JEE-MAIN

MODEL GRAND TEST

IMPORTANT INSTRUCTIONS:

1. Immediately fill in the Admission number on this page of the Test Booklet with **Blue/Black** Ball Point Pen only.
2. The candidates should not write their Admission Number anywhere (except in the specified space) on the Test Booklet/ Answer Sheet.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of 90 questions. The maximum marks are **300.**
5. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry** and **Mathematics** having **30 questions** in each subject and subject having **two sections.**
   (I) Section –I contains 20 **multiple choice** questions with only one correct option.
   Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.
   (II) Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only, if more than 5 questions attempted, First 5 attempted questions will be considered.

- The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**
  To cancel any attempted question bubble on the question number box.
  For example: To cancel attempted question 21. Bubble on 21 as shown below

Question Answered for Marking **Question Cancelled for Marking**
Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

6. Use **Blue / Black Point Pen only** for writing particulars / marking responses on the Answer Sheet. **Use of pencil is strictly prohibited.**
7. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electron device etc, except the Identity Card inside the examination hall.
8. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
9. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
10. **Do not fold of make any stray marks on the Answer Sheet**

PHYSICS

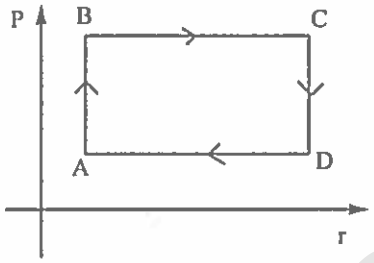
Section –A

(SINGLE CORRECT ANSWER TYPE)

1. Two radio active elements A and B have initially activity 10 Curie & 20 Curic Respectively. If A has twice the no. of moles as that of 'B'.The decay constant λ_A and λ_B can be

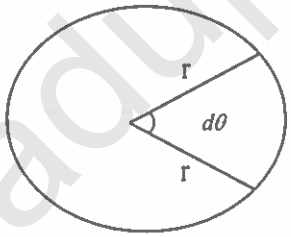
(1) (10 , 5) (2) (5 , 20) (3) (20,10) (4) (50, 100)

2. For path ABC, Heat given to the system is 60J and workdone by the system is 30J. For path ADC, work done by the system is 10J. The heat given to the system for path ADC is



(1) 100J (2) 80J (3) 40J (4) 60 J

3. A plant of mass in having angular momentum 'L' is revolving around the sun. the areal velocity of the plant will be



(1) L/m (2) L/2m (3) 2L/m (4) L/4m

4. The velocity of a particle 'v' at any instant is $\overline{v} = y\hat{i} + x\hat{j}$.The equation of trajectory of the particle is

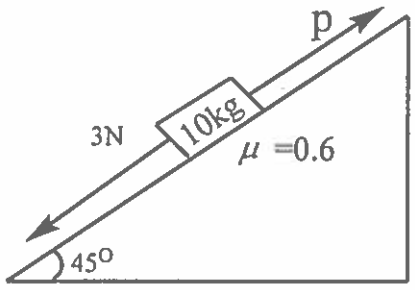
(1) $x^2 + y^2$ = constant (2) $y^2 = x^2$ + constant

(3) xy = constant (4) None

5. A proton and an alpha particle of the same velocity enter in a uniform magnetic field which is acting perpendicular to their direction of motion. The ratio of the radii of the circular paths described by the alpha particle and proton is

(1) 1:4 (2) 4:1 (3) 2:1 (4) 1:2

6. A block of mass 10kg is kept on a rough inclined plane as shown in figure. The coefficient of friction between the block and surface is 0.6. Two forces of magnitude 3N and P Newtons are acting on the block as shown figure. If friction on the block is acting upwards then minimum value of 'p' for which block remains at rest is



(1) 64N (2) 32 N (3) 12 N (4) 3 N

7. If current in a current currying wire is 1.5 A, number of free electrons per unit volume is $8\times10^{28}m^3$ and area of cross sectin is $5mm^2$ .Drift velocity of electrons will be

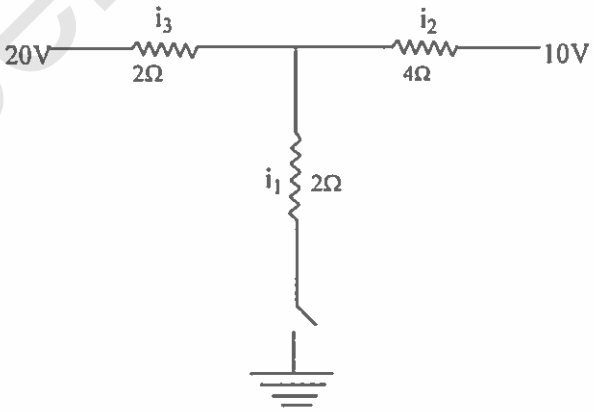
(1) 0.02 m/s (2) 2 mm/s

(3) 0.2 mm/s (4) None of these

8. In mixture 2 mole of He and 1 mole if Ar is present. Find $\frac{(V_{RMS})_{He}}{(V_{RMS})_{Ar}}$ at 300k

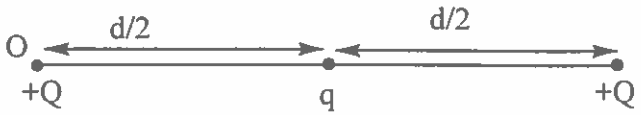
(1) 6.32 (2) 1.58 (3) 3.16 (4) 10

9. Value of I, (Ampere) when swith is closed is



(1) 2 (2) 5 (3) 10 (4) 1

10. If net force on charge kept at '0' is zero. The value of 'q' is



(1) + Q/2 (2) – Q/2 (3) + Q/4 (4) – Q/4

11. The bulk modulus of a liquid is $3\times10^{10} N/m^2$. The pressure required to reduce the volume of the liquid by 2% is

(1) $3\times10^{8} N/m^2$ (2) $9\times10^{8} N/m^2$ (3) $6\times10^{8} N/m^2$ (4) $12\times10^{8} N/m^2$

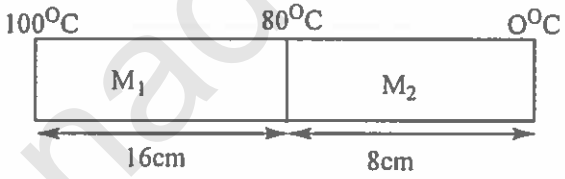
12. A particle experiences a variable force $\vec{F}=(4x\hat{i}+3y^2.\hat{J})$ in a horizontal x- y plane. Assume distance in meters and

force on Newtons. If the particle moves from port (1,2) to point (2,3) in the x-y plane. Then the kinetic energy changes by

(1) 50J (2) 12.5 J (3) 25.J (4) 0J

13. Two metallic blocks M_1 and M_2 of same area of cross-section are connected toeach other (as shown in figure). If the thermal conductivity of M_2 is k then the thermal conductivity of M_1 will be

[Assume stady state hent conduction]



(1) 10k (2) 8k (3) 12.5 k (4) 2k

14. A carnot engine whose heat sinks at $27^{O}C$, has an efficiency of 25%. By how many degrees should the tempeture of the source be changed to increases the efficiency by 100% of the original efficiency?

(1) Increases by $18^{O}C$ (2) increases by $200^{O}C$

(3) increases by $120^{O}C$ (4) increases by $73^{O}C$

15. The equations of two waves are given by $y_1=5\sin 2\pi(x-vt)cm, y_2=3\sin 2\pi(x-vt+1.5)cm$. These waves are simultaneously passing through a string. The amplitude of the resulting wave is

(1) 2 cm (2) 4 cm (3) 5.8 cm (4) 8 cm

16. Identify the pair of physical quentities which have different dimensions

(1) Wave number and Rydberg's constent

(2) Stress and Cofficient of Elasticity

(3) Coercivity and magnetisation

(4) Specific heat capacity and Latent heat

17. Nucleus A is having mass number 220 and it's binding energy per nucleon is 5.6 Mev. It splits in two fragments B and C of mass numbers 105 and 115. The binding energy of nucleons in B and C is 6.4 Mev per nucleon. The energy Q released for fission will be.

(1) 0.8 Mev (2) 275 Mev (3) 220 Mev (4) 176 Mev

18. A fly wheel is accelerated uniformly from rest and rotates through 5 rad in the first second. The angle rotated by the fly wheel in the next second, will be

(1) 7.5 rad (2) 15 rad (3) 20 rad (4) 30 rad

19. If the charge on a capacitor is increased by 2C, the energy stored in it increases by 44%. The original charge on the capacitor is (in C)

(1) 10 (2) 20 (3) 30 (4) 40

20. Two light beams of intensities in the ratio of 9:4 are allowed to interfere. The ration of the intensity of maxima and minima will be

(1) 2 : 3 (2) 16 : 81 (3) 9 : 3 (4) 25 : 1

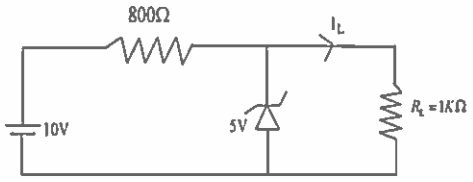
Section-B
(NUMERICAL VALUE TYPE)

21. A body is projected from the ground at an angle of 45^{o} with the horizontal. It's velocity after 2s is 20 m/s. The maximum height reached by the body during it's motion is _____m. (use $g = 10\,m/s^2$)

22. An antenna is placed in a dielectric medium of dielectric constant 6.25. If the maximum size of the antenna is 5.0mm, it can radiate a signal of minimum frequency of _____ GHz ($\mu_r = 1$ for dielectric medium)

23. A potentiometer wire of length 10m and resistance 20Ω is connected in series with a 25V battery and external resistance 30Ω. A cell of emf E in secondary circuit is balanced by 250 cm long potentiometer wire. The value of E (in Volt) is $x/10$. Then the value of 'x' is _____

24. In the given circuit, the value of current I_L will be _____ mA (When $R_L = 1K\Omega$)

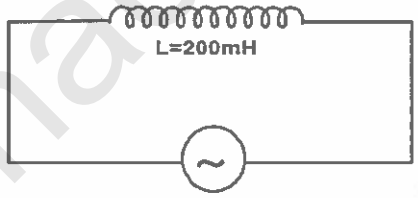


25. 0.056 kg of Nitrogen is enclosed in a vessel at a temperature of $127^{O}C$. The amount of heat required to double the speed of its molecules is _____ k cal

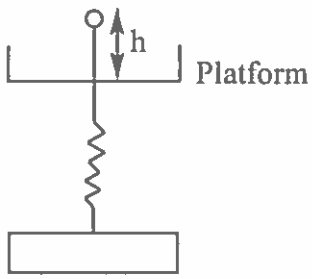
26. The metallic bob of simple pendulum has the relative density 5. The time period of this pendulum is 10s. If the metallic bob is immersed in water, then the new time period becomes $5\sqrt{x}\ s$. Then the value of 'x' is _____

27. Two radio active materials A and B have decay constants 25λ and 16λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of B to that of A will be 'e' after a time $\frac{1}{a\lambda}$. The value of a is _____

28. As shown in the figure an inductor of inductone 200 mH is connected to an AC source of emf 220V and frequency 50 Hz. The instantaneous voltage of the source is 0v when the peak value of current is $\frac{\sqrt{a}}{\pi}$ A. The value of 'a' is _____



29. A ball of mass 100g is dropped from a height h = 10 cm on a plat form fixed at the top of a vertical spring (as shown figure). The ball stays on the platform and the platform is dipressed by a distance h/2 spring constant is ____ N/m ($g = 10m/s^2$)



30. A ray of light is incident at an angle of incidence 60^o on the glass slab of refractive index $\sqrt{3}$. After regraction, the light ray emerges out from other parallel faces and lateral shift between incident ray and emergent ray is $4\sqrt{3}\,cm$. The thickness of the glass lab is _____ cm

CHEMISTRY

Section –A

(SINGLE CORRECT ANSWER TYPE)

31. Statement-I: When $AgNO_3$ solution is stirred with a spoon made of copper, solution turns blue.

Statement-II: In electro chemical series, Copper is above Silver

1) Both Statements I,II are true
2) Both Statements I,II are false
3) Statement-I is true, II is false
4) Statement-I is false, II is true

32. Assertion (A) : Solubility of gases in liquids decreases with rise in temperature

Reason(R): Dissolution of gases in liquids is exothermic reaction

1) Both A and R True and R is correct explanation of A
2) Both A and R True and R is not correct explanation of A
3) A is true ; R is false
4) A is false ; R is true

33. The number of moles of $KMnO_4$ that will be needed to react with one mole of ferrous sulphite in acidic medium is

1) 0.4
2) 0.6
3) 0.8
4) 1.0

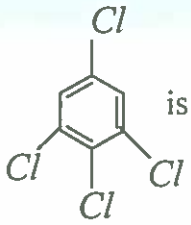
34. Consider the following oxidation/reduction process

a) $N_2 \xrightarrow{+e^-} N_2^{-1}$

b) $N_2 \xrightarrow{-e^-} N_2^{+1}$ c) $O_2 \xrightarrow{-e^-} O_2^{+1}$

d) $O_2^{+1} \xrightarrow{+2e^-} O_2^{-1}$ Magnetic moment does not change in

1) a
2) b
3) c
4) d

35. Dipole moment of  is 1.5D. Thus dipole moment of  is

1) 0.00D 2) 1.5D 3) 2.0D 4) 3.0D

36. The molarity of a solution obtained by mixing 750ml of 0.5M HCl with 250ml of 2M HCl will be

1) 0.875 2) 1M 3) 1.75M 4) 0.0975M

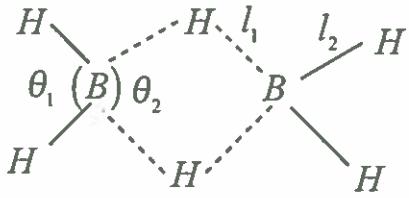
37. The ionic mobility of alkalimetal ions in aqeous solution is maximum for

1) K^+ 2) Rb^+ 3) Li^+ 4) Na^+

38. Correct order of basic strength is

1) $AsH_3 > SbH_3 > PH_3 > NH_3$ 2) $SbH_3 > AsH_3 > PH_3 > NH_3$

3) $NH_3 > PH_3 > AsH_3 > SbH_3$ 4) $PH_3 > AsH_3 > SbH_3 > NH_3$

39. In B_2H_6 

Select the correct statement

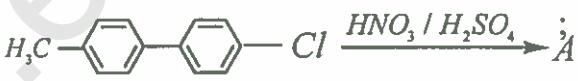
1) Bond angle $\theta_1 > \theta_2$ 2) Bond angle $\theta_2 > \theta_1$

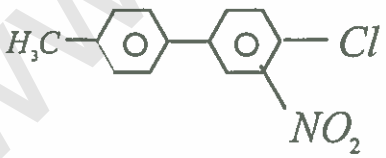
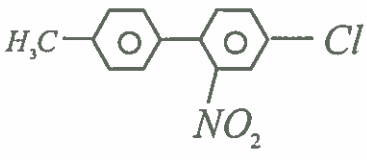
3) Bond length $l_1 = l_2$ 4) Bond length $l_2 > l_1$

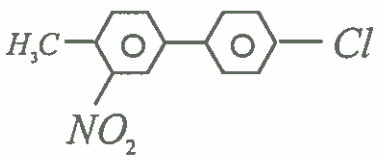
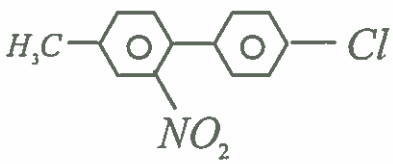
40. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in order

1) $GeX_2 < SiX_2 < SnX_2 < PbX_2$ 2) $SiX_2 < GeX_2 < PbX_2 < SnX_2$

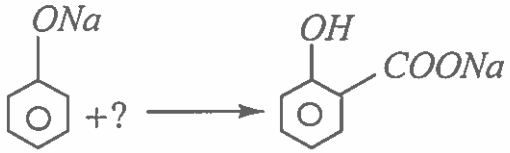
3) $SiX_2 < GeX_2 < SnX_2 < PbX_2$ 4) $PbX_2 < SnX_2 < GeX_2 < SiX_2$

41. The reaction  'A' (major) product is

1)  2) 

3)  4) 

42. Which one is missing reagent of Kolbe-Schmidt reaction



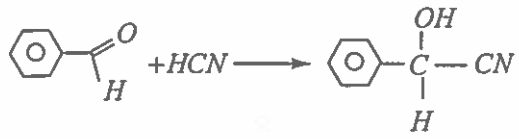
1) $HCOOEt$ 2) $(EtO)_2C=0$ 3) CO_2 4) $HCOONa$

43. Which of the following is not a synthesis of benzophenone $C_6H_5COC_6H_5$

1) $C_6H_6 + C_6H_5COCl \xrightarrow{AlCl_3}$ 2) $(C_6H_5)_2CHOH \xrightarrow[Acetone]{H_2CrO_4}$

3) $(C_6H_5)_2C=CH_2 \xrightarrow[(ii)Zn,HOAC]{(i)O_3}$ 4) $C_6H_5COOH + 2C_6H_5Li \xrightarrow[(ii)H_2O]{(i)Ether}$

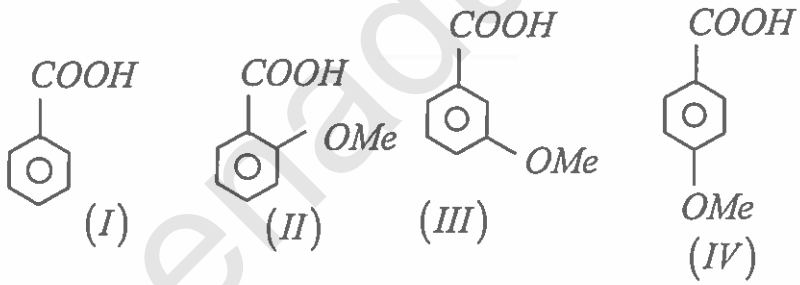
44. In the reaction given below, the product would be



1) a recemic mixture 2) Optically inactive

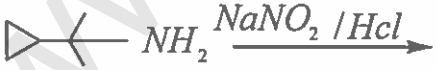
3) A meso compound 4) A mixture of diastereomers

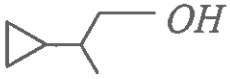
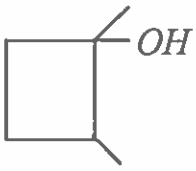
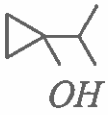
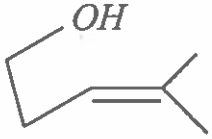
45. Arrange the following in decreasing order of acidic strength



1) $II > III > I = IV$ 2) $III > II > I > IV$

3) $II > III > I > IV$ 4) $I > II > III > IV$

46.  product the major product in the reaction is

1)  2)  3)  4) 

47. In both DNA and RNA, the heterocyclic base and phosphate ester linkages are at

1) C_5 & C_2 resp. Of the sugar molecule
2) C_2 & C_5 resp. Of the sugar molecule
3) C_1 & C_5 resp. Of the sugar molecule
4) C_5 & C_1 resp. Of the sugar molecule

48. If $NaCl$ is doped with $10^{-3} mole\%$ of $SrCl_2$ then number of cationic vacancies produced is

1) $10^{-5} mole^{-1}$
2) $6.02\times10^{20} mol^{-1}$
3) $6.02\times10^{18} mol^{-1}$
4) $6.02\times10^{-18} mol^{-1}$

49. Which has highest boiling point

1) $0.1M\ Na_2SO_4$
2) $0.1M\ C_6H_{12}O_6$
3) $0.1M\ MgCl_2$
4) $0.1M\ Al(NO_3)_3$

50. In Lyman series, shortest wavelength of H-atom appears at "x"m, then longest wavelength in Balmer series of He^+ appear at

1) $\frac{9x}{5}m$
2) $\frac{36x}{5}m$
3) $\frac{x}{4}m$
4) $\frac{5x}{9}m$

Section-B
(NUMERICAL VALUE TYPE)

51. For reaction, $A\rightarrow B$, half life time for a reaction at $[A]=0.1M$ is 200sec. And at $[A]=0.4M$ is 50sec. Thus order of the reaction is _____

52. On free radical chlorination reaction of butane how many different, dichloro alkanes would be formed? (both structural and stereo)

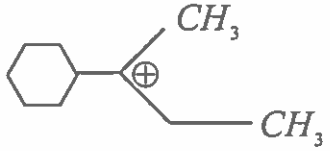
53. Graph between $\log\left(\frac{x}{m}\right)$ and $\log' p'$ is a straight line inclined at an angle of 45^0 and $\log k = 0.699$ for Freundlich's adsorption isotherm. Here $\frac{x}{m}$ is amount of adsorbate adsorbed per gram of adsorbent and given pressure $P = 0.8atm$

54. How many of the following are green house gases

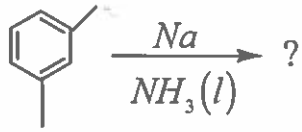
a) CO_2 b) CO c) O_3
d) $H_2O(vapour)$ e) NO f) $CFC'S$ g) C_2H_6 h) SO_3

55. $Fe_4\left[Fe(CN)_6\right]_3$ (Prussian blue) dissolves in excess $K_4\left[Fe(CN)_6\right]$ forming $KFe\left[Fe(CN)_6\right]$. Sum of oxidation number of iron atoms in it is _____

56. The total number of contributing structures showing hyper conjugation for the following Carbocation is



57. How many πe^- are present in the major product formed in the given reaction



58. 34.05ml of phosphrous vapour P_x weighs 0.0625gms at 546^0C and 1 bar pressure what is the value of x.

59. How many of the following has zero standard molar enthalpy of formation at 298K

a) $H_2O_{(s)}$ b) $H_{2(g)}$ c) $Br_{2(g)}$

d) $Cl_{2(g)}$ e) $CH_{4(g)}$ f) $H_2O_{(l)}$

g) $C_{(graphite)}$

60. $M(OH)_x$ has $K_{SP}=4\times10^{-12}$ and solubility $1\times10^{-4}M$. what is the value of x?

MATHEMATICS

Section – A

(SINGLE CORRECT ANSWER TYPE)

61. If the circle $(x-h)^2+(y-k)^2=r^2\ k>0$ touch $x-axis$ at $(1,0)$. If the line $x+y=0$ intercepts the circle at a P and Q such that the length of the chord PQ is 2 then the value of h+kr is

(1) 7 (2)9 (3) 10 (4) 4

62. If three squares are selected at random from chess board, then the probability that they form the letter "L" is

(1) $\frac{196}{64_{C_3}}$ (2) $\frac{49}{64_{C_3}}$ (3) $\frac{36}{64_{C_3}}$ (4) $\frac{98}{64_{C_3}}$

63. Let $x_1, x_2, ...x_n$ be "n" observations such that $\sum xi^2 = 400$ and $\sum xi = 80$. Then, a possible value of "n" among the following is

(1) 12 (2)9 (3) 18 (4)15

64. If the sum of the first n terms of the series $\sqrt{3}+\sqrt{75}+\sqrt{243}+\sqrt{507}+.....$ is $435\sqrt{3}$ then n equals

(1) 18 (2) 15 (3)13 (4) 29

65. Let $\vec{a}, \vec{b}$ and $\vec{c}$ are three non-zero vectors such that no two of them are collinear and $\left(\vec{a}\times\vec{b}\right)\times\vec{c} = \frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}$. If θ is the angle between vectors $\vec{b}$ and $\vec{c}$ then value of $\sin\theta$ is

(1) $\frac{2}{3}$ (2) $\frac{-2\sqrt{3}}{3}$ (3) $\frac{2\sqrt{2}}{3}$ (4) $\frac{-\sqrt{2}}{3}$

66. $z = \frac{\sqrt{3}}{2}+\frac{i}{2}\left(i=\sqrt{-1}\right)$ then $\left(1+iz+z^5+iz^8\right)^9$ is equal to

(1) $(-1+2i)^9$ (2) 0 (3) 1 (4) -1

67. Domain of function $f(x) = \ln\left|\frac{2b^2+x^2}{b^3-x^3}-\frac{2x}{bx+b^2+x^2}-\frac{1}{b-x}\right|$ is

(1) R (2) R^+ (3) $R-\left\{\frac{b}{2}\right\}$ (4) $R-\left\{b,\frac{b}{2}\right\}$

68. If $A=\left\{x: x^2-5x+6=0\right\}, B=\{2,4\}, C=\{4,5\}$ then $A\times(B\cap C)=$

(1) $\{(2,4),(3,4)\}$ (2) $\{(4,2),(4,3)\}$

(3) $\{(2,4),(4,4)\}$ (4) $\{(2,2),(3,3),(4,4),(5,5)\}$

69. The Boolean expression $(p\wedge\sim q)\Rightarrow(q\vee\sim p)$ is equivalent to

(1) $q\Rightarrow p$ (2) $p\Rightarrow q$ (3) $\sim q\Rightarrow p$ (4) $p\Rightarrow\sim q$

70. For the equation $3x^2+px+3=0, p>0$, if one of the roots is the square of the other, the integral value of p=___

(1) 1 (2) 3 (3) 5 (4) 9

71. If $\frac{x}{a}+\frac{y}{b}=1, \frac{x}{c}+\frac{y}{d}=1$ intersects the axes at four concyclic points and $a^2+c^2=b^2+d^2$ then these lines (can intersect at (a,b,c,d>0)

(1) $(1,\pm 1)$ (2) $(2,\pm 2)$

(3) $(3,\pm 3)$ (4) All the three points

72. If $f: R \to R$ is a function defined by $f(x)=\max\{x,x^3\}$ then set of all the points where $f(x)$ is not differentiable is

(1) $\{-1,1\}$ (2) $\{-1,0\}$ (3) $\{0,1\}$ (4) $\{-1,0,1\}$

73. The set of points of discontinuity of the function $f(x)=\underset{n\to\infty}{Lt}\frac{(2\sin x)^{2n}}{3^n-(2\cos x)^{2n}}$ is given by

(1) R (2) $n\pi\pm\frac{\pi}{3}, n\in z$ (3) $n\pi\pm\frac{\pi}{6}, n\in z$ (4) $n\pi, n\in z$

74. If the tangent to the curve $2y^3=ax^2+x^3$ at the point $(a,a), a>0$, cuts of the intercepts α and β on the axes where $\alpha^2+\beta^2=61$, then $a=$ ___

(1) 60 (2) 10 (3) 20 (4) 30

75. If $a=\omega\neq 1$, is a cube root of unity, $b=-785, c=2008i$ and $\Delta=\begin{vmatrix} a & a+b & a+b+c \\ 2a & 3a+2b & 4a+3b+2c \\ 3a & 6a+3b & 10a+6b+3c \end{vmatrix}$ then Δ equals

(1) $-i$ (2) i (3) 1 (4) $1-\omega i$

76. If $y=y(x)$ be the solution of the differential equation $xdy=(y+x^3\cos x)dx$ with $y(\pi)=0$ then $y\left(\frac{\pi}{2}\right)=$

(1) $\frac{\pi^2}{4}+\frac{\pi}{2}$ (2) $\frac{\pi^2}{2}+\frac{\pi}{4}$ (3) $\frac{\pi^2}{2}-\frac{\pi}{4}$ (4) $\frac{\pi^2}{4}-\frac{\pi}{2}$

77. The area of the region $\{(x,y)\in R^2 / 4x^2\le y\le 8x+12\}$ is

(1) $\frac{127}{3}$ (2) $\frac{128}{3}$ (3) $\frac{124}{3}$ (4) $\frac{125}{3}$

78. $\int \frac{5x^8+7x^6}{\left(x^2+1+2x^7\right)^2}dx = f(x)$ and $f(0)=0$ then $f(1)=$

(1) $-\frac{1}{2}$ (2) $-\frac{1}{4}$ (3) $\frac{1}{2}$ (4) $\frac{1}{4}$

79. $\lim_{n\to\infty}\left[\frac{n^2}{\left(n^2+1\right)(n+1)}+\frac{n^2}{\left(n^2+4\right)(n+2)}+\frac{n^2}{\left(n^2+9\right)(n+3)}\ldots\ldots\right]$ upto n terms] =

(1) $\frac{\pi}{8}+\frac{1}{4}\log 2$ (2) $\frac{\pi}{4}+\frac{1}{8}\log 2$ (3) $\frac{\pi}{4}-\frac{1}{8}\log 2$ (4) $\frac{\pi}{8}+\frac{1}{4}\log 2$

80. The distance of $(1,0,2)$ from the point of intersection of the line $\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{12}$ and plane $x-y+z=16$ is

(1) $2\sqrt{14}$ (2)0 (3) $3\sqrt{21}$ (4)13

Section-B
(NUMERICAL VALUE TYPE)

81. Tangent drawn to the hyperbola $4x^2-3y^2=36$ at the points P and Q intersects at $R(0,3)$ and Area of ΔPQR is $l\sqrt{m}$ then $l+m=$

82. The upper $\frac{3}{4}th$ portion of vertical pole subtends an angle $\tan^{-1}\left(\frac{3}{5}\right)$ at a point in the horizontal plane through its foot and at a distance 40 m from the foot. Given the height of the vertical pole is less than 100 m from the ground. Then the height of the vertical pole is

83. $\frac{\cos^{-1}\left(\frac{41}{49}\right)}{\sin^{-1}\left(\frac{2}{7}\right)}=$

84. The number of values of θ in the interval $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$ satisfying the equation $\left(\sqrt{3}\right)^{\sec^2\theta}=\tan^4\theta+2\tan^2\theta$ is

85. The numbers of different words that can be formed out of the letters of the word 'MORADABAD' taken four at a time is __

86. If the line $\frac{x-3}{2}=\frac{y+2}{-1}=\frac{z+4}{3}$ lies in the plane $lx+my-z=9$ then $l^2+m^2=$

87. $\underset{x\to 0}{Lt}\left[\left[\frac{100x}{\sin x}\right]+\left[\frac{99\sin x}{x}\right]\right]=$

Where [.] denotes the greatest integer function.

88. If $y=8x^3-60x^2+144x+57$ is a decreasing function in the interval (a,b) then $a^3+b^3=$

89. If m is the slope of a common tangent to the curves $\frac{x^2}{16}+\frac{y^2}{9}=1$ and $x^2+y^2=12$ then $12m^2=$

90. If $\left(\frac{3^6}{4^4}\right)K$ is the term, independent of x, in the binomial expansion of $\left(\frac{x}{4}-\frac{12}{x^2}\right)^{12}$, then K is equal to

KEY SHEET

PHYSICS

1	2	2	3	3	2	4	2	5	3
6	2	7	1	8	3	9	2	10	4
11	3	12	3	13	2	14	2	15	1
16	4	17	4	18	2	19	1	20	4
21	20	22	6	23	25	24	5	25	12
26	5	27	9	28	242	29	120	30	12

CHEMISTRY

31	1	32	1	33	2	34	4	35	2
36	1	37	2	38	3	39	1	40	3
41	3	42	3	43	2	44	1	45	3
46	2	47	3	48	3	49	4	50	1
51	2	52	6	53	4	54	5	55	5
56	6	57	4	58	4	59	3	60	2

MATHEMATICS

61	3	62	1	63	3	64	2	65	3
66	4	67	4	68	1	69	2	70	2
71	4	72	4	73	3	74	4	75	3
76	1	77	2	78	4	79	1	80	4
81	50	82	40	83	2	84	2	85	626
86	2	87	198	88	35	89	9	90	55

SOLUTIONS AND HINTS

Physics

1. $\lambda N = A$

$\frac{\lambda_A}{\lambda_B}.\frac{N_A}{N_B} = \frac{A_A}{A_B}$ $\qquad$ $\frac{N_A}{N_B} = 2$

$\frac{\lambda_A}{\lambda_B}(2) = \frac{10}{20} \Rightarrow \frac{\lambda_A}{\lambda_B} = \frac{5}{20}$

2. In process ABC

$\Delta U = 60 - 30 = 30$ J

In process ADC

$\Delta Q = \Delta U + DW = 30 + 10 = 40$

3. $dA = \frac{1}{2}r^2.d\theta \Rightarrow \frac{dA}{dt} = \frac{1}{2}r^2.w = \frac{L}{2m}$

$\left[\because L = \frac{M}{r^2.w}\right]$

4. $\overline{v} = y\hat{i} + x\hat{j}$

$\frac{dx}{dt} = y, \frac{dx}{dt} = ky, \frac{dx}{dt} = kx$; $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx} = \frac{kx}{ky}$

$\int y.dy = \int x.dx \quad \therefore x^2 - y^2 = k$

5. $R = \frac{mv}{qB}$; $\frac{R_\alpha}{R_P} = \frac{m_\alpha / q_\alpha}{m_P / q_P} = 2$; $\frac{y^2}{2} = \frac{x^2}{2} + \text{constant}$

6. $mg\sin\theta + 3 = P + \mu mg\cos\theta$

$\left[10 \times 10 \times \frac{1}{\sqrt{2}}\right] + 3 = p + \left[0.6 \times 10 \times 10 \times \frac{1}{\sqrt{2}}\right] \therefore$ p=32N

7. $v_d = \frac{i}{neA} = \frac{1.5}{1.6 \times 10^{-19} \times 5 \times 10^{-6} \times 8 \times 10^{28}} = 0.02$

8. $V_{RMS} = \sqrt{\frac{3RT}{M}}$

$\frac{(V_{RMS})_{He}}{(V_{RMS})_{Ar}} = \sqrt{\frac{M_{Ar}}{M_{He}}} = \sqrt{\frac{40}{4}} = \sqrt{10} = 3.16$

9. $\frac{v-20}{2}+\frac{v-10}{4}=\frac{v-0}{2}\Rightarrow v=10 \quad ; \quad i=\frac{V}{R}=\frac{10}{2}=5A$

10. Net force of q=0

$\frac{KQ^2}{(d/2)^2}+\frac{K.Q.q}{d^2}=0 \ \therefore q=-\frac{Q}{4}$

11. $B=-\frac{\Delta P}{\frac{\Delta r}{r}} \Rightarrow \Delta P=3\times10^{10}\times0.02 \ =6\times10^8 \ N/m^2$

12. $w=\int\vec{F}.d\vec{r}=\int_1^2 4x.dx+\int_2^3 3y^2.dy \ =2\times3+(27-8)=25.J$

13. $\frac{dQ}{dt}=\frac{\Delta T_1}{\frac{l_1}{k_1.A}}=\frac{\Delta T_2}{\frac{l_2}{k_2.A}} \quad ; \quad \frac{20}{16}\times k^1-\frac{80}{8}\times k\Rightarrow k^1=8k$

14. Initially. $\frac{1}{4}=1-\frac{300}{T_H}\Rightarrow T_H=400k$

Finally It becomes $\frac{1}{2} \Rightarrow \frac{1}{2}=1-\frac{300}{T_H}$

$\therefore T_H=600k \ \therefore$ Thempeture of the source increages by 200^OC

15. $A=\sqrt{A_1^2+A_2^2+2A_1A_2cos\theta} \quad ; \quad A=\sqrt{(5)+(3)^2+2(5)(3).\cos(3\pi)}=2cm$

16. $S=\frac{Q}{m.\Delta t}$ and $L=\frac{Q}{m}$ both have different dimencsions

17. $^{220}A\rightarrow{}^{105}B+{}^{115}C$

$Q=[105\times6.4+115\times6.4]-[220\times5.6]Mev$

Q = 176 Mev

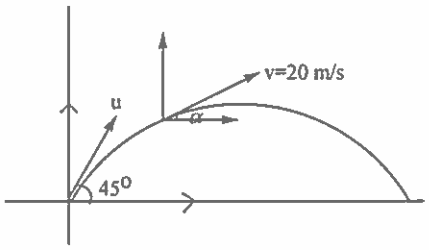
18. $\theta_1=\frac{1}{2}\times(2\times1-1)$

$5=\frac{1}{2}.\alpha \ \Rightarrow \alpha=10.rad/S^2$

$\theta_2=\frac{1}{2}.\alpha(2\times2-1)\Rightarrow\theta_2=\frac{1}{2}\times10\times3=15rad$

19. $u_i=\frac{q^2}{2c}.u_f=\frac{(q+2)^2}{2c} \quad ; \quad \frac{u_f-vi}{vi}\times100=44 \ \Rightarrow q=10C$

20. $\frac{I_{max}}{I_{min}}=\left(\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right)^2=(5/1)^2=25/1$

21. 

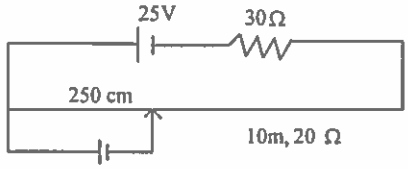
$VCos\alpha = u.Cos45^O \quad ; \quad VSin\alpha = uSin45^O - gt$

On Solvingwe get u = $20\sqrt{2}\ m/s$

$$H = \frac{u^2.\sin^2 45^O}{2g} = 20.m$$

22. $V = f\lambda$

$$\frac{3\times10^8}{\sqrt{6.25}} = f\times20\times10^{-3} \Rightarrow f = 6\times10^9\ Hz$$

23. 

$$\therefore E = I\times\frac{20}{4} = \frac{25}{30+20}\times\frac{20}{4} \quad ; \quad E = \frac{1}{2}\times5 = 2.5v$$

$$E = \frac{25}{10} \quad ; \quad \frac{x}{10} = \frac{25}{10} \quad ; \quad X = 25$$

24. $V_L = 5V\ as\ V_2 = 5V \quad \therefore I_L = \frac{V_L}{R_L} = \frac{5}{10^3} = 5mA$

25. $v\alpha\sqrt{T}$

$T_f = 1600k, \quad T_i = 400k$

26. $T = 2\pi\sqrt{\frac{l}{g}} = 10$

$$T^1 = 2\pi\sqrt{\frac{l}{g(1-1/\rho)}} = 2\pi\sqrt{\frac{l}{g}\times\frac{5}{4}} = 10\sqrt{5/4} = 5\sqrt{5}$$

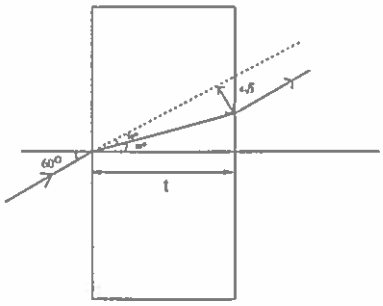
27. $N_A = No.e^{-25\lambda t} \ ; \ N_B = No.e^{-16\lambda t} \quad ; \quad \frac{N_B}{N_A} = e = e^{9\lambda t} \quad ; \quad t = \frac{1}{9\lambda}$

28. $I_{rms} = \frac{V_{rms}}{Z} \ ; Z = X_L = \omega L = 2\pi\times50\times\frac{200}{1000} = 20\pi$

$$\therefore I_{rms} = \frac{220}{20\pi} = \frac{11}{\pi} \quad \therefore I_{peak} = \sqrt{2}\times\frac{11}{\pi} = \frac{\sqrt{2\times121}}{\pi} = \frac{\sqrt{242}}{\pi} \quad ; \quad a = 242$$

29. $mg(h+h/2)=\frac{1}{2}.k(h/2)^2$

$0.1\times10\times0.15=\frac{1}{2}.k.(0.05)^2 \Rightarrow k=120\,N/m$

30. 

$1\times\sin 60^o=\sqrt{3}\sin r$

$r=30^o \;\therefore I_1=4\sqrt{3}\times2=8\sqrt{3}\,cm$

Thickness $t=l_1\cos30^\circ \;=8\sqrt{3}\times\frac{\sqrt{3}}{2}=12$ cm

Chemistry

31. $Cu+2AgNO_3\rightarrow Cu(NO_3)_2+2Ag$

Blue

In electro chemical series copper is above silver thus it is better reducing agent. When $AgNO_3$ solution is stirred with copper spoon, Ag is displaced and 'Cu' is oxidized to $Cu^{+2}(blue)$. Thus both statements are true.

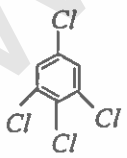
32. Dependence of solubility of a gas on temperature.

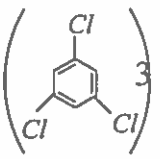
33. $5FeSO_3+3MnO_4^-+H^+\rightarrow5Fe^{+3}+5SO_4^{-2}+3Mn^{+2}$ 5 moles $FeSO_3$ - 3 moles - MnO_4^-

1 mole $FeSO_3=\frac{3}{5}=0.6$

34. In $O_2^+\rightarrow O_2^{-1}$ conversion $(n=1)$

Both ions have same number of unpaired electrons so no change in Magnetic moment.

35. In 

bond moments due to 

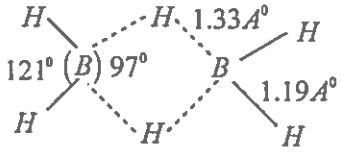
3 'Cl' atoms gets cancelled.

Hence for remaining 'Cl' it becomes 1.5D

36. $M_R = \frac{M_1V_1 + M_2V_2}{V_1 + V_2} = \frac{750 \times 0.5 + 250 \times 2}{750 + 250} = \frac{875}{1000} = 0.875M$

37. Ionic mobilities α size of ion so Rb^+ has more size hence it will be less hydrated hence move fastly.

38. Basic strength of hydrides decreases down group.

39. In Diborane 

$\theta_1 > \theta_2$

40. Due to inert pair effect stability of +2 oxidatin state increases down group so

$Pb^{+2}(PbX_2)$ is more stable

$Si^{+2}(SiX_2)$ is least stable.

41. $-'CH_3'$ being an activating group decides the position of incoming electrophile. So $E^{\oplus}$ adds at ortho position to $-'CH_3'$ group

42. CO_2 is a reactant.

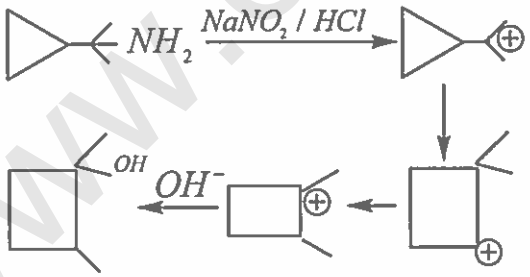
43. In case of oxidation with H_2CrO_4 further reaction may proceed to give Benzoic acid

44. Since CN^- attacks at planar SP^2 – hybridized carbon, the attack is possible from both sides and hence, a recemic mixture is obtained

45. Due to ortho effect II is more acidic in III – I effect only dominates so

$II > III > I > IV$

46. On rearrangement 4 membered ring is formed



47. Linkage positions in DNA and RNA.

48. If $Na^{+1}Cl$ doped with $SrCl_2$, equal number of cationic vacancies are produced as number ions doped

So, $10^{-3}\,mole\%\,SrCl_2 = 10^{-3}\,mole\%$ of Calionic vacancies $= \dfrac{10^{-3}\times 6\times 10^{23}}{100} = 6\times 10^{18}$

49. $\Delta T_b \alpha i$

Greater the value of 'i' higher is boiling point for $Na_2SO_4 \rightleftharpoons 2na^{+} + SO_4^{-2}$ total 3 ions

$i = 1 + 2x$

$C_6H_{12}O_6 \rightleftharpoons C_6H_{12}O_6$ only 1 ion $i = 1$

$MgCl_2 \rightleftharpoons Mg^{+2} + 2Cl^{-}$ $3ions\, i = 1 + 2x$

$Al(NO_3)_3 \rightleftharpoons Al^{+3} + 3NO_3^{-}$ 4 ions $i = 1 + 3x$

50. $\dfrac{1}{\lambda} = \bar{v} = R_H Z^2 \left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)$

i) For lyman series $n_1 = 1, n_2 = \infty$ (Shortest 'λ')

$$\frac{1}{\lambda_{min}} = \bar{v}_{max} = R_H (1)^2 \left(\frac{1}{1^2} - \frac{1}{\infty^2}\right)$$

ii) For longest wavelength in Balmer series

$n_1 = 2, n_2 = 3,$ He^{+} ion

$$\frac{1}{\lambda_{max}} = \bar{v}_{min} = R_H (Z)^2 \left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{1}{x}(2)^2 \left(\frac{5}{36}\right)$$

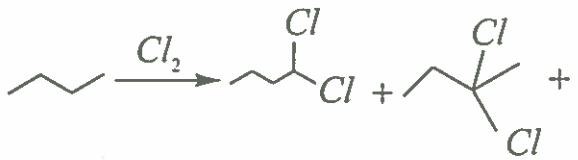
$$\frac{1}{\lambda_{max}} = \frac{5}{9x} \Rightarrow \lambda_{max} = \frac{9x}{5}$$

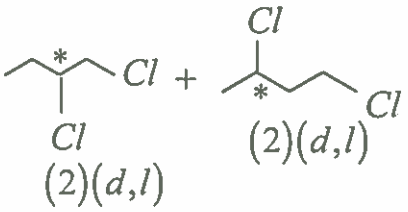
51. $t_{1/2} \alpha \left(\dfrac{1}{a}\right)^{n-1}$; $\dfrac{t_{1/2}^{I}}{t_{1/2}^{II}} = \left(\dfrac{a_2}{a_1}\right)^{n-1}$ n= order of RVN

$$\left(\frac{200}{50}\right) = \left(\frac{0.4}{0.1}\right)^{n-1}$$

$4 = (4)^{n-1} \Rightarrow n - 1 = 1$

$n = 2$

52. 



Total 6 isomers possible

53. Given $\theta = 45^0$ slope (m) = $\tan 45^0 = 1$

$$(m) = \frac{1}{n} = 1 \Rightarrow n = 1$$

& $\log K = 0.699$

$K = 10^{0.6999} = Anti\log(0.7)$

$= 5$

$$\Rightarrow \frac{x}{m} = K(P)^{1/n}$$

$= 5(0.8)^1$

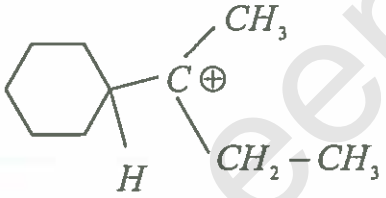
$= 4$

54. Green house gases are CO_2, O_3, H_2O vapour, CFC'S and NO

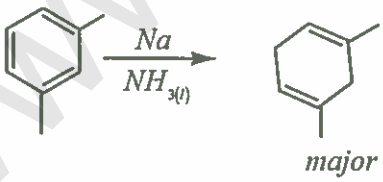
55. In $KFe[Fe(CN)_6] \rightleftharpoons K^+ + Fe[Fe(CN)_6]^{-1}$

+3 +2

56. 6 hyper conjugate structures are possible as there are 6 $\alpha-$ hydrogens are present at $\alpha-$position to Carbo cation



Total 6

57. 

major

2π bonds & $4\pi e^-$ are present

58. $PV = nRT = \frac{W}{M}RT$

M (Molar mass of P_x) $= \frac{WRT}{PV}$

$T = 546^0 C$ $= \frac{0.0625 \times 0.083 \times 819}{1 \times 34 \times 10^{-3}}$

$= 546 + 273$ $= 124.7 gm$

$= 819K$ Molar mass $P_x = 124.7$

$31x = 124.7$

$x \cong 4$

59. For elemental froms in standard state $\Delta_f^{H^0} = 0$

So, $Cl_{2(g)}, H_{2(g)}$, C (graphite) has $\Delta_f^{H^0} = 0$

60. For $M_1(OH)x$ $K_{sp} = 1^1.x^x.S^{1+x}$

$\Rightarrow x^x S^{1+x} = 4 \times 10^{-12}$

$x^x \left(10^{-4}\right)^{1+x} = 4 \times 10^{-12}$

Mathematics

61. $C = (1, r)$

$PQ = 2$

$2\sqrt{r^2 - d^2} = 2$

$r^2 = 1 + d^2 = 1 + \frac{|1+r|}{\sqrt{2}}$; $r = 3 \Rightarrow (h,k) = (1,3)$

62. $n(s) = 64_{C_3}$

Let "E" be the event of selecting 3 squares which form the letter "L".

The number of ways of selecting squares consisting of 4 unit squares is 7X7=49

Each square with 4 unit squares form 4 L shapes consisting of 3 unit squares.

$n(E) = 7X7X4 = 196$

$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{196}{64_{C_3}}$

63. We have $\frac{\sum xi^2}{n}-\left(\frac{\sum xi}{n}\right)^2\geq 0\Rightarrow \frac{400}{n}-\frac{6400}{n^2}\geq 0\Rightarrow n\geq 16$

64. $435\sqrt{3}=\sqrt{3}[1+5+9+13+----]$

$435=\frac{n}{2}[2+(n-1)4]$; $435=n(2n-1)$ $\therefore n=15$

65. Given $(\vec{b},\vec{c})=\theta$ And $(\vec{a}\times\vec{b})\times\vec{c}=\frac{1}{3}|\vec{b}||\vec{c}|\vec{a}$

$(\vec{a}.\vec{c})\vec{b}-(\vec{b}.\vec{c})\vec{a}=\frac{1}{3}|\vec{b}||\vec{c}|\vec{a}$ $\therefore \vec{a}.\vec{c}=0,-\vec{b}.\vec{c}-\frac{1}{3}|\vec{b}||\vec{c}|$

$-|\vec{b}||\vec{c}|\cos\theta=\frac{1}{3}|\vec{b}||\vec{c}|$

$\cos\theta=\frac{-1}{3}\in\theta_2$ $\therefore sin\theta=\sqrt{1-\cos^2\theta}=\sqrt{1-\frac{1}{9}}=\sqrt{\frac{8}{9}}=\frac{2\sqrt{2}}{3}$

66. $Z=\frac{\sqrt{3}}{2}+\frac{i}{2}=\cos\frac{\pi}{6}+i\sin\frac{\pi}{6}$; $iZ=i\cos\frac{\pi}{6}-\sin\frac{\pi}{6}=\frac{i\sqrt{3}}{2}-\frac{1}{2}$

$Z^5=\cos\frac{5\pi}{6}+i\sin\frac{5\pi}{6}=\frac{-\sqrt{3}}{2}+i\frac{1}{2}$; $iZ^8=i\left(\cos\frac{8\pi}{6}+i\sin\frac{8\pi}{6}\right)=i\left(\frac{-1}{2}-i\frac{\sqrt{3}}{2}\right)=\frac{-i}{2}+\frac{\sqrt{3}}{2}$

Now $(1+iZ+Z^5+iZ^8)^9=\left(1+\frac{i\sqrt{3}}{2}-\frac{1}{2}-\frac{\sqrt{3}}{2}+\frac{i}{2}-\frac{i}{2}+\frac{\sqrt{3}}{2}\right)^9=\left(\frac{1}{2}+i\frac{\sqrt{3}}{2}\right)^9$

$=\left(\cos\frac{\pi}{3}+i\sin\frac{\pi}{3}\right)^9=\cos\frac{9\pi}{3}+i\sin\frac{9\pi}{3}=-1$

67. $f(x)=\ln\left|\frac{2b^2+x^2}{b^3-x^3}-\frac{2x}{bx+b^2+x^2}-\frac{1}{b-x}\right|>0$

$\Rightarrow\frac{2b^2+x^2}{b^3-x^3}-\frac{2x}{bx+b^2+x^2}-\frac{1}{b-x}\neq 0$

$\Rightarrow\frac{2b^2+x^2-2x(b-x)-bx-b^2-x^2}{b^3-x^3}\neq 0$

$\Rightarrow x\neq b,2x^2-3bx+b^2\neq 0$

$(2x-b)(x-b)\neq 0$

$x\neq b,b/2$

$\therefore Domain=R\setminus\{b,b/2\}$

68. $A=\{2,3\}, B\cap C=\{4\}$; $A\times(B\cap C)=\{(2,4),(3,4)\}$

69. $(p\wedge\sim q)\to(q\vee\sim p) \Rightarrow (p\wedge\sim q)\vee(q\vee\sim p)$

$\Rightarrow(\sim p\vee q)\vee(\sim p\vee q) \Rightarrow \sim p\vee q \Rightarrow p\Rightarrow q$

70. $3x^2+px+3=0$

Roots $\alpha,\beta=\alpha^2$

$\alpha+\alpha^2=\frac{-p}{3};\alpha^3=1$

$\omega+\omega^2=\frac{-p}{3} \therefore \alpha=\omega$

$-1=\frac{-p}{3}\Rightarrow \boxed{p=3}$

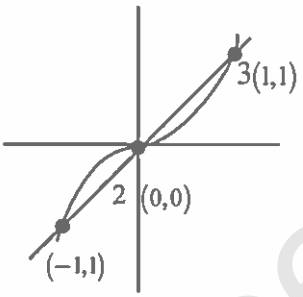
71. $P.I=\left(\frac{ac(b-d)}{bc-ad},\frac{bd(c-a)}{bc-ad}\right)=(h,k)let$

Concyclic $\Rightarrow ac=bd$

$a^2+c^2=b^2+d^2\Rightarrow(a-c)^2=(b-d)^2$

$\Rightarrow a-c=\pm(b-d) \therefore h=\pm k$

72.



73. Denominator = 0

$3^n=(2\cos x)^{2x}$

$\cos^2 x=\frac{3}{4}=\cos^2\frac{\pi}{6}$

74. Tangent line is $5x-6y+a=0$

$\alpha=-\frac{a}{5},\beta=\frac{a}{6}\Rightarrow a=30$

75. $\Delta = a\begin{vmatrix} 1 & a+b & a+b+c \\ 2 & 3a+2b & 4a+3b+2c \\ 3 & 6a+3b & 10a+6b+3c \end{vmatrix}$

$C_2 \to C_2 - bC_1, C_3 \to C_3 - cC_1$

$$= a\begin{vmatrix} 1 & a & a+b \\ 2 & 3a & 4a+3b \\ 3 & 6a & 10a+6b \end{vmatrix} = a^2\begin{vmatrix} 1 & 1 & a+b \\ 2 & 3 & 4a+3b \\ 3 & 6 & 10a+6b \end{vmatrix}$$

$C_3 \to C_3 - bC_2$

$$= a^2\begin{vmatrix} 1 & 1 & a \\ 2 & 3 & 4a \\ 3 & 6 & 10a \end{vmatrix} = a^3\begin{vmatrix} 1 & 1 & 1 \\ 2 & 3 & 4 \\ 3 & 6 & 10 \end{vmatrix}$$

$C_2 \to C_2 - C_1, C_3 \to C_3 - C_2$

$$= a^3\begin{vmatrix} 1 & 0 & 0 \\ 2 & 1 & 1 \\ 3 & 3 & 4 \end{vmatrix} = a^3 = \omega^3 = 1$$

76. $\frac{xdy - ydx}{x^2} = \frac{x^3 \cos x}{x^2}$

$$\int \frac{d}{dx}\left(\frac{y}{x}\right) = \int x\cos x dx$$

$$\frac{y}{x} = x\sin x + \cos x + 1$$

$$\Rightarrow y\left(\frac{\pi}{2}\right) = \frac{\pi^2}{4} + \frac{\pi}{2}$$

77. Solving $4x^2 = 8x + 12$

$x = -1, 3$

$$R.A = \int_{-1}^{3}\left(8x + 12 - 4x^2\right)dx =$$

$$\left(4x^2 + 12x - \frac{4x^3}{3}\right)_{-1}^{3}$$

$$= (36 + 36 - 36) - \left(-4 - 12 + \frac{4}{3}\right)$$

$$= 36 + 8 - \frac{4}{3} = \frac{128}{3}$$

78. $f(x)=\int \frac{5x^{-6}+7x^{-8}}{\left(2+x^{-7}+x^{-5}\right)^2}dx$

$2+x^{-7}+x^{-5}=t$

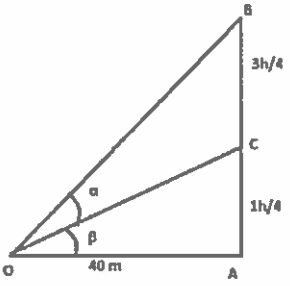
$f(x)=\frac{1}{2+x^{-7}+x^{-5}}+c \quad ; \quad f(0)=0 \Rightarrow c=0 \Rightarrow f(1)=\frac{1}{4}$

79. $\int_0^1 \frac{1}{(1+x^2)(1+x)}dx=\frac{\pi}{8}+\frac{1}{4}\log 2$

80. $P.I=(5,3,14)=P.Q=(1,0,2) \quad ; \quad PQ=\sqrt{16+9+144}=13$

81. P,Q are $\left(\pm\sqrt{45},-12\right) \quad ; \quad \Delta PQR=\frac{1}{2}(15)\left(2\sqrt{45}\right)=45\sqrt{5}$

82. From fig, Given $\alpha=\tan^{-1}\left(\frac{3}{5}\right)\Rightarrow \tan\alpha=\frac{3}{5}$



$\tan\beta=\frac{h}{160} \quad ; \quad \tan(\alpha+\beta)=\frac{h}{40}$

Now $\tan\alpha=\tan\left((\alpha+\beta)-\beta\right)=\frac{\tan(\alpha+\beta)-\tan\beta}{1+\tan(\alpha+\beta)\tan\beta}$

$\frac{3}{5}=\frac{\frac{h}{40}-\frac{h}{160}}{1+\left(\frac{h}{40}\right)\left(\frac{h}{160}\right)}=\frac{120h}{6400+h^2}$

$\therefore 6400+h^2=200h \Rightarrow h^2-200h+6400=0 \quad \Rightarrow (h-160)(h-40)=0$

$h=160$ (or) $h=40$

83. Let $\sin^{-1}\left(\frac{2}{7}\right)=x \quad ; \quad \sin x=\frac{2}{7}$

$\cos 2x=1-2\sin^2 x=1-\frac{8}{49}=\frac{41}{49} \quad ; 2x=\cos^{-1}\left(\frac{41}{49}\right)$

$\therefore 2\sin^{-1}\left(\frac{2}{7}\right)=\cos^{-1}\left(\frac{41}{49}\right)$

84. $\theta \in \left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$

Given $\left(\sqrt{3}\right)^{\sec^2\theta} = \tan^4\theta + 2\tan^2\theta$

$= \left(\tan^2\theta + 1\right)^2 - 1 = \sec^4\theta - 1$

It is possible only when $\sec^2\theta = 2$

$\sec\theta = \pm\sqrt{2} \Rightarrow \theta = \frac{-\pi}{4}, \frac{\pi}{4}$

No.of values of $\theta = 2$

85. MORADABAD

Total letters $= 9$

$A's - 3, D's - 2, \text{Re}\,maining - 4$

Different types of letters 6

No.of 4 letter words formed

(i)All different $= 6_{P_4} = 360$

(ii)Two different two alike $2_{C_1} \times 5_{C_2} \times \frac{4!}{2!} = 240$

(iii)3 alike one different $1_{C_1} \times 5_{C_1} \times \frac{4!}{3!} = 20$

(iv)2 alike of one type and 2 alike of other type $= 2_{C_2} \times \frac{4!}{2!2!} = 6$

Total no.of 4 letter words = 360+240+20+6= 626

86. $(3,-2,-4)$ lies in $lx + my - z = 9$

$3l - 2m + 4 = 9 \rightarrow (1)$

$2l - m - 3 = 0 \rightarrow (2)$

$l = 1, m = -1$

87. If $x > 0 \rightarrow \frac{x}{\sin x} > 1 \quad = \sec^4\theta - 1$

It is possible only when $\sec^2\theta = 2$

$\sec\theta = \pm\sqrt{2} \Rightarrow \theta = \frac{-\pi}{4}, \frac{\pi}{4}$

No.of values of $\theta = 2$

88. $a=2, b=3 \Rightarrow a^3+b^3=8+27=35$

89. $y=mx+c$ is a common tangent to the curves

$\therefore c^2=r^2\left(1+m^2\right)=\left(a^2m^2+b^2\right) \Rightarrow 12m^2=9$

90. $\left(\frac{x}{4}-\frac{12}{x^2}\right)^{12}$ for independent term, $r=\frac{np}{p+q}$ $r=\frac{12(1)}{1+2}=4$

$\therefore$ independent term, $T_5=12_{C_4}\left(\frac{1}{4}\right)^8(12)^4=\frac{495\times3^4\times4^4}{4^8}$

$$=\frac{55\times3^2\times3^4}{4^4}=\frac{55\times3^6}{4^4} \quad \therefore k=55$$