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 -2(Adv-2021-P2-Model)** **Date: 27-08-2023**

Time: 02.00Pm to 05.00Pm **CTA-03** **Max. Marks: 180**

27-08-2023_Sr.Super60_NUCLEUS&STERLING_BT_Jee-Adv(2021-P2)_CTA-03_Syllabus

PHYSICS : RPTA-1 TO RPTA.4 SYLLABUS

CHEMISTRY : RPTA-1 TO RPTA.4 SYLLABUS

MATHEMATICS : RPTA-1 TO RPTA.4 SYLLABUS

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

JEE-ADVANCE-2021-P2-Model

Time: 3:00Hr's **IMPORTANT INSTRUCTIONS** **Max Marks: 180**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 6)	Questions with Multiple Correct Choice with Partial mark	+4	-2	6	24
Sec – II(Q.N : 7 – 12)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 13 – 16)	Paragraph Questions with Single Answer Type	+3	-1	4	12
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 – 25)	Questions with Multiple Correct Choice with Partial mark	+4	-2	6	24
Sec – II(Q.N : 26 – 31)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 32 – 35)	Paragraph Questions with Single Answer Type	+3	-1	4	12
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 – 44)	Questions with Multiple Correct Choice with Partial mark	+4	-2	6	24
Sec – II(Q.N : 45 – 50)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 51 – 54)	Paragraph Questions with Single Answer Type	+3	-1	4	12
Sec – IV(Q.N : 55 – 57)	Questions with Non-negative Integer Value Type	+4	0	3	12
Total				**19**	**60**

PHYSICS

Max. Marks: 60

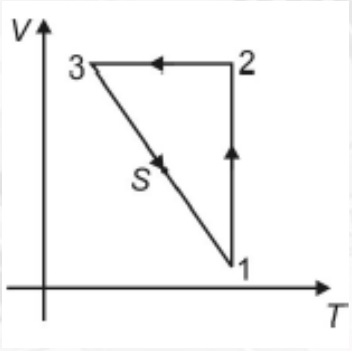
SECTION-1(Maximum Marks: 24)

One or More Type

- 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)
- 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.

1. An ideal gas is taken through a cyclic process $1 \to 2 \to 3 \to 1$. At 1 temperature is 127^0C and volume is 20cm^3, while at 3 temperature is 27^0C and volume is $50\,\text{cm}^3$. The gas attains a state S in the process $3 \to 1$ where the pressure is same as at 2, then



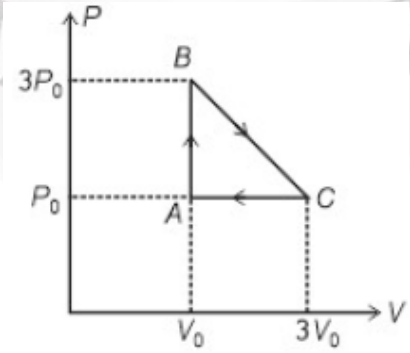
A) The volume of the gas at S is nearly 23.1cm^3

B) The volume of the gas at S is nearly 41.2cm^3

C) Net work done by the gas in cyclic process is positive

D) Work done by the gas in process $1 \to 2$ is negative

2. One mole of an ideal monatomic gas is taken through a cyclic process ABCA as shown in the P-V graph. Choose the correct statement(s).



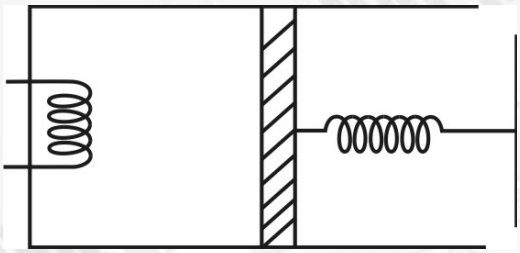
A) Heat absorbed by the gas in the process AB is $3P_0V_0$

B) Maximum temperature attained during the cycle is $\frac{4P_0V_0}{R}$

C) Maximum temperature of the cycle is attained when pressure is $2P_0$

D) Work done by the gas in the complete cycle is $2P_0V_0$

3. An ideal monoatomic gas is confined by a spring loaded massless piston of cross-section $8\times10^{-3}m^2$. Initially the gas is at 300 K and occupies a volume of $2.4\times10^{-3}m^3$ and the spring is in its relaxed state. The gas is heated by an electric heater until piston moves out without friction by 0.1 m. Force constant of the spring is 8000 N/m, atmospheric pressure 1×10^5 N/m, the cylinder and piston are thermally insulated, the piston and spring are massless and there is no friction between the piston and cylinder. Neglect the heat lost through the wire of the heater. The heat capacity of the heater is neglected.



A) Final temperature of gas is 800 K **B)** Heat supplied by heater is 720 J

C) Change in internal energy is 600 J **D)** Work done by the gas is 120 J

4. A screen is kept at a distance of 1 m from the object. A converging lens when placed between the object and screen, at any two positions 80 cm apart, forms a sharp image of the object on the screen. If the size of the object is 6 mm, then

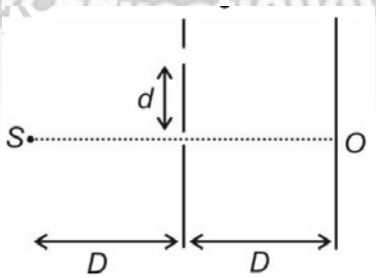
A) Focal length of lens is 9 cm

B) The magnitude of magnification at first position when object is near to the lens is 9

C) The size of image at second position when lens is nearer to screen than object is 54 mm

D) The product of magnification m1 and m2 at two position is –1

5. In the arrangement shown below, S is the source of light of wavelength λ. If



A) There is minima at O, then minimum value of d is $\sqrt{\frac{\lambda D}{2}}$

B) There is minima at O, then minimum value of d is $\sqrt{\lambda D}$

C) There is maxima at O, then minimum value of d is $\sqrt{2\lambda D}$

D) There is maxima at O, then minimum value of d is $\sqrt{\lambda D}$

6. Four coherent and monochromatic sources of light, emit light of wavelength λ travelling along x axis and each having intensity I_0, are placed along x-axis at x = 0, d, 2d and 3d. Let P be a far away point on the x-axis. Then at point P

A) There will be minima if $d=\frac{\lambda}{4}$ **B)** There will be minima if $d=\frac{\lambda}{8}$

C) Intensity is $4I_0$ if $d=\frac{\lambda}{2}$ **D)** Intensity is $3I_0$ if $d=\frac{\lambda}{6}$

SECTION-2(Maximum Marks: 12)

Paragraph with Numerical

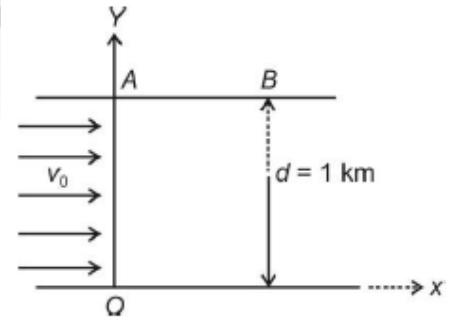
- This section contains THREE (03) question stems.
- There are TWO (02) questions corresponding to each question stem.
- The answer to each question is a NUMERICAL VALUE.
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the 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. 7 and 8

Question Stem

In the figure shown the velocity of river current grows in proportion to the perpendicular distance from the bank and reaches its maximum v_0=9kmph, in the middle. A boat is so moving in the river that its velocity v = 18 kmph relative to the water is constant and perpendicular to the direction of river flow. Assume the width of the river is d and boat starts from point O with reference to the above situation answer the following questions



7. If the boat reached at point B on the other bank of river the ratio of OA and AB is n:1. Then 'n' is

8. Now assume that boat want to cross the river in minimum possible time, then (Assuming speed of boat in still water is always 18kmph) the time taken to cross the river is $\frac{1}{n}$ hrs. Then n is

Question Stem for Question Nos. 9 and 10

Question Stem

A rectangular box of length l consisting of two chambers of length l/2 each, separated by a smooth piston, lies on a horizontal surface with the piston being movable along its length. Each chamber consists of n moles of gas at pressure P_0, volume V_0 and temperature $T_0=127^0C$. Initially the walls of the box are conducting and the piston is pushed slowly such that the temperature virtually remains constant. By the time the ratio of volumes of the chambers become 3 : 1 an amount of heat equal to Q is exchanged with the surroundings. On the other hand if walls are insulated and piston alone is conducting, the temperature of the gas becomes T in the larger chamber by the time volume ratio becomes 3 : 1. Let C_P be equal to 2R.

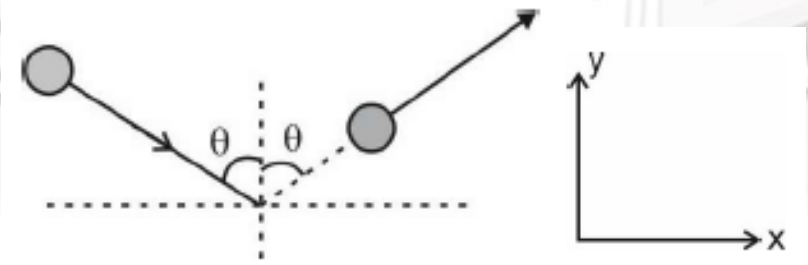
9. Then the magnitude of Q is $nRT_0 \ln x$ then x is

10. The value of T in ^0C is approximately

Question Stem for Question Nos. 11 and 12

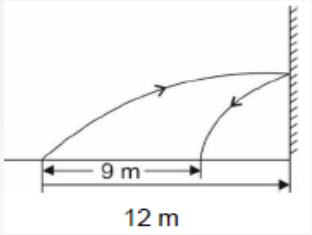
Question Stem

A ball is moving with speed u strikes a wall. Initial velocity of the ball is at θ angle from normal. If the collision is elastic, the normal component of velocity will get reversed while the component of velocity parallel to the surface remains unchanged.

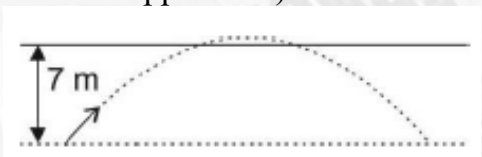


So, initial velocity of the ball is $u\sin\theta\hat{i}-u\cos\theta\hat{j}$. Then final velocity of the ball will be $u\sin\theta\hat{i}+u\cos\theta\hat{j}$. The path of the ball after collision would be the mirror image in wall of the path of the ball in case if there were no collision

11. A particle is projected with some speed at angle 45^0 with horizontal. There is a wall at a distance 12 m from the point of projection. The collision of the ball from wall is elastic. After the collision ball lands on ground at distance 9 m from the point of projection. The height at which the ball hit the wall is



12. There are two parallel horizontal walls separated by height 7 m. A ball is projected with speed 20 m/s at angle 37^0 from horizontal. If the collision of the ball with wall is elastic, then find the range of the ball ($g = 10 m/s^2$)
(consider only one collision with upper wall)



SECTION-3(Maximum Marks: 12)
Paragraph with Single Answer Type

- This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) 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 none of the options is chosen (i.e. the question is unanswered);
Negative Marks : −1 In all other cases.

Paragraph-I

If the measurement errors in all the independent quantities are known, then it is possible to determine the error in any dependent quantity. This is done by the use of series expansion and truncating the expansion at the first power of the error. For example, consider the relation $z = x / y$. If the errors in x, y and z are $\Delta x, \Delta y$ *and* Δz respectively, then

$$z \pm \Delta z = \frac{x \mid \pm \Delta x}{y \pm \Delta y} = \frac{x}{y}\left(1 \pm \frac{\Delta x}{x}\right)\left(1 \pm \frac{\Delta y}{y}\right)^{-1}$$

The series expansion for $\left(1 \pm \frac{\Delta y}{y}\right)^{-1}$, to first power in $\Delta y / y$, is $1 \mp (\Delta y / y)$. The relative errors in independent variables are always added. So the error in z will be

$$\Delta z = z\left(\frac{\Delta x}{x} + \frac{\Delta y}{y}\right).$$

The above derivation makes the assumption that $\frac{\Delta x}{x} << 1, \frac{\Delta y}{y} << 1$. Therefore, the higher powers of these quantities are neglected.

13. Consider the ratio $r = \frac{(1-a)}{(1+a)}$ to be determined by measuring a dimensionless quantity a. If the error in the measurement of a is $\Delta a (\Delta a / a << 1)$, then what is the error Δr in determining r?

A) $\frac{\Delta a}{(1+a)^2}$ **B)** $\frac{2\Delta a}{(1+a)^2}$ **C)** $\frac{2\Delta a}{(1-a)^2}$ **D)** $\frac{2a\Delta a}{(1-a)^2}$

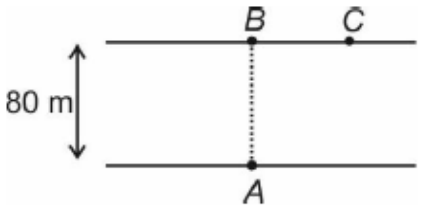
14. In an experiment the initial number of radioactive nuclei is 3000. It is found that 1000 ± 40 nuclei decayed in the first 1.0 s. For $|x| << 1$, $\ln(1+x) = x$ up to first power in x. The error $\Delta\lambda$, in the determination of the decay constant λ, in s^{-1}, is (the relation between initial & final number of nuclei is $N = N_0 e^{-\lambda t}$)

A) 0.04 **B)** 0.03 **C)** 0.02 **D)** 0.01

Paragraph-II

If a swimmer crosses a river (width = 80 m) from point *A* and swims perpendicular to the banks w.r.t. river then he will reach point *C* lying at distance of $\frac{400}{3} m$ from point *B* in 2 minutes. Based on the given information answer the following questions.

15. Velocity of swimmer with respect to river, is



A) 4km/hr **B)** 3.2 km/hr **C)** 5 km/hr **D)** 2.4 km/hr

16. If the man crosses the river travelling minimum distance *d*, then

A) $d = \frac{400}{3} m$

B) $d = \frac{500}{3} m$

C) $d = 200m$

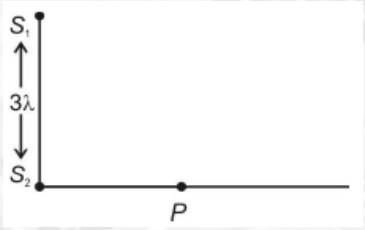
D) 100

SECTION-4(Maximum Marks: 12)
Non-Negative Integer Answer Type

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer 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. Two coherent point sources S_1 *and* S_2 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. The smallest (non-zero) distance on this line from S_2 where a minima of intensity will occur is $\frac{11\lambda}{k}$ where k is 10n then n is



18. Two full turns of the circular scale of a screw gauge cover a distance of 1 mm on its main scale. The total number of divisions on the circular scale is 50. Further, the screw gauge has a zero error of –0.03 mm. If main scale reading is 3 mm and circular scale reading is 35 during the measurement of diameter of a wire. Then diameter of wire is $\left(3+\frac{x}{100}\right)mm$. The value of x is 19n then n is

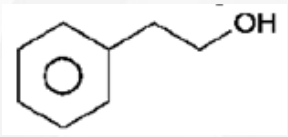
19. A cubical box of side 1 metre contains helium gas (atomic weight 4) at a pressure of $100 N/m^2$. During an observation time of 1 second, an atom travelling with root mean square speed parallel to one of the edges of the cube was found to make 500 hits with a particular wall without any collision with any other atom. Temperature of gas is x × 80 kelvin, find x. $\left(R=\frac{25}{3}J/mol\ K\right)$

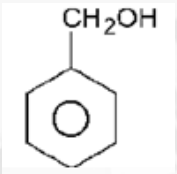
CHEMISTRY **Max. Marks: 60**

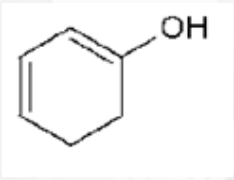
SECTION-1(Maximum Marks: 24)
One or More Type

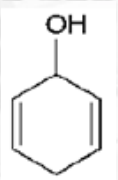
- This section contains SIX (06) questions.
- Each question has FOUR options (A), (B), (C) and (D). ONE OR MORE THAN ONE of these four option(s)
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following 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.

20. Which of the following compound does exhibit mesomeric or resonance effect?

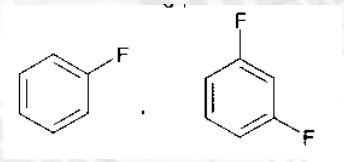
A) 

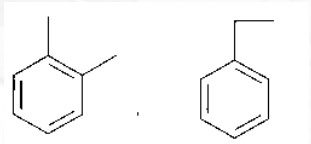
B) 

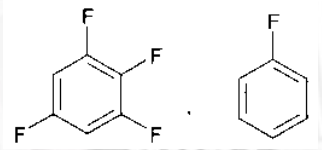
C) 

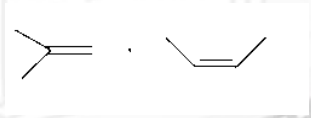
D) 

21. Which of the following pair has same net dipole moment

A) 

B) 

C) 

D) 

22. Pick the correct statement(s)

A) Number of carboxylic acid group present in tartaric acid is two.

B) The IUPAC name of cinnamic acid is 2-phenyl but 2-enoic acid

C) Prop-2-enoic acid is also known as crotonic acid

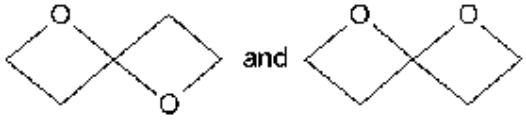
D) The IUPAC name of X is propane-1,2,3-trinitrile, where X is

$NC\text{-}CH_2\text{-}CH(CN)\text{-}CH_2\text{-}CN$

23. Which of the following statement is not correct?

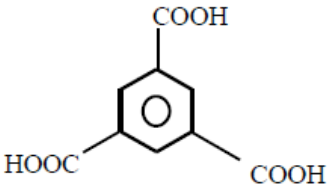
A) Butanoic acid and 2-methylpropanoic acid are position isomers.

B) Most stable form of ethylene glycol is anti, conformer.

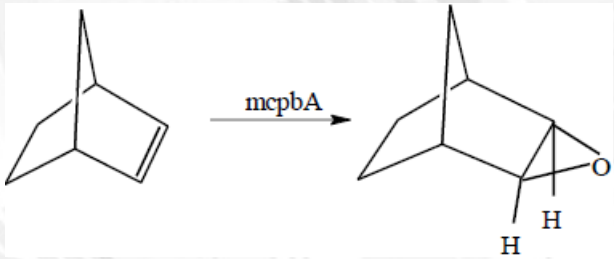
C)  are geometrical isomers

D) Only two isomeric monochloro derivatives are possible for propane

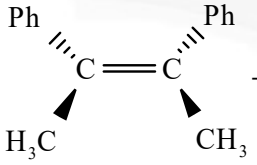
24. Which of the following reaction is/are correct

A) $HC \equiv C - COOH \xrightarrow[\text{Fe tube}]{\text{Red hot}}$ 

B) $Me - \equiv - Me \xrightarrow[2.\ Br_2/H_2O]{1.\ Na,\ NH_{3(l)}}$ Meso compound (Major)

C) 

D) $CH \equiv CH \xrightarrow[\Delta]{NH_4Cl,\ CuCl} CH_2 = CH - C \equiv CH \xrightarrow{HCl}$ Chloroprene

25.  $\xrightarrow{x}$ Meso-2,3-diphenylbutane

'x' can be

A) $NH_2 - NH_2 + H_2O_2$ **B)** $(i)B_2H_6$ in THF; $(ii)CH_3CO_2H$

C) H_2/Pd **D)** $(i)B_2H_6$ in THF; $(ii)H_2O_2/OH^+$

SECTION-2(Maximum Marks: 12)

Paragraph with Numerical

- This section contains THREE (03) question 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. 26 and 27

Question Stem

1,2 – dibromo propane $\xrightarrow[(2)CH_3-CH_2-Br]{(1)NaNH_2}$ Pent – 2 – yne $\xrightarrow[liq.NH_3(80\%yeild)]{Li}$ A $\xrightarrow[100\%yeild]{O_3/Zn,H_2O}$ B + C

26. Weight of $NaNH_2$ required to convert one mole 1,2-dibromopropane is (Assume 100% conversion) x gm, then value of $\frac{x}{2}$ is $[Na=23, N=14]$

27. What would be weight of C (Assuming it contains less carbon than B)

Question Stem for Question Nos. 28 and 29

Question Stem

$2CH \equiv CH \xrightarrow[NH_4Cl]{Cu_2Cl_2} A \xrightarrow[1eq]{HCl} B \xrightarrow[\Delta]{R_2O_2} C$

Answer the following questions on the basis of above sequence of reactions:

28. Degree of unsaturation in A is x. Find $\frac{x}{2}$.

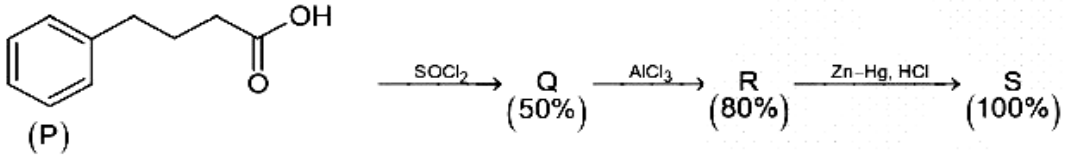
29. Ratio of number of carbon atom to number of H-atom in molecule B is

Question Stem for Question Nos. 30 and 31

Question Stem

When substituted benzenes undergo electrophilic attack, group already on the ring affect both, the rate of the reaction and the site of attack. We say, therefore, that substituent groups affect both **reactivity** and **orientation** in electrophilic aromatic substitutions. Find the reactions of Benzene or benzene derivatives and answer the following

30. In the reaction sequence given below is carried out with one mole of reactant (P), the amount of product (S) formed (in g) is _____



31. $[A]+\text{Coke}\longrightarrow[B]\xrightarrow{H_3O^+}[C]\xrightarrow{\text{Red hot Cu-Tube}}\text{Mesitylene}$

The Number of valence electrons in element [A] are

SECTION-3(Maximum Marks: 12)
Paragraph with Single Answer Type

- This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) 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 none of the options is chosen (i.e. the question is unanswered);
Negative Marks : −1 In all other cases.

Paragraph-I:

There are three outcomes for a reaction at an asymmetric atom. Consider the replacement of a group X by Y in the following reaction

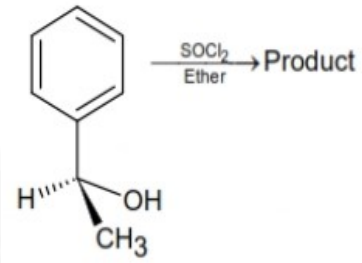
If (A) is the compound obtained, the process is called retention of configuration.

If (B) is the only compound obtained, the process is called inversion of configuration.

If a 50 : 50 mixture of the above two is obtained then the process is called racemisation and the product is optically inactive, as one isomer will rotate light in the direction opposite to another.

In general if during a reaction no bond to the stereocentre is broken, the product will have the same general configuration of group around the stereocentre as that of reactant. Such a reaction is said to proceed with retention of configuration.

32.



Which is correct statement regarding the above reaction?

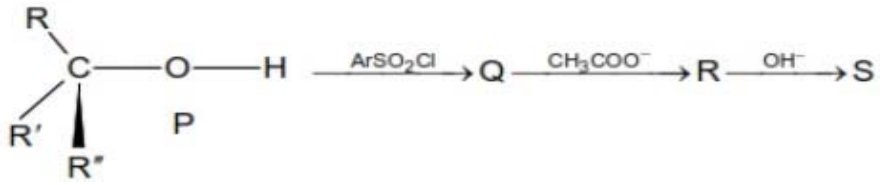
A) Kinetically, reaction is bimolecular

B) Stereo chemically, the configuration is retained

C) Stereo chemically Walden inversion take place

D) In place of ether when pyridine used, we get a racemic mixture

33.



Which of the following statement is/are correct?

A) P and R must have the same configuration
B) S and R must have the same configuration
C) P and S must rotate plane polarized light to the same direction
D) Two among the 3 steps mentioned above involve inversion of configuration

Paragraph-II:

A stereoselective reaction forms one steroisomers preferentially over another steroisomer In this reaction for reaction steroisomerism may or may not possible. A reaction is streospecific if the reactant can exist as stereoisomers and each stereoisomers of reactant forms a different stereoisomer or a different set of stereoisomers of the product.
All sterospecific reaction are stereoselective but a steroselective reaction may or may not stereospecific.

	LIST-I (Reaction)		LIST-II(Nature of reaction)		LIST-III (major product)
I)		**A)**	Sterospecific	**P)**	Erythro isomer
II)		**B)**	Steroselective	**Q)**	Threoisomer
III)		**C)**	Regeoselective	**R)**	Meso
IV)		**D)**	Only syn addition	**S)**	Racemicmiture

34. Incorrect match among the following is
A) I-B-P **B)** I-A-R **C)** II-A-S **D)** II-C-Q

35. Incorrect match among the following is
A) III-C-S **B)** IV-C-S **C)** IV-D-P **D)** IV-A-Q

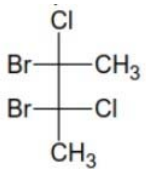
SECTION-4(Maximum Marks: 12)
Non-Negative Integer Answer Type

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer 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:

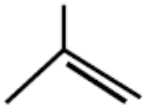
Full Marks : +4 If ONLY the correct integer is entered;
Zero Marks : 0 In all other cases.

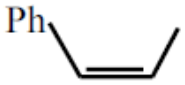
36. How many maximum number of nitro product(s) is/are formed when $CH_3CH_2CH_3$ reacts with fuming HNO_3?

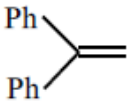
37. The total number(s) of stable conformers with non – zero dipole moment for the following compounds is/are

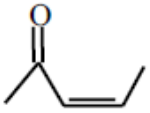


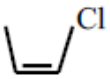
38. How many alkenes react faster than propene with diluted H_2SO_4.

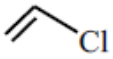
(a) 

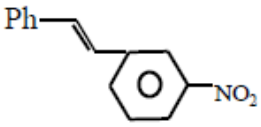
(b) 

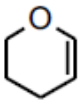
(c) 

(d) 

(e) 

(f) 

(g) 

(h) 

(i) 

MATHEMATICS

Max. Marks: 60

SECTION-1(Maximum Marks: 24)

One or More Type

- 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)
- 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.

39. $f:[1,\infty)\to[a,\infty)$ defined by $f(x)=2^{2x^2-4x}$; $g:\left[\frac{\pi}{2},\pi\right]\to[c,d]$ defined by $g(x)=\frac{\cos x+3}{\cos x+2}$

Are two invertible functions which of the following is/are true

A) $f^{-1}(x)=\frac{4+\sqrt{16-8\log_2 x}}{4}$

B) Range of function $h(x)=4ax^2+2cx+d$ is $\left[-\frac{1}{4},\infty\right)$

C) value of c is $\frac{1}{3}$

D) value of a is $\frac{1}{4}$

40. Let $f(x)=\lim\limits_{n\to\infty}\left(\frac{2x^{2n}\sin\frac{1}{x}+x}{1+x^{2n}}\right)$ then which of the following is/are correct?

A) $\lim\limits_{x\to\infty} x\,f(x)=2$

B) $\lim\limits_{x\to0} f(x)=\frac{2\sin1+1}{2}$

C) $\lim\limits_{x\to0} f(x)=0$

D) $\lim\limits_{x\to-\infty} f(x)=0$ if $n\in N$

41. Set of values of 'a' for which

$$\lim_{x\to2}\left\{\frac{(a-1)(x-2)^2-2a^2\ln(\cos(x-2))}{x^2+4-2(2x+\ln\cos(x-2))}\right\}^{\frac{\sqrt{x^2-4}}{\sqrt{x-2}+\sqrt{x}-\sqrt{2}}}=\frac{1}{4}$$ is 'A'. Then

A) $0\in A$ **B)** $1\in A$ **C)** $-1\in A$ **D)** $-2\in A$

42. Which of the following is/are correct

A) Range of $f(x)=\frac{1}{[x]}$ is $[-1,1]-\{0\}$, where $[.]$ is G.I.F

B) fundamental period of the function $g(x)=5\cos^6\left(\frac{2x-\pi}{4\pi^2}\right)-3\cos\left(\frac{2x-\pi}{2\pi^2}\right)$ is $2\pi^3$.

C) Number of solutions of equation $\frac{\ln x}{x}=\frac{\ln 10}{10}$ is two

D) $f:[0,3]\to R; f(x)=2x^3-15x^2+36x+1$ is injective mapping

43. Which of the following statements is/are true?

A) If f is differentiable at x = c, then $\lim_{h\to 0}\frac{f(c+h)-f(c-h)}{2h}$ exists and equals $f^1(c)$.

B) Given a function f and a point c in the domain of f, if the $\lim_{h\to 0}\frac{f(c+h)-f(c-h)}{h}$ exists, then the function is differentiable at x = c

C) Let $g(x)=\begin{cases}x^2\sin\frac{1}{x^2}, & x\neq 0\\ 0, & x=0\end{cases}$, then g^1 exists everywhere on R

D) Let $g(x)=\begin{cases}x^2\sin\frac{1}{x^2}, & x\neq 0\\ 0, & x=0\end{cases}$, then g^1 exists and g^1 is continuous, everywhere on R

44. Let [x] denote the greatest integer less than or equal to x. Now $g(x)$ is defined as below:

$$g(x)=\begin{cases}[f(x)], x\in\left(0,\frac{\pi}{2}\right)\cup\left(\frac{\pi}{2},\pi\right)\\ 3, x=\frac{\pi}{2}\end{cases}$$

where $f(x)=\frac{2\left(\sin x-\sin^n x\right)+\left|\sin x-\sin^n x\right|}{2\left(\sin x-\sin^n x\right)-\left|\sin x-\sin^n x\right|}, n\in R$. Then which of the following is/are correct

A) $g(x)$ is continuous and differentiable at $x=\frac{\pi}{2}$ when $n>1$

B) $g(x)$ is continuous and differentiable at $x=\frac{\pi}{2}$ when $0<n<1$

C) $g(x)$ is continuous but not differentiable at $x=\frac{\pi}{2}$ when $n>1$

D) $g(x)$ is continuous but not differentiable at $x=\frac{\pi}{2}$ when $0<n<1$

SECTION-2(Maximum Marks: 12)

Paragraph with Numerical

- This section contains THREE (03) question 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. 45 and 46

Question Stem

Consider a cubic, $f(x)=ax^3+bx^2+cx+4, a,b,c\in R$ and $f''\left(\frac{-2}{3}\right)=0$ and tangent drawn to the graph of the function $y=f(x)$ at $x=\frac{-2}{3}$ is $y=\frac{5x}{3}+\frac{100}{27}$

45. The value of $(a+b+c)$ is equal to:

46. If g is the inverse of f, then $\frac{d}{dx}\left(g(x).f(g(x))\right)$ at x = 4 is equal to :

Question Stem for Question Nos. 47 and 48

Question Stem

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

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

48. If $f(x)$ is increasing for all $x\in R$, then number of values of λ

Question Stem for Question Nos. 49 and 50

Question Stem

If $f(x)=\int\frac{x^7-x^5+x^3-x}{x^{10}+1}dx=A\ln\left|x^8-x^6+x^4-x^2+1\right|+B\ln\left|x^2+1\right|+C$, $f(0)=0$,

then answer the following

49. The value of A equals

50. The absolute value of B equals

SECTION-3(Maximum Marks: 12)
Paragraph with Single Answer Type

- This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) 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 none of the options is chosen (i.e. the question is unanswered);
Negative Marks : −1 In all other cases.

Paragraph-I:

Let $f'(\sin x)<0$ and $f''(\sin x)>0 \forall x \in \left(0,\frac{\pi}{2}\right)$ and $g(x)=f(\sin x)+f(\cos x)$

51. Which of the following is true in $\left(0,\frac{\pi}{2}\right)$?

A) g' is increasing **B)** g' is decreasing

C) g' is non-increasing **D)** g' is neither increasing nor decreasing

52. Which of the following is true?

A) $g(x)$ is decreasing in $\left(\frac{\pi}{4},\frac{\pi}{2}\right)$ **B)** $g(x)$ increasing in $\left(0,\frac{\pi}{4}\right)$

C) $g(x)$ is monotonically increasing **D)** None of these

Paragraph-II:

Let $f:R\to R$ be a continuous and differentiable function such that

$f(x+y)=f(x).f(y)\forall x,y, f(x)\neq 0$ and $f(0)=1$ and $f'(0)=2.$

Let $g(xy)=g(x).g(y)\forall x,y$ and $g'(1)=2; g(1)\neq 0$

53. Identify the correct option

A) $f(2)=e^4;\ g(3)=9$ **B)** $f(2)=2e^2;\ g(3)=9$

C) $f(1)<4;\ g(3)=3$ **D)** $f(3)>729;\ g(3)=3$

54. The number of values of x, where $f(x)=g(x)$:

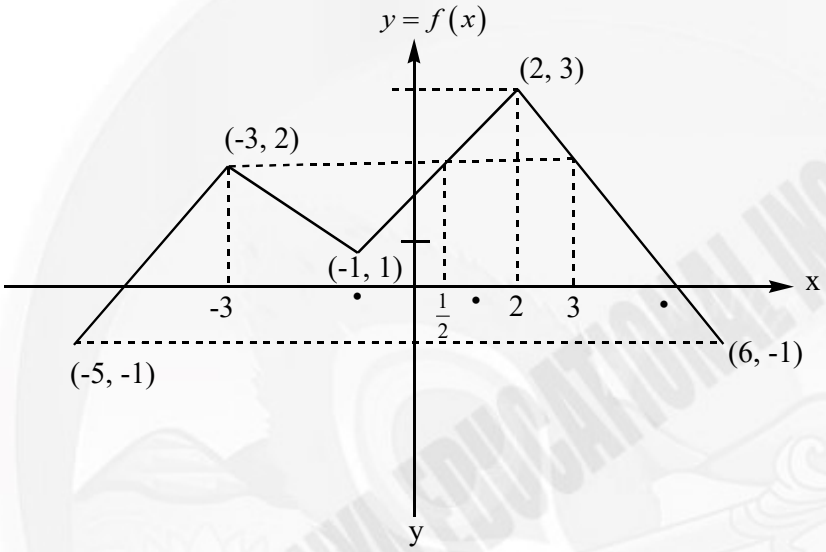
A) 0 **B)** 1 **C)** 2 **D)** 3

SECTION-4(Maximum Marks: 12)
Non-Negative Integer Answer Type

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer 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.



Let $f:[-5,6]\to R$ be a real valued function whose graph is given as follow, then number of solutions of $f(f(f(x)))=3$ is

56. If $\int\frac{\tan^4 x}{1-\tan^2 x}dx = A\tan x + B\ln\left|\sec 2x+\tan 2x\right| + C.x + D$ then the value of $\left|\frac{A}{BC}\right|$ equals

57. If $f(x)=\int\frac{x^2}{\left(1+x^2\right)\left(1+\sqrt{1+x^2}\right)}dx$ and $f(0)=0$ then the value of $\left[\left|f(1)\right|\right]$ equals

$\left([.]\,is\ GIF\right)$

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