Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.Super60_NUCLEUS & STERLING_BT **JEE-MAIN** **Date: 23-09-2023**

Time: 09.00Am to 12.00Pm **RPTM-08** **Max. Marks: 300**

IMPORTANT INSTRUCTION:

1. Immediately fill in the Admission number on this page of the Test Booklet with **Blue/Black** Ball Point **Pen** only.
2. The candidates should not write their Admission Number anywhere (except in the specified space) on the Test Booklet/ Answer Sheet.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of 90 questions. The maximum marks are **300.**
5. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry** and **Mathematics** having **30 questions** in each subject and subject having **two sections.**
   (I) Section –I contains 20 **multiple choice** questions with only one correct option.
   Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.
   (II) Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only, if more than 5 questions attempted, First 5 attempted questions will be considered.
   - The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

   To cancel any attempted question bubble on the question number box.
   For example: To cancel attempted question 21. Bubble on 21 as shown below

Question Answered for Marking **Question Cancelled for Marking**

Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

6. Use **Blue / Black Point Pen only** for writing particulars / marking responses on the Answer Sheet. **Use of pencil is strictly prohibited.**
7. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electron device etc, except the Identity Card inside the examination hall.
8. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
9. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
10. **Do not fold of make any stray marks on the Answer Sheet**

Name of the Candidate (in Capital): _____

Admission Number: | | | | | | | | | | |

Candidate's Signature:_____ **Invigilator's Signature:** _____

23-09-23_Sr.Super60_ NUCLEUS & STERLING_BT _ Jee-Main_RPTM-08_Test Syllabus

PHYSICS : Rigid body Dynamics 2: Conservation of angular momentum; Collision of point masses with rigid bodies, Rolling with and without slipping, Toppling

RPTM-08(15Q-RPTM.7 SYLLABUS+15Q CUMULATIVE SYLLABUS)

CHEMISTRY : 1.Classification of Elements and Periodicity in Properties:
Modern periodic law and the present form of periodic table; electronic configuration of elements; periodic trends in atomic radius, ionic radius, ionization enthalpy, electron gain enthalpy, valence, oxidation states, electronegativity and chemical reactivity.
2.Chemical bonding and Molecular Structure:
Orbital overlap and covalent bond; Hybridisation involving s,p and d orbitals only(Excluding Hybridisation in complexes); Molecular orbital energy diagrams for homo nuclear diatomic species (upto Ne2); Hydrogen bond; Polarity in molecules, dipole moment; VSEPR model and shapes of molecules (linear, angular, triangular, square planar, pyramidal, square pyramidal, trigonal bipyramidal, tetrahedral and octahedral).
3.Hydrogen:
Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides –ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxide-preparation, reactions, uses and structure; hydrogen as a fuel; hardness of water

RPTM-08(15Q-RPTM.7 SYLLABUS+15Q CUMULATIVE SYLLABUS)

MATHEMATICS : Vectors & 3D-Geometry

RPTM-08(15Q-RPTM.7 SYLLABUS+15Q CUMULATIVE SYLLABUS)

PHYSICS **Max Marks: 100**

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

1. STATEMENT-1: The force of friction in the case of a disc of mass m rolling without slipping down on inclined plane of inclination α is $\frac{1}{3}mg\sin\alpha$

STATEMENT-2: When the disc rolls without slipping, friction is required because for rolling condition velocity of point of contact is zero

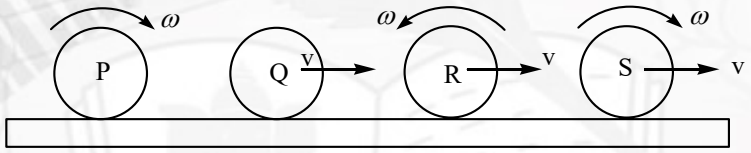
1) Both statements are TRUE and STATEMENT-2 is the correct explanation of STATEMENT-1.

2) Both statements are TRUE but STATEMENT-2 is not the correct explanation of STATEMENT-1.

3) STATEMENT-1 is TRUE and STATEMENT-2 is FALSE

4) STATEMENT-1 is FALSE and STATEMENT-2 is TRUE

2. Four solid spheres are made to move on a rough horizontal surface. Sphere P is given a spin and released. Sphere Q is given a forward linear velocity. Sphere R and S are given linear and rotational motions as shown in the figure. Directions of the friction force on spheres P, Q, R, S are respectively.



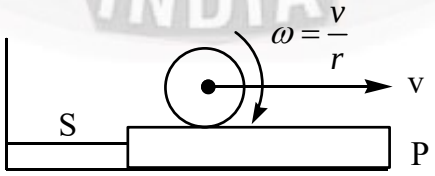
1) Right, Left, Right, Left

2) Right, Left, Left, Right

3) Left, Right, Left, either Left or Right

4) Right, Left, Left, either Left or Right

3. A cylinder is rolling without slipping on a horizontal plane P. The friction between the plank P and the cylinder is sufficient for no slipping. The coefficient of friction between the plank and the ground surface is zero. Initially, P is attached with a string S as shown in the figure. If the string is now burned, then



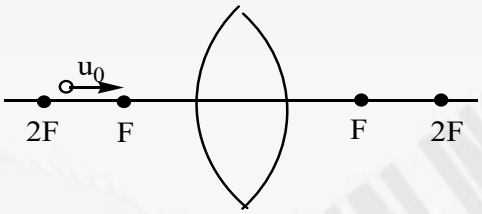
1) The plank will start motion with a speed v along forward direction

2) The plank will start motion with a speed v along backward direction

3) The plank will remain static

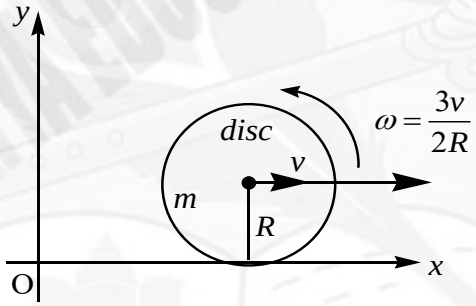
4) Linear velocity of the cylinder will decrease and angular velocity will increase

4. A point object is moving with speed $u_0 = 2m/s$ at a position somewhere between 2F and F in front of a convex lens. The speed of its image is



1) $> 2m/s$ **2)** $< 2m/s$ **3)** $= 2m/s$ **4)** May be 1 or 2

5. The angular momentum of the disc which spins with $\vec{\omega} = \frac{3v}{2R}\hat{k}$ and its CM moves with a velocity $\vec{v} = v\hat{i}$ about O will be



1) $\frac{3mvR}{2}\hat{k}$ **2)** $\frac{mvR}{2}\hat{k}$ **3)** $-\frac{3mvR}{2}\hat{k}$ **4)** $-\frac{mvR}{4}\hat{k}$

6. STATEMENT-1: A disc is rolling on an inclined plane without slipping. The velocity of centre of mass is V. The other points on the disc lie on a circular arc having same speed as centre of mass.

STATEMENT-2: When a disc is rolling on an inclined plane. The magnitude of velocities of all the point from the contact point is same, having distance equal to radius r.

1) Both statements are TRUE and STATEMENT-2 is the correct explanation of STATEMENT-1.

2) Both statements are TRUE but STATEMENT-2 is not the correct explanation of STATEMENT-1.

3) STATEMENT-1 is TRUE and STATEMENT-2 is FALSE

4) STATEMENT-1 is FALSE and STATEMENT-2 is TRUE

7. An aeroplane flying at a constant speed releases a food-packet for flood victims. As the packet drops away from the aeroplane,

1) it will always be vertically below the aeroplane only if the aeroplane was flying at an angle of 45^0 to the horizontal.

2) it will always be vertically below the aeroplane only if the aeroplane was flying horizontally.

3) it will gradually fall behind the aeroplane if the aeroplane was flying horizontally.

4) it will always be vertically below the aeroplane as seen by the pilot of the aeroplane.

8. The following motion is based in the law of conservation of angular momentum

a) rotation of top

b) diving of diver

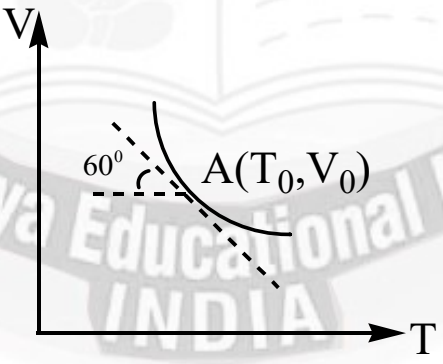
c) rotation of ballet dancer on smooth horizontal surface

d) a solid sphere that rolls down on an inclined plane

1) A, B and C are true **2)** A, B and D are true

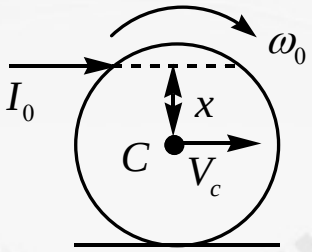
3) B, C, and D are true **4)** A, C and D are true

9. A gas is undergoing an adiabatic process. At a certain stage A, the values of volume and temperature (V_0, T_0). From the details given in the graph, find the value of adiabatic constant γ.



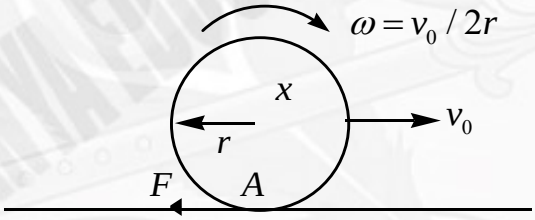
1) $\frac{V_0}{\sqrt{3}T_0}+1$ **2)** $\frac{V_0\sqrt{3}}{T_0}+1$ **3)** $\frac{3V_0}{T_0}+1$ **4)** $\frac{V_0}{T_0}+\sqrt{3}$

10. Spherical ball of radius r initially at rest on a rough horizontal surface is hit horizontally at a point at a distance $x=\frac{r}{2}$ above the centre line. Due to this sharp impulse the centre of the ball acquires a velocity v_c. After some time, the ball will start pure rolling with a velocity equal to



1) $\frac{15V_c}{14}$ **2)** $\frac{6V_c}{14}$ **3)** $\frac{15V_c}{7}$ **4)** $\frac{6V_c}{7}$

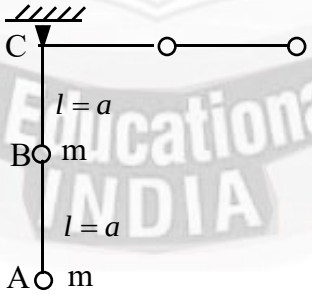
11. A solid sphere of mass M and radius r slips on a rough horizontal plane. At some instant it has translational velocity $v_0=3.5m/s$ and rotational velocity about the centre $v_0/2r$. The translational velocity after the sphere starts pure rolling is



1) $3m/s$ in forward direction **2)** $3m/s$ in backward direction

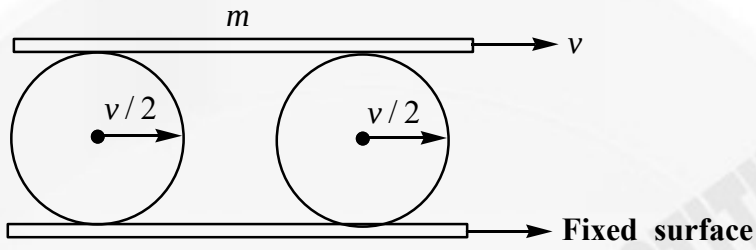
3) $\frac{49}{12}m/s$ in forward direction **4)** $\frac{49}{12}m/s$ in backward direction

12. A weightless rod of length $2a$ carries two equal masses 'm', each one tied at lower end A and the other at the middle of the rod at B. The rod can rotate in vertical plane about a fixed horizontal axis passing through C. The rod is released from rest in horizontal position. The speed of the mass B at the instant rod become vertical is:



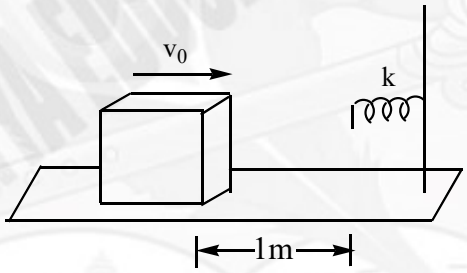
1) $\sqrt{\frac{3ga}{5}}$ **2)** $\sqrt{\frac{4ga}{5}}$ **3)** $\sqrt{\frac{6ga}{5}}$ **4)** $\sqrt{\frac{7ga}{5}}$

13. A plate of mass m is placed on a solid and hallow spheres each of mass m. If the speed of the plate is v, assuming pure rolling of the spheres with all contacting surfaces, the kinetic energy of the system (spheres + plate) will be



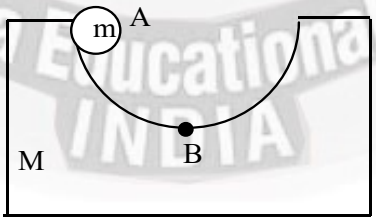
1) $\frac{43}{50}mv^2$ **2)** $\frac{33}{50}mv^2$ **3)** $\frac{43}{60}mv^2$ **4)** $\frac{53}{60}mv^2$

14. A block of mass $m=2kg$ is moving with velocity v_0 towards a massless unstretched spring of force constant $k=20N/m$. Coefficient of friction between the block and the ground is $\mu=0.2$. Find the maximum value of v_0, so that after pressing the spring the block does not return back but stop there permanently.



1) $\sqrt{\frac{5}{26}}m/s$ **2)** $\sqrt{\frac{28}{5}}m/s$ **3)** $3\sqrt{\frac{1}{5}}m/s$ **4)** $\sqrt{\frac{26}{5}}m/s$

15. A block of mass $M=2kg$ with a semicircular track of radius $R=1.1m$ rests on a horizontal frictionless surface. A uniform cylinder of radius $r=10cm$ and mass $m=1.0kg$ is released from rest from the top point A. The cylinder slips on the semicircular frictionless track. The speed of the block when the cylinder reaches the bottom of the track at B is $\left(g=10m/s^2\right)$



1) $\sqrt{\frac{10}{3}}m/s$ **2)** $\sqrt{\frac{4}{3}}m/s$ **3)** $\sqrt{\frac{5}{2}}m/s$ **4)** $\sqrt{10}m/s$

16. **Assertion:** The potential energy can be defined only in conservative field

Reason: The value of potential energy depends on the reference level (level of zero potential energy).

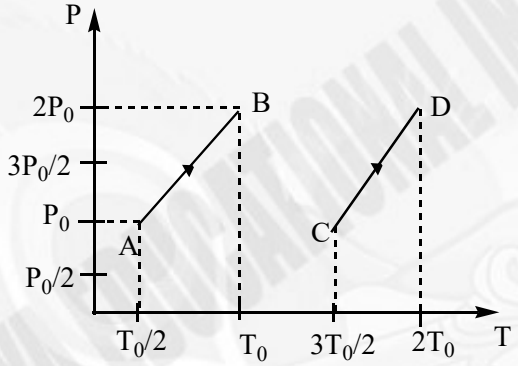
1) Assertion and reason both are true and the reason is correct explanation of assertion.

2) Assertion and reason both are true but reason is not correct explanation of assertion.

3) Assertion is true but reason is wrong.

4) Assertion and reason both are wrong.

17. P-T graph for same number of moles of two ideal gases are shown. Find the path along which volume decreases.



1) A to B **2)** B to A **3)** C to D **4)** D to C

18. **Assertion:** The phase difference between any two points on a wavefront is zero.

Reason: Corresponding to a beam of parallel rays of light, the wavefronts are planes parallel to one another.

1) Assertion and reason both are true and the reason is correct explanation of assertion.

2) Assertion and reason both are true but reason is not correct explanation of assertion.

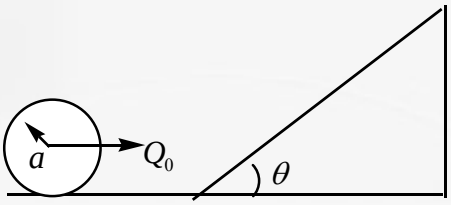
3) Assertion is true but reason is wrong.

4) Assertion and reason both are wrong.

19. An ideal gas undergoes a process in which PV^{-2} = constant, where V is the volume occupied by the gas initially at pressure P. At the end of the process, rms speed of gas molecules has became $2^{1/2}$ times of its initial value. Find the value of C_v so that energy transferred by the heat to the gas is '2' times of the initial energy.

1) $\frac{5R}{3}$ **2)** $\frac{3R}{5}$ **3)** $3R$ **4)** $\frac{R}{3}$

20. A solid sphere rolls along a horizontal plane with constant speed v_0. It encounters an inclined plane at an angle θ and climbs upward. Assuming that it rolls without slipping, how far up the sphere will it travel?

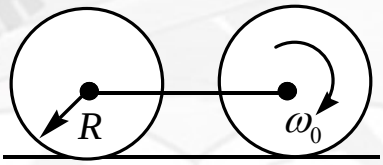


1) $\frac{v_0^2}{5g\sin\theta}$ **2)** $\frac{7V_0^2}{10g\sin\theta}$ **3)** $\frac{v_0^2}{2g\sin\theta}$ **4)** $\frac{10v_0^2}{7g\sin\theta}$

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).
Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

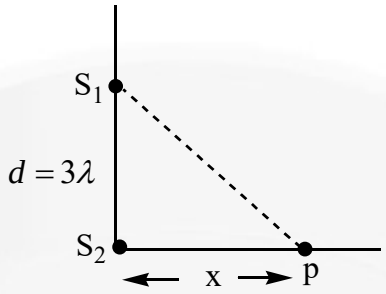
21. The assembly of two discs as shown in figure is placed on a rough horizontal surface and the front disc is given an initial angular velocity ω_0. It is given that friction is sufficient to sustain rolling in the rear wheel from the beginning of motion and radius of the discs R=1m. Then the ratio of final linear and angular velocity when both the discs start rolling is____



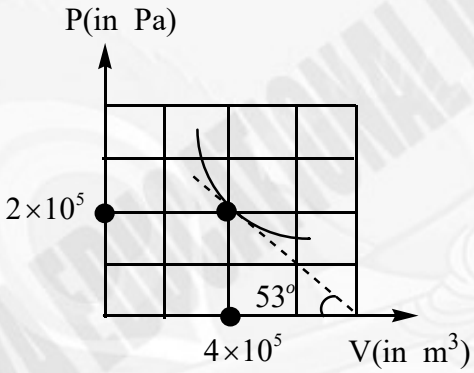
22. Two spherical stars A and B emit blackbody radiation. The radius of A is 400 times that of B and A emits 10^4 times the power emitted from B. The ratio $\left(\frac{\lambda_A}{\lambda_B}\right)$ of their wavelengths λ_A and λ_B at which the peaks occur in their respective radiation curves is

23. A solid spherical ball rolls without slipping on a table. Ratio of its rotational kinetic energy to total kinetic energy is $\frac{(2+n)}{35}$ then the value of n is_____

24. Two coherent point sources S_1 *and* S_2 vibrating in phase emit light of wavelength λ. The separation between the sources is 3λ. Consider a line passing through S_2 and perpendicular to the line S_1S_2. If the smallest distance from S_2 where a minimum of intensity occurs is $\frac{(n+5)\lambda}{20}$, find n



25. $P-V$ graph for an ideal gas undergoing polytropic process PV^m = constant is shown here. Then the value of 3m is_____

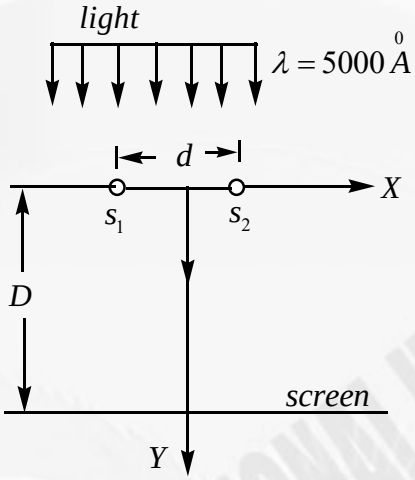


26. The potential energy of a particle of mass m free to move along x-axis is given by $U=\frac{1}{2}kx^2$ for $x<0$ and $U=0$ for $x\geq 0$ (x denotes the x-coordinate of the particle and k is a positive constant). If the total mechanical energy of the particle is E, then its speed at $x=-\sqrt{\frac{2E}{k}}$ is

27. A circular platform is free to rotate in a horizontal plane about a vertical axis passing through it's center. Its radius R=2m and its moment of inertia about the axis is $200kgm^2$. It is initially at rest. A 50 kg man stands on the edge of the platform and begins to walk along the edge at the speed of 1 ms^{-1} relative to the ground. Time taken by the man to complete one revolution is $\frac{\lambda\pi}{10}$sec then the value of λ is_____

28. The figure shows two slits S_1 *and* S_2 in a horizontally fixed place. Here $d=1mm, D=1m$ Take origin at O, (midpoint of S_1 *and* S_2) and XY plane as shown in the figure. The screen is released from rest under gravity vertically downwards from the initial position as shown. (take $g=10ms^{-2}$)

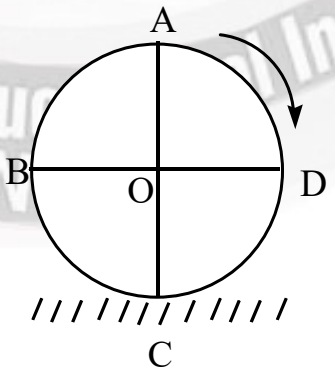
The velocity of central maxima at $t = 5\text{sec}$ is_____ ms^{-1}



29. When a 2 kg car driven at 20 m/s on a level road is suddenly put into neutral gear (i.e. allowed to coast), the velocity decreases in the following manner:

$V = \dfrac{20}{1+\left(\dfrac{t}{20}\right)} m/s$ where t is the time in sec. The power (in Watt) required to drive this car at speed 10 m/s on the same road is

30. A wheel rolls on a plane surface without slipping. At a certain instant velocity and acceleration of center 'O' are $1m/s$ *and* $3m/s^2$. Radius of the wheels is 0.5 m, BD is horizontal and AC is vertical. If at that instant ratio of acceleration of point 'C' and that of point 'A' on the wheels is $\dfrac{2}{\sqrt{N}}$. Find N.



CHEMISTRY

Max Marks: 100

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

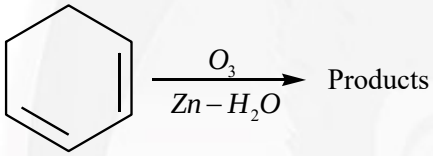
31. Select the chain propagation steps in the free radical chlorination of methane.

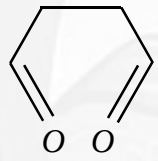
I) $Cl_2 \rightarrow 2Cl^{\bullet}$ II) $Cl^{\bullet} + CH_4 \rightarrow CH_3Cl + H^{\bullet}$ III) $Cl^{\bullet} + CH_4 \rightarrow \dot{C}H_3 + HCl$

IV) $H^{\bullet} + Cl_2 \rightarrow HCl + Cl^{\bullet}$ V) $\dot{C}H_3 + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$

1) II, III, V **2)** I,III,VI **3)** III, V **4)** III, IV, V

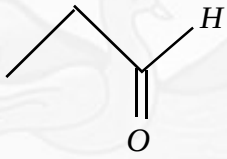
32.





1)

2)



3) Both (1) and (2) **4)**

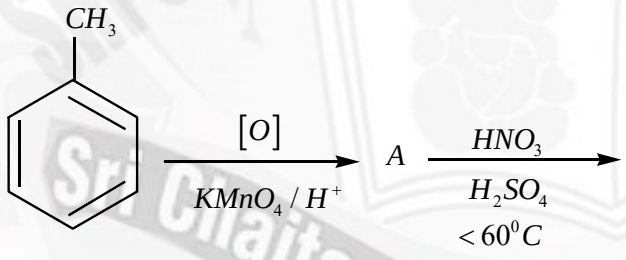
33. The alkyne $H_3C - CH_2 - C \equiv CH$ and $H_3C - C \equiv C - CH_3$ can be distinguished by the following methods except

1) Tollen's reagent **2)** Ammoniacal Cu_2Cl_2 solution

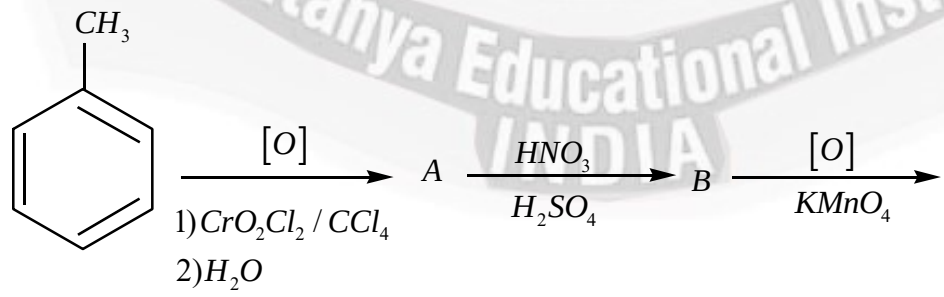
3) Na-metal **4)** Baeyer's reagent

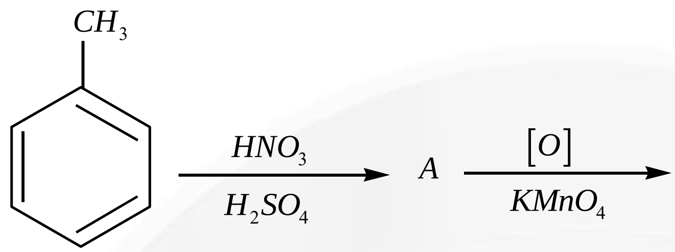
34. m-nitrobenzoic acid can be obtained by

I)



II)



III) 

1) (I), (III) **2)** (II), (III) **3)** (I), (II), (III) **4)** (I), (II)

35. Assertion(A):-amino acids are generally obtained by acid or enzyme hydrolysis of proteins but not by alkaline hydrolysis

Reason(R): An alkali racemises amino acids

1) Both A and R are correct

2) Both A and R are incorrect

3) A is true but R is false

4) A is false but R is true

36. Match the following

List-I	**List-II**
1) Urea formaldehyde resin	a) $\left(-NH-(CH_2)_5-CO-\right)_n$
2) Neoprene	b) $\left(-NH-(CH_2)_6-NH-\right)_n$
3) PVC	c) $\left(\begin{matrix}-CH_2-C=CH-CH_2-\\ \vert \\ Cl\end{matrix}\right)_n$
4) Nylon-6	d) $\left(\begin{matrix}-CH_2-CH-\\ \vert \\ Cl\end{matrix}\right)$
	e) $\left(NH-CO-NH-CH_2-\right)_n$

The correct match is

1) 1-e; 2-d; 3-c; 4-b **2)** 1-e; 2-c; 3-b; 4-d

3) 1-a; 2-c; 3-d; 4-b **4)** 1-e; 2-c; 3-d; 4-a

37. Match the following

1) Morphine	a) Antipyretic
2) Aspirin	b) Narcotic analgesic
3) Paracetamol	c) Tranquillizer
4) Luminal	d) Non-narcotic
	e) Antiseptic

1) 1-b, 2-d, 3-a, 4-c **2)** 1-b, 2-c, 3-e, 4-d

3) 1-d, 2-b, 3-a, 4-e **4)** 1-a, 2-e, 3-b,4-d

38. Assertion: $-NH_2$ group is less ring activating than $-NHCOCH_3$ group

Reason: Because in $-NHCOCH_3$ the lone pair on N atom is conjugated not only with benzene nucleus but also with $>C=O$ group called cross-conjugation.

1) If both assertion and reasons are CORRECT, and reason is the CORRECT explanation of the assertion.

2) If both assertion and reasons are CORRECT, but reason is NOT the CORRECT explanation of the assertion.

3) If assertion is CORRECT, but reason is INCORRECT

4) If assertion is INCORRECT, but reason is correct

39. Match the column

Column I (Acid)	Column II (pK_a value)
1) $HCOOH$	p) 1.73
2) CH_3COOH	q) 3.74
3) $PhCOOH$	r) 4.17
4) $(COOH)_2$	s) 4.75

1) A-q, B-s, C-r, D-p **2)** A-q, B-s, C-p, D-r

3) A-s, B-q, C-r, D-p **4)** A-r, B-q, C-s, D-p

40. **Assertion(A):** POF_3 exist but NOF_3 does not exist

Reason (R): Phosphorus can form five bonds by expanding its octet while Nitrogen can not expand its octet to form five bonds

1) Assertion is true, Reason is true but Reason is correct explanation for Assertion

2) Assertion is true, Reason is true and Reason is not the correct explanation for Assertion

3) Assertion is true, Reason is false

4) Assertion is false, Reason is true

41. In which of the following pair of species, all bond angles are equal?

1) $CO_3^{2-}, COCl_2$ **2)** $PO_4^{3-}, POCl_3$

3) BF_4^-, BH_4^- **4)** CH_3F, CH_4

42. Select the correct statements of the following bond angle

1) Among H_2O and OF_2; OF_2 has highest bond angle

2) Among PF_4^- and PF_4^+; PF_4^- has higher bond angle(with respect to axial bond angle)

3) Among ClF_3 and BF_3; ClF_3 has lower adjacent bond angle

4) NH_3 and PH_3 both have same bond angle

43. **Statement I:** Terrestrial hydrogen contains 0.0156 % of deuterium mostly in the form of HD
Statement II: Among the isotopes of hydrogen, tritium is radioactive and emits low energy β^- particles

1) Statement I is correct but Statement II is incorrect

2) Statement I is incorrect but Statement II is correct

3) Both Statement I and Statement II are correct

4) Both statement I and statement II are incorrect

44. Which of the followng is the correct order regarding electron gain enthalpies(ignore negative sign)?

1) F > Cl > Br > I **2)** Cl > Br > I > F

3) Cl > F > Br > I **4)** F > Br > Cl > I

45. Which of the following statements is incorrect?

1) Germanium, Arsenic, Antimony and Tellurium are all metalloids

2) Accoding to orbital overlap concept, greater the overlap the stonger is the bond formation between two atoms and that two atoms moust be in opposite spin

3) The crossed arrow used to represent (in chemistry) dipole moment symbolises the direction of the shift of electron density in the molecule

4) $H_2 > D_2$ (Enthalpy of bond dissociation in $kJ\ mol^{-1}$ at 298.2 K)

46. Among the $XeF_2, SF_2Cl_2, XeOF_2, ICl_2^-, IOCl_4^-$ and F_2ClO^+

Statement I: XeF_2, $XeOF_2$ *and* ICl_2^- have zero dipole moment

Statement II: $IOCl_4^-$ and F_2ClO^+ have different electronic arrangement at central atom

Statement III: $IOCl_4^-$, SF_2Cl_2 and F_2ClO^+ have equal number of lone pairs of electrons at the central atom

Statement IV: All bond angles in each of species SF_2Cl_2, $IOCl_4^-$ and F_2ClO^+ are identical

The correct order for the abvoe statements is: (Given that: T for True and F for False)

1) FTTF **2)** TTFF **3)** FFFF **4)** TFTF

47. Which of the following statement or order is incorrect?

1) $H_2O > D_2O > H_2O_2$: dielectric constant

2) $D_2O > H_2O > H_2O_2$: melting point

3) At atmospheric pressure ice crystallises in the hexagonal form, but at very low temperatures it condenses to cubic form

4) $D_2O > H_2O > H_2O_2$: density

48. Which of the following statement is correct?

1) In the reaction between H_2O_2 and $KMnO_4$ in acidic medium, H_2O_2 act as oxidising agent

2) In the reaction between H_2O_2 and $HOCl$ in acidic medium, H_2O_2 act as reducing agent

3) In the reaction between H_2O_2 and PbS in acidic medium, H_2O_2 act as reducing agent

4) In the reaction between H_2O_2 and KIO_4, H_2O_2 act as an oxidising agent

49. Which of the following can induce explosive decomposition of H_2O_2 ?

1) Urea **2)** Acetanilide **3)** Glycerol **4)** Dust

50. Compounds A and C in the following reaction are

$$CH_3CHO \xrightarrow[(ii)\,H_2O]{(i)\,CH_3MgBr} (A) \xrightarrow{H_2SO_4,\Delta} (B) \xrightarrow[(ii)\,H_2O_2/OH^-]{(i)\,BH_3;THF} (C)$$

1) Identical **2)** Position isomers

3) Functional isomers **4)** Optical isomers

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**
Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

51. How many of the following compounds having odd number of electrons.

$Cs_2O, MgO, Cl_2O, ClO_2, NO, NO_2, N_2O_4, N_2O_5, CaOCl_2, N_2O, CO_2$

52. Find the number of molecules which are planar:

(i) SF_4 (ii) XeF_6 (iii) XeF_2 (iv) XeF_4 (v) H_2O (vi) NH_3 (vii) PH_3 (viii) PCl_5 (ix) PCl_3

53. Number of lone pair –bond pair repulsions at 90^0 are 'x' in $[BrICl]^-$, Number of lone pair – bond pair repulsions at 90^0 are 'y' in BrF_4^-.

Find the value of $(x+y)$

54. Consider the following reactions:

(i) $I_2 + H_2O_2 + 2(OH)^- \rightarrow x\ moles\ of\ O_2 + other\ products$

(ii) $2MnO_4^- + 3H_2O_2 \xrightarrow{in\ basic\ medium} y\ moles\ of\ O_2 + other\ products$

Then the value of $(x+y)$ is:

55. Consider the reaction:

$K_2S_2O_8(s) + 2D_2O(liquid) \rightarrow 2A(aq) + B(liquid)$

Weight(in grams) of B obtained in the above reaction is:

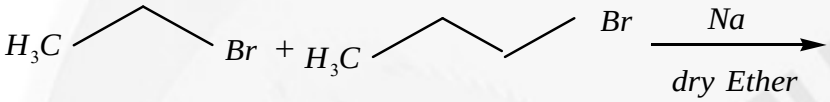
56. Maximum number of optical isomers possible for fructose.

57. How many of the following are biodegradable polymers:

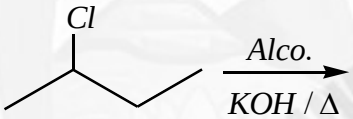
Nylon-6; Nylon-6,6; Nylon-2 Nylon-6; PHBV; Polyglycolic acid; Polylactic acid: Polyacrylonitrile

58. How many cyclic compounds are possible with formula C_6H_{12} (excluding stereo)

59. How many different organic compounds obtained by the following reaction?



60. Identify total number of 'β'-elimination reactions

i)


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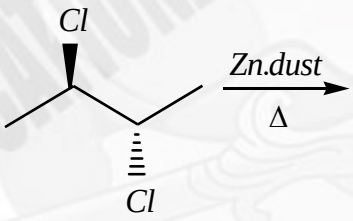

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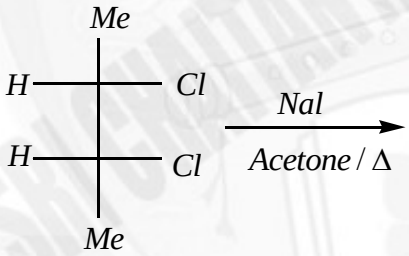

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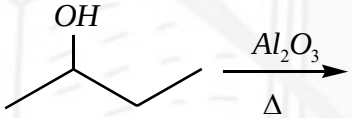

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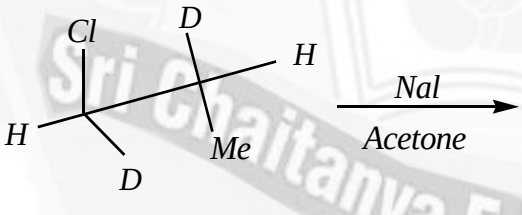

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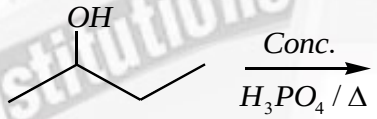
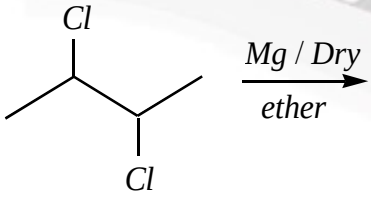


vii)


MATHEMATICS **Max Marks: 100**

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

61. Let S be the set of all (λ,μ) for which the vectors $\lambda\hat{i}+\hat{j}+\hat{k},\hat{i}+2\hat{j}-\mu\hat{k}$ and $3\hat{i}-4\hat{j}+5\hat{k}$, where $\lambda-\mu=2$, are coplanar, then $\sum_{(\lambda,\mu)\in S} 80\left(\lambda^2+\mu^2\right)$ is equal to

1) 970 **2)** 2370 **3)** 2290 **4)** 995

62. Let $\vec{a}=5\vec{p}+2\vec{q}$ and $\vec{b}=\vec{p}-3\vec{q}$ be the adjacent sides of a parallelogram. If $|\vec{p}|=2\sqrt{2},|\vec{q}|=3$ and angle between $\vec{p}$ and $\vec{q}$ is $\frac{\pi}{4}$, then the length of smaller diagonal of parallelogram is

1) 8 **2)** $\sqrt{617}$ **3)** 15 **4)** $\sqrt{593}$

63. The vector $\bar{c}$, directed along the internal bisector of the angle between the vectors $\bar{a}=7\hat{i}-4\hat{j}-4\hat{k}$ and $\bar{b}=-2\hat{i}-\hat{j}+2\hat{k}$ with $|\bar{c}|=7\sqrt{6}$ is

1) $\pm\frac{5}{3}\left(\hat{i}-7\hat{j}+2\hat{k}\right)$ **2)** $\pm\frac{7}{3}\left(\hat{i}-7\hat{j}+2\hat{k}\right)$

3) $\pm\frac{5}{3}\left(\hat{i}+7\hat{j}+2\hat{k}\right)$ **4)** $\pm\frac{7}{3}\left(\hat{i}+7\hat{j}+2\hat{k}\right)$

64. 4-points whose position vectors $\bar{a},\bar{b},\bar{c}$ and $\bar{d}$ are coplanar and $(\sin\alpha)\bar{a}+(3\sin2\beta)\bar{b}+(4\sin3\gamma)\bar{c}-\bar{d}=\bar{o}$ then the least value of $\sin^2\alpha+\sin^2 2\beta+\sin^2 3\gamma$ is

1) $\frac{1}{14}$ **2)** $\frac{1}{16}$ **3)** $\frac{1}{20}$ **4)** $\frac{1}{26}$

65.

	List-I		List-II
P)	Given four points $A(2,1,0), B(1,0,1), C(3,0,1)$ *and* $D(0,0,2)$. Point D lies on a line L orthogonal to the plane determined by points A, B, C. If point of intersection of plane ABC and line L is (x_0, y_0, z_0), then $(7x_0 + 2y_0 + 8z_0)$ is equal to	1)	9
Q)	If volume of parallelepiped formed by vectors $\vec{a}\times\vec{b}, \vec{b}\times\vec{c}$ *and* $\vec{c}\times\vec{a}$ is 25 square units, then the volume of parallelopiped formed by vectors $\vec{a}+\vec{b}, \vec{b}+\vec{c}$ *and* $\vec{c}+\vec{a}$ is equal to	2)	10
R)	A variable plane at a distance of $\frac{\sqrt{3}}{2}$ units from the origin cuts the coordinate axes at P, Q and R. If the centroid $G(u,v,w)$ of triangle PQR satisfies the relation $u^{-2}+v^{-2}+w^{-2}=\lambda$, then λ is equal to	3)	11
S)	Let $\vec{\alpha}=-\hat{i}+\hat{j}+2\hat{k}$ and $\vec{\beta}=-\hat{i}-2\hat{j}-\hat{k}$ be two vectors. The area of parallelogram having diagonals $\sqrt{3}\vec{\alpha}$ and $2\vec{\beta}$ is equal to	4)	12

Code

1) P-3; Q-2; R-1; S-4 **2)** P-3; Q-2; R-4; S-1

3) P-2; Q-3; R-4; S-1 **4)** P-2; Q-3; R-1; S-4

66. The foot of perpendicular of the point $(2,0,5)$ on the line $\frac{x+1}{2}=\frac{y-1}{5}=\frac{z+1}{-1}$ is (α,β,γ).

Then which of the following is NOT correct

1) $\frac{\gamma}{\alpha}=\frac{5}{8}$ **2)** $\frac{\beta}{\gamma}=-5$ **3)** $\frac{\alpha\beta}{\gamma}=\frac{4}{15}$ **4)** $\frac{\alpha}{\beta}=-8$

67. The shortest distance between the lines $x=y=z$ and $x+y-1=0=z$ is

1) $\frac{1}{2}$ **2)** $\frac{1}{\sqrt{2}}$ **3)** $\frac{1}{\sqrt{3}}$ **4)** $\frac{1}{\sqrt{6}}$

68. If $I_1 = \int_0^1 \frac{e^{Tan^{-1}x}}{\sqrt{1+x^2}}dx,$

$I_2 = \int_0^1 \frac{xe^{Tan^{-1}x}}{\sqrt{1+x^2}}dx$

$I_3 = \int_0^1 \frac{x^2e^{Tan^{-1}x}}{\sqrt{1+x^2}}dx$

Then match the following lists

List-I	**List-II**
P) $I_1 + I_2 =$	**1)** 1
Q) $I_3 =$	**2)** $\sqrt{2}e^{\frac{\pi}{4}} - 1$
R) $I_1 + I_2 + 2I_3 =$	**3)** $\frac{1}{2}$
s) $\frac{I_1 + I_2 + 2I_3}{I_1 + I_2 + 1}$	**4)** $\sqrt{2}e^{\frac{\pi}{4}}$

Codes

1) P-3;Q-2;R-1;S-4 **2)** P-1;Q-2;R-4;S-2

3) P-2;Q-3;R-4;S-1 **4)** P-1;Q-4;R-3;S-1

69. If equation of the plane that contains the point $(-2,3,5)$ and is perpendicular to each of the planes $2x+4y+5z=8$ and $3x-2y+3z=5$ is $\alpha x+\beta y+\gamma z+97=0$ then $\alpha+\beta+\gamma=$

1) 17 **2)** 16 **3)** 15 **4)** 18

70. A variable plane passes through a fixed point (a,b,c) and meets the axes A, B, C. The locus of the point of intersection of the planes through A, B, C and parallel to the co-ordinate planes is

1) $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=2$ **2)** $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=1$

3) $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=-2$ **4)** $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=-1$

71. **STATEMENT-1:** f is an even function, g and h are odd functions, all 3 being polynomials. Given $f(1)=0, f(2)=1, f(3)=-5, g(1)=1, g(-3)=2, g(5)=3, h(1)=3, h(3)=5$ *and* $h(5)=1$. The value of $f(g(h(1)))+g(h(f(3)))+h(f(g(-1)))$ is equal to zero.

STATEMENT-2: If a polynomial function $P(x)$ is odd then $P(0)=0$

1) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

2) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

3) Statement-1 is true, statement-2 is false

4) Statement-1 is false, statement-2 is true

72. If $\lim_{x\to 0}\frac{x+\sin x-x\cos x-\tan x}{x^n}$ exists and is non-zero finite value, then the value of n is

1) 3 **2)** 4 **3)** 5 **4)** 6

73. Let $f:R\to R$ be defined by $f(x)=x^3+3x+1$ and g is the inverse of f then the value of $g''(5)$ is equal to

1) $\frac{-1}{6}$ **2)** $\frac{-1}{36}$ **3)** $\frac{1}{6}$ **4)** $\frac{1}{36}$

74. **STATEMENT-1:** $\lim_{n\to\infty}\left(\frac{1.2}{n^3+2n^2+1}+\frac{2.3}{n^3+2n^2+2}+\frac{3.4}{n^3+2n^2+3}+---+\frac{1}{n+1}\right)$ is equal to $\frac{1}{3}$

STATEMENT-2: Let f,g,h be three functions such that $f(x)\le g(x)\le h(x)$ for all x in same interval containing the point $x=c$ and if $\lim_{x\to c}f(x)=\lim_{x\to c}h(x)=l$ then $\lim_{x\to c}g(x)=l$

1) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

2) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

3) Statement-1 is true, statement-2 is false

4) Statement-1 is false, statement-2 is true

75. If $\int\left(x^{24}+x^{16}+x^{8}\right)\left(2x^{16}+3x^{8}+6\right)^{1/8}dx=\frac{1}{\alpha}\left(2x^{24}+3x^{16}+6x^{8}\right)^{\frac{\beta}{\gamma}}+C$ (Where C is constant of integration and β,γ are coprime numbers) then the value of $(\alpha+\beta+\gamma)$ is

1) 51 **2)** 61 **3)** 71 **4)** 81

76. The value of the definite integral $\int_0^{\pi}\ln(1+\cos x)dx$ is

1) $-\pi\ln 2$ **2)** $\frac{-\pi}{2}\ln 2$ **3)** $-2\pi\ln 2$ **4)** $\frac{-\pi}{4}\ln 2$

77. Area lying between the curves $y^2=2x$ *and* $y=x$ is

1) $\frac{1}{3}$ **2)** $\frac{3}{4}$ **3)** $\frac{2}{3}$ **4)** $\frac{5}{4}$

78. Let $f(x)=\int_{-5}^{x}\left(t^2-t+2\right)\left(t^2-t-2\right)\left(t^2-t-6\right)\left(t^2-t-12\right)dt$

STATEMENT-I: The sum of values of x at which $f(x)$ is maximum is -1

STATEMENT-2: If $f'(c)=0,$ then $f(x)$ is either maximum or minimum at $x=c$ and $x=c$ is not an inflectional point.

1) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

2) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

3) Statement-1 is true, statement-2 is false

4) Statement-1 is false, statement-2 is true

79. The degree of the differential equation satisfying the relation $\sqrt{1-x^2}+\sqrt{1-y^2}=a(x-y)$ where 'a' is arbitrary constant, is

1) 1 **2)** 2 **3)** 3 **4)** does not exist

80. The value of the definite integral $\int_0^1 \frac{4x^3\left(1+x^{4(2009)}\right)}{\left(1+x^4\right)^{2011}}dx$, is equal to

1) $\frac{1}{2009}$ **2)** $\frac{1}{2010}$ **3)** $\frac{1}{2011}$ **4)** $\frac{1}{2012}$

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).
Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

81. Let $f(x)=\begin{cases}5, & -\infty<x\le 2\\ px, & 2<x<4\\ 3x-q, & 4\le x<\infty\end{cases}$ and

$g(x)=\begin{cases}3x+2, & -\infty<x<1\\ x+1, & 1\le x<\infty\end{cases}$. If $\lim_{x\to 1} f(g(x))=5$ then find the value of $2p+q=$

82. If p_1 *and* p_2 are the length of the perpendiculars from origin on the tangent and normal drawn to the curve $x^{2/3}+y^{2/3}=6^{2/3}$, respectively then find the value of $4p_1^2+p_2^2=$

83. If $f(x)=\int\frac{5x^8+7x^6}{\left(x^2+1+2x^7\right)^2}dx,(x\ge 0), f(0)=0$ and $f(1)=\frac{1}{k}$, then the value of k is

84. If $f(x)=\begin{cases}\sqrt{\{x\}}, & x\notin I\\ 1 & x\in I\end{cases}$ and $g(x)=\{x\}^2$ where $\{x\}$ is fractional part of x, then area between

$f(x)$ *and* $g(x)$ for $x\in[0,10]$ is A then $\frac{3}{5}A$ is

85. If $y=f(x)$ satisfies the differential equation

$\frac{dy}{dx}+\frac{x}{1+x^2}y=\frac{x}{1+x^2}, f(0)=\frac{4}{3}$, then the value of $f\left(\sqrt{8}\right)+\frac{8}{9}=$

86. Let G_1, G_2 *and* G_3 be the centroids of the triangular faces OBC, OCA and OAB respectively of a tetrahedron OABC (where 'O' is the origin). If V_1 denotes the volume of the tetrahedron OABC and V_2 that of the parallelepiped with OG_1, OG_2 and OG_3 as three concurrent edges, then the value of $\frac{198V_2}{V_1}$ is

87. If $\vec{a},\vec{b},\vec{c}$ are three vectors such that $|\vec{a}|=|\vec{c}|=1, |\vec{b}|=4, |\vec{b}\times\vec{c}|=2, 2\vec{b}=\vec{c}+\lambda\vec{a}$ where λ is a scalar. If the value of 'λ' is equal to $\sqrt{\alpha-\beta\sqrt{3}}$ where α,β are real numbers, then the value of $\alpha+\beta$

88. If P and Q two points in xy-plane on the curve $y=x^7-2x^5+5x^3+8x+5$ such that $\overrightarrow{OP}.\vec{i}=2$ *and* $\overrightarrow{OQ}.\vec{i}=-2$ and magnitude of $\overrightarrow{OP}+\overrightarrow{OQ}=2M$ (Where 'O' is the origin) then find the value of M

89. Two intersecting lines lying in a plane P_1 have equations $\frac{x-1}{2}=\frac{y-3}{1}=\frac{z-4}{-3}$ and $\frac{x-1}{-1}=\frac{y-3}{2}=\frac{z-4}{4}$. If the equation of the plane P_2 is $2x-y+z=21$ and distance between P_1 *and* P_2 is $K\sqrt{6}$ then K is

90. Let $\vec{r}=(\vec{a}\times\vec{b})\sin x+(\vec{b}\times\vec{c})\cos y+2(\vec{c}\times\vec{a})$ where $\vec{a}$, $\vec{b}$, $\vec{c}$ are non – zero and non – coplanar vectors. If $\vec{r}$ is orthogonal to $\vec{a}+\vec{b}+\vec{c}$, then the minimum value of $\frac{20}{\pi^2}(x^2+y^2)$

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