JEE MAIN

COURSE
NUCLEUS

TEST CODE				
1	1	2	8	6

MOCK TEST-7

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 **Mathematics** , **Chemistry** and **Physics** 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 : $\ln 2 = 0.693$, $\ln 1.1 = 0.095$, $\ln 3 = 1.09$, $e = 1.6 \times 10^{-19}$, $m_e = 9.1 \times 10^{-31}$ kg]

Take: $\epsilon_0 = 8.85 \times 10^{-12}$ C²/Nm², g = 10 m/s², S_{water} = 1 cal/gm °C, L_{ice} = 80 cal/gm. , g = 10 m/s² unless otherwise stated

MATHEMATICS

Q.1 The statement $(p \to \sim q) \leftrightarrow (p \wedge q)$ is

(1) A tautology (2) A contradiction (3) $p \vee q$ (4) $\sim p \wedge q$

Q.2 The standard deviation of scores 1, 2, 3, 4, 5, 6, 7 is

(1) 4 (2) $\sqrt{7}$ (3) 2 (4) $\sqrt{5}$

Q.3 Let $a_1, a_2, a_3, \ldots\ldots\ldots\ldots, a_n$ are in A.P. where each term is positive, then

$$\sum_{k=1}^{n-1} \frac{1}{\sqrt{a_k} + \sqrt{a_{k+1}}} = \frac{\lambda}{\sqrt{a_1} + \sqrt{a_n}}$$, then λ is equal to

(1) 2n – 1 (2) n + 1 (3) n – 1 (4) 2n + 1

Q.4 Let α, β, γ are roots of $4x^3 - 3x^2 + 2x - 1 = 0$, then $\sum \left(\frac{1}{\alpha\beta}\right)^2$ is equal to

(1) 7 (2) – 7 (3) 14 (4) – 14

Q.5 Let A and B are two sets having 6 and 4 distinct elements respectively. Let N is the number of onto functions $f : A \to B$, such that there are exactly 3 elements in A associated with the greatest element of set B, then N is equal to

(1) 60 (2) 120 (3) 150 (4) 180

SPACE FOR ROUGH WORK

Q.6 Let A and B are two events of a random experiment such that $P(A)=\frac{1}{4}$, $P\left(\frac{B}{A}\right)=\frac{1}{2}$ and $P\left(\frac{A}{B}\right)=\frac{1}{4}$, then $P\left(\frac{\overline{A}}{\overline{B}}\right)$ is equal to

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

Q.7 Number of terms free from radical sign in the expansion of $\left(\sqrt{5}+\sqrt[4]{11}\right)^{100}$ is

(1) 24 (2) 25 (3) 26 (4) 27

Q.8 The locus of mid point of chords of the circle $x^2+y^2=4$, which subtend 60° angle at the centre is

(1) $x^2+y^2=3$ (2) $x^2+y^2=\sqrt{3}$

(3) $x^2+y^2-2x-2y=1$ (4) None of these

Q.9 A variable line passing through the point $P\left(2,\frac{3}{2}\right)$ meets co-ordinate axes at points A & B, then locus of the foot of perpendicular from origin on the line is

(1) $x^2+y^2-4x-3y=0$ (2) $2x^2+2y^2-4x-3y=0$

(3) $x^2+y^2-3x+4y=0$ (4) $2x^2+2y^2+4x+3y=0$

Q.10 Length of the latus rectum of the conic described parametrically as $y=10t+4$, $x=5t^2+2$ is

(1) 5 (2) 10 (3) 20 (4) 25

Q.11 Consider lines $L_1 : y=\sqrt{3}x-4\sqrt{3}\cdot\lambda$ and $L_2 : \lambda y=4\sqrt{3}-\sqrt{3}\cdot\lambda x$, then locus of the point of intersection of lines $L_1=0$ and $L_2=0$ is

(1) A hyperbola with $e=\frac{2}{\sqrt{3}}$ (2) A hyperbola with $e=2$

(3) An ellipse with $e=\frac{1}{\sqrt{3}}$ (4) None of these

SPACE FOR ROUGH WORK

Q.12 In an ellipse, the triangle formed by end point of minor axis with focii is equilateral triangle, then reciprocal of eccentricity, is

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

Q.13 Let e and e' are the eccentricities of a hyperbola & its conjugate hyperbola, then

(1) $e' = \frac{e}{\sqrt{e^2+1}}$ (2) $e' = \frac{e}{\sqrt{e^2-1}}$ (3) $e' = \frac{\sqrt{e^2-1}}{e}$ (4) $e' = \frac{\sqrt{e^2+1}}{e}$

Q.14 Eccentricity of the hyperbola $S : 9x^2 - 16y^2 - 18x - 64y = 199$ is

(1) $\frac{2}{3}$ (2) $\frac{3}{2}$ (3) $\frac{5}{4}$ (4) $\frac{16}{9}$

Q.15 Consider the lines $L_1 : \vec{r} = (\lambda + 1)\left(\hat{i} + \hat{j} + \hat{k}\right)$ and $L_2 : \vec{r} \cdot \left(2\hat{i} + \hat{j} + \hat{k}\right) - 1 = 0 = \vec{r} \cdot \left(3\hat{i} + \hat{j} + 2\hat{k}\right) - 2$, then shortest distance between them is

(1) $\sqrt{2}$ (2) $2\sqrt{2}$ (3) $\frac{1}{\sqrt{2}}$ (4) None of these

Q.16 Equation of a line passing through point P(3, –4, 1) and meeting line $\frac{x-3}{2} = \frac{y+1}{-3} = \frac{z-2}{-1}$ at point Q, such that PQ is parallel to plane $2x + y - z = 5$ is

(1) $\frac{x-3}{1} = \frac{y+4}{-3} = \frac{z-1}{-1}$ (2) $\frac{x-3}{1} = \frac{y+4}{3} = \frac{z+1}{-1}$

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

Q.17 Distance of origin from plane containing lines $L_1 : \bar{r} = (2 + \lambda)\hat{i} + (1 + 7\lambda)\hat{j} + (-2 - 5\lambda)\hat{k}$ and $L_2 : \bar{r} = (4 + \mu)\hat{i} + (-3 + \mu)\hat{j} - \mu\hat{k}$ is

(1) $\frac{1}{\sqrt{14}}$ (2) $\frac{2}{\sqrt{14}}$ (3) $\frac{3}{\sqrt{14}}$ (4) $\frac{4}{\sqrt{14}}$

SPACE FOR ROUGH WORK

Q.18 Let S is the locus of variable point z in complex plane, such that $\left|\frac{2z+i}{z+2i}\right| \le 1$, then area of region bounded by S is

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

Q.19 Let x < 0, then $\cos^{-1}\sqrt{1-x^2}$ =

(1) $\pi - \cos^{-1}x$ (2) $-\sin^{-1} x$ (3) $\pi - \sin^{-1} x$ (4) $\sin^{-1} x$

Q.20 Let $f(x) = \begin{cases} x \cdot \left(\dfrac{e^{\frac{1}{x}} - e^{\frac{-1}{x}}}{e^{\frac{1}{x}} + e^{\frac{-1}{x}}}\right); & x \ne 0 \\ 0; & x = 0 \end{cases}$, then which of the following is incorrect?

(1) f (x) is continuous at x = 0 (2) f (x) is differentiable at x = 0
(3) Left hand derivative at x = 0 is – 1 (4) Right hand derivative at x = 0 is 1

Q.21 Let $f(x) = \log_e x + 2x^3 + 3x^5$, where x > 0 and g (x) is the inverse function of f (x), then g' (5) is equal to

(1) $\frac{1}{11}$ (2) $\frac{1}{22}$ (3) $\frac{2}{11}$ (4) $\frac{1}{33}$

Q.22 $\int_0^{\frac{\pi}{2}} \frac{x\sin 2x}{\sin^4 x + \cos^4 x} dx$ is equal to

(1) $\frac{\pi^2}{4}$ (2) $\frac{\pi^2}{8}$ (3) $\frac{\pi^2}{16}$ (4) None of these

SPACE FOR ROUGH WORK

Q.23 The value of $\lim_{n\to\infty}\left(\frac{1}{n^n}\prod_{r=1}^{n}(n+r)\right)^{\frac{1}{n}}$ is

(1) $\frac{1}{e}$ (2) $\frac{2}{e}$ (3) $\frac{4}{e}$ (4) $\frac{8}{e}$

Q.24 Let $f(x)=\begin{cases}\lambda-2x; & x<0\\ 7x+5; & x\ge 0\end{cases}$, then range of λ such that f (x) has smallest value at x = 0 is

(1) $\lambda \le 5$ (2) $\lambda \in (0, 5)$ (3) $\lambda \ge 5$ (4) $\lambda \in (0, \infty)$

Q.25 If $4x - y = 5$ is tangent to curve $ax^3 = y^2 + b$ at (2,3), then

(1) a = b (2) 3a = 2b (3) b – 3a = 1 (4) 3a + b = 10

Q.26 Let f (x) and g (x) be continuous function in $x \in [0, 2]$ and differentiable in $x \in (0, 2)$ such that f (0) = 3, g (0) = 2 & f (2) = 7. Let there exists a real number $c \in [0, 2]$, such that $f'(c) = 2\,g'(c)$, then g (2) must be

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

Q.27 Consider curves $S_1 : y = \frac{x}{e^x}$, $S_2 : y = x \cdot e^x$, then area bounded by S_1, S_2 and line x = 1 is

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

Q.28 Let C is a curve such that slope of tangent at any point of curve is double the slope of polar radius of the point, then nature of the curve is

(1) circle (2) parabola (3) ellipse (4) hyperbola

SPACE FOR ROUGH WORK

Q.29 Quadratic equation such that sum of its roots is $\left(\frac{1}{\sin 10°}-\frac{\sqrt{3}}{\cos 10°}\right)$ and product of its roots is $\left(\frac{\sin 85°-\sin 35°}{\cos 65°}\right)$ has

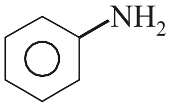
(1) Imaginary roots (2) Real & equal roots (3) Rational roots (4) Irrational roots

Q.30 Let $P=\begin{bmatrix}\sin\theta & -\cos\theta\\ \cos\theta & \sin\theta\end{bmatrix}$ & P^T is transpose of P and $Q=P\cdot A\cdot P^T$ where $A=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}$, then trace of matrix $\left(P^T\cdot Q^{2018}\cdot P\right)$ is

(1) 0 (2) 1 (3) 2 (4) 2018

SPACE FOR ROUGH WORK

Q.31 Calculate number of $H_3O^+(aq)$ ion in 100 ml 0.1 M NH_4Cl.
[**Given :** $K_b(NH_3) = 10^{-5}$]
(1) 10^{17} (2) 10^6 (3) 1.2044×10^{22} (4) 6.022×10^{17}

Q.32 

$\xrightarrow[\Delta]{CHCl_3, KOH} X \xrightarrow[H_2O]{LiAlH_4} Y$; (Y) is

(1) $Ph-NH-CH_3$ (2) $Ph-CH_2-NH_2$ (3) $Ph-NH-C(=O)-H$ (4) $Ph-\overset{\oplus}{N}\equiv\overset{\ominus}{C}$

Q.33 Which of the following is coloured tetrahedral complex species?
(1) $[Cu(PPh_3)_4]^+$ (2) $[Zn(H_2O)_6]^{2+}$ (3) $[Cu(NH_3)_4]SO_4$ (4) MnO_4^-

Q.34 Bridges made of iron are protected by connecting them to a metal block, which is replaced annually. The corrosion of iron is represented by chemical equation :

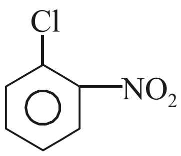
$$2Fe(s) + 2H_2O(l) + O_2(g) \longrightarrow 2Fe(OH)_2$$

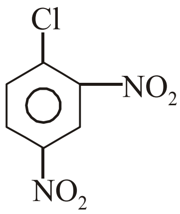
Which of the following metals is best suited as sacrificial anode?

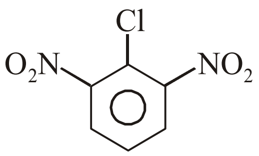
[**Given :** $E^0_{Fe^{2+}(aq.)/Fe(s)} = -0.44V$]

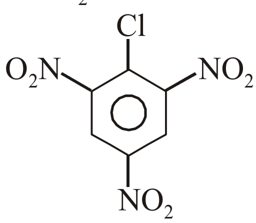
(1) Ag ($Ag^+ + 1e^- \rightarrow Ag(s)$ $E^\circ = 0.8V$) (2) Cd ($Cd^{2+} + 2e^- \rightarrow Cd(s)$ $E^\circ = -0.4V$)
(3) Cu ($Cu^{2+} + 2e^- \rightarrow Cu(s)$ $E^\circ = +0.34V$) (4) Mg ($Mg^{2+} + 2e^- \rightarrow Mg(s)$ $E^\circ = -2.37V$)

Q.35 Which one of the following compounds is most reactive for Nucleophilic aromatic substitution reaction ?

(1) 

(2) 

(3) 

(4) 

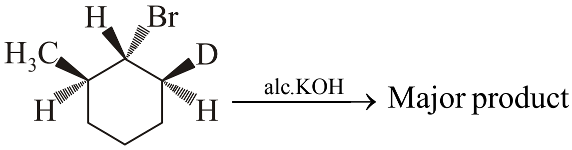
SPACE FOR ROUGH WORK

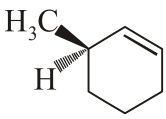
Q.36 An octahedral complexes with d^x electronic configuration can not have Jahn-Teller distortion, irrespective of spin of complex. The value of x can not be -

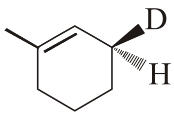
(1) 3 (2) 5 (3) 8 (4) 10

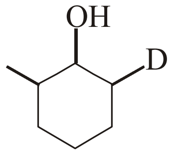
Q.37 The pressure of a gas inside a spherical container is maintained at 2 atm. If the average velocity of the gas molecules inside the container is increased by a factor of two, keeping the pressure same, then by how much would surface area of container increase ?

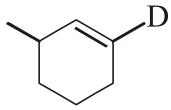
(1) $2^{2/3}$ (2) $2^{4/3}$ (3) $2^{-1/3}$ (4) 1

Q.38 

(1) 

(2) 

(3) 

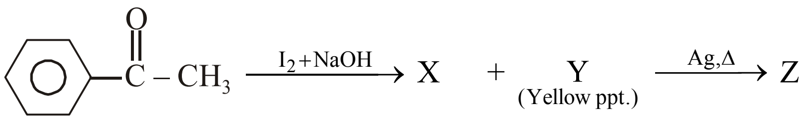
(4) 

Q.39 Ranbir shot a rocket in air on Diwali, which filled sky with multiple green and red coloured sparkles, which may be due to presence of

(1) Sodium nitrate and Magnesium oxide respectively.
(2) Barium chloride and Strontium carbonate respectively.
(3) Strontium carbonate and Barium chloride respectively.
(4) Calcium chloride and Sodium nitrate respectively.

Q.40 If radius of second Bohr orbit is 'r', then the de-Broglie wavelength in fourth Bohr orbit is -

(1) $8\pi r$ (2) $2\pi r$ (3) r/2 (4) $4\pi r$

Q.41 

Identify final product 'Z' :

(1) CHI_3 (2) $HC \equiv CH$ (3) $Ph-\overset{O}{\overset{||}{C}}-\overset{\ominus}{O}Na^{\oplus}$ (4) $H_2C = CH_2$

SPACE FOR ROUGH WORK

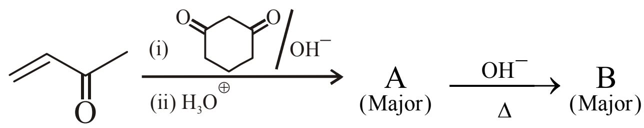
Q.42 When sodium is gradually added to liquid NH_3 then which of the following property do not change ?
(1) Magnetic moment (2) Electrical Conductivity
(3) Colour (4) Oxidation state of Nitrogen

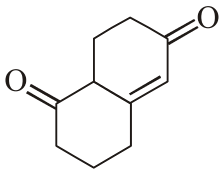
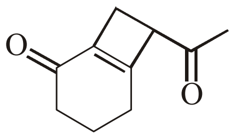
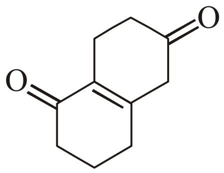
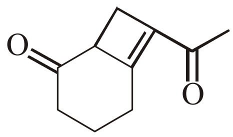
Q.43 The maximum amount of CH_3Br that can be produced from 8g of CH_4 and 40 g of Br_2 by following reaction.
$CH_4 + Br_2 \rightarrow CH_3Br + HBr$
(1) 11.87 g (2) 47.5 g (3) 23.7 g (4) 24 g

Q.44 Which base is present in RNA but not in DNA?
(1) Uracil (2) Cytosine (3) Guanine (4) Adenine

Q.45 Which of the following would not give disproportionation reaction on hydrolysis?
(1) KO_2 (2) N_2O_5 (3) XeF_4 (4) K_2O_2

Q.46 Which of the following observation indicates collegative properties ?
(i) A 1M NaCl solution has higher vapour pressure than 0.5 M $BaCl_2$.
(ii) A 0.5 M NaOH(aq.) solution freezes at a lower temperature than pure water.
(iii) Pure water freezes at higher temperature than pure ethanol.
(1) only I (2) only II (3) only III (4) I and II

Q.47 

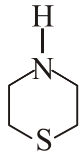
B is
(1)  (2)  (3)  (4) 

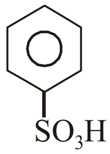
Q.48 If IF_7 undergoes stepwise hydrolysis then which of the following hybridisation is not observed in compound
(1) sp^3d^2 (2) sp^3d (3) sp^3 (4) sp^2

Q.49 A 500 g solution has 0.1 g fluoride concentration. Then fluoride concentration in term of ppm will be -
(1) 200 ppm (2) 100 ppm (3) 400 ppm (4) 50 ppm

SPACE FOR ROUGH WORK

Q.50 Which of the following compound(s) will give blue colour when it is converted into Lassaigne's extract and $FeSO_4$ is added followed by $FeCl_3$.

(I) 

(II) 

(III) $NH_2–OH$

(IV) $NH_2-NH-\overset{\overset{\large O}{||}}{C}-NH_2$

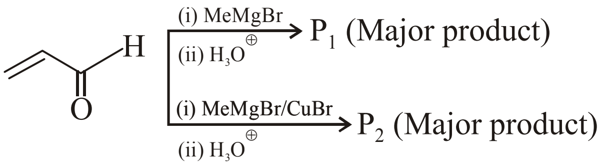
(1) I and IV (2) IV only (3) I, III and IV (4) I, II, III and IV

Q.51 If number of monovalent oxygen and number of divalent oxygen per tetrahedral unit of silicate are equal then the silicate can be :

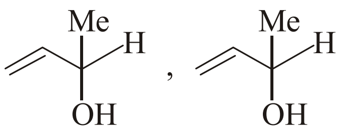
(1) Soro silicate (2) Neso silicate (3) Pyroxene (4) Sheet silicate

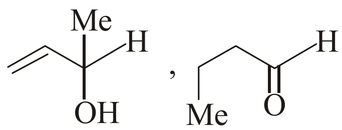
Q.52 The rate constant of a reaction increases by 50% when temperature is increased from 27°C to 32°C. Therefore energy of activation of reaction is- [**Given :** ln 1.5 = 0.4, R = 8 $Jmol^{-1} K^{-1}$]

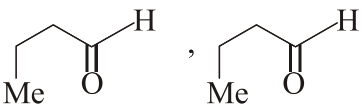
(1) 134.69 kJ/mol (2) 58.56 kJ/mol (3) 67.34 kJ/mol (4) 29.28 kJ/mol

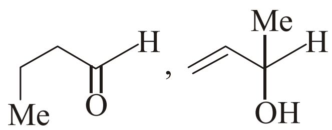
Q.53 

P_1 and P_2 respectively are :

(1) 

(2) 

(3) 

(4) 

Q.54 An alkali metal 'M' reacts with air and products are hydrolysed. If gas obtained turns red litmus into blue then metal 'M' can be :

(1) Li (2) Na (3) K (4) Al

SPACE FOR ROUGH WORK

Q.55 Identify the **correct** statement :

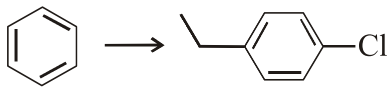
(1) In hexagonal close packing (HCP) fourth layer is exactly aligned with first layer.

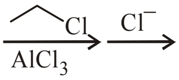
(2) Octahedral voids are present at the edge of hexagonal close packed unit cell.

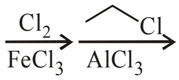
(3) Silicon carbide (SiC) is conductor of electricity.

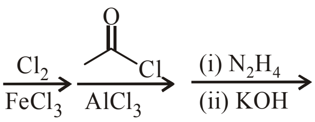
(4) ReO_3 is like metallic copper in its conductivity and apperance.

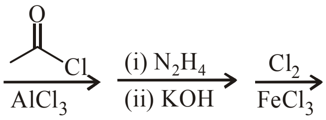
Q.56 Choose the best reaction sequence that could be used to perform the following transformation.



(1) 

(2) 

(3) 

(4) 

Q.57 Which one of the following is an **incorrect** statement ?

(1) The ionisation potential of nitrogen is greater than that of chlorine

(2) The electron affinity of fluorine is greater than that of chlorine

(3) The ionisation potential of beryllium is greater than that of boron.

(4) The electronegativity of fluorine is greater than that of chlorine.

Q.58 Identify the **incorrect** statement about Freundlich adsorption isotherm.

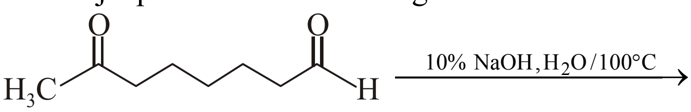
(1) Freundlich isotherm explains the behavior of adsorption of gas on solid surface in approximate manner.

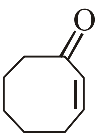
(2) In equation $\frac{x}{m} = KP^{1/n}$, $\frac{1}{n}$ can have values between 0 and 1.

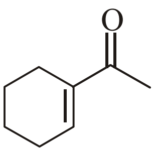
(3) Probable range of n is 2 to 10.

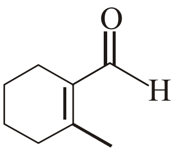
(4) Why isotherm approach saturation at high pressure, can be explained by Freundlich isotherm.

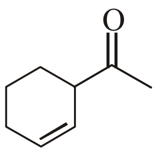
Q.59 Which is the major product of the following reaction ?



(1) 

(2) 

(3) 

(4) 

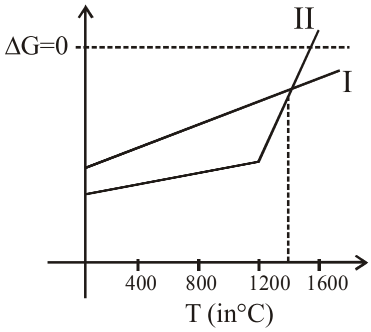
SPACE FOR ROUGH WORK

Q.60 If ΔG vs T graph of

I $\rightarrow$ $\frac{4}{3}Al + O_2 \longrightarrow \frac{2}{3}Al_2O_3$

II $\rightarrow$ $2Mg + O_2 \longrightarrow 2MgO$

is given as below :

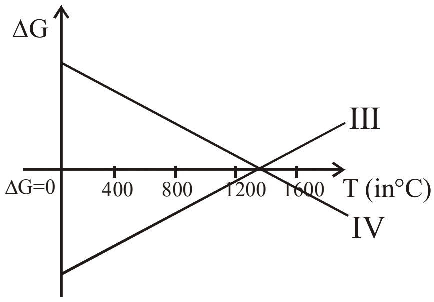


Then ΔG vs T graph of reaction

III $\rightarrow 3Mg + Al_2O_3 \longrightarrow 3MgO + 2Al$

IV $\rightarrow 3MgO + 2Al \longrightarrow 3Mg + Al_2O_3$

are :

(1)


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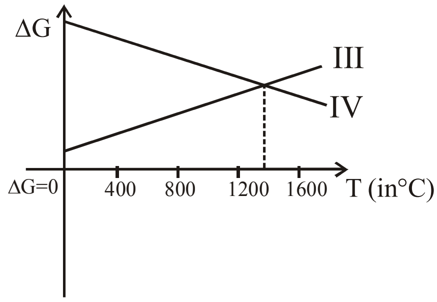

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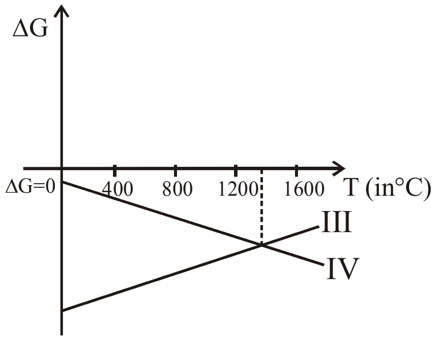

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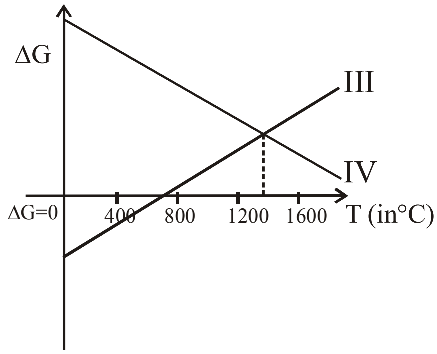
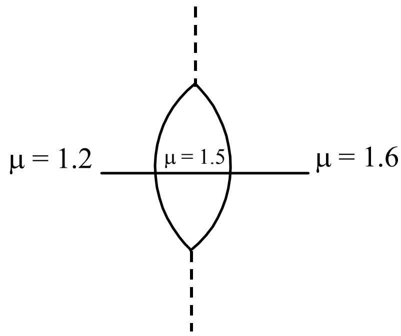


SPACE FOR ROUGH WORK

Q.61 In hydrogen atom, if potential energy of electron in ground state is assumed to be zero, then its energy in first excited state is equal to
(1) – 3.4 eV (2) 23.8 eV (3) 17.2 eV (4) – 6.8 eV

Q.62 A diatomic molecule having atoms of masses m_1 and m_2 has its potential energy function about the equilibrium separation r_0 as given by $U(r) = -A + B(r - r_0)^2$ where A and B are constants. When the atom vibrate at high temperature condition, the square of angular frequency of vibration will be
(1) $\frac{2B}{m_1}$ (2) $\frac{2B}{m_2}$ (3) $\frac{2B(m_1 + m_2)}{m_1 m_2}$ (4) $\frac{B(m_1 + m_2)}{2m_1 m_2}$

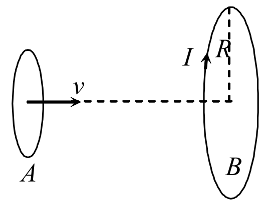
Q.63 A thin equiconvex lens of glass has radii of curvature of its surfaces 30 cm each. This lens has different medium on its two sides as shown in the figure. The refractive indices of the mediums on the two sides of the lens are 1.2 and 1.6, and refractive index of the glass is 1.5. The focal length of the lens in the shown figure is for parallel beam incident from left



(1) 30 cm (2) 60 cm
(3) 120 cm (4) 240 cm

Q.64 A circuit consists of a capacitor and a resistor having resistance R = 220 Ω connected in series. When an alternating e.m.f. of peak voltage $V_0 = 220\sqrt{2}$ V is applied to the circuit, the peak current in steady state is observed to be I_0 = 1A. The phase difference between the current and the voltage is
(1) 30° (2) 45° (3) 60° (4) 90°

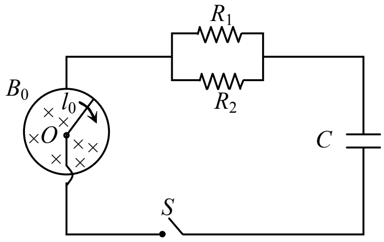
Q.65 Loop A of radius $r(r << R)$ moves towards a constant current carrying loop B with a constant velocity v in such a way that their planes are parallel and coaxial. The distance between the loops when the induced emf in loop A is maximum is



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

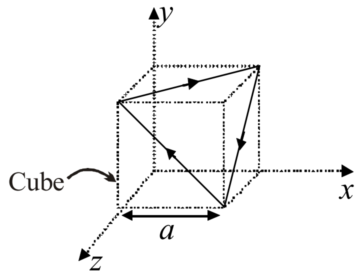
SPACE FOR ROUGH WORK

Q.66 There is a small metallic ring of radius l_0 and having negligible resistance placed perpendicular to a constant magnetic field B_0. One end of a rod is hinged at the centre of ring O and other end is placed on the ring. Now rod is rotated with constant angular velocity ω_0 by some external agent and circuit is connected as shown in the figure, initially switch is open and capacitor is uncharged. If switch S is closed at t = 0, then calculate heat loss from the resistor R_2 from t = 0 to the instant when voltage across the capacitor becomes V_0. (Assume plane of ring to be horizontal and friction to be an absent at all the contacts). (Assume, $R_2 = 2R_1$, $B_0 l_0^2 \omega_0 = 4V_0$)



(1) $\frac{1}{2}CV_0^2$ (2) $\frac{1}{6}CV_0^2$ (3) $\frac{2}{3}CV_0^2$ (4) $\frac{1}{3}CV_0^2$

Q.67 Calculate the magnetic moment associated with the loop carrying current I_0 as shown in the figure is



(1) $\frac{3\sqrt{3}}{2}I_0a^2$ (2) $\frac{2\sqrt{2}}{3}I_0a^2$

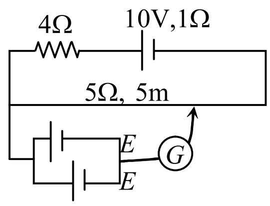
(3) $\frac{2}{5}I_0a^2$ (4) $\frac{\sqrt{3}}{2}I_0a^2$

Q.68 A uniform wire of resistance R is shaped into a regular n-sided polygon (n is even). The equivalent resistance between any two corners can have

(1) the maximum value $\frac{R}{2}$ (2) the maximum value $\frac{R}{n}$

(3) the minimum value $R\left(\frac{n-1}{n^2}\right)$ (4) the minimum value $\frac{R}{n}$

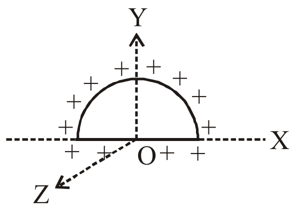
Q.69 A resistance of 4Ω and a wire of length 5 metres and resistance 5Ω are joined in series and connected to a cell of e.m.f. 10V and internal resistance 1Ω. A parallel combination of two identical cells is balanced across 300 cm of the wire. The e.m.f. of each cell is



(1) 1.5 V (2) 3.0 V
(3) 0.67 V (4) 1.33 V

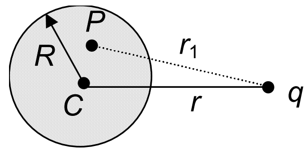
SPACE FOR ROUGH WORK

Q.70 The semicircular ring shown in the figure has radius R and carries a charge Q distributed uniformly over it. A point charge Q is taken from the point (0, 0, 2R) to the point (0, 2R, 0). The work done in doing this is equal to W. After fixing the charge at its new position, the ring is rotated in anticlockwise sense about x-axis through an angle $\pi/2$. Considering all motion to be slow, the work done in rotating the ring is



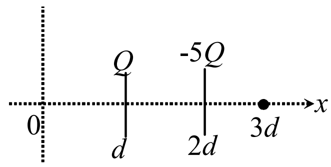
(1) W (2) –W (3) $W + \frac{Q^2}{4\pi\varepsilon_0 R}$ (4) $-W + \frac{Q^2}{4\pi\varepsilon_0 R}$

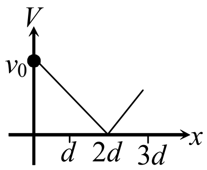
Q.71 A point charge is placed at a distance r from center of a conducting neutral sphere of radius R (r > R). The potential at any point P inside the sphere at a distance r_1 from point charge due to induced charge of the sphere is given by [$k = \frac{1}{4\pi\varepsilon_0}$]

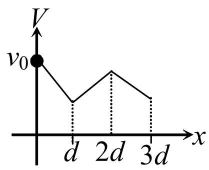


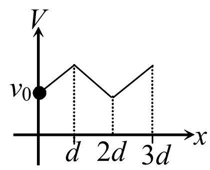
(1) kq/r_1 (2) kq/r (3) $kq/r - kq/r_1$ (4) $-kq/R$

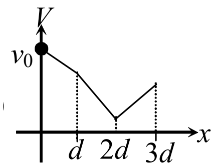
Q.72 Two large identical plates are placed in front of each other at x = d and x = 2d as shown in figure. If charges on plates are Q and –5Q, the potential versus distance graph for region x = 0 to x = 3d is (d is very small and potential at x = 0 is v_0)



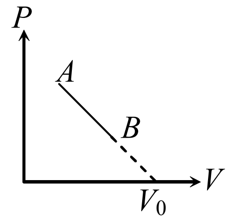
(1) 

(2) 

(3) 

(4) 

Q.73 An ideal monatomic gas is undergoing a process AB shown in the P-V diagram. Its intercept on V axis is V_0. Volume of the gas when its temperature will be maximum is



(1) $\frac{3}{5}V_0$ (2) $\frac{1}{4}V_0$ (3) $\frac{V_0}{2}$ (4) $\frac{2}{3}V_0$

SPACE FOR ROUGH WORK

Q.74 A wave disturbance in a medium is described by $y(x,t) = 0.02\cos\left(50\pi t + \frac{\pi}{2}\right)\cos(10\pi x)$

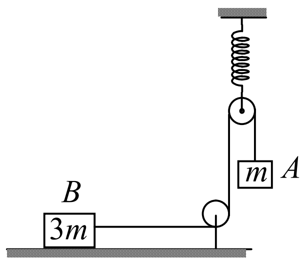
where x and y are in meter and t is in second. Then
(1) First node occurs at x = 0.15m
(2) First antinode occurs at x = 0.3 m
(3) The speed of interfering waves is 5.0 m/s
(4) The wavelength is 0.5 m

Q.75 A sound wave of wavelength λ travels towards the right horizontally with a velocity V. It strikes and reflects from a vertical plane surface, traveling at a speed v towards the left. The number of crests striking in a time interval of three seconds on the wall is
(1) $3(V+v)/\lambda$ (2) $3(V-v)/\lambda$ (3) $(V+v)/3\lambda$ (4) $(V-v)/3\lambda$

Q.76 An organ pipe of length 3.9 π m, open at both ends is driven to third harmonic standing wave pattern. If the maximum amplitude of pressure oscillations is 1% of mean atmospheric pressure $(P_0 = 10^5\ N/m^2)$. The maximum displacement of the particle from mean position will be
(Velocity of sound = 200 m/s and density of air = 1.3 kg/m^3)
(1) 2.5 cm (2) 5 cm (3) 1 cm (4) 2 cm

Q.77 A closed organ pipe of length 99.4 cm is vibrating in its first overtone and in always resonance with a tunning fork having frequency $f = (300 - 2t)$ Hz, where t is time in second. The rate by which radius of organ pipe changes when its radius is 1 cm, is (speed of sound in organ pipe = 320 m/s)
(1) $\frac{1}{72}$ m/s (2) $\frac{1}{36}$ m/s (3) $\frac{1}{18}$ m/s (4) $\frac{1}{9}$ m/s

Q.78 In the given figure, string, spring and pulleys are massless. Block A, performing SHM of amplitude 1 m and time period $\pi/2$ sec. If block B remains at rest, then minimum value of co-efficient of friction between block B and surface will be (g = 10 m/s^2)
(1) $\frac{1}{2}$ (2) $\frac{13}{15}$ (3) $\frac{2}{3}$ (4) $\frac{4}{5}$



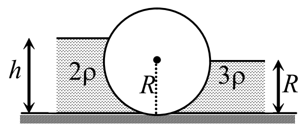
SPACE FOR ROUGH WORK

Q.79 The equation of a particle executing SHM is given by $x = 3\cos\left(\frac{\pi}{2}\right)t$ cm, where t is in seconds. The distance travelled by the particle in the first 8.5 s is

(1) $\left(24+\frac{3}{\sqrt{2}}\right)$ cm (2) $\left(27-\frac{3}{\sqrt{2}}\right)$ cm (3) $\left(24-\frac{3}{\sqrt{2}}\right)$ cm (4) $\left(27+\frac{3}{\sqrt{2}}\right)$ cm

Q.80 Three capillaries of length L, L/2 and L/3 are connected in series. Their radii are r, r/2 and r/3 respectively. Then if stream-line flow is to be maintained and the pressure across the first capillary is P, then
(1) the pressure difference across the ends of second capillary is 8P
(2) the pressure difference across the third capillary is 81P
(3) the pressure difference across the ends of the second capillary is 16P
(4) the pressure difference across the third capillary is 9P

Q.81 In the figure shown, the heavy cylinder (radius R) resting on a smooth surface separates two liquids of densities 2 ρ and 3 ρ. The height h for the equilibrium of cylinder must be (Neglect atmospheric pressure)

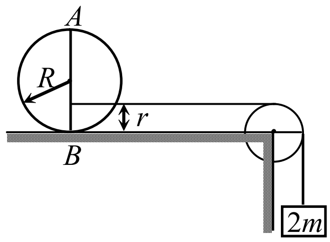


(1) $\frac{3R}{2}$ (2) $R\sqrt{\frac{3}{2}}$ (3) $R\sqrt{2}$ (4) $R\sqrt{\frac{3}{4}}$

Q.82 An artificial satellite of mass m is moving in a circular orbit at a height equal to the radius R of the earth. Suddenly due to internal explosion the satellite breaks into two parts of equal masses. One part of the satellite stops just after the explosion. The increase in the mechanical energy of the system (satellite + earth) due to explosion will be (Given: acceleration due to gravity on the surface of earth is g)

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

Q.83 An uniform ring of radius R, is fitted with a massless rod AB along its diameter. An ideal horizontal string (whose one end is attached with the rod at a height r) passes over a smooth pulley and other end of the string is attached with a block of mass double the mass of ring as shown. The co-efficient of friction between the ring and the surface is μ. When the system is released from rest, the ring moves such that rod AB remains vertical. The value of r is



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

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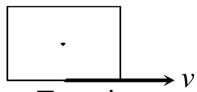
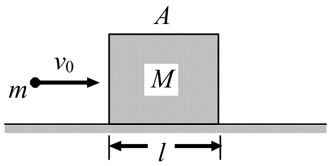
Q.84 A cubical block of mass M and dimensions a is kept on a smooth horizontal surface. One corner is given an impulse so that the corner attains velocity V as shown. The instantaneous angular velocity is



Top view

(1) $\frac{3V}{2a}$ (2) $\frac{V}{4a}$ (3) $\frac{3V}{4a}$ (4) $\frac{3V}{a}$

Q.85 A bullet of mass m moving with velocity v_0 hits a wooden plank A of mass M placed on a smooth horizontal surface. The length of the plank is l. The bullet experiences a constant resistive force F inside the block. The minimum value of v_0 such that it is able to come out of the plank is



(1) $\sqrt{\frac{Flm}{M^2}}$ (2) $\sqrt{\frac{2Fl(M+m)}{Mm}}$ (3) $\sqrt{\frac{2Flm}{M^2}}$ (4) $\sqrt{\frac{Fl(M+m)}{Mm}}$

Q.86 The least count of a stop watch is 1/5 second. The time of 20 oscillations of a pendulum is measured to be 25 seconds. The minimum percentage error in the measurement of time will be

(1) 0.1% (2) 0.8% (3) 1.8% (4) 8%

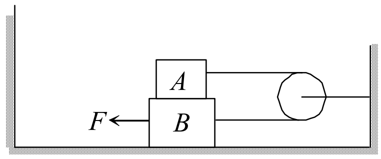
Q.87 An aeroplane is rising vertically with acceleration f. Two stones are dropped from it at an interval of time t. The distance between them at time t' after the second stone is dropped will be

(1) $\frac{1}{2}(g+f)tt'$ (2) $\frac{1}{2}(g+f)(t+2t')t$

(3) $\frac{1}{2}(g+f)(t-t')^2$ (4) $\frac{1}{2}(g+f)(t+t')^2$

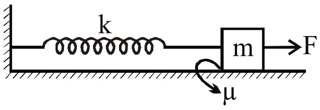
SPACE FOR ROUGH WORK

Q.88 The masses of the blocks A and B are 0.5 kg and 1 kg respectively. These are arranged as shown in the figure and are connected by a massless string. The coefficient of friction between all contact surfaces is 0.4. The force needed to move the block B with constant velocity will be ($g = 10\ m/s^2$)



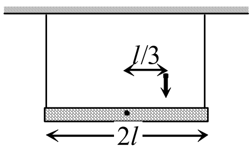
(1) 5 N (2) 10 N (3) 15 N (4) 20 N

Q.89 A block of mass 'm' is pulled by horizontal constant force F = 5 μmg over a rough surface of coefficient of friction μ as shown. Initially spring was at its natural length, the position where block will finally comes to rest will be



(1) $\frac{\mu mg}{k}$ (2) $\frac{4\mu mg}{k}$ (3) $\frac{6\mu mg}{k}$ (4) $\frac{8\mu mg}{k}$

Q.90 A rod of mass m and length $2l$ hangs by two identical light threads tied to its ends. An insect of mass $\frac{3}{8}m$ hits the rod with a speed v at a distance $l/3$ from the centre of the rod as shown and sticks to it. As a result one of the thread breaks. The acceleration of the insect just after the thread breaks given that the insect remains at rest with respect to the rod



(1) g /4 (2) 3g/4 (3) 2g/3 (4) g

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

HINTS & SOLUTIONS
MATHEMATICS

Q.1

p	q	$\sim q$	$p \to \sim q$	$p \wedge q$	$(p \to \sim q) \leftrightarrow (p \wedge q)$
T	T	F	F	T	F
T	F	T	T	F	F
F	T	F	T	F	F
F	F	T	T	F	F

Q.2 $$\bar{x} = \frac{1+2+3+4+5+6+7}{7} = \frac{7\times 8}{2\times 7} = 4$$

$$\therefore \sigma = \sqrt{\frac{9+4+1+0+1+4+9}{7}} = \sqrt{\frac{28}{7}} = 2$$

Q.3 $$\frac{1}{\sqrt{a_1}+\sqrt{a_2}} + \frac{1}{\sqrt{a_2}+\sqrt{a_3}} + \text{.........} + \frac{1}{\sqrt{a_{n-1}}+\sqrt{a_n}}$$

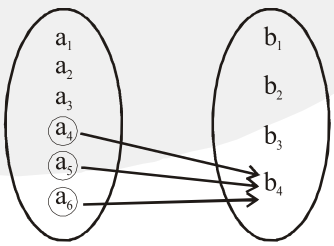
$$= \frac{\sqrt{a_2}-\sqrt{a_1}}{d} + \frac{\sqrt{a_3}-\sqrt{a_2}}{d} + \frac{\sqrt{a_4}-\sqrt{a_3}}{d} + \text{........} + \frac{\sqrt{a_n}-\sqrt{a_{n-1}}}{d}$$

$$= \frac{\sqrt{a_n}-\sqrt{a_1}}{d} = \frac{a_n - a_1}{\left(\sqrt{a_n}+\sqrt{a_1}\right) d} = \frac{(n-1)}{\sqrt{a_1}+\sqrt{a_n}}$$

$$\frac{\alpha^2+\beta^2+}{(\alpha\beta} \qquad \frac{\Sigma\alpha^2 - 2\Sigma\alpha\beta}{(\alpha\beta\gamma)^2}$$

$$= \frac{\left(\frac{3}{4}\right)^2 - 2\cdot\frac{2}{4}}{\left(\frac{1}{4}\right)^2} = \frac{\frac{9}{16}-1}{\frac{1}{16}} = -7$$

Q.5 Let $b_1 < b_2 < b_3 < b_4$



$\therefore$ N = ${}^6C_3 \cdot (3!) = 20 \times 6 = 120$

Q.6 $P(A)\cdot P\left(\frac{B}{A}\right) = P(B)\cdot P\left(\frac{A}{B}\right)$

$\Rightarrow \frac{1}{4}\times\frac{1}{2} = P(B)\times\frac{1}{4}$

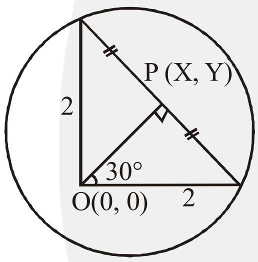
$\therefore P(B) = \frac{1}{2}$; $P(A) = \frac{1}{4}$ and $P(A\cap B) = \frac{1}{8}$

$\therefore P\left(\frac{\overline{A}}{\overline{B}}\right) = \frac{P(\overline{A}\cap\overline{B})}{P(\overline{B})}$

$= \frac{1-P(A\cup B)}{1-P(B)} = \frac{1-\left(\frac{1}{2}+\frac{1}{4}-\frac{1}{8}\right)}{1-\frac{1}{2}} = \frac{3}{4}$

Q.7 $T_{r+1} = {}^{100}C_r\, 5^{\frac{100-r}{2}} \cdot 11^{\frac{r}{4}}$,
where r = 0, 1, 2, ..., 100
$\therefore$ r must be 0, 4, 8,........,100 $\rightarrow$ N = 26 terms

Q.8 $OP = 2\cos 30^\circ = \sqrt{3}$

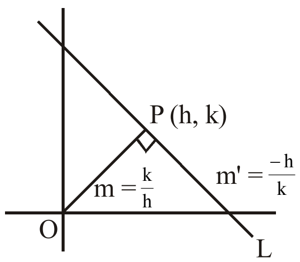


$\therefore OP^2 = 3$
$\therefore X^2 + Y^2 = 3$

Q.9 $\therefore$ Line is $(y-k) = \frac{-h}{k}(x-h)$

$\downarrow$ $P\left(2, \frac{3}{2}\right)$

$\Rightarrow \left(\frac{3}{2}-k\right) = \frac{-h}{k}(2-h)$



$\Rightarrow \frac{3k}{2} - k^2 = -2h + h^2$

$\Rightarrow \frac{3y}{2} + 2x = x^2 + y^2$

$\Rightarrow 2x^2 + 2y^2 - 4x - 3y = 0$

Q.10 $(y-4)^2 = 100t^2 = 100\left(\frac{x-2}{5}\right)$

$\Rightarrow (y-4)^2 = 4\cdot 5\,(x-2)$
$\therefore$ length of LR = 20

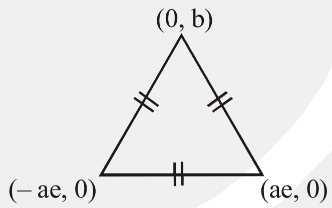
Q.11 $L_1 : y = \sqrt{3}\cdot x - 4\cdot\sqrt{3}\cdot\lambda$
$\Rightarrow (y-\sqrt{3}\,x) = -4\sqrt{3}\ \lambda$
$L_2 : \lambda y = -\sqrt{3}\cdot\lambda\cdot x + 4\cdot\sqrt{3}$

$\Rightarrow y = -\sqrt{3}\cdot x + \frac{4\sqrt{3}}{\lambda} \Rightarrow (y+\sqrt{3}\,x) = \frac{4\sqrt{3}}{\lambda}$

$\Rightarrow (y-\sqrt{3}\,x)\,(y+\sqrt{3}\,x) = -16\cdot 9$
$\Rightarrow y^2 - 3x^2 = -144 \Rightarrow 3x^2 - y^2 = 144$

$\therefore\ e = \sqrt{1+\frac{1}{\left(\frac{1}{3}\right)}} = \sqrt{1+3} = 2$

Q.12 $(2ae)^2 = b^2 + a^2e^2$
$\Rightarrow 3a^2e^2 = b^2$



$\Rightarrow 3e^2 = \frac{b^2}{a^2} = 1 - e^2 \Rightarrow e^2 = \frac{1}{4}$

$\therefore e = \frac{1}{2}$

Q.13 $\frac{1}{e^2} + \frac{1}{e'^2} = 1 \Rightarrow \left(\frac{1}{e'}\right)^2 = 1 - \frac{1}{e^2} = \frac{e^2-1}{e^2}$

$\therefore e' = \frac{e}{\sqrt{e^2-1}}$

Q.14 $S_1 : 9(x^2 - 2x + 1) - 16(y^2 + 4y + 4)$
$= 199 + 9 - 64$
$\Rightarrow 9(x-1)^2 - 16(y+2)^2 = 144$

$$\Rightarrow \frac{(x-1)^2}{16} - \frac{(y+2)^2}{9} = 1$$

$$\therefore\ e = \sqrt{1+\frac{9}{16}} = \frac{5}{4}$$

Q.15 L_1 through Point A (1, 1, 1) and dir <1, 1, 1>
L_2 through point B (1, – 1, 0) and dir
<1, – 1,– 1>

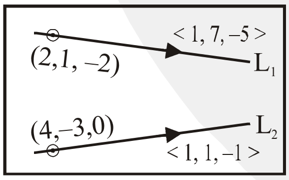
$$\therefore\ S{\cdot}D = \frac{\begin{vmatrix} 0 & 2 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & -1 \end{vmatrix}}{\sqrt{4+4+0}} = \frac{2}{2\sqrt{2}} = \frac{1}{\sqrt{2}}$$

Q.16 Line joins P(3, – 4, 1)
& Q($2\lambda + 3, -3\lambda - 1, 2 - \lambda$) and $\overrightarrow{PQ} \cdot \vec{n} = 0$
$\Rightarrow < 2\lambda, -3\lambda + 3, 1 - \lambda > \perp < 2, 1, -1>$
$\Rightarrow 4\lambda - 3\lambda + 3 - 1 + \lambda = 0 \Rightarrow 2\lambda + 2 = 0$
$\therefore\ \lambda = -1$
$\therefore$ P(3, –4, 1) and Q(1,2,3)

$$\therefore\ \frac{x-3}{1-3} = \frac{y+4}{2+4} = \frac{z-1}{3-1} \Rightarrow \frac{x-3}{-2} = \frac{y+4}{6} = \frac{z-1}{2}$$

$$\therefore \text{ line is } \frac{x-3}{1} = \frac{y+4}{-3} = \frac{z-1}{-1}$$

Q.17 π is $x + 2y + 3z + 2 = 0$



$$\therefore\ P = \left|\frac{2}{\sqrt{1+4+9}}\right| = \frac{2}{\sqrt{14}}$$

Q.18 $|(2x) + i(2y+1)|^2 \le |(x) + i(y+2)|^2$
$\Rightarrow 4x^2 + 4y^2 + 4y + 1 \le x^2 + y^2 + 4y + 4$
$\Rightarrow 3x^2 + 3y^2 \le 3 \Rightarrow x^2 + y^2 \le 1$ and Area $= \pi$

Q.19 If $x < 0$; then $\cos^{-1}\sqrt{1-x^2} = -\sin^{-1} x$

Q.20 $\lim_{x\to 0} f(x) = 0 \therefore$ continuous
but LHD = – 1 and RHD = 1

Q.21 $g'(f(x)) = \frac{1}{f'(x)}$

$$\Rightarrow g'(\ln x + 2x^3 + 3x^5) = \frac{1}{\frac{1}{x} + 6x^2 + 15x^4}$$

$$\text{put } x = 1 \Rightarrow g'(5) = \frac{1}{1+6+15} = \frac{1}{22}$$

Q.22 $$I = \int_0^{\frac{\pi}{2}} \frac{x \sin 2x}{\sin^4 x + \cos^4 x} dx$$

$$\text{and } I = \int_0^{\frac{\pi}{2}} \frac{\left(\frac{\pi}{2} - x\right)\sin 2x}{\cos^4 x + \sin^4 x} dx$$

$$\therefore\ 2I = \frac{\pi}{2}\int_0^{\frac{\pi}{2}} \frac{\sin 2x}{1 - \frac{1}{2}\left(1 - \cos^2 2x\right)} dx$$

$$= \frac{\pi}{2}\int_0^{\frac{\pi}{2}} \frac{\sin 2x}{\frac{1}{2}\left(1 + \cos^2 2x\right)} dx$$

$$\therefore\ I = \frac{\pi^2}{8}$$

Q.23 $$L = \lim_{n\to\infty}\left(\left(1+\frac{1}{n}\right)\left(1+\frac{2}{n}\right).....\left(1+\frac{n}{n}\right)\right)^{\frac{1}{n}}$$

$$\therefore\ \ln L = \lim_{n\to\infty}\frac{1}{n}\sum_{r=1}^{n}\ln\left(1+\frac{r}{n}\right)$$

$$= \int_0^1 \ln(1+x)\,dx$$

$$\therefore\ \ln L = 2\ln 2 - 1 \Rightarrow L = \frac{4}{e}$$

Q.24 $\lambda \ge f(0) \Rightarrow \lambda \ge 5$

Q.25 $ax^3 = y^2 + b \xrightarrow{(2,3)} 8a = 9 + b$ (i)

and $3ax^2 = 2y \cdot y' \xrightarrow[\text{and } y'=4]{(2,3)} 3a \cdot 4 = 2 \cdot 3 \cdot 4$

$\therefore$ a = 2 and b = 7

Q.26 $\frac{f'(c)}{g'(c)} = \frac{f(2)-f(0)}{g(2)-g(0)} \Rightarrow 2 = \frac{7-3}{g(2)-2}$

$\therefore g(2) - 2 = 2 \Rightarrow g(2) = 4$

Q.27 $A = \int_0^1 \left(x \cdot e^x \cdot - \frac{x}{e^x} \right) dx = \frac{2}{e}$

Q.28 $\frac{dy}{dx} = 2 \cdot \frac{y}{x}$

$\Rightarrow \frac{dy}{y} = 2\frac{dx}{x} \Rightarrow ln|y| = 2\,ln|x| + c$

$\Rightarrow x^2 = \lambda y$

Q.29 $\alpha + \beta = \dfrac{\left(\frac{\cos 10°}{2} - \frac{\sqrt{3}}{2}\sin 10° \right) \times 2}{2\cos 10° \sin 10° \times \frac{1}{2}}$

$\therefore \alpha + \beta = 4 \cdot \frac{\cos(60° + 10°)}{\sin 20°} = 4$

and $\alpha \cdot \beta = \frac{2\sin 25° \cos 60°}{\cos 65°} = 1$

$\therefore x^2 - 4x + 1 = 0$

$\Delta = 16 - 4 = 12$ (Not perfect square)

Q.30 $P^T \cdot P = \begin{bmatrix} \sin\theta & \cos\theta \\ -\cos\theta & \sin\theta \end{bmatrix} \begin{bmatrix} \sin\theta & -\cos\theta \\ \cos\theta & \sin\theta \end{bmatrix}$

$\therefore P^T \cdot P = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$

$\therefore P^T \cdot (Q)^{2018} \cdot P = A^{2018} = \begin{bmatrix} 1 & 2018 \\ 0 & 1 \end{bmatrix}$.

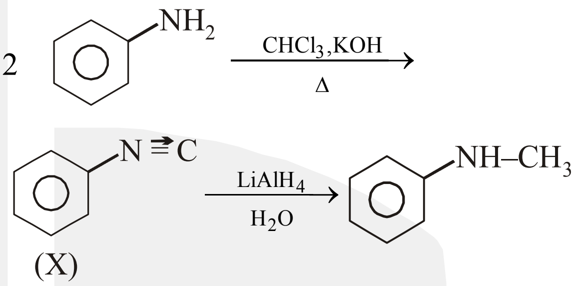
CHEMISTRY

Q.31 $[H_3O^+] = \sqrt{\frac{K_w.C}{K_b}} = 10^{-5}$ M ; $n_{H_3O^+}$

$= 10^{-6}$ mol

$\therefore N_{H_3O^+} = 6.020 \times 10^{17}$ **Ans.**

Q.32



Q.33 (1) $[Cu(PPh_3)_4]^+ \rightarrow$ Tetrahedral ; SFL; $\Delta\uparrow$; Intensity $\downarrow$

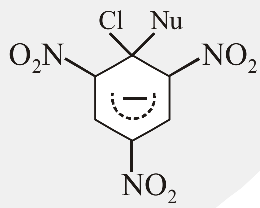
(2) $[Zn(H_2O)_6]^{2+} \rightarrow$ Octahedral complex

(3) $[Cu(NH_3)_4]SO_4 \rightarrow$ Tetrahedral ; $\Delta\uparrow$; Intensity $\downarrow$; SFL

(4) $MnO_4^- \rightarrow d^3s$, Tetrahedral complex ; purple coloured due to LMCT

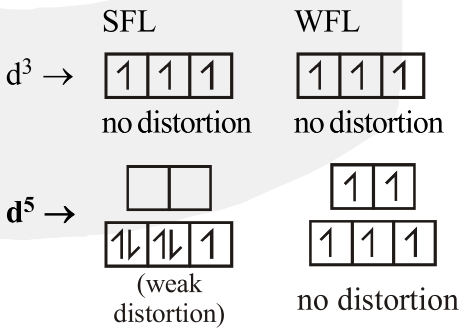
Q.34 Theory based

Q.35

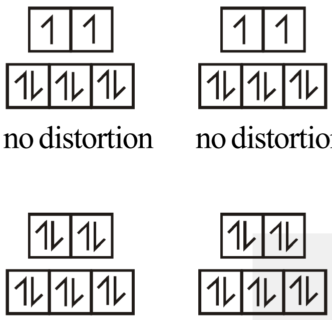


Rate of $S_NAR \propto$ stability of C^-

Q.36



$d^8 \rightarrow$



no distortion   no distortion

$d^{10} \rightarrow$

no distortion   no distortion

Q.37 Let, initial volume be V_i.

$\therefore \frac{4}{3}\pi r_i^3 = V_i$

$\therefore A_i = 4\pi r_i^2 = 4\pi\left(\frac{3V_i}{4\pi}\right)^{2/3}$ ....(i)

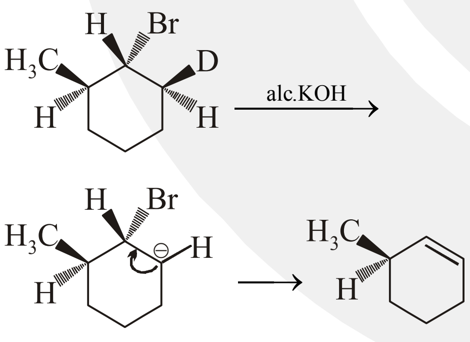
$V_{avg} = \sqrt{\frac{8RT}{\pi M}} = \sqrt{\frac{8PV}{\pi n M}}$

But, if V_{avg} becomes twice then volume becomes 4-times keeping P and n constant

$\therefore \frac{4}{3}\pi r_f^3 = 4V_i \Rightarrow A_f = 4\pi r_f^2 = 4\pi\left(\frac{3\times 4V_i}{4\pi}\right)^{2/3}$

$\therefore \frac{A_f}{A_i} = 4^{2/3} = 2^{4/3}$ **Ans.**

Q.38



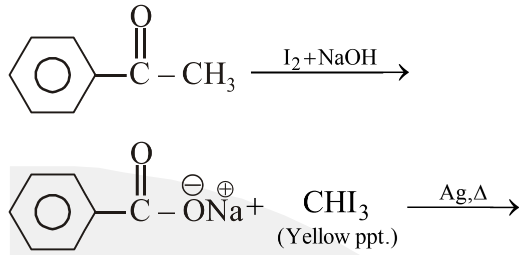
Q.39 (1) Na → Golden yellow, Mg → does not show colour with flame.
(2) Ba → Apple green, Sr → Crimson red.
(3) Sr → Crison red, Ba → Apple green
(4) Ca → Brick red, Na → Golden yellow

Q.40 $\frac{r_4}{r} = \frac{a_0\times 16/Z}{a_0 \times 4/Z} \quad \therefore r_4 = 4r$

and $2\pi r_4 = 4\lambda$

$\therefore \lambda = \frac{2\pi r_4}{4} = 2\pi r$

Q.41



$HC \equiv CH$

Q.42 $Na + (x+y)\ NH_3(l) \rightarrow [Na^+(NH_3)_x] + [e^-(NH_3)_y]$

Q.43 $CH_4 + Br_2 \rightarrow CH_3Br + HBr$
n = 0.5 mol   0.25 mol   0   0
(L.R.)

$\therefore n_{CH_3Br} = 0.25$ mol.

$\therefore m_{CH_3Br} = \frac{1}{4}\times 95$ g
$= 23.75$ g **Ans.**

Q.45 (1) $\overset{-1}{KO_2} + H_2O \longrightarrow \overset{(+5)}{KOH} + \overset{(-2)}{H_2O_2} + \overset{(0)}{O_2}$

(2) $\overset{+5}{N_2O_5} + H_2O \longrightarrow \overset{(+5)}{HNO_3}$

(3) $\overset{+4}{Xe}F_4 + H_2O \rightarrow \overset{0}{Xe} + \overset{+6}{Xe}O_3 + HF + O_2$

(4) $K_2O_2 + H_2O \xrightarrow{RT} KOH + H_2O + O_2$

Q.46 Theory based

Q.48 $IF_7 + 4H_2O \rightarrow HIO_4 + 7HF$ (complete hydrolysis)

$\underset{(sp^3d^3)}{IF_7} + H_2O \rightarrow 2HF + \underset{(sp^3d^2)}{IOF_5} \xrightarrow{+H_2O}$

$2HF + \underset{(sp^3d)}{IO_2F_3} \xrightarrow{+H_2O} 2HF + \underset{(sp^3)}{IO_3F} \xrightarrow{+H_2O} HF + \underset{(sp^3)}{IOF_4}$

Q.49 F^- concentration $= \frac{0.1}{500} \times 10^6$ ppm

$= 200$ pm **Ans.**

Q.51 No. of monovalent oxygen = no.of divalent oxygen = (2)
Name : Pyroxene (single chain)

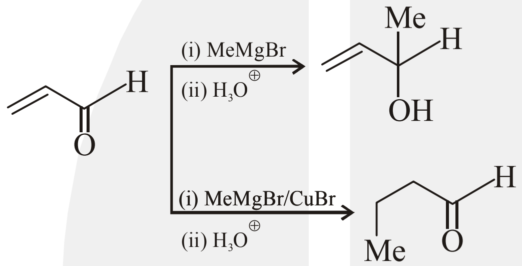
Q.52 $\ln\left(\frac{k_{32°C}}{k_{27°C}}\right) = \frac{E_a}{R}\left(\frac{1}{300} - \frac{1}{305}\right)$

$\Rightarrow \ln 1.5 = \frac{E_a}{R}\left(\frac{5}{300 \times 305}\right)$

$\therefore E_a = \left(\frac{0.4 \times 8 \times 300 \times 305}{5 \times 1000}\right)$ kJ/mol

$= 58.56$ kJ/mol **Ans.**

Q.53



Q.54 $Li + air \rightarrow Li_3N + Li_2O + Li_2O_2$

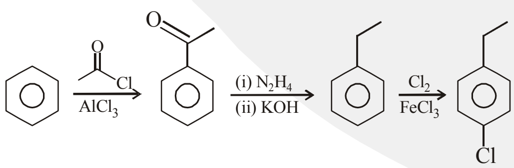
$\downarrow H_2O$

NH_3 + LiOH

(Basic-turns red litmus into blue)

Q.55 Theory based

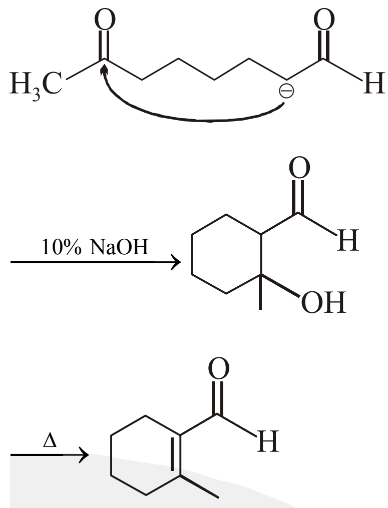
Q.56



Q.57 E.A. $\rightarrow$ Cl > F

Q.58 Theory based

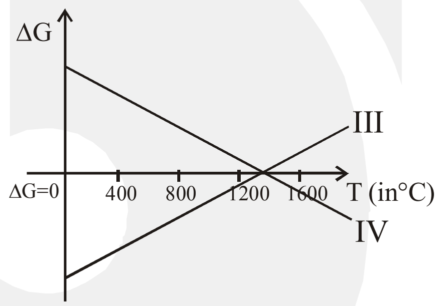
Q.59



α,β unsaturated aldehyde

Q.60

	at T < 1400°C	at T > 1400°C
III $\rightarrow 3Mg + Al_2O_3 \longrightarrow 3MgO + 2Al$	$\Delta G < 0$	$\Delta G > 0$
IV $\rightarrow 3MgO + 2Al \longrightarrow 3Mg + Al_2O_3$	$\Delta G > 0$	$\Delta G < 0$



PHYSICS

Q.61 In the reference frame of infinity, U = 0
$E_1 = -13.6$ eV, $K_1 = 13.6$ eV, $U_1 = -27.2$ eV
$E_2 = -3.4$ eV, $K_2 = 3.4$ eV, $U_2 = -6.8$ eV
Now for U_1 to be zero,
we have to add 27.2 eV to U_1.
Hence $E_2 = -3.4 + 27.2 = 23.8$ eV

Q.62 $F = -\frac{dU}{dr} = -2B(r - r_0)$

$\omega^2 = \frac{K}{m_{reduced}} = \frac{2B}{m_1 m_2}(m_1 + m_2)$

Q.63 $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_0 - \mu_1}{R_1} + \frac{\mu_2 - \mu_0}{R_2}$

When $u = \infty$ $V = f$

$$\frac{1.6}{f} = \frac{1.5-1.2}{+30} + \frac{1.6-1.5}{-30}$$

$f = 240$ cm

Q.64 $$1 = \frac{220\sqrt{2}}{\sqrt{R^2 + X_c^2}}$$

$$R^2 + X_C^2 = 220 \times 220 \times 2$$

$$X_c^2 = \left[2 \times (220)^2\right] - [220]^2$$

$$X_C = (220)$$

$$\tan\phi = \frac{Xc}{R} = \frac{220}{220} = 1$$

$$\phi = 45^0$$

Q.65 Magnetic flux through the loop A;

$$\phi = B\pi r^2 = \frac{\mu_0 I R^2}{2\left(R^2 + x^2\right)^{3/2}} \pi r^2$$

Induced emf in the loop A;

$$\varepsilon = -\frac{d\phi}{dt} = \frac{\mu_0 I R^2 \pi r^2}{2}\left(-\frac{3}{2\left(R^2+x^2\right)^{5/2}} 2x \frac{dx}{dt}\right)$$

$$= -\frac{3\mu_0 I R^2 \pi r^2 v}{2}\left[\frac{x}{\left(R^2+x^2\right)^{5/2}}\right]$$

Induced emf is maximum when $\frac{d\varepsilon}{dx} = 0$

$$\left(R^2 + x^2\right) - 5x^2 = 0 \text{ or } x = \frac{R}{2}$$

Q.66 Voltage across rod $= \frac{1}{2} B_0 l_0^2 \omega_0$

Charge on capacitor $= CV_0$

$$v \times q = \frac{1}{2} CV_0^2 + H_{R_1} + H_{R_2}$$

$$CV_0 \times \frac{1}{2} B_0 l_0^2 \omega_0 = \frac{1}{2} CV_0^2 + \frac{R_2}{R_1} H_{R_2} + H_{R_2}$$

$$\frac{1}{2} CV_0 B_0 l_0^2 \omega_0 - \frac{1}{2} CV_0^2 = \frac{H_{R_2}[R_2 + R_1]}{R_1}$$

$$H_{R_2} = \frac{R_1}{R_1 + R_2}\left[\frac{1}{2} CV_0 B_0 l_0^2 \omega_0 - \frac{1}{2} CV_0^2\right]$$

$$= \frac{R_1}{R_1 + R_2} \times \frac{1}{2} CV_0 [B_0 l_0^2 \omega_0 - V_0]$$

$$= \frac{1}{2} CV_0^2$$

Q.67 Magnetic moment $M = NIA$

$$M = I_0 \frac{\sqrt{3}}{4} (\sqrt{2}a)^2 = \frac{\sqrt{3}}{2} I_0 a^2$$

Q.68 Resistance between opposite corner is $\frac{R}{2}$ and $\frac{R}{2}$ which is parallely connected.

$\therefore$ Maximum value $= \frac{R}{4}$

For adjacent corner two resistance $\frac{R}{n}$ and $\left(\frac{n-1}{n}\right) R$ are parallel connected

So minimum resistance is $= R \frac{(n-1)}{n^2}$

Q.69 $$E = \pi l = \frac{Vl}{L} = \frac{iR}{L} \times l$$

$$\Rightarrow \quad E = \frac{E}{R + R_h + r} \times \frac{R}{L} \times l$$

$$\Rightarrow \quad E = \frac{10}{5+4+1} \times \frac{5}{5} \times 3 = 3\,V$$

Q.70 Work done to rotate the ring is equal to work done to return the charge at its initial position.

Q.71 Potential of centre of sphere $= \frac{Kq}{r} + V_i = \frac{Kq}{r}$

where V_i = potential due to induced charge at centre = 0 [$\therefore\ \Sigma q_i = 0$ and all induced charges are equidistance from centre]

$\therefore$ potential at point $P = \frac{Kq}{r} = \frac{Kq}{r_1} + V_i$

(For conductor all points are equipotential)

$\therefore\ V_i = K\left(\frac{q}{r} - \frac{q}{r_1}\right)$

Q.72 Slope of potential from x = 0 to x = d is

$-\frac{4Q}{2\varepsilon_0 A} = -\frac{2Q}{\varepsilon_0 A}$

Slope of potential from x = d to x = 2d is

$-\frac{3Q}{\varepsilon_0 A}$

Slope of potential from x = 2d to x = 3d is

$\frac{2Q}{\varepsilon_0 A}$

Q.73 Isotherm of maximum temperature has line AB as tangent on it at $\frac{V_0}{2}$

Q.74 $y(x,t) = 0.02\cos\left(50\pi t + \frac{\pi}{2}\right)\cos(10\pi x)$

$\equiv A\cos\left(\omega t + \frac{\pi}{2}\right)\cos kx$

Node occurs when $kx = \frac{\pi}{2} \Rightarrow 10\pi x = \frac{\pi}{2}$

$\Rightarrow x = 0.05$ m

Antinode occurs when $kx = \pi \Rightarrow 10\pi x = \pi$

$\Rightarrow x = 0.1$ m

Speed of wave (v) $= \frac{\omega}{k} = \frac{50\pi}{10\pi} = 5$ m/s

Wavelength $(\lambda) = \frac{2\pi}{k} = 0.2$ m

Q.75 The relative velocity of sound waves with respect to the walls is $V + v$.

Hence, the apparent frequency of the waves striking the surface of the wall is $\frac{(V+v)}{\lambda}$.

The number of positive crests striking per second is the same as frequency.

In three seconds, the number is $[3(V+v)]/\lambda$.

Q.76 $y = 2A\cos kx \sin \omega t$ (assuming $t = 0, y = 0$),

$\lambda = \frac{2l}{3}$

as $\Delta P = B\frac{dy}{dx} = B\,2Ak\sin kx \sin\omega t$,

$\Delta P_{max} = B(2A)k$ also $v = \sqrt{\frac{B}{\rho}}$

$\Rightarrow 2A = 2.5$ cm.

Q.77 $f = \frac{3v}{4(L+0.6r)}$

$\frac{df}{dt} = \frac{3v}{4}\left(-\frac{1}{(L+0.6r)^2}\cdot(0.6)\frac{dr}{dt}\right)$

$-2 = -\frac{3v}{4}\left(0.6\frac{dr}{dt}\right)$

$\frac{8}{3v\times 0.6} = \frac{dr}{dt}$

$\frac{dr}{dt} = \frac{1}{72}$ m/s

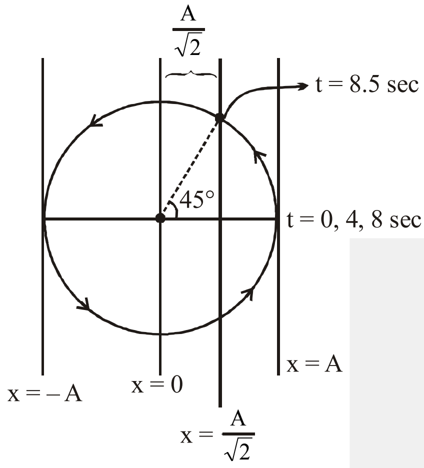
Q.78 Maximum tension in string $= T = mg + m\omega^2 A$

$\mu(3mg) = mg + m\left(\frac{2\pi}{\pi/2}\right)^2$

$\Rightarrow \mu = \frac{13}{15}$

Q.79 In 8.5 sec

$\theta = \omega t = \frac{17\pi}{4} = 4\pi + \frac{\pi}{4}$



$\therefore$ Distance $= 8A + A - \frac{A}{\sqrt{2}}$

$= 9A - \frac{A}{\sqrt{2}} = 27 - \frac{3}{\sqrt{2}}$ cm

Q.80 $\frac{dQ}{dt} = \frac{\pi P r^4}{8\eta L}$

As capillaries are joined in series, so (dQ/dt) will be same for each capillary.

Hence, $\frac{\pi P r^4}{8\eta L} = \frac{\pi P'(r/2)^4}{8\eta(L/2)} = \frac{\pi P''(r/3)^4}{8\eta(L/3)}$

So, pressure difference across the ends of 2nd capillary

$p' = 8P$

and across the ends of 3rd capillary

$p'' = 27P$

Q.81 $\rho h^2 =$ constant

Q.82 Conserving momentum during the explosion

$mv = \frac{m}{2} \times 0 + \frac{m}{2} v'$ or $v' = 2v$

Increase in the mechanical energy $= \Delta K + \Delta U$

$= \Delta K + 0 = \frac{1}{2}\frac{m}{2}(2v)^2 - \frac{1}{2}mv^2 = \frac{1}{2}mv^2$

$= \frac{GMm}{4R} = \frac{mgR}{4}$ $\left[v = \sqrt{\frac{GM}{2R}}\right]$

Q.83 $T(R - r) = \mu mgR$; $2mg - T = 2ma$;

$T - \mu mg = ma$

On solving, we get

$\therefore \quad r = R\left(1 - \frac{3\mu}{2(1+\mu)}\right)$

Q.84 $2M\frac{a^2}{3}\omega - Mv\frac{a}{2} = 0$; $\omega = \frac{3V}{4a}$

Q.85 From Newton's third law, force F will act on the block in forward direction

Acceleration of block $a_1 = \frac{F}{M}$

retardation of bullet $a_2 = \frac{F}{m}$

relative retardation of bullet

$a_r = a_1 + a_2 = \frac{F(M+m)}{Mm}$

Applying $v^2 = u^2 - 2a_r l$

$0 = v_0^2 - \frac{2F(M+m)}{Mm}.l$

or $\quad v_0 = \sqrt{\frac{2Fl(M+m)}{Mm}}$

Therefore, minimum value of v_0 is

$\sqrt{\frac{2Fl(M+m)}{Mm}}$

Q.86 $\frac{\Delta T}{T} \times 100 = \frac{\frac{1}{5}}{25} \times 100 = 0.8\%$

Q.87 The displacement between first stone and aeroplane after t second $(h_1) = \frac{1}{2}(g + f)t^2$

After time t,

Velocity of aeroplane $= u + ft$

Velocity of first stone $= u - gt$

Where u is velocity of aeroplane when first stone is dropped.

The relative speed of second stone with respect to first stone $= (u + ft) - (u - gt)$

$$= (g + f)t$$

The relative displacement between first and second stone after time $t'(h_2)$

$$= (g + f)tt'$$

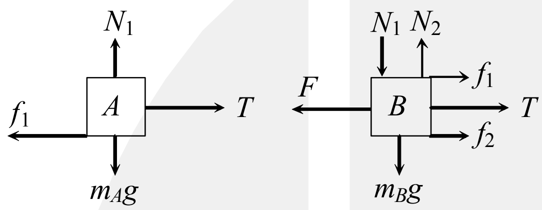
$$h_1 + h_2 = \frac{1}{2}(g + f)t^2 + (g + f)tt'$$

$$= \frac{1}{2}(g + f)(t + 2t')t$$

Q.88 $m_A = 0.5kg$, $m_B = 1kg$

From F.B.D. of block A,

$T = f_1 = \mu m_A g = 2N$



From F.B.D. of block B,

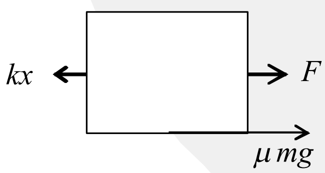
$f_2 = \mu N_2 = 6N$

$F = T + f_1 + f_2 = 2 + 2 + 6 = 10N$

Q.89 Block will return after maximum elongation.

i.e. $F.x_{max} - \frac{1}{2} Kx^2_{max} - \mu g x_{max} = 0$

$$x_{max} = \frac{2(F - \mu mg)}{k} = \frac{8\mu mg}{k}$$



So block will finally comes to rest while returning i.e. $v = 0$ & $a = 0$

By work energy theorem while returning

$$-\left(\frac{1}{2}kx^2 - \frac{1}{2}kx^2_{max}\right) - (F + \mu mg)(x_{max} - x) = 0$$

$$\Rightarrow x = \frac{4\mu mg}{k}$$

Q.90 $mgl + \frac{3mg}{8}\left(l + \frac{l}{3}\right) = \left[m\left(\frac{4l^2}{3}\right) + \frac{3}{8}m\left(\frac{4l}{3}\right)^2\right]\alpha$

$$\alpha = \frac{3g}{4l}$$

$a = g$