



# Sri Chaitanya IIT Academy.,India.

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ICON Central Office - Madhapur - Hyderabad

Sec: **Sr.Super60\_NUCLEUS & STERLING\_BT**

**Paper -1(Adv-2020-P1-Model)**

**Date: 17-09-2023**

**Time: 09.00Am to 12.00Pm**

**RPTA-07**

**Max. Marks: 198**

**17-09-2023\_Sr.Super60\_NUCLEUS&STERLING\_BT\_Jee-Adv(2020-P1)\_RPTA-07\_Syllabus**

## PHYSICS

: Rigid body Dynamics 1 : Rigid body, moment of inertia, parallel and perpendicular axes theorems, moment of inertia of uniform bodies with simple geometrical shapes; Angular momentum; Torque; Dynamics of rigid bodies with fixed axis of rotation; Rolling without slipping of rings, cylinders and spheres; Equilibrium of rigid bodies

## CHEMISTRY

: Biomolecules, Polymers, Chemistry in Everyday Life & POC:

Biomolecules: Carbohydrates: Classification; Mono- and di-saccharides (glucose and sucrose); Oxidation; Reduction; Glycoside formation and hydrolysis of disaccharides (sucrose, maltose, lactose); Anomers. Proteins: Amino acids; Peptide linkage; Structure of peptides (primary and secondary); Types of proteins (fibrous and globular). Isoelectric pH Nucleic acids: Chemical composition and structure of DNA and RNA, Vitamins

Polymers: Types of polymerization (addition, condensation); Homo and copolymers; Natural rubber; Cellulose; Nylon; Teflon; Bakelite; PVC; polythene, synthetic rubber, Bio-degradable polymers; Applications of polymers. Chemistry in Everyday Life: Drug-target interaction; Therapeutic action, and examples (excluding structures), of antacids, antihistamines, tranquilizers, analgesics, antimicrobials, and antifertility drugs; Artificial sweeteners (names only); Soaps, detergents, and cleansing action.

POC: Detection of elements (N, S, halogens); Detection and identification of the following functional groups: hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl, amino and nitro. Separation of Binary mixture, Purification and characterization of organic compounds.

## MATHEMATICS

: Total Integral Calculus

Name of the Student: \_\_\_\_\_

H.T. NO:

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**JEE-ADVANCE-2020-P1-Model**

Time: 3:00Hour's

**IMPORTANT INSTRUCTIONS**

Max Marks: 198

**PHYSICS:**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total mark
Sec – I(Q.N : 1 – 6)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 7 – 12)	<b>Questions with Multiple Correct Choice +1 partial marks</b>	4	-2	6	24
Sec – III(Q.N : 13 – 18)	Questions with Numerical Value Answer Type	4	0	6	24
<b>Total</b>				<b>18</b>	<b>66</b>

**CHEMISTRY:**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 19 – 24)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 25 – 30)	<b>Questions with Multiple Correct Choice +1 partial marks</b>	4	-2	6	24
Sec – III(Q.N : 31 – 36)	Questions with Numerical Value Answer Type	4	0	6	24
<b>Total</b>				<b>18</b>	<b>66</b>

**MATHEMATICS:**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 37 – 42)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 43 – 48)	<b>Questions with Multiple Correct Choice +1 partial marks</b>	4	-2	6	24
Sec – III(Q.N : 49 – 54)	Questions with Numerical Value Answer Type	4	0	6	24
<b>Total</b>				<b>18</b>	<b>66</b>

Sec: Sr.Super60\_ **NUCLEUS & STERLING\_BT**

Space for rough work

Page 2

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## PHYSICS

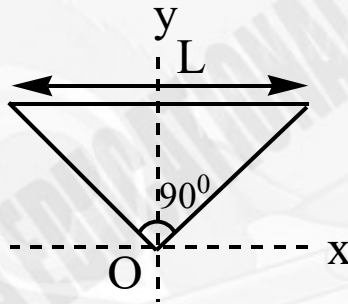
Max Marks: 66

SECTION – I  
(SINGLE CORRECT ANSWER TYPE)This section contains **SIX** (06) questions.

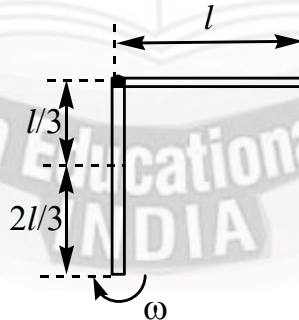
- Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated **according to the following marking scheme**:

**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

1. The figure shows a uniform isosceles triangular plate of mass  $M$  and base  $L$ . The angle at the apex is  $90^\circ$ . The apex lies at the origin and the base is parallel to  $x$ -axis. The moment of inertia of the plate about an axis parallel to  $z$ -axis and passing through  $\left(\frac{L}{2}, \frac{L}{2}, 0\right)$  is



- A)  $\frac{ML^2}{3}$       B)  $\frac{ML^2}{4}$       C)  $\frac{ML^2}{5}$       D)  $\frac{ML^2}{6}$
2. A thin uniform rod of mass  $M$  and length  $\ell$  is hinged at an end and released from rest in the horizontal position. The tension at a point located at a distance  $\ell/3$  from the hinge point will be lesser than the hinge reaction by  $\Delta T$  when the rod becomes vertical. Then  $\Delta T$  is equal to



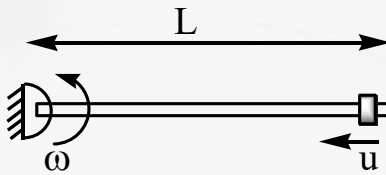
- A)  $Mg$       B)  $\frac{Mg}{4}$       C)  $\frac{Mg}{3}$       D)  $\frac{Mg}{2}$



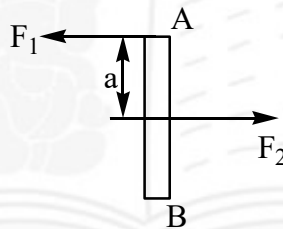




3. A small bead of mass  $M$  is launched from one end of a horizontal rod with speed  $u$  along the rod having same mass  $M$ . The rod is free to rotate in a vertical plane about the hinged end. Simultaneously the rod is given angular velocity  $\omega$  as shown in the figure. The torque on the system about the hinge immediately after imparting  $u$  and  $\omega$  is  $3Mg \frac{L}{2} + x$ . Then  $x$  is equal to

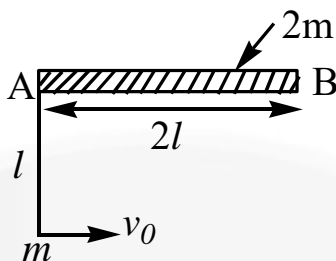


- A)  $2Mu\omega L$       B)  $-2Mu\omega L$       C)  $Mu\omega L$       D)  $-Mu\omega L$
04. A small disc is at rest at the top of a rough inclined plane. It rolls without slipping. At the bottom of the inclined plane there is a rough vertical groove of radius 'R'. In order to loop the groove, the minimum height of incline required is (Assume pure rolling on the inner cylindrical surface of groove)
- A)  $\frac{15R}{4}$       B)  $\frac{13R}{4}$       C)  $\frac{11R}{4}$       D)  $\frac{9R}{4}$
05. A thin uniform rod AB of mass  $1.0 \text{ kg}$  makes translationally motion with acceleration  $2.0 \text{ m/s}^2$  due to two anti-parallel force  $F_1$  and  $F_2$ . The distance between the point at which these forces are applied is equal to  $a = 20 \text{ cm}$ . If  $F_2 = 5.0 \text{ N}$ , find the torque of  $F_1$  about end B in  $\text{Nm}$



- A) 3      B) 4      C) 2      D) None of these
06. A uniform rod AB having mass  $2m$  and length  $2\ell$  is kept on a smooth horizontal plane. This rod is orthogonally connected to a horizontal taut string whose other end has a connected particle of mass  $m$ . If particle is given initial horizontal velocity  $v_0$ , perpendicular to string, then just after giving this velocity, the tension in the string is  $\frac{mv_0^2}{n\ell}$ . Then the value of  $n$  is





A) 1

B) 2

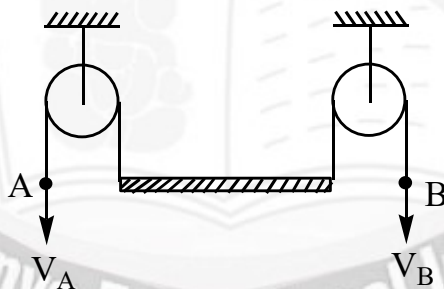
C) 3

D) 4

### SECTION – II (ONE OR MORE CORRECT ANSWER TYPE)

- This section contains **SIX** (06) questions.
- Each question has **FOUR** options. **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 none of the options is chosen (i.e. the question is unanswered);  
**Negative Marks**: -2 In all other cases

7. A thin uniform rod of mass 5kg and length 1 m is held in horizontal position with the help of strings attached to ends of rod, other ends of strings are held by some external agent. Now end A is pulled down with speed  $V_A = 3t$  and B is pulled down with speed  $V_B = t$ , where 't' is time in sec. Choose the correct choice(s) at time  $t = 0$  [Take  $g = 10 \text{ m/s}^2$ ]

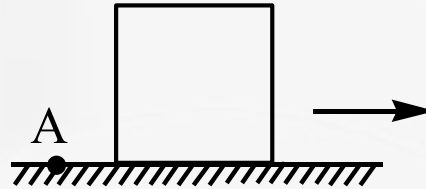


- A) Angular acceleration of rod is  $2 \text{ rad/s}^2$
- B) Angular acceleration of one end of rod wrt the other end is  $2 \text{ rad/s}^2$
- C) Instantaneous axis of rotation is at a distance of 0.5m from right end of rod
- D) Instantaneous axis of rotation is at a distance of 0.75m from right end of rod

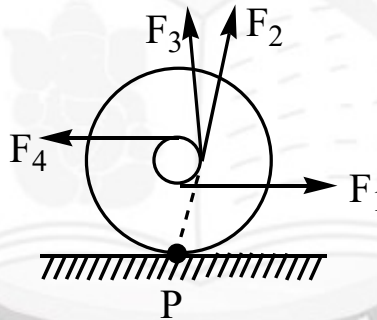




08. A block of mass 'm' moves on a horizontal rough surface with initial velocity 'v'. The height of the centre of mass of the block is 'h' from the surface. Consider torque and angular momentum about a point 'A' on the surface of sliding



- A) Torque of normal reaction is greater than the torque of gravity  
B) Angular momentum of the block decreases during sliding  
C) Torque of the forces acting on block is zero and angular momentum is constant  
D) Angular momentum depends on the moment of inertia of the block about its centre of mass
09. A spool of wire rests on a horizontal surface as shown in figure. As the wire is pulled, the spool does not slip at contact point P. On separate trials, each one of the forces  $F_1$ ,  $F_2$ ,  $F_3$  and  $F_4$  is applied to the spool. For each one of these, the frictional force on the spool will be towards



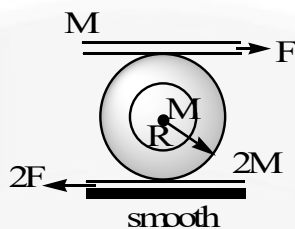
- A) Left if  $F_1$  is applied  
B) Left if  $F_2$  is applied  
C) Left when vertical force  $F_3$  is applied  
D) Right if  $F_4$  is applied



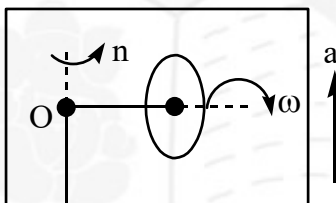




10. A solid cylinder is sandwiched between two planks. Two constant horizontal forces  $F$  and  $2F$  are applied on the planks as shown. Masses of planks and cylinder are indicated in the figure. Radius of the cylinder is  $R$ . Then

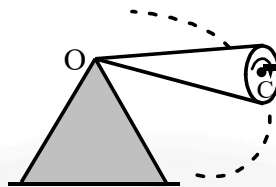


- A) the acceleration of the centre of mass of cylinder is towards right  
 B) the acceleration of the centre of mass of cylinder is towards left  
 C) frictional force on the upper plank is  $\frac{5F}{26}$   
 D) frictional force on the lower plank is  $\frac{5F}{26}$
11. Consider a gyroscope, in which a uniform disc of radius  $R = 5.0 \text{ cm}$  at the end of a light rod of length  $l = 10 \text{ cm}$  is mounted on the floor of an elevator going up with a constant acceleration  $a = 6 \text{ m/s}^2$ . The other end of the rod is hinged at O. Plane of the disc is perpendicular to rod. Let mass of the disc is 200 grams and mass of rod and friction are to be neglected. The disc has angular velocity  $\omega$  about the rod, and the rod-disc system (gyroscope) is precessing about vertical axis passing through O at rate  $n = 0.5 \text{ rps}$ . Then  
 [Take  $g = 9.8 \text{ m/s}^2$ ]



- A)  $\omega = 400 \text{ rad/s}$  approximately  
 B)  $n$  is proportional to  $\ell$   
 C) Rate of change of  $\omega$  vector is proportional to torque about O  
 D) Precession frequency decreases when torque about O increases
12. A round cone with half-angle  $\alpha = 45^\circ$  and the radius of the base  $R = 10 \text{ cm}$  rolls uniformly without slipping over horizontal plane. The apex is hinged at the point O (see figure) which is at the same level as the point C, the centre of the base. The velocity of the point C is  $v = 10 \text{ ms}^{-1}$



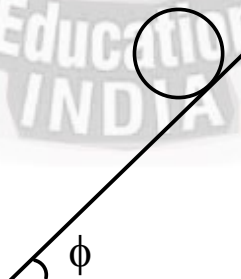


- A) The angular velocity vector of cone about O has magnitude  $100 \text{ rad/s}$   
 B) The angular velocity vector of cone about O has magnitude  $100\sqrt{2} \text{ rad/s}$   
 C) The angle made by this angular velocity vector with vertical is  $45^\circ$   
 D) The direction of this angular velocity vector about O is constant

**SECTION – III**  
**(NUMERICAL VALUE TYPE)**

- This section contains **SIX** (06) 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.
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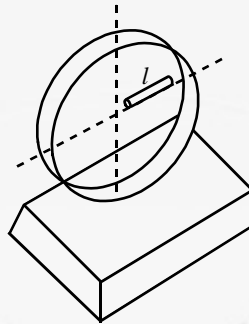
13. A particle of mass 'm' is projected with an initial velocity  $u$  at an angle  $\theta$  to horizontal. The maximum rate of change of angular momentum during its flight above horizontal surface about the point of projection is  $K m u^2 \sin 2\theta$ . The value of  $K$  is \_\_\_\_
14. A cubical block of mass  $M$  and edge  $a$  slides down a rough inclined plane of inclination  $\theta$  with a uniform velocity. The maximum torque of the normal force on the block about any point on the contact surface has a magnitude of  $K Mga(\sin \theta + \cos \theta)$ . The value of  $k$  is \_\_\_\_
15. A hollow sphere of mass  $100\text{g}$  is released from the top of an inclined plane of inclination  $\phi (= 45^\circ)$  and height  $h (= 8 \text{ m})$ . The coefficient of friction between the plane and the sphere is  $0.2$ . The work done (in J) by the force of friction as the sphere rolls down the inclined plane is  $w_1$  in rotation about centre of mass and  $w_2$  in translation of centre of mass. Find the value of  $w_1 - w_2$  ( $g = 10 \text{ m/s}^2$ )



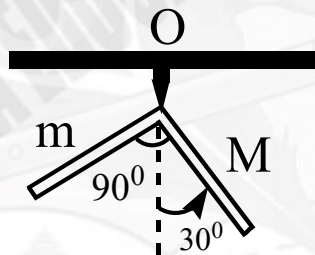




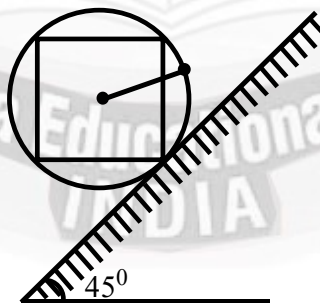
16. A uniform slender rod of length  $l$  and mass  $m$  is rigidly attached to a circular hoop of radius  $l$  as shown. The mass of the hoop is negligible. If the rod and hoop are released from rest on a fixed horizontal surface in the position illustrated, the initial value of normal reaction by the horizontal surface is  $nmg$  (friction is sufficient to prevent slipping). Find the value of  $n$ .



17. Two uniform rods of equal lengths but different masses are rigidly joined to form an L-shaped body, which is then pivoted as shown. If in equilibrium the body is in the shown configuration, ratio  $\left(\frac{m}{M}\right)$  will be  $\sqrt{x}$ . The value of  $x$  is \_\_\_\_\_



18. Four identical rods, each of mass  $m$  are welded at their ends to form a square and the corners are then welded to a metal hoop of radius  $r$  and mass  $m$ . The rigid assembly of rods and hoop is allowed to roll down the inclined rough surface. If the minimum value of the coefficient of static friction which will prevent slipping is  $k/10$ . Find the value of  $k$

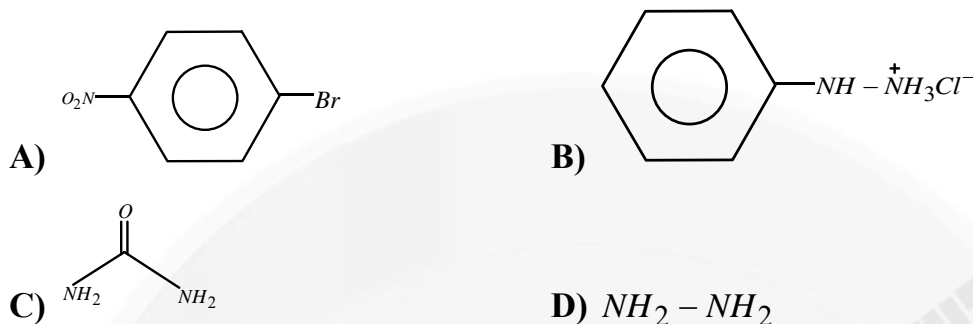


**Negative Marks:** -1 In all other cases

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24. Which of the following molecules do not give positive Lassaigne's test



**SECTION – II**  
**(ONE OR MORE CORRECT ANSWER TYPE)**

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25. Which of the following are addition polymers.

- A) HDPE      B) LDPE      C) Natural Rubber      D) PVC

26. Select the correct statements from the following

A) Natural Rubber is branched polymer of 2 – methyl – 1, 3 – butadiene

B) Density of HDPE is high due to close packing

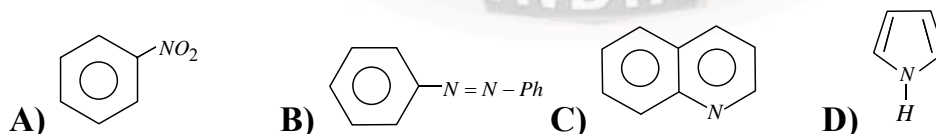
C) Bakelite formation starts with the initial formation of o and or p – hydroxymethyl phenol derivatives.

D) Nylon 2 – nylon 6 is an alternating polymer of glycine and aminocaproic acid.

27. Which of the following are bacteriostatic antibiotics

- A) Erythromycin      B) ofloxacin      C) chloramphenicol      D) penicilline

28. Which of the following compounds are not responsive to Kjeldahl method of estimation of nitrogen.

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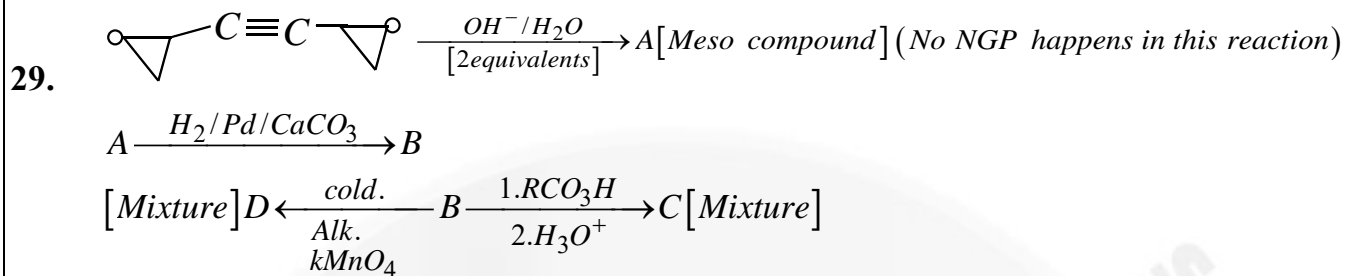
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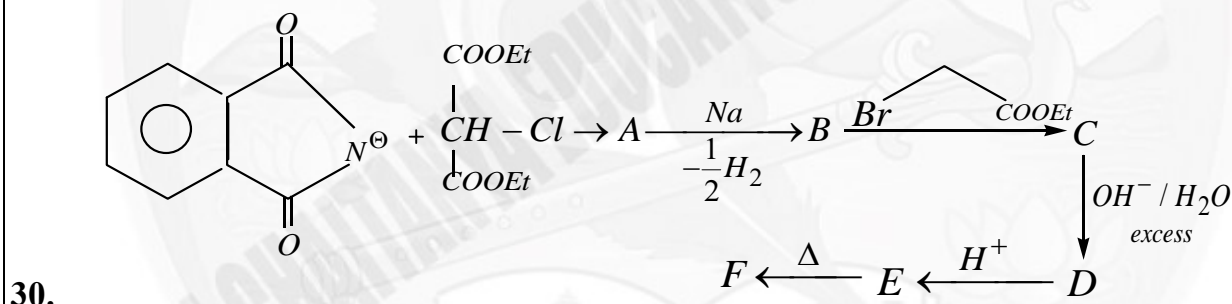
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Choose the correct statements

- A) One of the compounds in the mixture "D" is  $C_4$ , epimer of reduced product of D – glucose [with  $NaBH_4$ ]  
 B) Mixture "C" is optically inactive, but is resolvable  
 C) Mixture "D" contains diastereomers  
 D) All the corresponding aldohexoses of compounds of mixtures C & D give osazone with phenylhydrazine.



Choose the correct statements with respect to above synthetic sequence. [ $p^{k_1}$ ,  $p^{k_2}$  &  $p^{k_3}$  of "F" respectively, are 1.88, 3.65, 9.67]

- A) Compound "F" is aspartic acid  
 B)  $P^I$  of "F" is in the acidic range of  $P^H$  scale  
 C) At  $P^H = 1.5$ , "F" exists as conjugate acid  
 D) At  $P^H = 2.765$  net charge on "F" is zero.

### SECTION – III (NUMERICAL VALUE TYPE)

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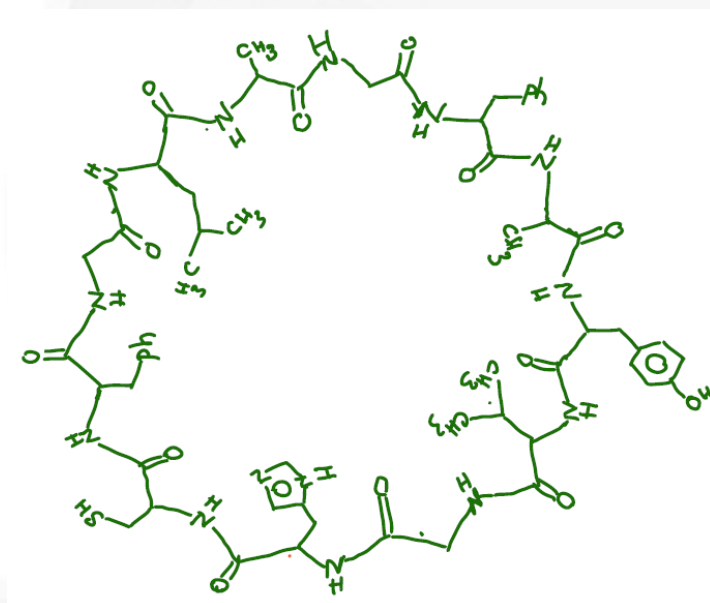


31. Study the following peptide and select the total no. of correct statements:  
 $Lys - Ser - Asp - Cys - Val - Tyr$
- i) Net charge [only magnitude] at  $P^H = 8$  is 3
  - ii) Net charge [only magnitude] at  $P^H = 8$  is 2
  - iii) Net charge [only magnitude] at  $P^H = 12.5$  is 4
  - iv) Net charge [only magnitude] at  $P^H = 12.5$  is 5
  - v) There is only one amino acid which gives nihrin test
  - vi) There is only one amino acid which responds to xanthoprotic test
  - vii) There is only one amino acid which responds to nitroprusside test
  - viii) There are total 32 geometrical isomers, which are possible if one assumes that there is restricted rotation across the peptide bond due to resonance.
  - ix) 1 mole of above peptide consumes 5 moles of  $AC_2O$  in the acylation reaction.  
(Assume individual amino acids wherever there is necessity for tests).
32. If a polythene sample contains two monodisperse fractions in the ratio 2:3 with degree of polymerization 100 and 200 respectively, then its weight average molecular weight will be:
33. An open amide of 10g is subjected to Kjeldahl method to estimate the nitrogen. Liberated ammonia is treated with 1M & 200 mL of  $H_2SO_4$  and the left acid is back titrated with 1.5 M, 200 mL  $NaOH$  solution. Same quantity of compound when analyzed for carbon & hydrogen gave 63% of C & 11% of H. [Note:- After dividing by smallest fraction round off the final number of atoms to nearest whole number].
- Molar mass of the compound =  $x(\text{gm} / \text{mole})$
- Total no. of monomethyl primary amides which give optically active amines on reaction with  $Br_2 / NaOH = y$ ; then  $x + y = ?$
34. How many of the following statements are correct
- 1) D - Fructose is oxidized by  $Br_2 / H_2O$
  - 2) D - Fructose exists in the furanose form, in sucrose
  - 3) D - Glucose & D - Mannose are diastereomers
  - 4) D - Glucose & D - Galactose are  $C_2$  - epimers



- 5) Sucrose contains two  $\alpha$  – glycosidic linkages
- 6) D – Glucose & D – Fructose are diastereomers
- 7) Anomers of D – Glucose are diastereomers
- 8) All epimeric pairs are anomeric pairs
- 9) Sucrose exhibits mutarotation
- 10) Reduction product of D – (+) – Glucose [with  $\text{NaBH}_4$ ]  
Consumes 6 moles of  $\text{AC}_2\text{O}$ . On treatment with excess quantity of  $\text{AC}_2\text{O}$ .

35.



Total no. of different amino acids present in the above polypeptide =  $x$

Total no. of water molecules produced in the formation of above polypeptide =  $y$

Total no. of glycine units =  $z$

Then  $x + y + z = ?$

36. How many of the following are antiseptics.

Norethindrone, Alitame,  $\text{CHI}_3$ , dettol, soframycin, Bithionol, 0.2% phenol, 1% phenol, iodine, ofloxacin, chloramphenicol, salvarsan.



**MATHEMATICS****Max Marks: 66****SECTION – I  
(SINGLE CORRECT ANSWER TYPE)**This section contains **SIX** (06) questions.

- Each question has **FOUR** options. **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**37.** For positive integer  $n$ , define

$$f(n) = n + \frac{16 + 5n - 3n^2}{4n + 3n^2} + \frac{32 + n - 3n^2}{8n + 3n^2} + \frac{48 - 3n - 3n^2}{12n + 3n^2} + \dots + \frac{25n - 7n^2}{7n^2}.$$

Then the value of  $e^{\left(4 - \lim_{n \rightarrow \infty} f(n)\right)}$  is equal to

- A)  $\left(\frac{7}{3}\right)^{4/3}$       B)  $\left(\frac{7}{3}\right)^{3/4}$       C)  $\left(\frac{7}{4}\right)^{4/3}$       D)  $\left(\frac{7}{4}\right)^{3/4}$

**38.**  $f(x)$  and  $h(x)$  are two real valued continuous function and let  $\int h(x) dx = f^{-1}(x)$  and $f(x) = x^3 + x + \sin 2\pi x + 2$  and the value of  $\int_2^4 xh(x) dx$  is ' $k$ ', then the value of ' $4k$ ' is,

- A) 4      B) 11      C)  $\frac{11}{4}$       D) 16

**39.** Let  $R$  be real numbers and  $f: R \rightarrow R$  such that  $\forall x, y \in R, |f(x) - f(y)| \leq |x - y|^{100}$  and $f(100) = 1$ , then find the area bounded by curve  $y = \min\{f(x), x^2, e^{2-x}\}$ ,  $x$ -axis and line  $x = 4$ . In sq.u

- A)  $\frac{7}{3}$       B)  $\frac{7}{3} - \frac{1}{e^2}$       C)  $\frac{4}{3} - \frac{1}{e^2}$       D)  $\frac{7}{3} + \frac{1}{e^2}$

**40.** If solution of the differential equation  $\frac{dy}{dx} = y(x) + \int_0^1 y(x) dx$  and  $y(0) = 1$  is  $y(x)$ , thenthe value of  $[y(1) - 7]$  (where  $[.]$  denotes the greatest integer function) is

- A) 6      B) 5      C) 4      D) 0





41. If  $f(x) = \sin x + \cos x$  and  $g(x) = \begin{cases} \frac{|x|}{x}, & x \neq 0 \\ 2, & x = 0 \end{cases}$ , then the value of  $\int_{-\pi/4}^{2\pi} g \circ f(x) dx$  is

equal to:

- A)  $\frac{3\pi}{4}$       B)  $\frac{\pi}{4}$       C)  $\pi$       D)  $3\pi$

42.  $\int \frac{dx}{1x^2 + [x]^2 + 1 - 2x[x]} = ([.] \text{ denotes G.I.F})$

- A)  $\frac{\pi}{2}$       B)  $\frac{\pi}{4}$       C)  $\pi$       D)  $\frac{\pi}{3}$

### SECTION – II (ONE OR MORE CORRECT ANSWER TYPE)

- This section contains **SIX** (06) questions.
- Each question has **FOUR** options. **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 none of the options is chosen (i.e. the question is unanswered);

**Negative Marks:** -2 In all other cases

43. If  $I = \int \frac{(1-y)dx}{\ln x^x + xy^{-1}}$ ,  $J = \int \frac{\ln x^x + xy^{-1}}{1-y} dy$ , where  $xy^{-1} = x^y$

- A)  $I = x + c_1$       B)  $J = y + c_2$       C)  $I = y + c_1$       D)  $J = x + c_2$

44.  $\int \sqrt{\frac{1 - \cos x}{\cos \alpha - \cos x}} dx$ , where  $0 < \alpha < x < \pi$ , equals:

- A)  $2 \ln(\cos \alpha / 2 - \cos x / 2) + c$       B)  $2 \cos^{-1}\left(\frac{\cos x / 2}{\cos \alpha / 2}\right) + c$   
 C)  $2\sqrt{2} \ln(\cos \alpha / 2 - \cos x / 2) + c$       D)  $-2 \sin^{-1}\left(\frac{\cos x / 2}{\cos \alpha / 2}\right) + c$

45. If the line  $x = \alpha$  divides the area of region

$S = \{(x, y) \in R^2, x^5 \leq y \leq x^2, 0 \leq x \leq 1\}$  into two equal parts then which of the following is/are CORRECT?





A)  $\left(\frac{3}{4}\right)^{1/3} < \alpha < 1$

B)  $0 < \alpha < \left(\frac{3}{4}\right)^{1/3}$

C)  $\alpha = \frac{2\alpha^6 + 1}{4\alpha^2}$

D)  $2\alpha^2 + 4\alpha^3 - 1 = 0$

46.  $\int \sec^2 \theta (\sec \theta + \tan \theta)^2 d\theta$  equals:

A)  $\frac{3(\sec \theta + \tan \theta)}{2} [2 + \tan \theta (\sec \theta + \tan \theta)] + c$

B)  $\frac{(\sec \theta + \tan \theta)}{3} [2 + 4 \tan \theta (\sec \theta + \tan \theta)] + c$

C)  $\frac{(\sec \theta + \tan \theta)}{6} [(\sec \theta + \tan \theta)^2 + 3] + c$

D)  $\frac{(\sec \theta + \tan \theta)}{3} [2 + \tan \theta (\sec \theta + \tan \theta)] + c$

47. Let function  $f(x)$  satisfy  $x^2 f'(x) + 2xf(x) = e^x$  and  $f(2) = \frac{e^2}{4}$ . Which of the following is/are CORRECT?

A)  $f(x) = 1$  has exactly one real solution

B)  $f(x) = 3$  has exactly three real solutions

C)  $f(x)$  has local maxima but no local minima

D)  $f(x)$  has local minima but no local maxima

48. If  $\frac{dy}{dx} = \frac{\sin y + x}{\sin 2y - x \cos y}$  and  $y(0) = \frac{\pi}{2}$ , then:

A) If  $y(a) = -\frac{\pi}{2}$ , then  $a = 0, 2$

B) If  $y(a) = -\frac{\pi}{2}$ , then  $a = 1, 2$

C)  $\sin y \in \left(-\sqrt{\frac{2}{3}}, \sqrt{\frac{2}{3}}\right)$

D)  $\sin y \in \left[-1, -\sqrt{\frac{2}{3}}\right] \cup \left[\sqrt{\frac{2}{3}}, 1\right]$







### SECTION – III (NUMERICAL VALUE TYPE)

- This section contains **SIX (06)** 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**:

**Full Marks:** +4 **If ONLY** the correct numerical value is entered;

**Zero Marks:** 0 In all other cases

49. A curve passing through  $(1,1)$  and  $(0,k)$  satisfies the differential equation  $(y + ye^{x/y})dx + e^{x/y}(y - x)dy = 0$ , then  $[k]$  is equal to (where  $[.]$  denotes greatest integer function)
50. The area enclosed by the curves  $y = \sin x + \cos x$  and  $y = |\cos x - \sin x|$  over the interval  $\left[0, \frac{\pi}{2}\right]$  is  $A$ , value of  $[A^2]$  is \_\_\_\_\_.  $[.]$  is GIF
51.  $\int \frac{\sin 7x}{\sin x} dx = Ax + B \sin 2x + C \sin 4x + D \sin 6x + E$  then  $\frac{1}{A} + \frac{1}{B} + \frac{1}{C} + \frac{1}{D} =$
52. Let  $f : \mathbb{R} \rightarrow [-3, 3]$  be a differentiable function and  $g$  is differentiable function such that  $f\left(\frac{\pi}{2}\right) = -2$ ,  $g(x) = \int_x^{\frac{\pi}{2}} [f'(t) \sin t + f(t) \cos t] dt$  for  $x \in \left(0, \frac{\pi}{2}\right]$ , then  $\left| \lim_{x \rightarrow 0} g(x) \right| =$
53. The value of  $\lim_{n \rightarrow \infty} \frac{1}{e^{n-1}} \int_0^n \frac{dx}{e^x (e^{x+3} + 2e^2 - 1)}$  equals to
54.  $\int \frac{\sec x (2 + \sec x)}{(1 + 2 \sec x)^2} dx = \frac{\sin x}{P + \cos x} + c$ , then  $P =$





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100  
All India Open  
Category Ranks

**32**

BELOW  
1000  
All India Open  
Category Ranks

**181**

BELOW  
100  
All India  
Category Ranks  
Count

**89**

BELOW  
1000  
All India  
Category Ranks  
Count

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