Sri Chaitanya IIT Academy.,India.

SEC: Sr.Super60_NUCLEUS&STERLING_BT	**JEE-MAIN**	**Date: 02-09-2023**
Time: **09.00Am to 12.00Pm**	**RPTM-05**	**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
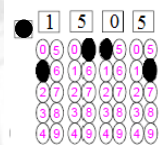
   Question Answered for Marking   **Question Cancelled for Marking**

   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: _____

02-09-23_Sr.Super60_ NUCLEUS&STERLING_BT _ Jee-Main_RPTM-05_Test Syllabus

PHYSICS   : NLM, Friction, Circular motion, WPE Newton's laws of motion; Inertial and uniformly accelerated frames of reference; Static and dynamic friction; Kinetic and potential energy; Work and power, Uniform circular motion, Conservation of mechanical energy

RPTM-05 (15Q-RPTM.5 SYLLABUS+15Q CUMULATIVE SYLLABUS)

CHEMISTRY   :. Alcohols, Phenols , Ethers & Amines: Alcohols : Physical properties; Reactions: esterification, dehydration (formation of alkenes and ethers); Reactions with: sodium, phosphorus halides, $ZnCl_2$/concentrated HCl, thionyl chloride; Conversion of alcohols into aldehydes, ketones and carboxylic acids

Phenols: Physical properties; Preparation, Electrophilic substitution reactions of phenol (halogenation, nitration, sulphonation); Reimer-Tiemann reaction, Kolbe reaction; Esterification; Etherification; Aspirin synthesis; Oxidation and reduction reactions of phenol.

Ethers : Preparation, Properties &Reactions

Amines: Basicity of substituted anilines and aliphatic amines, Preparation from nitro compounds, nitriles and amides; Reactions: Hoffmann bromamide degradation,

Gabriel phthalimide synthesis; Reaction with nitrous acid, Azo coupling reaction of

diazonium salts of aromatic amines; Sandmeyer and related reactions of diazonium salts; Carbylamine reaction, Hinsberg test, Alkylation and acylation reaction

RPTM-05 (15Q-RPTM.5 SYLLABUS+15Q CUMULATIVE SYLLABUS)

MATHEMATICS   : Definite Integration

RPTM-05 (15Q-RPTM.5 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 I: A cyclist is moving on an unbanked road with a speed of $7 kmh^{-1}$ and takes a sharp circular turn along a path of radius of 2 m without reducing the speed. The static friction coefficient is 0.2. The cyclist will not slip and pass the curve. $\left(g = 9.8 m / s^2 \right)$

Statement II: If the road is banked at an angle of $45°$ cyclist can cross the curve of 2 m radius with the speed of $18.5 kmh^{-1}$ without slipping.

In the light of the above statements, choose the correct answer from the options given below.

1) Statement I is correct and statement II is incorrect

2) Statement I is incorrect and statement II is correct

3) Both statement I and statement II are true

4) Both statement I and statement II are false

2. A man pushes eight identical blocks on horizontal frictionless surface with horizontal force F. The force that block-1 exerts at block-2 has magnitude F_{21} and the force that block-7 exerts on the block -8 is F_{87} Find $\dfrac{F_{21}}{F_{87}}$

$\xrightarrow{\quad F \quad}$

1	2	3	4	5	6	7	9

1) 3   **2)** 5   **3)** 7   **4)** 9

3. A wedge of mass M= 10 kg. height h=3m and angle of inclination $\alpha = 37°$ is at rest on a horizontal surface. There is a small point –like object (mass m $= 0.5 kg$) next to the slope as shown in the figure. At what acceleration must wedge be moved in order that the point like object reaches its top in a time $t = 5s$ (Neglect the friction between point like object and wedge)
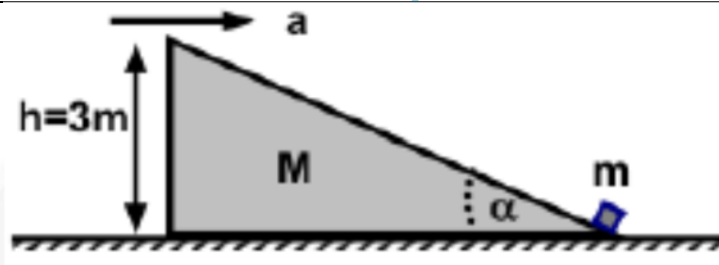
1) $2m/s^2$ **2)** $4m/s^2$ **3)** $8m/s^2$ **4)** $10m/s^2$

4.   An object of mass M starts from rest at the bottom of a fixed incline of height H. A person decides to push the object up the incline in one of two ways with an applied force shown in the diagram. In each of the trials, the object reaches the top of the incline with speed V. How would the work done by the person on the block compare for the two trials? Assume the same constant non-zero coefficient of kinetic friction between the incline and the object for both trials

Trial 1
Force parallel to floor

Trial 2
Force parallel to incline
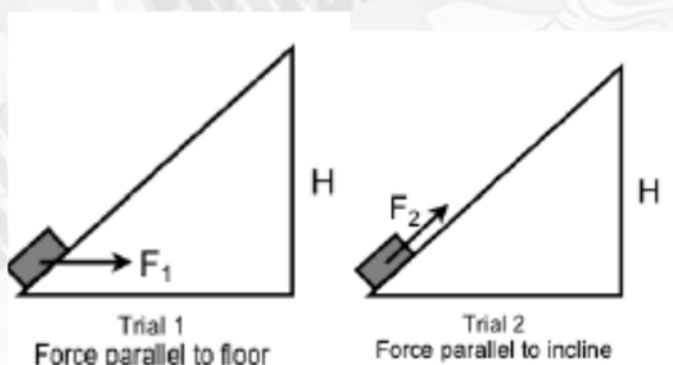
1) More work would be done in Trial 1.

2) More work would be done in Trial 2

3) It is impossible to determine for which trial there would be more work done
   without knowing the value of the speed V.

4) It is impossible to determine for which trial there would be more work done
   Without knowing the value of the coefficient of kinetic friction

5. All the blocks are attached to an ideal pulley. If accelerations of blocks $m_1 = m$, $m_2 = 3m$, $m_3 = m$, $m_4 = 2m$ are a_1, a_2, a_3 and a_4 respectively then choose the correct option for a_1, a_2, a_3 and a_4 respectively
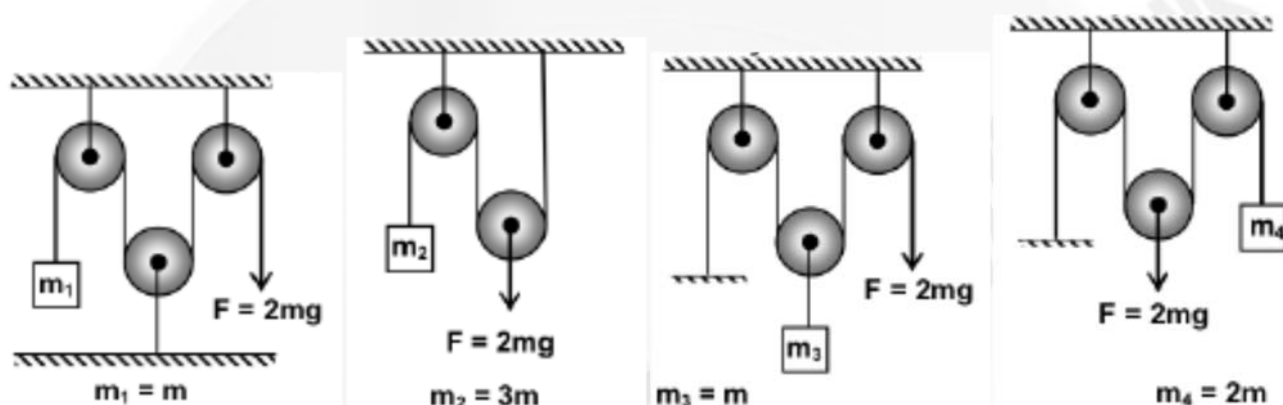

1)
a_1	a_2	a_3	a_4
$g\uparrow$	$2g\uparrow$	$3g\uparrow$	$g/2\downarrow$

2) $g\uparrow$ $2g/3\downarrow$ $3g\uparrow$ $g/2\downarrow$

3) $2g/3\downarrow$ $2g\uparrow$ $3g\uparrow$ $g\uparrow$

4) $g\downarrow$ $g/2\downarrow$ $3g\downarrow$ $2g/3\downarrow$

6. A string of mass m (can be non uniform as well) is suspended through two points which are not in same horizontal level. Tension in the string at the end points are T_1, and T_2 and at the lowest point is T_3. Mass of string in terms of T_1, T_2 and T_3 can be represented a (uniform gravity 'g' exists downwards)
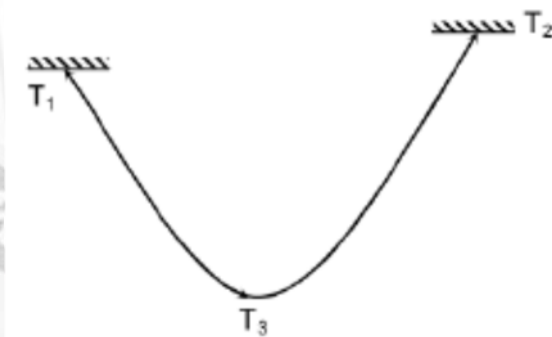
1) $\dfrac{\sqrt{T_1^2 - T_3^2} + \sqrt{T_2^2 - T_3^2}}{g}$ 2) $\dfrac{(T_1 + T_2 - 2T_3)}{g}$ 3) $\dfrac{\sqrt{T_1^2 + T_2^2}}{g}$ 4) $\dfrac{\sqrt{T_1^2 + T_3^2} + \sqrt{T_2^2 + T_3^2}}{g}$

7.   A man of mass 60 kg hangs himself from a massless spring balance. Which itself suspended from an ideal string-pulley system as shown in the figure. The string AB can bear maximum 900 N. Choose correct statement.
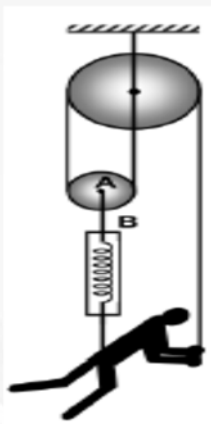

   1) The man is never ever able to read his correct weight in the spring balance.

   2) If man able to manage himself at rest, the spring balance reads his true weight.

   3) The maximum magnitude of acceleration, man can manage is 12.5 m/s^2 while Moving upward.

   4) When man moves downward with acceleration 5 m/s^2 , the spring balance will read $40\,kg$

8.   Given below are two statements:
   Statement-I: An elevator can go up or down with uniform speed when its weight is balanced with the tension of its cable.
   Statement-II: Force exerted by the floor of an elevator on the foot of a person standing on it is more than his/her weight when the elevator goes down with increasing speed. In the light of the above statements, choose the correct answer from the options given below:

   1)   Both statement I and statement II are false

   2)   Statement I is true but Statement II is false

   3) Both Statement I and Statement II are true

   4) Statement I is false but Statement II is true

**9.** A particle whose velocity is given as $\vec{v} = \hat{i} + 6t\hat{j}\ m/s$ is moving in $x - y$ plane. At $t = 0$, particle is at origin. Find the radius of curvature of path at point $\left(\dfrac{\sqrt{2}}{3}m, \dfrac{2}{3}m\right)$

1) $1.5m$ **2)** $3.0m$ **3)** $4.5m$ **4)** $6.0m$

10. An ideal string- pulley system is shown in the figure and system is released from rest. Choose correct option.
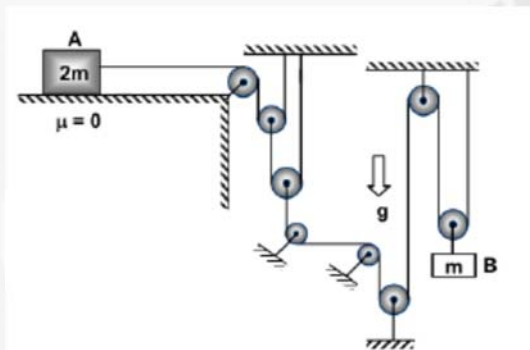
1) When mass B moves with speed $4m/s,$ the speed of mass A is $1m/s.$

2) When mass B moves with speed $1m/s,$ the speed of mass A is $4m/s.$

3) In the time interval in which the mass A covers distance 8 m, in the same time Interval, mass B travels a distance $1\ m.$

4) In the time interval in which the mass A covers distance 1 m, in the same time Interval, mass B travels a distance 8 m.

11. In the given figure, a long platform of mass m is placed on a frictionless surface. Two blocks of masses 4m and m (where m=10 kg) are placed on the platform. For both blocks, the coefficient of static friction with the platform equal to 0.16 and the coefficient of kinetic friction is equal to 0.10. The blocks are connected by a light ideal string through a light pulley (mounted at a movable massless stand), which is acted upon by an unknown horizontal force F. If the acceleration of the platform is $2m/s^2$, find the value of unknown force $F\ and\ \ acceleration$ of blocks 4m and m as a_1 and a_2 respectively.
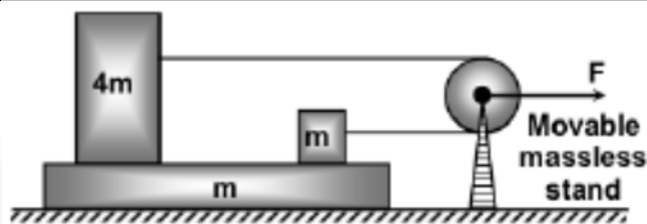
$F(N)$ $a_1(m/s^2)$ $a_2(m/s^2)$

1) $180N$, $2m/s^2$, $8m/s^2$ **2)** $180N$, $8m/s^2$, $2m/s^2$

3) $90N$, $2m/s^2$, $8m/s^2$ **4)** $90N$, $8m/s^2$, $2m/s^2$

12. Given below are two statements:

Statement I: Area under velocity- time graph gives the displacement travelled by the body in a given time.

Statement II: Area under acceleration –time graph is equal to velocity- in the given time.

In the light of given statements, choose the correct answer from the options given below:

1) Both Statement I and Statement II are true.

2) Statement I is correct but Statement II is false.

3) Statement I is incorrect but Statement II is true.

4) Both Statement I and Statement II are false

13. Point A on the rod AB has an acceleration of $5m/s^2$ and a velocity of 6 m/s at an instant as shown in the figure. The acceleration of the end B at the same moment is:
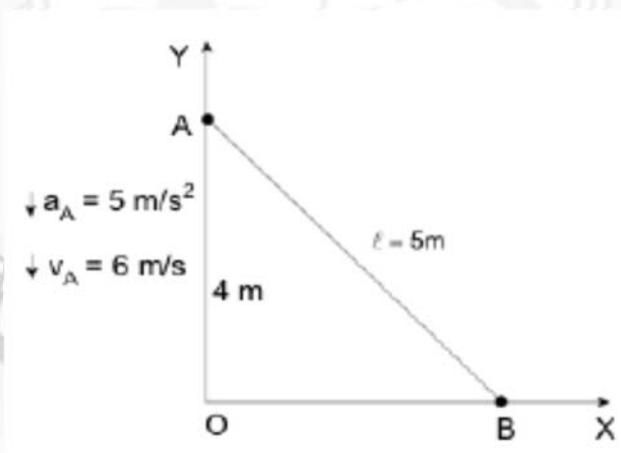
1) $-\dfrac{80}{3}\hat{i}\, m/s^2$ **2)** $\dfrac{80}{3}\hat{i}\, m/s^2$ **3)** $-\dfrac{40}{3}\hat{i}\, m/s^2$ **4)** $-\dfrac{75}{6}\hat{i}\, m/s^2$.

14. The question has Statement I and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.

Statement 1: If you push on a cart being pulled by a horse so that it does not move, the cart pushes you back with an equal and opposite force.

Statement 2: The cart does not move because the force described in statement I cancel each other.

    1) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

    2) Statement 1 is false, Statement 2 is true.

    3) Statement 1 is true, Statement 2 is false.

    4) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.

15. Given below are two statements:

Statement I: If heat is added to a system, its temperature must increase.

Statement II: If positive work is done by a system in a thermodynamic process, its volume must increase.

In the light of the above statement, choose the correct answer from the options given below:

    1) Statement I is true but Statement II is false

    2) Both Statement I and Statement II are true

    3) Both Statement I and Statement II are false

    4) Statement I is false but Statement II is true

16. Two moles of an idea monoatomic gas is taken through a cyclic process as shown in the P-T diagram. In the process BC, PT^{-2} = constant. Then the ratio of heat absorbed and heat released by the gas during the process AB and process BC respectively is
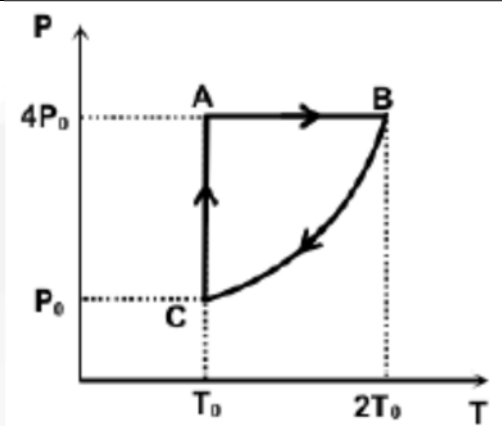
1) 2   **2)** 3   **3)** 5   **4)** 6

17. Two ends of a rod of uniform cross sectional area are kept at temperatures $3T_0$ and T_0 as shown. The thermal conductivity of the rod varies as $k = \alpha T$, (where α is a constant and T is absolute temperature). In steady state, the temperature of the middle section of the rod is
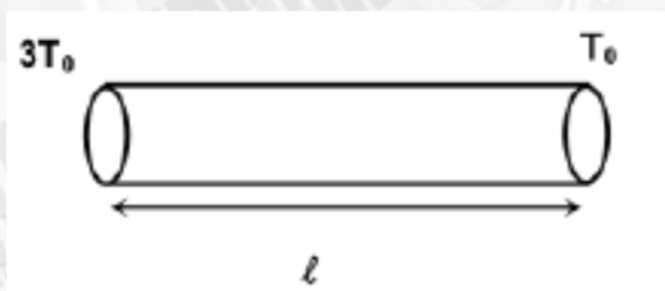

1) $\sqrt{7}T_0$ **2)** $\sqrt{5}T_0$ **3)** $2T_0$ **4)** $\sqrt{3}T_0$

18. The molar heat capacity of an ideal gas in a process varies as $C = Cv + \alpha T^2$ (where C_v is molar heat capacity at constant volume and α is a constant). Then the equation of the process is

1) $Ve^{-\left(\frac{\alpha T^2}{2R}\right)} = \text{constant}$ **2)** $Ve^{-\left(\frac{\alpha T^2}{R}\right)} = \text{constant}$

3) $Ve^{-\left(\frac{2\alpha T^2}{R}\right)} = \text{constant}$ **4)** $Ve^{-\left(\frac{3\alpha T^2}{2R}\right)} = \text{constant}$

19. When a particle of mass m is suspended from a massless spring of natural length ℓ, the length of the spring becomes 2ℓ. When the same mass moves in conical pendulum , the length of the spring becomes L. The radius of the circle of conical pendulum is:

1) $\dfrac{L}{L-\ell}\sqrt{L(L-\ell)}$

2) $\dfrac{L}{L-\ell}\sqrt{L(L-2\ell)}$

3) $\sqrt{L(L-\ell)}$

4) $\sqrt{L^2-2\ell^2}$

20. A point object is kept at a distance of 2 m from origin on X- axis. A quarter cylinder of radius R=30 cm and refractive index $\mu=1.5$ having its axis $\perp$ to plane of paper is placed between the object and the parabolic reflector at a distance of 130 cm from origin as shown in figure. The position of the image after reflection from the parabolic reflector $y^2=2x$ is
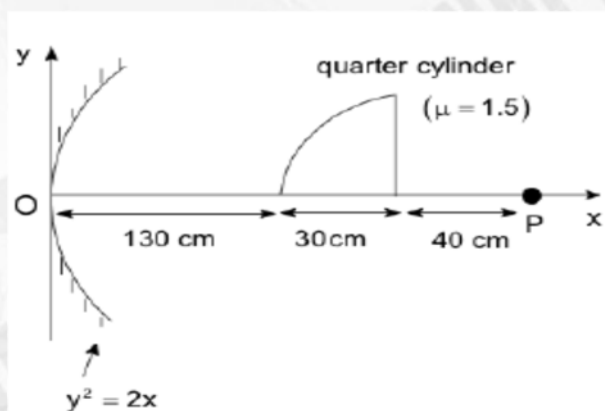
1) 25 cm
2) 50 cm
3) 100 cm
4) 150 cm

(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. A cylinder of mass M and radius R moves with constant speed V through a region of space that contains dust particles of mass m ($m << M$) which are at rest. There are n number of particles per unit volume. The cylinder moves in a direction perpendicular to its axis. Assume that the particles do not interact with each other and bounce with same speed after hitting cylinder. The drag force per unit length of the cylinder require to maintain the speed v constant for the cylinder is $\dfrac{K}{3}nmRv^2$ Find the value of K?
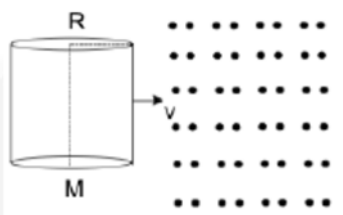
22. A spherical aquarium of radius 10 cm filled with water of refractive index 4/3 is kept as shown. One half of aquarium is silvered and other half is smooth. The thickness of aquarium is negligible. A fish is moving towards left with a velocity 6 m/s. An observer detects two images of the fish. Find the relative velocity (in m/s) between the two images of the fish as seen by the observer.
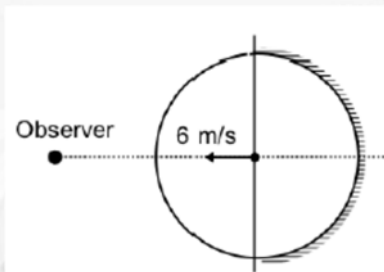
23. A parallel beam of monochromatic light of wavelength 4500 A is incident of YDSE. Let I_0 is the intensity of incident light. Now two glass slabs G_1 and G_2 are kept infront of both slits S_1 and S_2. The refractive index of G_1 is 1.9 and for G_2 it is 1.6. The thickness of each glass slab is $15\mu m$. It is observed that glass G_1 transmits $\dfrac{1}{16}th$ and G_2 transmits $\dfrac{1}{25}th$ of incident energy. If $I_0 = 8Watt / m^2$, then find the intensity $\left(in\ W / m^2\right)$ observed at point 'O' on the screen
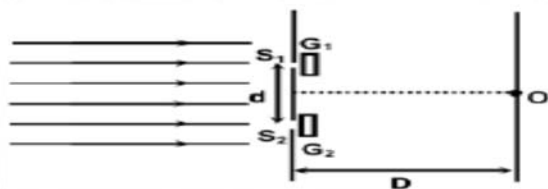

24. Suppose that one of the slits in YDSE is wider than the other, so the amplitude of the light reaching on screen from one slit, acting alone, is thrice that from the other slit, acting alone. The intensity for Central Bright Fringe is $I_0 = 5W / m^2$. Then find the intensity $I\left(W / m^2\right)$ on the screen for (angular position) $\theta = 37°$. (Take $d / \lambda = 5 / 6$, where d is the separation between the slits and λ is the Wave length of the light)

25. A uniform ring of mass m is placed on a rough horizontal fixed surface as shown in the figure. The coefficient of friction between the left part of the ring and left part of the horizontal surface is $\mu_1 = 0.6\pi$ and between right half and the surface is $\mu_2 = 0.2\pi$. At the instant shown, now the ring has been imparted an angular velocity in clockwise sense in the figure shown. At this moment magnitude of acceleration of centre O of the ring (in m/s^2) is $\left(take\ g = 10\,m/s^2\right)$
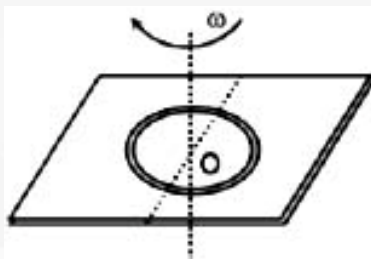

26. A gas bubble produced from a under water expiosion oscillates with period I. The period T is found to be proportional to the ath power of pressure (P), b^{th} power of density (d) and c^{th} power of the total energy (E) of explosion. Using dimensional analysis find the value of $\left(a + 4b + c\right)$. (Round off to the closest integer)

27. Light from a monochromatic point source S is incident on the two slits of an opaque wall placed at a distance L as shown in the diagram, Intensity of interference pattern is observed at the point P on the screen placed at a distance L behind the slits. When the upper slit is shifted upward then the distance between the slits is changed from 200 μm to 400 μm, the intensity at P changes from I_{max} to $\dfrac{3}{4}I_{max}$. If L=1 m, then find the wave length of light used $\left(in\ A\right)$
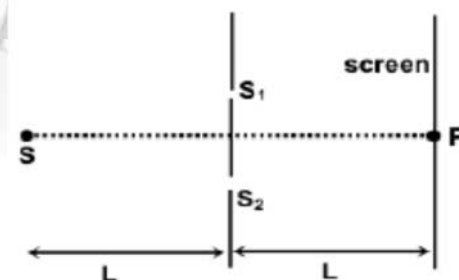
28. A power output from a certain experimental car design to be shaped like a cube is proportional to the mass m of the car. The force of air friction on the car is proportional to Av^2, where v is the speed of the car and A is the cross-sectional area. On a level surface the car has a maximum speed v_{max}. Assume that all versions of this design have the same density. Then v_{max} is proportional to $m^{1/c}$. Find C.

29. A flexible drive belt runs over a frictionless pulley as shown in figure. The pulley is rotating freely about the vertical axis passing through the centre O of the pulley. The vertical axis is fixed on the horizontal smooth surface. The mass per unit length of the drive belt is $1\ kg/m$ and the tension in the drive belt $8\ N$. The speed of the drive belt is 2 m/s. Find the net normal force applied by the belt on the pulley in Newton.
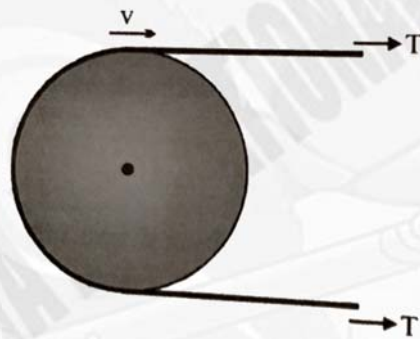
30. Two identical particles A & B of mass $m = 2\ kg$ is connected at the end of the spring $(k = 50\ N/m)$ and placed on a smooth horizontal surface. Now, force $F = 10N$ and $2F$ are applied on the particles in opposite direction as shown in figure. Initially spring is in natural length. Simultaneously particle A receives an impulse towards B which imparts speed v_0 to it find v_0 in m/s for which length of elongation is two times the length of compression in the spring during subsequent motion?
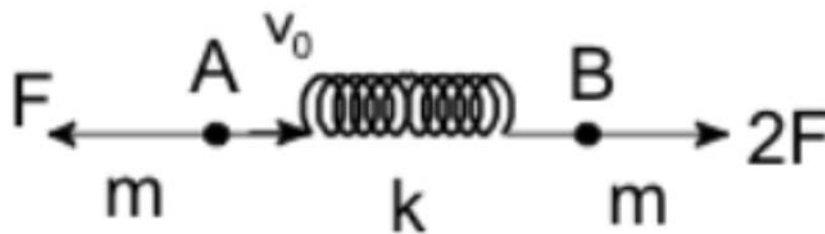
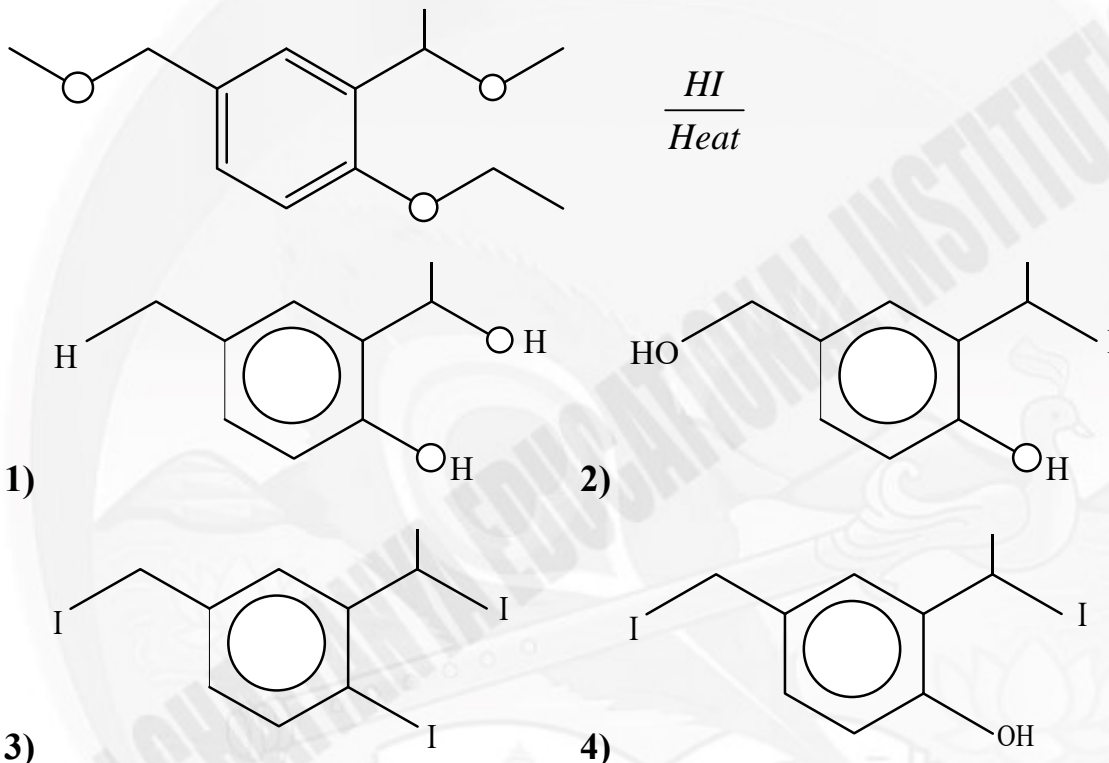**CHEMISTRY**   **Max Marks: 100**

(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. The major product formed in following reaction is:

$$\frac{HI}{Heat}$$

1)

2)

3)

4)

32. Given below are two statements one is labeled as assertion (A) and other is labeled as Reason (R)

Assertion (A): Synthesis of vinyl phenyl ether may be achieved by Williamson synthesis

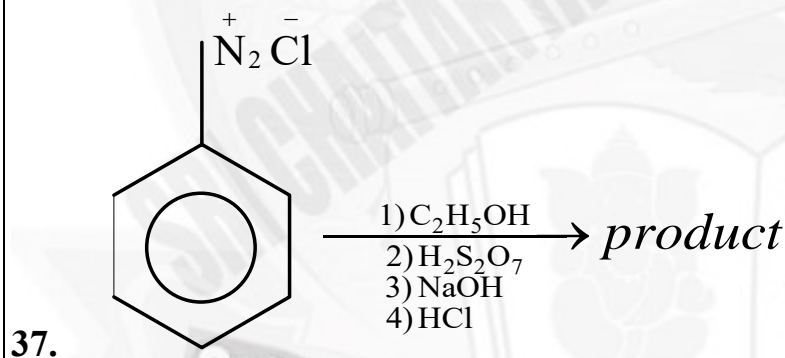**Reason (R):** chlorobenzene reacts with sodium vinyl oxide yields vinyl phenyl ether

In the light of the above statements choose the most appropriate answer from the options given below.

1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

2) (A) is correct but (R) is not correct

3) Both (A) and (R) not correct

4) Both (A) and (R) are correct (R) is not correct explanation of (A)

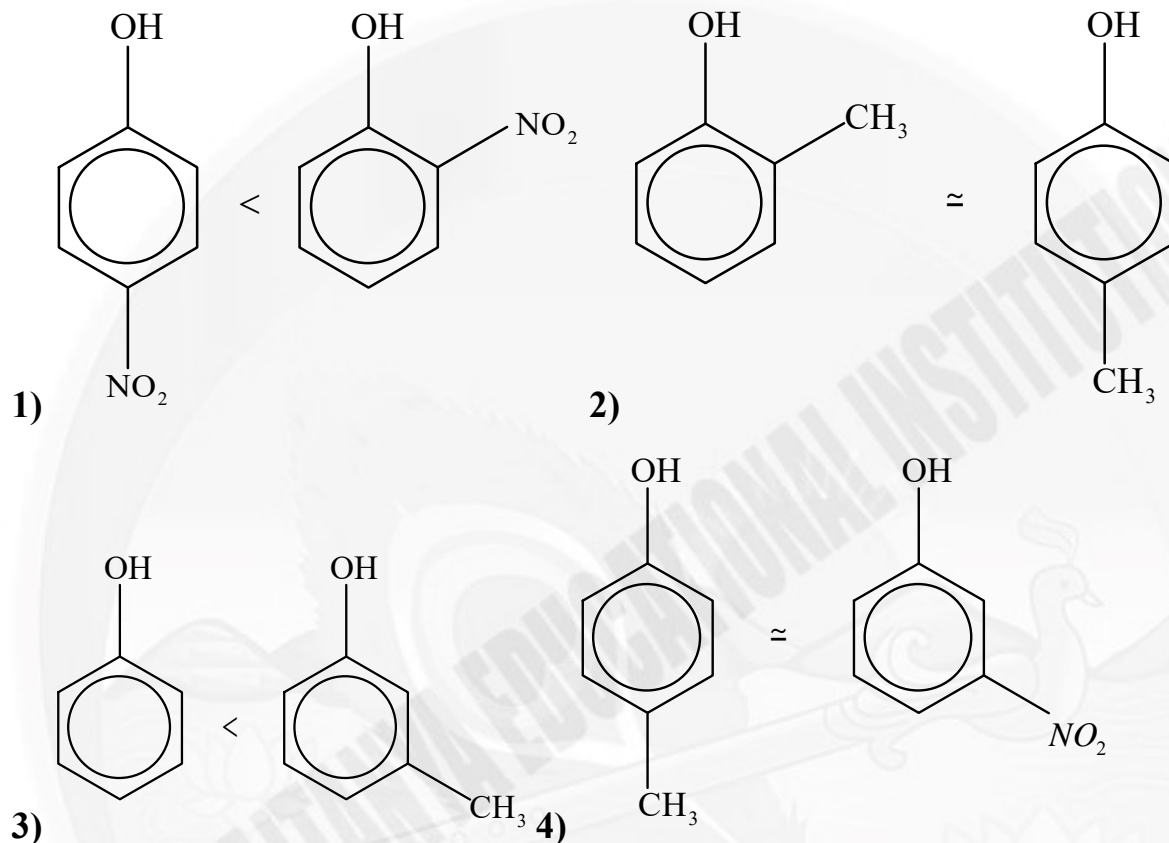33. Consider the following reaction $C_2H_5OH + H_2SO_4 \rightarrow product$

   among the following which one cannot be formed as a product under any condition?

   1) Ethylene   2) Acetylene   3) Diethyl ether   4) Ethyl hydrogen sulphate

34. **Assertion (A) :** Ethoxy ethane and butanol-1 have almost same miscibility with water

   Reason (R) : Ethoxy ethane and butanol-1 have form Hydrogen bond with water

   1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

   2) (A) is correct but (R) is not correct

   3) Both (A) and (R) are not correct

   4) Both (A) and (R) are correct (R) is not correct explanation of (A)

35. Phenol industrially prepared from

   1) benzene sulphonic acid   2) Cumene

   3) benzene diazonium chloride   4) chlorobenzene

36. Which of the following statements is incorrect

   1) benzene diazonium fluoroborate is stable at room temperature

   2) benzene diazonium fluoroborate is almost insoluble in water

   3) diazonium salts stability due to '+I' effect of benzene

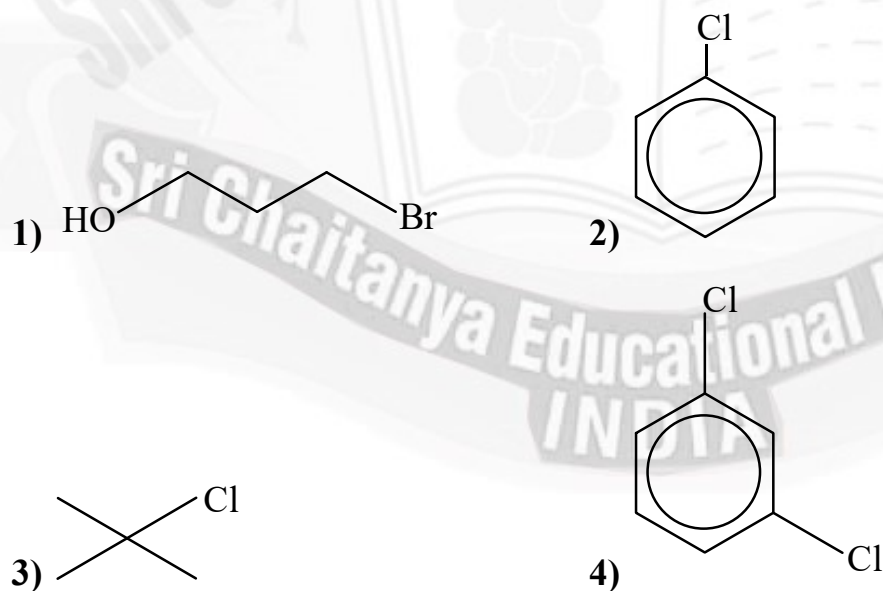   4) cyanobenzene easily prepared from diazonium salt

$\overset{+}{N_2}\overset{-}{Cl}$ on benzene ring

$$\xrightarrow[\substack{2)\,H_2S_2O_7 \\ 3)\,NaOH \\ 4)\,HCl}]{1)\,C_2H_5OH} \quad product$$

37.

1) benzene ring with SO_3H 2) benzene ring with NH_2 3) benzene ring with OH 4) benzene ring
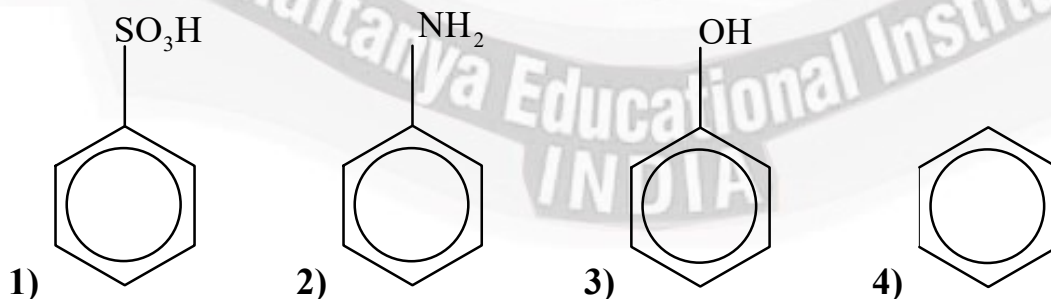
38. Identify the correct acidic strength order of following pairs

1)

OH (with NO$_2$ para) < OH (with NO$_2$ ortho)

2)

OH (with CH$_3$ ortho) ≈ OH (with CH$_3$ para)

3)

OH < OH (with CH$_3$ meta)

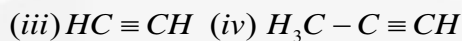**4)**

OH (with CH$_3$ para) ≈ OH (with NO$_2$ meta)

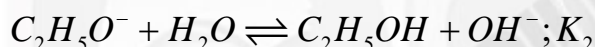**39.** From which of the following compound Grignard reagent cannot be prepared directly using ether and magnesium

1) HO⌇⌇⌇Br

2) Cl attached to benzene ring

3) (CH$_3$)$_3$C–Cl

4) benzene ring with two Cl substituents

40. The correct order of acidity of the following hydrocarbon is

(i) (cyclopentadiene structure) (ii) (methylenecyclopropene structure) $(iii) HC \equiv CH$ $(iv) H_3C - C \equiv CH$
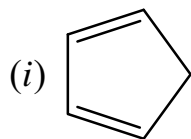
1) $i > ii > iii > iv$ 2) $iii > iv > ii > i$ 3) $i > iii > iv > ii$ 4) $iv > iii > i > ii$

41. Given below are two statements for the

(phenoxide structure) O^- $+ H_2O \rightleftharpoons$ (phenol structure) OH $+ OH^-$; K_1

$C_2H_5O^- + H_2O \rightleftharpoons C_2H_5OH + OH^-$; K_2
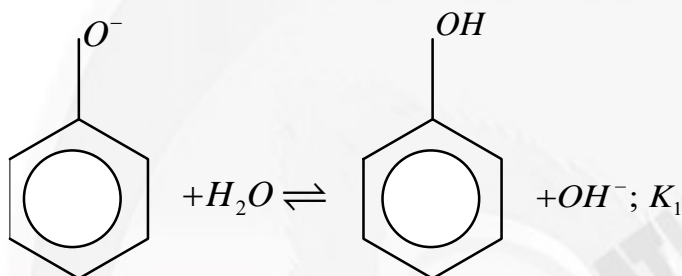
Statement I: the value of k_2 less than K_1

Statement II: Phenoxide is a weaker base than ethoxide

In the light of the above statements, choose the most appropriate answer from the options given below
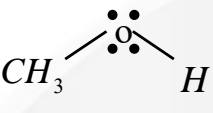
1) Both statement I and statement II are correct

2) Both statement I and statement II are incorrect

3) Statement I is correct but statement II is incorrect

4) Statement II is correct but statement I is incorrect

42. Which of the following statement is incorrect

1) methyldene chloride used as paint remover

2) chloroform is used to produce Freon Refrigerant

3) Chlorofluoro carbon compounds of methane, ethane, propane are collectively known as freons

4) Tetrachloro methane is used to prepare chlorofluoro carbons

43. Among the following which will be the most powerful Nucleophile in water?

1) F^- **2)** Cl^- **3)** Br^- **4)** I^-

44. **Assertion:** $CH_3 \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} H$ bond angle at oxigen is less than ideal tetrahedral bond angle.

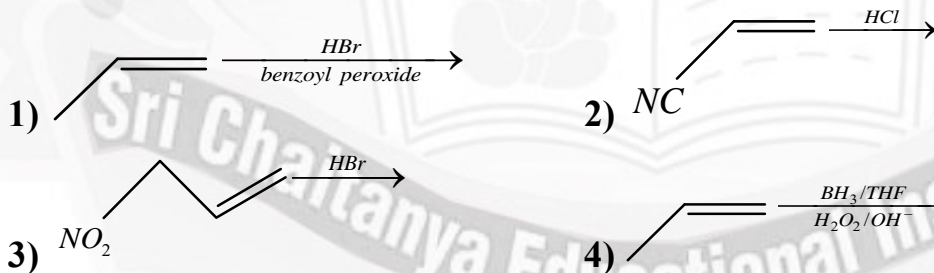**Reason:** Lone pair-lone pair repulsion decreases bond angle in methanol at oxigen

1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion

2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion

3) Assertion is true but Reason is false

4) Both Assertion and Reason are false

45. **Assertion:** Aryl sulphonic acid on reacting with $NaOH$ at high temperature followed by acidification gives phenol
Reason: This reaction is electrophilic substitution reaction
1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion

2)) Both Assertion and Reason are true but Reason is not the correct explanation of

Assertion

3) Assertion is true but Reason is false

4) Both Assertion and Reason are false

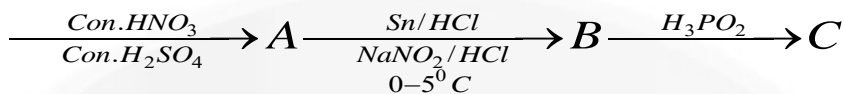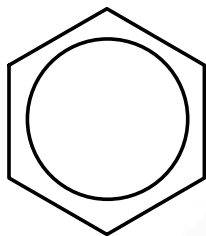**46.** Which of the following involving markonikov's addition

1)
$$\diagup\!\!=\!\!\!=\xrightarrow[benzoyl\ peroxide]{HBr}$$

2)
$$NC\diagup\!\!\diagdown\!\!=\!\!\!=\xrightarrow{HCl}$$

3)
$$NO_2\diagup\!\!\diagdown\!\!=\!\!\!=\xrightarrow{HBr}$$

4)
$$\diagup\!\!=\!\!\!=\xrightarrow[H_2O_2/OH^-]{BH_3/THF}$$

47. Number of moles of HI consumed by glycerol to give 3-Iodopropene

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

48. Number of resonance structures possible in tropylium cation

1) 7   **2)** 3   **3)** 5   **4)** 6

$$\bigcirc \xrightarrow[Con.H_2SO_4]{Con.HNO_3} A \xrightarrow[\substack{NaNO_2/HCl \\ 0-5^0 C}]{Sn/HCl} B \xrightarrow{H_3PO_2} C$$

49.

Number of unhybridised orbitals in compound 'c'

1) 18   **2)** 12   **3)** 6   **4)** 24

50. In which of the following, polysubstitution may takes place?

1) $PhH + CH_3COCl \xrightarrow{Anhyd.AlCl_3} Ph - \overset{\overset{O}{\|}}{C} - CH_3$

2) $PhH + CH_3Cl \xrightarrow{Anhyd.AlCl_3} Ph - CH_3$

3) $PhH + HNO_3 \xrightarrow{H_2SO_4} Ph - NO_2$

4) $PhH + H_2SO_4 \xrightarrow{90°C} Ph - SO_3H$

(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.
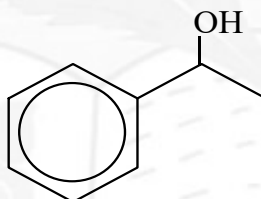
51. Number of compounds giving (i) Red colouration with ceric ammonium nitrate and also (ii) Blue colouration with victor mayer test
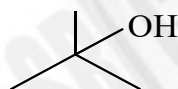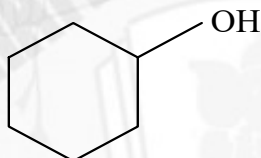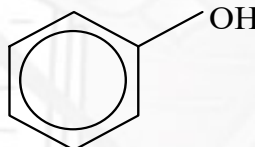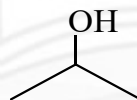
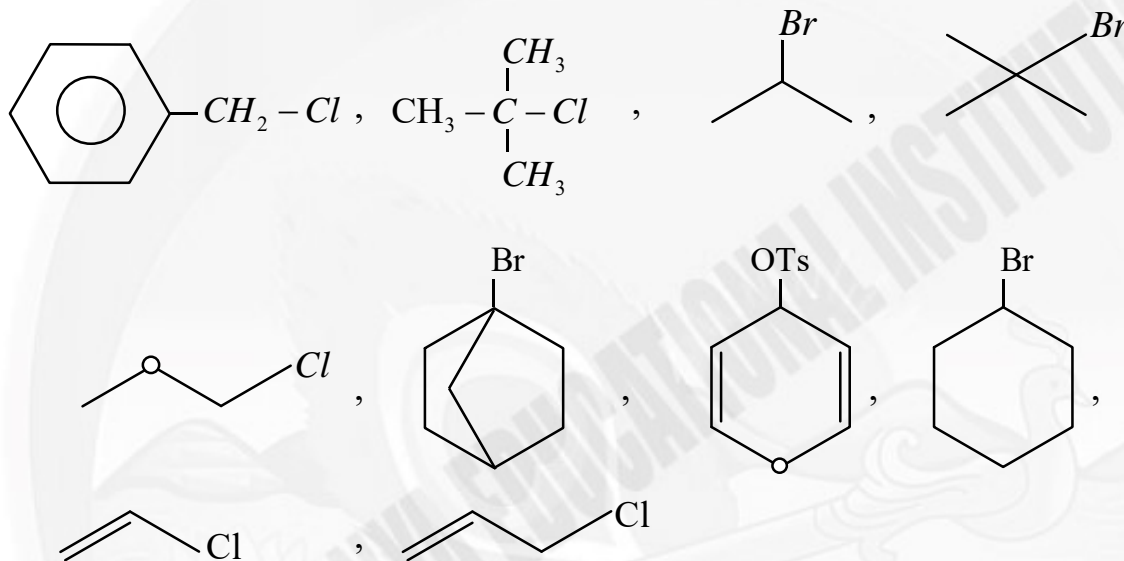(i)   (ii)   (iii)   (iv)

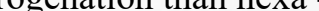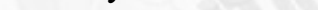(v)   (vi)   (vii)   (viii)

52. how many of the following are more basic than phenyl methanamine
i) Benzanamine   ii) N, N-dimethyl aniline
iii) N-Ethylethanamine   iv) N, N-dimethyl methanamine
v) N-methyl phenyl methanamine   vi) 2,6-dimethylaniline
vii) N-phenyl ethanamide

53. How many of the following are white precipitates
i) 2,4,6-tribromophenol
ii) Iodoform
iii) 2,4,6 tribromo aniline
iv) Chloroform
v) P-aminoazobenze

54. Number of unshared electron pairs in electrophile of carbylamine test

55. The number of substrates those can give both SN^1 and SN^2 reactions are

56. How many of the following are having more heat of hydrogenation than hexa -2, 4-diene

i)

ii)

iii)

iv)

57. Number of stereo centres of the following compound
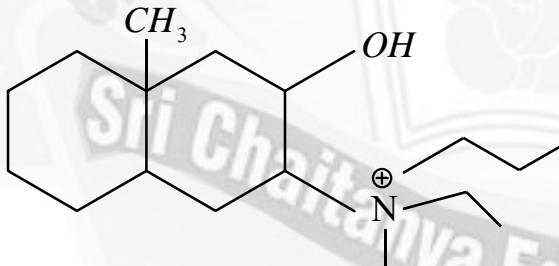
58. Number of planar atoms in propyne

59. $ClCH_2 - CH_2 - Cl \xrightarrow[2)C_2H_5Cl]{1) x\,mole\,NaNH_2} C_2H_5 - C \equiv C - C_2H_5$

60. Number of amide isomers exist for $C_5H_{11}ON$ which on treatment with $NaOH / Br_2$ will give amines

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 $f : R \to [4, \infty)$ be an onto quadratic function whose leading coefficient is 1, such that

$f'(x) + f'(2-x) = 0$. Then the value of $\int_1^3 \dfrac{dx}{f(x)}$ is equal to

1) $\dfrac{1}{4}$ 　　　　 2) $\dfrac{1}{8}$ 　　　　 3) $\dfrac{\pi}{4}$ 　　　　 4) $\dfrac{\pi}{8}$

62. Let g be a continuous even function on R such that $g(x) = f^1(x)$ and $f(1) = 3$ then

$\int_{-1}^{1} f^2(x) g(x) dx$ is equal to

1) 0 　　　　 2) 9 　　　　 3) 18 　　　　 4) 27

63. Let f be a differentiable function satisfying $\int_1^{f(x)} f^{-1}(t) dt = \dfrac{1}{3}\left(x^{\frac{3}{2}} - 8 \right) \forall x > 0$ and $f(1) = 0$,

then the value of $f(9)$ is

1) 3 　　　　 2) 9 　　　　 3) 0 　　　　 4) 2

64. Match the elements of **Column-I** with **Column-II**

Column-I　　　　　　　　　　　　　**Column-II**

(A) $f(x) = \sin x - x^2 + 1$ 　　　　 (p) Has point of minima

(B) $f(x) = x \log_e x - x + e^{-x}$ 　　 (q) Has point of maxima

(C) $f(x) = -x^3 + 2x^2 - 3x + 1$ 　　 (r) Is always increasing

(D) $f(x) = \cos \pi x + 10x + 3x^2 + x^3$ 　 (s) Is always decreasing

a) A-p 　 B-q 　 C-r 　 D-s 　 b) A-r 　 B-s 　 C-p 　 D-q

c) A-s 　 B-r 　 C-q 　 D-p 　 d) A-q 　 B-p 　 C-s 　 D-r

65. **Statement 1:** If $27a + 9b + 3c + d = 0$, then the equation $f(x) = 4ax^3 + 3bx^2 + 2cx + d = 0$

has at least one real root lying in interval $(0,3)$

Statement 2: If $f(x)$ is continuous in $[a,b]$, derivable in (a,b) such that $f(a) = f(b)$,

then there exist at least one point $c \in (a,b)$ such that $f'(c) = 0$

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.

66. Let $f : R \to R$ be a differential function such that

$f\left(\dfrac{\pi}{4}\right) = \sqrt{2}, f\left(\dfrac{\pi}{2}\right) = 0$, and $f'\left(\dfrac{\pi}{2}\right) = 1$ and let

$g(x) = \displaystyle\int_{x}^{\pi/4} \left(f'(t)\sec(t) + \sec(t)\tan(t) f(t) \right) dt$ for $x \in \left[\dfrac{\pi}{4}, \dfrac{\pi}{2}\right)$ Then

$\displaystyle\lim_{x \to \left(\frac{\pi}{2}\right)^{-}} g(x)$ is equal to

1) 2 **2)** 3 **3)** 4 **4)** -3

67. If $U_n = \left(1 + \dfrac{1}{n^2}\right)\left(1 + \dfrac{2^2}{n^2}\right)^2 \cdots \left(1 + \dfrac{n^2}{n^2}\right)^n$, then $\displaystyle\lim_{n \to \infty} (U_n)^{\frac{-4}{n^2}}$ is equal to

1) $\dfrac{16}{e^2}$ **2)** $\dfrac{4}{e}$ **3)** $\dfrac{4}{e^2}$ **4)** $\dfrac{e^2}{16}$

68. Let $f(x)$ be a continuous function on R.

If $\displaystyle\int_{0}^{1} (f(x) - f(2x)) dx = 5$ and $\displaystyle\int_{0}^{2} (f(x) - f(4x)) dx = 10$

Then the value of $\displaystyle\int_{0}^{1} (f(x) - f(8x)) dx$ is equal to

1) 0 **2)** 5 **3)** 10 **4)** 15

69. Statement 1: For all $a, b \in R$ the function $f(x) = 3x^4 - 4x^3 + 6x^2 + ax + b$ has exactly one extremum

Statement 2: If a cubic function is monotonic, then its graph cuts the $x - axis$ only once

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.

70. **Statement-1:** Let $I_k = \int\limits_0^\pi \dfrac{\sin kx}{\sin x}dx$ Then $\sum\limits_{k=1}^{2022} I_k = 1011\pi$

    Statement-2: $\sin(n\pi - \theta) = \begin{cases} -\sin\theta \ when\, n\, is\, even \\ \ \ \sin\theta \ when\, n\, is\, odd \end{cases}$

    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.

71. If $f(x) = x^5 + 5x - 1$ then $\int\limits_5^{41} \dfrac{dx}{\left(f^{-1}(x)\right)^5 + 5.f^{-1}(x)}$ equals

    1) 0   **2)** ln 2   **3)** ln 7   **4)** $\ln\left(\dfrac{41}{5}\right)$

72. $f(x) = \int \dfrac{5e^{8\log x} + 7e^{6\log x}}{\left(e^{2\log x} + 2e^{7\log x} + 1\right)^2}dx \, (x>0)$

    and $f(1) = 1/4$ then $f(2) =$

    1) $\dfrac{128}{7}$ **2)** $\dfrac{128}{261}$ **3)** $\dfrac{256}{261}$ **4)** $\dfrac{216}{261}$

73. If $f(x) = \int \dfrac{x^2 \sin 2x - \sin 2x(x\tan x - 1)}{\left(x^2 + 1\right)^2}dx$

    and $f(0) = 0$ then $f(\pi/4) =$

    1) $\dfrac{8}{\pi^2 + 16}$ **2)** $\dfrac{4}{\pi^2 + 16}$ **3)** $\dfrac{1}{\pi^2 + 16}$ **4)** $\dfrac{1}{\pi^2 + 9}$

74. Let f be a continuous function on R such that

$$f(1/9n) = \left(\sin n^2 + 2n + 5\right)e^{-n^2-n} + \frac{9n^2 + 5n + 6}{3n^2 + n + 1}.$$ Then the value of f(0) is

1) 3   2) $1/2$ 3) 0   4) 2

75. **Statement 1:** The maximum value of $\left(\sqrt{-3 + 4x - x^2} + 4\right)^2 + (x-5)^2 \,(where\, 1 \le x \le 3)$ is 36

Statement 2: The maximum distance between the point $(5, -4)$ and the point on the circle

$(x-2)^2 + y^2 = 1 \, is \, 6$

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.

76. Let $f_1(x) \, and \, f_2(x)$ be continuous and differentiable functions. If

$f_1(0) = f_1(2) = f_1(4), f_1(1) + f_1(3) = f_2(0) = f_2(2) = f_2(4) = 0$ and if

$f_1(x) = 0 \, and f_2^1(x) = 0$ do not have common root, then the minimum number of zeros of

$f_1^1(x) f_2^1(x) + f_1(x) f_2^{11}(x) in [0,4], is$

1) 1   2) 2   3) 3   4) 4

77. $\displaystyle\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\cos x}{1 + e^x} dx$

1) 1   2) $\dfrac{\pi}{2}$ 3) π 4) 0

78. Let $f(x) = \lim\limits_{n\to\infty} n^2 \left(x^{\frac{1}{n}} - x^{\frac{1}{n+1}} \right) : x > 0$ then $\int x \cdot f(x)\, dx =$

1) $\dfrac{x^2}{2}\log x + c$ 2) $\dfrac{x^2}{2}\log x - \dfrac{x^2}{2} + c$ 3) $\dfrac{x^2}{2}\log x + \dfrac{x^2}{2} + c$ 4) $\dfrac{x^2}{2}\log x - \dfrac{x^2}{4} + c$

79. Value of 'K' so that $f(k) = \int_0^4 |4x - x^2 - k| dx$ is minimum is

1) 3   2) 2   3) 25   4) 36

80. The value of the integral $\int_0^{\pi/2} \frac{1 + 2\sin x}{(2 + \sin x)^2} dx$ is equal to

1) 2   2) 1   3) $\frac{1}{2}$ 4) 0

(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 $f(x)$ be periodic function with fundamental period 12. If $\int_{-6}^{12} f(x)dx = 9$ and

$\int_0^{12} f(x)dx = 12$ then the value of $\left| \int_0^6 f(x)dx \right|$

82. The value of $\int_0^1 (1 - x^7)^{\frac{1}{4}} dx - \int_0^1 (1 - x^4)^{1/7} dx$

83. Number of values of x satisfying $\int_0^x t^2 \sin(x - t)dt = x^2$ in $[0,100]$

84. If $I_1 = \int_0^1 (1 - x^{50})^{100} dx$, $I_2 = \int_0^1 (1 - x^{50})^{101} dx$ then $5050 \cdot \frac{I_1}{I_2} =$

85. Let $f(x)$ be a quadratic function such that $f(0) = 1$ and $\int \frac{f(x)}{x^2(x+1)^3} dx$ is a rational

functions then $f'(0)$ is

86. Let $g(x) = |4x^3 - x| \cos \pi x$ then number of points where $g(x)$ is non differentiable in

$(-\infty, \infty)$ is equal to

87. Let $P(x)$ be a real polynomial of degree 3 which vanishes at $x = 3$. Let $P(x)$ have local minima at $x = 1$, local maxima at $x = -1$ and $\int_{-2}^{+2} P(x) dx = 24$, then the absolute value of leading coefficient of the polynomial $P(x)$ is equal to _____

88. If f is differentiable function such that $f^{1}(2) = \dfrac{1}{2}$ then $\underset{h \to 0}{Lt} \dfrac{f\left(2 + h^{4}\right) - f\left(2 - h^{4}\right)}{h^{4}}$ is equal to

89. If $f(2023) = \pi/2$ & $f(x) = f(2x) \forall x \in R$ & $f(x)$ is continuous for $x \in R$, then the value of $\lim\limits_{x \to 0} \dfrac{5\cos\left(f(x)\right) - 3\sqrt{\cos f(x)}}{\sin^{2} x + x^{3}}$

90. Let $f(x) = \dfrac{e^{x} - e^{-x}}{2}$ and if $f(g(x)) = x$ then the value of $g\left(\dfrac{e^{2022} - 1}{2e^{1011}}\right)$