NARAYANA IIT ACADEMY INDIA

43 YEARS OF EXCELLENCE

Sec: XII-IIT **Date :01-08-2022**

Time : 3 Hrs. **CTM – 04** **Max. Marks : 300**

JEE MAIN Model

PHYSICS :

Section	Question Type	+Ve Marks	–Ve Marks	No.of Qs	Total marks
Sec – I (Q.N : 1 – 20)	Questions with Single Correct Choice	4	–1	20	80
Sec – II (Q.N : 21 – 30)	Questions with Numerical Answer Type(+ / – Decimal Number)	4	0	10	20
Total				30	100

CHEMISTRY :

Section	Question Type	+Ve Marks	–Ve Marks	No.of Qs	Total marks
Sec – I (Q.N : 31 – 50)	Questions with Single Correct Choice	4	–1	20	80
Sec – II (Q.N : 51 – 60)	Questions with Numerical Answer Type(+ / – Decimal Number)	4	0	10	20
Total				30	100

MATHEMATICS:

Section	Question Type	+Ve Marks	–Ve Marks	No.of Qs	Total marks
Sec – I (Q.N : 61 – 80)	Questions with Single Correct Choice	4	–1	20	80
Sec – II (Q.N : 81 – 90)	Questions with Numerical Answer Type(+ / – Decimal Number)	4	0	10	20
Total				30	100

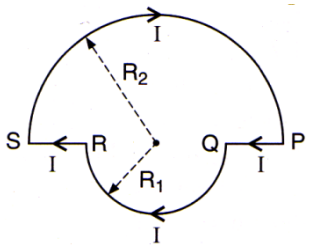
PHYSICS **Max.Marks:100**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 in all other cases.

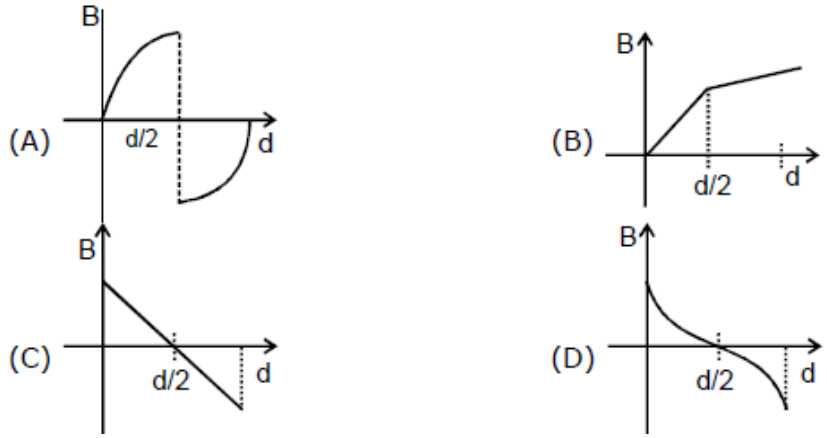
1. A wire loop PQRS formed by joining two semicircular wires of radii R_1 and R_2 carries a current I as shown in the adjoining fig. The magnetic induction at the centre O is:



(A) $\frac{\mu_0 I\pi}{4\pi R_1}$ (B) $\frac{\mu_0 I\pi}{4\pi R_2}$

(C) $\frac{\mu_0}{4\pi} I\pi\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ (D) $\frac{\mu_0}{4\pi} I\pi\left(\frac{1}{R_1}+\frac{1}{R_2}\right)$

2. A uniform beam of positively charged particles is moving with a constant velocity parallel to another beam of negatively charged particles moving with the same velocity in opposite direction separated by a distance d. The variation of magnetic field B along a perpendicular line draw between the two beams is best represented by



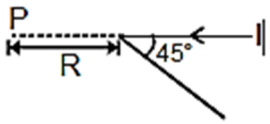
3. Equal current *i* is flowing in three infinitely long wires along positive x, y and z directions. The magnitude field at a point (0, 0, –a) would be :

(A) $\frac{\mu_0 i}{2\pi a}\left(\hat{j}-\hat{i}\right)$ (B) $\frac{\mu_0 i}{2\pi a}\left(\hat{i}+\hat{j}\right)$ (C) $\frac{\mu_0 i}{2\pi a}\left(\hat{i}-\hat{j}\right)$ (D) $\frac{\mu_0 i}{2\pi a}\left(\hat{i}+\hat{j}+\hat{k}\right)$

4. If the ratio of magnetic fields at two point in a definite direction due to a long current carrying wire is 3/4, then the ratio of the distances of these points from the wire will be :

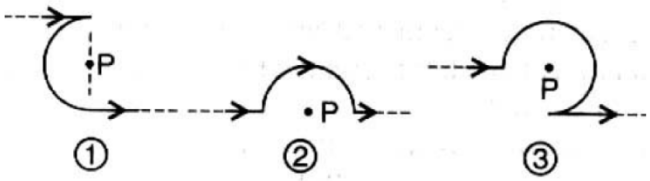
(A) $\frac{2}{\sqrt{3}}$ (B) $\frac{4}{3}$ (C) $\sqrt{\frac{3}{4}}$ (D) $\sqrt{\frac{3}{2}}$

5. A long straight wire, carrying current I, is bent at its midpoint to form an angle of 45°. Induction of magnetic field at point P, distant R from point of bending is equal to :



(A) $\frac{\left(\sqrt{2}-1\right)\mu_0 I}{4\pi R}$ (B) $\frac{\left(\sqrt{2}+1\right)\mu_0 I}{4\pi R}$ (C) $\frac{\left(\sqrt{2}-1\right)\mu_0 I}{4\sqrt{2}\pi R}$ (D) $\frac{\left(\sqrt{2}+1\right)\mu_0 I}{4\sqrt{2}\pi R}$

6. The magnetic field B at the centre of a circular coil of radius r is π times that due to a long straight wire at a distance *r* from it, for equal current. The adjoining diagram shows three cases: in all cases the circular part has radius *r* and straight ones are infinitely long. For the same current the field B at centre P in cases 1, 2, 3 has the ratio:



(A) $\left(-\frac{\pi}{2}\right):\left(\frac{\pi}{2}\right):\left(\frac{3\pi}{4}-\frac{1}{2}\right)$ (B) $\left(-\frac{\pi}{2}+1\right):\left(\frac{\pi}{2}+1\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$

(C) $\left(-\frac{\pi}{2}\right):\left(\frac{\pi}{2}\right):\left(\frac{3\pi}{4}\right)$ (D) $\left(-\frac{\pi}{2}-1\right):\left(\frac{\pi}{2}-\frac{1}{4}\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$

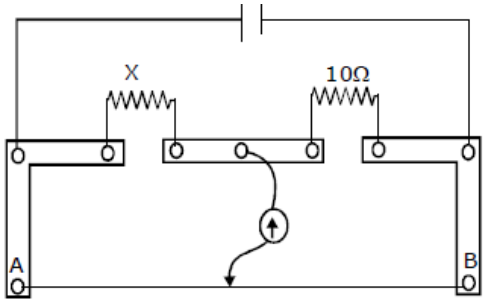
7. Two straight long conductors AOB and COD are perpendicular to each other and carry current I_1 and I_2. The magnitude of the magnetic induction at a point P at a distance *d* from the point O in a direction perpendicular to the plane ABCD is:

(A) $\frac{\mu_0}{2\pi d}\left(I_1+I_2\right)$ (B) $\frac{\mu_0}{2\pi d}\left(I_1-I_2\right)$ (C) $\frac{\mu_0}{2\pi d}\sqrt{I_1^2+I_2^2}$ (D) $\frac{\mu_0}{2\pi d}\left(\frac{I_1 I_2}{I_1+I_2}\right)$

8. A current loop consists of two identical semicircular part each of radius R, one lying in the *x*, *y*-plane and the other in *x*, *z*-plane. If the current in the loop is *i*. The resultant magnetic field due to the two semicircular parts at their common centre is:

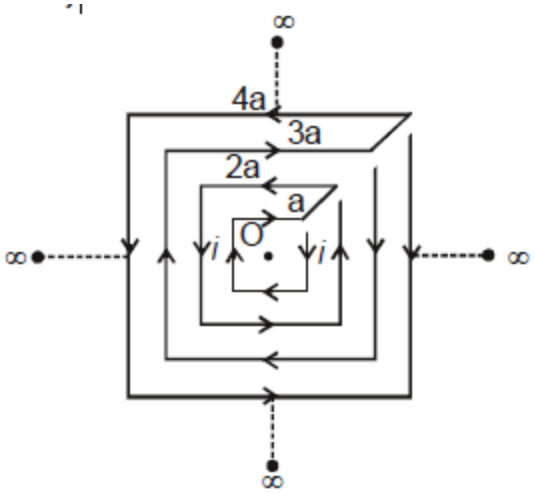
(A) $\frac{\mu_0 i}{2\sqrt{2}R}$ (B) $\frac{\mu_0 i}{2R}$ (C) $\frac{\mu_0 i}{4R}$ (D) $\frac{\mu_0 i}{\sqrt{2}R}$

9. A meter bridge is set-up as shown, to determine an unknown resistance 'X' using a standard 10 ohm resistor. The galvanometer shows null point when tapping- key is at 52 cm mark. The end-corrections are 1 cm and 2 cm respectively for the ends A and B. The determined value of 'X' is



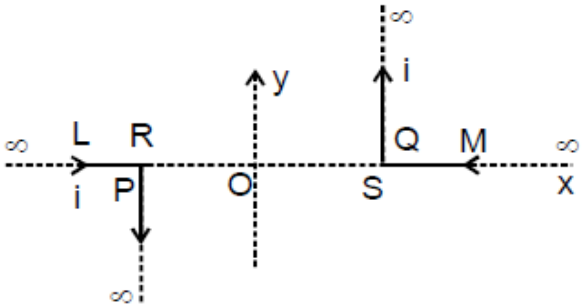
(A) 10.2 ohm (B) 10.6 ohm (C) 10.8 ohm (D) 11.1 ohm

10. Determine the magnitude of magnetic field at the centre of the current carrying wire arrangement shown in the figure. The arrangement extends to infinity. (The wires joining the successive square are along the line passing through the centre)



(A) $\frac{\mu_0 i}{\sqrt{2}\pi a}$ (B) 0 (C) $\frac{2\sqrt{2}\,\mu_0 i}{\pi a}\ln 2$ (D) none of these

11. A pair of stationary and infinitely long bent wires is placed in the X-Y plane as shown in figure. The wires carry currents of 10 A each as shown. The segments L and M are along the x-axis. The segments P and Q are parallel to the y-axis such that OS = OR = 0.02 m. Find the magnetic induction at the origin O.



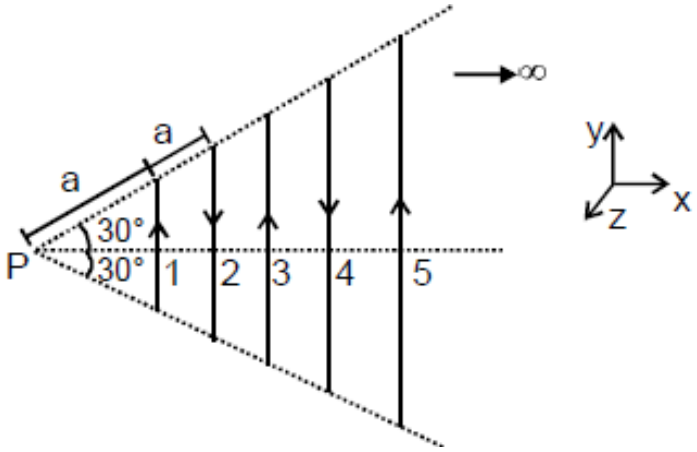
(A) 1×10^{-4} wb / m^2, towards the reader.

(B) 1×10^{-4} wb / m^2, opposite to the reader.

(C) 2×10^{-4} wb / m^2, towards the reader.

(D) zero

12. Infinite number of straight wires each carrying current I are equally placed as shown in the figure. Adjacent wires have current in opposite direction. Net magnetic field at point P is

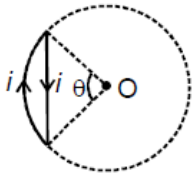


(A) $\frac{\mu_0 I}{4\pi}\frac{\ln 2}{\sqrt{3}a}\hat{k}$ (B) $\frac{\mu_0 I}{4\pi}\frac{\ln 4}{\sqrt{3}a}\hat{k}$ (C) $\frac{\mu_0 I}{4\pi}\frac{\ln 4}{\sqrt{3}a}\left(-\hat{k}\right)$ (D) Zero

13. Two mutually perpendicular conductors carrying currents I1 and I2 lie in one plane. Locus of the point at which the magnetic induction is zero, is a
(A) circle with centre as the point of intersection of the conductor.
(B) parabola with vertex as the point of intersection of the conductors
(C) straight line passing through the point of intersection of the conductors
(D) rectangular hyperbola

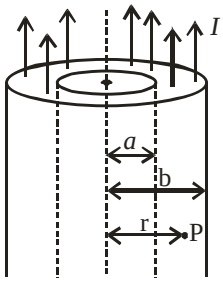
14. A direct current is passing through a wire. It is bent to form a coil of one turn. Now it is further bent to form a coil of two turns but at smaller radius. The ratio of the magnetic induction at the centre of this coil and at the centre of the coil of two turn is
(A) 1 : 4 (B) 4 : 1 (C) 2 : 1 (D) 1 : 1

15. Net magnetic field at the centre of the circle O due to a current carrying loop as shown in figure is ($\theta < 180°$)



(A) zero
(B) perpendicular to paper inwards
(C) perpendicular to paper outwards
(D) is perpendicular to paper inwards if $\theta \leq 90°$ and perpendicular to paper outwards if $90° \leq \theta < 180°$

16. A hollow cylindrical wire of inner radius *a* and outer radius *b* varies current I as shown in fig. If the current density is uniform across its cross section, find the magnetic field at point P such that a < r <
b.

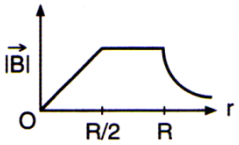


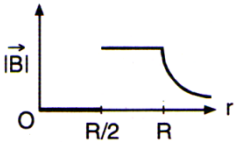
(A) $\frac{\mu_0 i\left(r^2-a^2\right)}{2\pi\left(b^2-a^2\right)r}$ (B) $\frac{\mu_0 ir}{2\pi\left(b^2-a^2\right)}$ (C) $\frac{\mu_0 iab}{2\pi\left(b^2-a^2\right)r}$ (D) zero

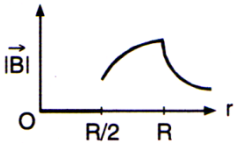
17. A large metal thin sheet carries an electric current along its surface. If the current per unit length is λ, then the magnetic field near the metal sheet is

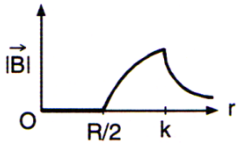
(A) $\frac{\mu_0\lambda}{2}$ (B) $\frac{\mu_0\lambda}{2\pi}$ (C) $\mu_0\lambda$ (D) $\frac{\mu_0\lambda}{\pi}$

18. An infinitely long hollow conducing cylinder with inner radius R/2 and outer radius R carries a uniform current density along its length. The magnitude of the magnetic field $\left|\vec{B}\right|$ as a function of the radial distance *r* from the axis is best represented by:

(A) 

(B) 

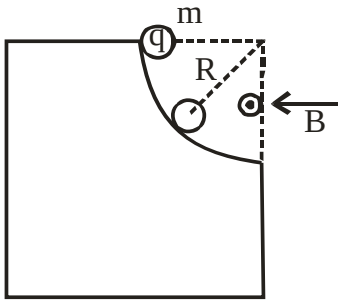
(C) 

(D) 

19. An α-particle and a proton travel with same velocity in a magnetic field perpendicular to the direction of their velocities. Find the ratio of their circular paths:

(A) 4 : 1 (B) 1 : 4 (C) 2 : 1 (D) 1 : 2

20. In the figure, a charged sphere of mass *m* and charge q starts sliding from rest on a vertical fixed circular track of radius R from the position shown. There exists a uniform and constant horizontal magnetic field of induction B. The maximum force exerted by the track on the sphere is:



(A) mg (B) $3mg - qB\sqrt{2gR}$ (C) $3mg + qB\sqrt{2gR}$ (D) $mg = qB\sqrt{2gR}$

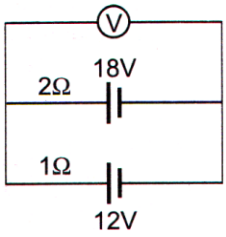
SECTION – II

(Numerical Value Answer Type)

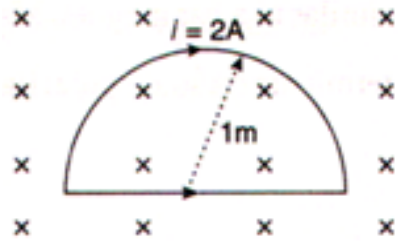
This section contains 10 questions. The answer to each question is a Numerical values comprising of positive or negative decimal number. [**Answer any Five (5) Integer Questions]**

Marking scheme: +4 for correct answer, 0 in all other cases.

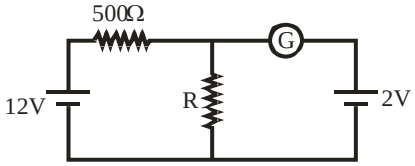
21. Two batteries, one of emf 18 volt and internal resistance 2Ω and the other of emf 12 volt and internal resistance 1Ω, are connected as shown in the adjoining figure. The voltmeter V will record a reading of n volt. Then value of n will be



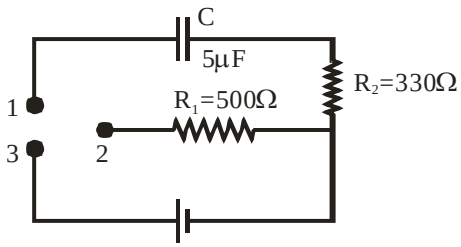
22. In the figure shown a semicircular wire loop is placed in a uniform magnetic field B = 1.0T. The plane of the loop is perpendicular to the magnetic field. Current i = 2A flows in the loop in the directions shown. The radius of the loop is 1.0 m. The magnitude of the magnetic force is n Newton. Find the value of n



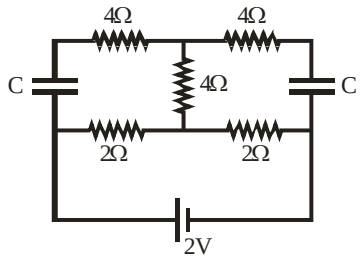
23. In the given circuit, the galvanometer shows zero defection. If the batteries A and B have negligible internal resistance. The value of resistor R is 50n. Find n



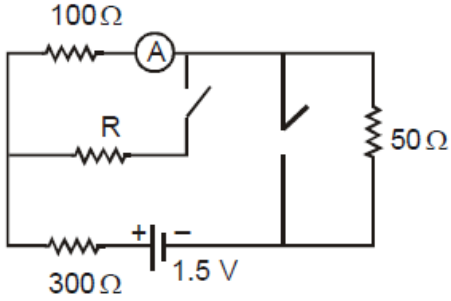
24. A condenser of capacity 5μF is connected to a constant source of emf 200 volts as shown in fig. The amount of heat produced in R_1 when key is thrown from contact 1 to 2 will be $n \times 10^{-2}$ Joule. Find n



25. The power of the circuit in steady-state condition is *n*. Find *n*



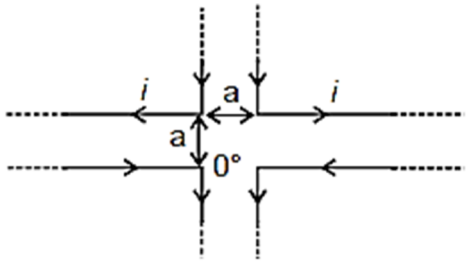
26. In the circuit shown in figure the reading of ammeter is the same with both switches open as with both 0 closed. Then find the resistance R. (ammeter is ideal)



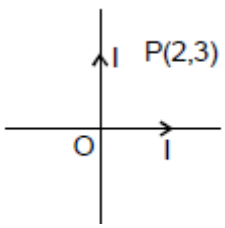
27. A long wire carrying a current *i* is bent to form a plane angle α. If the magnetic field B at a point on the bisector of this angle situated at a distance x from the vertex is $\frac{\mu_0 i}{2\pi x}\cot\frac{\alpha}{n}$ find the value of n is ___

28. Two parallel long wires A and B carry currents i_1 and i_2 $(<i_1)$. When i_1 and i_2 are in the same direction, the magnetic field at a point mid way between the wires is $10\,\mu T$. If i_2 is reversed, the field becomes $30\,\mu T$. The ratio i_1 / i_2 is

29. Four infinitely long 'L' shaped wires, each carrying a current *i* have been arranged as shown in the figure. The magnetic field intensity at the point 'O' equidistant from all the four corners is



30. Two mutually perpendicular insulated long conducting wires carrying equal currents I, intersect at origin. Then the resultant magnetic induction at point P (2m, 3m) is $\frac{\mu_0 I}{2N\pi}$ then N is



CHEMISTRY **Max.Marks:100**

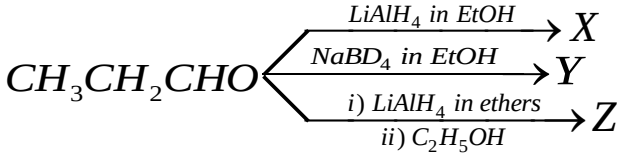
SECTION – I

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 in all other cases.

31.



Among the following incorrect one is

(A) Both X and Z are n-propyl alcohol (B) X is H_2, Z is n-propyl alcohol

(C) Y is CH_3CH_2CHDOH (D) In third reaction nuclephile is $\left(AlH_4\right)^-$

32. For the reaction of HCHO with very concentrated base, the correct rate equation is

(A) $r = k\left[HCHO\right]\left[OH^-\right]^3$ (B) $r = k\left[HCHO\right]^2\left[OH^-\right]^2$

(C) $r = k\left[HCHO\right]^2\left[OH^-\right]$ (D) $r = k\left[HCHO\right]\left[OH^-\right]^2$

33. Which one of the following reagents is not suitable for the conversion of $R-\overset{\overset{O}{\|}}{C}-Cl \longrightarrow RCHO$

(A) H_2 / Pd – $BaSO_4$, quinoline (B) $LiAl\left(OCMe_3\right)_3H$

(C) $Sn\left(C_4H_9\right)_3H$ (D) $LiAlH_4$

34. Among the following which one is insoluble in water

(A) HCHO (B) CH_3CHO

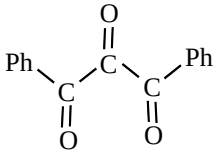
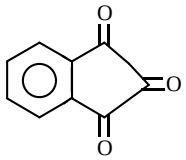
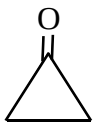
(C) $CH_3CH_2CH_2CHO$ (D) $CH_3CH_2CH_2CH_2CH_2CHO$

35. The correct dipole moment order is

(a) methanal b) Ethanal c) propanone

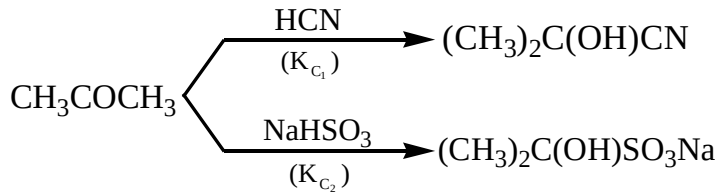
(A) a > b > c (B) c > b > a (C) b > a > c (D) c > a > b

36. Among the following which can form readily isolable hydrate

a)  b) CCl_3CHO c)  d) 

(A) only b (B) only a, b (C) only a, d (D) a, b, c,d

37.



Correct statements among the following are

A) $K_{C_1} > K_{C_2}$ because SO_3^{2-} is larger than CN^-

B) $K_{C_1} > K_{C_2}$ because SO_3^{2-} is smaller than CN^-

C) $K_{C_1} = K_{C_2}$

D) $K_{C_1} < K_{C_2}$

38. Assertion (A): The solubility of aldehydes and ketones in water decreases with increase of size of the alkyl group
Reason (R): Alkyl groups are electron releasing groups
(A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true and R is not the correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

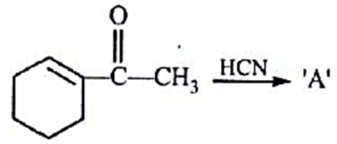
39. $CH_3CH_2CH_2CHO \xrightarrow{x} CH_3CH_2CH_2COOH$
In the above reaction X is an oxidizing agent and X is _____.
(A) Tollens reagent (B) Fehlings reagent (C) HNO_3 (D) All the above

40. The reaction product of the compound 'A' with excess of methyl magnesium iodide followed by acidic hydrolysis yields tertiary butanol. The compound could be
(A) Methanol (B) ethanol (C) propanal (D) Methyl ethanoate

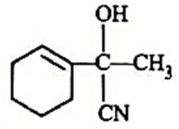
41. For hydrolysis of the following functional groups, the decreasing order of reactivity
A) $RCOOR > RCOCl > RCONH_2$
(B) $RCOCl > RCOOR > RCONH_2$
(C) $RCOCl > RCONH_2 > RCOOR$
(D) $RCOOR > RCONH_2 > RCOCl$

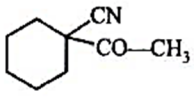
42. In the given reaction :
$H_2C = CH - CHO \xrightarrow{[X]} H_2C = CH - CH_2OH[X]$ will be :
(A) $H_2 / Ni\,\Delta$ (B) Pt / H_2
(C) $NaBH_4$ (D) H_2/Wilkinson catalyst

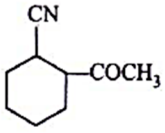
43. Consider the reaction:

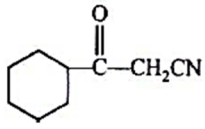


Compound (A) is :

(A) 

(B) 

(C) 

(D) 

44. On vigorous oxidation by permanganate solution $(CH_3)_2C=CH-CH_2CHO$ gives:

(A) $(CH_3)_2CO$ and $OHC-CH_2-CHO$

(B) $(CH_3)_3COH$ and HCHO

(C) $(CH_3)_3CO$ and $OHC-CH_2-COOH$

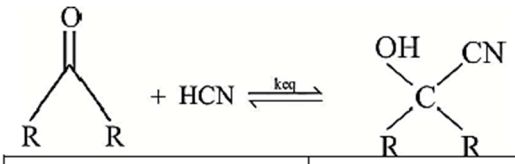
(D) $(CH_3)_2CO$ and $CH_2(COOH)_2$

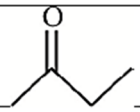
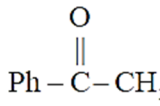
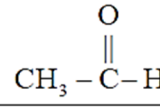
45. Which alkene is formed from the following reaction $CH_3CH_2CH_2CH = PPh_3$ + 2 – Butanone

(A) 3-methyl-3-heptene (B) 4-methyl-3-heptene

(C) 5-methyl-3-heptene (D) 1-methyl-5-methane

46.

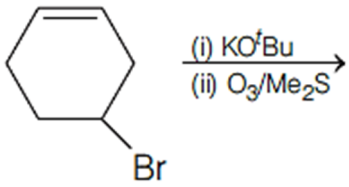


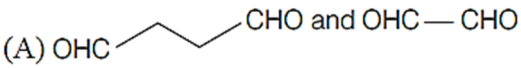
Reactant	K_{eq}
PhCHO	a
	b
	c
	d

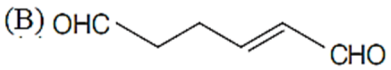
The correct order of decreasing value of K_{eq} is:

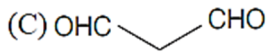
(A) a > b > c > d (B) d > a > b > c (C) d > b > a > c (D) d > a > c > d

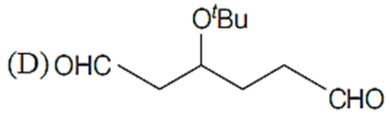
47. The major product(s) obtained in the following reaction is/are



(A) 

(B) 

(C) 

(D) 

48. In the following reaction,

Carbonyl compound + $MeOH \overset{HCl}{\rightleftharpoons}$ acetal

Rate of the reaction is the highest for:

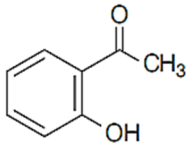
(A) Acetone as substrate and methanol in excess

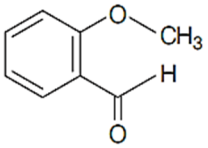
(B) Propanal as substrate and methanol in stoichiometric amount

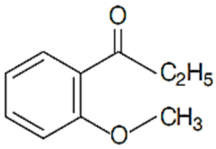
(C) Acetone as substrate and methanol in stoichiometric amount

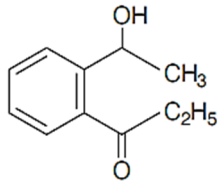
(D) Propanal as substrate and methanol in excess

49. An organic compound neither reacts with neutral ferric chloride solution nor with Fehling solution. It however, reacts with Grignard reagent and gives positive iodoform test. The compound is

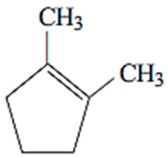
(A) 

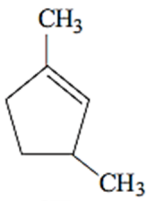
(B) 

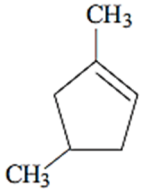
(C) 

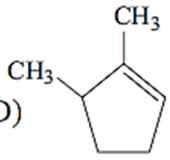
(D) 

50. Which compound would give 5-keto-2-methyl hexanal upon ozonolysis?

(A) 

(B) 

(C) 

(D) 

SECTION – II

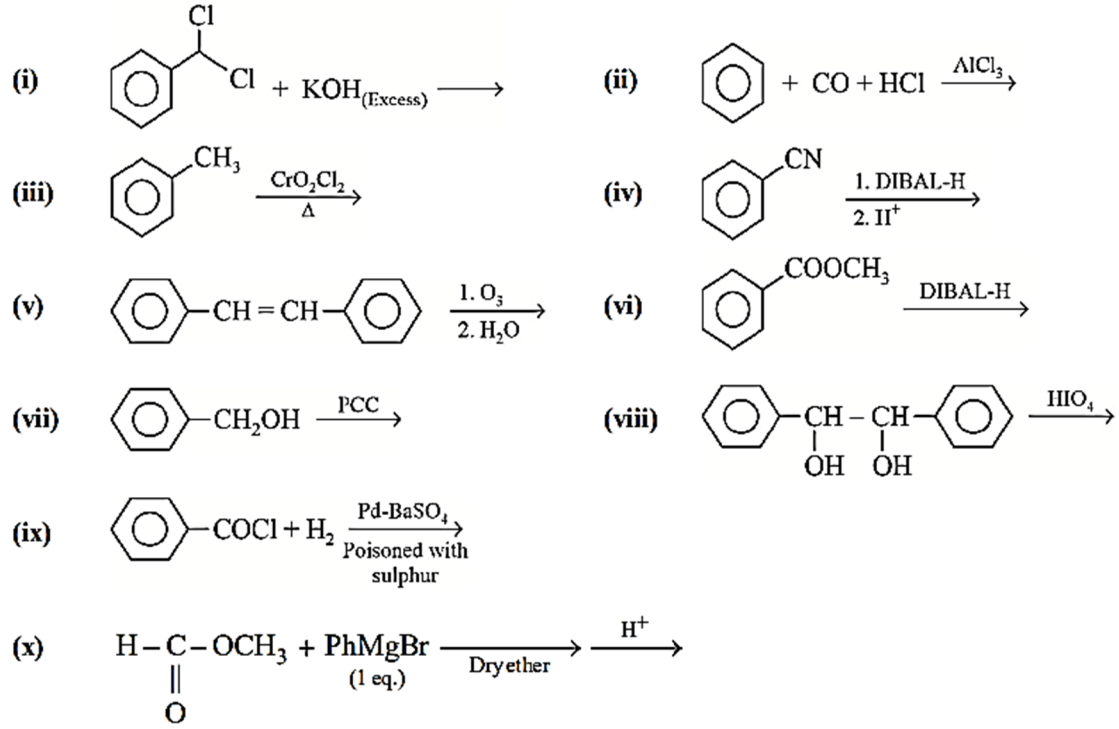
(Numerical Value Answer Type)

This section contains 10 questions. The answer to each question is a Numerical values comprising of positive or negative decimal number. **[Answer any Five (5) Integer Questions]**

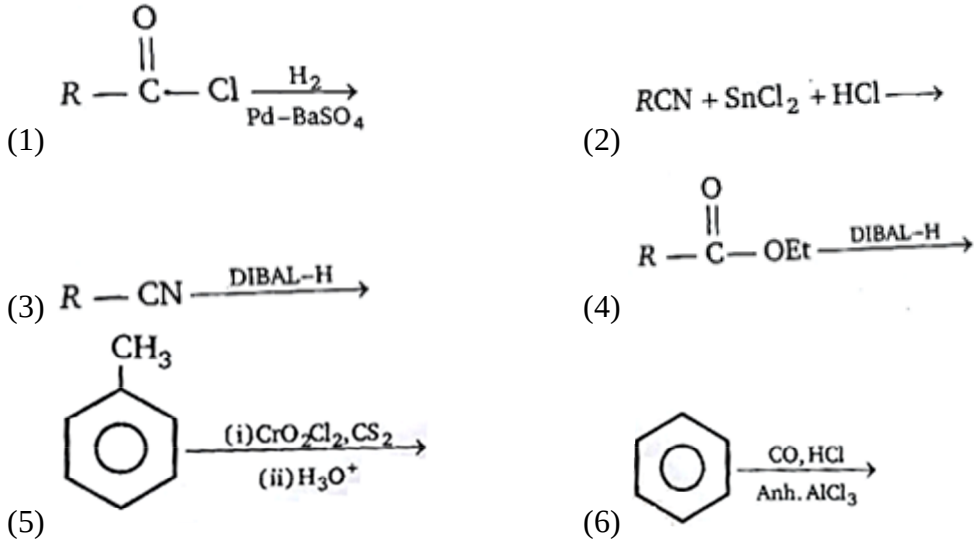
Marking scheme: +4 for correct answer, 0 in all other cases.

51. Consider all possible isomeric ketones, including stereoisomers of MW = 100. All these isomers are independently reacted with $NaBH_4$ (**NOTE:** stereoisomers are also reacted separately). The total number of ketones that give a racemic product(s) is/are

52. How many of the following reactions produce benzaldehyde?

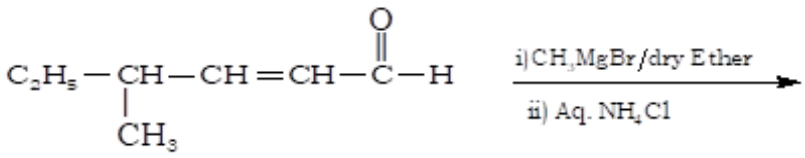


53. If x = number of reactions from which aldehyde can be obtained.



Then x = ?

54.

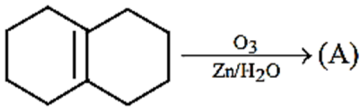


Number of possible isomeric products formed on direct addition

55. What type of isomerism is shown by all isomers possible with formula $C_4H_{10}O$ (write number).

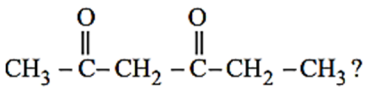
56. How many isomers are possible with molecular formula C_2H_4O

57. Go through the following reaction :

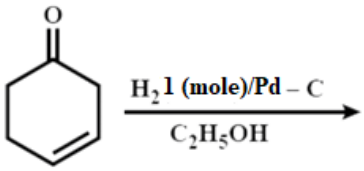


The degree of unsaturation in the product (A) is…..

58. During ozonolysis of mixture of 2 mol each of m–xylene and o–xylene, maximum no of moles of methyl glyoxal generated is/are_____.

59. How many enol forms are possible for  ?

60. In the following reaction, the molecular mass of product is M. The value of M/41 is..



MATHEMATICS **Max. Marks :100**

SECTION – I

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 in all other cases.

61. Let f and g be differentiable function such that $f'(x)=2g(x)$, $g'(x)=-f(x)$, and let $T(x) = (f(x))^2 - (g(x))^2$. Then $T'(x)$ is equal to

(A) $T(x)$ (B) 0

(C) $2f(x)\,g(x)$ (D) $6f(x)\,g(x)$

62. If $y^2 = P(x)$ is a polynomial of degree 3, then $2\dfrac{d}{dx}\left(y^3\dfrac{d^2y}{dx^2}\right)$ is equal to

(A) $P(x)+P'(x)$ (B) $P(x)P'(x)$

(C) $P(x)P'''(x)$ (D) a constant

63. The solution set of $f'(x)>g'(x)$ where $f(x)=\dfrac{5^{2x+1}}{2}$ and $g(x)=5^x+4x\log_e 5$ is

(A) $(1,\infty)$ (B) $(0, 1)$ (C) $[0,\infty)$ (D) $(0,\infty)$

64. Let $f(x)=\sin x$; $g(x)=x^2$ and $h(x) = \log_e x$. If $u(x) = h(f(g(x)))$, then $\dfrac{d^2u}{dx^2}$ is

(A) $2\cos^3 x$ (B) $2\cot x^2 - 4x^2\,\text{cosec}^2 x^2$

(C) $2x\cot x^2$ (D) $-2\,\text{cosec}^2 x$

65. If $y = e^{\sqrt{x}} + e^{-\sqrt{x}}$ then $xy_2 + \dfrac{y_1}{2}$ is equal to

(A) y (B) $x\left(e^{\sqrt{x}} + e^{-\sqrt{x}}\right)$ (C) $\dfrac{y}{4}$ (D) $y\sqrt{x}$

66. The function f(x) satisfying $\dfrac{f(b)-f(a)}{b-a} \neq f'(x)$ for any $x\in(a,b)$ is

(A) $f(x)=x^{1/3}$, $a=-1$, $b=1$ (B) $f(x)=\begin{cases}2 & x=1\\ x^2 & 1<x<2\\ 1 & x=2\end{cases}$, $a=1$, $b=2$

(C) $f(x)=x|x|$; $a=-1$, $b=1$ (D) $f(x)=1/x$; $a=1$, $b=4$

67. If $y = 2x + \cot^{-1} x + \log_e\left(\sqrt{1+x^2}-x\right)$, then y

(A) decreases on $(-\infty,\infty)$ (B) decreases on $[0,\infty)$

(C) neither decreases nor increases on $[0,\infty)$ (D) increases on $(-\infty,\infty)$

68. The two curves $x^3-3xy^2+2=0$ and $3x^2y-y^3-2=0$

(A) cut at right angles (B) touch each other

(C) cut at an angle $\pi/3$ (D) cut at an angle $\pi/4$

69. The sum of the intercepts of a tangent to $\sqrt{x}+\sqrt{y}=\sqrt{a}$, $a>0$ upon the coordinate axes is

(A) 2a (B) a (C) a/2 (D) $\sqrt{a}$

70. The point of intersection of the tangents drawn to the curve $x^2y=1-y$ at the points where it is met by the curve xy = 1 – y is given by

(A) $(0,-1)$ (B) (1, 1) (C) (0, 1) (D) (1, 0)

71. A dynamite blast blows a heavy rock straight up with a launch velocity of 160 m/sec. It reaches a height of $s = 160t - 16t^2$ after t sec. The velocity of the rock when it is 256 m above the ground on the way up is

(A) 98 m/s (B) 96 m/s (C) 104 m/s (D) 48 m/s

72. The point on the curve $y^3+3x^2=12y$ where the tangent is vertical is

(A) $(\pm 4/\sqrt{3},-2)$ (B) $(\pm\sqrt{11/3},1)$ (C) (0, 0) (D) $(\pm 4/\sqrt{3},2)$

73. The slope of the tangent to the curve represented by $x=t^2+3t-8$ and $y=2t^2-2t-5$ at the point $M(2,-1)$ is

(A) 7/6 (B) 2/3

(C) 3/2 (D) 6/7

74. A triangle has two of its vertices at P (a, 0), Q(0, b) and the third vertex R(x, y) is moving along the straight line y = x. If A be the area of the triangle, then $\frac{dA}{dx}=$

(A) $\frac{a-b}{2}$ (B) $\frac{a-b}{4}$ (C) $\frac{a+b}{2}$ (D) $\frac{a+b}{4}$

75. If $x=\sec\theta-\cos\theta$, $y=\sec^n\theta-\cos^n\theta$, then $\left(x^2+4\right)\left(\frac{dy}{dx}\right)^2$ is equal to

(A) $n^2\left(y^2-4\right)$ (B) $n^2\left(4-y^2\right)$ (C) $n^2\left(y^2+4\right)$ (D) n^2y^2

76. If f, g, h are differentiable functions of x and $\Delta=\begin{vmatrix} f & g & h \\ (xf)' & (xg)' & (xh)' \\ (x^2f)'' & (x^2g)'' & (x^2h)'' \end{vmatrix}$ then Δ'(the derivative of Δ with respect to x) is given by

(A) $\begin{vmatrix} f' & g' & h' \\ f & g & h \\ (x^3f'')' & (x^3g'')' & (x^3h'')' \end{vmatrix}$ (B) $\begin{vmatrix} f & g & h \\ f' & g' & h' \\ (x^2f'')' & (x^2g'')' & (x^2h'')' \end{vmatrix}$

(C) $\begin{vmatrix} f & g & h \\ f' & g' & h' \\ (x^3f'')' & (x^3g'')' & (x^3h'')' \end{vmatrix}$ (D) 0

77. If $f(x) = xe^{x(1-x)}$ then f(x) is

(A) increasing on $\left[-\frac{1}{2}, 1\right]$ (B) decreasing on R

(C) increasing on R (D) decreasing on $\left[-\frac{1}{2}, 1\right]$

78. The two curves $y^2 = 4x$ and $x^2 + y^2 - 6x + 1 = 0$ at the point (1, 2)

(A) intersect orthogonally (B) intersect at an angle $\frac{\pi}{3}$

(C) touch each other (D) are parallel

79. The angle between the tangents to the curve $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at the points (a, 0) and (0, b) is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{6}$

80. The value of *a* in order that f(x) = sin x – cos x – *a*x + *b* decreases for all real values is given by

(A) $a \geq \sqrt{2}$ (B) $a < \sqrt{2}$ (C) $a \geq 1$ (D) $a < 1$

SECTION – II

(Numerical Value Answer Type)

This section contains 10 questions. The answer to each question is a Numerical values comprising of positive or negative decimal number. [**Answer any Five (5) Integer Questions]**

Marking scheme: +4 for correct answer, 0 in all other cases.

81. If $f(x) = \cot^{-1}\left(\frac{x^x - x^{-x}}{2}\right)$, then $|f'(1)|$ equals

82. If $f(0) = 0$, $f'(0) = 2$ then the derivative of $y = \frac{f(f(f(f(x))))}{4}$ at x = 0 is

83. If $f(x) = |x - 2|$ and $g(x) = f(f(x))$, then for x > 20, $g'(x)$ is equal to

84. Let $f\left(\frac{x+y}{2}\right)=\frac{1}{2}[f(x)+f(y)]$ for real x and y. If $f'(0)$ exists and equals – 1 and f(0) = 1 then the value of $|f(2)|$ is

85. If A square units is the area formed by the positive x-axis, and the normal and tangent to the circle $x^2+y^2=4$ at $(1, \sqrt{3})$ then $\frac{A}{\sqrt{3}}$ is equal to

86. If the point on $y = x \tan\alpha - \frac{ax^2}{u^2\cos^2\alpha}, (\alpha > 0)$, where the tangent is parallel to y = x has an ordinate $u^2/4a$, then $4\sin^2\alpha$ is equal to

87. The function f(x) = 2 log (x – 2) – x^2 + 4x + 1 increases in the interval (m, n), $m, n \in N$ then the value of m + n is

88. Let f be a function defined for all $x \in R$. If f is differentiable and $f(x^3)=x^5$ for all $x \in R\ (x \neq 0)$, then the value of $\frac{f'(27)}{5}$ is

89. The curve $y=ax^3+bx^2+cx$ is inclined at 45° to x-axis at (0, 0) but it touches x-axis at (1, 0), then the value of $\frac{|a+b|}{c}, a, b, c \in Z$ is

90. The range of values of 'a' for which the function $f(x)=x^3+(a+2)x^2+3ax+5$ may be monotonic in R, is (m, n), $m, n \in Z$ then the value of m + n is

DETAILS OF PAPER SETTER :

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