ALL INDIA TEST SERIES

FULL TEST – I

Time Allotted: 3 Hours **Maximum Marks: 432**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part has only one section: **Section-A**.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with black pen for each character of your Enrolment No. and write your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 to 03 and 10 to 12)** contains 6 multiple choice questions which have only one correct answer. Each question carries **+8 marks** for correct answer and **– 2 mark** for wrong answer.

Section-A (04 to 09 and 13 to 30) contains 24 multiple choice questions which have only one correct answer. Each question carries **+4 marks** for correct answer and **– 1 mark** for wrong answer.

Name of the Candidate	
Enrolment No.	

Useful Data

PHYSICS

Acceleration due to gravity	$g = 10\ m/s^2$
Planck constant	$h = 6.6 \times 10^{-34}$ J-s
Charge of electron	$e = 1.6 \times 10^{-19}$ C
Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$
Density of water	$\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure	$P_a = 10^5\ N/m^2$
Gas constant	$R = 8.314\ J\ K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	0.0821 Lit atm $K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2$ Cal $K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's constant	h	=	6.625×10^{-34} J·s
		=	6.625×10^{-27} erg·s
1 Faraday		=	96500 coulomb
1 calorie		=	4.2 joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

Atomic masses: H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108, Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.

Physics

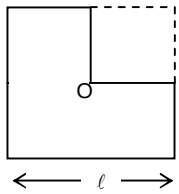
PART – I

SECTION – A

Single Correct Choice Type

This section contains **30 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. One quarter of the plate is cut from a square plate as shown in the figure. If 'M' is the mass of the plate and 'ℓ' is the length of each side, then the moment of inertia of the plate about an axis passing through 'O' and perpendicular to the plate is



(A) $M\ell^2 / 8$ (B) $3M\ell^2/4$

(C) $M\ell^2/3$ (D) $3M\ell^2$

2. A block is suspended by an ideal spring constant K. If the block is pulled down by constant force F and if maximum displacement of block from it's initial position of rest is z, then

(A) z = F/K (B) z = 2F/K

(C) work done by force F is equal to 2Fz.

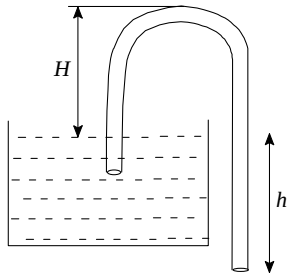
(D) increase in potential energy of the spring is $\frac{1}{2}Kz^2$

3. A particle starts from rest and moves with an acceleration of $a = \{2 + |t - 2|\}$ m/s^2, the velocity of the particle at t = 4 sec is

(A) 2 m/s (B) 4 m/s

(C) zero (D) 12 m/s.

4. A large tank filled with water of density ρ and surface tension γ is being siphoned out using a glass capillary tube of cross-sectional radius *r*. If the siphon action starts without any external agent, then (angle of contact is zero).

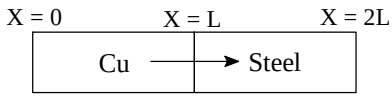


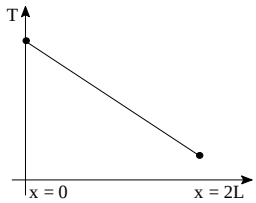
(A) $H < \frac{\gamma}{\rho gr}$ (B) $H < \frac{2\gamma}{\rho gr}$

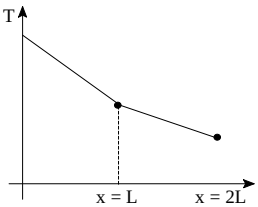
(C) $H - h < \frac{2\gamma}{\rho gr}$ (D) $\sqrt{H^2 - h^2} < \frac{\gamma}{\rho gr}$

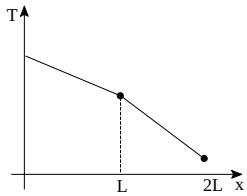
Space for Rough work

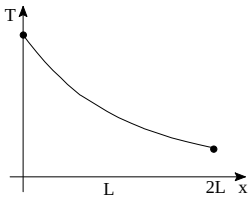
5. A copper rod and a steel rod of equal cross-sections and lengths (L) are joined side by side and connected between two heat baths as shown in the figure. If heat flows through them from x = 0 to x = 2L at a steady rate, and conductivities of the metals are K_{cu} & K_{steel} ($K_{cu} > K_{steel}$), then the temperature varies as: (convection and radiation are negligible)



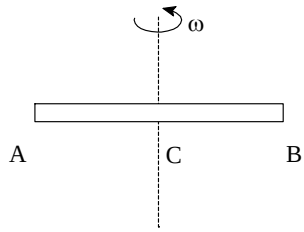
(A) 

(B) 

(C) 

(D) 

6. A non –conducting rod AB of length *l* has a total charge q. The rod is rotated about an axis passing through its center of mass with a constant angular velocity ω as shown in the figure. The magnetic moment of the rod is

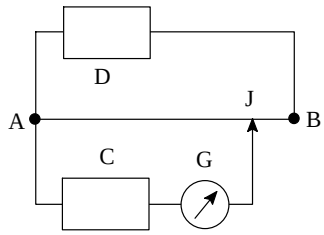


(A) $\frac{q\omega l^2}{12}$ (B) $\frac{q\omega l^2}{3}$

(C) $\frac{q\omega l^2}{24}$ (D) $\frac{q\omega l^2}{6}$

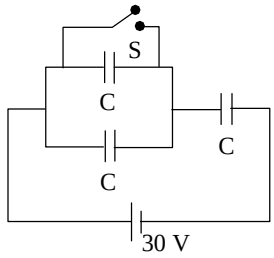
Space for Rough work

7. The figure shows a potentiometer arrangement. *D* is the driving cell, *C* is the cell whose e.m.f. is to be determined. *AB* is the potentiometer wire and *G* is a galvanometer. *J* is a sliding contact which can touch any point on *AB*. Which of the following are essential conditions for obtaining balance?



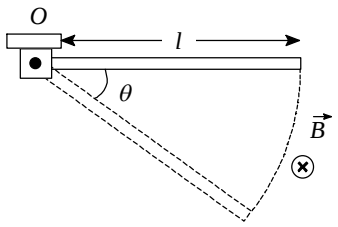
(A) The e.m.f. of *D* must be greater than the e.m.f. of *C*
(B) The positive terminals of D and C both must be joined to A
(C) The resistance of G must be less than the resistance of AB
(D) None of these

8. Three capacitors each having capacitance $C = 2\ \mu F$ are connected with a battery of e.m.f. 30 V as shown in the figure. When the switch *S* is closed. The amount of charge flown through the battery is



(A) 20 μC (B) 24 μC
(C) 10 μC (D) 40 μC

9. A conducting rod of length *l* is hinged at point *O*. It is free to rotate in a vertical plane. There exists a uniform magnetic field $\vec{B}$ in horizontal direction. The rod is released from the position shown in the figure. The potential difference between the two ends of the rod when it rotates through an angle θ is proportional to:



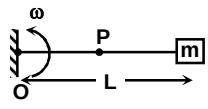
(A) ℓ^2 (B) $\ell^{3/2}$
(C) sin θ (D) None of these

10. If $\vec{a}$ and $\vec{b}$ are two non parallel vectors then $\left[\vec{a}\times(\vec{a}\times\vec{b})\right].[\vec{a}\times\vec{b}]$ is equal to
(A) a^3b^2 (B) $a^2(\vec{a}.\vec{b})$
(C) zero (D) None of these

11. A boat goes downstream for half an hour and then goes upstream for half an hour. The total distance travelled by the boat in the ground frame for this is 20 km. Ii is known that speed of the boat relative to the river for the whole trip was constant and greater than the speed of the river. The distance travelled by the boat in the frame of the river for this is
(A) zero (B) 20 km
(C) 10 km (D) can't be determined

Space for Rough work

12. A particle of mass m is attached to a rod of length L and it rotates in a circle with a constant angular velocity ω. An observer P is rigidly fixed on the rod at a distance L/2 from the centre. The acceleration of m and the pseudo force on m from the frame of reference of P must be respectively

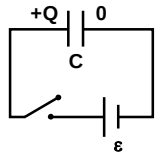


(A) zero, zero
(B) zero, $m\omega^2\frac{L}{2}$
(C) $\omega^2\frac{L}{2}$, $m\omega^2\frac{L}{2}$
(D) zero, $m\omega^2 L$

13. For a certain organ pipe open at both ends, the successive resonance frequencies are obtained at 510, 680 and 850 Hz. The velocity of sound in air is 340 m/s. The length of the pipe must be
(A) 2 m
(B) 0.5 m
(C) m
(D) 0.25 m

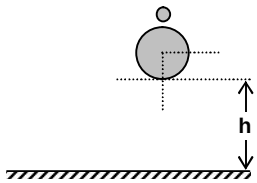
14. A short linear object of length 1 mm lies along the axis of a biconvex lens of focal length 5 cm at a distance of 15 cm. The length of the image will be approximately
(A) 1/16 mm
(B) 1/4 mm
(C) 1/2 mm
(D) 1/8 mm

15. The left plate of the capacitor shown in the figure above carries a charge +Q while the right plate is uncharged at t = 0. The total charge on the right plate after closing the switch will be



(A) $\frac{Q}{2} + C\varepsilon$
(B) $\frac{Q}{2} - C\varepsilon$
(C) $-\frac{Q}{2}$
(D) $-C\varepsilon$

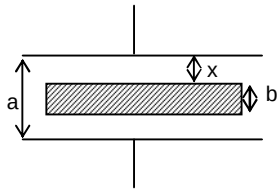
16. A small sphere and a big sphere are released from rest with a very small gap from height h as shown in the figure. The mass of bigger sphere is very large as compared to mass of smaller sphere the height from the point of collision of smaller sphere with the bigger sphere to which the smaller sphere will rise if all the collisions are elastic

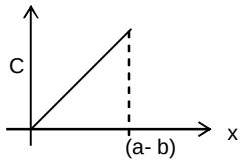


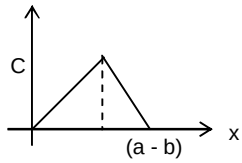
(A) 2h
(B) 4h
(C) 6h
(D) 9h

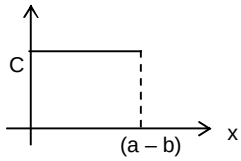
Space for Rough work

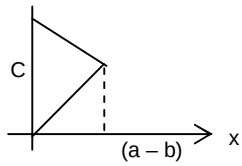
17. The distance between two parallel plates of a capacitor is a. A conductor of thickness b(b < a) is inserted between the plates as shown in the figure. The variation of effective capacitance between the surfaces of conductor and plate as a function of the distance (x) is best represented by



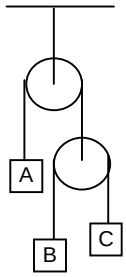
(A)


(B)


(C)


(D)


18. Three blocks A, B and C having masses m kg 2kg and 3 kg are attached by massless strings and ideal pulleys as shown in the figure. When the system is released from rest if the block 'A' remains stationary , the mass of block 'A' is



(A) 2.2 kg (B) 2.6 kg
(C) 2.4 kg (D) 4.8 kg

19. A block of mass 2 kg is attached to one end of a massless rod of length $\frac{1}{\pi}$m . The rod is fixed to a horizontal plane at the other end such that the block and rod are free to revolve on a horizontal plane. The coefficient of friction between the block and surface is 0.1. Block is made to rotate with uniform speed by applying a constant external force in tangential direction on the block. The work done by external force when the rod rotates by 90^0 is

(A) 0 (B) 10 joule

(C) $\frac{\pi}{2}$ joule (D) 1 joule

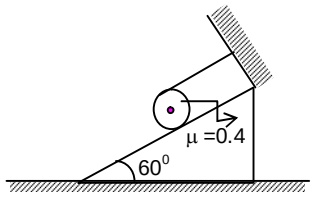
20. A solid sphere of radius R, and dielectric constant 'k' has spherical cavity of radius R/4. A point charge q_1 is placed in the cavity. Another charge q_2 is placed outside the sphere at a distance of r from q. Then Coulombic force of interaction between them is found to be 'F_1'. When the same charges are separated by same distance in vacuum then the force of interaction between them is found to be F_2 then

(A) $F_1 = F_2/k$ (B) $F_2 = F_1/k$

(C) $F_1 . F_2 = \frac{1}{k}$ (D) $F_1 = F_2$

Space for Rough work

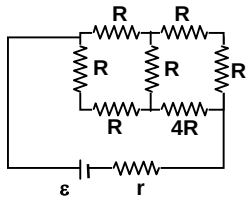
21. A solid cylinder is wrapped with a string and placed on an inclined plane as shown in the figure. Then the frictional force acting between cylinder and plane is



(A) zero (B) 5 mg

(C) $\frac{7mg}{2}$ (D) $\frac{mg}{5}$

22. The relation between R and r (internal resistance of the battery) for which the power consumed in the external part of the circuit is maximum.



(A) R = r (B) $R = \frac{r}{2}$

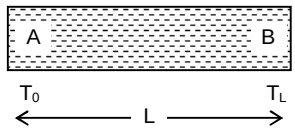
(C) R = 2r (D) R = 1.5 r

23. An equilateral triangular loop having a resistance R and length of each side 'ℓ' is placed in a magnetic field which is varying at $\frac{dB}{dt}$ = 1 T/s. The induced current in the loop will be

(A) $\frac{\sqrt{3}}{4}\frac{\ell^2}{R}$ (B) $\frac{4}{\sqrt{3}}\frac{\ell^2}{R}$

(C) $\frac{\sqrt{3}}{4}\frac{R}{\ell^2}$ (D) $\frac{4}{\sqrt{3}}\frac{R}{\ell^2}$

24. The temperature of a mono-atomic gas in an uniform container of length 'L' varies linearly from T_0 to T_L as shown in the figure. If the molecular weight of the gas is M_0, then the time taken by a wave pulse in travelling from end A to end B is

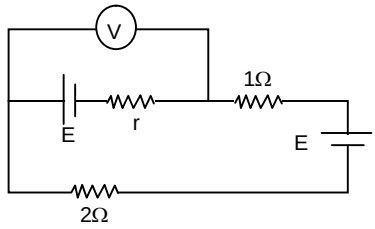


(A) $\frac{2L}{(\sqrt{T_L}+\sqrt{T_0})}\sqrt{\frac{3M}{5R}}$ (B) $\sqrt{\frac{3(T_L-T_0)}{5RM_0L}}$

(C) $\frac{2L}{(\sqrt{T_L}-\sqrt{T_0})}\sqrt{\frac{3M}{5R}}$ (D) $L\sqrt{\frac{M_0}{2R(T_L-T_0)}}$

Space for Rough work

25. In the given circuit the reading of ideal voltmeter is E/2. The internal resistance of the battery is



(A) $1\,\Omega$ (B) $\frac{2}{3}\Omega$

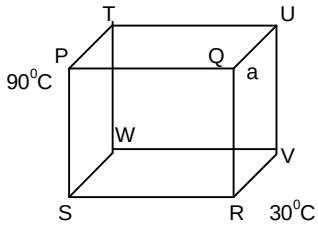
(C) $\frac{2}{5}\Omega$ (D) $\frac{5}{2}\Omega$

26. The specific heat capacity of a monoatomic gas for the process TV^2 = constant is (where R is gas constant)

(A) $\frac{R}{2}$ (B) 2R

(C) $\frac{R}{3}$ (D) $\frac{R}{4}$

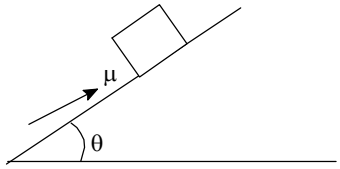
27. 12 identical rods made of same material are arranged in the form of a cube. The temperature of 'P' and 'R' are maintained at 90^0 C and 30^0C respectively. Then the temperature of point 'V', when steady state is reached,



(A) 65°C (B) 60°C

(C) 20°C (D) 50°C

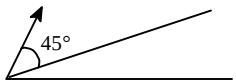
28. A block is placed at the the bottom of an inclined plane and slided upwards with some initial speed. It slides up the incline, stops after time t_1, and slides back in a further time t_2. The angle of inclination of the plane with the horizontal is θ and the coefficient of friction is μ. Then



(A) $t_1 > t_2$ (B) $t_1 < t_2$

(C) $t_1 = t_2$ (D) $t_1 = t_2$ only if $\theta = \frac{\pi}{4}$

29. A projectile is thrown from the base of an inclined plane at an angle 45° with the plane. At what angle may it hit the plane again?



(A) 30° (B) 45°

(C) 60° (D) all of the above.

30. In an artificial satellite which of the following process of heat transfer will not take place?

(A) Conduction (B) Convection

(C) Radiation (D) All of the above

Space for rough work

Chemistry

PART – II

SECTION – A
Straight Objective Type

This section contains 30 multiple choice questions numbered 1 to 30. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. Which one of the following is correct?
   (A) If one component of a binary liquid-liquid solution deviate negatively from Raoult's law, then the solution will form minimum boiling point azeotrope.
   (B) for a solution of two liquids (A and B), $V_{sol} > V_A + V_B$; then A and B can be separated by fractional distillation.
   (C) Deep sea divers use a mixture of He and O_2 instead of air due to less solubility of He in blood in comparison to N_2, which cause the bends, i.e. pain due to bubbling of untreated gas dissolved in blood.
   (D) All of the above.

2. A compound is composed of two elements A and B, element A constitute f.c.c. lattice, while B occupy all the tetrahedral voids, in this way another simple cubic is constituted by element B, inside the fcc unit cell of element A. If all the points/particles along any one edge of inner cube of every unit cell, are missing then what is the new empirical formula of the compound
   (A) A_4B_6 (B) A_2B_8
   (C) A_2B_3 (D) AB_4

3. Which of the following gives yellow precipitate with aq. $AgNO_3$?
   (A) KIO_3 (B) KI
   (C) CHI_3 (D) CH_2I_2

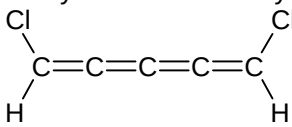
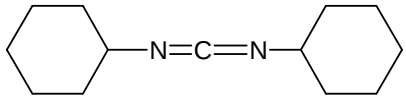
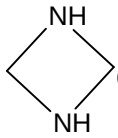
4. How many planes of symmetry and axis of symmetry are there in one molecule of PCl_3F_2, respectively?
   (A) 4, 7 (B) 7, 13
   (C) 7, 10 (D) 4, 10

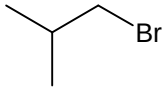
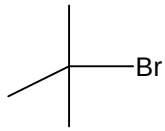
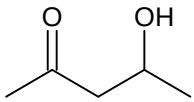
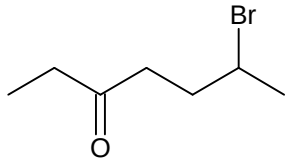
5. Two cylinders A and B of equal volumes are filled and equal masses of N_2 and O_2, respectively. Cylinder A is kept at 300 K while B is kept at 600 K, then (assume ideal behaviour of both gases)
   (A) Average kinetic energy of N_2 (per mole) in A is equal to that of O_2 in B.
   (B) Molecules in cylinder B move twice as fast as those in A.
   (C) Pressure in flask A is less than that of B.
   (D) Average velocity of N_2 is equal to rms velocity of O_2, in the given conditions.

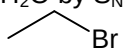
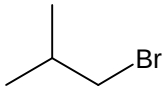
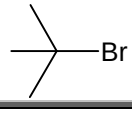
Space for Rough work

6. The ratio of time periods taken by electron in 1^{st} and 3^{rd} orbits of He^+ ion, for each revolution is.....
(A) 1 : 9 (B) 1 : 27
(C) 8 : 27 (D) 8 : 9

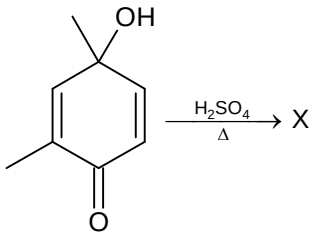
7. The equilibrium constant of mutarotation of α-D-glucose to β-D-glucose is 1.8. If specific rotation of α-D-glucose is 112^o and that of mixture is 59^o; what is specific rotation of β-D-glucose?
(A) -112^o (B) -59^o
(C) $+29.6^o$ (D) -29.6^o

8. Which of the following is correct?
(A) cis-cycloalkane is always more stable than trans cycloalkane.
(B)  does not show geometrical isomerism
(C)  show geometrical isomerism.
(D)  does not show any type of isomerism

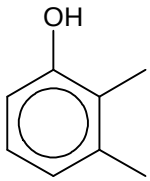
9. Which of the following will undergo $E1_{cB}$.?
(A) 
(B) 
(C) 
(D) 

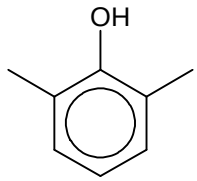
10. From which of the following halogen can be replaced by H_2O by S_N1?
(A) CH_3 — Br (B) 
(C)  (D) 

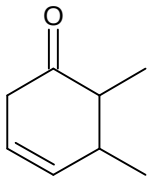
Space for Rough work

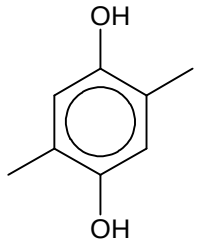
11. 

Product X is :

(A) 

(B) 

(C) 

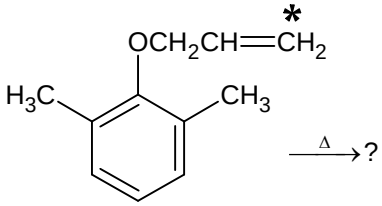
(D) 

12. Which of the following can not be used for protection of carbonyl group?
(A) $CH_2(OH)CH_2CHO$ (B) $CH_2(OH)—CH_2CH_2(OH)/H^+$
(C) $CH_2(OH)\ CH_2(OH)/H^+$ (D) $HS(CH_2)_3SH$

13. The configuration of the C-2 epimer of D-glucose is
(A) 2R, 3S, 4R, 5S (B) 2R, 3S, 4R, 5R
(C) 2S, 3S, 4R, 5R (D) 2S, 3R, 4R, 5S

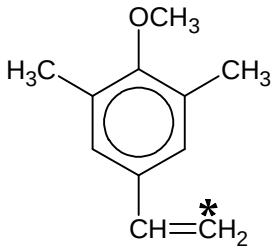
Space for Rough work

14.

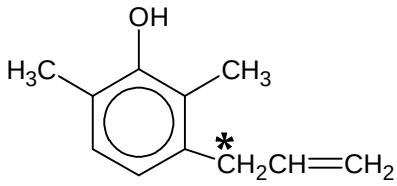


The product is

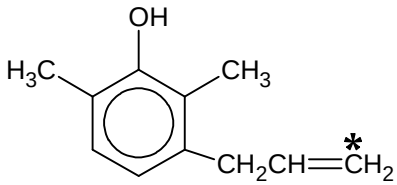
(A)



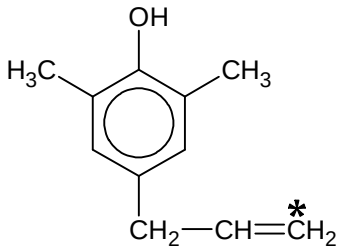
(B)



(C)



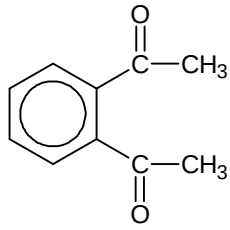
(D)



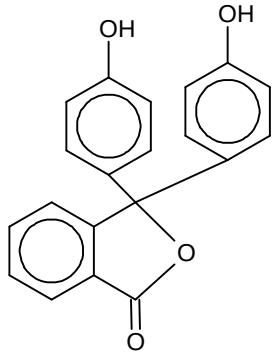
15. Acetophenone $\xrightarrow{HCO_3H}$ A (Major) $\xrightarrow{H_3O^+}$ B + C $\xrightarrow{\text{Phthalic Anhydride/H}^+}$ Indicator (D) is

(A) PhOH

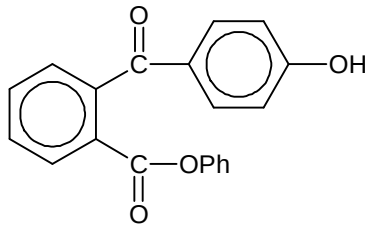
(B)



(C)



(D)



Space for Rough work

16. The complex $[Fe(H_2O)_5(NO)]^{2+}$ is formed in the ring test for nitrate when freshly prepared $FeSO_4$ solution is added to aqueous solution of NO_3^- followed by addition of conc. H_2SO_4. The complex is formed by charge transfer in which:
(A) Fe^{2+} charges to Fe^{3+}, NO to NO^+
(B) Fe^{3+} charge to Fe^{2+} and NO changes to NO^+
(C) Fe^{2+} changes to Fe^+ and NO changes to NO^+
(D) Fe^{2+} changes to Fe^{3+} and NO^+ changes to NO

17. Which of the following match is correct?

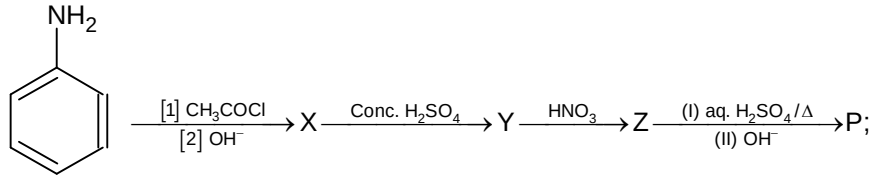
	Ore/ Minerals	**Element**
(A)	Bauxite	B
(B)	Magnetite	Mn
(C)	Bornite	B
(D)	Cerussite	Pb

18. Which of the following is correct about Boron nitride $\{(BN)_x\}$?
(A) All the atoms of the ring are uncharged
(B) It is insulator, unlike graphite
(C) Inter-layer distance in its graphite like structures, is less than that of graphite
(D) Resonance energy of each hexagon of $(BN)_x$ is greater than that of Benzene.

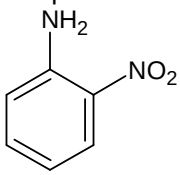
19. Which of the following is true?
(A) Oxides of Ge, Sn and Pb are amphoteric in nature
(B) Producer gas is produdced in incomplete combustion of C by air ($O_2 + N_2$)
(C) SnO is much better reducing agent than PbO.
(D) All are correct

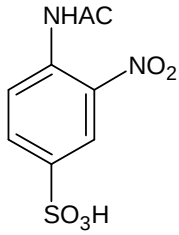
20. Which of the following can not be used as nitrating agent in Electrophilic Aromatic Substitution of benzene?
(A) N_2O_5/MeCN (B) $C_2H_5ONO_2$
(C) $C_2H_5NO_2$ (D) $NO_2.SO_3$

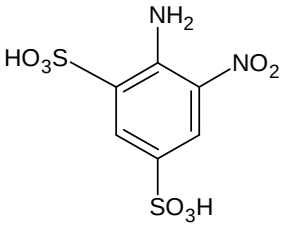
Space for Rough work

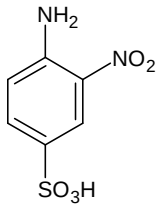
21. 

What is the product 'P' of the above reaction

(A) 

(B) 

(C) 

(D) 

22. Which of the following is tetrahedral and paramagnetic complex?

(A) $\left[NiCl_4\right]^{2-}$ (B) $\left[Ni(CN)_4\right]^{2-}$

(C) $\left[Cu(NH_3)_4\right]^{2+}$ (D) $\left[Ni(CO)_4\right]$

23. Which of the following statement is correct?

(A) Free energy (G) is a path function

(B) In the expression G = H – TS, TS is the part of the system's energy that is disordered, already.

(C) ΔG for a system is equal to $T\Delta S_{Total}$ in magnitude

(D) Statement A is incorrect but statement B and C are correct

Space for Rough work

24. All the elements A, B, C and D form homonuclear diatomic molecules and conform anion of type X^- also. In a series of experiments the following observations are made:

(i) $2B^- + C_2 \longrightarrow 2C^- + B_2$

(ii) $2A^- + C_2 \longrightarrow$ no reaction

(iii) $2D^- + C_2 \longrightarrow 2C^- + D_2$

(iv) $2B^- + D_2 \longrightarrow B_2 + 2D^-$

Which of the following statement is correct?
(A) A_2 is the strongest oxidizing agent among all A_2, B_2, C_2 and D_2.
(B) Correct order of reduction potentials is $A_2 > C_2 > D_2 > B_2$.
(C) (A) and (B) are correct statements as well as it can also be concluded that B corrode at fastest rate among all the four elements.
(D) All the above statements are correct.

25. What is the solubility product of CaF_2 at room temperature, if $\overset{o}{\Lambda}_m\left(Ca^{2+}\right) = 1.04 \times 10^{-2}$ Sm^2/mol

$\overset{o}{\Lambda}_m\left(F^-\right) = 4.8 \times 10^{-3}$ Sm^2/mol

$\kappa_{CaF_2(\text{Saturated Solution})} = 4.25 \times 10^{-3}$ S / m at room temperature.

$\kappa_{H_2O} = 2 \times 10^{-4}$ S / m

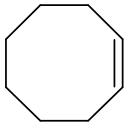
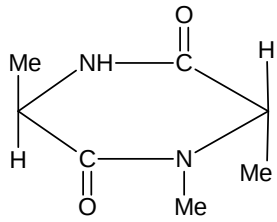
(A) 4.05×10^{-4} M^3 (B) 2.025×10^{-4} M^3
(C) 3.32×10^{-11} M^3 (D) 4.05×10^{10} M^3

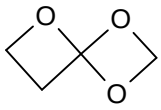
26. Some times yellow turbidity appears while passing H_2S gas even in the absence of II_{nd} group of basic radicals. This is because:
(A) Sulphur is present in the mixture as impurity.
(B) IV group radicals are precipitated as sulphides.
(C) The oxidation of H_2S gas by some acid radicals.
(D) III^{rd} group radicals are precipitated as hydroxides.

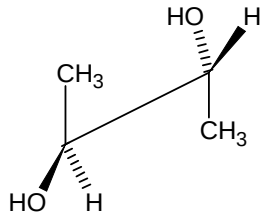
27. In low temperature range fraction of heat supplied to an ideal diatomic gas system, at constant pressure, which bring change in its internal energy is approx.....?
(A) 0.71 (B) 0.75
(C) 0.60 (D) 0.50

Space for Rough work

28. By which of the following methods, Cl_2 can be produced?
(A) By treating $KClO_3$ with iodine (I_2)
(B) By heating a mixture of NaBr and $NaBrO_3$ with HCl
(C) By treating $CaOCl_2$ and NaI mixture with HCl solution.
(D) By treating NaCl with H_2SO_4

29. Which of the following is optically active?
(A) 
(B) 

(C) 

(D) 

30. Which of the following will cause symmetric cleavage of B_2H_6?
(A) NH_3 (B) $N(CH_3)_3$
(C) $NH_2 - C_2H_5$ (D) $HN(CH_3)_2$

Space for Rough work

Mathematics

PART – III

SECTION – A
Straight Objective Type

This section contains **30 multiple choice questions** numbered 1 to 30. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. For $n \geq 3$ circles, the value of n for which the number of radical axis is equal to number of radical centres is
   (A) 3 (B) 4
   (C) 5 (D) none of these

2. Consider a circle, $x^2 + y^2 = 1$ and point $P\left(1, \sqrt{3}\right)$ ·PAB is a secant drawn from P intersecting circle in A and B (distinct) then range of |PA| + |PB| is
   (A) $\left[2, 2\sqrt{3}\right]$ (B) $\left(2\sqrt{3}, 4\right]$
   (C) (0, 4] (D) none of these

3. Consider a curve $|z - i| = 2$ and a point $z_1 = 3 - i$, then the length of tangent made from the point (z_1) to the curve is
   (A) 2 (B) 3
   (C) 5 (D) none of these

4. The total number of 1 word, 2 word, 3 word sentences that can be formed using the letters of the word SAMSUNG is
   (A) 8! (B) 18 × 7!
   (C) 11 × 7! (D) none of these

5. Consider a line $z(i - 1) + \bar{z}(i + 1) = 0$ in the argand plane and a point $z_1 = 2 + 3i$ then the reflection of z_1 in the given line is
   (A) 2 – 3i (B) –2 + 3i
   (C) 3 + 2i (D) none of these

Space for Rough work

6. The sequence a_n is defined by $a_1 = \frac{1}{2}$, $a_{n+1} = a_n^2 + a_n$. Also, $S = \frac{1}{a_1+1} + \frac{1}{a_2+1} + ... + \frac{1}{a_{100}+1}$ then [S] (where [.] denotes the greatest integer function) is
(A) 1 (B) 2
(C) 3 (D) none of these

7. Consider a plane $\bar{r} \cdot (2\hat{i} + 2\hat{j} - \hat{k}) = 5$ which cuts a circular section from the sphere $|\bar{r}| = 9$ then the volume of the cone formed by taking circular cross section as base and vertex as centre of sphere is
(A) $\frac{3520\pi}{27}$ (B) $\frac{40}{9}\sqrt{11}\pi$
(C) $\frac{64}{9}\pi$ (D) none of these

8. Let, $t_r = r!$ and $S_n = \sum_{r=1}^{n} r!$ then $\frac{S_n}{24} = a + \frac{\lambda}{24}$; $a, \lambda \in N$ where λ is
(A) 7 (B) 23
(C) 9 (D) none of these

9. If $z = \begin{bmatrix} O & I \\ I & O \end{bmatrix}$ where O, I are 2 × 2 null and identity matrix then det(|z|) is
(A) 1 (B) –1
(C) 0 (D) none of these

10. Given that $f(x) + f\left(\frac{1}{1-x}\right) = \frac{2(1-2x)}{x(1-x)}$, $x \in R$, $x \neq 0, 1$ then the given f(x) is
(A) one–one (B) many one
(C) f(0) = 1 (D) none of these

11. The area between the curve $y^2(a + x) = (a - x)^3$ and its vertical asymptote is
(A) $\frac{\pi}{2}a^2$ (B) $2\pi a^2$
(C) $3\pi a^2$ (D) none of these

Space for Rough work

12. If the given curve satisfies the differential equation $e^y dx + (xe^y + 2y)dy = 0$ and also passes through (0, 0) then the possible equation of curve can be
(A) $xe^y + y = 0$ (B) $x + y^2e^y = 0$
(C) $x^2e^x + ye^y = 1$ (D) none of these

13. Let $\bar{v}$ be a unit vector which follows the equation, $\bar{v} \times \bar{b} = \bar{c}$. Also, $|\bar{b}| = 2$ and $|\bar{c}| = \sqrt{3}$ then
(A) $\bar{v} = -\bar{b} + \bar{b} \times \bar{c}$ (B) $\bar{v} = \frac{3}{4}(\bar{b} + 2\bar{b} \times \bar{c})$
(C) $\bar{v} = \frac{1}{4}(\bar{b} + \bar{b} \times \bar{c})$ (D) none of these

14. If the tangent to the curve $y = 1 - x^2$ at $x = \alpha (0 < \alpha < 1)$ meets the axes at P and Q. Also α varies, the minimum value of the area of the triangle OPQ is k times the area bounded by the axes and the part of the curve for which $0 < x < 1$, then k is
(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{2}{\sqrt{3}}$
(C) $\frac{1}{2}$ (D) $\frac{3}{2}$

15. Consider a parabola $y^2 = \alpha x$ and a point $\left(-\frac{\alpha}{4}, 0\right)$ then midpoint of centres of the circles touching the tangents from given point and its chord of contact is
(A) $\frac{\alpha}{2}$ (B) $\frac{\alpha}{4}$
(C) $\frac{3\alpha}{2}$ (D) none of these

16. Consider a curve $(2x + y - 1)^2 = 5(x - 2y - 3)$ then the possible coordinates of foci are
(A) $\left(\frac{5}{4}, \frac{3}{4}\right)$ (B) $\left(\frac{3}{4}, -\frac{1}{2}\right)$
(C) $\left(\frac{5}{4}, \frac{3}{2}\right)$ (D) none of these

Space for Rough work

17. Consider the curves C_1: $x^2 + y^2 = 1$ and $C_2 : \frac{x^2}{\sin^2\theta} + \frac{y^2}{\cos^2\theta} = 1$. If a common tangent $y = mx + c$ is drawn to C_1, C_2 then $\left(\frac{\pi}{4} < \theta < \frac{\pi}{2}\right)$

(A) $m \in \phi$ (B) $c = 1$

(C) $m = \frac{1}{\sqrt{2}}$ (D) none of these

18. Consider a parabola $x^2 = 4y$ and a hyperbola $xy = 1$. A tangent is drawn to parabola meets the hyperbola in A and B then locus of midpoint of AB is

(A) straight line (B) parabola

(C) ellipse (D) none of these

19. If the following represent the two lines with real point of intersection then $\alpha_1 x + \alpha_2 y = k_1$, $\beta_1 x + \beta_2 y = k_2$. Also, (α_1, α_2), (β_1, β_2) lie on $x^2 + y^2 = 1$ then

(A) $\alpha_1\beta_1 + \alpha_2\beta_2 \in [0, 2]$

(B) lines can represent asymptotes of rectangular hyperbola

(C) $\alpha_1\beta_1 + \alpha_2\beta_2 \in [-2, 0]$

(D) none of these

20. $g(n) = \int_0^{n^2+n+1} e^{x/2-[x/2]}\left(\frac{x}{2} - \left[\frac{x}{2}\right]\right) d(x - [x])$; $n \in N$ then g(n)

(A) has minimum value as $\frac{1}{4} + \sqrt{e}$ (B) has maximum value as $3 - \sqrt{e}$

(C) has minimum value as $\frac{3}{4} - \sqrt{\frac{e}{4}}$ (D) none of these

21. Consider a sequence f(x), $n \in I^+ \cup \{0\}$ defined by $f(0) = 0$, $f(n + 1) = \sqrt{6 + f(n)}$ then $\lim_{n\to\infty} f(n)$ is

(A) 1 (B) 2

(C) 3 (D) none of these

Space for Rough work

22. If $(a-a')^2+(b-b')^2+(c-c')^2=p$ and $(ab'-a'b)^2+(bc'-b'c)^2+(ca'-c'a)^2=q$, then the perpendicular distance of the line $ax+by+cz=1$, $a'x+b'y+c'z=1$ from origin, is

(A) $\sqrt{\frac{p}{q}}$ (B) $\sqrt{\frac{q}{p}}$

(C) $\frac{p}{\sqrt{q}}$ (D) $\frac{q}{\sqrt{p}}$

23. Consider a function, f : R $\to$ R such that f(x + a) = $\frac{1}{2}+\sqrt{f(x)-f^2(x)}$, a is a real constant. If f(x) is periodic then its period can be

(A) $\frac{a}{2}$ (B) a

(C) 2a (D) none of these

24. Consider an identity matrix (n × n) I_n; $\lambda \in R^+$ then |Adj(λI_n)| is

(A) λ^{n-1} (B) $\lambda^{n(n-1)}$

(C) λ^n (D) $\lambda^{2(n-1)}$

25. Let $A_1, A_2, A_3, \ldots, A_7$ be skew symmetric matrices of same order then $1\cdot(A_1)^1 + 3\cdot(A_2)^3 + 5(A_3)^7 + \ldots + 13(A_7)^{13}$ is

(A) symmetric (B) skew symmetric

(C) neither symmetric nor skew symmetric (D) none of these

26. Given the expansion $(a+p)^{m-1} + (a+p)^{m-2}(a+q) + (a+p)^{m-3}(a+q)^2 + \ldots + (a+q)^{m-1}$ [$a \neq -q$ and $p \neq q$] then coefficient of a^t is

(A) $\frac{{}^mC_t\left[p^t-q^t\right]}{p-q}$ (B) ${}^mC_t\frac{p^{m-t}-q^{m-t}}{p-q}$

(C) $\frac{{}^mC_t\left[p^t+q^t\right]}{p-q}$ (D) ${}^mC_t\frac{p^{m-t}+q^{m-t}}{p-q}$

Space for Rough work

27. Consider a curve C : $y^2 = 8x$ and line L : $2x + y = 3$. If three distinct points A, B, C are selected at random on L, then the maximum probability that the tangents drawn from A, B, C to $y^2 = 8x$ are mutually perpendicular is [For points A, B, C, $S_1 > 0$]

(A) 1 (B) $\frac{1}{3}$

(C) $\frac{2}{3}$ (D) none of these

28. Let F, F′, F″ be continuous in [0, ln 2] and f(0) = 0, f′(0) = 3, f(ln 2) = 6, f′(ln 2) = 4 and $\int_0^{\ln 2} e^{-2x} f(x)\,dx = 3$ then $\int_0^{\ln 2} e^{-2x} f''(x)\,dx$ is

(A) 10 (B) 13

(C) 12 (D) none of these

29. Consider circles S : $x^2 + y^2 = 1$ and S′ : $(x - 4)^2 + (y - 0)^2 = 9$. Now a circle is drawn touching S, S′ externally and also their direct common tangent then its radius is

(A) $3\left(4 + 2\sqrt{3}\right)$ (B) $\frac{3}{4}\left(4 - 2\sqrt{3}\right)$

(C) $4 - 2\sqrt{3}$ (D) none of these

30. Given that a, b, c are sides of the triangle ΔABC such that $z = \log_{2^a + 2^{-a}}\left[4(ab + bc + ca) - (a + b + c)^2\right]$ then z has a real value if and only if

(A) a = b = 2c (B) 3a = 2b = c

(C) a – b = 3c (D) none of these

Space for Rough work