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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_BT **Paper -2(New Model-P1)** **Date: 17-09-2023**

Time: 02.00Pm to 05.00Pm **GTA-02** **Max. Marks: 198**

17-09-2023_Sr.Super60_NUCLEUS_BT_Jee-Adv(New Model-P1)_GTA-02_Syllabus

PHYSICS : TOTAL SYLLABUS

CHEMISTRY : TOTAL SYLLABUS

MATHEMATICS : TOTAL SYLLABUS

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

JEE-ADVANCED- Sri Chaitanya IIT Special -P1-Model(New Model-P1)

Time:3Hr's **IMPORTANT INSTRUCTIONS** **Max Marks: 198**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 6)	Questions with Multiple Correct Choice Type	+4	-2	6	24
Sec – II(Q.N : 7 – 10)	Numerical Value Answer Type	+3	0	4	12
Sec – III(Q.N : 11 – 15)	Questions with Non-negative Integer Value Type	+3	0	5	15
Sec – IV(Q.N : 16 – 20)	**Two** Paragraph with Numerical Value Answer Type	+3	0	5	15
Total				**20**	**66**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 – 26)	Questions with Multiple Correct Choice Type	+4	-2	6	24
Sec – II(Q.N : 27 – 30)	Numerical Value Answer Type	+3	0	4	12
Sec – III(Q.N : 31 – 35)	Questions with Non-negative Integer Value Type	+3	0	5	15
Sec – IV(Q.N : 36– 40)	**Two** Paragraph with Numerical Value Answer Type	+3	0	5	15
Total				**20**	**66**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 41 – 46)	Questions with Multiple Correct Choice Type	+4	-2	6	24
Sec – II(Q.N : 47 – 50)	Numerical Value Answer Type	+3	0	4	12
Sec – III(Q.N : 51 – 55)	Questions with Non-negative Integer Value Type	+3	0	5	15
Sec – IV(Q.N : 56 – 60)	**Two** Paragraph with Numerical Value Answer Type	+3	0	5	15
Total				**20**	**66**

MATHEMATICS

Max. Marks: 66

SECTION-1(Maximum Marks: 24)

MULTIPLE CORRECT

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).
Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

1. Which of the following is/are **CORRECT**?

A) The minimum value of the function $f(x)=x^{\frac{3}{2}}+x^{\frac{-3}{2}}-4\left(x+\frac{1}{x}\right)$ for all permissible real x, is –10.

B) Let f(0) = 0 and $\int_0^2 f'(2t)e^{f(2t)}dt=5$, then the value of f(4) equals ln(11).

C) If $x_1,x_1,x_2,x_3,.....x_{n-1}$ be n zero's of the polynomial $P(x)=x^n+\alpha x+\beta$, where $x_i\neq x_j\forall i,j$ then $(x_1-x_2)(x_1-x_3)(x_1-x_4).....(x_1-x_{n-1})$, equals $n(n-1)x_1^{n-2}$.

D) Let f(x) be a differentiable function such that $f(x)+f'(x)\leq 1\forall x\in R$ and f(0) = 0, then the greatest value of f(1) is $1-\frac{1}{e}$.

2. Let $P=\tan^2\frac{\pi}{16}+\tan^2\frac{2\pi}{16}+\tan^2\frac{3\pi}{16}+\tan^2\frac{5\pi}{16}+\tan^2\frac{6\pi}{16}+\tan^2\frac{7\pi}{16}$, then which of the following is/are **TRUE?**

A) Number of positive prime divisors of P are 2.

B) Maximum digit in P is 4.

C) P is a prime number.

D) Absolute difference of the digits of P is 1.

3. Let $x=ky^2+2, k>0$ then which of the following is/are **TRUE**?

A) Equation of the tangent line, drawn to the graph of $x=ky^2+2$ at the point $\left(4,\frac{\sqrt{2}}{\sqrt{k}}\right)$ passes through origin $(0,0)$.

B) Equation of tangent line, drawn to the graph of $x = ky^2 + 2$ at the point $\left(4, \frac{\sqrt{2}}{\sqrt{k}}\right)$ passes through the point (1, 0).

C) Let R be the region, in the first quadrant, bounded by x-axis, the graph of $x = ky^2 + 2$ and the line x = 4. Then area of the region R decreases as ***k*** increases.

D) Let R be the region, in the first quadrant, bounded by the x-axis, the graph of $x = ky^2 + 2$ and the tangent line, drawn to the curve at $\left(4, \frac{\sqrt{2}}{\sqrt{k}}\right)$ and is equal to $\frac{8}{3}$ square units, then the value of ***k*** is $\frac{1}{8}$.

4. Let A, P, B are collinear points on lines y = 0, y = 2x, y = 3x respectively. If PA.PB is minimum (for a fixed P), then which of the following is/are **TRUE?**

A) PA = PB **B)** PA > PB

C) Slope of PA may lie in $(-\infty, -1)$ **D)** A, B are not equidistant from origin

5. Let ABCD be a rectangle with A(0, 0), B(4, 0), C(4, 4) and D(0, 4). Rectangle is folded in such a way that corner B always lies on line AD, then which of the following statement(s) is/are **CORRECT?**

A) As the point B moves on AD the crease thus formed will touch a fixed parabola whose focus is at (4, 0).

B) As the point B moves on AD the crease thus formed will touch a fixed parabola whose focus is at $\left(\frac{3}{2}, 0\right)$.

C) As the point B moves on AD the crease thus formed will touch a fixed parabola whose equation is $y^2 = 8(x-2)$.

D) As the point B moves on AD the crease thus formed will touch a fixed parabola whose equation of directrix is y = 2x.

6. OABC is a tetrahedron of volume $\frac{2}{3}$ cubic unit. Also $BC=\sqrt{2}, \angle AOB=\frac{\pi}{4}$ and OA + OB = 4, then which is/are **CORRECT** ?

A) Area of triangle AOB cannot exceed $\sqrt{2}$ sq. unit

B) The length of altitude drawn from vertex C to the opposite base is $\sqrt{2}$ units.

C) OC = 2 unit

D) $AC > \left(2\sqrt{2}-1\right)$

SECTION-2(Maximum Marks: 45)
NUMERICAL VALUE

This section contains **FOUR (04)** questions. The answer to each question is a **NUMERICAL VALUE**, For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. 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: (e.g. 0004.32, 003.43, 6.23, 7.00, -0.33, -.30, 30.27, -127.30, -1234.50).
Full Marks: +3 If **ONLY** the correct numerical value is entered; Zero Marks: 0 In all other cases.

7. Consider the set of odd integers S = {1,3,5,7,9,11,13,15,17,19,21}.Let P(S) denote the set of subsets of S. Let $T \in P(S)$, we define R_T be the sum of elements of T and $K = \sum_{T \in P(S)} R_T$. The value of $\left[\frac{K}{121}\right]$ is _____([.] denotes GIF)

8. For any acute angled triangle ABC, Let M denotes the maximum value of $\frac{\sin A}{A}+\frac{\sin B}{B}+\frac{\sin C}{C}$, (A, B, C are angles of triangle) then greatest integer less than or equal to $\frac{2\pi M}{3}$ is

9. If z is a complex number such that $|z|=1$, then the square of the maximum value of $\left|z^4+z^3-2z^2i+z+1\right|$ is

10. Two circles touch the x–axis and the line y = mx. They meet at (9, 6) and at one more point and the product of their radii is $\frac{117}{2}$ then value of m^2 is _____

SECTION-3(Maximum Marks: 15)
NON-NEGATIVE INTEGER ANSWER TYPE

This section contains **FIVE (05)** 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 : +3 If ONLY the correct integer is entered;
Zero Marks: 0 In all other cases.

11. The number of solution(s) of the equation $e^{\int_0^{\infty} \frac{t\,dx}{\left(x+x^{2023}\right)\left(x+\frac{1}{x}\right)}} = \int_0^t xe^{t^2-x^2}\,dx$ is equal to

12. If $x_1 < x_2 < x_3$ are the three real roots for the equation $\sqrt{2023}\,x^3 - 4047\,x^2 + 2 = 0$. Then the value of $x_2\left(x_1 + x_3\right)$ is ____

13. Consider a parabola $y^2 = \sqrt{2}x$. From a point where its directrix intersects the line $2\sqrt{2}x - \sqrt{2}y + 3 = 0$, a normal to the parabola is drawn, meeting the parabola at M (foot of normal) and N. R is point of intersection of tangent at M and chord ON produced (O is origin). If angle $\angle MRN$ is θ then value of $\left|\tan\theta\right|$ is

14. Consider a cubic function $f(x) = ax^3 + bx^2 + cx + 4, a,b,c \in R$ 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 $y = \frac{5x}{3} + \frac{100}{27}$.

The value of (a + b + c) is equal to _____

15. Let $L_1 : x = y = z$

$L_2 : x - 1 = y - 2 = z - 3$ be two lines.

Let from origin O(0, 0, 0) on L_1, perpendicular is drawn to L_2 has foot A. Segment OA is rotated about O by an angle 90^0 such that L_2 moves along with it, without changing its direction and becomes L_3. A becomes B (α,β,γ) then $\alpha + \beta + \gamma$ is equal to _____

SECTION-4(Maximum Marks: 15)
NUMERICAL VALUE WITH PARAGRAPH

This section contains TWO (02) paragraphs. Based on each paragraph has 2 or 3 questions. (2 Paragraph- 2 + 3 = 5Q or 3+2=5Q)
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. (e.g. 0004.32, 003.43, 6.23, 7.00, -0.33, -.30, 30.27, -127.30, -1234.50).
Answer to each question will be evaluated according to the following marking scheme:
Full Marks: +3 If ONLY the correct numerical value is entered at the designated place;
Zero Marks:0 in all other cases

Paragraph-I

Let A and B are square matrices of order 2 with real elements such that

$AB = A^2B^2 - (AB)^2$ and det (B) = 3.

16. The value of det (A+3B) – det (B+3A) is equal to _____

17. The value of det (A – 5B) – det (B – 5A) is equal to _____

Paragraph-II

Consider the functions $f(x) : R \to R$ and $g(x) : R \to R$ such that

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

18. Minimum distance between y = f (x) and y = g (x) is of the form $\frac{a}{b\sqrt{c}}$ units

(a, b & c are natural numbers satisfying GCD(a, b) =1 and c is prime). The least value of a + b + c is equal to _____

19. A tangent parallel to y = g(x) is drawn to the curve y = f(x) such that the tangent cuts the coordinate axes at A and B, the area of the triangle OAB is (where O is the origin) R square units, then the value of 144R is _____

20. Minimum distance between y = f (x) and x = f (y) is of the form $\frac{a}{b\sqrt{c}}$ units

(a, b & c are natural numbers satisfying GCD(a, b) =1 and c is prime). The least value of a + b + c is equal to _____

PHYSICS

Max. Marks: 66

SECTION-1(Maximum Marks: 24)

MULTIPLE CORRECT

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).
Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

21. A gas of hydrogen like atoms can absorb radiations of 68 eV. Consequently, the atoms emit radiations of only three different wavelength. All the wave lengths are equal or smaller than that of the absorbed photon. Then choose the correct statement(s)

(hc = 12400 eV-$\overset{0}{A}$

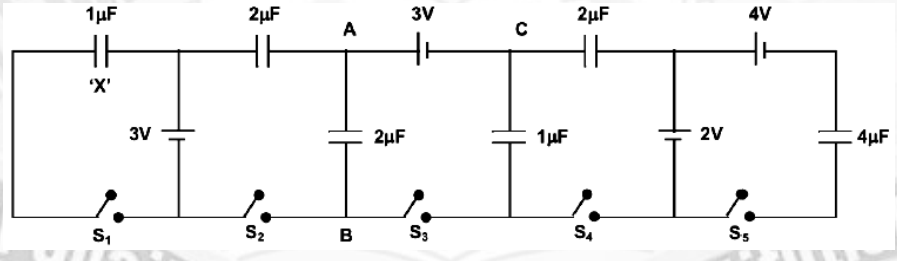
A) The lionization energy of the atoms is 489.6 eV.

B) The atomic number of atoms is 6.

C) The minimum wavelength of emitted radiation is 28.49 $\overset{0}{A}$

D) Initially the atom was in first excited state.

22. Six capacitors and four ideal batteries are connected in a circuit as shown in the figure. Initially all capacitors are uncharged and all switches were open. Now, all switches are closed simultaneously. Which of the following statement(s) is/are correct for the circuit shown in figure?



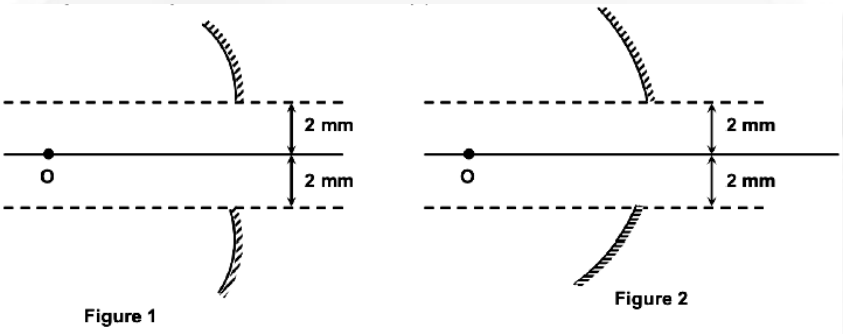
A) Work done by 4V battery is $8\mu J$.

B) The potential difference between point A and B is $\frac{19}{7}V$.

C) Charge flow by 3V battery from 'C' to 'A' is $\frac{32}{7}\mu C$.

D) Charge stored in capacitor 'X' is $3\mu C$.

23. A concave mirror forms real image of a point object 'O' lying on the optical axis at a distance of 60 cm from the pole of mirror. The focal length of mirror is 30 cm. Now, the mirror is cut into two halves symmetrically. In figure-1 both halves are shifted at a distance of 2 mm apart in a direction perpendicular to the optical axis. In figure-2 both halves are rotated about 'O' with reference to original position. Let I_1 and I_2 are the image formed by both halves in both figure. Charge the correct statement(s).



A) In figure-2 I_1 and I_2 are coincide.

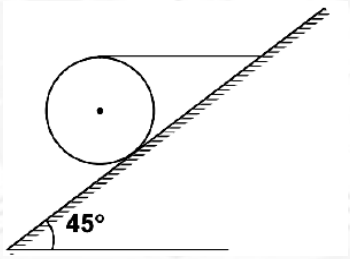
B) In figure-1 I_1 and I_2 are separated.

C) In figure-1, the distance between I_1 and I_2 is 8 mm.

D) In figure-2 the distance between I_1 and I_2 is 4 mm.

24. A sphere of mass 10 kg is kept stationary on a rough inclined plane as shown in figure. String is massless and inextensible. At equilibrium string remains horizontal.

Choose correct statement(s): $\left(g = 10ms^{-2}\right)$



A) Tension in string is $\left(\frac{100}{\sqrt{2}+1}\right)N$

B) Friction force acting on sphere is $\left(\frac{100}{\sqrt{2}+1}\right)N$

C) Minimum value of coefficient of friction for equilibrium is 1

D) Normal reaction between sphere and inclination is $50\sqrt{2}N$.

25. Electrons having de-Broglie wave length λ are incident on target in X-ray tube. Minimum wavelength of X-rays generated is λ_1. Then choose INCORRECT statement(s).

A) If λ is increased the value of λ_1 decreases.

B) If λ is increased the value of λ_1 increases.

C) The value of λ_1 will not change if target metal is changed.

D) The value of λ_1 does not depend on λ.

26. Two waves having same wavelength λ in vaccum are in phase initially. First wave travels a path length L_1 in medium of refractive index n_1 and second wave travels path length L_2 in medium of refractive index n_2. They are now combined in vaccum. Based on above information choose correct option(s).

A) Phase difference between waves after combination is $\frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$.

B) Frequency of both waves remains unchanged when they travel through different medium.

C) Phase difference between waves after combination is $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1} - \frac{L_2}{n_2}\right)$

D) Frequency of wave in medium with more refractive index will be more.

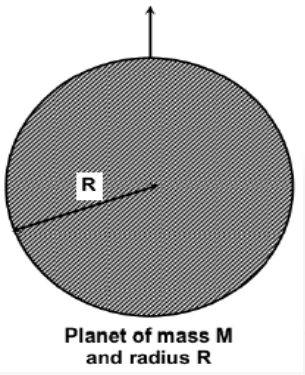
SECTION-2(Maximum Marks: 12)

NUMERICAL VALUE

This section contains **FOUR (04)** questions. The answer to each question is a **NUMERICAL VALUE,** For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. 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: (e.g. 0004.32, 003.43, 6.23, 7.00, - 0.33, - .30, 30.27, - 127.30, -1234.50).

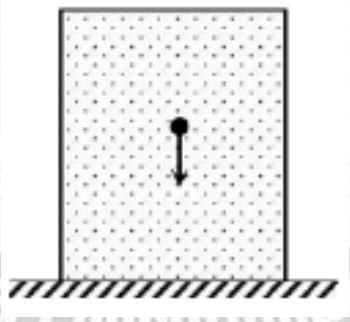
Full Marks: +3 If **ONLY** the correct numerical value is entered; Zero Marks: 0 In all other cases.

27. A small body of mass 'm' is projected from the surface of a given planet as shown in the figure. If small body has velocity which is just sufficient to get out from the gravity of planet then time taken by small body to reach a height of 3R from the surface of planet is $K\sqrt{\frac{2R^3}{GM}}$, find K = ?



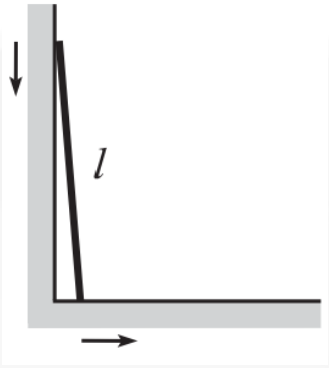
28. A screw gauge is used to measure the thickness of a thin sheet of copper. The pitch of screw gauge is 0.2 mm and total number of division on circular scale is 200. When two jaws are brought in contact then 160^{th} division of circular scale is exactly coincide with the main scale line, and that the zero of main scale is barely visible. When thickness of sheet is measured with screw gauge then main scale reading is 0.6mm and 100^{th} division coincide with the main scale line. Find the thickness of copper sheet in mm.

29. A dense liquid is completely filled in a closed large container and kept at rest on a horizontal surface. A steel ball is moving downward with a constant speed of 0.5 cm/sec. Find the momentum of dense liquid in C.G.S unit, if its density is 3 gm/cm^3. Given that volume is steel ball of $1.5cm^3$.



30. A ladder of length ℓ and uniform mass density stands on a frictionless floor and leans against a frictionless wall. It is initially held motionless, with its bottom end an infinitesimal distance from the wall. It is then released, whereupon the bottom end slides away from the wall, and the top end slides down the wall. When it loses contact with the

wall, what is the horizontal component of the velocity of the center of mass? If it is $\sqrt{g\ell/n}$ find n = ?

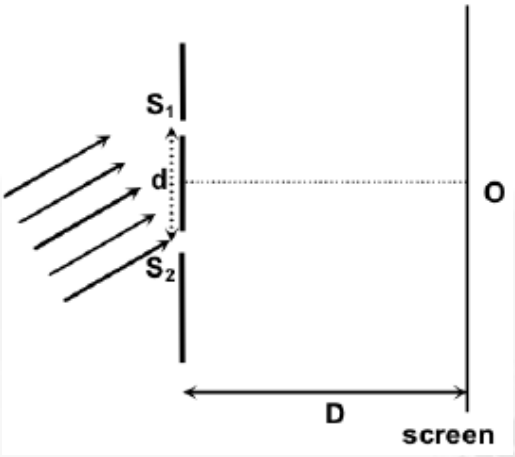


SECTION-3(Maximum Marks: 15)

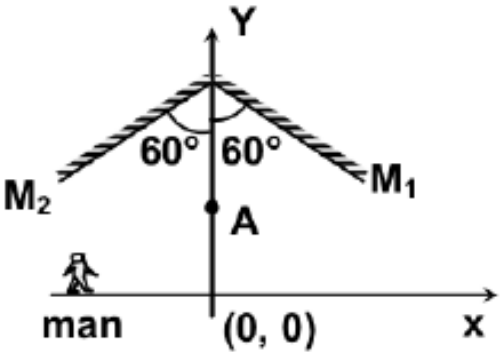
NON-NEGATIVE INTEGER ANSWER TYPE

This section contains **FIVE (05)** 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 : +3 If ONLY the correct integer is entered;
Zero Marks: 0 In all other cases.

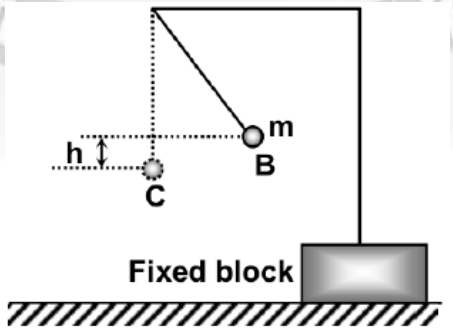
31. A monochromatic light of wavelength λ_0 and intensity I_0 is incident on YDSE experiment. The distance between slits S_1S_2 is 'd' (d <<D). The angle made by parallel beam light with the normal to the plane of slits in $\sin^{-1}\left(\frac{3\lambda}{2d}\right)$. Now, if a transparent glass slab of thickness $\frac{3\lambda}{2(\mu-1)}$ is kept infront of one of the slits, where 'μ' is refractive index of glass slab. Find the intensity (in W/m^2) at the geometrical centre 'O' of the screen. (Given, d = 1mm, D = 2m, $\mu=\frac{4}{3}, \lambda = 400\,\overset{0}{A}$ and $I_0 = 4.00\,W/m^2$). If intensity is I, find $\frac{I}{4}=?$



32. Two large plane mirrors M_1 and M_2 are kept at an angle of 120^0 as shown in figure. The coordinates of intersection of plane mirror is (0, 2 meter). A man moves along x-axis. Find the length ℓ (in meter) on x-axis for which man can see image of point A formed by mirrors. (Height of man is negligible). If ℓ is $4\sqrt{x}$, find x = ?

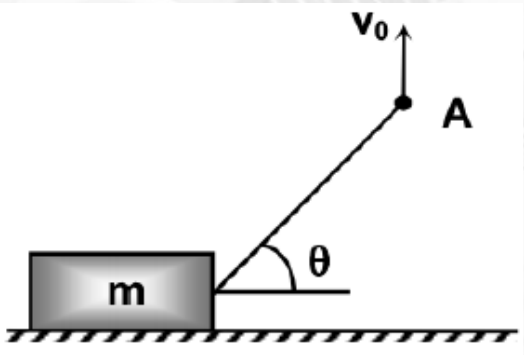


33. A small positively charged ball B of mass m is suspended by an insulating thread of negligible mass. Another positively charged small ball C is moved slowly from a large distance until it is in the original position of the first ball. As a result the ball B rises by h. How much work (in joule) has been done by the agent moving the charge C? (Given m = 1kg, $g = 10 m/s^2$ and h = 10 cm)



34. A pipe P open at one end and closed at the other end is filled with hydrogen gas at temperature 27^0C. An another pipe Q is filled with a mixture of gases consisting of 1 mole of helium and 1 moles of oxygen gases at temperature 77^0C. Then length of the pipe Q is $\sqrt{5}$ times the length of pipe P and it is open at both ends. The air column in pipe P is vibrating in first overtone and the air column in pipe Q is vibrating in second overtone. If the ratio of the frequencies of vibrations of air column in pipes P and Q is n : 1, find the value of n.

35. A block of mass m = 1kg is placed on a frictionless horizontal surface. One end of a massless string of length 0.8 m is connected to the block. The string is straight and the other end of the string is moved vertically up with constant velocity v_0. When the string makes an angle $\theta = 30^0$ with the horizontal surface the block leaves the surface. Find the speed v_0(in m/s) (given g = 10 m/s^2)

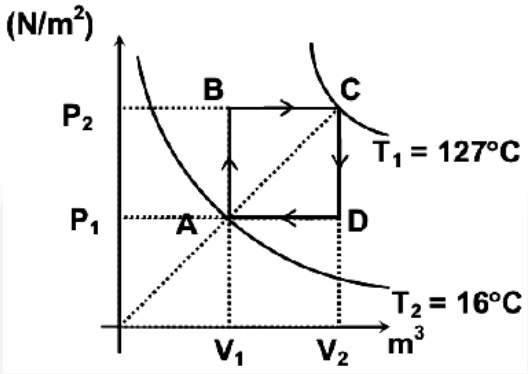


SECTION-4(Maximum Marks: 15)
NUMERICAL VALUE WITH PARAGRAPH

This section contains TWO (02) paragraphs. Based on each paragraph has 2 or 3 questions. (2 Paragraph- 2 + 3 = 5Q or 3+2=5Q)
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/roundoff** the value to **TWO** decimal places. (e.g. 0004.32, 003.43, 6.23, 7.00, - 0.33, - .30, 30.27, - 127.30, -1234.50).
Answer to each question will be evaluated according to the following marking scheme:
Full Marks: +3 If ONLY the correct numerical value is entered at the designated place;
Zero Marks:0 in all other cases

Paragraph-I

Between two isotherms, a cyclic process ABCDA is performed with one mole of ideal mono-atomic gas. If the work done by the gas in one complete cycle is X Joule and temperature of gas at state B is $T_B = Y$ Kelvin. (Take gas constant R = 8.31 $Jmol^{-1}K^{-1}$)

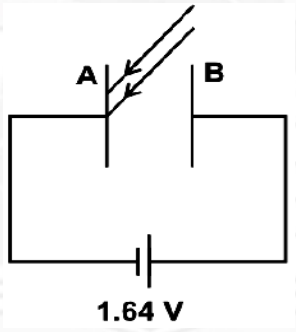


36. The value of X is …….

37. The value of Y is …….

Paragraph-II

In the arrangement shown in the figure, light of wavelength 500 nm is incident on plate A of a parallel plate capacitor. The emitted photoelectrons from plate A are accelerated by a potential difference of 1.64 V. These electrons strike the another plate B from which electromagnetic radiations are emitted. The minimum wavelength of emitted photons is 620 nm. The work function of the metal is X eV and the maximum kinetic energy of photoelectrons emitted from metal A is Y eV. (Given hc = 1240 eV – nm)



38. The value of X is ……..

39. The value of Y is ……..

40. Minimum De-Broglie wavelength of photo-electrons emitted from plate A_____ (in A^0)

CHEMISTRY

Max. Marks: 66

SECTION-1(Maximum Marks: 24)

MULTIPLE CORRECT

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).
Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

41. Consider the following three anions

$$\underset{X}{HC\equiv\overline{C}} \qquad \underset{Y}{CH_3-C\equiv\overline{C}} \qquad \underset{Z}{CH_3-C\equiv C-\overline{C}H_2}$$

HX, HY and HZ are conjugate acids of X,Y and Z respectively

Choose the correct statement(s)

A) $\left|p^{Ka}(HX)-p^{Ka}(HY)\right|<\left|p^{Ka}(HY)-p^{Ka}(HZ)\right|$

B) HY on warming with mercury (II) sulphate and dilute sulphuric acid at 333K forms a ketone that has lower boiling point than propan-1-ol

C) In each molecule of HX, HY are HZ, there and two mutually particular nodal planes, for π bonds and each nodal plane is perpendicular to molecular axis.

D) HZ is more stable than HY.

42. Observe the following two reactions

$$SiH_3Cl+(SiH_3)_2NH \xrightarrow[yield]{100\%} X \xrightarrow{NH_3} Y+NH_4Cl\,.$$

$$3CH_3Cl+NH_3 \xrightarrow{100\%\,yield} S \xrightarrow[(ii)\,distillation\ to\ separate\ organic\ compound]{(i)\ neutralised\ with\ sufficient\ NaOH} P+Q_{(aq)}$$

$$\underset{organic\ compound}{P} \xrightarrow{CH_3COOH} Z$$

$$Q_{(aq)} \xrightarrow{AgNO_3(aq)} \underset{white\ ppt}{AgCl}$$

Select the correct statement(s)

A) 'P' has pyramidal geometry around nitrogen atom

B) All atoms of molecule Y can be on the same plane

C) 'P' is more basic than Y

D) Z contains $-\overset{O}{\overset{\|}{C}}-N-$ linkage

43. Which of the following combinations or processes leads to formation of a paramagnetic species?

A) Electrolysis of very dilute sodium chloride solution

B) Reaction between 2-ethyl anthraquinol and dioxygen (O_2)

C) Heating of Galena with conc HNO_3

D) Potassium in water at room temperature

44. Consider one mole of a real gas **A**, with equation of state P(V –b) = RT where 'b' is a constant. Which of the following is/are correct statement(s) about **A**?

P = pressure, V=volume, T-temperature in Kelvin R = 8.314J $K\,mol^{-1}$

A) Density of **A** is less than ideal gas $\forall$ P > 0

B) Potential energy of **A,** due intermolecular forces, is either greater than (or) equal to that of ideal gas

C) If 5J of heat is given to **A**, and 2J work is done by the **A** then, its internal energy increases by 3J which is true for ideal gas also

D) Compressibility factor (Z) of **A** is directly proportional to 'P'.

45. Which of the following statement(s) is/are true?

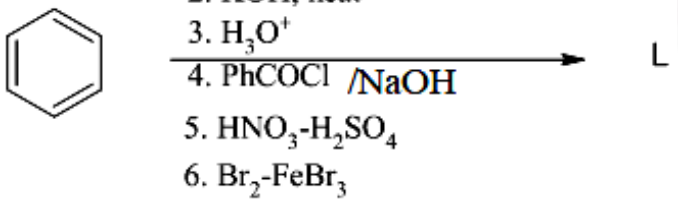
A) polyhydroxy aldehydes and ketones cannot be obtained by hydrolysis of glucose

B) Gluconic acid is obtained by oxidation of saccharic acid with conc. HNO_3

C) When cellucose is treated with acetic anhydride, maximum number of acetyl groups per pyranose ring is 3 (excluding terminal units)

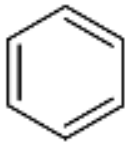
D) (+) – Glucose exists as a pair of anomers where each anomer is a six membered cyclic acetal

46. Consider the following reactions (a), (b) and (c)



a)

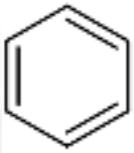
b)



1. $CH_3Cl/AlCl_{3(anhy)}$
2. HNO_3-H_2SO_4
3. $KMnO_4$- NaOH, Heat
4. H_3O^+
5. PhOH, H^+,H_2O
6. Br_2-$FeBr_3$

→ M

c)



1. HNO_3-H_2SO_4
2. Br_2-$FeBr_3$
3. Zn-HCl
4. $NaNO_2$-HCl
5. H_2O, boil
6. PhCOCl /NaOH
7. HNO_3-H_2SO_4

→ N

L, M and N are mono nitro compounds and major products of that given reaction series.

Select the correct statement(s)

A) L and M are structural isomers.

B) L and N are identical.

C) L and N are esters of same carboxylic acids.

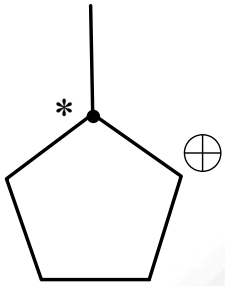
D) M and N are identical

SECTION-2(Maximum Marks: 12)

NUMERICAL VALUE

This section contains **FOUR (04)** questions. The answer to each question is a **NUMERICAL VALUE,** For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. 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: (e.g. 0004.32, 003.43, 6.23, 7.00, -0.33, -.30, 30.27, -127.30, -1234.50).
Full Marks: +3 If **ONLY** the correct numerical value is entered; Zero Marks: 0 In all other cases.

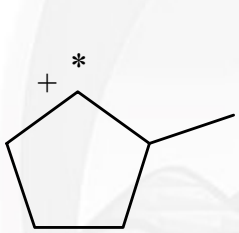
47. Following carbocation undergoes either methyl shift with rate constant (K_2) (or) hydride shift with rate constant (K_1) from same carbon at 300K. Both elementary reactions follow Arrhenius equation and have same pre-exponential factor



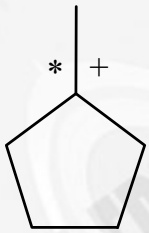
*labeled carbon represents radioactive carbon from which methyl or hydride shift occurs

If $K_1 = \frac{1}{16}K_2$, then find (a – b) in units of K. cal/mol

where 'a' and 'b' represent energy of activation (k. cal/mol) for formation of



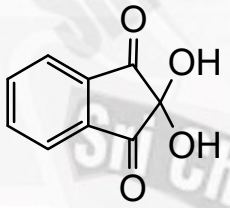
and



from given cation respectively.

$R = 2\ cal\ mol^{-1}\ K^{-1}$ $\log_e 2 = 0.70$

48. Ninhydrin is a powerful oxidizing agent, and reacts with amino acids to form purple compound. This is used to identify spots in TLC in the separation of mixture of amino acids.



Ninhydrin

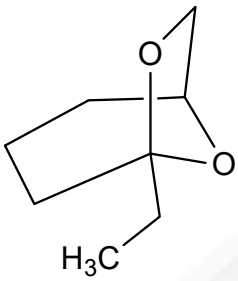
+ valine $\longrightarrow$ X (purple colour compound) + Y (Decarboxylated & deaminated form) + CO_2 + H_3O^+

(Oxidation state of carbon is '+1' that connected to oxygen atom in **Y**)

a = Total number of nitrogen atoms in 'X'

b = total number of structural isomers of 'Y' in which oxidation state of carbon, connected to oxygen atom, is +1(excluding Y)

Report (a + b)



7.10 g

$$\xrightarrow[\begin{array}{l}2.CH_3COCl(2eq)\\3.NaBH_4\\4.H_2SO_4,heat\\5.\ (i)O_3\ (ii)\ Zn\text{-}H_2O\end{array}]{1.H_3O^+} Z \quad + \quad P$$

P

$$\xrightarrow[\begin{array}{l}2.\ SOCl_2\\3.\ Zn,\ heat\\4.\ LiAlH_4\\5.\ PBr_3\end{array}]{1.\ H_3O^+} \underset{\text{Organic compound}}{R}$$

49. Z has lower molecular mass than P (aliphatic compound) and does not give iodoform test.

Mass of R (in grams) is……

All reactions are assumed to proceeded with 100 % yield.

C =12u, Br = 80u, O =16u, H =1u

50. What is the emf of the following cell (in volt)?

$$Cu_{(s)}\left|Cu^{+2}_{(aq,2M)}\right\|Zn^{+2}_{(aq,2M)}\left|Zn_{(s)}\right.$$

Given

$$Pt_{(s)}\left|H_{2(g)}(1bar)\right|H^{+}_{(aq,2M)}\left|Cu^{+2}_{(aq,1M)}\right|Cu_{(s)}\ E=+0.322V$$

$$Pt_{(s)}\left|H_{2(g)}(1bar)\right\|H^{+}_{aq,1M}\left\|Zn^{+2}_{aq(1M)}\right|Zn_{(s)}\ E=-0.760V$$

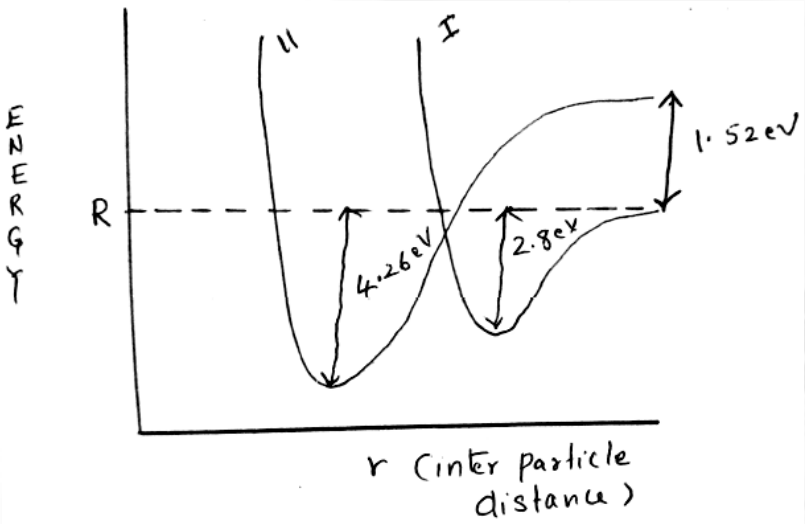
$$\frac{RT}{F}=0.06 \quad \log 2=0.30$$

SECTION-3(Maximum Marks: 15)

NON-NEGATIVE INTEGER ANSWER TYPE

This section contains **FIVE (05)** 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 : +3 If ONLY the correct integer is entered;
Zero Marks: 0 In all other cases.

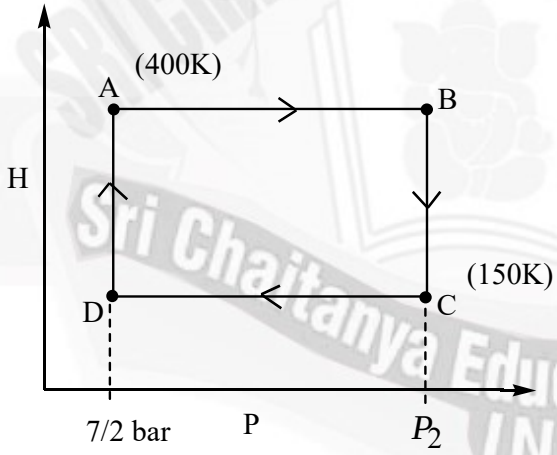
51. Curve I and II represent formation of sodium chloride either as covalent molecule from neutral isolated atoms of sodium and chlorine or as ionic from isolated gaseous sodium and chloride ions



R = Reference energy set as '0' (for isolated Na & Cl atoms)

What is the absolute electron gain enthalpy of gaseous uni positive sodium ion (per ion in eV), if electron affinity of isolated chlorine atom is 3.62 eV? Give your value to nearest integer

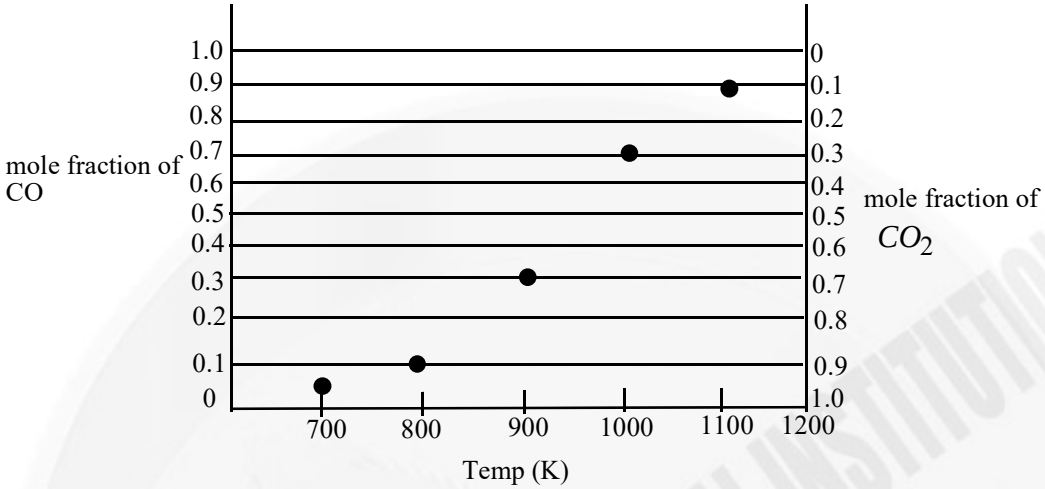
52.



In the given enthalpy (H) vs pressure (P) graph for reversible process ABCDA (1 mol of ideal gas) if $\left|2\Delta S_{A\to B}+\Delta S_{C\to D}\right|=1.4 cal/K$ then find 'P_2' in bar

R = 2 cal/K.mol and $ln\,2 = 0.7$

53.

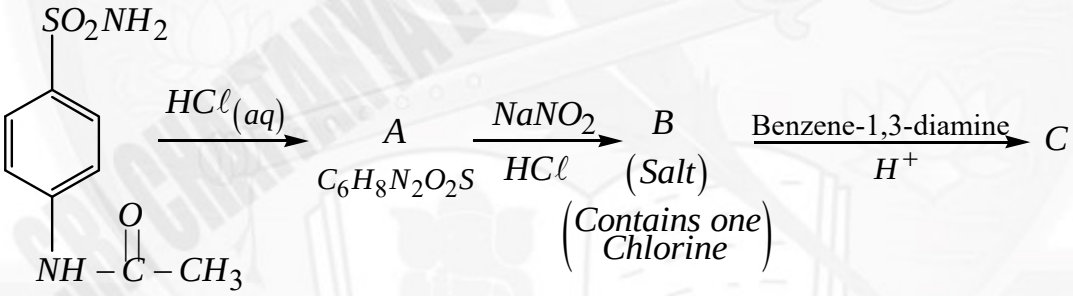


Consider the following equilibrium

$C_{(s)} + CO_{2(g)} \rightleftharpoons 2CO_{(g)}$

Above diagram shows temperature dependence of the composition of equilibrium mixture at P = 1 bar. What is the K_p of reaction at 827^0C ? Given: $\left(0^0C = 273K\right)$

Report your value to nearest integer.



54. Total number of hetero atoms in compound 'C' is (Hetero atoms are other than carbon and hydrogen).

55. When one mole of Chromite ore is fused with sodium carbonate in free access to air, how many moles of carbon dioxide gas is produced?

SECTION-4(Maximum Marks: 15)

NUMERICAL VALUE WITH PARAGRAPH

This section contains TWO (02) paragraphs. Based on each paragraph has 2 or 3 questions. (2 Paragraph- 2 + 3 = 5Q or 3+2=5Q)
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. (e.g. 0004.32, 003.43, 6.23, 7.00, -0.33, -.30, 30.27, -127.30, -1234.50).
Answer to each question will be evaluated according to the following marking scheme:
Full Marks: +3 If ONLY the correct numerical value is entered at the designated place;
Zero Marks:0 in all other cases

Paragraph-I

Magnetic moment of the complex ion due to central metal ion is a combination of electron(s) spin and orbital interactions.

Following is the list of some complex ions with magnetic moment (in BM) given immediately after formula of complex ion or complex

List :

$K_4\left[Mn(CN)_6\right]$	2.2
$\left[Fe(H_2O)_6\right]^{2+}$	5.3
$K_2\left[MnCl_4\right]$	5.9

Answer the following questions based on magnetic properties of 3d-transition metal ions and their complexes.

56. What is the spin only magnetic moment (in BM) of a divalent ion in aqueous solution if its atomic number is 24? Report the value to nearest integer.

57. Sum of number of 3d-orbitals which are involved in hybridisation, in all central metal ions in their respective complexes as given in the list, is…….

Paragraph-II

Compound **A** shows the following reactions:

(i) It evolved di- hydrogen gas with potassium.

(ii) When reacted with HCl and $ZnCl_2$ mixture, turbidity due to compound J appears immediately.

Compound **A**, was passed over alumina at 350^0C to give a compound **B**. Compound **B** on reductive ozonolysis gave two neutral compounds **C** and **D**. Only Compound **C** gave a positive test with Fehling's solution, but **D** did not give positive test with Fehling's solution. When 8.8 mg of compound **A** is dissolved in 0.50 g of camphor the melting

point of the camphor is lowered by 8 K where **A** neither under does association nor dissociation.

K_f (camphor) =40 K mol^{-1} Kg

Compound A contains approximately 68.18% carbon, 13.16% hydrogen and remaining oxygen.

Atomic mass: C = 12u, H = 1u, O = 16u, Cl=35.5u

58. How much amount of compound D, in grams, can be formed by using all the carbon in the 0.5 mole of compound C?

59. To form a monolayer, over water in a cubic vessel, 10.65 mg of **J** (Effective area of each molecule is 0.15 nm^2) are required. The number of Unit cells of an ionic solid AB with rock salt structure can be packed in such an empty cube is 10^y. What is the value of y? (Radius of cation is 0.50 pm and anion is 1.00 pm)

$$1\text{amu} = \frac{1}{6\times10^{23}} = \frac{1}{Avogadro\ \ constant}$$

60. When compound B is mono-brominated with NBS, how many different isomers (including stereo isomers) are formed? Consider only Allylic bromination.

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