Test Date: 12/07/2020

Aakash

Medical | IIT-JEE | Foundations

(Divisions of Aakash Educational Services Limited)

B

CODE

Regd. Office: Aakash Tower, 8, Pusa Road, New Delhi-110005, Ph.011-47623456

Time : 3 hrs

Mock Test_CoE_XII

MM : 240

for JEE (Advanced) - 2020

Test – 2A (Paper – II)_Actual Pattern-2015

Topics covered:

PHYSICS : **MOCK TEST on Complete Syllabus**

CHEMISTRY : **MOCK TEST on Complete Syllabus**

MATHEMATICS : **MOCK TEST on Complete Syllabus**

General Instructions:

Pattern of the questions are as under:

(i) The question paper consists of 3 parts (Physics, Chemistry and Mathematics). Each part has **3 sections.**

(ii) **Section-1:** This section contains **8** questions. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9. Each question carries **+4 marks** for correct answer. There is no negative mark for wrong answer.

(iii) **Section-2:** This section contains **8** multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.** Each question carries **+4 marks** for correct answer, **0 mark** if not attempted and **–2 marks** for wrong answer.

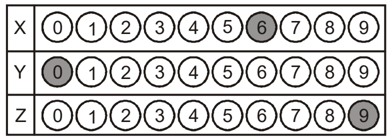
(iv) **Section-3:** This section contains 2 paragraphs. Based upon each paragraph, 2 multiple choice questions have to be answered. Each question has one or more than one correct answer and carries **+4 marks** for correct answer, **0 mark** if not attempted and **–2 marks** for wrong answer.

PART – I: PHYSICS

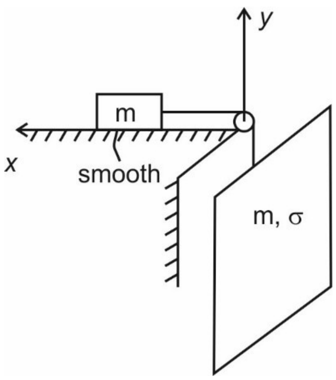
SECTION - 1

Integer Value Type

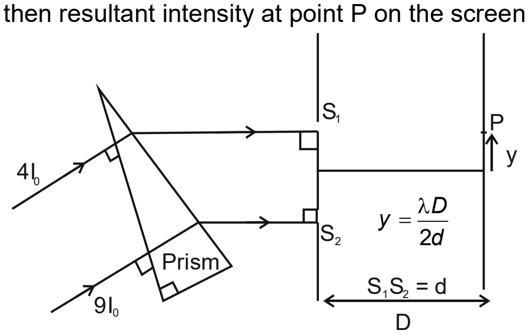
This section contains **8** questions. The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively



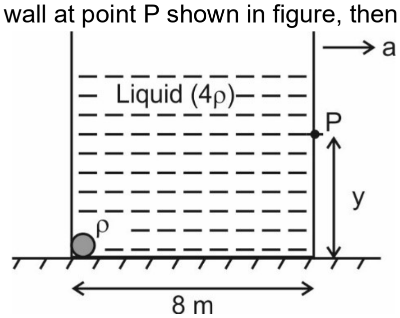
1. Large non conducting plate having mass m and uniform charge density σ is connected to block of same mass as shown. System is related at t = 0. At time $t = t_0$ a charge particle (q, m) is projected with velocity $\vec{V} = V_0\hat{i} + V_0\hat{k}$ near the plate. If magnetic force experiences by charge particle just after projection is $\frac{\mu_0 \sigma g t_0 V_0 q}{K}$, then find value of K



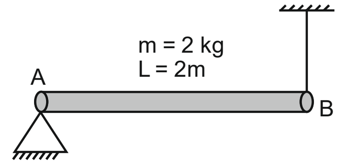
2. Two parallel light beam of intensities $4I_0$ and $9I_0$ are incident normally on standard YDSE after passing through prism. If light beams falls normally on prism and after passing through prism it falls normally on slits as shown then resultant intensity at point P on the screen comes into KI_0, find K



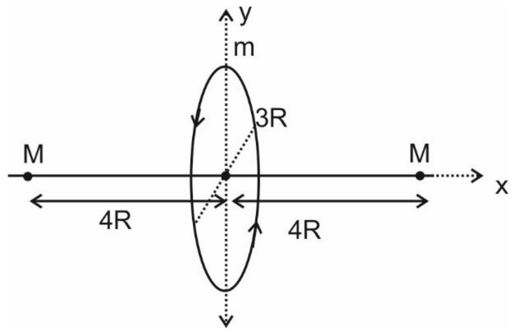
3. A tall vessel having liquid of density 4ρ is made to accelerate rightward with constant acceleration a = $2g$. A small spherical ball of density ρ situated at its left bottom corner of the vessel is released from rest. If it collide with vessel wall at point P shown in figure, then value of y (in m) is equal to



4. A uniform rod is kept horizontal with the help of a string at B, end A of rod is kept over a smooth obstacle. If just after cutting the string normal reaction at A comes out K newton then value of K is



5. A point mass m performs circular motion in Y-Z plane under the action of gravitational force exerted by two point masses M situated on X-axis at a distance 4R from the centre of circle (radius 3R) as shown. If speed of point mass is $V = \sqrt{K\left(\frac{6GM}{125R}\right)}$, then value of K is



6. Two vessels of different materials are similar in size in every aspect. The same quantity of ice filled in them gets melted in 20 minute and 40 minutes respectively. If ratio of thermal conductivity of the material is K : 1, then value of K is

7. A pendulum has time period T in air. When it is made to oscillate in water. It acquired a time period T'. If $\frac{T'}{T} = \sqrt{2}$, then specific gravity of pendulum bob is equal to

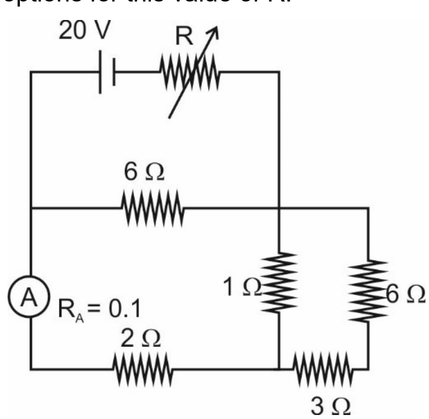
8. A vessel contains a mixture of 1 mole of O_2 and 2 mole of N_2 at 300 K. If ratio of average rotational K.E. per O_2 molecule to that of N_2 molecule is 1 : K then value of K is

SECTION - 2

One or More Options Correct Type

This section contains **8** multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.**

9. In the shown circuit variable resistance R is adjusted so that power consumed by this resistance R is maximum. Choose the correct options for this value of R.



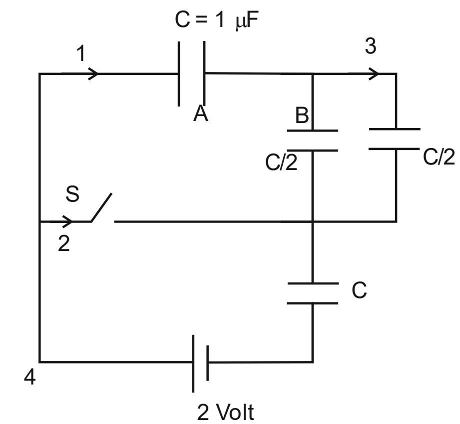
(A) Value of R is 2 Ω

(B) Reading of Ammeter is $\frac{5}{3}A$

(C) Rate of work done by the battery is 100 W

(D) Reading of Ammeter is $\frac{10}{3}A$

10. In the shown circuit initially switch S was open for long time. Now if switch S is closed, then



(A) Charge flown in the direction 3 is $-\frac{1}{3}\mu C$

(B) Charge flown in the direction 2 is $\frac{5}{4}\mu C$

(C) Work done by battery is $\frac{8}{3}\mu J$

(D) Work done by battery is $\frac{5}{3}\mu J$

11. If equation of standing wave in a medium is given as

y = (2 cm) sin(2πx) cos(100πt), here x is in cm and t is in sec then

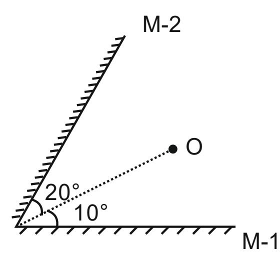
(A) Total number of nodes between $x = \frac{1}{8}$ cm to $x = \frac{9}{4}$ cm are four

(B) Phase difference between two particle situated at $x_1 = \frac{1}{8}$ cm and $x_2 = \frac{5}{4}$ cm is zero

(C) Amplitude of the particle at $x = \frac{1}{4}$ cm is 2cm

(D) Amplitude of the particle at $x = \frac{1}{4}$ cm is 1cm.

12. A point object O is placed in between two plane mirrors M-1 and M-2 as shown then (If two images coincide with each other then consider them as two different images formed by mirror and count them)



(A) Total no. of images formed by M-1 is 6

(B) Total no. of images formed by M-1 is 5

(C) Total no. if images formed by M-2 is 6

(D) Total no. of images formed by M-1 is 7

13. The radiation emitted by lithium atom when an electron jumps from n = 4 to n = 3 falls on a metal surface to produce photoelectrons. When photoelectrons with maximum K.E are made to move perpendicular to a uniform magnetic field 4 × 10^{-4} T, they trace out a circular path of radius 1.68 cm. Choose the correct options

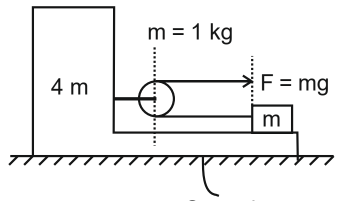
(A) Wavelength of radiation falling on the metal is 2 × 10^{-7} m

(B) Wavelength of radiation falling on the metal is 4 × 10^{-6} m

(C) Work function of the metal is 2eV

(D) Work function of the metal is 4 eV

14. In the shown arrangement initially block of mass m is at a distance of l = 2 m from pulley. If a force F = mg is force is applied at one end of the string then (assuming all surface to be smooth) (g = 10 m/s^2)



(A) Time after which black collides with the pulley is $\sqrt{\frac{4}{15}}$ s

(B) Time after which block collides with the pulley is $\sqrt{\frac{2}{15}}$ s

(C) Acceleration of 4 m during motion is 5 m/s^2

(D) Acceleration of 4 m during motion is 10 m/s^2

15. The displacement (X) and the velocity (V) of a particle moving in the positive X-direction are related as $v = 10\sqrt{x}$. At t = 0, the particle was at x = 0, then

(A) Initial velocity of the particle was zero

(B) Initial velocity of the particle was 1.5 m/s^2

(C) The acceleration of the particle is 1.5 m/s^2

(D) The acceleration of the particle is 50 m/s^2

16. Displacement of a particle in a string placed along x-direction is represented by y. Which of the following expression for y describe wave motion

(A) $y = \cos kx \sin \omega t$

(B) $y = k^2x^2 - \omega^2 t^2$

(C) $y = \cos^2(kx + \omega t)$

(D) $y = \cos\left(kx^2 - \omega^2 t^2\right)$

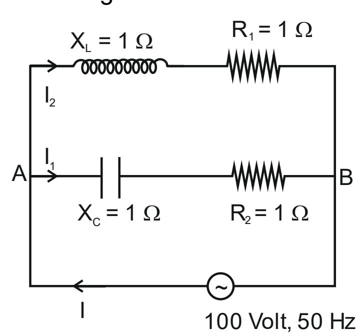
SECTION - 3

Paragraph Type

This section contains **2 paragraphs**, each describing theory, experiment, data etc. **Four questions** relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should has **one or more than one correct answers** among the four given choices (A), (B), (C) and (D).

Paragraph for Question Nos. 17 and 18

Consider the shown A.C circuit. RMS voltage of 100 volt and 50 Hz is applied between point A and B



17. For the shown circuit choose the correct options

(A) $I_1 = 50\sqrt{2}$

(B) I_1 = 50 A

(C) I = 100 A

(D) $I = 100\sqrt{2}$

18. If resistance R_1 is short circuited then choose the correct option

(A) $I_1 = 50\sqrt{2}\,A$

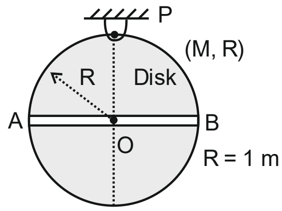
(B) I_1 = 50 A

(C) $I_2 = 100\sqrt{2}\,A$

(D) I_2 = 100 A

Paragraph for Question Nos. 19 and 20

Starting from point A an insect (mass m) perform motion in a groove AB made along the horizontal diameter inside the uniform circular disk. Disk is hinged at point P so that it can rotate freely in vertical plane as shown. Insect perform motion along groove in such a way so that acceleration of centre of mass of disk is always zero (Given $\frac{R}{g} = \frac{1}{\pi^2}\sec^2$)($\pi^2 = 10$)



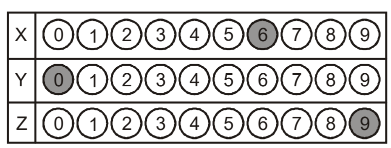
19. If insect start its motion from point A, at $t = 0$ then
    (A) At $t = 1$ sec insect will be at point B
    (B) At $t = 2$ sec insect will be at point B
    (C) Acceleration of insect will be maximum at A
    (D) Acceleration of insect will be maximum at O
20. Choose the correct option regarding motion of insect
    (A) Maximum velocity of insect during motion is π m/s
    (B) Maximum velocity of insect during motion is π^2 m/s
    (C) Maximum acceleration of insect during motion is 10 m/s^2
    (D) Maximum acceleration of insect during motion is 5 m/s^2

PART – II: CHEMISTRY

SECTION - 1

Integer Value Type

This section contains **8** questions. The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively



21. White phosphorus, yellow phosphorus or simply tetraphosphorus (P_4) exists as molecules made up of four atoms in a tetrahedral structure. Calculate the value of expression $\frac{x.y}{z}$ regarding phosphorus molecule. Where
    x = Total no. of vertex angles in one P_4 molecule
    y = Total no. of lone pairs in one P_4 molecule
    z = Total no. of P – P bonds in one P_4 molecule
22. How many of the following Ammonium Salts will evolve Ammonia gas on heating?
    NH_4NO_2, NH_4NO_3, $(NH_4)_2Cr_2O_7$, $(NH_4)_2CO_3$. CH_3COONH_4, NH_4ClO_4 , NH_4Cl, $(NH_4)_2S$, $(NH_4)_2C_2O_4$, $(NH_4)_2SO_4$
23. An ionic crystal (KCl) in which Cl^- ions form CCP lattice. The number of K^+ ions present at a distance of $\frac{\sqrt{5}\,A}{2}$ from Cl^- ion at the corner is P. Calculate the value of $\frac{P}{6}$. [A = edge length]

24. A binary ideal solution formed by two volatile liquids A and B. If total vapour pressure of this solution is represented as:

    Ps(in mm of Hg) = 100 – 50 X_B [Ps = Total pressure] X_B = Mole fraction of B in liquid state. This solution is passed through different distillation stages and at particular stage it is found that the mole fraction of A in vapour phase is $\frac{4}{7}$. The total vapour pressure of solution at this stage of distillation is 10x. What is the value of x?

25. Consider the following covalent compounds in their solid state and find the value of expression (x – y + z)

    N_2O_5, Cl_2O_6, PCl_5, I_2Cl_6, XeF_6, PBr_5

    Where x = Total no of compounds in which central atom of Cationic or anionic part is *sp*^{3} hybridised?

    y = Total no of compounds having 90° bond angle either in cationic or anionic part

    z = Total no. of compounds having 109°28' bond angle either in cationic or anionic part

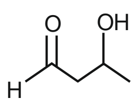
26. An electrode is prepared by dipping a silver strip into a solution saturated with silver thiocyanate, AgSCN and containing 0.1 M SCN^{-1}. The cell potential of the Voltaic cell constructed by connecting this electrode as the cathode to the standard Hydrogen Half-cell as the anode is 0.45 V. The K_{SP}(AgSCN) calculated is x × 10^{-7}. What is the value of (to the nearest integer) 'x'? (Use $10^{11.86} = 7.2 \times 10^{11}$)

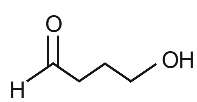
27. Vander Waal's gas equation may be expressed as $Z = 1 + \frac{B}{V_m} + \frac{C}{V_m^2} + ...$ where V_m = molar volume of gas. If B = –0.105 L mol^{-1} and C = 4 × 10^{-4} L^2 mol^{-2} at 127°C, then value of Vander Waal's constant 'a' (in atm L^2 mol^{-2}) is (Given R = 0.08 L – atm/ K mol)

28. Aldol reaction is used in large scale production of the commodity chemical pentaerythritol and the synthesis of heart disease drug Lipitor (atorvastatin). Calculate value of (x + y) from the list of compounds given below, if

    x = No. of compounds obtained by Aldol reaction

    y = No. of compounds that react with $NaHCO_3$


(A)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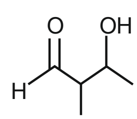
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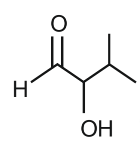
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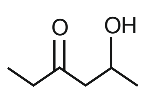
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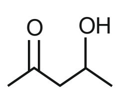
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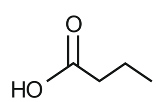
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SECTION - 2

One or More Options Correct Type

This section contains **8** multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.**

29. Select the correct option(s) for X, Y and Z for the chemical change

$$\underset{1}{Xe} + \underset{:\,20}{F_2} \xrightarrow[60-70\text{ bar}]{573\text{ K}} X \xrightarrow{H_2O} Y \xrightarrow{H_2O} Z \xrightarrow{H_2O} XeO_3$$

(A) X, Y and Z are in same oxidation state

(B) X, Y and Z have equal number of lone pairs at central atom

(C) X, Y and Z all are non-planar

(D) X, Y and Z all have equal number of covalent bonds

30. Potassium permanganate is an inorganic compound with the chemical formula $KMnO_4$. It is Purplish-black crystalline solid that dissolves in water to give intensely pink or purple solution. Pick out the correct statement(s).

(A) MnO_2 dissolves in conc. HCl but does not form Mn^{+4} ions

(B) Decomposition of acidic $KMnO_4$ is not catalysed by sun light

(C) MnO_4^{-2} is strongly oxidising and stable only in very strong alkali. In dilute alkali, water or acidic solution it disproportionates.

(D) $KMnO_4$ doesnot act as oxidising agent in alkaline medium

31. One mole of $O_2(g)$ initially at a temperature of 120 K and pressure of 4 atm is expanded adiabatically to 1 atm in such a way that the temperature of the gas falls to 90 K? C_P of O_2 is 28.2 JK^{-1} mol^{-1} and is constant over the required temperature range. Oxygen gas is supposed to behave as an ideal gas. Choose the correct option(s) [log2 = 0.3, log 3 = 0.47]

(A) q = 0

(B) w = +597 J

(C) $\Delta H = -846$ J

(D) $\Delta S_{sys} = 3.416$ J K^{-1}

32. Which of the following given reaction among the given reactions is corret?

(A) $2HNO_3 \xrightarrow{\Delta} H_2O + 2NO_2 + \frac{1}{2}O_2$

(B) $3H_2SO_3 \longrightarrow 2H_2SO_4 + S\downarrow + H_2O$

(C) $HClO_3 \longrightarrow HClO_4 + ClO_2 + H_2O$

(D) $CH_3COOK \xrightarrow{\Delta} K_2CO_3 + CH_3COOH$

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

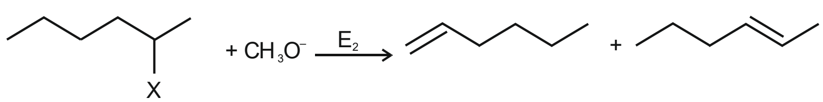
(A) In the metal carbonyl complexes C – O bond length is more than that in a CO molecule

(B) The pair of compounds $[Cr(H_2O)_6]Cl_3$ and $[CrCl_3(H_2O)_3]$. $3H_2O$ show hydrate isomerism

(C) d_{z^2} orbital of central metal atom/ions is used in *dsp*^{2} hybridisation

(D) Facial and meridional isomers associated with $[Ma_3b_3]^{\pm n}$ type complex compound both are optically inactive

34. The following bimolecular elimination reaction (E_2) is carried out with different halogen leaving groups. The percent yield of the two products for each leaving group is listed below?



X = I	–10	19%	81%
X = Br	–9	28%	72%
X = Cl	–7	33%	67%
X = F	3.2	70%	30%

Which of the following statement(s) is/are TRUE concerning E_2 reaction

(A) Based on the pKa values of the conjugate acids I^- is the best leaving group and F^- is the poorest leaving group

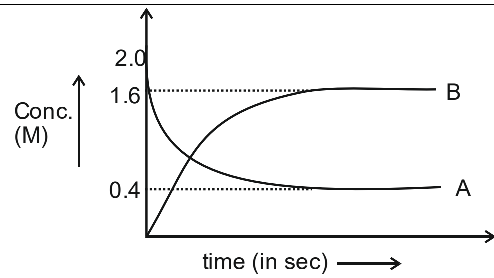
(B) When I^-, Br^- and Cl^- are used as leaving groups Zaitsev's rule is followed

(C) F^- is the strongest base and the transition state for reaction with fluoride as the leaving group has the least double bond character

(D) Statements (B) and (C) are incorrect

35. For the reaction $A \underset{K_2\,Sec^{-1}}{\overset{K_1\,Sec^{-1}}{\rightleftharpoons}} B$, following graph is given

$K_1 = 4 \times 10^{-2}$ sec^{-1}. Which is/are correct statement(s) $\left(\ln 2 = 0.7,\ \ln \frac{8}{7} = 0.14\right)$



(A) Equilibrium constant is 4.0

(B) Time taken for completion of 50% of equilibrium conc. of B is 14 sec

(C) Time taken for completion of 10% of equilibrium conc. of A is 2.8 sec

(D) Rate constant of backward reaction is 10^{-2} sec^{-1}

36. A hydrogen like atom (atomic no. Z) is in a higher excited state of quantum number 'n'. This excited atom can make a transition to the first excited state by successively emitting two photons of energies 10.20 eV and 17.00 eV. Alternatively the atom from same excited state can make a transition to the second excited state by successively emitting two photons of energies 4.25 eV and 5.95. Then select the correct statement(s)

(A) The value of atomic no (Z) = 3 and excited state (n) = 6

(B) The value of atomic no (Z) = 2 and excited state (n) = 5

(C) The atom during transition from n = 6 to n = 2 emits radiations in visible region

(D) The atom during transition from n = 2 to n = 1 emits radiations in infra-red region

SECTION - 3

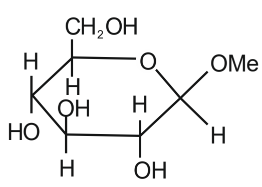
Paragraph Type

This section contains **2 paragraphs**, each describing theory, experiment, data etc. **Four questions** relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should has **one or more than one correct answers** among the four given choices (A), (B), (C) and (D).

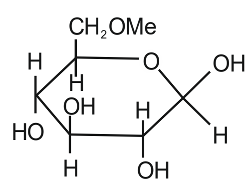
Paragraph for Question Nos. 37 and 38

$$\underset{(A)}{\text{D-Glucopyranose}} \xrightarrow[\text{HCl}]{\text{MeOH}} (B) \xrightarrow[\text{Me}_2\text{SO}_4/\text{OH}^-]{\text{Excess of}} (C) \xrightarrow{\text{dil. HCl}} (D)$$

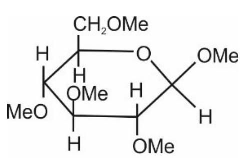
37. Identify the correct structure

(A) 

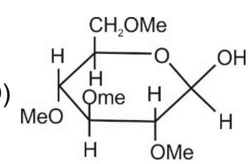
(Compound B)

(B) 

(Compound B)

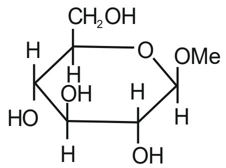
(C) 

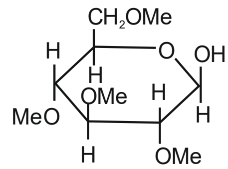
(Compound C)

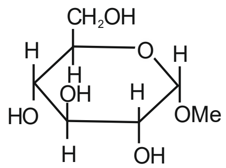
(D) 

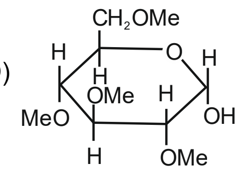
Compound (C)

38. Identify the compound (D) formed in the above reaction

(A) 

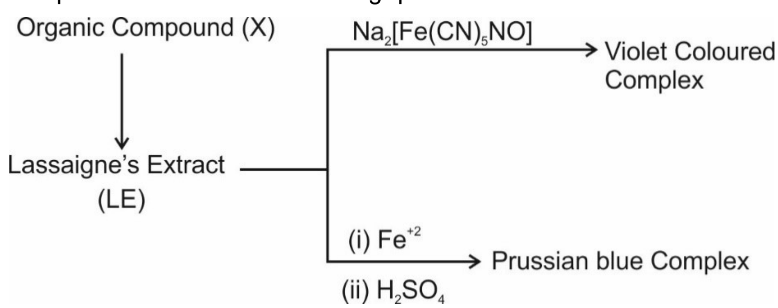
(B) 

(C) 

(D) 

Paragraph for Question Nos. 39 and 40

In the study of any organic compound it is important to know the element present in it. In addition to carbon & hydrogen organic compounds contain other elements e.g. nitrogen, Sulphur, halogens etc. The various methods used for qualitative analysis to identify elements and for the measurement of percentage composition of elements. Based on the purification and characterization of organic compounds. Answer the following questions



39. The above L.E. on treatment with Fe^{+2} doesn't give blood red colour due to the

(A) Presence of halogen in the Organic compound

(B) Absence of Sulphur in the Organic Compound

(C) Dissociation of NaSCN into Na_2S and NaCN

(D) Formation of Nitroprusside ion $[Fe(CN)_5NOS]$

40. 0.3 g of an organic compound gave 50 cm^3 of nitrogen in Duma's method for estimation of nitrogen collected at 300 K and 700 mm pressure. Calculate percentage of nitrogen in the compound. (Vapour pressure of H_2O at 300 K = 5 mm of Hg]

(A) 28.01 (B) 24.4

(C) 22.4 (D) 17.46

PART – III: MATHEMATICS

SECTION - 1

Integer Value Type

This section contains **8** questions. The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively

X	0	1	2	3	4	5	6	7	8	9
Y	0	1	2	3	4	5	6	7	8	9
Z	0	1	2	3	4	5	6	7	8	9

41. If $\sum_{n=1}^{\infty} 3^{n-1}\sin^3\left(\frac{674}{3^{n-1}}\right) = 1011a + b\sin(2022)$,then $\frac{1}{|a|}+\frac{1}{|b|}$ equals

42. If the angle between two faces of a regular tetrahedron is $\cos^{-1}\left(\frac{4}{9}-\frac{4}{9}a+\frac{4}{9}a^2.....\infty\right)$ (|a| < 1) then $\cot^{-1}a + \cot^{-1}\left(\frac{a}{1-a}\right) + \cot^{-1}3a = n\pi$, then the value of [*n*] is (where [.] denotes the greatest integer function)

43. If $y\left(x^2+(y+1)^2\right)dx + x(x+1)dy = (x+1)(y+1)(xdx+ydy+dx+dy)$, represents a curve passing through origin and (a, b) such that a = b + 1 then $\left[\left|\frac{a}{b}\right|\right]$ is ([.] is the greatest integer function)

44. If *x* > 0 and $\int \frac{\left(x^7+x^4\right)dx}{\left(2x^{10}+10x^8+25x^6+4x^5+20x^3+4\right)} = \frac{1}{a}\left(\cot^{-1}\left(\frac{x^5}{\rho'(x)}\right)\right)+K$, then $\left|\frac{2\rho'(1)}{a}\right|$ equals (where *K* is constant of integration)

45. If $x \in [0, 2\pi]$ then the number of solution(s) of $2^{[\tan x]} + 3^{[\sin x]} + 5^{[\cos x]} = 1$ is, (where [.] denotes the greatest integer function)

46. If $f(x) = \begin{vmatrix} x^2+x+1 & 3x & x+2 \\ 3x & x^2+x+1 & x+2 \\ x^2+2x & x^2+2x & 2x+1 \end{vmatrix}$. If the area bounded by curve *f*(*x*) and the co-ordinate axes is A and S = 1 + 2A + 3A^2 + 4A^3 ….. ∞ then $\frac{16}{5}$S , equals

47. If $a_1, a_2, a_3 \ldots\ldots a_{2020}$ and $b_1, b_2, b_3 \ldots. b_{2020}$ are in A.P with common difference 1 and 2 respectively $(a_i \neq b_i)$, then the number of common tangents to the parabolas given by

    $P_i : y^2 = 4a_i(x - b_i)$ is

48. If z_1, z_2, z_3 are three complex numbers such that

    $|z_1| = 2|z_2| = 4|z_3|$, then maximum value of $\left|\frac{z_1}{z_2}+\frac{2z_2}{z_3}+\frac{4z_3}{z_1}\right|$ is

SECTION - 2

One or More Options Correct Type

This section contains **8** multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.**

49. If a, b, c ∈ R and $\sin^6 a + 3\sin^2 a\cos^2 b + \cos^6 b = 1$, then

    (A) a = b (B) a = π + b

    (C) a = π – b (D) a = 2π – b

50. The value of $\lim_{x\to 1^-}(1-x)\sum_{k=1}^{\infty}\frac{x^k}{1+x^k}$ is

    (A) $\frac{1}{e}$ (B) ln2

    (C) 1 (D) $\frac{\pi}{2}$

51. PN is the normal to the ellipse $\frac{x^2}{9}+y^2=1$ at P, meeting major axis at N. If NP is produced outwards away from N such that QP = PN, then

(A) Locus of Q is an ellipse
(B) Eccentricity of Locus at Q is $\frac{4}{5}$
(C) Eccentricity of Locus at $Q=\frac{5}{4}$
(D) Locus of Q in a Hyperbola

52. If $A=\begin{bmatrix} 1 & -2 & -6 \\ -3 & 2 & 9 \\ 2 & 0 & -3 \end{bmatrix}$ and $B=\begin{bmatrix} -5 & 9 & -4 \\ -6 & 10 & -4 \\ -6 & 9 & -3 \end{bmatrix}$, then

(A) $A^3 = B^T$
(B) $A^2 = B^T$
(C) $A^n\left(B^T\right)^{n+1}A=A$ if n is even
(D) $A^n\left(B^T\right)^{n+1}A=A^3$ if n odd

53. Let S and S' be two circles touching side BC of triangle ABC at B and C respectively. If x and y be the radii of the circles and these circles also passes through the vertex A. If $\sin A=\frac{1}{4}$ and geometric mean of x and y is an integer, then possible length of side BC is

(A) 2
(B) $\frac{4}{3}$
(C) $\frac{5}{2}$
(D) $\frac{2}{3}$

54. If $f(x)=2^{2x}-2^{x+1}\cos^2(x/2)+2\sin^2(x/2)+\cos^2 x$, then

(A) $f(x)$ has minimum value at $x = 0$
(B) $f(x)$ has maximum value at $x = 0$
(C) $f(x) + |x| = 0$ has one solution
(D) $f(x) + |x| = 0$ has no solution

55. If $2ax^2+6xy+2by^2=1$ represents a curve whose minimum distance from origin is $r\ (a,b\geq 0)$, then

(A) $r=\frac{1}{3}$ for a = 0, b = 4
(B) $r=\frac{1}{3}$ for a = 4, b = 6
(C) $r=\frac{1}{5}$ for a = 8, b = 12
(D) $r=\frac{1}{5}$ for a = 12, b = 8

56. If $L=\lim\limits_{t\to 0}\frac{(t+1)^2-t.\ln(1+t)^{1+a}+b\sin t+c}{t^3}=\frac{5}{6}$, then

(A) $a = 0$
(B) $b = 2$, $c = 1$
(C) $b = -2$, $c = -1$
(D) $b = 2$, $c = -1$

SECTION - 3

Paragraph Type

This section contains **2 paragraphs**, each describing theory, experiment, data etc. **Four questions** relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should has **one or more than one correct answers** among the four given choices (A), (B), (C) and (D).

Paragraph for Question Nos. 57 and 58

Consider a function $f(x) = 2x^3 - 3x$. A circle is inscribed in the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1;(a>b)$ such that both the curves are concentric, Where $a, b\sqrt{2}$ are integers. Eccentricity of the ellipse is $\frac{1}{\sqrt{2}}$.

57. If $f(a) = -1$ and radius of the circle is a root of the equation $f'(x) = 0$, then area bounded between the ellipse and the circle is

(A) $\pi\left(\frac{\sqrt{2}-1}{2}\right)$

(B) $\pi\left(\frac{\sqrt{2}+1}{2}\right)$

(C) $\pi\sqrt{2}$

(D) $\frac{\pi}{\sqrt{2}}$

58. With the foci of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ (mentioned in Q. 57) as ends of major axis another ellipse is drawn whose eccentricity is $\frac{1}{\sqrt{2}}$. $E_2 : \frac{x^2}{a_1^2}+\frac{y^2}{b_1^2}=1$, then the area bounded between E_2 and the given circle is

(A) $\frac{\left(\sqrt{2}+1\right)\pi}{2\sqrt{2}} A$

(B) $\frac{\left(\sqrt{2}-1\right)\pi}{2\sqrt{2}}$

(C) $\left(\sqrt{2}+1\right)\frac{\pi}{2}$

(D) $\left(\sqrt{2}-1\right)\frac{\pi}{2}$

Paragraph for Question Nos. 59 and 60

A curve $y = f(x)$ satisfies the differential equation $x^3(dy - dx) + (xdy - 2ydx) = 2x^2ydx$, and it is given that $f(1) = \frac{\pi}{4}$

59. The equation of the curve is

(A) $y = \tan^{-1}x$

(B) $y = x^2\tan^{-1}x$

(C) $y = \frac{\tan^{-1}x}{x}$

(D) $y = \frac{\tan^{-1}x}{x^2}$

60. If $L = \lim\limits_{x\to 0}\frac{f'(x)}{\left(e^x - x - 1\right)}$, then L is

(A) 2

(B) 4

(C) 6

(D) 8

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