Sri Chaitanya IIT Academy.,India.

A.P T.S KARNATAKA TAMILNADU MAHARASTRA DELHI RANCHI

A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

Sec:Sr.Super60_NUCLEUS & STERLING_BT **Paper -1(Adv-2021-P1-Model)** **Date: 13-08-2023**

Time: 09.00Am to 12.00Pm **RPTA-02** **Max. Marks: 180**

13-08-2023_Sr.Super60_NUCLEUS&STERLING_BT_Jee-Adv(2021-P1)_RPTA-02_Syllabus

PHYSICS : Geometrical optics: Rectilinear propagation of light; Reflection and refraction at plane and spherical surfaces; Total internal reflection; Deviation and dispersion of light by a prism; Thin lenses; Combinations of mirrors and thin lenses; Magnification. Experiments: focal length of a concave mirror, convex mirror and a convex lens using u-v method (parallax method), The plot of the angle of deviation vs angle of incidence for a triangular prism. Refractive index of a glass slab using a travelling microscope.

CHEMISTRY : GOC: Inductive effect, Resonance and hyperconjugation; Keto-enol tautomerism; Hydrogen bonding- definition and their effects on physical properties of alcohols and carboxylic acids; Inductive and resonance effects on acidity and basicity of organic acids and bases; Polarity and inductive effects in alkyl halides; Reactive intermediates produced during homolytic and heterolytic bond cleavage; Formation, structure and stability of carbocations, carbanions and free radicals Alkanes:Preparation, properties and reactions of alkanes. Homologous series, physical properties of alkanes(melting points, boiling points and density) and effect of branching on them; Combustion and halogenations of alkanes (including allylic and benzylic halogenation); Preparation of alkanes by Wurtz reaction and decarboxylation reaction, Corey-House Reaction.

MATHEMATICS : Application of Differentiation (AOD)

Name of the Student: _____ **H.T. NO:** | | | | | | | |

JEE-ADVANCE-2021-P1-Model

Time:3Hr's **IMPORTANT INSTRUCTIONS** **Max Marks: 180**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 4)	Questions with Single Correct Choice	+3	-1	4	12
Sec – II(Q.N : 5 – 10)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 11 – 16)	Questions with Multiple Correct Choice with partial mark	+4	-2	6	24
Sec – IV(Q.N : 17 – 19)	Questions with Non-negative Integer Value Type	+4	0	3	12
Total				**19**	**60**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 20 – 23)	Questions with Single Correct Choice	+3	-1	4	12
Sec – II(Q.N : 24 – 29)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 30 – 35)	Questions with Multiple Correct Choice with partial mark	+4	-2	6	24
Sec – IV(Q.N : 36– 38)	Questions with Non-negative Integer Value Type	+4	0	3	12
Total				**19**	**60**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 39 – 42)	Questions with Single Correct Choice	+3	-1	4	12
Sec – II(Q.N : 43 – 48)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 49 – 54)	Questions with Multiple Correct Choice with partial mark	+4	-2	6	24
Sec – IV(Q.N : 55 – 57)	Questions with Non-negative Integer Value Type	+4	0	3	12
Total				**19**	**60**

PHYSICS **Max Marks: 60**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 4 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases. Section 1 (Max Marks: 12)

- Section 1 contains Four questions
- Each Question has Four Options and Only One of these four will be the correct answer.
- For each question, choose the option corresponding to the correct answer
- The Marking scheme to evaluate Answer to each question will be :
- Full Marks: **+3** (If the answer is correct)
- Zero Marks: **0** (If the question is unanswered)
- Negative Marks: -1 (In all other cases)

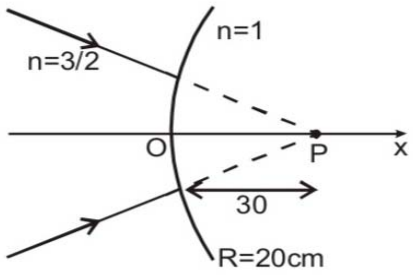
1. A plane mirror is moving with velocity $4\hat{i}+5\hat{j}+8\hat{k}$. A point object in front of the mirror moves with a velocity $3\hat{i}+4\hat{j}+5\hat{k}$. Here $\hat{k}$ is along the normal to the plane mirror and facing towards the object. The velocity of the image is:

A) $-3\hat{i}-4\hat{j}+5\hat{k}$ **B)** $3\hat{i}+4\hat{j}+11\hat{k}$ **C)** $-3\hat{i}-4\hat{j}+11\hat{k}$ **D)** $7\hat{i}+9\hat{j}+11\hat{k}$

2. A point object is kept between a plane mirror and a concave mirror facing each other. The distance between the mirrors is 22.5 cm. Plane mirror is placed perpendicular to principal axis of concave mirror. The radius of curvature of the concave mirror is 20 cm. What should be the distance of the object from the concave mirror so that after two successive reflections the final image is formed on the object itself ? (consider first reflection from concave mirror)

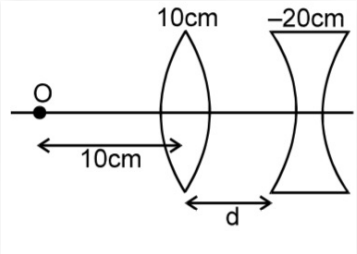
A) 12 cm **B)**15 cm **C)** 10 cm **D)** 7.5 cm

3. The image for the converging beam after refraction through the curved surface (in the given figure) is formed at:



A) $x=40cm$ **B)** $x=\frac{40}{3}cm$ **C)** $x=-\frac{40}{3}cm$ **D)** $x=\frac{180}{7}cm$

4. What should be the value of distance d so that final image is formed on the object itself ? (Focal lengths of the lenses are as given in the figure).



A) 10 cm **B)** 20 cm **3)** 5 cm **4)** None of these

SECTION 2

- This section contains **THREE (03)** questions stems.
- There are **TWO (02)** questions corresponding to each question stem.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks: +2*** If ONLY the correct numerical value is entered at the designated place;
- **Zero Marks:0** in all other cases

Question Stem for Question Nos. 5 and 6

Question Stem

A prism of refractive index $\sqrt{2}$ has refracting angle 60°. Answer the following questions

5. In order that a ray suffers minimum deviation it should be incident at an angle (in degree):

6. Angle of maximum deviation without TIR (in degree) is:
(take $\sin 15^{\circ} = 0.23$ and $\sin^{-1}(0.32)=19$ degree)

Question Stem for Question Nos. 7 and 8

Question Stem

A converging lens of focal length 10 cm and a diverging lens of focal length 5 cm are placed 5cm apart with their principal axes coinciding. A beam of light travelling parallel to the principal axis and having a beam diameter 5.0 mm, is incident on the converging lens

7. Find the beam diameter of the emergent beam (in mm)

8. Find out the ratio of emergent and incident intensities

Question Stem for Question Nos. 9 and 10

Question Stem

A certain material has refractive indices 1.53, 1.60 and 1.68 for red, yellow and violet light respectively.

9. Calculate the dispersive power

10. Find the angular dispersion (in degree) produced by a thin prism of angle 6^o

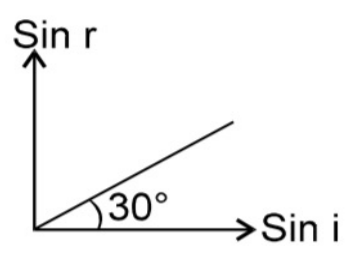
SECTION 3

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks: +4*** If only (all) the correct option(s) is (are) chosen;
- ***Partial Marks: +3*** If all the four options are correct but **ONLY** three options are chosen,
- ***Partial Marks: +2*** If three or more options are correct but **ONLY** two options are chosen, both of which are correct:
- ***Partial Marks: +1*** If two or more options are correct but **ONLY** one option is chosen and it is a correct option;
- ***Zero Marks: 0*** If unanswered;
- ***Negative Marks: -2*** In all other cases.
- For example, in a question, if (A), (B) and (D) are the **ONLY** three options corresponding to the correct answer, then

Choosing ONLY (A), (B) and (D) will get +4 marks;
Choosing ONLY (A), will get +1 mark;
Choosing ONLY (B), will get +1 mark;
Choosing ONLY (D), will get +1 mark;
Choosing no option(s) (i.e. the question is unanswered) will get 0 marks and

Choosing any other option(s) will get -2 marks.

11. A ray of monochromatic light is incident on the plane surface of separation between two media x and y with angle of incidence 'i' in the medium x and angle of refraction 'r' in the medium y. The graph shows the relation between sin r and sin i.



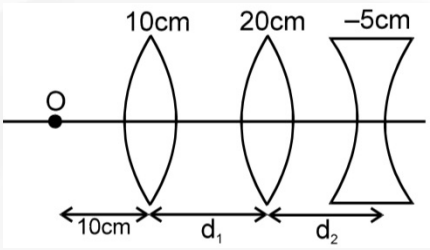
A) the speed of light in the medium y is $(3)^{1/2}$ times than in medium x.

B) the speed of light in the medium y is $(1/3)^{1/2}$ times than in medium x.

C) the total internal reflection can take place when the incidence is in x.

D) the total internal reflection can take place when the incidence is in y.

12. The value of $d_1 \& d_2$ for final rays to be parallel to the principal axis are: (focal length of the lenses are written above the respective lenses in the given figure)



A) $d_1 = 10cm, d_2 = 15cm$ **B)** $d_1 = 20cm, d_2 = 15cm$

C) $d_1 = 30cm, d_2 = 15cm$ **D)** None of these

13. A man wants to photograph a white donkey as a Zebra after fitting a glass with black streaks onto the lens of his camera.

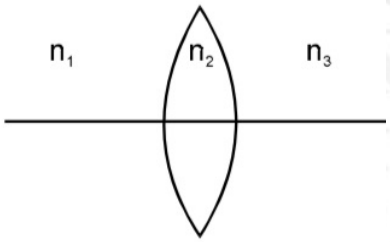
A) The image will look like a black donkey on the photograph

B) The image will look like a Zebra on the photograph

C) The image will be more intense compared to the case in which no such glass is used.

D) The image will be less intense compared to the case in which no such glass is used.

14. An equiconvex lens of refractive index n_2 is placed such that the refractive index of the surrounding media is as shown. Then the lens:



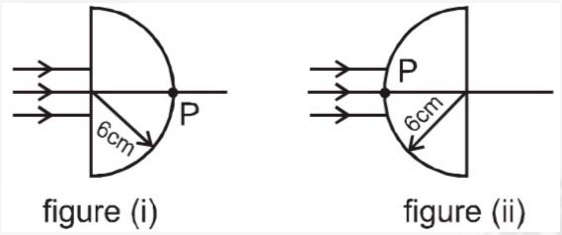
A) must be diverging if n_2 is less than the arithmetic mean of n_1 *and* n_3

B) must be converging if n_2 is greater than the arithmetic mean of n_1 *and* n_3

C) may diverging if n_2 is less than the arithmetic mean of n_1 *and* n_3

D) Will neither be diverging nor converging if n_2 is equal to arithmetic mean of n_1 *and* n_3

15. A parallel bean of light is incident normally on the flat surface of a hemisphere of radius 6 cm and refractive index 1.5, placed in air as shown in figure (i). Assume paraxial ray approximation.



A) The rays are focused at 12 cm from the point P to the right, in the situation as shown in figure (i)

B) The rays are focused at 16 cm from the point P to the right, in the situation as shown in figure (i)

C) If the rays are incident at the curved surface (figure (ii)) then these are focussed at distance 18 cm from point P to the right.

D) If the rays are incident at the curved surface (figure (ii)) then these are focussed at distance 14 cm from point P to the right.

16. A ray is incident on a refracting surface of $RI\ \mu$ at an angle of incidence i and the corresponding angle of refraction is r. The deviation of the ray after refraction is given by $\delta = i - r$. Then, one may conclude that

A) r increases with I

B) δ increases with i

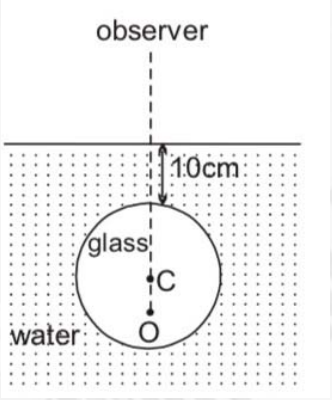
C) δ decreases with I

D) the maximum value of δ is $Cos^{-1}\left(\frac{1}{\mu}\right)$

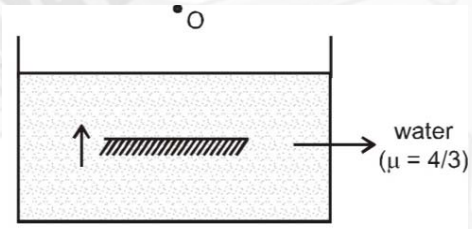
SECTION 4

- This section contains **THREE (03)** question.
- The answer to each question is a **NON-NEGATIVE INTEGER.**
- For each question, enter the correct integer corresponding to the answer the using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks*** : **+4** If ONLY the correct integer is entered;
- ***Zero Marks*** : **0** In all other cases.

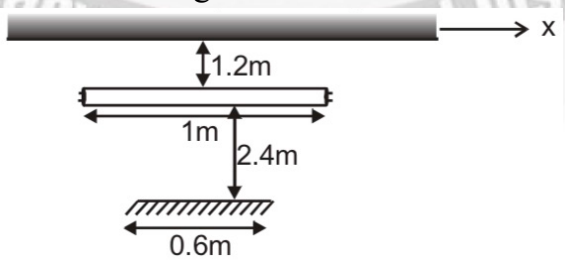
17. There is a small air bubble inside a glass sphere ($\mu = 1.5$) of radius 5 cm. The bubble is at 'O' at $7.5\,cm$ below the surface of the glass. The sphere is placed inside water ($\mu = 4/3$) such that the top surface of glass is 10 cm below the surface of water. The bubble is viewed normally from air. If the apparent depth of the bubble is D then the value of $= 90 + 19 - 60 = 49^{o}$.



18. Mirror in the arrangement shown in figure is moving up with speed 4 cm/sec. Find the speed of final image of object O (in cm/s) formed after two refraction and one reflection.



19. A fluorescent lamp of length 1 m is placed horizontally at a depth of 1.2 m below a ceiling. A plane mirror of length 0.6 m is placed below the lamp parallel to and symmetric to the lamp at a distance 2.4 m from it as shown in figure. Find the length in meters (distance between the extreme points of the visible region along x-axis) of the reflected patch of light on the ceiling.

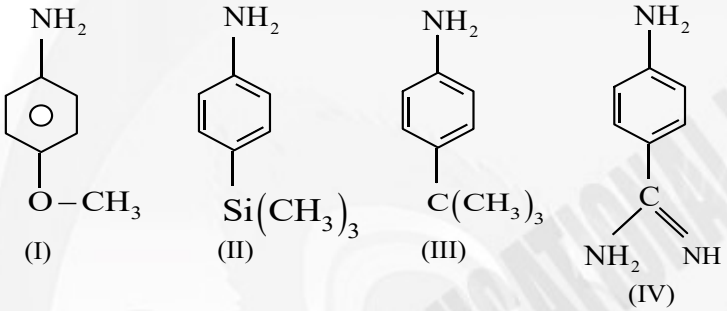


CHEMISTRY **Max. Marks: 60**

SECTION 1

- This section contains **Four (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:
- *Full Marks* : +3 If ONLY the correct option is chosen;
- *Zero Marks* : 0 If the none of the options is chosen (i.e. the question is unanswered);
- *Negative Marks* : -1 In all other cases.

20.

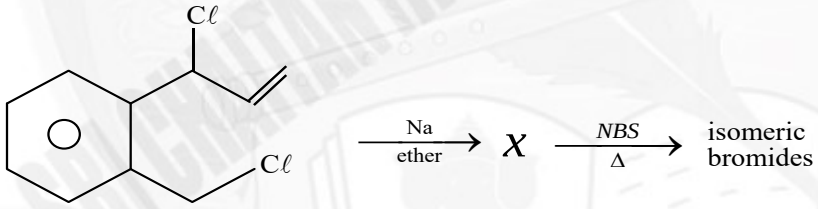


Correct basic strength order is ?

A) $IV > III > II > I$ **B)** $II > III > I > IV$

C) $IV > I > III > II$ **D)** $IV > I > II > III$

21.



How many isomeric mono bromo products are formed from x excluding vinyl and aryl halides?

A) 3 **B)** 4 **C)** 6 **D)** 2

22. Incorrect statement about maleic acid and fumaric acid is ?

A) Maleic acid is more soluble than fumaric acid in water.

B) Melting points of fumaric acid is greater than maleic acid

C) P^{Ka_1} of maleic acid is more than P^{Ka_1} of fumaric acid.

D) Ka_2 of maleic acid is less than Ka_2 of fumaric acid.

23. Which of the following is more basic than N, N-dimethyl aniline?

A) Phenylmethanamine **B)** Acetanilide

C) Aniline **D)** Benzamide

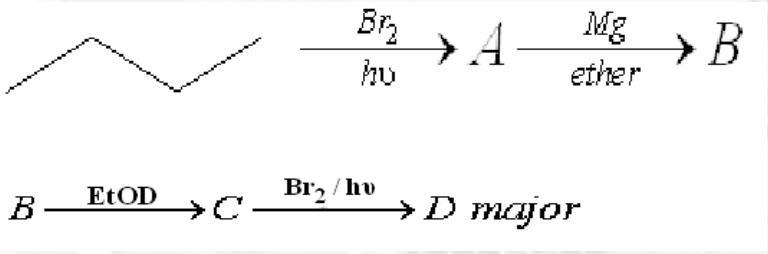
SECTION 2

- This section contains **THREE (03)** questions stems.
- There are **TWO (02)** questions corresponding to each question stem.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks*** **: +2** If ONLY the correct numerical value is entered at the designated place;
- ***Zero Marks*** **: 0** In all other cases.

Question Stem for Question Nos. 24 and 25

Question Stem

Consider following reaction



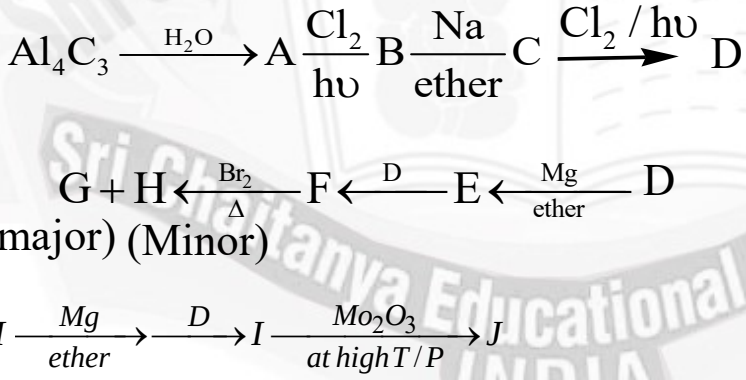
At $wt.(s)\ of\ [C=12, H=1, D=2.01\ and\ Br=79.90]$

24. Molecular weight of C is _____

25. Molecular weight of D is _____

Question Stem for Question Nos. 26 and 27

Question Stem



26. Number of gaseous hydrocarbons formed in above reaction sequence is _____

27. If total number of hybridized orbitals in J is x and I is y then value of $\frac{y}{x}$ is _____

Question Stem for Question Nos. 28 and 29

Question Stem

An alkane having molecular weight 72 have 3 isomers x,y,& z and their boiling point order is x > y > z then answer following questions

28. _____isomeric monochloro derivatives are possible for y.

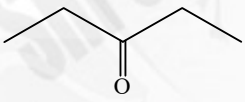
29. Total Number of Primary C- H bonds in x,y & z is _____

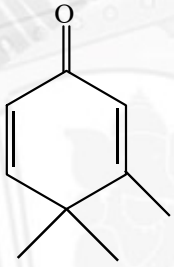
SECTION 3

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks: +4*** If only (all) the correct option(s) is (are) chosen;
- ***Partial Marks: +3*** If all the four options are correct but **ONLY** three options are chosen,
- ***Partial Marks: +2*** If three or more options are correct but **ONLY** two options are chosen, both of which are correct:
- ***Partial Marks: +1*** If two or more options are correct but **ONLY** one option is chosen and it is a correct option;
- ***Zero Marks: 0*** If unanswered;
- ***Negative Marks: -2*** In all other cases.
- For example, in a question, if (A), (B) and (D) are the **ONLY** three options corresponding to the correct answer, then

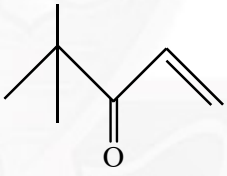
Choosing ONLY (A), (B) and (D) will get +4 marks;
Choosing ONLY (A), will get +1 mark;
Choosing ONLY (B), will get +1 mark;
Choosing ONLY (D), will get +1 mark;
Choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
Choosing any other option(s) will get -2 marks.

30. How many of the following can show keto-enol tautomersim ?

A) 

B) 

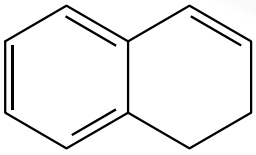
C) 

D) 

31. Which of the following molecules in pure form is/are stable at room temperature ?

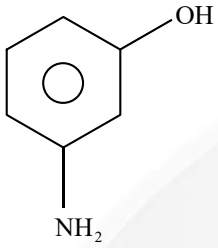
A) 

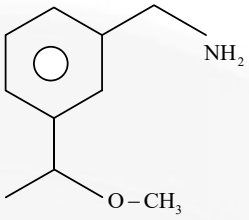
B) 

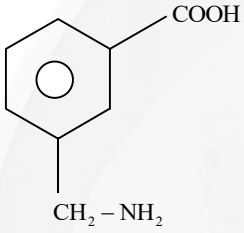
C) 

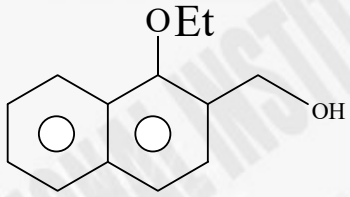
D) 

32. How many of the following are soluble in both aq NaOH and dil HCl ?

A) 

B) 

C) 

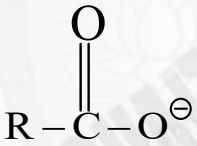
D) 

33. Which of the following are more acidic than methanoic acid

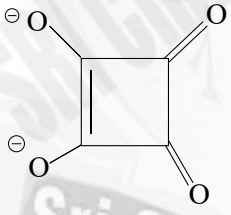
A) Chloro acetic acid **B)** Acetic acid

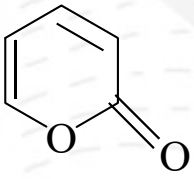
C) Benzoic acid **D)** picric acid

34. In which of the following compounds all C-O bonds have equal bond length?

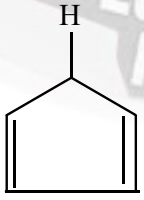
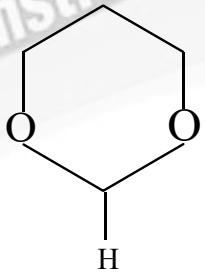
A) 

B) CO_3^{-2}

C) 

D) 

35. With respect to compound I – IV select correct statements

$CH_3 - C \equiv C - H$ (I)  **(II)**  **(III)**  **(IV)**

A) Compound III is more acidic than IV

B) Conjugate base of II is more stable than conjugate base of I

C) All $C-H$ bonds of II are in same plane.

D) Compound (I) has maximum 4 atoms in same plane.

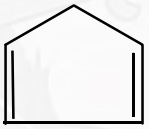
SECTION 4

- This section contains **THREE (03)** question.
- The answer to each question is a **NON-NEGATIVE INTEGER.**
- For each question, enter the correct integer corresponding to the answer the using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated <u>according to the following marking scheme:</u>
- ***Full Marks*** **: +4** If ONLY the correct integer is entered;
- ***Zero Marks*** **: 0** In all other cases.

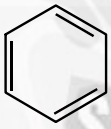
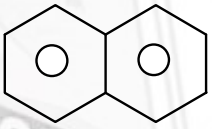
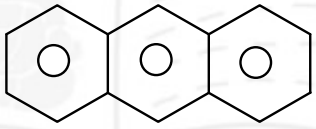
36. The maximum number of alkanes which contain at least one tertiary carbon atom having molecular weight 100 (Note: acyclic only)

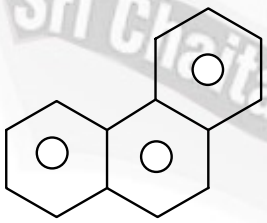
37. Consider following compounds and find out the value of x+y . If x is the number of most acidic compound and Y is the number of least acidic compound.

$\underset{(1)}{CH_2=CH-CH_2-OH}$ $\underset{(2)}{Ph-CH_2-OH}$ $\underset{(3)}{Ph-C\equiv C-H}$

$\underset{(4)}{H-C\equiv C-COOH}$ $\underset{(5)}{CH=CH-\overset{\overset{O}{\|}}{C}-OH}$  (6) $\underset{(7)}{Ph-COOH}$ $\underset{(8)}{H-COOH}$

38. Number of resonating structures of

 is x,  is y,  is z and

for  is P

Then value of X+Y+Z - P is _____

Note: (Consider canonical structures have no charges)

MATHEMATICS **Max. Marks: 60**

SECTION -1

- This section contains **Four (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:
- *Full Marks* : +3 If ONLY the correct option is chosen;
- *Zero Marks* : 0 If the none of the options is chosen (i.e. the question is unanswered);
- *Negative Marks* : -1 In all other cases.

39. If the function $f(x)=(4-p)x^3+(p-2)x^2+\left(p^2-25\right)x+2$ has a local minimum at some $x\in(-\infty,0)$ and a local maximum at some $x\in(0,\infty)$ then the true set of values of p is____

A) $(4,5)$ **B)** $(-\infty,-5)\cup(4,5)$ **C)** $(-5,5)$ **D)** $(5,\infty)$

40. The number of integral values of K for which the equation $e^x=\frac{K}{x-3}$ has exactly two solutions is _____

A) 5 **B)** 6 **C)** 7 **D)** 9

41. Let $f(x)=\left\{\frac{x-\sin x}{5}\right\}$ where $\{t\}$ denotes fractional part of t. If the number of points in $(0,20\pi)$ where $f(x)$ in non derivable is the number of different values of c of L.M.V.T for the twice differentiable function $g(x)$ i.e, $g'(c)=\frac{g(b)-g(a)}{b-a}$ for some $c\in(a,b)$ and the minimum number of points where $g''(x)$ vanishes is n then the integral part of $\frac{n}{2}$ is _____

A) 10 **B)** 11 **C)** 12 **D)** 5

42. If from the point $(h,2-5h), h\in R, h\neq 1$, two distinct tangents are drawn to the curve $y=x^3-3x^2-ax+b$ then $a+b$ is equal to

A) 1 **B)** 3 **C)** 4 **D)** -1

SECTION-2

- This section contains **THREE (03)** questions stems.
- There are **TWO (02)** questions corresponding to each question stem.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks: +2*** If ONLY the correct numerical value is entered at the designated place;
- ***Zero Marks: 0*** In all other cases.

Question Stem for Question Nos. 43 and 44

Question Stem

Let $f(x)$ and $g(x)$ be two differentiable functions on R satisfying

$$f(x)=\frac{x^3}{2}+1-x\int_0^x g(t)dt \text{ and } g(x)=x-\int_0^1 f(t)dt$$

43. Then $\frac{2}{3}(x-\text{intercept})$ of normal drawn to $y=f(x)$ at point P whose abscissa is 2 is ___

44. The number of points where $f(|x|)$ is non-differentiable is ___

Question Stem for Question Nos. 45 and 46

Question Stem

Consider $f(x)=\cos 2x+2\lambda^2 x+(2\lambda+1)(\lambda-1)x^2, \lambda\in R$

45. For $\lambda=1$, if $f(3x^2-2x+1)<f(x^2-2x+9)$ then the number of integral values of x in $[-10,10]$ is___

46. If $\alpha\neq\beta$ and $f\left(\frac{\alpha+\beta}{2}\right)<\frac{f(\alpha)+f(\beta)}{2}$ for all α and β then the smallest positive integral value of λ is___

Question Stem for Question Nos. 47 and 48

Question Stem

Let $f(x)$ be a cubic polynomial which has local maximum at $x=-1$ and $f'(x)$ has a local minimum at $x=1$If $f(-1)=10$ and $f(0)=5$ then.

47. One fifth of the distance between horizontal tangents of $y=f(x)$ is

48. Sum of all non-negative integers which lies between the roots of $f(x)=0$ is ____

SECTION -3

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks*** **: +4** If only (all) the correct option(s) is (are) chosen;
- ***Partial Marks*** **: +3** If all the four options are correct but **ONLY** three options are chosen,
- ***Partial Marks*** **: +2** If three or more options are correct but **ONLY** two options are chosen, both of which are correct:
- ***Partial Marks*** **: +1** If two or more options are correct but **ONLY** one option is chosen and it is a correct option;
- ***Zero Marks*** **: 0** If unanswered;
- ***Negative Marks: -2*** In all other cases.
- For example, in a question, if (A), (B) and (D) are the **ONLY** three options corresponding to the correct answer, then Choosing ONLY (A), (B) and (D) will get +4 marks; Choosing ONLY (A), will get +1 mark; Choosing ONLY (B), will get +1 mark; Choosing ONLY (D), will get +1 mark; Choosing no option(s) (i.e. the question is unanswered) will get 0 marks and

Choosing any other option(s) will get -2 marks.

49. If a tangent drawn to the curve $f(x)=x^3-9x-1$ at $P(x_0, f(x_0))$ meets the curve again at Q, m_A denotes the slope of the tangent at A and m_{OB} denotes the slope of line joining origin O and a point B on the curve then

A) $m_Q-4m_P=27$ **B)** $m_Q-4m_p=9$

C) $\frac{m_{OP}}{m_{OQ}}=2$ where $x_0=1$ **D)** $\frac{m_{OP}}{m_{OQ}}=\frac{1}{2}$ where $x_0=1$

50. Let $f:\left[0,\frac{\pi}{2}\right]\to[0,1]$ be a differentiable function such that $f(0)=0$, $f\left(\frac{\pi}{2}\right)=1$ then

A) $f'(\alpha)=\sqrt{1-(f(\alpha))^2}$ for all $\alpha\in\left(0,\frac{\pi}{2}\right)$

B) $f'(\alpha)=\frac{2}{\pi}$ for all $\alpha\in\left(0,\frac{\pi}{2}\right)$

C) $f'(\alpha)=\frac{1}{\pi}$ for atleast one $\alpha\in\left(0,\frac{\pi}{2}\right)$

D) $f'(\alpha)=\frac{8\alpha}{\pi^2}$ for at least one $\alpha\in\left(0,\frac{\pi}{2}\right)$

51. Let $f:R\to(-\infty,-1]$ be a function defined by

$f(x)=(ab+2a-b-2)x^5-(a^3-2a+1)x^3+(a^2-2a-3)x^2+(a^2+2b)x-5,\ a,b\in R$.

If $f(x)$ is surjective then the possible value of a-b is _____

A) $\frac{9}{2}$ **B)** $-\frac{7}{2}$ **C)** $-\frac{5}{2}$ **D)** $\frac{11}{2}$

52. Let $f(x)$ be a function such that $f\left(\frac{x}{y}\right)=\frac{f(x)}{f(y)}\forall x,y\in R,\ y\neq 0\ f(y)\neq 0$ and the slope of tangent to $y=f(x)$ at $x=1$ is 2. If a tangent to the curve $g(x)=1+f(x)$ at a point (α,β) makes a trapezium of greatest area with axes and the line $x=1$ then

A) $4\beta-2\alpha=4$ **B)** $4(\alpha+\beta)=7$ **C)** $\beta+\frac{\alpha}{2}=\frac{5}{2}$ **D)** $\frac{\beta}{\alpha}=\frac{3}{2}$

53. Let $f(x)=e^{(P+1)x}-e^{x}$ for real $p>0$ and $g(t)=\int_{t}^{t+1} f(x)e^{t-x}dx$

If $f(x)$ is minimum at $x=x_p$ and $g(t)$ is minimum at $t=t_P$ then.

A) $x_P=\dfrac{\ln(p+1)}{p}$ **B)** $t_P=\dfrac{-1}{p}\ln\left(\dfrac{(p+1)\left(e^{p}-1\right)}{p}\right)$

C) $\lim\limits_{p\to 0^+}(x_P-t_P)=\dfrac{1}{2}$ **D)** $\lim\limits_{p\to 0^+}(x_P-t_P)=2$

54. If $a=\left(\dfrac{51}{50}\right)^{\frac{101}{2}}, b=\left(\dfrac{50}{49}\right)^{\frac{99}{2}}, c=\left(\dfrac{101}{100}\right)^{\frac{201}{2}}, d=\left(\dfrac{100}{99}\right)^{\frac{199}{2}}$

Then choose the correct options ?

A) $a>c$ **B)** $a>b$ **C)** $c<d$ **D)** $c<b$

SECTION 4

- This section contains **THREE (03)** question.
- The answer to each question is a **NON-NEGATIVE INTEGER.**
- For each question, enter the correct integer corresponding to the answer the using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:
- ***Full Marks*** **: +4** If ONLY the correct integer is entered;
- ***Zero Marks*** **: 0** In all other cases.

55. If $f(x)=\left(\sqrt{4-x^2}-3\right)^2+\left(\sqrt{4-x^2}+1\right)^3$ and the maximum value of $f(x)$ is N then $\dfrac{N}{7}=$____

56. If $f(x)=4x^3-x^2-2x+1$ and $g(x)=\begin{cases}\min\{f(t)/0\le t\le x\} & 0\le x\le 1\\ 3-x & 1<x\le 2\end{cases}$ then

$2\left(g\left(\dfrac{1}{4}\right)+g\left(\dfrac{3}{4}\right)+g\left(\dfrac{5}{4}\right)\right)=$ _____

57. A cone is circumscribed about a sphere of radius r and θ is the semivertical angle of cone. If the volume of the cone is minimum then $9\sin\theta=$____

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