SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

Sec: SR MPC	**Jee Main**	**Date: 16-08-20**
Time: 09:00 AM to12:00 Noon	**GT-15**	**Max.Marks:300**

MATHS

1. If the lines $\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-1}{4}$ and $\frac{x-3}{1}=\frac{y-k}{2}=\frac{z}{1}$ intersect, then the value of k is

   1) $\frac{3}{7}$ 2) $\frac{2}{9}$ 3) $\frac{9}{2}$ 4) $\frac{7}{3}$

2. Sides of an isosceles triangle are $7x-y-4=0$ and $x+y+1=0$. If (1, 2) is on the base, then the equation to the base is

   1) $3x+2y-7=0$ 2) $3x-y-1=0$ 3) $x-3y+5=0$ 4) $3x+y-5=0$

3. Let $f(x)$ be a quadratic expression which is positive for all real x. If $g(x)=f(x)+f'(x)+f''(x)$, then for any real x,

   1) $g(x) < 0$ 2) $g(x) > 0$ 3) $g(x) = 0$ 4) None of these

4. If $f(x)$ is a polynomial of degree '>2' satisfying the relation $f(x)+f(2x)=5x^2-18$ then $f^1(1)$ is equal to

   1) 1

   2) 3

   3) Cannot be found since degree of $f(x)$ is not given

   4) 2

5. The equation of the tangent to the curve $y=x+\frac{4}{x^2}$, that is parallel to the x-axis is

   1) y = 0 2) y = 1 3) y = 2 4) y = 3

6. The lines $\frac{x-1}{2}=\frac{y}{-1}=\frac{z}{2}$ and $x-y+z-2=0=l\,x+3z+5$ are coplanar for l =

   1) $-\frac{97}{11}$ 2) $-\frac{43}{5}$ 3) $-\frac{73}{9}$ 4) $-\frac{31}{7}$

7. Triangle is formed by the lines $x+y=0, x-y=0$ and $lx+my=1$. If l and m vary subject to the condition $l^2+m^2=1$, then the locus of its circumcentre is

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

3) $(x^2+y^2)^2=4x^2y^2$ 4) $(x^2-y^2)^2=(x^2+y^2)^2$

8. Length of the normal chord of the parabola $y^2=4x$ which makes an angle of $\frac{\pi}{4}$ with the axis of x is

1) 8 2) $8\sqrt{2}$ 3) 4 4) $4\sqrt{2}$

9. The top of a hill observed from the top and bottom of a building of height h is at angles of elevation p and q respectively. The height of the hill is

1) $\frac{h\cot q}{\cot q-\cot p}$ 2) $\frac{h\cot p}{\cot p-\cot q}$ 3) $\frac{h\tan p}{\tan p-\tan q}$ 4) $\frac{h\tan p}{\cot q+\cot p}$

10. The value of $\int_{e^{-1}}^{e^2}\left|\frac{\log_e x}{x}\right|dx$ is

1) 3/2 2) 5/2 3) 3 4) 5

11. $\lim_{n\to\infty}\frac{1}{n}\left[\sec^2\frac{p}{4n}+\sec^2\frac{2p}{4n}+\sec^2\frac{3p}{4n}+.....+2\right]=$

1) 4 2) $\frac{4}{p}$ 3) $\frac{p}{4}$ 4) $\frac{1}{p}$

12. If x, y, z not all zeroes and $ax+by+cz=0, bx+cy+az=0, cx+ay+bz=0$ then $x:y:z=$ (ω is non real complex cube root of unity)

1) 3:4:5 2) $1:\omega:\omega^2$ 3) 1:2:3 4) 1:3:7

13. Let $\vec{a},\vec{b},\vec{c}$ be three non-zero, non-collinear vectors such that $\vec{a}\times(\vec{b}\times\vec{c})=\frac{1}{2}|\vec{a}||\vec{b}|\vec{c}$. If q is the angle between $\vec{a}$ and $\vec{b}$, then $\tan q=$

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

14. If $P=\begin{bmatrix}1 & \cos A & \cos B\\ \cos A & 1 & \cos C\\ \cos B & \cos C & 1\end{bmatrix}$ $Q=\begin{bmatrix}0 & \cos A & \cos B\\ \cos A & 0 & \cos C\\ \cos B & \cos C & 0\end{bmatrix}$ where A, B, CÍ R are two 3´ 3 matrices such that det(P) = det(Q), then the value of $\cos^2 A+\cos^2 B+\cos^2 C$ is equal to

1) $\frac{3}{2}$ 2) $\frac{9}{4}$ 3) 1 4) $\frac{3}{4}$

15. For two sets, each of size 5, the variances are given to be 4 and 5 and the corresponding means are given to be 2 and 4 respectively. The variances of the combined data set is

1) 11/2 2) 6 3) 13/2 4) 5/2

16. If $a_1, a_2, a_3, ...a_{2n}$ are in A.P. then $a_1^2 - a_2^2 + a_3^2 - a_4^2 + ...+ a_{2n-1}^2 - a_{2n}^2 =$

1) 0 2) $\frac{n}{2n-1}\left(a_1^2 - a_{2n}^2\right)$

3) $\frac{n-1}{2n-1}\left(a_1^2 - a_{2n}^2\right)$ 4) $\frac{n}{n-1}\left(a_1^2 - a_{2n}^2\right)$

17. A tangent is drawn at the point $\left(3\sqrt{3}\cos q, \sin q\right); 0 < q < \frac{p}{2}$ of an ellipse $\frac{x^2}{27}+\frac{y^2}{1}=1$. The least value of the sum of the intercepts on the coordinate axis by this tangent is attained at $q =$

1) $\frac{p}{6}$ 2) $\frac{p}{3}$ 3) $\frac{p}{8}$ 4) $\frac{p}{4}$

18. If $0 < x < 1000$ and $\left[\frac{x}{2}\right]+\left[\frac{x}{3}\right]+\left[\frac{x}{5}\right]=\frac{31}{30}x$ (where [x] is greatest integer function) then number of values of x is

1) 34 2) 33 3) 32 4) 31

19. A test is made upto 5 questions, for each question there are 4 possible answers and only one is correct. For every right choice you gain 1 mark while for each wrong choice there is a penalty of 1 mark. The probability of getting atleast 2 marks answering to every question in a random way is:

1) $\frac{1}{16}$ 2) $\frac{1}{64}$ 3) $\frac{15}{64}$ 4) $\frac{1}{1024}$

20. The equation of the curve passing through the point $\left(1, \frac{p}{4}\right)$ and having slope of tangent at any point (x, y) as $\frac{y}{x} - \cos^2\frac{y}{x}$, is

1) $x = e^{1-\tan(y/x)}$ 2) $x = e^{1+\tan(y/x)}$

3) $x = 1 - \tan(y/x)$ 4) $y = e^{1-\cot\left(\frac{y}{x}\right)}$

21. If $x \in \left(0, \frac{p}{2}\right)$, one solution of $\frac{\sqrt{3}-1}{\sin x} + \frac{\sqrt{3}+1}{\cos x} = 4\sqrt{2}$ is $\frac{p}{12}$, the other solution must be $\frac{l\,p}{36}$, then l is

22. If $\int \left(x^{7n} + x^{2n} + x^n\right)\left(2.x^{6n} + 7.x^n + 14\right)^{\frac{1}{n}}.dx = \frac{n\left(2x^{7n} + 7x^{2n} + 14x^n\right)^{\frac{n+1}{n}}}{K(n+1)} + C$

where $n \in N$, then K =

23. 'n' persons are sitting on a round table and shake hands with each other. Shake hand between neighbours are called direct shake hands otherwise they are called indirect shake hands. If number of indirect shake hands is atmost three more than direct shake hands, then sum of all possible values of n is

24. $\lim\limits_{x\to\infty} \frac{\log_e x^n - [x]}{[x]}$ = (n> 0 & [.] denotes Greatest Integer Function)

25. Each student in a class of 40, studies atleast one of the subjects English, Mathematics and Economics. 16 study English, 22 Economics and 26 Mathematics, 5 study English and Economics, 14 Mathematics and Economics and 2 study all the three subjects. The number of students who study English and Mathematics but not Economics is

PHYSICS

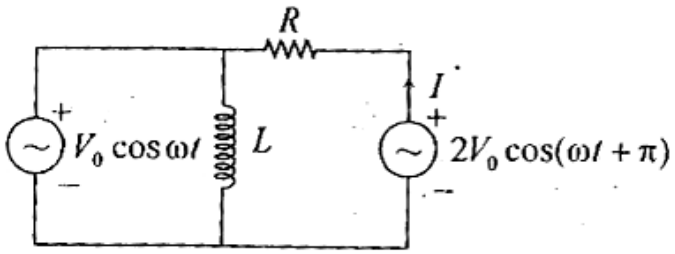
26. The ratio of powers of thin convex and thin concave lens is $\frac{3}{2}$ and equivalent focal length of the combination kept in contact is 30 cm. Their individual focal lengths respectively (in cm) are

1) 75, –50 2) 75, 50 3) 10, –15 4) 15, –10

27. A block released on a rough inclined plane of inclination 30^o slides down the plane with an acceleration g/4, where g is acceleration due to gravity. The coefficient of friction between the block and the inclined plane is

1) $1/3\sqrt{3}$ 2) $1/\sqrt{3}$ 3) $1/2\sqrt{3}$ 4) $\sqrt{3}/2$

28. The diagram shows an ac circuit with two voltage sources of same frequency. Find out the value of current I shown in the fig.



1) $I = \dfrac{V_0 \cos(\omega t)}{R}$ 2) $I = \dfrac{V_0 \cos(\omega t + \pi/2)}{R}$

3) $I = \dfrac{V_0 \cos \omega t}{R}$ 4) $I = \dfrac{-3V_0 \cos \omega t}{R}$

29. A neutron is moving with velocity 'u'. It collides head on and elastically with an atom of mass number A. If the initial K.E. of the neutron is E, how much K.E. is retained by neutron after collision?

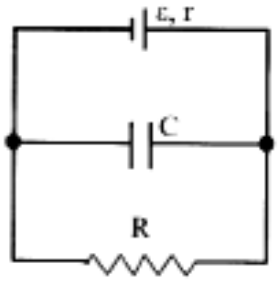
1) $\left[A/(A+1)\right]^2 E$ 2) $\left[A/(A+1)^2\right] E$

3) $\left[(1-A)/(A+1)\right]^2 E$ 4) $\left[(A+1)/(A-1)\right]^2 E$

30. A tuning fork of frequency 340 Hz is vibrated just above a closed organ pipe of length 120 cm. Speed of sound in air is $340\ m.s^{-1}$. Water is slowly poured into the tube. Minimum length of water column required for resonance is:

1) 25 cm 2) 75 cm 3) 45 cm 4) 95 cm

31. The electric field strength in the capacitor shown below is $E = 50\ V.cm^{-1}$. The distance between the plates of the capacitor *d* is 0.5mm, square plates are of area $100\ cm^2$, the resistance $R = 5\Omega$, the internal resistance of batteries $r = 0.1\Omega$.



1) The emf of the battery is 2.35V

2) The attractive force between the plates is $2.2 \times 10^{-4} N$ (approx)

3) The charge on the plates is $42.25' 10^{-10} C$

4) The current through the battery in steady state is 0.5A

32. A satellite is revolving in a circular orbit at a height 'h' from the earth's surface (R radius of the earth, h<<R). The minimum increase in its velocity required so that the satellite could escape from the earth's gravitational field, is close to:

1) $\sqrt{gR}$ 2) $\sqrt{gR/2}$ 3) $\sqrt{gR}\left(\sqrt{2}-1\right)$ 4) $\sqrt{2gR}$

33. Height of a TV tower is 150 m. To double its coverage range, height of that tower must be increased by

1) 300 m 2) 150 m 3) 450 m 4) 600 m

34. If $V = Ax + Be^{-Ct}$ where v is velocity, x is distance, t is time then dimensions of A, B and C are:

1) LT^{-1}, L, T 2) T^{-1}, LT^{-1}, T^{-1} 3) L, LT^{-1}, T 4) T, T, T

35. Half life of a radio–active nuclide Na^{24} is 15 hour. The number of beta particles emitted by this nuclide of mass $1\mu g$ in one hour is nearly $\left(e^{-0.046} = 0.9548\right)$

1) $1.18' 10^{15}$ 2) $1.10' 10^{15}$ 3) $1.16' 10^{15}$ 4) $1.13' 10^{15}$

36. A galvanometer has resistance 100Ω and it requires $100\mu A$ for full scale deflection. A resistor 0.1Ω is connected to make it an ammeter. The smallest current required in the circuit to produce the full scale deflection is:

1) 110.1 mA 2) 101 mA 3) 101.1 mA 4) 100.1 mA

37. The plates of a parallel plate capacitor have an area of 90 cm^2 each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400 V supply. How much electrostatic energy is stored by the capacitor?

1) $1.56\mu J$ 2) $2.56\mu J$ 3) $3.56\mu J$ 4) $4.56\mu J$

38. A student performs an experiment to determine the Young's modulus of wire, exactly 2 m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of ± 0.05 mm at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with a uncertainty of ± 0.01 mm. Take $g = 9.8\ m.s^{-2}$ (exact). The Young's modulus obtained from the reading is

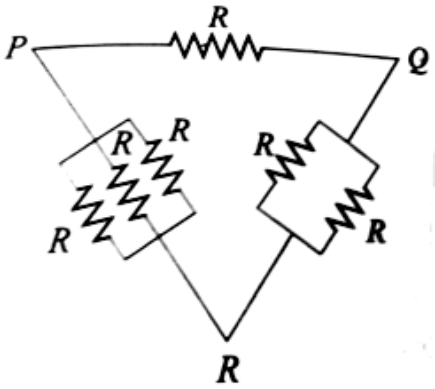
1) $(2.0 \pm 0.3)' \ 10^{11} N.m^{-2}$ 2) $(2.0 \pm 0.2)' \ 10^{11} N.m^{-2}$

3) $(2.0 \pm 0.1)' \ 10^{11} N.m^{-2}$ 4) $(2.0 \pm 0.5)' \ 10^{11} N.m^{-2}$

39. There is a horizontal film of soap solution. On it a thread is placed in the form of a loop. The film is pierced inside the loop and thread becomes a circular loop of radius 'R'. If surface tension of loop is 'T', the tension in the thread is

1) $\frac{pR^2}{T}$ 2) pR^2T 3) $2pRT$ 4) $2RT$

40. Six identical resistors are connected as shown in the figure. The equivalent resistance will be



1) Maximum between P and R 2) Maximum between Q and R

3) Maximum between P and Q 4) All are equal

41. A convex lens of focal length 9cm be placed between two point sources S_1 and S_2 which are 24 cm apart so that images of both sources formed at the same place. Find the distance between lens and S_1?

1) 4 cm 2) 5 cm 3) 6 cm 4) 8 cm

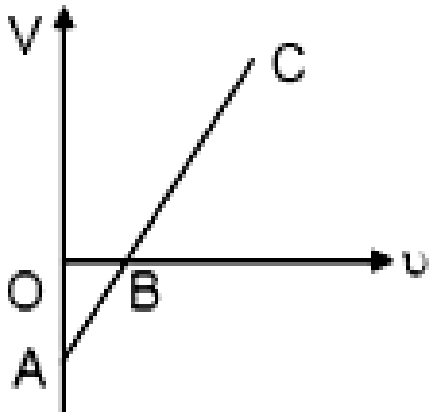
42. Imagine an atom made of a proton and a hypothetical particle of double the mass of the electron but having the same charge as the electron. Apply the Bohr atom model and consider all possible transitions of this hypothetical particle to the first excited level. The longest wavelength photon that will be emitted has wavelength (given in terms of the Rydberg constant R for the hydrogen atom) equal to

1) $\frac{9}{5R}$ 2) $\frac{36}{5R}$ 3) $\frac{18}{5R}$ 4) $\frac{4}{R}$

43. The moment of inertia of thin rod of linear density λ and length l about an axis passing through one end and perpendicular to its length is

1) $\frac{\lambda l^2}{12}$ 2) $\frac{\lambda l^2}{3}$ 3) $\frac{\lambda l^3}{12}$ 4) $\frac{\lambda l^3}{3}$

44. The stopping potential V for photoelectric emission from a metal surface is plotted along Y–axis and frequency of incident light along X–axis. A straight line is obtained as shown. Planck's constant is given by



1) Slope of the line
2) Product of slope of the line and charge on the electron
3) Intercept along Y–axis divided by charge on the electron
4) Product of intercept along X–axis and mass of the electron

45. At a temperature of 30^0C, the susceptibility of a paramagnetic material is found to be x. Its susceptibility at 333^0C is

1) x 2) 0.5x 3) 2x 4) 0.09x

46. A uniform magnetic field exists in region given by $\vec{B} = 3\hat{i} + 4\hat{j} + 5\hat{k}$. A rod of length 5m placed along y–axis is moved along x–axis with constant speed $1\, m.s^{-1}$. Then induced emf in the rod will be(in V)

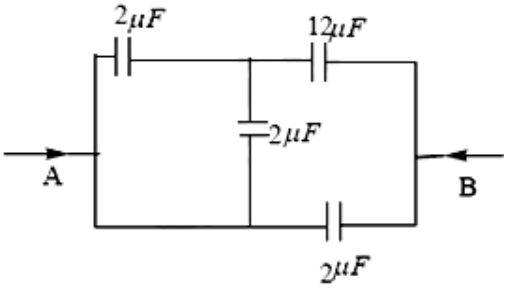
47. A 60W monochromatic point source radiating equally in all directions in vacuum. The amplitude of electric field at a distance of 2m from the source is…..(in $N.C^{-1}$)

48. An ideal liquid is kept in a cylindrical vessel which is rotated about its axis. The liquid rises at the sides. If the diameter of the vessel is 0.10 m, the speed of rotation is 2 rpsand $g = 10\ m.s^{-2}$, the difference in height of the liquid at its sides and the centre of the vessel is nearly (in m)

49. A particle of mass m = 3kg moves along a straight line $4y - 3x = 2$ where x and y are

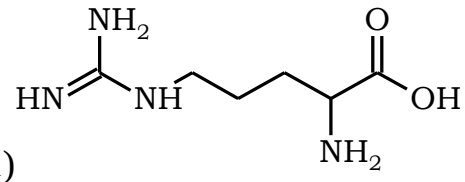
in meters with constant velocity $v = 5\ ms^{-1}$. The magnitude of angular momentum about the origin(in $kg\ m^2 s^{-1}$)

50. Four capacitors are connected in a circuit as shown in the figure. The effective capacitance in *mF* between points A and B will be

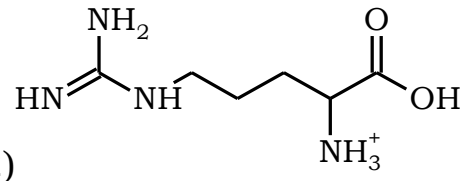


CHEMISTRY

51. The correct structure of arginine in a strongly acidic solution (pH = 2) is:



1)



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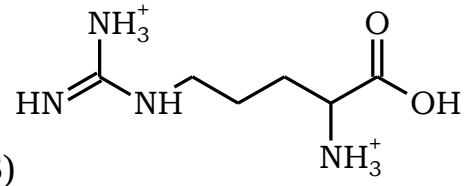

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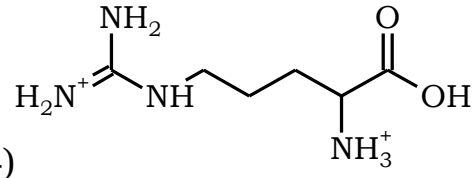
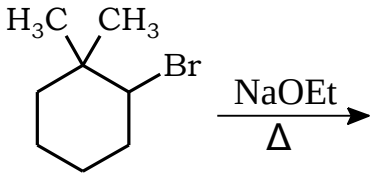
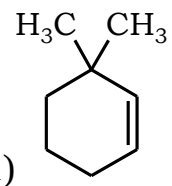


4)

52. The major product of the following reaction is:





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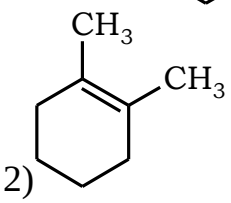

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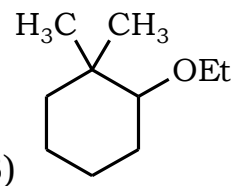

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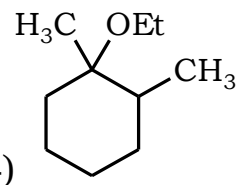
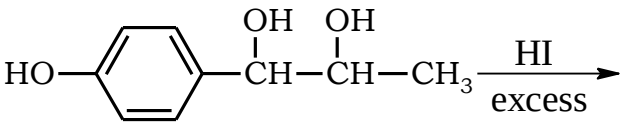
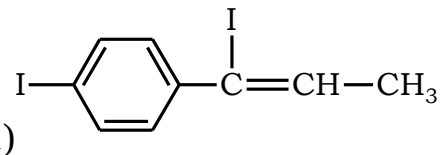


4)

53. The major product of the following conversion is:





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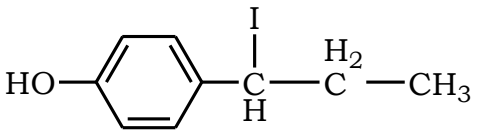

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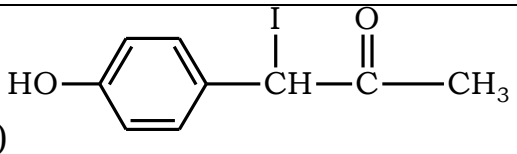
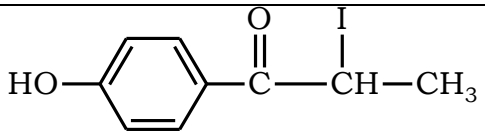
3) 

4) 

54. The two monomers for the synthesis of biodegradable polymer Nylon-2,6

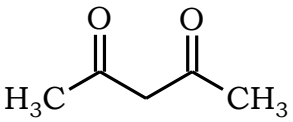
1) NH_2CH_2COOH and $NH_2(CH_2)_4COOH$

2) $H_2NCH_2CH_2NH_2$ and $HOOCCH_2CH_2CH_2CH_2COOH$

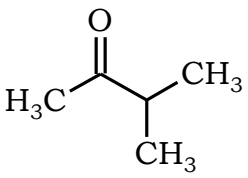
3) $HOOCCOOH$ and $H_2NCH_2CH_2CH_2CH_2CH_2CH_2NH_2$

4) H_2NCH_2COOH and $H_2NCH_2CH_2CH_2CH_2CH_2COOH$

55. The compound which will not form Grignard product with one equivalent Grignard reagents are:



(A)



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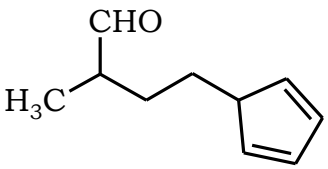

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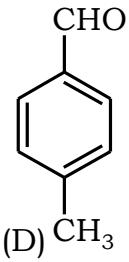
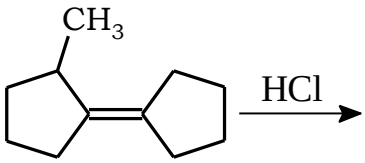
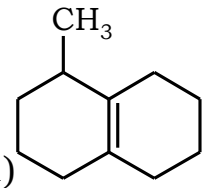


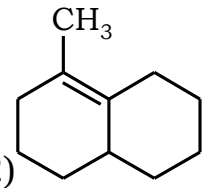
(D)

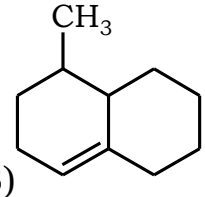
1) A,C 2) Only C 3) A,B,C,D 4)A,C and D

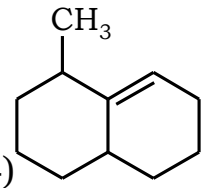
56. The major product of the following reaction is:



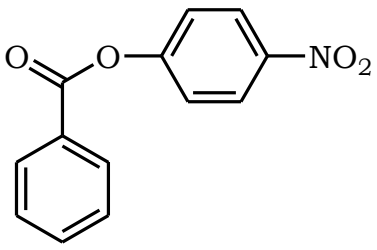
1) 

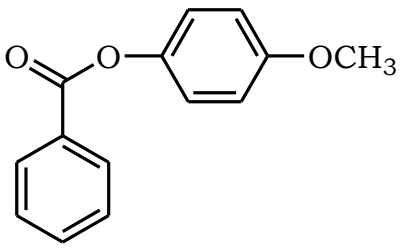
2) 

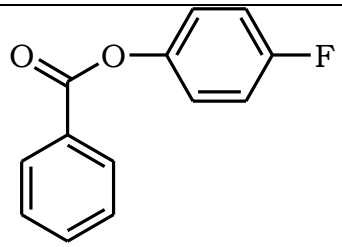
3) 

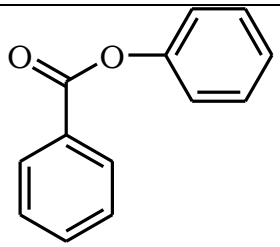
4) 

57. The decreasing order of the reactivity of the following with $LiAlH_4$ is:

(A) 

(B) 

(C) 

(D) 

1) A>B>C>D 2) B>C>D>A 3) A>C>D>B 4) A>C>B>D

58. Which of the following is not a property of hydrophilic sol?

1) High concentration of dispersed phase can be easily attained.

2) Coagulation is reversible.

3) Viscosity and surface tension are nearly as that of water.

4) The charge on the particles may depend on the p^H value; it may be positive, negative or even zero.

59. The rate constant, the activation energy and the Arrhenius parameter of a chemical reaction at $25°C$ are $3.0\times10^{-4}s^{-1}$, 104.4 kJ/mol and $6.0\times10^{14}s^{-1}$, respectively. The value of the rate constant as $T\to\infty$, is

1) 2.0×10^{-18} 2) 6.0×10^{-14} 3) infinity 4) 3.0×10^{-4}

60. What is the equilibrium constant of the reaction:

$Fe(OH)_{3(s)} + 3H_3O^+ \rightleftharpoons Fe^{3+} + 6H_2O$; K_{sp} of $Fe(OH)_3 = 4\times10^{-38}$

1) 2.5×10^{-5} 2) 4.0×10^{4} 3) 4.0×10^{-4} 4) 4.0×10^{-80}

61. The magnetic moment of a tetrahedral homoleptic Co^{2+} complex is 3.9 BM. The suitable ligand is

1) Cl^- 2) SCN^- 3) Br^- 4) Any one of these

62. The element that do not exhibit allotropy:

1) P 2) As 3) Sb 4) Bi

63. Chlorine on reaction with hot and concentrated sodium hydroxide gives

1) $NaCl$ & $NaoCl$ 2) $NaCl$ & $NaClO_3$ 3) O_2 & O_3 4) O_2 & OCl_2

64. The correct order of atomic radii is

1) Sc> Fe > V > Zn 2) Sc> Fe > Zn > V

3) Sc> V > Zn > Fe 4) Sc> Zn > V > Fe

65. The element that does not show its form $p\pi - p\pi$ multiple bonds:

1) C 2) Si 3) P 4) Pb

66. The calcium presents in human body play an important role in which of the following:

I) Calcium is important for the growth of bones and teeth

II) It plays an important role in neuromuscular function, inter-neuronal transmission

III) It plays an important role in blood coagulation and cell membrane integrity

1) I and II only 2) I and III only 3) I, II & III 4) III only

67. Which is not correct about photochemical smog?

1) It is formed during warm dry and sunny element

2) The main components present in photochemical smog result by the action of sun light on unsaturated hydrocarbons and oxides of nitrogen

3) The components present photochemical smog has oxidation properties

4) Photochemical smog is present in stratosphere

68. The pair of metals that can be extracted by leaching with sodium cyanide in hydrometallurgical process?

1) Zn & Cu 2) Ag &Au 3) Au & Ag 4) Zn &Pb

69. Which of the following is not related in the formation of ozone?

1) It is formed in stratosphere

2) It is formed by absorbing UV light by O_2

3) It is an endothermic process

4) Ozone formed once remains constantly in atmosphere

70. The weight of H_2O_2 present in 1 lit of 5.6 vol H_2O_2 solution is

1) 17 g 2) 34 g 3) 68 g 4) 8.5 g

71. A quantity of 50 g of water is saturated with HCl gas to get 75 ml of solution containing 40% HCl, by mass. The density of solution formed is(in g/ml)

72. The molar conductivity of NH_4Cl, OH^- and Cl^- at infinite dilution is 150, 200 and 75 S cm^2mol^{-1}, respectively. If the molar conductivity of a 0.01 M- NH_4OH solution is 22 S cm^2mol^{-1}, then its degree of dissociation is

73. Phenol dimerizes in benzene. If the observed molecular mass of phenol in solution is 120, its degree of dimerization is

74. The volume strength of a sample of H_2O_2 is '8.96 vol'. The mass of H_2O_2 present in 250 ml of this solution is (in g)

75. A sample of gas in a closed container of fixed volume is at 250 K and 400 mm of Hg pressure. If the gas is heated to 375 K, its pressure increases to 600 mm of Hg. By what factor will be the average speed of the molecules increases?

SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

Sec: SR MPC	**Jee-Main**	**Date: 16-08-20**
Time: 09:00 AM to12:00 Noon	**GT-15**	**Max.Marks:300**

KEY SHEET

MATHS

1	**3**	2	**4**	3	**2**	4	**3**	5	**4**
6	**4**	7	**1**	8	**2**	9	**2**	10	**2**
11	**2**	12	**2**	13	**2**	14	**3**	15	**1**
16	**2**	17	**1**	18	**2**	19	**2**	20	**1**
21	**11**	22	**14**	23	**14**	24	**-1**	25	**5**

PHYSICS

26	**3**	27	**3**	28	**4**	29	**2**	30	**3**
31	**4**	32	**3**	33	**3**	34	**2**	35	**4**
36	**4**	37	**2**	38	**2**	39	**4**	40	**3**
41	**3**	42	**3**	43	**4**	44	**2**	45	**2**
46	**25**	47	**30**	48	**0.02**	49	**6**	50	**5**

CHEMISTRY

51	**4**	52	**1**	53	**2**	54	**4**	55	**1**
56	**1**	57	**3**	58	**3**	59	**2**	60	**2**
61	**4**	62	**4**	63	**2**	64	**4**	65	**4**
66	**3**	67	**4**	68	**3**	69	**4**	70	**1**
71	**1.11**	72	**0.08**	73	**0.433**	74	**6.8**	75	**1.22**

SOLUTIONS

MATHS

1. $P(2\lambda+1,3\lambda-1,4\lambda+1), Q(\mu+3,2\mu+k,\mu)$

Where P and Q are same

$\Rightarrow 2\lambda+1=\mu+3$

$4\lambda+1=\mu$

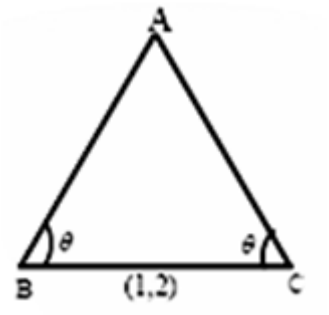
Solving $\lambda=-\frac{3}{2}$ and $\mu=-5$

$3\lambda-1=2\mu+k \; K=3\lambda-2\mu-1=\frac{9}{2}$

2. Let equation of AB; $7x-y-4=0\Rightarrow m_1=7$

Equation of AC is $x+y+1=0\Rightarrow m_2=-1$

Slope of BC is m



$\tan\theta=\left|\frac{m_1-m}{1+mm_1}\right|=\left|\frac{m_2-m}{1+m_2m}\right|\Rightarrow m=-3,\frac{1}{3}$

3. $f(x)=ax^2+bx+c>0\Rightarrow a>0, b^2-4ac<0$

$g(x)=f(x)+f'(x)+f''(x)=ax^2+(2a+b)x+2a+b+c$

$=\left(\sqrt{a}x+\frac{2a+b}{2\sqrt{a}}\right)^2+2a+b+c-\frac{(2a+b)^2}{4a}$

$=\left(\sqrt{a}x+\frac{2a+b}{2\sqrt{a}}\right)^2+a-\frac{\left(b^2-4ac\right)}{4a}>0$ since each term is positive

4. degree of f(x) is not given

5. $y'=1-\frac{8}{x^3}=0\Rightarrow x=2, y=3$

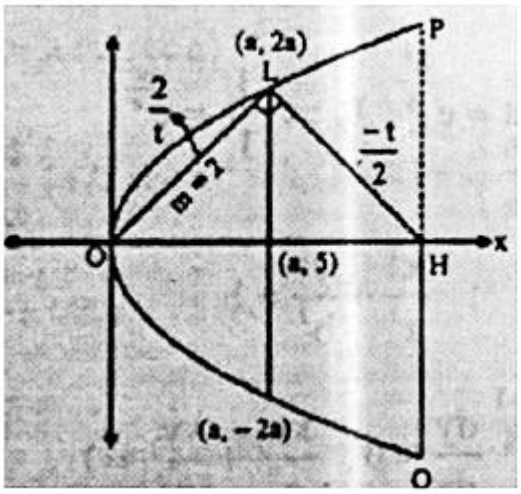
The tangent is $\frac{y-3}{x-2}=m=0. \quad \therefore y=3$

6. us $\frac{\left|\left[\bar{a}-\bar{c}\ \bar{b}\ \bar{d}\right]\right|}{\left|\bar{b}\times\bar{d}\right|}$

7. Circumcentre of the triangle formed by the given lines is given by $\left(\frac{\ell}{\ell^2-m^2},\frac{m}{\ell^2-m^2}\right)$

Hence the locus of this point is $\left(x^2-y^2\right)^2=x^2+y^2$

8.



$N: y+tx=2t+t^3$; slope of the normal is –t

hence $-t=1\Rightarrow t=-1$

$\Rightarrow$ coordinates of P are $(1,-2)$

Hence parameter at Q, $t_2=-t_1-2/t_1=1+2=3$

$\therefore$ coordinates at Q are $(9,6)$

$\therefore l(PQ)=\sqrt{64+64}=8\sqrt{2}$

9. let AD be the building of heigth ‘h’ and BP be the hill, then

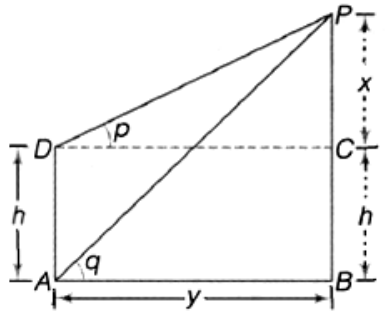
$\tan q=\frac{h+x}{y}$ ….(i)

And $\tan p=\frac{x}{y}$

$\Rightarrow y=x\cot p$ …(ii)

From Eqs. (i) and (ii), we get,

$$\tan q = \frac{h+x}{x\cot p}$$



$$\Rightarrow x\cot p = (h+x)\cot q$$

$$\Rightarrow x = \frac{h\cot q}{\cot p - \cot q}$$

$$\Rightarrow h + x = \frac{h\cot q}{\cot p - \cot q} + h$$

$$\therefore \text{height of hill} = \frac{h\cot p}{\cot p - \cot q}$$

10. $Let\ I = \int_{e^{-1}}^{e^2} \frac{|\log_e x|}{x} dx$

$$= \int_{e^{-2}}^{1} \left|\frac{|\log_e x|}{x}\right| dx + \int_{1}^{e^2} \left|\frac{|\log_e x|}{x}\right| dx$$

$$= \int_{e^{-2}}^{1} \left(-\frac{|\log_e x|}{x}\right) dx + \int_{1}^{e^2} \frac{\log_e x}{x} dx$$

Put $\log_e x = \Rightarrow \frac{dx}{x} = dz$

$$\therefore I = \int_{-1}^{0} (-z) dz + \int_{0}^{2} z\, dz$$

$$= \left[\frac{-z^2}{2}\right]_{-1}^{0} + \left[\frac{z^2}{2}\right]_{0}^{2}$$

$$= -\frac{1}{2}[0-1] + \frac{1}{2}[4-0]$$

$$= \frac{1}{2} + 2 = \frac{5}{2}$$

11. $\int_0^1 \tan^2\left(\frac{\pi}{4}x\right) dx$

12. Given homogenous equations has a non-zero solution $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = 0.$

13. (b) $\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \frac{1}{2}|\vec{a}||\vec{b}|\vec{c}$

$\vec{b}\left(\vec{a}.\vec{c}\right) - \vec{c}\left(\vec{a}.\vec{b}\right) = \frac{1}{2}|\vec{a}||\vec{b}|\vec{c}$

$\vec{a}.\vec{c} = 0$

$\Rightarrow -\left(\vec{a}.\vec{b}\right) = \frac{1}{2}|\vec{a}||\vec{b}|$

$-|\vec{a}||\vec{b}|\cos\theta = \frac{1}{2}|\vec{a}||\vec{b}|$

$\cos\theta = -\frac{1}{2}; \theta = \frac{2\pi}{3}; \sin\theta = \frac{\sqrt{3}}{2}$

14. Expand the determinants.

15. $s_x^2 = 4; s_y^2 = 5; \bar{x} = 2; \bar{y} = 4$

$\frac{\sum xi}{5} = 2; \sum xi = 10; \sum yi = 20$

$\sigma_x^2 = \frac{1}{2}\left(\sum xi\right)^2 - \left(\bar{x}\right)^2 = \frac{1}{5}\left(\sum yi\right)^2 - 16$

$\sum xi^2 = 40; \sum yi^2 = 105$

$\sigma_z^2 = \frac{1}{10}\sum\left(x_i\right)^2 + \sum\left(y_i\right)^2 - \left(\frac{\bar{x} + \bar{y}}{2}\right)^2$

$= \frac{1}{10}(40 + 105) - 9 = \frac{145 - 90}{10} = \frac{55}{10} = \frac{11}{2}$

16. $a_1 - a_2 = a_2 - a_3 = ... = -d$

17. Equation of tangent is $\frac{x\cos\theta}{3\sqrt{3}} + y\sin\theta = 1$

Sum of intercepts o the axes $l = \frac{3\sqrt{3}}{\cos\theta} + \frac{1}{\sin\theta}$

$\frac{dl}{d\theta} = 3\sqrt{3}\sec\theta\tan\theta - \operatorname{cosec}\theta\cot\theta = 0 \Rightarrow 3\sqrt{3}\tan^3\theta - 1 = 0$

$\therefore \tan\theta = \frac{1}{\sqrt{3}} \Rightarrow \theta = \frac{\pi}{6}$ (check for minima by yourself)

18. LHS is integral RHS is also integral, for which x is multiple of 30.

$x = 30, 60, 90, ...990$

19. To get atleast 3 marks, atleast 4 must be right.

$n = 5; p = \frac{1}{4}; q = \frac{3}{4}, r = 4 or 5$

$P(r \geq 4) = {}^5C_1\left(\frac{1}{4}\right)^4 .\left(\frac{3}{4}\right) + {}^5C_5\left(\frac{1}{4}\right)^5$

$= 5.\frac{1}{256}.\frac{3}{4} + \frac{1}{4^5} = \frac{16}{4.256} = \frac{1}{64}$

20. Given, $\frac{dy}{dx} = \frac{y}{x} - \cot^2\frac{y}{x}$

$\Rightarrow \frac{xdy - ydx}{x} = -\left(\cos^2\frac{y}{x}\right)dx$

$\Rightarrow \sec^2\left(\frac{y}{x}\right)\left\{\frac{xdy - ydx}{x^2}\right\} = -\frac{dx}{x}$

$\Rightarrow \sec^2\frac{y}{x}.d\left(\frac{y}{x} = -\frac{dx}{x}\right)$

$\Rightarrow \tan\frac{y}{x} = -\log x + C$ (after integrating)

At $x = 1, y = \frac{\pi}{4}$ and C=1

$\therefore \tan\left(\frac{y}{x}\right) = 1 - \log x$

$\Rightarrow \log x = 1 - \tan(y/x)$

$\therefore x = e^{1-\tan(y/x)}$

21. $\sin\left(x + \frac{p}{12}\right) = \sin 2x$

22. use integration by substitution.

23. ${}^nC_2 - n \geq n + 3$

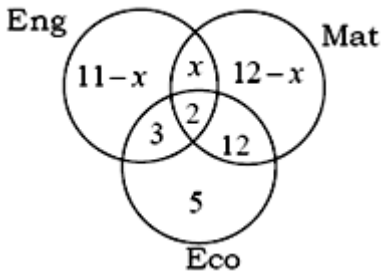
$\Rightarrow n^2-5n-6\le 0$

$n\in[-1,6]\Rightarrow n=2,3,4,5,6$

24. $$\lim_{x\to\infty}\frac{n\ln x-[x]}{[x]}=\lim_{x\to\infty}\frac{n\ln x-[x]}{[x]}-1=-1+\lim_{x\to\infty}\left[\frac{\frac{n\ln x}{x}}{\frac{[x]}{x}}\right]=-1+\lim_{x\to\infty}\left[\frac{\frac{n\ln x}{x}}{1-\frac{\{x\}}{x}}\right]=-1$$

Since $\lim_{x\to\infty}\frac{\ln x}{[x]}=\lim_{x\to\infty}\frac{1}{x}=0\Rightarrow\frac{\{x\}}{x}<\frac{1}{x}\to 0\,as\,x\to\infty$

25. $28-2x+22=40$



$2x=10\Rightarrow x=5$

PHYSICS

26. $\frac{P_C}{P_D}=\frac{3}{2}$ Þ $\frac{f_C}{f_D}=\frac{2}{3}$ and $\frac{1}{f_C}+\frac{1}{f_D}=\frac{1}{30}$,

solving $f_c = 50cm,\ f_D = -\ 75cm$

$f_c = 10cm,\ f_D = 15cm$

27. Acceleration $a = mg\cos q$

$\frac{g}{4} = mg\cos 30^0$

$\frac{g}{4} = mg\frac{\sqrt{3}}{2},\ m = \frac{1}{2\sqrt{3}}$

28. Conceptual

29. $E=K_1+K_2$

$E=\frac{mV_1^2}{2}+\frac{mAV_2^2}{2}$

$$E = \frac{mV^2}{2}$$

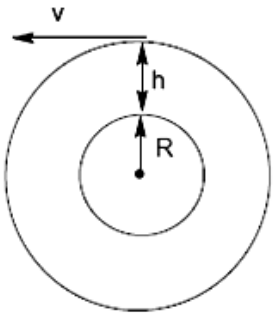
$$V_2 - V_1 = U$$

30. Length of air column = $\frac{l}{4}, \frac{3l}{4}, ...$

Min length of water column = $L - \frac{3l}{4}$

31. Conceptual

32.



$$\frac{GmM}{(R+h)^2} = \frac{GMm}{R}$$

$$v = \sqrt{\frac{GM}{R}}$$

$$\frac{1}{2}mv_1^2 = \frac{GMm}{R} = 0$$

$$v_1 = \sqrt{\frac{2GM}{R}}$$

$$\Delta V = \sqrt{\frac{GM}{R}}\left(\sqrt{2} - 1\right)$$

$$= \sqrt{gR}\left(\sqrt{2} - 1\right)$$

33. $d = \sqrt{2Rh}$ and $d^1 = \sqrt{2Rh^1} \Rightarrow h^1 = 600m$

34. $A \Rightarrow T^{-1}\ B \Rightarrow LT^{-1}\ C \Rightarrow T^{-1}$

35. No. of b particles = No. of nuclei decay

$$\lambda = \frac{0.693}{T} = \frac{0.693}{15} hr^{-1} = 0.04621$$

$$N_0 = \frac{1 \times 10^{-6}}{24} \times 6.023 \times 10^{23} = 2.51 \times 10^{16}$$

$N_1 = N_0\left(1-e^{-\lambda t}\right)$

$N_1 = 2.51\times10^{16}\left(1-e^{-0.04621}\right)$

$N_1 = 2.51\times10^{16}\left(1-0.9548\right)$

36. Let required current is I, then $\left(I - I_g\right)R_s = I_g.R_g$

Þ $\left(I - 100mA\right)' 0.1 = 100mA' 100$

\ $I = 100.1mA$

37. $A = 90cm^2 = 90' 10^{-4} m^2, d = 2.5mm = 2.5' 10^{-3} m$

$C = \dfrac{\varepsilon_0 A}{d} = \dfrac{8.85\times10^{-12}\times9\times10^{-3}}{2.5\times10^{-3}}$ or C=32pF

$U = \dfrac{1}{2}CV^2 = \dfrac{1}{2}\times32\times10^{-12}\times400^2$ or $U = 2.56\mu J$

38. $y = \dfrac{FL}{Al} = \dfrac{4MgL}{\pi d^2 l}$

Where $M = 1.0kg\left(exat\right), g = 9.8ms^{-2}\left(exat\right)$

$L = 2m\left(exact\right), l = 0.8mm = 0.8\times10^{-3}m$

$\Delta l = \pm0.05mm, d = 0.4mm = 0.4\times10^{-3}m$

$\Delta d = \pm0.01mm$

Substituting the values of M,g,L,d and 1 in eq. (1) we get

$Y = 2.0\times10^{11}Nm^{-2}$

From eq. (1) the proportionate uncertainty in Y is given by

$\dfrac{\Delta Y}{Y} = \dfrac{2\Delta d}{d} + \dfrac{\Delta l}{l} = \dfrac{2\times0.01mm}{0.4mm} + \dfrac{0.05mm}{0.8mm}$

Since the values of M, g and L are exact, $\Delta M = 0, \Delta g = 0$ and $\Delta L = 0$. Hence

$\dfrac{\Delta Y}{Y} = \dfrac{2\Delta d}{d} + \dfrac{\Delta l}{l} = \dfrac{2\times0.01mm}{0.4mm} + \dfrac{0.05mm}{0.8mm}$

$= 0.05 + 0.0625 = 0.1125$

$\therefore \Delta Y = 0.1125\times Y = 0.1125\times2.0\times10^{11}$

$= 0.225 \times 10^{11} Nm^{-2}$

Since the value of Y is correct only up to the first decimal place, the value of ΔY must be rounded off to the first decimal place. Thus $\Delta Y = 0.2 \times 10^{11} Nm^{-2}$. Therefore, the result of the experiment is

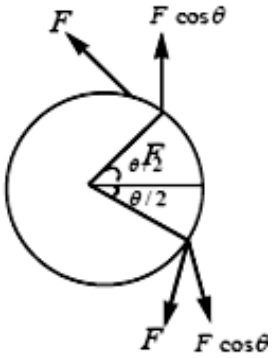
$Y + \Delta Y = (2.0 \pm 0.2) 10^{11} Nm^{-2}$

39. $2F \sin\frac{\theta}{2} = (T.dl)$

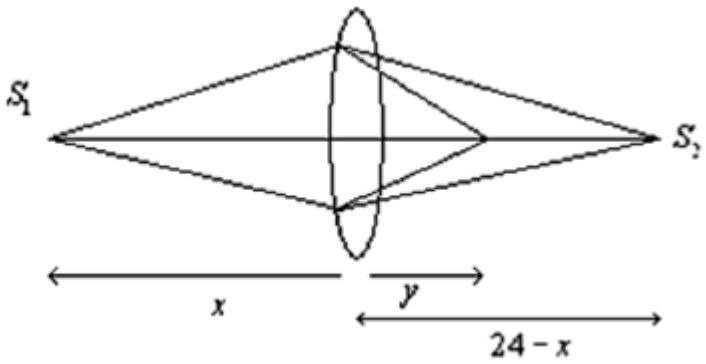
$2F\frac{\theta}{2} = 2T.dl$

$F\frac{dl}{R} = 2T.dl$

$F = 2TR$



40. Conceptual



41.

$\frac{1}{y} + \frac{1}{x} = \frac{1}{9}$

$-\frac{1}{y} + \frac{1}{24 - x} = \frac{1}{9}$

$$\frac{1}{x}+\frac{1}{24-x}=\frac{2}{9}$$

$$\frac{24}{24x-x^2}=\frac{2}{9}$$

$$\Rightarrow x=6\text{cm or } 18\text{ cm}$$

42. $R^1 = 2R$

$$l = \frac{36}{5.2R} = \frac{18}{5R}$$

43. $I = \frac{Ml^2}{3}$

44. $eV_0 = hu - W$ where V_0 is the stopping potential.

45. Conceptual

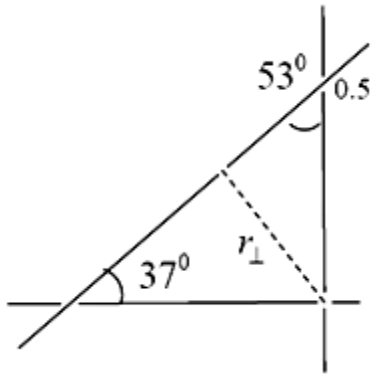
46. Only $\hat{k}$ component of magnetic field will produce the motional emf.

$e = BVl = (5)(5)(1) = 25V$.

47. $I = \frac{P}{4pr^2} = \frac{1}{2}e_0E_0^2C$

48. $h = \frac{R^2w^2}{2g}$

49. $y = \frac{3}{4}x + 0.5$

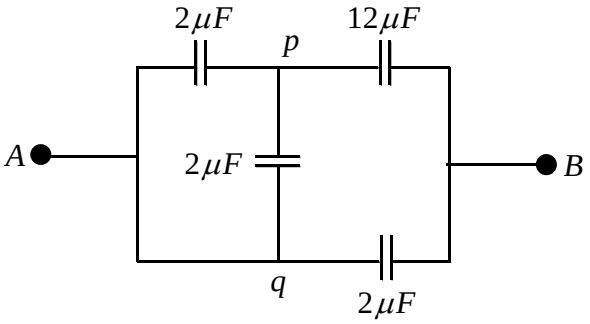


$\therefore \theta = 37°$

$r_\perp = 0.5\sin 53° = 0.4m$

$L = mvr_\perp = (3)(5)(0.4) = 6 - m^2/s$

50.



$$C_{pq} = \frac{2\times 2}{2+2} = 4MF$$

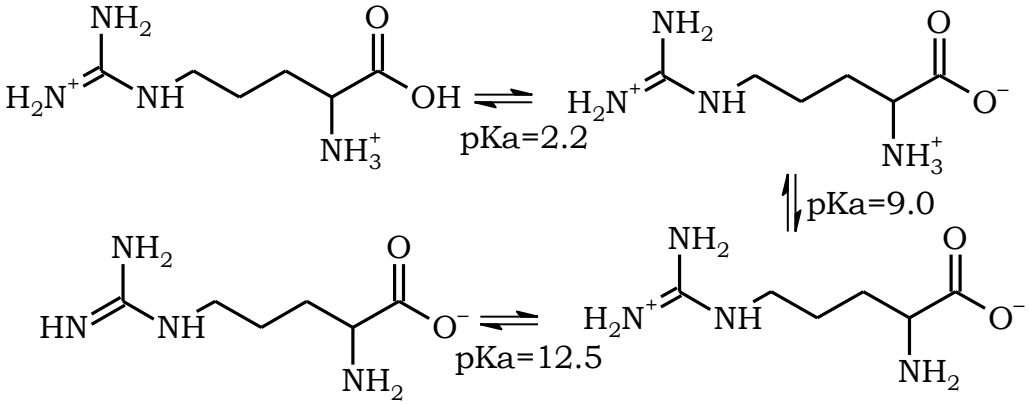
$$C_{qy} = \frac{4\times 12}{12+4} = 3MF$$

$$C_{AB} = c_{qY} + c_{qB}$$

$$= 3+2 = 4MF$$

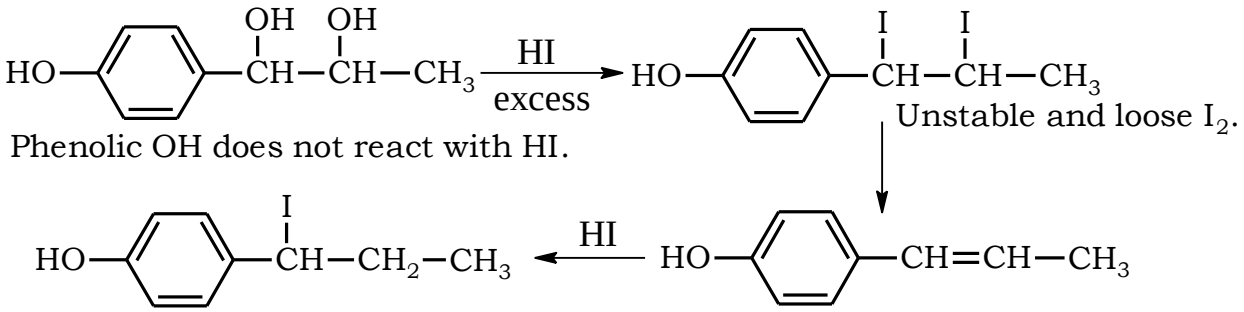
CHEMISTRY

51.



52. Secondary halides with alkoxide undergo elimination majorly.

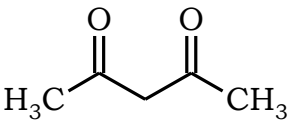
53.



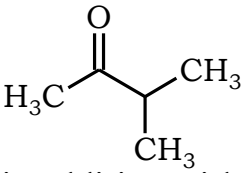
54. Nylon-2,6:

H_2NCH_2COOH(Glycine) and $H_2NCH_2CH_2CH_2CH_2CH_2COOH$(Amino caproic acid)

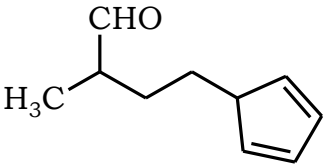
55.



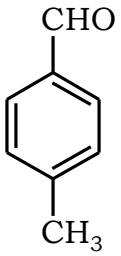
Acid-base with Grignard



Nucleophilic addition with Grignard

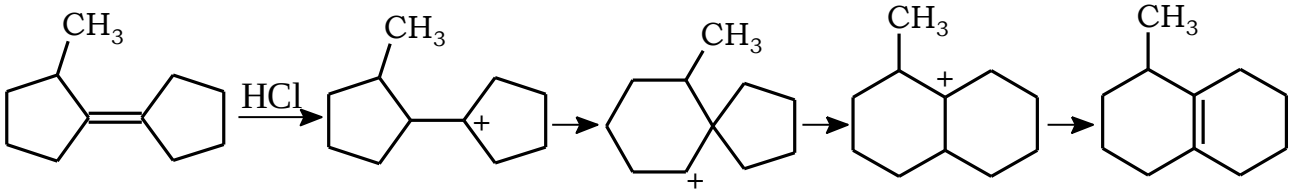


Acid-base with Grignard



Nucleophilic addition with Grignard

56.



57. Esters undergo nucleophilic substitution followed by nucleophilic addition with $LiAlH_4$.In the given molecules rate of nucleophilic substitution directly proportional to electropositivity of carbonyl group.

58. Statement based

59. $K = A$ as t ® ¥

60. $Fe(OH)_3(s) f \quad Fe^{+3}(aq) + 3OH^-$

$3H^+ + 3OH^- \square 3H_2O$

$Fe(OH)_3 + 3H^+ \text{ ® } Fe^{+3} + 3H_2O$

$K_c = \frac{[F_e^{+3}]}{[1H]^3}$ Þ $K_{sp} = 5' (3s)^3 = 5' 27' 5^3$ Þ $4' 10^{-38} = 27' 5^4$

$5^4 = \frac{27}{4' 10^{-38}}$ $S = H_2O$ ® $H^+ + OH^-$ Þ $[H^+] = 10^{-7}$ Þ $k_w = \frac{[H^+]\,OH^-]}{k_w(H_2O)}$

61. 3 unpairede's / possible with storng Field ligand

62.

63. $2\underset{Cold\ dil}{NaOH} + Cl_2 \rightarrow Nacl + Naocl + H_2O$

$6\underset{hot,con}{NaOH} + 3Cl_2 \rightarrow 5Nacl + NaclO_3 + 3H_2O$

64. Order of Atomic radii: sc to Ni decrease , then up to Zn increase

65. Catennation ,Pb shows +2 oxidation state

66

67

68. Au,Ag Extracted by leacting with NaCN

69

70. Volume Stength = $11.2 \times M$

$5.6 = 11.2 \times m \quad m = \frac{5.6}{11.2} = 0.5\ mol/lit$

$w = n \times Gmw \quad = 0.5 \times 34 \Rightarrow 17g\ Per\ lit$

71. $d = \frac{m}{v} = \frac{50 + m_{HCl}}{75}$

72. $\lambda^{\alpha}{}_{NH_4OH} = \lambda_{NH_4Cl} + \lambda_{OH^{--\lambda_4-}} = 150 + 200 - 75 = 275 \Rightarrow \alpha = \frac{\lambda_c}{\lambda^{\infty}{}_c} = \frac{22}{275} = 0.08$

73. $i = \frac{Normal\ Mol.mass}{observed\ Mol.mass} = \frac{94}{120} = 0.78$

$\underset{1-a}{\overset{1}{2(C_6H_5OH)}} \text{®} \ \underset{a/2}{\overset{0}{(C_6H_5OH)_2}}$

$i = \frac{1 - \alpha + \frac{\alpha}{2}}{1} \Rightarrow 0.78 = 1 - \alpha + \frac{\alpha}{2} \Rightarrow \alpha = 0.433$

74. $V.S = M \times 11.2 \Rightarrow 8.96 = M \times 11.2 \Rightarrow M = 0.8$

$M = \frac{W}{GMW} \times \frac{1000}{Vml} \Rightarrow 0.8 = \frac{W}{34} \times \frac{1000}{250} \Rightarrow W = 6.8\ g$

75. $V_z = \sqrt{\frac{8RT}{pM}}$