JEE MAIN

COURSE
NUCLEUS

TEST CODE				
1	1	2	6	8

MOCK TEST-3

Class: **XII** ***Time:*** **3 Hours.** ***Max. Marks:*** **360**

IMPORTANT INSTRUCTIONS

1. The question paper consists of **'90'** objective type questions. There are **'30'** questions each in **Physics**, **Mathematics** and **Chemistry** respectively. **Please fill the OMR answer Sheet accordingly and carefully.**

2. Each question has four choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

3. You will be **awarded 4 marks** for each question, if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble are darkened. In all other cases, **minus one (–1) mark** will be awarded.

4. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 3 above.

5. Use **Black or Blue Ball Point Pen** only for filling particulars.

6. Use of **Calculator, Log Table, Slide Rule and Mobile** is not allowed.

7. Rough work is to be done on the space provided at the bottom and in end of the booklet for this purpose in the Test Booklet only.

8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator. However, the candidates are allowed to take away this Test Booklet with them.

9. Do not fold or make any stray marks on the Answer Sheet.

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USEFUL DATA

Atomic weights: Al = 27, Mg = 24, Cu = 63.5, Mn = 55, Cl = 35.5, O = 16, H = 1, P = 31, Ag = 108, N = 14, Li = 7, I = 127, Cr = 52, K=39, S = 32, Na = 23, C = 12, Br = 80, Fe = 56, Ca = 40, Zn = 65.5, Ti = 48, Ba = 137, U = 238, Co= 59, B =11, F = 19, He = 4, Ne = 20, Ar = 40 , Mo = 96

[Take : ln 2 = 0.693, ln 1.1 = 0.095**,** ln 3 = 1.09, e = 1.6×10^{-19}, $m_e = 9.1 \times 10^{-31}$ kg]

Take: $\in_0 = 8.85 \times 10^{-12}$ C^2/Nm^2, g = 10 m/s^2, S_{water} = 1 cal/gm °C, L_{ice} = 80 cal/gm. , g = 10 m/s^2 unless otherwise stated

PHYSICS

Q.1 A special kind of ruler can be used to measure reaction time. You position the 'zero' mark between your friend's first finger and thumb. Without warning, you let go of the the rular, and your friend has to grab it as soon as possible. You can read the reaction time from labelled marks on the ruler. The marks, are separated from each other by 0.01 s intervals of falling time. This means that

(1) each mark is the same distance from the one before it.

(2) the marks get closer together as you go away from the zero.

(3) the marks get further apart as you go away from the zero.

(4) as you go away from the zero, the marks get closer together then further apart again.

Q.2 An object moves to the East across a frictionless surface with constant speed. A person then applies a constant force to the North on the object. What is the resulting path that the object takes?

(1) a straight line path partly Eastward, partly Northward

(2) a straight line path totally to the North

(3) a parabolic path opening toward the North

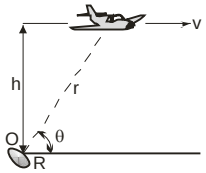
(4) a parabolic path opening toward the East

Q.3 An aeroplane is flying vertically upwards. When it is at a height of 1000m above the ground and moving at a speed of 367 m/s., a shot is fired at it with a speed of 567 m/s from a point directly below it. What should be the acceleration of aeroplane so that it may escape from being hit ?

(1) >5 m/s^2 (2) >10 m/s^2 (3) <10 m/s^2 (4) Not possible

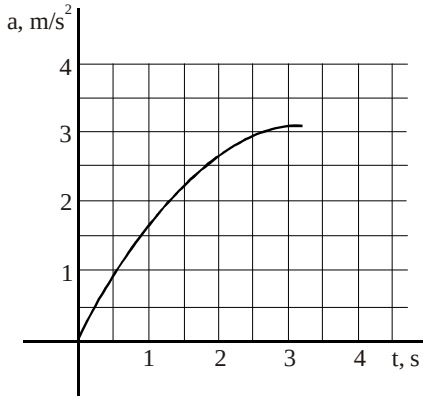
SPACE FOR ROUGH WORK

Q.4 A jet plane flying at a constant velocity V at a height h = 8 km is being tracked by a radar R located at O directly below the line of flight. If the angle θ is decreasing at the rate of 0.025 rad/s., when $\theta = 60°$ the velocity of the plane is :



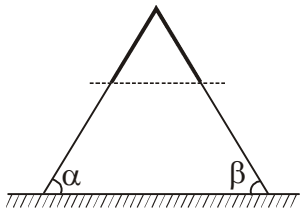
(1) 1440 km/h (2) 960 km/h (3) 1920 km/h (4) 480 km/h

Q.5 The figure Shows the acceleration of a particle versus time graph. The particle starts from rest at t = 0. Find the approximate velocity at t = 1s.



(1) 0.9 m/s (2) 1.6 m/s (3) 3.6 m/s (4) 0.1 m/s

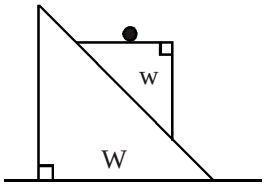
Q.6 A uniform rope of length L and mass M is placed on a smooth fixed wedge as shown. Both ends of rope are at same horizontal level. The rope is initially released from rest, then the magnitude of initial acceleration of rope is



(1) Zero (2) $M(\cos\alpha - \cos\beta)g$ (3) $M(\tan\alpha - \tan\beta)$ (4) None of these

SPACE FOR ROUGH WORK

Q.7 Figure shows two 45° wedges, the smaller wedge w has a horizontal top face. It can slide down the larger wedge W, which is on a horizontal table. All the surfaces are smooth. A mass m sits on the top face of the upper wedge. Describe qualitatively the motion of the system once it is released from rest.



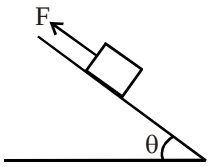
(1) m moves ↙, w moves ↘, W moves ↙

(2) m moves ↓, w moves ↘, W moves ↙

(3) m moves ↙, w moves ↘, W moves ←

(4) m moves ↓, w moves ↘, W moves ←

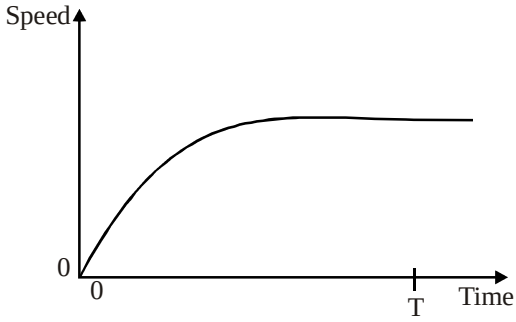
Q.8 A block of mass m is kept on a rough inclined plane with coefficient of friction μ. The force required to just move the block up is



(1) $\mu mg \cos\theta$ (2) $mg \sin\theta$

(3) $mg \sin\theta + \mu mg \cos\theta$ (4) $mg \sin\theta - \mu mg \cos\theta$

Q.9 The variation of the vertical speed with time of a ball falling in air is shown below.



During the time from 0 to T, the ball gains kinetic energy and loses gravitational potential energy ΔE_P. Which of the following statements must be correct?

(1) ΔE_P is equal to the gain in kinetic energy

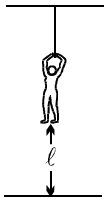
(2) ΔE_P is equal to the work done against air resistance

(3) ΔE_P is greater than the gain in kinetic energy

(4) ΔE_P is less than the work done against air resistance

SPACE FOR ROUGH WORK

Q.10 One end of a light rope is tied directly to the ceiling. A man initially at rest on the ground starts climbing the rope hand over hand upto a height ℓ.



From the time he starts at rest on the ground to the time he is hanging at rest at a height ℓ, how much work was done on the man by the rope?

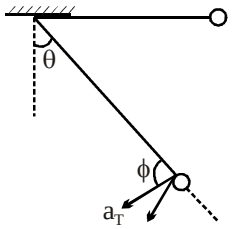
(1) 0 (2) $Mg\ell$ (3) $-Mg\ell$

(4) It depends on how fast the man goes up.

Q.11 A car of mass 1000 kg moves on a circular road with a speed of 20 m/s. Its direction changes by 90° after travelling 628 m on the road. The centripetal force acting on the car is

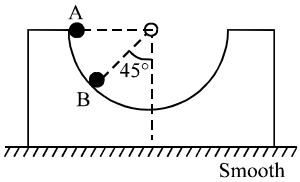
(1) 500 N (2) 750 N (3) 1000 N (4) 1500 N

Q.12 A pendulum bob is released from horizontal position shown. At an angular position θ, its total acceleration makes an angle ϕ with string, ϕ is -



(1) 0 (2) $\tan^{-1}(2\tan\theta)$ (3) $\tan^{-1}\left(\frac{\tan\theta}{2}\right)$ (4) $\frac{\pi}{2}$

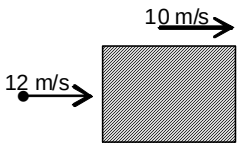
Q.13 A ball of mass m is released from A inside a smooth wedge of mass m as shown in the figure. What is the speed of the wedge when the ball reaches point B?



(1) $\left(\frac{gR}{3\sqrt{2}}\right)^{1/2}$ (2) $\sqrt{2gR}$ (3) $\left(\frac{5gR}{2\sqrt{3}}\right)^{1/2}$ (4) $\sqrt{\frac{3}{2}gR}$

SPACE FOR ROUGH WORK

Q.14 A light particle moving horizontally with a speed of 12 m/s strikes a very heavy block moving in the same direction at 10 m/s. The collision is one dimensional and elastic. After the collision, the particle will



(1) Move at 2 m/s in its original direction
(2) Move at 8 m/s in its original direction
(3) Move at 8 m/s in opposite to its original direction
(4) Move at 12 m/s in opposite to its original direction

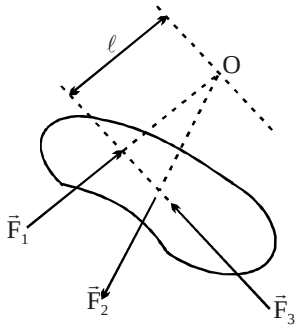
Q.15 A particle A suffers an oblique elastic collision with a particle B that is at rest initially. If their masses are the same, then, after the collision :
(1) they will move in opposite directions
(2) A continues to move in the original direction while B remains at test
(3) they will move in mutually perpendicular directions
(4) A comes to rest and B starts moving in the direction of the original motion of A

Q.16 A space vehicle of mass 200 kg is observed at t = 0 to pass through the origin of reference frame oxyz with velocity $\vec{v}_0 = 150$ m/s $\hat{i}$ relative to the frame. Due to explosive charges, the vehicle separates into three parts A, B and C of mass 100 kg, 60 kg and 40 kg respectively. At t = 2s the positions of parts A and B are observed to be at A (500, – 200, 250) and B (250, 0, – 100), where the coordinates are expressed in metres. The position of part C at that time is

(1) $500\hat{i} - 200\hat{j} + 250\hat{k}$ (2) $250\hat{i} - 100\hat{k}$

(3) $-125\hat{i} + 500\hat{j}$ (4) $-125\hat{i} + 500\hat{j} - 475\hat{k}$

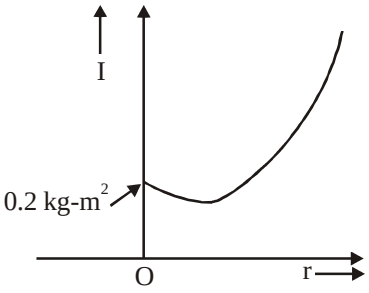
Q.17 Figure shows three coplanar forces acting on an object which does not have any other forces acting on it. Marks the correct options.



(1) Object can be in equilibrium
(2) Magnitude of net torque about O is $F_3\ell$.
(3) If $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \vec{0}$ object can be in equilibrium.
(4) The torque on the object is zero about the point of intersection of F_2 and F_3.

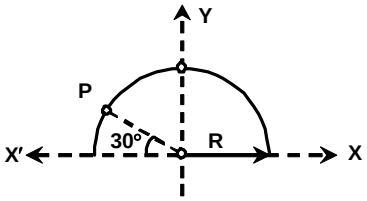
SPACE FOR ROUGH WORK

Q.18 Figure below shows the variation of the moment of inertia of a uniform rod about an axis normal to its length with the distance of the axis from the end of the rod. The moment of inertia of the rod about an axis passing through its centre and perpendicular to the its length is



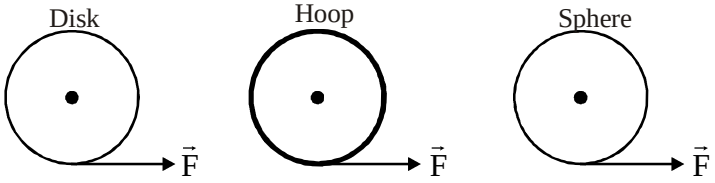
(1) 0.5 kg-m^2 (2) 0.15 kg-m^2 (3) 0.10 kg-m^2 (4) 0.05 kg-m^2

Q.19 A semi-circular disc of radius 1 m and mass = 4 kg is lying on the horizontal x-y plane. If XX' is the axis of rotation of the body and a force $= 2N\hat{k}$ is applied at point P, the magnitude of angular acceleration is equal to (the region is gravity free)



(1) 2 rad/s^2 (2) 3 rad/s^2
(3) 1 rad/s^2 (4) 0.5 rad/s^2

Q.20 A uniform disk, a thin hoop (ring), and a uniform sphere, all with the same mass and same outer radius, are each free to rotate about a fixed axis through its center. Assume the hoop is connected to the rotation axis by light spokes. With the objects starting from rest, identical forces are simultaneously applied to the rims, as shown. Rank the objects according to their angular momentum after a given time t, least to greatest.



(1) all tie (2) disk, hoop, sphere
(3) hoop, disk, sphere (4) hoop, sphere, disk

Q.21 Your snapshot of a street also contains a car that was passing by while you were taking the photograph. Which part of a wheel of the car is least blurry
(1) the center (2) the bottom (3) the top (4) all sides—equally

SPACE FOR ROUGH WORK

Q.22 A star 2.5 times the mass of the sun and collapsed to a radius of 1200 km rotates with a angular speed of ω. What can be the value of ω so that an object placed on its equator remain stuck to its surface due to gravity ? (mass of the sun = 2×10^{30} kg)

(1) 30 rad/s (2) 50 rad/s (3) 40 rad/s (4) 10 rad/s

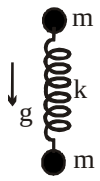
Q.23 A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is 11 kms^{-1}, the escape velocity from the surface of the planet would be

(1) 1.1 kms^{-1} (2) 11 kms^{-1} (3) 110 kms^{-1} (4) 0.11 kms^{-1}

Q.24 In a certain oscillatory system (particle is performing SHM) the amplitude of motion is 5 m and the time period is 4 sec. The minimum time taken by the particle for passing between points, which are at distances of 4 m and 3 m from the centre and on the same side of it will approximately be

(1) 0.12 sec. (2) 0.16 sec. (3) 0.18 sec. (4) 0.19 sec

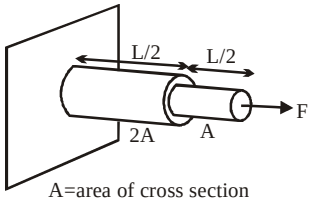
Q.25 A mass m is hung on an ideal massless spring. Another equal mass is connected to the other end of the spring. The whole system is at rest. At t = 0, m is released and the system falls freely under gravity. Assume that natural length of the spring is L_0, its initial stretched length is L and the acceleration due to gravity is g. What is distance between masses as function of time.



(1) $L_0 + (L - L_0) \cos \sqrt{\frac{2k}{m}}\, t$ (2) $L_0 \cos \sqrt{\frac{2k}{m}}\, t$

(3) $L_0 \sin \sqrt{\frac{2k}{m}}\, t$ (4) $L_0 + (L - L_0) \sin \sqrt{\frac{2k}{m}}\, t$

Q.26 The bar shown in the figure is made of a single piece of material. It is fixed at one end. It consists of two segments of equal length $\frac{L_0}{2}$ but different cross-sectional area A and 2A. What is the change in length of the entire system under the action of an axial force F. Consider the shape of joint to remain circular. (Given : y is young's modulus).

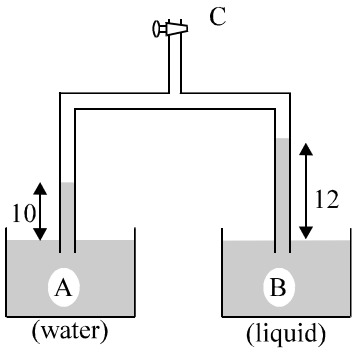


A=area of cross section

(1) $\frac{3FL}{4Ay}$ (2) $\frac{3FL}{8Ay}$ (3) $\frac{3FL}{2Ay}$ (4) None of these

SPACE FOR ROUGH WORK

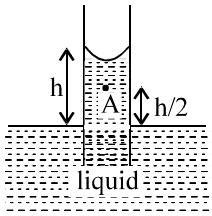
Q.27 The limbs of a glass U-tube are lowered into vessels A and B, A containing water. Some air is pumped out through the top of the tube C. The liquids in the left hand limb A and the right hand limb B rise to heights of 10 cm and 12 cm respectively. The density of liquid B is :



(1) 0.75 gm/cm^3 (2) 0.83 gm/cm^3 (3) 1.2 gm/cm^3 (4) 0.25 gm/cm^3

Q.28 A steady non-turbulent stream of water comes out of a tap and falls vertically downward. As it does so, the diameter of the stream appears to get smaller. What is the primary reason?
(1) The water's surface tension constricts the stream.
(2) Air pressure, which decreases with altitude, squeezes the stream
(3) The water is accelerating under gravity and so the stream must get thinner as the flow rate (velocity times cross-sectional area) must be constant.
(4) The flow does not constrict; it is an optical illusion.

Q.29 In the diagram shown the liquid has density ρ. Atmospheric pressure is P_0. The pressure at point A is :



(1) $P_0 + \frac{\rho gh}{2}$ (2) $P_0 - \frac{\rho gh}{2}$

(3) $\frac{\rho gh}{2}$ (4) None of these

Q.30 An air bubble of radius r rises steadily through a liquid of density ρ with velocity v. The coefficient of viscosity of liquid is

(1) $\frac{2}{9}\frac{r^2\rho g}{v}$ (2) $\frac{2}{9}\frac{r^2 g}{v\rho}$ (3) $\frac{2}{9}\frac{v\rho g}{r^2}$ (4) $\frac{2}{9}\frac{\rho g}{vr^2}$

SPACE FOR ROUGH WORK

Q.31 $2 \cdot C_0 + \frac{2^2}{2} \cdot C_1 + \frac{2^3}{3} \cdot C_2 + ... + \frac{2^{11}}{11} \cdot C_{10}$ ($C_r = {}^{10}C_r$) is equal to

(1) $\frac{2^{11}}{11}$ (2) $\frac{2^{11}-1}{11}$ (3) $\frac{3^{11}}{11}$ (4) $\frac{3^{11}-1}{11}$

Q.32 If $60^a = 3$ and $60^b = 5$ then the value of $12^{\frac{1-a-b}{2(1-b)}}$ equals

(1) 2 (2) 3 (3) $\sqrt{3}$ (4) $\sqrt{12}$

Q.33 The set of values of x satisfying the inequality $\frac{1}{\log_4 \frac{x+1}{x+2}} \le \frac{1}{\log_4 (x+3)}$ is

(1) $(-3, -2)$ (2) $(-3, -2) \cup (-1, \infty)$
(3) $(-1, \infty)$ (4) none

Q.34 Given that $x + \sin y = 2008$ and $x + 2008 \cos y = 2007$ where $0 \le y \le \pi/2$. The value of $[x + y]$, is. (Here $[x]$ denotes greatest integer function)

(1) 2007 (2) 2008 (3) 2009 (4) 2010

Q.35 Let p be the statement 'Ram races' and q be the statement 'Ram wins'. Then $\sim(p \vee (\sim q))$ is

(1) Ram does not race and Ram does not win.
(2) It is true that Ram races or Ram does not win.
(3) Ram does not race and Ram wins.
(4) It is not true that Ram races and Ram does not win.

Q.36 A vertical pole PS has two marks at Q and R such that portions PQ, PR and PS subtend angles α, β, γ respectively at a point on the ground which is at distance x from the bottom of pole P. If PQ = a, PR = b, PS = c and $\alpha + \beta + \gamma = 180^o$, then x^2 is equal to

(1) $\frac{a^3}{a+b+c}$ (2) $\frac{b^3}{a+b+c}$ (3) $\frac{c^3}{a+b+c}$ (4) $\frac{abc}{a+b+c}$

SPACE FOR ROUGH WORK

Q.37 If $A = \left\{ x \mid x \in N \text{ and } x < 6\frac{1}{4} \right\}$ and $B = \left\{ x \mid x \in N \text{ and } x^2 \le 5 \right\}$. Then the number of subsets of set $A \times (A \cap B)$ which contains exactly 3 elements is

(1) 126 (2) 220 (3) 280 (4) 144

Q.38 The relation P defined from R to R as $a\,P\,b \Leftrightarrow 1 + ab > 0$, for all $a, b \in R$ is

(1) reflexive only (2) reflexive and symmetric only

(3) transitive only (4) equivalence

Q.39 If $x_1, x_2 \& x_3$ are the three real solutions of the equation

$$x^{\log_{10}^2 x + \log_{10} x^3 + 3} = \frac{2}{\frac{1}{\sqrt{x+1}-1} - \frac{1}{\sqrt{x+1}+1}}$$ where $x_1 > x_2 > x_3$, then

(1) $x_1 + x_3 = 2x_2$ (2) $x_1 . x_3 = x_2^2$ (3) $x_2 = \frac{2x_1x_2}{x_1 + x_2}$ (4) $x_1^{-1} + x_2^{-1} = x_3^{-1}$

Q.40 The variance of 20 observations is 5. If each observation is multiplied by 2 then the new variance of the resulting observations, is

(1) 5 (2) 10 (3) 20 (4) 40

Q.41 The last two digits of the number 3^{400} are

(1) 81 (2) 43 (3) 29 (4) 01

Q.42 There exist positive integers A, B and C with no common factors greater than 1, such that $A \log_{200} 5 + B \log_{200} 2 = C$. The sum $(A + B + C)$ equals

(1) 5 (2) 6 (3) 7 (4) 8

Q.43 The expression $E = \sin^2\alpha + \sin^2\beta + \sin^2\left(\frac{\pi}{2} - (\alpha+\beta)\right) + 2\sin\alpha \cdot \sin\beta \cdot \sin\left(\frac{\pi}{2} - (\alpha+\beta)\right)$ is

(1) independent of both α and β (2) independent of α but dependent on β

(3) independent of β but dependent on α (4) dependent on both α and β.

Q.44 Smallest positive x satisfying the equation $\cos^3 3x + \cos^3 5x = 8\cos^3 4x \cdot \cos^3 x$ is

(1) 15° (2) 18° (3) 22.5° (4) 30°

SPACE FOR ROUGH WORK

Q.45 If the quadratic equations $3x^2 + ax + 1 = 0$ and $2x^2 + bx + 1 = 0$ have a common root, then the value of the expression $5ab - 2a^2 - 3b^2$ is

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

Q.46 Solution set of the inequality $x + 1 \le \frac{6}{x}$ is

(1) $(0, 2]$ (2) $[-3, 2)$

(3) $(-\infty, -3] \cup (0, 2]$ (4) $[-3, 0) \cup (2, \infty)$

Q.47 The sum to infinity of the series $\frac{1}{1} + \frac{1}{1+2} + \frac{1}{1+2+3} + \ldots\ldots$ is equal to

(1) 2 (2) 5/2 (3) 3 (4) none of these

Q.48 Consider the sequence $8A + 2B, 6A + B, 4A, 2A - B, \ldots\ldots$ Which term of this sequence will have a coefficient of A which is twice the coefficient of B?

(1) 10^{th} (2) 14^{th} (3) 17^{th} (4) none

Q.49 If $3 + \frac{1}{4}(3 + d) + \frac{1}{4^2}(3 + 2d) + \ldots\ldots +$ upto $\infty = 8$, then the value of d is

(1) 9 (2) 5 (3) 1 (4) none of these

Q.50 Let k_1, k_2 $(k_1 < k_2)$ be two values of k for which the expression $x^2 - y^2 + kx + 1$ can be factorised into two real linear factors, then $(k_2 - k_1)$ is equal to

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

Q.51 Number of integral values of 'a' for which the quadratic equation, $2x^2 - (a^3 + 8a - 1)x + a^2 - 4a = 0$ possesses roots of opposite sign is,

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

Q.52 If $x = \frac{n\pi}{2}$, satisfies the equation $\sin\frac{x}{2} - \cos\frac{x}{2} = 1 - \sin x$ & the inequality $\left|\frac{x}{2} - \frac{\pi}{2}\right| \le \frac{3\pi}{4}$, then:

(1) $n = -1, 0, 3, 5$ (2) $n = 1, 2, 4, 5$

(3) $n = 0, 2, 4$ (4) $n = -1, 1, 3, 5$

SPACE FOR ROUGH WORK

Q.53 Let p and q be any two logical statements and $r : p \rightarrow (\sim p \vee q)$. If r has a truth value F, then the truth values of p and q are respectively

(1) F, F (2) T, T (3) F, T (4) T, F

Q.54 The median of a set of 9 distinct observations is 10.5. If each of the largest 4 observations is increased by 3 and each of the smallest 4 observations is decreased by 2, then the new median of the new set

(1) increased by 3 (2) decreased by 2

(3) increased by 1 (4) remains the same as of original set

Q.55 Let *a* and *b* be the coefficient of x^3 in $(1 + x + 2x^2 + 3x^3)^3$ and $(1 + x + 2x^2 + 3x^3 + 4x^4)^3$, respectively then

(1) a = b (2) a > b (3) a < b (4) a + b = 22

Q.56 If one solution of the equation $x^3 - 2x^2 + ax + 10 = 0$ is the additive inverse of another, then which one of the following inequalities is true?

(1) $-40 < a < -30$ (2) $-30 < a < -20$ (3) $-20 < a < -10$ (4) $-10 < a < 0$

Q.57 Let r_1, r_2 and r_3 be the solutions of the equation $x^3 - 2x^2 + 4x + 5074 = 0$ then the value of $(r_1 + 2)(r_2 + 2)(r_3 + 2)$ is

(1) 5050 (2) 5066 (3) – 5050 (4) – 5066

Q.58 If $\log_{(5.2^x+1)} 2$; $\log_{(2^{1-x}+1)} 4$ and 1 are in Harmonical Progression then

(1) x is a positive real (2) x is a negative real

(3) x is rational which is not integral (4) x is an integer

Q.59 If the roots of the cubic $x^3 - px^2 + qx - r = 0$ are in G.P. then

(1) $q^3 = p^3r$ (2) $p^3 = q^3r$ (3) pq = r (4) pr = q

Q.60 If for an A.P. $a_1, a_2, a_3, \ldots, a_n, \ldots$

$a_1 + a_3 + a_5 = -12$ and $a_1 a_2 a_3 = 8$

then the value of $a_2 + a_4 + a_6$ equals

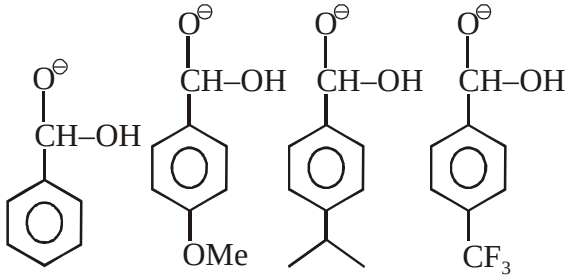
(1) – 12 (2) – 16 (3) – 18 (4) – 21

SPACE FOR ROUGH WORK

Q.61 Which of the following is **incorrectly** matched ?

Formula	**colour**	**electrolyte**
(1) $[Co(NH_3)_6]Cl_3$	yellow	1 : 3
(2) $[Co(NH_3)_5Cl]Cl_2$	purple	1 : 1
(3) $[Co(NH_3)_4Cl_2]Cl$	green	1 : 1
(4) $[Co(NH_3)_4Cl_2]Cl$	violet	1 : 1

Q.62 Arrange the given intermediates in decreasing order of their hydride donation tendency :



(a) **(b)** **(c)** **(d)**

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

Q.63 The following cell at 298 K, two weak acids (HA) and (HB) with pk_a (HA) = 5 and pk_a (HB) = 7 of equal molarity have been used as shown.
$Pt|H_2(g, 1atm)|HA(1M)||HB(1M)|H_2(g,1atm)|Pt$
Thus, emf of the cell is -

(1) $\frac{-0.059}{2}V$ (2) –0.059V (3) $\frac{0.0591}{2}V$ (4) 0.059V

Q.64 Which of the following addition reaction will result into a complex salt ?

(1) $KCl(aq) + MgCl_2(aq) \xrightarrow{\Delta}$

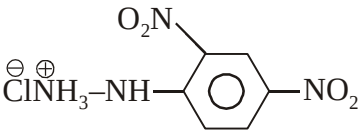
(2) $(NH_4)_2SO_4(aq) + FeSO_4(aq) \xrightarrow{\Delta}$

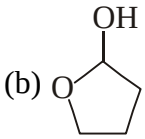
(3) $K_2SO_4(aq) + Al_2(SO_4)_3(aq) \xrightarrow{\Delta}$

(4) $CoCl_3(aq) + KNO_2(aq) \xrightarrow{\Delta}$

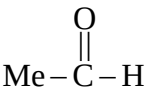
SPACE FOR ROUGH WORK

Q.65 Identify compounds which give precipitate with Tollen's reagent.

(a) 

(b) 

(c) Me – C ≡ C – H

(d) 

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

Q.66 The standard half-cell reduction potential of $Fe^{3+}(aq) \mid Fe$ is – 0.036 V and that of $OH^- \mid Fe(OH)_3(s) \mid Fe$ is – 0.756 V. The value of log K_{sp} for $Fe(OH)_3$ at 298 K is

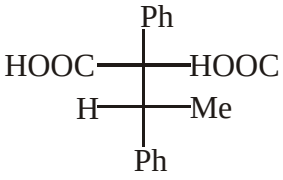
(1) – 36 (2) –36.52 (3) – 96.0 (4) – 87.7

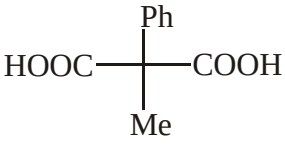
Q.67 Which of the following co-ordination entity is chiral?

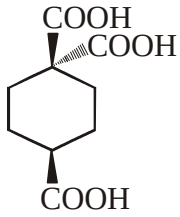
(1) cis-$[CrCl_2(ox)_2]^{3-}$ (2) trans-$[CrCl_2(ox)_2]^{3-}$

(3) fac-$[Co(NH_3)_3(NO_2)_3]$ (4) Mer-$[Co(NH_3)_3(NO_2)_3]$

Q.68 In which compound the products obtained upon prolonged heating can not be separated by fractional distillation.

(1) 

(2) 

(3) 

(4) None

SPACE FOR ROUGH WORK

Q.69 Which of the following is **correct** relation ?

(1) $\Delta S = \left(\frac{\partial E}{\partial T}\right) \times nF$

(2) $\left(\frac{\partial E}{\partial T}\right)_P = \frac{\Delta G - \Delta H}{T}$

(3) $\left(\frac{\partial E}{\partial T}\right)_P = \frac{\partial(\Delta S)}{\partial T}$

(4) $-\Delta S = \left(\frac{\partial E}{\partial T}\right)_P \times n$

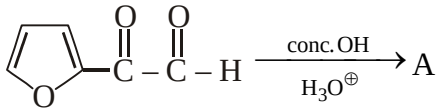
Q.70 Two complexes $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$ can't be distinguished by -

(1) Reaction with $AgNO_3$

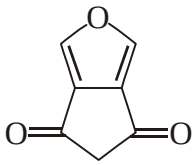
(2) Reaction with $BaCl_2$

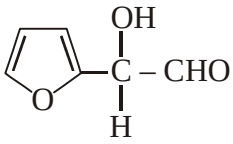
(3) Molar conductance measurement.

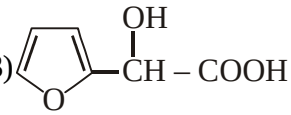
(4) Optical acitivity

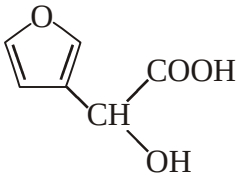
Q.71 

The product A is

(1) 

(2) 

(3) 

(4) 

SPACE FOR ROUGH WORK

Q.72 Select the incorrect statement based on the following half-reaction -

$Cu^{2+} + 2e^- \rightarrow Cu$; $E^\circ = 0.34$ V

$Zn^{2+} + 2e^- \rightarrow Zn$; $E^\circ = -0.76$ V

$SO_4^{2-} + 4H^+ + 2e^- \rightarrow SO_2 + 2H_2O$; $E^\circ = 1.37$ V

(1) Copper reacts with dil. H_2SO_4 forming H_2 and SO_2

(2) Copper reacts with con. H_2SO_4 forming SO_2

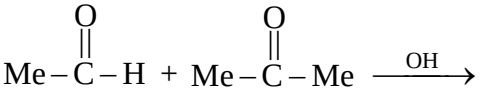
(3) Zinc reacts with con. H_2SO_4 forming SO_2

(4) Zinc reacts with dil. H_2SO_4 forming H_2

Q.73 In which of the following complexes, change in colour is not observed on heating ?

(1) $CuSO_4.5H_2O$ (2) $[Ti(H_2O)_6]Cl_3$ (3) $CoCl_2.6H_2O$ (4) $[Zn(H_2O)_6]Cl_2$

Q.74 Find the total number of Aldol products in given reaction.



(1) Five (2) Four (3) Six (4) Eight

Q.75 The reaction : $2NO_2(g) \rightleftharpoons N_2O_4(g)$, has $\Delta G^0_{298K} = -6$ kJ mol^{-1} . If in the reaction mixture the partial pressure of NO_2 is 0.4 atm and partial pressure of N_2O_4 is 0.2 atm than -

(1) The reaction will proceed forward to attain equilibrium.

(2) The reaction will proceed backward to attain equilibrium.

(3) The reaction is at equilibrium.

(4) Direction of reaction can not be predicted.

Q.76 Select a **incorrect** match :

(1) During photographic film fixation process the complex formed is $[Ag(S_2O_3)_2]^{3-}$

(2) Complex formed in Mond's process is $[Ni(CO)_4]$

(3) Complex formed in removal of hardness of water is Na_2 EDTA.

(4) Complex used to inhibit growth of tumor is cis-platin.

SPACE FOR ROUGH WORK

Q.77 Which statement is not true :

(1) Protonation increases electrophilic nature of carbonyl group.

(2) $CF_3SO_3^-$ is better leaving group than $CH_3SO_3^-$

(3) Benzyl carbonium ion is stabilized by resonance.

(4) $CCl_3CH(OH)_2$ is unstable.

Q.78 The standard heat of combustion of carbon(s), sulphur(s) and carbon disulphide(*l*) are – 390, – 290 and – 1100 kJ/mol respectively. The standard heat of formation of carbon disulphide (*l*) is -

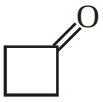
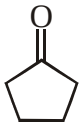
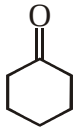
(1) – 130 $kJmol^{-1}$ (2) + 130 $kJmol^{-1}$ (3) – 420 $kJmol^{-1}$ (4) + 420 $kJmol^{-1}$

Q.79 If $E^{\ominus}_{M^{+3}/M^{+2}}$ of Mn, Fe and Co is +1.57, + 0.77 and + 1.97 respectively then this irregularity is due to

(1) d^5 configuration of Fe^{2+} (2) d^5 configuration of Mn^{3+}

(3) d^5 configuration of Co^{3+} (4) d^5 configuration of Fe^{3+}

Q.80 Which of the following ketones has the largest equilibrium constant for addition of water?

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

Q.81 What will be the O–H bond enthalpy for the following reaction at 25°C.

$$\frac{1}{2}H_2(g) + \frac{1}{2}O_2(g) \rightarrow OH(g);\ \Delta H = -10 \text{ kcal}$$

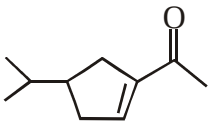
Given : $\Delta_a H(H_2,g) = 104$ $kcalmol^{-1}$, $\Delta_a H(O_2,g) = 120$ $kcalmol^{-1}$

(1) 234 kcal mol^{-1} (2) 122 kcal mol^{-1} (3) 244 kcal mol^{-1} (4) 100 kcal mol^{-1}

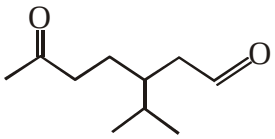
Q.82 Which of the following is an example of interstitial carbide :

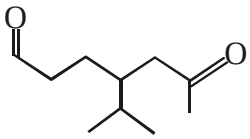
(1) CaC_2 (2) Fe_3C (3) SiC (4) Mg_2C_3

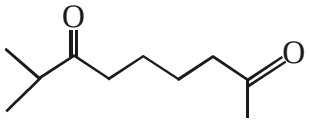
SPACE FOR ROUGH WORK

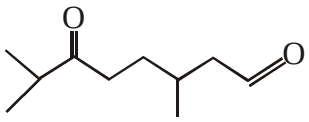
Q.83 A $\xrightarrow[\Delta]{\text{NaOEt, Et-OH}}$ 

Identify reactant A.

(1) 

(2) 

(3) 

(4) 

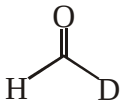
Q.84 The heat of neutralization of four acids HA, HB, HC and HD are – 13.7, – 9.4, – 11.2 and – 12.4 kcalmol^{-1}. Which of the following salt solution will have the highest pH ?

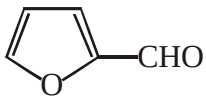
(1) NaA (2) NaB (3) NaC (4) NaD

Q.85 A policeman asks a drunk driver to exhale in a solution 'X'. By observing the change in colour of solution 'X', he confirms that driver is drunk. Solution 'X' used by policeman is -

(1) $Ca(OH)_2$ (2) $Ba(OH)_2$ (3) $K_2Cr_2O_7/H^+$ (4) conc. H_2SO_4

Q.86 Identify that compounds that give cannizaro reaction.

(1) $Me_2CH-\overset{\overset{O}{\|}}{C}-H$ (2) 

(3) 

(4) All of these

Q.87 What would be the entropy change for the vaporization of 1 mol liquid water at 100°C if the latent heat of vaporization of water is 37.3 kJg^{-1} ?

(1) 100 Jmol^{-1} (2) 0.1 Jmol^{-1} (3) 1800 Jmol^{-1} (4) 180 Jmol^{-1}

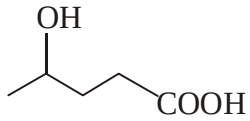
SPACE FOR ROUGH WORK

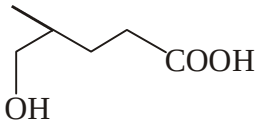
Q.88 Which lanthanoid may exhibit +4 oxidation state ?

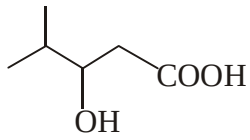
(1) Europium (Eu) (2) Praseodymium (Pr)

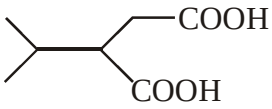
(3) Ytterbium(Yb) (4) Lutetium (Lu)

Q.89 The compound which gives Lactone on heating in the presence of conc. $H^{\oplus}$ medium.

(a) 

(b) 

(c) 

(d) 

(1) a, b (2) c (3) b, c (4) b

Q.90 One mol of an ideal monoatomic gas is heated at constant volume from 27°C to 127°C. What will be the value of $\frac{\Delta U_{sys}}{\Delta S_{sys}}$ for the process- [**Given :** ln 2 = 0.7 , ln 3 = 1.1]

(1) 111.11 K (2) 222.22 K (3) 333.33 K (4) 444.44 K

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ANSWER KEY

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1 1 2 6 8

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans	3	3	2	2	1	1	4	3	3	1	3	3	1	2	3
Q.No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans	4	2	4	3	1	2	4	3	3	1	1	2	3	2	1
Q.No.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans	4	1	3	2	3	4	2	2	2	3	4	2	1	2	2
Q.No.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans	3	1	4	1	4	3	2	4	4	1	4	3	2	1	4
	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC
Q.No.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans	2	2	2	4	1	2	1	2	1	4	3	1	4	3	1
	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC
Q.No.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans	3	4	2	4	1	2	2	1	2	3	4	3	2	1	3

HINTS & SOLUTIONS

PHYSICS

Q.2 Component of velocity along north will increase

Q.3 $V_{rel}^2 = u_{rel}^2 - 2a_{rel}S_{rel}$
$0 = (200)^2 - 2(a_{rel})\ (1000)$
or $a_{rel} = 20\ m/s^2$
So to avoit the hit,
$a_{rel} > 20\ m/s^2$
or $a_p > 10\ m/s^2$

Q.4 ω_0^2 .025 rad/s
$V_2^1 = r\omega$

$$= \frac{h}{\sin 60^\circ} \times 0.025 = \frac{8\times 0.025}{\sin 60^\circ}$$

$$V = \frac{V'}{\sin 60^\circ} = \frac{8\times 0.025}{\sin^2 60^\circ}$$

$$= \frac{8\times 0.025}{3} \times 4 \times 1000 = 960\ km/h$$

Counting ... e graph from
t = 0 to t = ... velocity.

$\because$ $l_1 + l$ ... $= l_2 \sin$ ...

$l +$ ... l

$$l_1 = \frac{L}{1+\frac{\sin\alpha}{\sin\beta}},\ l_2 = \frac{L\sin\beta}{\sin\beta + \sin\alpha} \times \frac{\sin\alpha}{\sin\beta}$$

$$l_2 = \frac{L\sin\alpha}{\sin\alpha + \sin\beta}$$

$$m_1 = \frac{m \sin\beta}{\sin\alpha + \sin\beta}, \quad m_2 = \frac{m \sin\alpha}{\sin\alpha + \sin\beta}$$

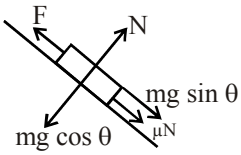
Let $\alpha > \beta$

$m_1 g \sin\alpha - T = m_1 a$

$T - m_2 g \sin\beta = m_2 a$

$$a = \frac{m_1 g \sin\alpha - m_2 g \sin\beta}{m_1 + m_2} = 0$$

Q.8

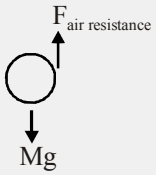


$N = mg \cos q$

$F = mg \sin\theta + \mu N$

Q.9 By COE loss in gravitational P.E. = gain in K.E.

+ work against air resistance.

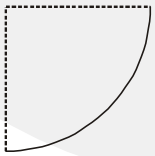


Q.10 This is subtle, because it is the force that the rope applies to the man that causes him to move upward, against the force of gravity. Nonetheless, as he climbs hand over hand, the hand that is holding the rope is always stationary, while man's body and his free hand move upward. Since the force of the rope is applied to the man's stationary hand, there is no displacement of the object to which the force is applied, and hence no work done.

Q.11 $628 = \frac{\pi}{2} R$

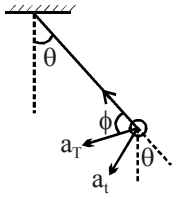
$628 = \frac{3.14}{2} R$

$\Rightarrow R = 400$



$$F = \frac{mv^2}{R} = 1000 \times \frac{20^2}{400} = 1000 \text{ N}$$

Q.12 $mgl \cos\theta = \frac{1}{2} mv^2$



$$\frac{v^2}{l} = 2g \cos\theta$$

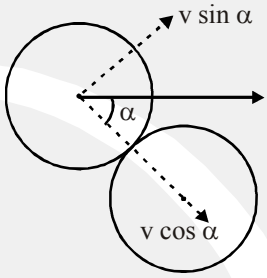
$ma_t = mg \sin\theta$

$$\tan f = \frac{a_t}{a_R} = \frac{g \sin\theta}{2g \cos\theta} = \frac{\tan\theta}{2}$$

Q.14 $e = 1 = \frac{10 - V}{12 - 10}$

$V = 8$ m/s

Q.15 As masses are equal and collision elastic



$\therefore$ velocity along line of impact gets exchanged and

velocity perpendicular to line of impact remains unchanged.

Q.16 $\vec{v}_0 = \frac{100\vec{v}_1 + 60\vec{v}_2 + 40\vec{v}_2}{200}$

$\vec{v}_1 = 250\hat{i} - 100\hat{j} + 125\hat{k}$

$\vec{v}_2 = 125\hat{i} - 50\hat{k}$

$$\vec{v}_3 = \frac{x\hat{i} + y\hat{j} + z\hat{k}}{t} \quad t = 2$$

Q.18 $\frac{mL^2}{3} = 0.2$

$\frac{mL^2}{12} = I$

$\frac{I}{0.2} = \frac{1}{4} \Rightarrow I = 0.05$

Q.19 $R \sin 30° \times 2 = I\alpha = 4 \times \frac{1^2}{4} \times \alpha$

$\alpha = 1 \text{ rad/s}^2$

Q.20 $\Delta\vec{L} = \vec{J}_R = \int \vec{L}dt = \vec{L}t$

Same for all

Q.21 If car is in pure rolling; contact point is instantaneously at rest whereas topmost point has maximum speed. Even if there is slipping forward rolling and car is moving forward, topmost point has greater speed.

Q.22 $\frac{Gm}{R^2} - \omega^2 R > 0$

Q.23 $v_{esc} = \sqrt{\frac{2GM}{R}} = \sqrt{\frac{2G \times 10M}{R/10}}$

$= 10 \times 11 = 110 \text{ km/s}$

Q.25 In CM frame both the masses execute SHM with

$\omega = \sqrt{\frac{k}{\mu}} = \sqrt{\frac{2k}{m}}$

Initially particles are at extreme

distance $= L_0 + (L - L_0)\cos\sqrt{\frac{2k}{m}}\, t$

Q.26 $F = \frac{YA}{L/2} \cdot \Delta L_1$

$\therefore DL_1 + DL_1 = \frac{3FL}{4YL}$

$F = \frac{Y \cdot 2A}{L/2} \cdot \Delta L_2$

Q.27 Pressure at p & that at q are equal as they are both equal to atmospheric pressure.

$\Rightarrow$ $\left.\begin{array}{l} P \to p_f + p_\omega \times g \times \frac{10}{100} \\ Q \to p_f + p_2 \times g \times \frac{12}{100} \end{array}\right\}$ equating

$\Rightarrow p_w 10 = p_2 \times 12 \quad \Rightarrow p_2 = 0.83 \text{ g/cm}^3$

Q.29 Pressure at liquid surface outside the capillary is P_0. As we go up a distance h/2 pressure decreases by $\rho gh/2$

Q.30 $F_{stokes} = F_{buoyancy}$

$6\pi\eta rv = \left(\frac{4}{3}\pi r^3\right)\rho g$

MATHEMATICS

Q.31

Q.32 $60^a = 3 \quad \Rightarrow \quad a = \log_{60}3$

$60^b = 5 \quad \Rightarrow \quad b = \log_{60}5$

let $x = 12^{\frac{1-a-b}{2(1-b)}}$

$\log_{12}x = \frac{1-a-b}{2(1-b)} = \frac{1-(a+b)}{2(1-b)}$

$= \frac{1-(\log_{60}3 + \log_{60}5)}{2(\log_{60}60 - \log_{60}5)} = \frac{1-(\log_{60}15)}{2(1-\log_{60}5)}$

$= \frac{\log_{60}4}{2\log_{60}12}$

$= \frac{1}{2}\log_{12}4 = \log_{12}2 \quad (a + b = \log_{16}15)$

$\therefore \quad \log_{12}x = \log_{12}2 \Rightarrow x = 2$ Ans.]

Q.33 Domain is $(-3,-2) \cup (-1,\infty)$; for $x > -1$, LHS is negative & RHS is positive and for $-3 < x < -2$ it is the other way $\Rightarrow x > -1$ is the final answer]

Q.34 $x + \sin y = 2008$

subtract $x + 2008\cos y = 2007$

$\sin y - 2008\cos y = 1$

$\sin y = 1 + 2008\cos y$

This is possible only if $\cos y = 0$

$\therefore \quad y = \frac{\pi}{2}$ and $x = 2007$

$x + y = 2007 + \frac{\pi}{2} \quad \Rightarrow$

$[x + y] = 2008$ **Ans.**]

Q.35 Given
p : Ram races
q : Ram wins
$\therefore$ The statement of given proposition $\sim(p \vee (\sim q)) = \sim p \wedge q$ is
"Ram does not race and Ram wins." **Ans.**]

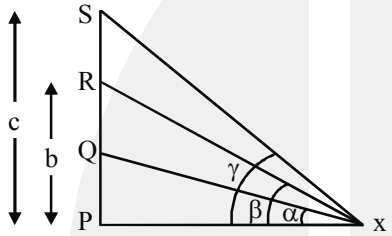
Q.36 We have

$$\tan\alpha = \frac{a}{x},\ \tan\beta = \frac{b}{x} \text{ and } \tan\gamma = \frac{c}{x}$$

$\therefore$ $\alpha + \beta + \gamma = 180^\circ$, so

$$\tan\alpha + \tan\beta + \tan\gamma = \tan\alpha \tan\beta \tan\gamma$$

or $$\frac{a}{x}+\frac{b}{x}+\frac{c}{x}=\frac{a}{x}\cdot\frac{b}{x}\cdot\frac{c}{x}$$



or $$x^2 = \frac{abc}{a+b+c}$$]

Q.37 $A = \{1, 2, 3, 4, 5, 6\} \Rightarrow n(A) = 6$
$B = \{1, 2\} \Rightarrow n(B) = 2$
$\therefore A \cap B = \{1, 2\} \Rightarrow n(A \cap B) = 2$
So, number of elements in $A \times (A \cap B) = 12$
$\therefore$ Number of subsets containing 3 elements = ${}^{12}C_3 = 220$]

Q.38

Q.39 RHS when simplified is equal x.

$$x_1 = 1\ ;\ x_2 = \frac{1}{10}\ ;\ x_3 = \frac{1}{100}$$

Q.40 $$\frac{1}{20}\sum_{i=1}^{20}(x_i - \bar{x})^2 = 5$$

$$\sum_{i=1}^{20}(x_i - \bar{x})^2 = 100$$

New, observations are,
$2x_1, 2x_2, 2x_3, ..., 2x_{20}$

Their mean,

$$\bar{x} = \frac{2(x_1 + x_2 + ...x_{20})}{20} = 2\bar{x}$$

Now, variance,

$$\frac{1}{20}\sum_{i=1}^{20}(2x_i - 2\bar{x})^2 = \frac{1}{20} \times 4\sum_{i=1}^{20}(x_i - \bar{x})^2$$

$$= \frac{1}{20} \times 4 \times 100 = 20$$]

Q.41 $3^{400} = 81^{100} = (1 + 80)^{100} = {}^{100}C_0 + {}^{100}C_1\, 80 + ... + {}^{100}C_{100}\, 80^{100}$
$\Rightarrow$ Last two digits are 01]

Q.42 $A \log_{200} 5 + B \log_{200} 2 = C$

$$\frac{A\log 5}{\log 200} + \frac{B\log 2}{\log 200} = C$$

$A \log 5 + B \log 2 = C \log 200 = C \log(5^2\ 2^3)$
$= 2C \log 5 + 3C \log 2$
hence, $A = 2C$
$B = 3C$
for no common factor greater than 1, $C = 1$
$\therefore$ $A = 2;\ B = 3 \Rightarrow A + B + C = 6$
Ans.]

Q.43 Let
$E = \sin^2\alpha + \sin^2\beta + \cos^2(\alpha + \beta) + 2 \cdot \sin\alpha \cdot \sin\beta \cdot \cos(\alpha + \beta)$
$= \sin^2\alpha + \sin^2\beta + \cos^2(\alpha + \beta) + [\cos(\alpha - \beta) - \cos(\alpha + \beta)] \cdot \cos(\alpha + \beta)$
$= \sin^2\alpha + \sin^2\beta + (\cos^2\alpha - \sin^2\beta) = 1$. **Ans.**]

Aliter: $E = \sin^2\alpha + \sin^2\beta + \cos^2(\alpha + \beta) + 2\sin\alpha \sin\beta \cos(\alpha + \beta)$
$= \sin^2\alpha - \sin^2(\alpha + \beta) + \sin^2\beta + 1 + 2\sin\alpha \sin\beta \cos(\alpha + \beta)$
$= -\sin(2\alpha + \beta) \cdot \sin\beta + \sin^2\beta + 1 + 2\sin\alpha \sin\beta \cos(\alpha + \beta)$
$= 1 - \sin\beta[\sin(2\alpha + \beta) - \sin\beta] + 2\sin\alpha \sin\beta \cos(\alpha + \beta)$
$= 1 - \sin\beta[2\cos(\alpha + \beta)\sin\alpha] + 2\sin\alpha \sin\beta \cos(\alpha + \beta)$
$= 1 - 2\sin\alpha \sin\beta \cos(\alpha + \beta) + 2\sin\alpha \sin\beta \cos(\alpha + \beta)$
$\therefore$ $E = 1 \Rightarrow$ (A). **Ans.**]

Q.44 $\cos^3 3x + \cos^3 5x = (2\cos 4x \cos x)^3$
$= (\cos 5x + \cos 3x)^3$
$\cos^3 3x + \cos^3 5x = \cos^3 5x + \cos^3 3x + 3\cos 5x \cos 3x (\cos 5x + \cos 3x)$
$\Rightarrow (3\cos 3x \cdot \cos 5x)(2\cos 4x \cdot \cos x) = 0$
$\Rightarrow \cos x \cdot \cos 3x \cdot \cos 4x \cdot \cos 5x = 0$

$\therefore x = (2n+1)\frac{\pi}{2}, (2n+1)\frac{\pi}{6}, (2n+1)\frac{\pi}{8}, (2n+1)\frac{\pi}{10}$

$\Rightarrow$ smallest + ve values of x is $\frac{\pi}{10}$ i.e. 18° Ans.]

Q.45 $6x^2 + 2ax + 2 = 0$ and $6x^2 + 3bx + 3 = 0$

subtracting $x(2a - 3b) - 1 = 0 \Rightarrow x = \frac{1}{2a - 3b}$
(put in any equation)

$\therefore \quad 2\frac{1}{(2a-3b)^2} + \frac{b}{2a-3b} + 1 = 0$
$2 + b(2a - 3b) + (2a - 3b)^2 = 0$
$4a^2 + 5b^2 - 12ab + 2ab - 3b^2 + 2 = 0$
$-10ab + 6b^2 + 4a^2 + 1 = 0$
$\Rightarrow \quad 5ab - 3b^2 - 2a^2 = 1 \Rightarrow$ B]

Q.46 Answer is $(-\infty, -3] \cup (0, 2]$]

Q.47 $S = \frac{1}{1} + \frac{1}{1+2} + \frac{1}{1+2+3} + ...$

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

$= 2\left[\frac{1}{n} - \frac{1}{n+1}\right] \Rightarrow S_\infty = 2.$]

Q.48 coefficient of A in n^{th} term $= 8 + (n-1)(-2)$
$= 10 - 2n$

coefficient of B in n^{th} term $= 2 + (n-1)(-1)$
$= 3 - n$
$10 - 2n = 2(3 - n) \quad \Rightarrow \quad 10 = 6$
which is absurd $\Rightarrow$ none]

Q.49 $8 = 3 + \frac{1}{4}(3 + d) + \frac{1}{4^2}(3 + 2d) + ... + \text{upto} \infty$

$\frac{8}{4} = \frac{3}{4} + \frac{3+d}{4^2} + ...\infty$

$8 - 2 = 3 + \frac{d}{4} + \frac{d}{4^2} + \frac{d}{4^3} + ...\infty$

$6 = 3 + \frac{d/4}{1 - 1/4} \quad \Rightarrow \quad d = 9$]

Q.50 $x^2 + kx + 1 - y^2 = 0$

$x = -\frac{-k \pm \sqrt{4y^2 + k^2 - 4}}{2}$

for real linear factors $4y^2 + 0y + k^2 - 4$ must be a perfect square.
Hence $D = 0 \Rightarrow 0 - 16(k^2 - 4) = 0$
$\therefore \quad k = 2, -2 \Rightarrow k_1 = -2$
and $k_2 = 2$
$k_2 - k_1 = 2 - (-2) = 4$ **Ans.**

Aliternatively: Comparing $x^2 - y^2 + kx + 1$, with $Ax^2 + 2Hxy + By^2 + 2Gx + 2Fy + C$;

we get $A = 1, B = -1, H = 0, G = \frac{k}{2}$,
$F = 0, C = 1$
Now, using condition,
$ABC + 2FGH - AF^2 - BG^2 - CH^2 = 0$, we get

$-1 + \frac{k^2}{4} = 0 \Rightarrow k = \pm 2$

$\Rightarrow k_1 = -2, k_2 = 2$
Hence, $(k_2 - k_1) = 2 - (-2) = 4$. **Ans.**]

Q.51 $f(0) < 0 \Rightarrow a^2 - 4a < 0$
$\therefore a \in (0, 4)$.
Hence, number of integral value of a is 3.]

Q.52 Given $\left|\frac{x}{2} - \frac{\pi}{2}\right| \le \frac{3\pi}{4}$; let $x = \frac{n\pi}{2}$;

$\left|\frac{n\pi}{4} - \frac{\pi}{2}\right| \le \frac{3\pi}{4}$ or $|n\pi - 2\pi| \le 3\pi$

Hence possible n satisfying this case
0, 1, 2, 3, 4, 5

now given

$$\sin\frac{x}{2}-\cos\frac{x}{2}=(\sin\frac{x}{2}-\cos\frac{x}{2})^2$$

$\Rightarrow$ either $\sin\frac{x}{2}=\cos\frac{x}{2}$

or $\sin\frac{x}{2}-\cos\frac{x}{2}=1$

corresponding n can be 1, 2, 4 and 5.]

Q.53

p	q	~ p	~ p ∨ q	r
T	T	F	T	T
F	F	T	T	T
T	F	F	F	F
F	T	T	T	T

$\therefore$ Clearly from above table, If r has a truth value F, then the truth values of p and q are T and F respectively.]

Q.54 Median will remain same.

Q.55 $(1+z)^3$ where $z=x(1+2x+3x^2)$

$1+{}^3C_1z+{}^3C_2z^2+{}^3C_3z^3$

coefficient of x^3 in $(1+z)^3$

${}^3C_1(3)+{}^3C_2(4)+{}^3C_3(1)=22$

$\Rightarrow$ $a=22$

now again $(1+y)^3$

where $y=x(1+2x+3x^2+4x^3)$

$(1+y)^3=1+{}^3C_1y+{}^3C_2y^2+{}^3C_3y^3$

$\therefore$ coefficient of x^3 is

${}^3C_1(3)+{}^3C_2(4)+{}^3C_3(1)$

$=9+12+1=22$

$\Rightarrow$ $b=22$

Hence $a=b \Rightarrow$ $a+b=44$ Ans.]

Q.56 If α, β, γ are the roots then $\alpha+\beta+\gamma=2$; also $\alpha+\beta=0$ (where α, β are additive inverse)

$\therefore$ $\gamma=2$ which must satisfy the given equation

$\therefore$ $a=-5 \Rightarrow$ (D)]

Q.57 $x^3-2x^2+4x+5074=(x-r_1)(x-r_2)(x-r_3)$

put $x=-2$

$-8-8-8+5074=-(2+r_1)(2+r_2)(2+r_3)$

$\therefore$ $5050=-(2+r_1)(2+r_2)(2+r_3)$

$(2+r_1)(2+r_2)(2+r_3)=-5050$ **Ans.]**

Q.58

a , b, c are in H.P.

$$\Rightarrow b=\frac{2ac}{a+c} \quad \Rightarrow \frac{\log 4}{\log(2^{1-x}+1)}=\frac{2.\frac{\log 2}{\log(5.2^x+1)}.1}{\frac{\log 2}{\log(5.2^x+1)}+1}$$

$$\frac{2\log 2}{\log\left(2^{1-x}+1\right)}=\frac{2\log 2}{\log(5.2^x+1)[\log 2+\log(5.2^x+1)}$$

$10.\ t+2=2/t+1 \Rightarrow 10t^2+2t=2+t$

$(2^x=t)$

$10t^2+t-2=0$

$10t^2+5t-4t-2=0$

$5t(2t-1)-2(2t+1)=0$

$\Rightarrow t=2/5, -1/2$ (rejected)

$x\log 2=\log 2/5$

$\Rightarrow 2^x=2/5$

$x\log_2 2=1-\log_2 5$

$x=1-\log_2 5.$

Aliter: $\log_2(5\cdot 2^x+1), \frac{1}{2}\log_2(2^{1-x}+1), 1 \rightarrow$ A.P.

$\therefore$ $\log_2(2^{1-x}+1)=\log_2(5\cdot 2^x+1)+1$

$\therefore$ $2^{1-x}+1=(5\cdot 2^x+1)\times 2$

$\Rightarrow \frac{2}{2^x}+1=10\times 2^x+2$

$\therefore$ $2+t=10t^2+2t \Rightarrow 10t^2+t-2=0$

$\therefore$ $2^x=\frac{-1}{2^x}$ or $\frac{2}{5} \Rightarrow x=\log_2\frac{2}{5}=1-\log_2 5,$

$x<0.$]

Q.59 Let $\frac{\alpha}{\delta}, \alpha, \alpha\delta$ are the roots of the given cubic

$\therefore$ $\alpha^3=r$; $\alpha\left[\frac{1}{\delta}+1+\delta\right]=p$;

$\frac{\alpha^2}{\delta}+\alpha^2\delta+\alpha^2=q$ (Taken two at a time)

hence $\alpha^2 (\frac{1}{\delta} + \delta + 1) = q$;

$\therefore \quad \alpha = \frac{q}{p}$, also $\alpha^3 = r$;

$\therefore \quad \frac{q^3}{p^3} = r \Rightarrow q^3 = p^3 r$

Q.60 Let the 1st 5 terms of the A.P. are

$a - 2d , a - d , a , a + d , a + 2d$

now $a_1 + a_3 + a_5 = -12$

$\therefore \quad 3a = -12$

$\Rightarrow \quad a = -4$

also $a_1 . a_2 . a_3 = 8$

$(a - 2d)(a - d)a = 8$

$-4(-4-2d)(-4-d) = 8 \Rightarrow d = -3$

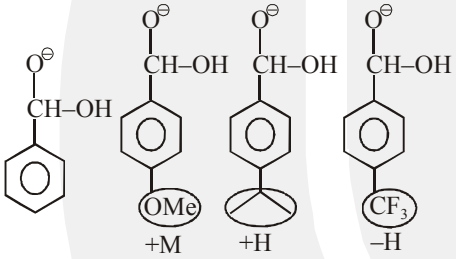
Hence the A.P. is $2 , -1 , -4, -7, -10, -13$,.w.....

Hence $a_2 + a_4 + a_6 = -21$

CHEMISTRY

Q.61 $[Co(NH_3)_5Cl]Cl_2 \longrightarrow$ purplecolour $\longrightarrow$ Electrolyte $\longrightarrow$ 1 : 2

Q.62



Hydride donation tendency α e^- donating group.

Q.63 HB HA

$H_2 + 2H^+ \rightleftharpoons 2H^+ + H_2$

1atm x y 1 atm

$\sqrt{10^{-7}} \quad \sqrt{10^{-5}}$

$K_a = 10^{-5}$

$[H^+] = \sqrt{K_a . C}$

$[H^+] = \sqrt{10^{-5}.1}$

$[H^+]_{HB} = \sqrt{10^{-7}.1}$

$E = 0 - \frac{0.0591}{2} \log \frac{10^{-5}}{10^{-7}} V$

$= -0.059V$

Q.64 (1) $KCl(aq) + MgCl_2(aq) \xrightarrow{\Delta} KCl.MgCl_2.6H_2O$

(Double salt) (Carnallite)

(2) $(NH_4)_2SO_4(aq) + FeSO_4(aq) \xrightarrow{\Delta} FeSO_4.(NH_4)_2SO_4.6H_2O$

(Mohr's salt) (Double salt)

(3) $K_2SO_4(aq) + Al_2(SO_4)_3(aq) \xrightarrow{\Delta} K_2SO_4.Al_2(SO_4)_3.24H_2O$

(Potash Alum) (Double salt)

(4) $CoCl_3(aq) + KNO_2(aq) \xrightarrow{\Delta}$ $K_3[Co(NO_2)_6]$

(Fisher's salt) (Complex salt)

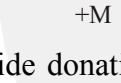
Q.65 (a) 

→ Present acidic 'H'

(b)

→ Not give ppt.

(c) $Me - C \equiv C - H \rightarrow$1-Alkyne has acidic 'H' t han give ppt.

(d) 

→ Not give ppt.

Q.66 $Fe(OH)_3 \rightleftharpoons Fe^{+3} + OH^-$

$\Delta G = -RT \ln K_{sp}$

$\downarrow Fe(OH)_3 + 3e^- \rightleftharpoons Fe(s);$

$\Delta G = -3F(-0.036)$

$Fe(OH)_3(s) \rightleftharpoons Fe^{+3}(aq) + 3OH^-(aq)$

$\Delta G = -RT \ln K_{sp}$

$Fe(OH)_3(s) + 3e^- \rightleftharpoons Fe(s) + 3OH^-$

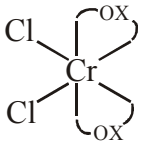
$\Delta G° = -3 FE°$

$-3F(-0.716) = -3F(0.036) - RT \ln K_{sp}$

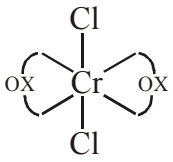
$+3F(-0.756) = +3F(0.036) + RT \ln K_{sp}$

On solving

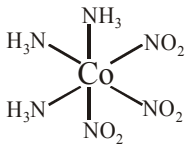
$\log K_{sp} = -36.52$

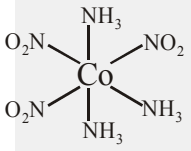
Q.67 (1) 

[POS absent]

(2) 

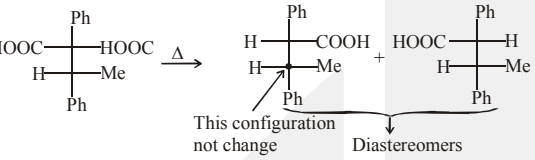
[POS present]

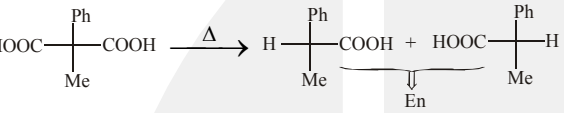
(3) 

(4) 

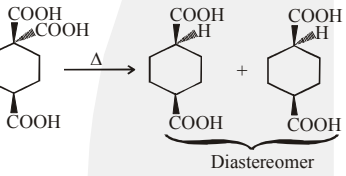
[POS present]

Q.68

(1) 

(2) 

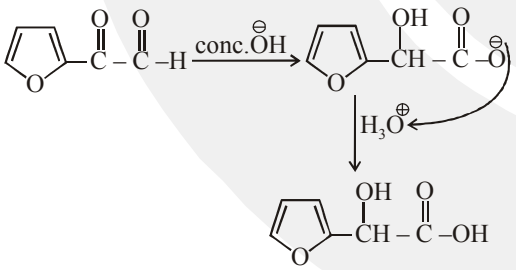
Enantiomer is not separated by fractional distillation.

(3) 

(4) None

Q.69 Theory based

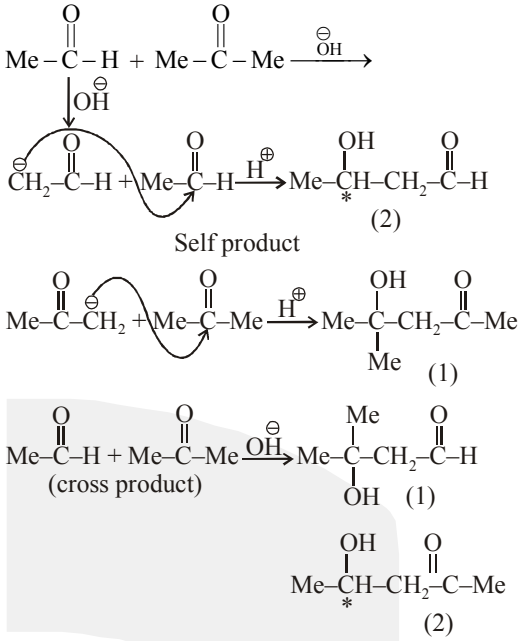
Q.70 Theory based

Q.71 

→: More reactive Aldehyde oxidise and Less reactive reduced.

Q.72 Theory based

Q.73 Due to d^{10} configuration Zn^{2+} does not impart any colour on heating

Q.74 

Total = 6 product **Ans.**

Q.75 $\Delta G = \Delta G° + RT\ln Q$

$= -6\text{kJ mol}^{-1} + 8 \times 298 \times \ln \dfrac{0.2}{(0.4)^2}$

$= -6\text{kJ mol}^{-1} + 8 \times 298 \times \ln \dfrac{10}{8}$

$= -6\text{kJ mol}^{-1} + \dfrac{2386}{1000} \times 2.303 \times (1-0.9)$

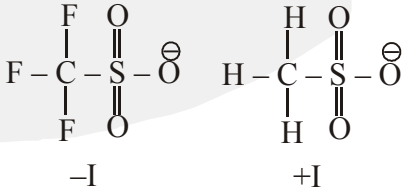
$= -6\ \text{kJmol}^{-1} + 2.366 \times 0.23\ \text{kJ mol}^{-1}$

$= -6 + 0.549 = -5.45\ \text{kJmol}^{-1}$

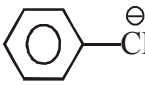
So, reaction is spontaneous in forward direction.

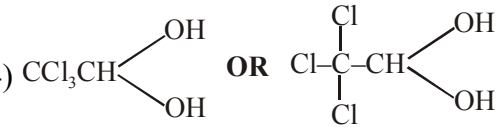
Q.76 $Na^+ + EDTA^{4-} \longrightarrow Na_4\ EDTA$

Q.77 (1) Protonation increases electrophilic of carbonyl group.

(2) 

$CF_3SO_3^-$ is better leaving group than $CH_3SO_3^-$ because $CH_3SO_3^-$ is weak base in compare of $CH_3SO_3^-$

(3)  (Resonance stabilized)

(4) 

Q.78 $C(s) + 2S(s) \rightarrow CS_2(l)$
$\Delta_f H° = -390 - (290) \times 2 - (-1100)$
$= +130\ kJmol^{-1}$

Q.79 $Mn \longrightarrow [Ar]\ 3d^5\ 4s^2$; $Mn^{3+} \longrightarrow d^4$
$Fe \longrightarrow [Ar]\ 3d^6\ 4s^2$; $Fe^{2+} \longrightarrow d^6$, $Fe^{3+} \longrightarrow d^5$
$Co \longrightarrow [Ar]\ 3d^7\ 4s^2$; $Co^{3+} \longrightarrow d^6$

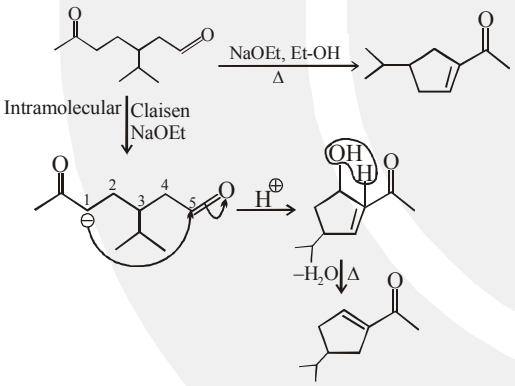
Q.80 Cyclopropone has largest equilibrium constant.

Q.81 $\Delta H = -10$ kcal

$$= \frac{1}{2} \times 104 + \frac{1}{2} \times 120 - E_{O-H} - 10 = 112 - E_{O-H}$$

$E_{O-H} = 122$ kcal mol^{-1}

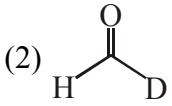
Q.82 CaC_2 & $Mg_2C_2 \rightarrow$ Ionic carbide
$Fe_3C \rightarrow$ Interstitial carbide
$SiC \rightarrow$ Covalent carbide

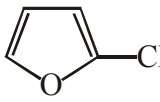
Q.83 

Q.84 The salt weakest acid will produce highest pH with strong base.

Q.85 $K_2Cr_2O_7/H^+ \longrightarrow$ Colour $\rightarrow$ Orange red
Alcohol means alkali added to $K_2Cr_2O_7/H^+$ its colour change to yellow due to formation of chromate ion.

Q.86 (1) $Me_2CH-\overset{\overset{O}{\|}}{C}-H \rightarrow$ These compound not give aldol than give Cannizaro reaction.

(2)  $\rightarrow$ No. α-H

(3)  $\rightarrow$ No. α-H

Q.87 $\Delta H_{vap} = 37.3 \times 18\ kJmol^{-1}$

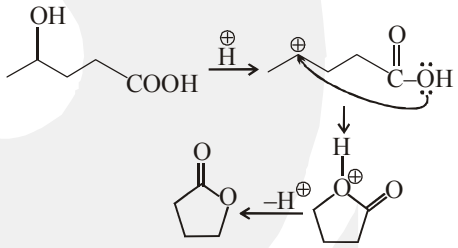
$$\Delta S_{vap} = \frac{\Delta H_{vap}}{373} \times \frac{373 \times 18 \times 10^3}{373} = 1800\ kJmol^{-1}$$

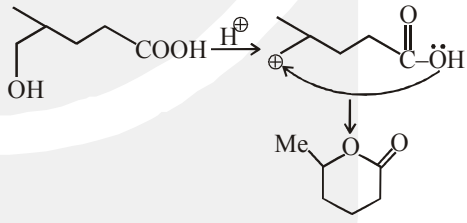
Q.88 (1) Europium (Eu) $\rightarrow [Xe]\ 4f^7\ 5d^0\ 6s^2$ $\rightarrow$ Half filled (+2)

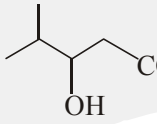
(2) Praseodymium (Pr) $\rightarrow [Xe]\ 4f^3\ 5d^0\ 6s^2$ $\rightarrow$ (+2, +3, +4, +5)

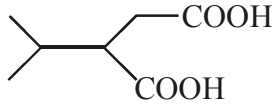
(3) Ytterbium(Yb) $\rightarrow [Xe]\ 4f^{14}\ 5d^0\ 6s^2$ $\rightarrow$ Full filled (+2)

(4) Lutetium (Lu) $\rightarrow [Xe]\ 4f^{14}\ 5d^1\ 6s^2$ $\rightarrow$ Full filled (+3, +2)

Q.89 (a) 

(b) 

(c)  $\rightarrow$ Not give

(d)  $\rightarrow$ Not give

Q.90 $\dfrac{\Delta U}{\Delta S} = \dfrac{nC_{v,m}(T_2 - T_1)}{nC_{v,m}\left(\dfrac{T_2}{T_1}\right)} = \dfrac{100}{\ln\left(\dfrac{400}{300}\right)} = 333\,K$ **Ans.**