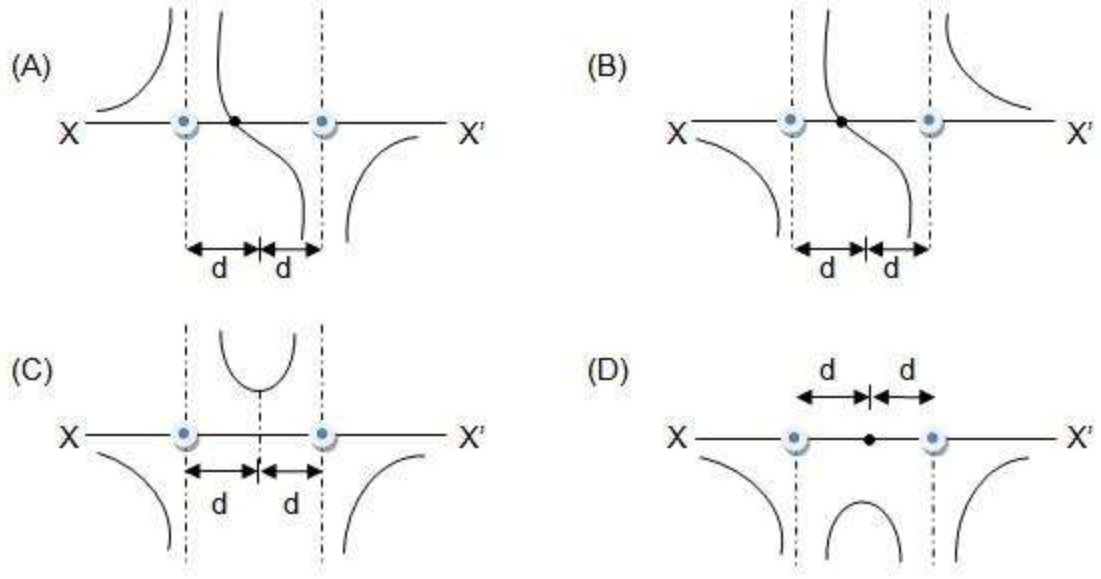
28. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height d/2. Neglecting subsequent motion and air resistance, its velocity v varies with height h above the ground as



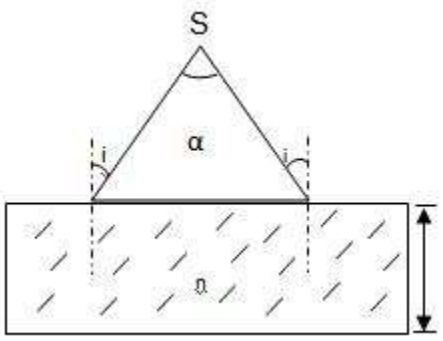
29. A coil of wire having finite inductance and resistance has a conducting ring placed co-axially within it. The coil is connected to a battery at time t= 0, so that a time dependent current I_1 (t) starts flowing through the coil. If I_2 (t) is the current induced in the ring, and B (t) is the magnetic field at the axis of the coil due to I_1 (t) then as a function of time (t > 0), the product I_2 (t) B (t)
(A) increases with time
(B) decreases with time
(C) does not vary with time
(D) passes through a maximum

30. A hollow double concave lens is made of very thin transparent material. It can be filled with air or either of two liquids L_1 or L_2 having refracting indices n1 and n2 respectively (n2 > n1 > 1). The lens will diverge a parallel beam of light if it is filled with
(A) air and placed in air
(B) air and immersed in L_1
(C) L_1 and immersed in L_2
(D) L_2 and immersed in L_1

31. Two long parallel wires are at a distance 2d a part. They carry steady equal currents flowing out of the plane of the paper as shown. The variation of the magnetic field B along the line XX' is given by



32. A diverging beam of light from a point source S having divergence angle α falls symmetrically on a glass slab as shown. The angles of incidence of the two extreme rays are equal. If the thickness of the glass slab is t and its refractive index is n, then the divergence angle of the emergent beam is



(A) Zero
(B) α
(C) $\sin^{-1}(1/n)$
(D) $2\sin^{-1}(1/n)$

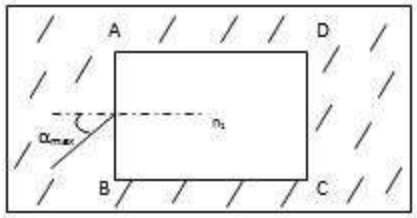
33. A rectangular glass slab ABCD of refractive index n1 is immersed in water of refractive index n2(n1 > n2). A ray of light is incident at the surface AB of the slab as shown. The maximum value of the angle of incidence αmax, such that the ray comes out only from the other surface CD, is given by

(A) $sin^{-1}\frac{n_1}{n_2}cos\left(sin^{-1}\frac{n_2}{n_1}\right)$

(B) $sin^{-1}\left[n_1\ cos\left(sin^{-1}\frac{1}{n_2}\right)\right]$

(C) $sin^{-1}\left(\frac{n_1}{n_2}\right)$

(D) $sin^{-1}\left(\frac{n_2}{n_1}\right)$



34. Two vibrating strings of the same material but lengths L and 2L have radii 2r and r respectively. They are stretched under the same tension. Both the strings vibrate in their fundamental modes, the one of length L with frequency v1. The ratio v1/v2 is given by
(A) 2
(B) 4
(C) 8
(D) 1

35. Two monoatomic ideal gases 1 and 2 of molecular masses m_1 and m_2 respectively are enclosed in separate containers kept at the same temperature. The ratio of the speed of sound is gas 1 to that in gas 2 is given by
(A) $\sqrt{(m_1/ m_2)}$
(B) $\sqrt{(m_2/ m_1)}$
(C) m_1/ m_2
(D) m_2/ m_1

IIT-JEE-Chemistry-Screening–2000

SCREENING

Time : Three hours Max. Marks : 100

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1. For the electrochemical cell, $M|M^+||X^-|X$, $E^o(M^+|M) = 0.44V$ and $E^o(X|X^-) = 0.33$ V. From this data one can deduce that:
(A) $M + X \rightarrow M^+ + X^-$ is the spontaneous reaction.
(B) $M^+ + X^- \rightarrow M + X$ is the spontaneous reaction.
(C) $E_{cell} = 0.77V$
(D) $E_{cell} = –0.7$ V

2. The Δ_fH^o for $CO_2(g)$, $CO(g)$ and $H_2O(g)$ are –393.5, –110.5 and –241.8 kJ mol^{-1} respectively. The standard enthalpy change (in kJ mol^{-1}) for the reaction $CO_2(g) + H_{2(g)} \rightarrow CO_{(g)} + H_2O_{(g)}$ is:

(A) 524.1 (B) 41.2
(C) –262.5 (D) –41.2

3. The number of P — O — P bonds in cyclic metaphosphoric acid is:
(A) zero (B) two
(C) three (D) four

4. The chemical processes in the production of steel from haematite ore involve:
(A) reduction
(B) oxidation
(C) reduction followed by oxidation
(D) oxidation followed by reduction

5. Which of the following has the highest nucleophilicity:
(A) F^- (B) OH^-
(C) CH_3^- (D) NH_2^-

6. The order of reactivities of the following alkyl halides for a SN2 reaction is:
(A) RF > RCI > RBr > RI (B) RF > RBr > RCI > RI
(C) RCI > RBr > RF > RI (D) RI > RBr > RCI > therefore

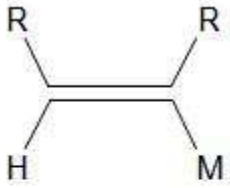
7. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$.
This represents its:
(A) excited state (B) ground state
(C) cationic form (D) anionic form

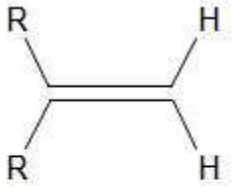
8. The correct order of acidic strength is:
(A) $CI_2O_7 > SO_2 > P_4O10$ (B) $CO_2 > N_2O_5 > SO_3$
(C) $Na_2O > MgO > AI_2O3$ (D) $K_2O > CaO > MgO$

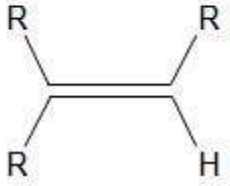
9. Which of the following, has the most acidic hydrogen:
(A) 3–hexanone (B) 2, 4-hexanedione
(C) 2, 5-hexanedione (D) 2, 3-hexanedione

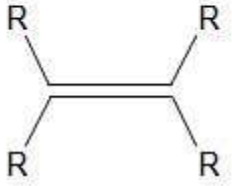
10. Benzoyl chloride is prepared from benzoic acid by:
(A) CI_2, hv (B) SO_2CI_2
(C) $SOCI_2$ (D) CI_2, H_2O

11. Which one of the following alkenes will react fastest with H_2 under catalytic hydrogenation condition :

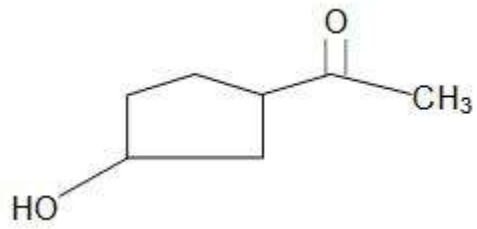
(A) 

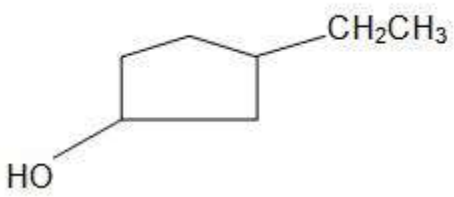
(B) 

(C) 

(D) 

12. The appropriate reagent for the following transformation :





(A) Zn(Hg), HCI (B) NH_2 NH_2, OH–
(C) H_2/Ni (D) $NaBH_4$

13. Electrolytic reduction of alumina to aluminium by Hall-Heroult process is carried out:
(A) in the presence of NaCI.
(B) in the presence of fluorite.
(C) in the presence of cryolite which forms a melt with lower melting temperature.
(D) in the presence of cryolite which forms a melt with higher melting temperature.

14. Amongst the following, identify the species with an atom in +6 oxidation state.
(A) MnO_4^- (B) $Cr(CN)_6^{3-}$

(C) NiF_6^{2-} (D) CrO_2CI_2

15. For the reversible reaction $N_2(g) + 3H_2(g) = 2NH_3(g)$ at 500oC, the value of Kp is 1.44×10^{-5} when partial pressure is measured in atmospheres. The corresponding value of Kc with concentration in mol L^{-1} is:
(A) $1.44 \times 10^{-5}/(0{,}082 \times 500)^{-2}$ (B) $1.44 \times 10^{-5}/(8.314 \times 773)^{-2}$
(C) $1.44 \times 10^{-5}/(0.082 \times 773)^{2}$ (D) $1.44 \times 10^{-5}/(0.082 \times 773)^{-2}$

16. The hybridization of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ are:

(A) sp, sp3 and sp2 respectively (B) sp, sp2 and sp3 respectively
(C) sp2, sp and sp3 respectively (D) sp2, sp3 and sp respectively

17. Amongst H_2O, H_2S, H_2Se and H_2Te, the one with the highest boiling point is:
(A) H_2O because of hydrogen bonding
(B) H_2Te because of higher molecular weight
(C) H_2S because of hydrogen bonding
(D) H_2Se because of lower molecular weight

18. Which of the following compounds will exhibit geometrical isomerism:
(A) 1-phenyl-2-butene (B) 3-phenyl-1-butene
(C) 2-phenyl-1-butene (D) 1, 1-diphenyl-1-propene

19. Molecular shapes of SF_4, CF_4 and XeF_4 are:
(A) the same, with 2, 0 and 1 lone pair of electrons respectively
(B) the same, with 1, 1 and 1 lone pair of electrons respectively
(C) different, with 0, 1 and 2 lone pairs of electrons respectively
(D) different, with 1, 0 and 2 lone pairs of electrons respectively

20. Among the following, the strongest base is:
(A) $C_6H_5NH_2$ (B) *p* – $NO_2C_6H_4NH_2$
(C) m – NO_2 – $C_6H_4NH_2$ (D) $C_6H_5CH_2NH_2$

21. The correct order of radii is:
(A) N < Be < B (B) $F^- < O^{2-} < N^{3-}$
(C) Na < Li < K (D) $Fe^{3+} < Fe^{2+} < Fe^{4+}$

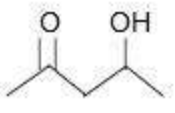
22. The number of nodal planes in a px orbital is:
(A) one (B) two
(C) three (D) zero

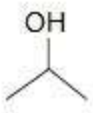
23. Ammonia can be dried by:
(A) conc. H_2SO_4 (B) P_4O_{10}
(C) CaO (D) anhydrous $CaCI_2$

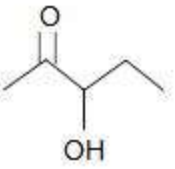
24. The rms velocity of hydrogen is √7 times the rms velocity of nitrogen. If T is the temperature of the gas:
(A) T (H_2) = T (N_2) (B) T (H_2) > T (N_2)
(C) T (H_2) < T (N_2) (D) T (H_2) = √7 T (N_2)

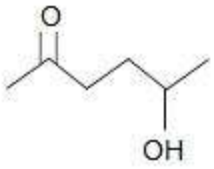
25. Propyne and propene can be distinguished by:
(A) conc. H_2SO_4 (B) Br_2 in CCI_4
(C) dil. $KMnO_4$ (D) $AgNO_3$ in ammonia

26. Which one of the following will most readily be dehydrated in acidic condition:

(A) 

(B) 

(A) 

(B) 

27. The compressibility of a gas is less than unity at STP. Therefore :
(A) Vm > 22.4 litres (B) Vm < 22.4 litres
(C) Vm = 22.4 litres (D) Vm = 44.8 litres

28. The rate constant for the reaction, $2N_2O_5 \rightarrow 4NO_2 + O_2$ is 3.0×10^{-5} s^{-1}. If the rate is 2.40×10^{-5} mol L^{-1} s^{-1}, then the concentration of N_2O_5 (in mol L^{-1}) is :
(A) 1.4 (B) 1.2
(C) 0.04 (D) 0.8

29. At 100oC and 1 am if the density of the liquid water is 1.0g cm^{-3} and that of water vapour is 0.0006 g cm^{-3}, then the volume occupied by water molecules in1 litre of steam at this temperature is:
(A) 6 cm^3 (B) 60 cm^3
(C) 0.6 cm^3 (D) 0.06 cm^3

30. When two reactants, A and B are mixed to give products C and D, the reaction quotient, Q, at the initial stages of the reaction :
(A) is zero (B) decreases with time
(C) is independent of time (D) increases with time

The questions below consist of an '**Assertion**' in column I and the '**Reason**' in column 2. Use of 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	Reason
31.	1-Butene on reaction with HBr in the presence of a peroxide produces 1-bromobutane	It involves the formation of primary radical.
32.	The first ionization energy of Be is greater than that of B.	2p orbital is lower in energy than 2s.

33.	The pressure of a fixed amount of an ideal gas is proportional to its temperature	Frequency of collisions and their impact both increase in proportion to the square root of temperature.
34.	Phenol is more reactive than benzene towards electrophilic substitution reaction	In the case of phenol, the intermediate carbocation is more resonance stabilized.
35.	The heat absorbed during the isothermal expansion of an ideal gas against vacuum is zero	The volume occupied by the molecules of an ideal gas is zero.

IIT-JEE-Mathematics–Screening-2000

SCREENING

Time : Two hours Max. Marks : 100

PART A

1. Let f (θ) = sin θ (sin θ + sin 3 θ). Then f (θ) :
(A) ≥ 0 only when θ ≥ 0 (B) ≤ 0 for all real θ
(C) ≥ 0 for all real θ (D) ≤ 0 only when θ ≤ 0

2. If x + y = k is normal to $y^2 = 12x$, then k is :
(A) 3 (B) 9
(C) –9 (D) –3

3. For $2 \le r \le n$, $\binom{n}{r} \div 2\binom{n}{r-1} \div \binom{n}{r-2} =$
(A) $\binom{n+1}{r-1}$ (B) $2\binom{n+1}{r+1}$
(C) $2\binom{n+2}{r}$ (D) $\binom{n+2}{r}$

4. If a and β (α < β) are the roots of the equation $x^2 + bx + c = 0$, where c < 0 < b, then :
(A) 0 < α < β (B) α < 0 < β < |α|
(C) α < β < 0 (D) α < 0 < |α| < β

5. Let f : R → R be any function. Define g : R → R by g (x) = | f (x) | for all x.
Then g is :
Onto if f is onto
One-one is f one-one
Continuous if, f is continuous
Differentiable if f is differentiable

6. The domain of definition of the function y (x) is given by the equation $2^x + 2^y = 2$ is :
(A) $0 < x \leq 1$ (B) $0 \leq x \leq 1$
(C) $-\infty < x \leq 0$ (D) $-\infty < x < 1$

7. If $x^2 + y^2 = 1$, then :
(A) $yy''' - 2(y')^2 + 1 = 0$ (B) $yy'' + (y')^2 + 1 = 0$
(C) $yy'' = (y')^2 - 1 = 0$ (D) $yy'' + 2(y')^2 + 1 = 0$

8. If a,b, c, d are positive real numbers such that a + b + c + d = 2, then M = (a + b) (c + d) satisfies the relation :
(A) $0 \leq M \leq 1$ (B) $1 \leq M \leq 2$
(C) $2 \leq M \leq 3$ (D) $3 \leq M \leq 4$

9. If the system of equations x – ky – z = 0, kx – y – z = 0, x + y – z = 0 has a non-zero solution, then possible values of k are :
(A) –1, 2 (B) 1, 2
(C) 0, 1 (D) –1, 1

10. The triangle PQR is inscribed in the circle $x^2 + y^2 = 25$. If Q and R have coordinates (3, 4) and (–4, 3) respectively, then ∠PQR is equal to:
(A) $\pi/2$ (B) $\pi/3$
(C) $\pi/4$ (D) $\pi/6$

11. In a triangle ABC, 2ac sin 1/2 (A – B + C) =
(A) $a^2 + b^2 - c^2$ (B) $c^2 + a^2 - b^2$
(C) $b^2 - c^2 - a^2$ (D) $c^2 - a^2 - b^2$

12. For $x \in R$, $\lim_{n \to \infty}((x-3)/(x+2))^x$ =
(A) e (B) e^{-1}
(C) e^{-5} (D) e^5

13. Consider an infinite geometric series with first term and common ratio r. If its sum is 4 and the second term is 3/4, then :

(A) a=4/7, r=3/7 (B) a =2, r = 3/8
(C) a = 3/2, r = 1/2 (D) a = 3, r = ¼

14. Let g (x) = $\int_0^x f(t)\,dt$, where f is such that $1/2 \le f(t) \le 1$ for t ∈ [0,1] and

$0 \le f(t) \le 1/2$ for t ∈[1,2]. Then g (2) satisfies the inequality:

(A) $-3/2 \le g(2) < 1/2$ (B) $0 \le g(2) < 2$
(C) $3/2 < g(2) \le 5/2$ (D) $2 < g(2) < 4$

15. In a triangle ABC, Let ∠ C= π/2. If r is the inradius and R is the circum-radius of the triangle, then 2 (r +R) is equal to :
(A) a + b (B) b + c
(C) c + a (D) a + b + c

16. How many different nine digit numbers can be formed from the number 223355888 by rearranging its digits so that the odd digits occupy even position :
(A) 16 (B) 36
(C) 60 (D) 180

17. If arg (z) < 0, then arg (–z) – arg (z) =
(A) π (B) –π
(C) -π/2 (D) π/2

18. Let PS be the median of the triangle with vertices P (2, 2), Q (6-1) and R (7, 3). The equation of the line passing through (1,–1) and parallel to PS is:
(A) 2x-9 y-7=0 (B) 2 x-9 y-11=0
(C) 2 x+9 y-11=0 (D) 2 x-9 y-11=0

19. A pole stands vertically inside a triangular park Δ ABC. If the angle of elevation of the top of the pole from each corner of the park is same, then in Δ ABC the foot of the pole is at the :
(A) centroid (B) circumcentre
(C) incentre (D) orthocenter.

20. If $f(x) = \begin{cases} e^{\cos x}\sin x & for\ |x| \le 2, \\ 2 & otherwise, \end{cases}$ then $\int_{-2}^{3} f(x)\,dx =$

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

21. The incentre of the triangle with vertices (1,√3), (0, 0) and (2, 0) is :
(A) (1,√3/2) (B) (2/3,1/√3)
(C) (2/3,√3/2) (D) (1,1/√3)

22. Consider the following statements in S and R :
S : Both sin x and cos x are decreasing functions in the interval (π/2,π)

R : If a differentiable function decreases in an interval (a, b), then its derivative also decreases in (a, b).
Which of the following is true :
(A) Both S and R are wrong
(B) Both S and R are correct, but R is not the correct explanation of S.
(C) S is correct and R is correct explanation for S.
(D) S is correct and R is wrong.

23. Let $f(x)=\int e^x (x-1)(x-2)\,dx$. Then f decreases in the interval :

(A) $(\infty,-2)$ (B) $(-2, -1)$
(C) $(1, 2)$ (D) $(2,+\infty)$

24. If the circles $x^2+y^2+2x+2ky+6=0$ and $x^2+y^2+2ky+k=0$ intersect orthogonally, then k is :

(A) 2 or –3/2 (B) –2 or 3/2
(C) 2 or 3/2 (D) $(2,+\infty)$

25. If the vectors $\vec{a},\vec{b}$ and $\vec{c}$ form the sides BC, CA and AB respectively of a triangle ABC, then:
(A) $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}=0$ (B) $\vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}$
(C) $\vec{a}\cdot\vec{b}=\vec{b}\cdot\vec{c}=\vec{c}\cdot\vec{a}$ (D) $\vec{a}\times\vec{b}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a}=0$

26. If the normal to the curve y=f (x) at the point (3, 4) makes an angle $3\pi/4$ with the positive x-axis then f' (3) =
(A) –1 (B) –3/4
(C) 4/3 (D) 1

27. Let the vectors a, b, c and d be such that $(a \times b) \times (c \times d) = 0$. Let P_1 and P_2 be planes determined by the pairs of vectors a, b and c, d respectively, then the angle between P1 and P2 is :
(A) 0 (B) $\pi/4$
(C) $\pi/3$ (D) $\pi/2$

28. Let $f(x)=\begin{cases}|x| & \text{for } 0<|x|\le 2\\ 1 & \text{for } x=0.\end{cases}$

Then at x = 0, f has :
(A) A local maximum (B) no local maximum
(C) a local minimum (D) no extremum

29. If $\vec{a},\vec{b}$ and $\vec{c}$ are unit coplanar vectors, then the scalar triple product $[2\vec{a}-\vec{b},\ 2\vec{b}-\vec{c},\ 2\vec{c}-\vec{a}]=$

(A) 0 (B) 1
(C) $-\sqrt{3}$ (D) $\sqrt{3}$

30. If b > a, then the equation (x-a)(x-b) –1 = 0 has :
(A) both roots in (a, b)
(B) both roots in (–∞, a)
(C) both roots in (b, + ∞)
(D) one root in (–∞, a) and the other in (b, + ∞)

31. If z_1, z_2 and z_3 are complex numbers such that
$|z_1| |z_2| = |z_3| = |1/z_1 + 1/z_2 + 1/z_3| = 1$, then $|z_1+z_2+z_3|$ is :

(A) equal to 1 (B) less than1
(C) greater than 3 (D) equal to 3

32. For the equation $3x^2+px+3=0, p>0$, if one of the root is square of the other, then p is equal to :
(A) 1/3 (B) 1
(C) 3 (D) 2/3

33. If the line x – 1 = 0 is the directrix of the parabola $y^2-kx+8=0$ then one of the values of k is :
(A) 1/8 (B) 8
(C) 4 (D) 1/4

34. For all $\in(0,1)$:
(A) $e^x < 1+x$ (B) $\log_e (1+x) < x$

(C) sin x > x (D) $\log_e x > x$.

35. The value of the integral $\int_{e^{-1}}^{e^2} |\log_e x / x| dx$ is :

(A) 3/2 (B) 5/2
(C) 3 (D) 5