# JEE-MAIN
# MODEL GRAND TEST

Time : 3 hrs ]  [Number of questions : 90

## MATHEMATICS

1. Given a cube $ABCDA_1B_1C_1D_1$ with lower base ABCD, upper base $A_1B_1C_1D_1$ and the lateral edges $AA_1, BB_1, CC_1, and\, DD_1$; M and $M_1$ are the centres of the faces ABCD and $A_1B_1C_1D_1$ respectively. O is a point on line $MM_1$ such that
$\overline{OA}+\overline{OB}+\overline{OC}+\overline{OD}=\overline{OM_1}$ Then $\overline{OM}=\lambda\overline{OM_1}$ if $\lambda=$

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

2. Equation of the plane parallel to the planes $x+2y+3z=5, x+2y+3z-7=0$ and equidistant from them is

1) $x+2y+3z=6$  2) $x+2y+3z=1$  3) $x+2y+3z+6=0$  4) $x+2y+3z+1=0$

3. A spherical iron ball 10 cm in radius is coated with a layer of ice of uniform thickness that melts at a rate of 50 cm--$^3$ /min. when the thickness of ice is 5 cm, then the rate at which the thickness of ice decreases is

1) $\frac{1}{36\pi}cm/\min$  2) $\frac{1}{18\pi}cm/\min$  3) $\frac{1}{54\pi}cm/\min$  4) $\frac{5}{6\pi}cm/\min$

4. Let $f(x)=(x^2-3x+2)\left|x^3-6x^2+11x-6\right|+\left|\sin\left(x+\frac{\pi}{4}\right)\right|$. The number of non-differentiable points of the function $y=f(x)$ in $[0,2\pi]$ equals

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

5. Let the line $\frac{x-2}{3}=\frac{y-1}{-5}=\frac{z+2}{2}$ lie in the plane $x+3y-\alpha z+\beta=0$. then $(\alpha,\beta)$ equals to

1) $(-6,7)$  2) $(5,-15)$  3) $(-5,5)$  4) $(6,-17)$

6. If $A=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 1\\ 0 & -2 & 4\end{bmatrix}, 6A^{-1}=A^2+cA+dI, then\,(c,d)$ is

1) $(-6,11)$ 2) $(-11,6)$ 3) $(11,6)$ 4) $(6,11)$

7. The sum of the products of the 2n numbers $\pm1,\pm2,\pm3,.....,\pm n$ taking two at a time is

1) $-\frac{n(n+1)}{2}$ 2) $\frac{n(n+1)(2n+1)}{6}$ 3) $\frac{-n(n+1)(2n+1)}{6}$ 4) $\frac{n(n+1)}{2}$

8. Given $lx^2-mx+5=0$ does not have distinct real roots then minimum value of $5l+m$ is

1) 5 2) –5 3) 1 4) –1

9. Extremities of a diagonal of rectangle are (0,0) and (4,3). The equations of the tangents to the circum circle of the rectangle which are parallel to this diagonal are

1) $16x+8y\pm25=0$ 2) $6x-8y\pm25=0$ 3) $8x+6y\pm25=0$ 4) $8x-6y\pm25=0$

10. If $A=\cot^{-1}\sqrt{\tan\theta}-\tan^{-1}\sqrt{\tan\theta}, then\,\tan\left(\frac{\pi}{4}-\frac{A}{2}\right)$ is equal to

1) $\sqrt{\cot\theta}$ 2) $\tan\theta$ 3) $\sqrt{\tan\theta}$ 4) $\cot\theta$

11. The set of values of ‘b’ for which the origin and the point (1,1) lie on the same side of the straight line $a^2x+aby+1=0\,\forall a\in R, b>0$ are

1) $b\in(2,4)$ 2) $b\in(0,2)$ 3) $b\in[0,2]$ 4) $b\in[2,4]$

12. If $P=\begin{bmatrix}\frac{\sqrt{3}}{2} & \frac{1}{2}\\ \frac{-1}{2} & \frac{\sqrt{3}}{2}\end{bmatrix}, A=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix} and\ Q=PAP^T$, then $P^T\left(Q^{2005}\right)P$ is equal to

1) $\begin{bmatrix}1 & 2005\\ 0 & 1\end{bmatrix}$ 2) $\begin{bmatrix}\sqrt{3}/2 & 2005\\ 1 & 0\end{bmatrix}$ 3) $\begin{bmatrix}1 & 2005\\ \sqrt{3}/2 & 1\end{bmatrix}$ 4) $\begin{bmatrix}1 & \sqrt{3}/2\\ 0 & 2005\end{bmatrix}$

13. Let p be the statement “x is an irrational number”, q be the statement “y is a transcendental number”. And r be the statement “x is a rational number iff y is a transcendental number”.

**Statement-1:** r is equivalent to either q or p

**Statement- 2 :** r is equivalent to $\sim(p\leftrightarrow\sim q)$.

1) Statement-1 is false, Statement-2 is true

2) Statement-1 is true, Statement-2 is true ; Statement-2 is a correct explanation for Statement-1

3) Statement-1 is true , Statement-2is true; Statement-2 is not a correct explanation for Statement-1

4) Statement-1 is false, Statement-2 is false

14. If $f\left(\frac{3x-4}{3x+4}\right)=x+2,$ then $\int f(x)dx=\frac{2}{3}x+\frac{k}{3}\log|x-1|+c,$ where k is equal to

1) -4 2) 4 3) -8 4) 8

15. If the focal distance of an end of the minor axis of any ellipse (referred to its axes as the axes of x and y respectively) is k and the distance between the foci is 2h, then its equation is

1) $\frac{x^2}{k^2}+\frac{y^2}{k^2+h^2}=1$ 2) $\frac{x^2}{k^2}+\frac{y^2}{h^2-k^2}=1$ 3) $\frac{x^2}{k^2}+\frac{y^2}{k^2-h^2}=1$ 4) $\frac{x^2}{k^2}+\frac{y^2}{h^2}=1$

16. $\lim_{x\to\frac{\pi}{2}}\frac{\left[1-\tan\left(\frac{x}{2}\right)\right][1-\sin x]}{\left[1+\tan\left(\frac{x}{2}\right)\right][\pi-2x]^2}$ is

1) $\infty$ 2) $\frac{1}{8}$ 3) 0 4) $\frac{1}{32}$

17. If $\int_0^{\pi} xf\left(\sin^3 x+\cos^2 x\right)dx = k\int_0^{\pi/2} f\left(\sin^3 x+\cos^2 x\right)dx$ *Then* $k=$ __

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

18. A man alternately tosses a coin and throws a dice beginning with the coin. The probability that he gets a head before he gets 5 or 6 in the dice is

1) $\frac{3}{4}$ 2) $\frac{1}{2}$ 3) $\frac{1}{3}$ 4) $\frac{1}{5}$

19. If the points $A(x,y+z), B(y,z+x)$ *and* $C(z,x+y)$ are such that $AB=BC$, then x, y, z are in

1) A.P 2) G.P 3) H.P 4) A.G.P

20. If the second term in the expansion $\left(\sqrt[13]{a}+\frac{a}{\sqrt{a^{-1}}}\right)^n$ is $14a^{5/2}$ then the value of $\frac{{}^nC_3}{{}^nC_2}$ is

1) 8 2) 12 3) 4 4) 16

21. If m = number of distinct rational numbers $\frac{p}{q}\in(0,1)$ such that $p,q\in\{1,2,3,4,5\}$ and n = number of onto mappings from $\{1,2,3\}$ to $\{1,2\}$, then m – n is

1) 1 2) -1 3) 0 4) 3

22. In a triangle ABC, medians AD and BE are drawn. If AD =4, $\angle DAB=\frac{\pi}{6}$ *and* $\angle ABE=\frac{\pi}{3}$, then the area of the $\Delta$ ABC is

1) $\frac{64}{3}$ 2) $\frac{8}{3}$ 3) $\frac{16}{3}$ 4) $\frac{32}{3\sqrt{3}}$

23. The area of the smaller part bounded by the semi-circle $y=\sqrt{4-x^2}$, $y=x\sqrt{3}$ and x-axis is

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

24. If $|z-1|+|z+3|\le 8$, then the range of values of $|z-4|$ is

1) $(0,8)$ 2) $[0,8]$ 3) $[1,9]$ 4) $[5,9]$

25. Let $A=\begin{pmatrix}1 & -1 & 1\\ 2 & 1 & -3\\ 1 & 1 & 1\end{pmatrix}$ $.and\ 10B=\begin{pmatrix}4 & 2 & 2\\ -5 & 0 & \alpha\\ 1 & -2 & 3\end{pmatrix}$. If B is the inverse of matrix A, then $\alpha$ is

1) 5 2) -1 3) 2 4) -2

26. The maximum distance from origin to a point on the curve x $=a\sin t-b\sin\left(\frac{at}{b}\right)$

$y=a\cos t-b\cos\left(\frac{at}{b}\right)$, both a, b > 0 is

1) $a-b$ 2) $a+b$ 3) $\sqrt{a^2+b^2}$ 4) $\sqrt{a^2-b^2}$

27. Coordinates of any point on the parabola, whose focus is $\left(\frac{-3}{2},-3\right)$ and the directrix is $2x+5=0$ is given by

1) $(2t^2+2, 2t-3)$ 2) $(2t^2-2, 2t-3)$

3) $(2t^2-2, 2t+3)$ 4) $(2t^2+2, 2t+3)$

28. Mean of 25 observations was found to be 78.4. But later on it was found that 96 was misread as 69. The correct mean is

1) 79.48 2) 76.54 3) 81.32 4) 78.4

29. If for real value of x, $\cos\theta=x+\frac{1}{x}$, then

1) $\theta$ is an acute angle 2) $\theta$ is a right angle

3) $\theta$ is an obtuse angle 4) no value of $\theta$ is possible

30. If y is a function of x and log $(x+y)-2xy=0$, then the value of $y^1(0)$ is equal to

1) 1 2) -1 3) 2 4) 0

## PHYSICS

31. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass *m*. If a force *F* is applied at the free end of the rope, the net force exerted on the rope will be

1) $F$ 2) $\frac{FM}{M+m}$ 3) $\frac{Fm}{M+m}$ 4) $\frac{FM}{M-m}$

32. Two plane concave lenses of glass of refractive index 1.5 have radii of curvature 20 cm and 30 cm respectively. They are placed in contact with the curved surfaces towards each other and the space between them is filled with a liquid of refractive index $\frac{5}{2}$. The focal length of the combination is

1) 6 cm  2) –92 cm  3) 108 cm  4) 12 cm

33. A body of mass m slides downward along a plane inclined at an angle $\alpha$. The coefficient of friction is $\mu$. The rate at which kinetic energy plus gravitational potential energy dissipates expressed as a function of time is

1) $\mu mtg^2 \cos\alpha$  2) $\mu mtg^2 \cos\alpha(\sin\alpha - \mu\cos\alpha)$

3) $\mu mtg^2 \sin\alpha$  4) $\mu mtg^2 \sin\alpha(\sin\alpha - \mu\cos\alpha)$

34. An enemy plane is flying horizontally at an altitude of 2km with a speed of 300m/s. An army man with an anti-aircraft gun on the ground sights the enemy plane when it is directly overhead and fires a shell with a muzzle velocity of 600m/s. At what angle with the vertical should the gun fired so as to hit the plane?

1) $60^0$  2) $45^0$  3) $30^0$  4) $75^0$

35. In a Young's double slit experiment, 12 fringes are observed to be formed in a certain segment of the screen when light of wavelength 600 nm is used. If the wavelength of light is changed to 400 nm, number of fringes observed in the same segment of the screen is given by

1) 12  2) 18  3) 24  4) 30

36. A standing wave set up in a medium is represented by y = 4 cos $\frac{\pi x}{3}$ sin40πt where x and y are in cm and t in sec. Find the distance between adjacent nodes

1) 3 cm  2) 6 cm  3) 1.5 cm  4) 12 cm

37. The wave disturbance propagating in the positive x-direction is given by y = $\frac{1}{1+x^2}$ at t = 0 and y = $\frac{1}{\left[1+(x-1)^2\right]}$ at t = 2 sec. Find the velocity of the wave. (x and y are in cm)

1) 0.5 cm/sec  2) 1 cm/sec  3) 2 cm/sec  4) 4 cm/sec

38. A light rod is pivoted at one end so that it can swing freely as a pendulum. Two masses 2m and m are attached to it at distances b and 3b respectively from the pivot. The rod is held horizontal and then released. The angular acceleration at the instant it is released is

1) $\frac{3mg}{4b}$  2) $\frac{g}{b}$  3) $\frac{5g}{11b}$  4) $\frac{11g}{5b}$

39. An open end organ pipe and a closed organ pipe have same length. The ratio of frequencies of their nth overtone is

1) $\frac{n+1}{2n+1}$  2) $\frac{2(n+1)}{2n+1}$  3) $\frac{n}{2n+1}$  4) $\frac{n+1}{2n}$

40. Let $\vec{F}$ be force acting on a particle having position vector $\vec{r}$. Let $\vec{\tau}$ be the torque due to this force about the origin, then:

1) $\vec{r}.\vec{\tau}=0$ *and* $\vec{F}.\vec{\tau}=0$
2) $\vec{r}.\vec{\tau}=0$ *but* $\vec{F}.\vec{\tau}\neq 0$
3) $\vec{r}.\vec{\tau}\neq 0$ *but* $\vec{F}.\vec{\tau}=0$
4) $\vec{r}.\vec{\tau}\neq 0$ *and* $\vec{F}.\vec{\tau}\neq 0$

41. Water from a tap emerges vertically downwards with an initial speed of 1 $ms^{-1}$. The cross sectional area of the tap is $10^{-4}\,m^2$. Assume that the pressure is constant throughout the stream of water and that the flow is steady. The cross-sectional area of the stream 0.15 m below the tap is

1) $5\times10^{-4}m^2$
2) $1\times10^{-5}m^2$
3) $5\times10^{-5}m^2$
4) $2\times10^{-5}m^2$

42. Two sirens situated 1 km apart are producing sound of frequency 330 Hz. A boy starts moving from one siren to the other with a speed of 2 m/s. If the speed of sound is 330 m/s, the no. of beats heard by the boy per second is

1) 2
2) 4
3) 1
4) 3

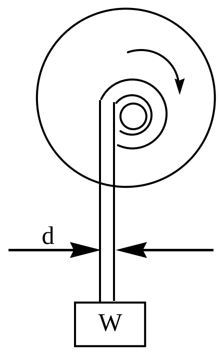
43. A particle has an initial velocity 9 m/s due east and a constant acceleration of 2 $m/s^2$ due west. The distance covered by the particle in the fifth second of its motion is

1) 0
2) 0.5 m
3) 2 m
4) none of these

44. The wavelength of $K_\alpha$ X-ray line of an element of atomic number Z = 11 is $\lambda$. The wave length of $K_\alpha$ X-ray line of another element of atomic number $Z_1$ is $4\lambda$. Then $Z_1$ is

1) 11
2) 44
3) 6
4) 4

45. A weight 'W' is attached to the end of a small rope of diameter 'd' is raised vertically by winding the rope on a reel as shown. If the reel is turned uniformly at the rate of 'n' revolutions per second , what will be the tension in the rope ? Neglect weight of the rope and slight lateral motion of the suspended weigh W




1) $W\left(1+\frac{\pi n^2 d}{g}\right)$
2) $W\left(1+\frac{2\pi n^2 d}{g}\right)$
3) $W\left(1+\frac{4\pi n^2 d}{g}\right)$
4) $W\left(1+\frac{8\pi n^2 d}{g}\right)$

46. If $\vec{E}=\left(3\vec{i}+4\vec{j}+8\vec{k}\right)$N/c, the electric flux through a surface area 100 $m^2$ lying in x-y plane is

1) $200Nm^2c^{-1}$ 2) $400Nm^2c^{-1}$ 3) $600Nm^2c^{-1}$ 4) $800Nm^2c^{-1}$

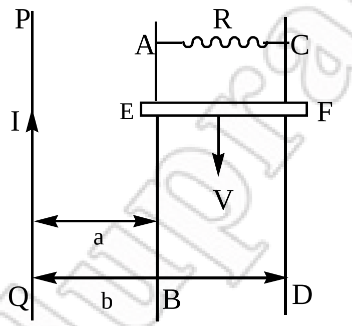
47. Two points charges +9q and +q are kept at a distance d from each other. A third charge –Q is placed at a distance x from +9q on the line joining the above charges. If all the charges are in equilibrium, then x is equal to

1) $\frac{3d}{4}$ 2) $\frac{d}{2}$ 3) $\frac{3d}{8}$ 4) $\frac{4d}{3}$

48. A proton, a deuteron and an alpha particle are accelerated through potentials of V , 2V and 4V respectively. Their velocities will bear a ratio

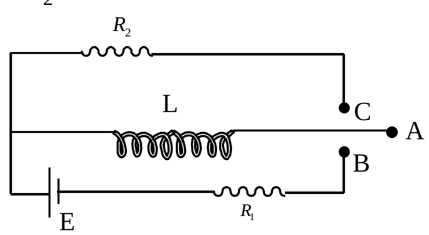
1) 1:1:1 2) $1:\sqrt{2}:1$ 3) $\sqrt{2}:1:1$ 4) $1:1:\sqrt{2}$

49. PQ is an infinite current carrying conductor. AB and CD are smooth conducting rods on which a conductor EF moves with constant velocity V as shown. The force needed to maintain constant speed of EF is




1) $\frac{1}{VR}\left[\frac{\mu_o IV}{2\pi}\ln\left(\frac{b}{a}\right)\right]^2$ 2) $VR\left[\frac{\mu_o IV}{2\pi}\ln\left(\frac{b}{a}\right)\right]^2$ 3) $\frac{V}{R}\left[\frac{\mu_o IV}{2\pi}\ln\left(\frac{b}{a}\right)\right]^2$ 4) $\frac{R}{V}\left[\frac{\mu_o IV}{2\pi}\ln\left(\frac{b}{a}\right)\right]^2$

50. The circuit shown in the figure consists of a battery of emf E, resistances $R_1$ and $R_2$ , inductance L and a two way switch ABC. First A is connected to B for a long time and then A is connected to C. The total heat produced in $R_2$ is




1) $L\frac{E^2}{R_1^2}$ 2) $\frac{LE^2}{4R_1^2}$ 3) $\frac{LE^2}{2R_1^2}$ 4) $\frac{LE^2}{2R_1R_2}$

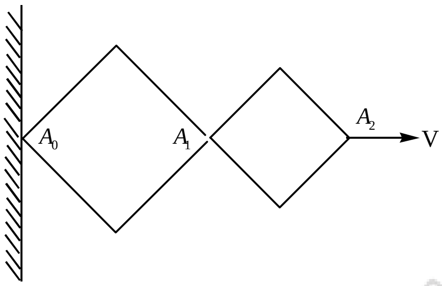
51. $\int\frac{dv}{\sqrt{2av-v^2}}=a^n\sin^{-1}\left[\frac{x}{a}-1\right]$ on the basis of dimensional analysis, the value of n is :

1) 0 2) -2 3) 3 4) none of these

52. The relation between time $t$ and distance $x$ is $t = ax^2 + bx$, where a and b are constants. If v is velocity of particle the acceleration of particle will be

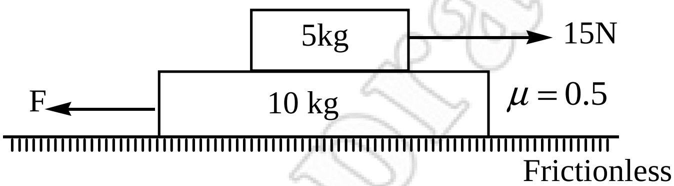
1) $-2abv^2$ 2) $2bv^3$ 3) $-2av^3$ 4) $2av^2$

53. The given hinge construction consists of two rhombus with the ratio 3 : 2. The vertex $A_2$ moves in the horizontal direction with a velocity $v$. The velocity of $A_1$ is :




1) 0.6 V 2) 0.7 V 3) 3 V 4) 2 V

54. The blocks are acted upon by forces as shown in figure




The friction coefficient between the two blocks is $\mu = 0.5$ . What maximum force 'F' can be applied on lower block so that there will be no relative motion between the two bodies?

1) 15 N 2) 25 N 3) 40 N 4) 45 N

55. $H^+$, $He^+$ and $O^+$ all having the same kinetic energy pass through a region in which there is a uniform magnetic field perpendicular to their velocity. The masses of $H^+$, $He^+$ and $O^{+2}$ and 1 amu, 4 amu and 16 amu respectively, then

1) $H^+$ will be deflected most
2) $O^{+2}$ will be deflected most
3) $H^+$ and $O^{+2}$ will be deflected equally
4) All will be deflected equally

56. A metal rod of cross- sectional area 2.0 cm$^2$ is being heated at one end. At some instant the temperature gradient is 5.0$^0$ C / cm at cross-section. A and in 2$^0$ c / cm at cross – section B. The heat capacity of the part AB of the rod in 0.5 J / $^0$C. Thermal conductivity of the material of the rod = 200 w / m $^0$C. Neglect any loss of heat to the atmosphere. Calculate the rate at which the temperature is increasing in the part of AB of the rod.

1) 24 $^0$C / sec 2) 40 $^0$C / sec 3) 16 $^0$C / sec 4) 48 $^0$C / sec

57. A thermally insulated piece of metal is heated under atmosphere by an electric current so that it receives electric energy at a constant power P. This leads to an increase of the absolute temperature T of the metal with time t as follows $T = at^{1/4}$ Then, the heat capacity $C_P$ is :

1) $\frac{4PT^3}{a^4}$ 2) $\frac{4PT^2}{a^3}$ 3) $4PT^2$ 4) none of these

58. The mean lives of a radioactive substance are 1620 years and 405 years for $\alpha$-emission and $\beta$-emission respectively. The time during which three fourth of a sample will decay if it is decaying both by $\alpha$-emission and $\beta$-emission simultaneously.

1) 449 years 2) 349 years 3) 249 years 4) 149 years

59. **Assertion(A) :** Invar steel is used to prepare clock pendulum

**Reason (R ) :** The coefficient of linear expansion of invar steel is infinity.

1) A and R are correct and R is correct explanation for A

2) A and R are correct and R is not correct explanation for A

3) A is true and R is false

4) A is wrong and R is true

60. **Assertion (A) :** Platinum is used to fuse into glass tube.

**Reason (R) :** Both platinum and glass have almost same values of coefficient of linear expansion

1) A and R are correct and R is correct explanation for A

2) A and R are correct and R is not correct explanation for A

3) A is true and R is false

4) A is wrong and R is true

## CHEMISTRY

61. In an experiment 50 mL of 0.1 M solution of a salt reacted with 25 mL of 0.1 M solution of sodium sulphite. The half equation for the oxidation of sulphite ion is $SO_3^{2-}(aq) + H_2O(l) \longrightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2e^-$. If the oxidation number of metal in the salt was 3, what would be the new oxidation number of the metal?

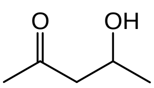
1) Zero 2) 1 3) 2 4) 4

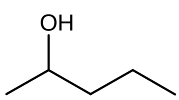
62. A and B are two allotropes of an element. One gram of A will differ from one gram of B in

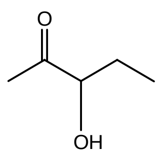
1) oxidation number 2) chemical composition

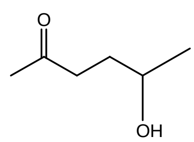
3) total number of atoms 4) atomic arrangement

63. Which one of the following will most readily be dehydrated in acidic conditions?

1) 

2) 

3) 

4) 

64. Molecular size of ICl and $Br_2$ is nearly same, but boiling point of ICl is about 40°C higher than that of $Br_2$. This might be due to

1) $I-Cl$ bond is stronger than $Br-Br$ bond

2) ionisation energy of I< ionization energy of Br

3) ICl is polar whereas $Br_2$ is non-polar

4) The size of I > size of Br

65. A mixture of $Al(OH)_3$ and $Fe(OH)_3$ can be separated easily by treating it with

1) HCl 2) $NH_4OH$ 3) $HNO_3$ 4) NaOH

66. What is the end product of the following sequence of operations?

$$CaC_2 \xrightarrow{H_2O} A \xrightarrow[Hg^{2+}]{Dil\,H_2SO_4} B \xrightarrow[H_2]{Ni} C$$

1) Methyl alcohol 2) Acetaldehyde 3) Ethyl alcohol 4) Ethylene

67. Two isotopes P and Q of atomic weights 10 and 20, respectively are mixed in equal amounts by weight. After 20 days, their weight ratio is found to be 1 : 4. Isotope P has a half – life of 10 days. The half-life of isotope Q is

1) zero 2) 5 days 3) 20 days 4) infinite

68. The crystals of ferrous sulphate on heating give

1) $FeO + SO_2 + H_2O$

2) $Fe_2O_3 + SO_3 + H_2O$

3) $Fe_2O_3 + SO_2 + SO_3 + H_2O$

4) $FeO + SO_3 + H_2SO_4 + H_2O$

69. A compound A of formula $C_3H_6Cl_2$ on reaction with alkali can give B of formula $C_3H_6O$ or C of formula $C_3H_4$. B , on oxidation gives a compound of the formula $C_3H_6O_2$ . C with dilute $H_2SO_4$ containing $Hg^{2+}$ ion gives D of formula $C_3H_6O$, which with bromine and NaOH gives the sodium salt of $C_2H_4O_2$ . Then A is

1) $CH_3CH_2CHCl_2$

2) $CH_3CCl_2CH_3$

3) $CH_2ClCH_2CH_2Cl$

4) $CH_3CHClCH_2Cl$

70. A substance will be deliquescent if its vapour pressure is

1) equal to the atmospheric pressure

2) equal to that of water vapour in the air

3) greater than that of water vapour in their air

4) lesser than that of water vapour in the air

71. When $PCl_5$ reacts with sulphuric acid, sulphuryl chloride $(SO_2Cl_2)$ is formed as the final product. This shows that sulphuric acid

1) is a dibasic acid

2) has great affinity for water

3) has two hydroxyl groups in its structure

4) is a derivative of sulphur dioxide

72. Identify X in the sequence, $X \xrightarrow[(ii) H_2O/H^+]{(i) CH_3MgCl} C_5H_{12}O \xrightarrow[375K]{Cu} C_5H_{10}$

1) $CH_3-\underset{\overset{\|}{O}}{C}-CH_2CH_3$

2) $CH_3CH_2CH_2CH_2CHO$

3) $(CH_3)_2CHCHO$

4) $CH_3CH_2CH_2CH_2OH$

73. Peptization is a process of

1) precipitating colloidal particles

2) Converting a sol into a gel

3) dispersing a precipitate into colloidal state

4) Removal of impurities of true solution state from a colloid

74. The solubility of noble gases in water shows the order

1) $He > Ar > Kr > Ne > Xe$

2) $He > Ne > Ar > Ar > Xe$

3) $Xe > Kr > Ar > Ne > He$

4) None of the above

75. The correct order of decreasing acid strength of trichloroaceticacid (A), trifluoroacetic acid (B), acetic acid (C) and formic acid (D), is

1) $A > B > C > D$

2) $A > C > B > D$

3) $B > A > D > C$

4) $B > D > C > A$

76. For the reaction, $N_2O_5 \longrightarrow 2NO_2 + \frac{1}{2}O_2$

Given, $-\frac{d[N_2O_5]}{dt} = k_1[N_2O_5]$; $\frac{d[NO_2]}{dt} = k_2[N_2O_5]$ ; and $\frac{d[O_2]}{dt} = k_3[N_2O_5]$

The relation between $k_1, k_2$ and $k_3$, is

1) $2k_1 = k_2 = 4k_3$

2) $k_1 = k_2 = k_3$

3) $2k_1 = 4k_2 = k_3$

4) $k_1 = 2k_2 = 4k_3$

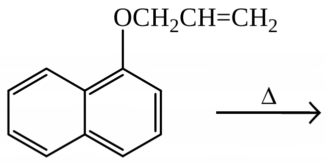
77. Which one is the most likely structure of $CrCl_3 \cdot 6H_2O$, if $\frac{1}{3}^{rd}$ of total chlorine of the compound is precipitated by adding $AgNO_3$ to its aqueous solution?

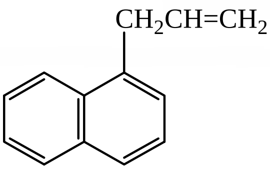
1) $CrCl_3 \cdot 6H_2O$

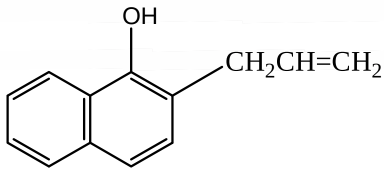
2) $[Cr(H_2O)_3Cl_3] \cdot (H_2O)_3$

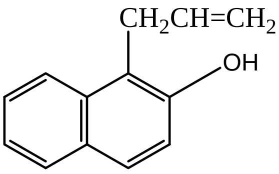
3) $[CrCl_2(H_2O)_4] \cdot Cl \cdot 2H_2O$

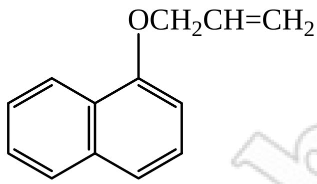
4) $[CrCl(H_2O)_5]Cl_2 \cdot H_2O$

78. The product formed in the given reaction is 

1) 

2) 

3) 

4) 

79. The decomposition of $N_2O_4$ to $NO_2$ is carried out at 280 K in chloroform. When equilibrium has been established, 0.2 mole of $N_2O_4$ and $2\times10^{-3}$ mole of $NO_2$ are present in a 2 L solution. The equilibrium constant for the reaction, $N_2O_4 \rightleftharpoons 2NO_2$, is

1) $1\times10^{-2}$ 2) $2\times10^{-3}$ 3) $1\times10^{-5}$ 4) $2\times10^{-5}$

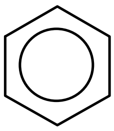
80. Tests on an aqueous solution of a sodium salt having an anion $X^{n-}$ gave the following results

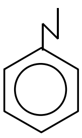
Anion, $X^{n-} \xrightarrow{K_2Cr_2O_7+H_2SO_4}$ Green solution; $X^{n-} \xrightarrow{Pb(NO_3)_2(aq)}$ Black precipitate

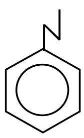
Which one of the following could be $X^{n-}$?

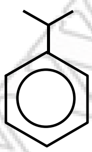
1) $I^-$ 2) $NO_2^-$ 3) $S^{2-}$ 4) $SO_4^{2-}$

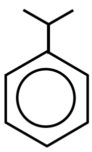
81. The major products (P&Q) in the given reaction sequence are

 $+Cl.CH_2CH_2CH_3 \xrightarrow{AlCl_3} P \xrightarrow[(ii)H_2O]{(i)O_2,\Delta} Q + phenol$

1) , and $CH_3CHO$

2) , and $CH_3COCH_3$

3) , and $CH_3COCH_3$

4) , and $CH_3CH_2CH$

82. A weak acid $HX\left(K_a = 1\times10^{-5}\right)$ on reaction with NaOH gives NaX. For 0.1 M aqueous solution of NaX, the per cent hydrolysis is

1) 0.001% 2) 0.01% 3) 0.15% 4) 1%

83. The given cell is $\underset{p_1(atm)}{Pt(H_2)} \| H^+(1M) \| H^+(1M) | \underset{p_2(atm)}{(H_2)Pt}$ . The cell reaction will be spontaneous if

1) $p_1 = p_2$ 2) $p_1 > p_2$ 3) $p_2 > p_1$ 4) $p_1 = 1atm$

84. Glucose gives many reactions of aldehyde because

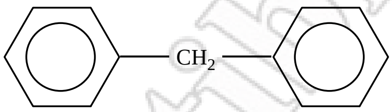
1) it is hydrolysed to acetaldehyde 2) it is a polyhydroxy ketone

3) it is a cyclic aldehyde

4) it is a hemiacetal in equilibrium with its aldehyde form in solution

85. For a reversible process at T = 300 K, the volume of 2 moles of an ideal gas is increased from 1 L to 10 L. The $\Delta H$ for isothermal change is

1) 11.47 kJ 2) 4.98 kJ 3) 0 4) 11.47 kJ

86. The molecular formula of diphenyl methane 


is $C_{13}H_{12}$ . How many structural isomers are possible when one of the hydrogens is replaced by a chlorine atom?

1) 6 2) 4 3) 8 4) 7

87. Bases common to DNA and RNA are

1) adenine, cytosine, uracil 2) guanine, adenine, cytosine

3) guanine, uracil, thymine 4) adenine, thymine, guanine

88. $Na^+$ ion is smaller in size than Na atom .Correct statement among the following is

1) nucleus in each case contains different nucleons

2) sodium atom has an electron less than the sodium ion

3) sodium atom has 11 electrons while sodium ion has 10 electrons with same nuclear positive charge

4) the force of attraction is less in $Na^+$ ion than in Na atom

89. The optically active tartaric acid is named as $D-(+)-$ tartaric acid because it is

1) dextro rotatory and derived from D-glucose

2) dextro rotatory and so it has D-configuration

3) dextro rotatory and derived from $D-(+)-$ glyceraldehyde

4) dextro rotatory when substituted by deuterium

90. Of the following which is a step-growth polymer?

1) Bakelite 2) Polyethylene 3) Teflon 4) PVC

# JEE-MAIN 2015

## MODEL GRAND TEST PAPER - II

**KEY SHEET**

**MATHEMATICS:-**

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

**PHYSICS :-**

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

**CHEMISTRY:-**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 61) 3 | 62) 4 | 63) 1 | 64) 3 | 65) 4 | 66) 3 | 67) 4 | 68) 3 | 69) 1 | 70) 4 |
| 71) 3 | 72) 1 | 73) 3 | 74) 3 | 75) 3 | 76) 1 | 77) 3 | 78) 2 | 79) 3 | 80) 3 |
| 81) 3 | 82) 2 | 83) 2 | 84) 4 | 85) 3 | 86) 2 | 87) 2 | 88) 3 | 89) 3 | 90) 1 |

# JEE-MAIN 2015

## MODEL GRAND TEST PAPER - II

### HINTS & SOLUTIONS

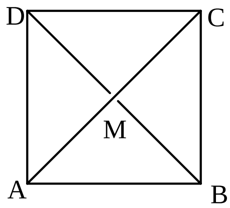
### MATHEMATICS

1. $\overline{OM_1} = \overline{OM} + \overline{MA} + \overline{OM} + \overline{MB} + \overline{OM} + \overline{MC} + \overline{OM} + \overline{MD}$

$= 4\overline{OM} + \left(\overline{MA} + \overline{MC}\right) + \left(\overline{MB} + \overline{MD}\right)$

$= 4\overline{OM} + \overline{O} + \overline{O}$

$= \overline{OM} = \frac{1}{4}\overline{OM}_1$




2. $x + 2y + 3z - \frac{(5+7)}{2} = 0$

3. $v = \frac{4}{3}\pi r^3$

$\frac{dv}{dt} = 4\pi r^2 \frac{dr}{dt}$

$\frac{50}{4\pi(10+5)^2} = \frac{dr}{dt}, \frac{dr}{dt} = \frac{50}{4\pi(225)} = \frac{1}{18\pi} cm/\text{min}$

4. Conceptual

5. Point on the line (2,1,-2) lies on the plane

$\Rightarrow 2\alpha + \beta = -5$

Normal perpendicular to the given line

$\Rightarrow 3(1) + (-5)(3) + 2(-\alpha) = 0$

$\Rightarrow \alpha = -6, \beta = 7$

6. Conceptual

7. $(1-1+2-2+......+n-n)^2$

$= 2(1^2 + 2^2 + ......n^2) + 2S$

S is the required product

$0 = \frac{n(n+1)(2n+1)}{6} + S$

$S = \frac{-n(n+1)(2n+1)}{6}$

8. $f(x) = lx^2 - mx + 5$ does not have

Distinct real roots $\Rightarrow f(x) \le 0 \; or \ge 0 \forall x \varepsilon R$

$f(0) = 5 > 0$

$f(-5) \ge 0$

$25l + 5m + 5 \ge 0$

$\Rightarrow 5l + m \ge -1$

-1 is the minimum

9. $C = \left(2, \frac{3}{2}\right) \; r = \frac{5}{2}$

$m = \frac{3}{4}, \; y - \frac{3}{2} = \frac{3}{4}(x-2) \pm \frac{5}{2}\sqrt{1 + \frac{9}{16}}$

10. $A = \tan^{-1}\frac{1}{\sqrt{\tan\theta}} - \tan^{-1}\sqrt{\tan\theta}$

$A = \tan^{-1}\left(\frac{1-\tan\theta}{2\sqrt{\tan\theta}}\right)$

$\tan\frac{\left(\frac{\pi}{2} - A\right)}{2} = \sqrt{\frac{1-\cos(\pi/2 - A),}{1+\cos(\pi/2 - A),}} = \sqrt{\frac{1-\sin A}{1+\sin A}}$

$= \sqrt{\frac{1 - \frac{(1-\tan\theta)}{(1+\tan\theta)}}{1 + \frac{(1-\tan\theta)}{(1+\tan\theta)}}} = \sqrt{\tan\theta}$

11. $L_{11}, L_{22}$ will have with the same sign

$L_{11} = 0 + 0 + 1 > 0$

$L_{22} = a^2 + ab + 1 > 0$

$\Rightarrow b^2 - 4 < 0$

$-2 < b < 2 \;\; but \; b > 0$

$\Rightarrow b \in (0, 2)$

12. $P^T P = I$

$P^T Q = P^T P A P^T = A P^T$

$P^T Q Q^{2004} P = A P^T Q^{2004} P$

$= A P^T Q \, Q^{2003} P$

$= A^2 P^T Q^{2003} P(so\ on\ like\ this)$

$= A^{2005} P^T P$

$= A^{2005}$

$= \begin{bmatrix} 1 & 2005 \\ 0 & 1 \end{bmatrix}$

13. From truth table, r is not equivalent to q or p and $\sim(p \leftrightarrow \sim q)$

14. $\frac{3x-4}{3x+4} = y$

$\frac{6x}{-8} = \frac{y+1}{y-1}$

$x = \frac{-4}{3}\left(\frac{y+1}{y-1}\right)$

$f(y) = \frac{-4}{3}\left(\frac{y+1}{y-1}\right) + 2 \ = \frac{2y-10}{3(y-1)}$

$\int f(x)dx = \frac{2(x-1)}{3(x-1)} - \frac{8}{3(x-1)}$

$\frac{2}{3}x - \frac{8}{3}\log(x-1) + c$

15. $B(0,b)$

Focal distance a+e(o)=k

a=k

2ae =2h

ae=h

$b^2 = a^2(1-e^2)$

$b^2 = k^2 - h^2$

16. $\underset{x\to\pi/2}{Lt} \frac{\tan\left(\frac{\pi}{4}-\frac{x}{2}\right)}{\pi-2x} \quad \frac{1-\cos\left(\frac{\pi}{2}-x\right)}{(\pi-2x)^2}$

$\frac{\tan\left(\frac{\pi}{4}-\frac{x}{2}\right)}{4\left(\frac{\pi}{4}-\frac{x}{2}\right)} \frac{1-\cos\left(\frac{\pi}{2}-x\right)}{4\left(\frac{\pi}{2}-x\right)^2} = \frac{1}{16}(1)\frac{1}{2} = \frac{1}{32}$

17. $I = \int_0^{\pi} (\pi - x) f(\sin^3 x + \cos^2 x) dx$

$$2I = \pi \int_0^{2\pi/2} f(\sin^3 x + \cos^2 x) dx$$

$$2I = 2\pi \int_0^{\pi/2} f\left(\sin^3 x + \cos^2 x\right) dx$$

$k = \pi$

18. $p = \dfrac{1}{2}$

$q = \dfrac{2}{6}$

$$P(E) = p + \bar{p}\,\bar{q}\,p + \bar{p}\,\bar{q}\,\bar{p}\,\bar{q}\,p = \frac{p}{1 - \overline{p}\overline{q}} = \frac{\frac{1}{2}}{1 - \frac{1}{2}\frac{4}{6}} \quad = \frac{3}{4}$$

19. A,B,C are collinear

$\Rightarrow B = \dfrac{A+C}{2}$

$\left(2y, 2(z+x)\right) = (x+z, 2y+z+x), \qquad 2y = x+z\ , \quad 2z + 2x = 2y + z + x$

$\Rightarrow \qquad z + x = 2y$

x ,y , z are in A.P

20. $n_{c_1} a^{\frac{n-1}{13}} (a\sqrt{a})^1 = 14a^{\frac{5}{2}}$

If n=14

The above is true

$\dfrac{n_{c_3}}{n_{c_2}} = 4$

21. p=1, q=2 or 3 or 4 or 5 = 4

P=2 q=3,4,5 =3

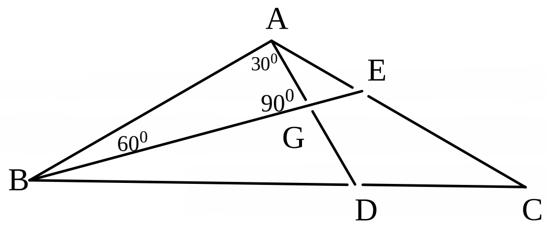
P=3 q=4 or 5 =2

P=4 q= 5 =1

m = (4+3+2+1)-1=9 [2/4=1/2]

$n = 2^3 - 2 = 6$

$m - n = 9 - 6 = 3$

22. 

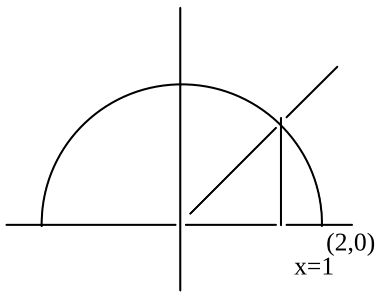

$$\frac{AG}{\sqrt{3}/2} = \frac{BG}{\frac{1}{2}} \Rightarrow \frac{2(4)}{3\sqrt{3}} = BG$$

$$BG = \frac{8}{3\sqrt{3}}$$

$$\Delta = 3(area\ \ of\ \ AGB)$$

$$= 3\frac{1}{2}(BG)(AG)$$

$$= 3\frac{1}{2}\frac{8}{3\sqrt{3}}\frac{2}{3}(4) = \frac{32}{3\sqrt{3}}$$

23. 


$$\sqrt{4-x^2} = x\sqrt{3}$$

$$\Rightarrow x = 1$$

$$Area = \int_0^1 \sqrt{3}x + \int_1^2 \sqrt{4-x^2}\,dx$$

$$= \left[\frac{\sqrt{3}}{2}x^2\right]_0^1 + \left[\frac{x}{2}\sqrt{4-x^2} + \frac{4}{2}\sin^{-1}\frac{x}{2}\right]_1^2$$

$$= \frac{2\pi}{3}$$

24. $|z-1| + |z+3| \le 8$

$\Rightarrow Z$ lies inside or on the ellipse with foci (-3,0)(1,0)

2a=8

a=4

Centre = (-1,0)

Vertices (3,0) (-5,0)

$|z-4|$ is the distance from Z to (4,0)

Max = 9 Min = 1

A' (-5,0) S'(-3,0) C(-1,0) S(1,0) A(3,0) P(4,0)

25. $|A| = 10$

$$adjA = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$$

$$A^{-1} = \frac{1}{10} adjA$$

$$B = \frac{1}{10}\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$$

$$\Rightarrow \alpha = 5$$

26. $op = \sqrt{x^2 + y^2}$

$$= \sqrt{a^2 + b^2 - 2ab\cos\left(\frac{at}{b} - t\right)}$$

$$\leq \sqrt{a^2 + b^2 + 2ab}, \left(-\cos\left(\frac{at}{b} - t\right) \leq 1\right)$$

$$\leq a + b$$

27. Equation of parabola

$$\Rightarrow \left(x + \frac{3}{2}\right)^2 + (y+3)^2 = \frac{(2x+5)^2}{4}$$

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

$$x + 2 = \frac{1}{2}t^2$$

$$= 2\left(\frac{t}{2}\right)^2$$

$$x = 2\left(\frac{t}{2}\right)^2 - 2 \left(let\ \frac{t}{2} is\ some\ t\right)$$

$\therefore x = 2t^2 - 2$

$y + 3 = 2\frac{1}{2}t$

$y = 2\left(\frac{t}{2}\right) - 3$

$Let \frac{t}{2}$ is some t .y=2t-3

28. $\frac{\Sigma xi}{25} = 78.4$

$\Sigma xi = 1960$

Correct value of $\Sigma xi = 1960 + 96 - 69 = 1987$

Correct mean $\frac{1987}{25} = 79.48$

29. $x + \frac{1}{x} \geq 2 \ or \leq -2$

$\therefore \cos\theta$ is not possible for any value of $\theta$

30. $\log(x + y) - 2xy = 0$

$x = 0 \Rightarrow \log y = 0$

$y = 1$

$\frac{1}{x + y}\left[1 + y^1\right] = 2\left[xy^1 + y\right]$

$if \quad x = 0, \ y = 1$

$1(1 + y^1) = 2(0 + 1)$

$y^1 = 2 - 1 = 1$

## PHYSICS

31. (3) Net force acting on the rope = (acceleration) system x (mass) rope = $\frac{Fm}{M + m}$

$a_{system} = \frac{F}{M + m}$

32. (4) $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ and $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

33. (2) The rate at which total mechanical energy dissipates with time is equal to the work done by the dissipative force per unit time.

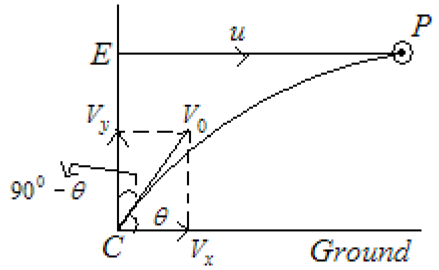
$\Rightarrow P_{dissipative} = fV = f(at)$

$\Rightarrow P_{dissipative} = \mu mtg \cos\alpha\left(g(\sin\alpha - \mu\cos\alpha)\right)$

34. (3) Let the shell hit the plane at $P$ and $t$ be the time taken for the shell to hit the plane.

The horizontal distance traveled by the shell = $EP = u \times t = V_x.t = V_0 \cos\theta t \;\; as\; V_x = V\cos\theta$

$$\therefore \cos\theta = \frac{u}{V_0} = \frac{300}{600} = \frac{1}{2} = \cos 60^0$$




Angle with the vertical = $90^0 - \theta = 30^0$

35. (2) Fringe width

So, decreases by a factor so no. of fringes in the same segment increases by a factor

36. (1) $K = \frac{2\pi}{\lambda} = \frac{\pi}{3} \Rightarrow \lambda = 6cm$ Distance between adjacent nodes $= \frac{\lambda}{2} = \frac{6}{2} = 3cm$

37. (1) Compare the given equation from

$$y = \frac{a}{b + (x \mp ct)^2}, \; (x \mp ct)^2 = (x-1)^2$$

Ct = 1 for t = 2 sec, so, C = $\frac{1}{2}$ cm/sec

38. (3) $\left[2mgb + mg(3b)\right] = \left[2m\left(b^2\right) + m(3b)^2\right]\alpha\left\{u\sin g\;\tau = I_{system}\alpha\right\}$

$$\Rightarrow \alpha = \frac{5g}{11b}$$

39. ((2) $f_{open} = (n+1)\frac{c}{2l}$, $f_{closed} = (2n+1)\frac{c}{4l}$

$$\frac{f_{open}}{f_{closed}} = \frac{2(n+1)}{2n+1}$$

40. $\vec{r}.\vec{\tau} = 0 \; and \; \vec{F}.\vec{\tau} = 0$

41. 3) Since $V^2 = 1^2 + 2(g)(0.15)$ $\quad \left\{\because v^2 - u^2 = 2as\right\}$

$$\Rightarrow v^2 = 4$$

$$\Rightarrow v = 2ms^{-1}$$

Further according to equation of continuity

$A_1u = A_2v$

$\Rightarrow 10^{-4}(1) = A_2(2)$

$\Rightarrow A_2 = 5\times10^{-5} m^2$

42. (2) $\left(\frac{c}{c-v_s} - \frac{c}{c+v_s}\right) n = \mathrm{f_{beats}} \Rightarrow \mathrm{f_{beats}} = \frac{2cv_s}{c^2 - vs^2}$ n =

43. (2) $v = u - at,\ 0 = 9 - 2t, t = 4.5\sec$

velocity will be zero at 4.5 sec. Then use $s = ut + \frac{1}{2}gt^2$

44. (3) $\frac{\sqrt{v_1}}{\sqrt{v}} = \frac{(Z_1 - 1)}{(11-1)}$

$Z_1 = 6$

45. (2) Tangential velocity of the rope, $\mathrm{v = r\omega}$

Tangential acceleration , $\mathrm{a = \frac{dv}{dt} = \frac{d}{dt}(r\omega) = \omega\frac{dr}{dt}}$

Here $\omega = 2\pi\mathrm{n}$ and $\mathrm{\frac{dr}{dt} = nd}$

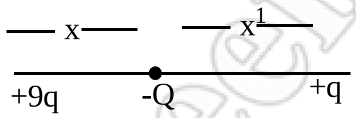
$\therefore \mathrm{a = 2\pi n^2 d}$

$\therefore \mathrm{T = w\left(1 + \frac{a}{g}\right) = w\left(1 + \frac{2\pi n^2 d}{g}\right)}$

46. (4) $\vec{A} = 100\vec{k}$

$\phi = \vec{E}.\vec{A} = \left(3\bar{i} + 4\bar{j} + 8\bar{k}\right).100\vec{k} = 800 Nm^2c^{-1}$

47. (1) For the charges to be in equilibrium, net force on any point charge should be zero




$$x^1 = \frac{d}{\sqrt{\frac{Q^1}{Q}} + 1}$$

$$x^1 = \frac{d}{\sqrt{\frac{9q}{q}} + 1} = \frac{d}{4}$$

$$x = d - x^1 = d - \frac{d}{4} = \frac{3d}{4}$$

48. (4)

$$v=\sqrt{\frac{2qV}{m}}$$

49. ((1) Induced emf = $\int_a^b Bvdt=\frac{\mu_o Iv}{2\pi}\ln\frac{b}{a}$

Power dissipated $=\frac{E^2}{R}=\vec{F}.\vec{v}\Rightarrow F=\frac{E^2}{vR}$

50. (3) Energy stored in the inductor = heat produced $=\frac{1}{2}Li_0^2=\frac{1}{2}L\left(\frac{E}{R_1}\right)^2=\frac{1}{2}L\frac{E^2}{R_1^2}$

51. ((1) $\frac{[dv]}{[v^2]}=[a^n]\Rightarrow n=0$

52. (3) $\frac{dt}{dx}=2ax\frac{dx}{dt}+b\frac{dx}{dt}\Rightarrow v=\frac{dx}{dt}=\frac{1}{(2ax+b)}\Rightarrow\frac{d^2x}{dt^2}=\frac{-2a}{(2ax+b)^3}=-2av^3$

53. (1) $v_{A0}=0$

$$\frac{l_1}{l_2}=\frac{3}{2}$$

$$\frac{V_{A1}}{V_{A2}}=\frac{3}{3+2}=\frac{3}{5}$$

$$v_{A1}=3x\frac{v}{5}=0.6v$$

54. (4) Limiting friction between the blocks $=4mg=0.5\times5\times10=25N$

Acceleration of upper block $=\frac{25-15}{5}=2m/s^2$

Lower block will also move the same acceleration

$$\therefore F-25=10\times2$$

$$F=45N$$

55. (1) $\frac{MV^2}{r}=qVB$

$$r=\frac{MV}{qB}\Rightarrow r^2=\frac{M^2V^2}{qB}$$

$$r^2=\frac{2M(KE)}{qB}$$

56. (1) $\frac{d\,T}{dt} = \frac{1}{C}\,KA\left[\frac{d\,T}{dx}\bigg|_{x=A} - \frac{d\,T}{dx}\bigg|_{x=B}\right]$

$= 24\ {}^0C / sec$

57. (1) $C_P = \frac{P}{\frac{dT}{dt}}$

where $\frac{dT}{dt} = \frac{a^4}{4T^3}$

58. (1) Total decay constant is $\frac{1}{1620} + \frac{1}{405} = \frac{1}{324}$

$\frac{No}{4} = N_0 e^{-\lambda t} \Rightarrow t = 449$ years

59. (3) Invar steel is used to prepare pendulum clock because its coefficient of linear expansion is very low.

60. (1) Platinum is used to fuse into glass because both have almost the same coefficient of linear expansion.

## CHEMISTRY

61. Meq of salt = Meq of $Na_2SO_3$

$50 \times 0.1 \times n = 25 \times 0.1 \times 2$

$\therefore \quad n = 1 \quad$ [change in (O.N.)]

$\therefore \quad M^{3+} + e^- \longrightarrow M^{2+}$

62. Allotropes of an element have the same chemical properties but have different arrangement of atoms and physical properties.

63. It undergoes dehydration easily as the product obtained is conjugated, and is more stable.

64. Polarity in a molecule gives rise to an increase in forces of attraction among molecules and thus, the boiling point increases.

65. Being amphoteric , $Al(OH)_3$ is soluble in NaOH solution whereas $Fe(OH)_3$ is insoluble.

66. $CaC_2 \xrightarrow{H_2O} C_2H_2 \xrightarrow[Hg^{2+}(catalyst)]{H_2O} CH_3CHO \xrightarrow[Ni]{H_2} CH_3CH_2OH$

67. Let $w$ g of each be taken, then initial mole of $P = \frac{w}{10}$; mol of $Q = \frac{w}{20}$

Final mole of $P = \dfrac{w_1}{5 \times 10}$

Final mole of $Q = \dfrac{4w_1}{20 \times 5}$

For $P$ $\quad \dfrac{P_{N_0}}{P_N} = e^{\lambda_1 t}$

For $Q$ $\quad \dfrac{Q_{N_0}}{Q_N} = e^{\lambda_2 t}$

$\therefore$ For $P$ $\quad \dfrac{w \times 5 \times 10}{10 \times w_2} = e^{\lambda_1 \times 20}$

For $Q$ $\quad \dfrac{w \times 20 \times 5}{20 \times w_1 \times 4} = e^{\lambda_2 \times 20}$

By Eqs. (i) and (ii) $4 = e^{(\lambda_1 - \lambda_2) \times 20}$

$$\therefore \qquad 20(\lambda_1 - \lambda_2) = \log_e 4$$

$$\text{or} \qquad 20\left(\frac{0.693}{10} - \frac{0.693}{t_{1/2}}\right) = \log_e 4$$

68. $FeSO_4 \cdot 7H_2O \xrightarrow{\Delta} FeSO_4 + 7H_2O;$

$2FeSO_4 \xrightarrow{\Delta} Fe_2O_3 + SO_2 + SO_3$

69. $$\underset{(A)}{C_3H_6Cl_2} \begin{cases} \xrightarrow{KOH} \underset{(B)}{C_3H_6O} \\ \qquad\qquad\qquad \text{or} \\ \xrightarrow{KOH\,(alc)} \underset{(C)}{C_3H_4} \end{cases}$$

$$CH_3C \equiv CH \xrightarrow[H^+.Hg^{2+}]{H_2O} CH_3COCH_3 \xrightarrow[+NaOH]{Br_2} CHBr_3 + CH_3COONa$$

Since, B and D are different, thus B is $CH_3CH_2CHO$ and so A is $CH_3CH_2CHCl_2$.

70. Higher vapour pressure of $H_2O$ in atomosphere will drive $H_2O$ vapours to the solute particles.

71. $HO{-}SO_2OH + PCl_5 \longrightarrow Cl{-}SO_2Cl + POCl_3 + 2HCl$

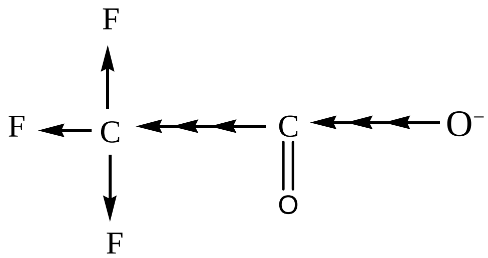
72. must be a tertiary alcohol as it gives alkene on treatment with Cu. Thus, $C_4H_8O$ is a ketone.

73. phenomenon of conversion of freshly precipitated mass into colloidal state by the action

of solute or solvent is called peptization.

74. The solubility of noble gases increases with increase in molecular weight due to increase in van der Waals' forces. However, these are sparingly soluble.

75. Follow applications of inductive effect. The negative charge on carboxylate ion is dispersed more due to $-IE$ of F atom.



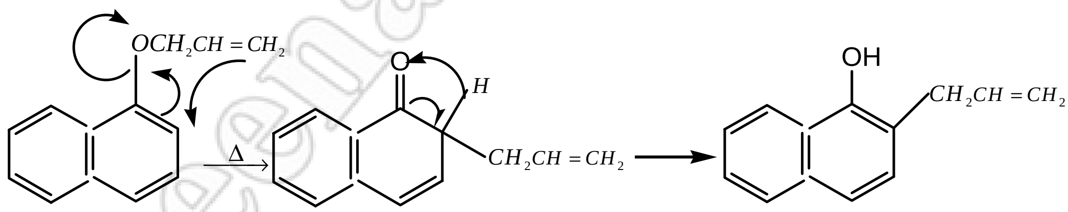

The carboxylate ion thus becomes more stable and the acid becomes more reactive.

76. $$\frac{-d[N_2O_5]}{dt}=\frac{1}{2}\frac{d[NO_2]}{dt}=\frac{2d[O_2]}{dt}$$

$$\therefore k_1[N_2O_5]=\frac{k_2}{2}[N_2O_5]=2k_3[N_2O_5]$$

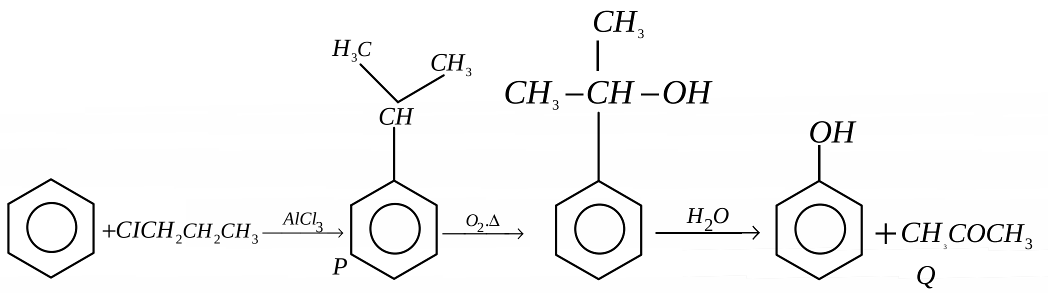
77. According to Werner's theory, only those ions are precipitated which are attached to the metal atoms with ionic bonds and are present outside the coordination sphere.

78.




79. $$K_c=\frac{[NO_2]^2}{[N_2O_4]}=\frac{\left[2\times10^{-3}/2\right]^2}{\left[\frac{0.2}{2}\right]}=1\times10^{-5}$$

80. PbS is black and $S^{2-}$ reacts with $K_2Cr_2O_7$ to give $Cr_2(SO_4)_3$ solution which is green.

81. 


82. For NaX,

$$\underset{1-h}{X^-} + H_2O \rightleftharpoons \underset{h}{HX} + \underset{h}{OH^-}$$

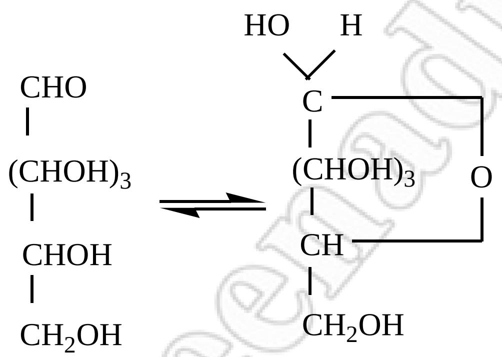
$$\therefore\ h = \sqrt{\frac{K_h}{C}} = \sqrt{\frac{K_w}{K_a \cdot C}} = \sqrt{\frac{10^{-14}}{10^{-5} \times 0.1}}$$

$$= \sqrt{10^{-8}} = 10^{-4}$$

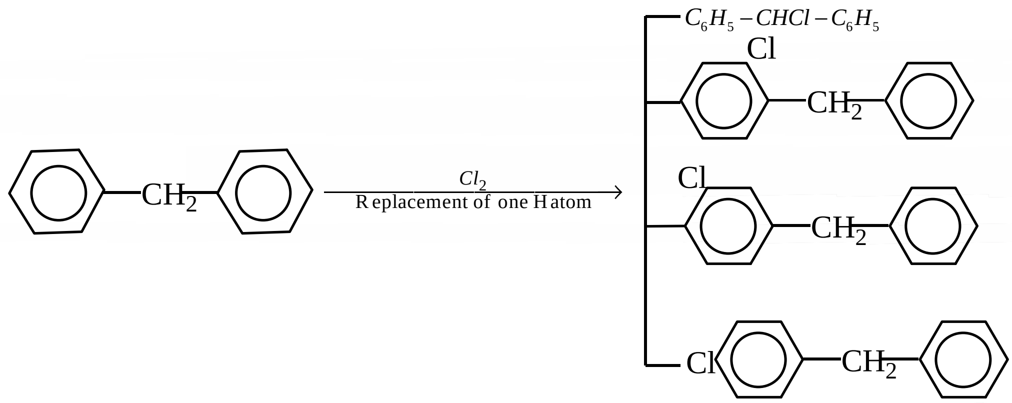
$$\therefore\ \%H = 10^{-4} \times 100 = 10^{-2} = 0.01$$

83. $$E_{cell} = \frac{0.059}{2} \log \frac{\left[H^+\right]^2_{RHS} \times p_{H_2(LHS)}}{p_{H_2(RHS)} \times \left[H^+\right]^2_{LHS}}$$

Thus, for positive $E_{cell}$, $P_{H_2(LHS)} > P_{H_2(RHS)}$

84. 


85. For isothermal process $\Delta H = \Delta E + \Delta(nRT)$

86. 


87. DNA has deoxyribose sugar; RNA has ribose sugar with three bases common as adenine, guanine and cytosine, DNA has fourth base thymine; RNA has uracil

88. This gives rise to higher e nuclear charge in $Na^+$ and the size of $Na^+$ becomes smaller due to more effective pull of valence shells towards nucleus.

89. In D-(+)-tartaric acid, the (+) is due to positive optical rotation and is derived from D–(+)– glyceraldehyde.

90. Bakelite is a step-growth polymer i.e., the condensation involving the reaction of functional group e.g., terylene, Bakelite etc.

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