FIITJEE FARIDABAD

MOCK PRACTICE PAPER FOR
JEE -Advance- 2020

MOCK PRACTICE PAPER-17

Time: 3 hours | *Maximum marks: 288*

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions
1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-1** is Mathematics, **Part-2** is Physics and **Part-3** is Chemistry.
4. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
5. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet
1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Sections.

(i) **Section-A (01 – 8)** contains **8** multiple choice questions which have **one or more than one** correct answers. Each question carries **+4 marks** for correct answer and **-2** for incorrect answer.

(ii) **Section-C (01 – 8)** contains **8** questions. The answer to each question is a single –digit integer, ranging from **0 to 9** (both inclusive). Each question you will be awarded +**4** marks for correct answer and **No** negative marking in this section.

(iii) **Section-B (01 – 04)** contains **4** matrix match type questions. You will award **2** marks for each row matching. Thus, each question carries a maximum of **+8 marks** for correct answer and **No** negative marking in this section.

Name of the Candidate :________________________________

Batch :________________ **Date of Examination :**____________________

Enrolment Number :________________________________

MATHS

SECTION – I
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

1. Let A,B,C be square matrices of same order and I is the unit matrix of same order such that $A+B+C=AB+BC+CA$. Consider the following statements

(i) $ABC=AC-CA$ (ii) $BCA=BA-AB$ (iii) $CAB=CB-BC$

A) (i) and (ii) are equivalent
B) (ii) and (iii) are equivalent
C) (i) and (iii) are equivalent
D) (i) , (ii) and (iii) are equivalent

2. Let $a_1<a_2<a_3<a_4<a_5<a_6$, $a_1,a_2,a_3,a_4,a_5,a_6\in R$

$p=a_1+a_2+a_3+........+a_6$

$q=a_1a_3+a_3a_5+a_5a_1+a_2a_4+a_4a_6+a_6a_2$

$r=a_1a_3a_5+a_2a_4a_6$. Then the equation $2x^3-px^2+qx-r=0$ has

A) one root between (a_1,a_2)
B) two roots between (a_1,a_3)
C) two roots between (a_1,a_4)
D) two roots between (a_3,a_5)

3. Which of the following is/are correct?

A) Suppose the functions f and g are continuous on [a, b] and differentiable on (a, b). then if $f'(x) = g'(x)$ for all x is (a, b), there exists a constant e such that $f(x) = g(x) + e$

B) Let f : [0, 2] $\rightarrow R$ be continuous and $f(0) = f(2)$. Then there exists x_1, x_2 in (0, 2) such that $x_1 - x_2 = 1$ and $f(x_1) = f(x_2)$

C) Consider $f(x) = \underset{n\to\infty}{\boldsymbol{lt}} \dfrac{\boldsymbol{ln}(2+x) - x^{2n}\,\boldsymbol{sin}\,x}{1+x^{2n}}$

$f(x)$ vanishes in $\left(0, \dfrac{\pi}{2}\right)$ as $f(0)$ and $f\left(\dfrac{\pi}{2}\right)$ differ in sign

D) Let $f(x)$ be a polynomial of degree n, say $f(x) = \sum_{k=0}^{n} C_k x^k$ such that the first and last coefficients C_o and C_n have opposite signs. Then $f(x) = 0$, for atleast one positive x.

4. Which of the following is/are correct?

A) 5 distinct green balls are to be put in 3 distinct boxes so that no box is empty. The no. of ways this can be done is 150

B) 5 distinct green balls are to be arranged in 3 distinct boxes so that boxes can have any number of balls. The number of ways this can done is 2520

C) 5 red identical balls, 6 green identical balls are to be arranged in 3 distinct boxes so that no box is empty. The number of ways this can be done is 465

D) There are three baskets of which first one contains unlimited number of apples, second one contains unlimited number of mangoes, third one contains unlimited number of oranges. The number of ways of selecting 5 fruits from those 3 baskets and arrange them linearly so that selection contains atleast one fruit from each kind is 150

5. Four points with position vectors $\bar{a}, \bar{b}, \bar{c}, \bar{d}$ are coplanar if there exists scalars x, y, z, w (not all zero) satisfying $x\bar{a} + y\bar{b} + z\bar{c} + w\bar{d} = 0$ and x + y + z + w = 0. Then which of the following is/are true

A) If exactly one of x, y, z, w is zero then the four points are coplanar as two points coincide.

B) If exactly two of x, y, z, w are zero then the four points are coplanar as two points coincide

C) If exactly one of x, y, z, w is zero then the four points are coplanar as three points are collinear

D) If exactly two of x, y, z, w are zero then the four points are coplanar as three points are collinear

6. If z is an unimodular complex number such that Re $(z-1)+\text{Re}(z^2) =$

$\int_0^{\frac{\pi}{2}} \sin x \ln|\sin x - \cos x| dx$ then which of the following can be true?

A) $z+\bar{z}=1$ B) $z+\bar{z}=-2$ C) $\arg(z)=\frac{\pi}{3}$ D) $\arg(z)=\pi$

7. Which of the following is/are correct

A) Order of the differential equation of a parabola whose axis and tangent at the vertex are neither co ordinate axes nor parallel to co ordinate axes, is 4

B) Order of the differential equation of any ellipse whose centre is given and whose major and minor axes are parallel to co ordinate axes, is 3

C) Order of the differential equation of any ellipse whose axes are neither co ordinate axes nor parallel to co ordinate axes and whose eccentricity is given is 4

D) Order of the differential equation of a pair of perpendicular lines, which do not pass through origin is 3

8. Sequence $\{a_n\}, n \ge 1, n \in N$ satisfy $a_1 = 0$, $a_{n+1} = 5a_n + \sqrt{24a_n^2+1}$ then

A) a_n is rational for all $n, n \in N$

B) $a_{n+1} = 10a_n - a_{n-1}, \forall n \ge 2, n \in N$

C) $(a_{n+1}).(a_{n-1}) = a_n^2 - 1, \forall n \ge 2, n \in N$

D) a_n is positive for all $n \ge 2, n \in N$

SECTION – II
(INTEGER ANSWER TYPE)

This section contains 8 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

1. If $a>2$ and $\int_0^\infty \frac{dx}{a^2+\left(x-\frac{1}{x}\right)^2}=\frac{\pi}{5050}$ and a = α^2.101, then α =

2. A function $f:R\to R$ satisfies the conditions
   i) $f(x)$ is continuous on $[0,\infty)$
   ii) $f(x)>0\ \forall\ x\in(0,\infty)$
   iii) $\frac{1}{2}\int_0^x f^2(t)dt=\frac{1}{x}\left[\int_0^x f(t)dt\right]^2$ then $\int_0^1 f(x)dx=$ (when $f(1)=2+\sqrt{2}$)

3. Three boxes are labeled as x,y,z and each box contains 5 balls numbered $1,2,3,4,5$, the balls in each box are well mixed. One ball is chosen at random from each of three boxes x,y,z and if α,β,γ are numbers on the ball respectively chosen then P is probability that $\alpha=\beta+\gamma$ then the value of $25P=$

4. AB is a diameter of a circle of unit radius. AB is extended to a point C. The tangent from C, to the circle meets it at T. P is the foot of perpendicular from B on the line CT. The maximum value of AP is k then $[k]=$……..(where [.] denotes G.I.F)

5. If p,q,r are complex numbers and all roots of the equation $z^3 + pz^2 + qz + r = 0$ lies on a circle with centre $(0,0)$ and radius 1 and (|p|<3) ,then the number of distinct real roots of equation $z^3 + |p|z^2 + |q|z + |r| = 0$ is/are ______.

6. If $\vec{a},\vec{b},\vec{c}$ are any three non-coplanar unit vectors such that $\left[\vec{a}\ \vec{b}\ \vec{c}\right] = 1$;

$\overrightarrow{K}_1 = \frac{\vec{a}+\vec{b}}{\sqrt{2}}; K_2 = \vec{c}$ and $\overrightarrow{K}_{i+2} = \overrightarrow{K}_{i+1} \times \overrightarrow{K}_i$ then the value of $\left[\overrightarrow{K}_{2014}\ \overrightarrow{K}_{2013}\ \overrightarrow{K}_{2012}\right] =$

7. PG is the normal to an ellipse at P whose eccentricity is ½ , G lies on major axis. GP is produced outwards to Q so that $PQ = GP$; then locus of Q is an ellipse whose eccentricity is e, then value of 1/e is

8. Number of solutions of $\cos^2\left(\left|\frac{\pi}{4}\left(\sin x + \sqrt{2}\cos^2 x\right)\right|\right) - \tan^2\left(\left|x + \frac{\pi}{4}\tan^2 x\right|\right) = 1, x \in [-2\pi, 2\pi]$ is

SECTION - III
(MATRIX MATCHING ANSWER TYPE)

This section contains 4 questions. Each question has four statements (A, B, C and D) given in Column I and four statements (P, Q, R and S) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in Q and R, then for the particular question darken the bubbles corresponding to Q and R in the OMR sheet.

1.

Column I		Column II	
A)	If $p=\frac{10^{999}+9.10^{998}+9^2.10^{997}+......+9^{999}.1}{10^{1000}-9^{1000}}$ then $205+\frac{(p+1)(p+100)}{p(p-2)}=$____	P)	6
B)	If $\sin(\sin x+\cos x)=\cos(\cos x-\sin x)$ and largest Possible value of $\sin x$ is $\frac{\pi}{k}$, then k, is ______	Q)	3
C)	Number of points in $(-5, 5)$ at which the function $f(x)=x\sin\left([x]^4-5[x]^2+4\right)$ is discontinuous, is _____ ([.] G.I.F)	R)	4
D)	If $\sqrt{x+y}+\sqrt{y-x}=a$ $\left(a\in R-\{0\}\right)\&\frac{d^2y}{dx^2}=\frac{k}{a^2}$ where k = ______	S)	2

2. **Matching**

Column I		Column II	
A)	The equation $\frac{x^2+ax+b}{x^2+x+1}=c$ has three distinct real roots then $a+b+c=$ __	P)	3
B)	Let $f(x)=ax^3+bx^2+cx+d$ be a cubic polynomial such that $ab<0$ & $ad<0$. All the roots of the equation $f(x)=0$ are real and distinct and $f(0)>0$ then number of tangents, to the curve $y=\left\|f(\|x\|)\right\|$ which are parallel to x-axis	Q)	9
C)	Let $y=f(x)$ be functions which has 5 points of local maxima and one point of local minima. If a is the minimum number of point where $f(x)$ is discontinuous, then a =___	R)	5
D)	If obtuse angle between the normals to the circle $x^2+y^2-6x-10y+33=0$ which are tangents to the circle $x^2+y^2=9$ is $cos^{-1}\left(\frac{a}{b}\right)$ where $a\&b$ are coprime. Then $\|a+b\|=$ ___	S)	4

3. Matching:

Column I		Column II	
A)	A continuous and differentiable function $y=f(x)$ is such that its graph cuts the line $y=px+q$ at 6 distinct points then the minimum number points at which $f''(x)=0$ is……..	P)	1
B)	Number of positive root(s) of the equation $f(x)=\frac{1}{(x+1)^3}-3x+\sin x=0$ is/are m & negative root(s) of the equation $f(x)=0$ is/are n then $3m+n=\ldots\ldots\ldots$	Q)	3
C)	Number of real roots of the equation $\sum_{i=1}^{6}\frac{a_i^2}{x-b_i}=c,(a_i\neq 0)$ (c is a constant) Where $b_1<b_2<b_3<b_4<b_5<b_6$	R)	4
D)	Let $A=\left[a_{ij}\right]$ $(1\le i,j\le 3)$ be a 3×3 matrix and $B=\left[b_{ij}\right]$ $(1\le i,j\le 3)$ be a 3×3 matrix such that $b_{ij}=\sum_{k=1}^{3}a_{ik}a_{jk}$. If $\det(A)=2$, then the value of $\det(B)$ is	S)	5

4. **Matching**

	Column I		Column II
A)	Vertices of ellipse $\frac{x^2}{p^2}+\frac{y^2}{q^2}=1$ are the foci of the hyperbola $\frac{x^2}{P^2}-\frac{y^2}{Q^2}=1$ and vertices of hyperbola are the foci of ellipse. If the eccentricity of ellipse is $\frac{1}{\sqrt{2}}$ and (t_1, t_2) is the point of intersection of ellipse and hyperbola, then the value of $\frac{9t_1^2}{t_2^2}$ is __	P)	5
B)	Vertices of a variable acute triangle ABC, lies on a fixed circle. If a,b,c and A,B,C are length of sides and angles of triangles ABC respectively and x_1, x_2, x_3 are distances of orthocentre from A,B,C respectively then find the maximum value of $\sqrt{3}\left(\frac{dx_1}{da}+\frac{dx_2}{db}+\frac{dx_3}{dc}\right)+15$ is _____	Q)	6

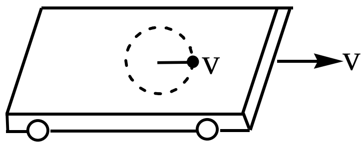
C)	Let ABCD be a square with sides of unit length. Points E and F are taken on sides AB and AD respectively so that $AE = AF$. Then maximum possible area of the quadrilateral CDFE is "k" square units. then 8k = ______	R)	36
D)	Consider the statements. 1) for $0 < A < \pi/6$, $A\sec A < \frac{\pi}{3\sqrt{3}}$ 2) for $0 < C, D < \frac{\pi}{4}$, $C\,\mathrm{cosec}\,C + D\,\mathrm{cosec}\,D < \frac{\pi}{\sqrt{2}}$ 3) for $0 < E, F, G < \pi/3$, $E\cot E + F\cot F + G\cot G > \frac{\pi}{\sqrt{3}}$ & number correct statements is k, then value of $5 + k =$ ______	S)	8

PHYSICS

SECTION – I
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

1. On a train moving along east with a constant speed v, a boy revolves a bob with string of length ℓ on smooth surface of the train, with same constant speed v relative to train. Mark the correct option (s).



A) Maximum speed of the bob is 2v in ground frame.

B) Tension in the string connecting the bob is $\frac{4mv^2}{\ell}$ at an instant shown

C) Tension in the string is $\frac{mv^2}{\ell}$ at all the moments

D) Minimum speed of bob is zero in ground frame.

2. A part of snapshot of progressive wave propagating in a uniform string is shown in figure-1 and a snapshot of standing wave in a string (identical to case-1) is shown in figure -2.

The amplitude, frequency and wave length of waves in both cases is same. *A* and *B* (anti node) are material cross-section on strings. At the instant shown both *A* &

B are at their respective maximum displacement. dE represents wave energy of small element of length dx.

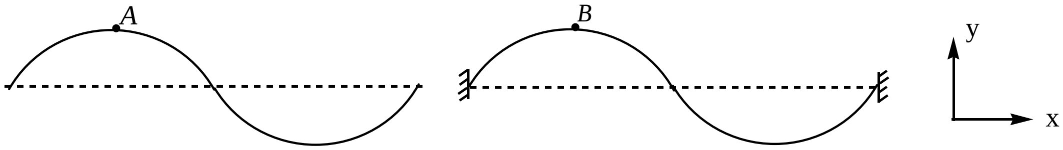


Fig-1 Fig-2

A) At the instant shown, power transfer at cross-section A and B is zero

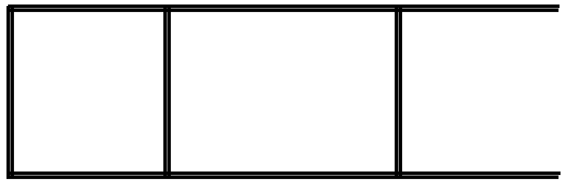
B) Instantaneous power transfer through A changes periodically but through B remain zero

C) *at the instant shown in figure* $\left.\frac{dE}{dx}\right|_{at\,A} = \left.\frac{dE}{dx}\right|_{at\,B} = 0$

D) $\left.\frac{dE}{dx}\right|_{at\,A}$ Changes periodically, while $\left.\frac{dE}{dx}\right|_{at\,B}$ remain zero all the time

3. Figure shows a long fixed container which has two freely movable (without friction) pistons. The container and pistons are made up of a thermally conducting material, that allows very slow transfer of heat. First compartment of container is filled with 2 moles of an ideal monoatomic gas at 200K and the 2nd compartment is filled with 1 moles of ideal diatomic gas at 500K. Initially pressure of gases in

both the compartment is same and equal to atmospheric pressure. Temperature of atmosphere is 300K. Finally gases achieve equilibrium. ‘R’ is the gas constant



compartment-1 compartment-2

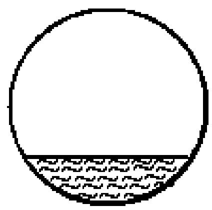
A) Heat transferred by gas in compartment -2 to the atmosphere is 700R

B) Heat transferred by gas in compartment -2 to the atmosphere is 500R

C) Work done by gas in compartment -2 on the gas in compartment -1 is 200R

D) Net heat transferred to gas in compartment -1 is 500R

4. A spherical glass vessel filled with liquid is kept in uniform gravity. Horizontal surface represents meniscus of liquid. Now complete system is kept in a gravity free space. Select correct statement(s)



A) Liquid wets the inner surface of the vessel

B) Liquid does not wet the inner surface of the vessel

C) finally liquid forms a drop and touches at the lowest point of vessel

D) finally liquid spreads over the inner surface of vessel

5. Three simple harmonic motions in the same direction having each of amplitude "a" and the same period are superposed. If each differs in phase from the next by $\pi/4$ then

A) Resultant amplitude is $(\sqrt{2} + 1)a$

B) Phase of resultant motion relative to first is 90°

C) The energy associated with the resulting motion is $(3 + 2\sqrt{2})$ time the energy associated with any single motion

D) Maximum speed of resultant SHM will be more than double of the initial SHM's

6. Three identical blocks each of mass $m = 1$ kg and volume 3×10^{-4} m^3 are suspended by massless strings from a support as shown. Underneath there are three identical containers (of negligible mass) containing same amount of water are placed over the scales. In Fig. A, the block is completely out of the water, in Fig. B, the block is completely submerged but not touching the beaker, and in Fig. C, the block rests on the bottom of the beaker. The scale in Fig. A reads 14 N.

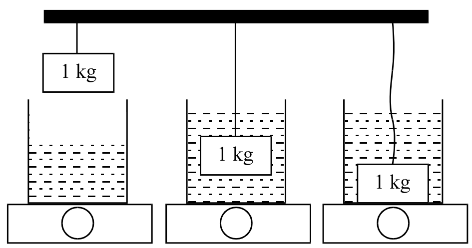


Fig. A Fig. B Fig. C

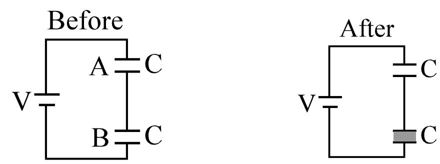
A) The tension in the string in Fig. B is 10 N

B) The tension in the string in Fig. B is 7 N

C) The reading of the scale in Fig. B is 17 N

D) The reading of the scale in Fig. C is 24 N

7. Two identical capacitors are connected in series as shown in the figure. A dielectric slab ($\kappa > 1$) is placed between the plates of the capacitor B and the battery remains connected. Which of the following statement(s) is/are correct following the insertion of the dielectric?



A) The charge supplied by the battery increases.

B) The capacitance of the system increases.

C) The electric field in the capacitor B increases.

D) The electrostatic potential energy of capacitor system decreases.

8. According to Bohr's theory of hydrogen atom, for the electron in the n^{th} permissible orbit,

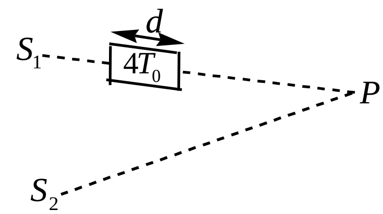
A) linear momentum $\propto \frac{1}{n}$ B) radius of orbit $\propto$ n

C) kinetic energy $\propto \frac{1}{n^2}$ D) angular momentum $\propto$ n

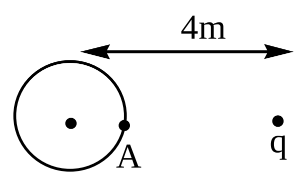
SECTION – II
(INTEGER ANSWER TYPE)

This section contains 8 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

1. Sound from two coherent sources S_1 and S_2 are produced in phase, and detected at point P, equidistant from both the sources. Speed of sound in normal air is 340 m/sec, but in some part in path S_1 there is a zone of Hot air having temperature 4 times the normal temperature, and width (d = 85 m). What should be minimum frequency of sound, so that minimum intensity can be found at P? (in Hz)

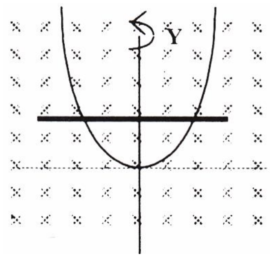


2. A neutral conducting solid sphere of radius 2m is placed such that its centre is 4m from a point charge q =2mC. The electric field intensity just outside at a point A on the sphere is found to be 2 N/C. If the induced charges per unit area at A is $x\,\varepsilon_o$. Find the value of x.

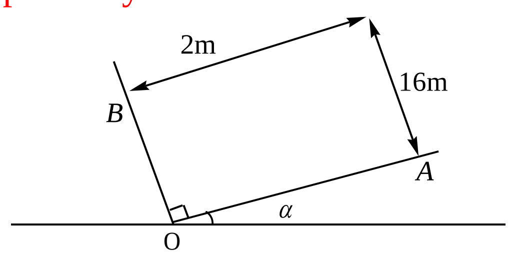


3. A conducting resistance less rod is bent as a parabola $y = Kx^2$, where K is a constant and a conductor of resistance per unit length λ starts sliding up from the horizon on the parabola with a constant acceleration a and the parabolic frame starts rotating with constant angular frequency ω about the axis of symmetry, as shown in the figure. There exist a uniform magnetic field B as shown in figure. The current induced in the rod when frame turns through an angle $\frac{\pi}{4}$ is $\frac{Ba\pi(\pi - 12)}{n \times 12\sqrt{2}\,\omega\lambda}$.

The value of 'n' is



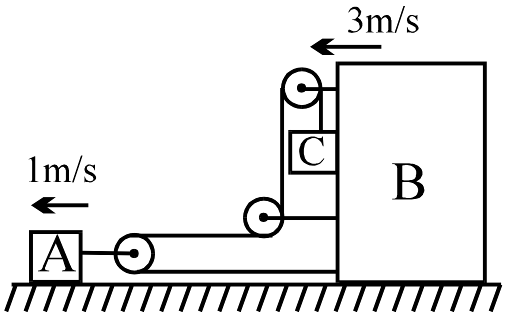
4. Two inclined planes OA and OB intersects at 'O' at 90º as shown in figure. An elastic ball is released at a point at perpendicular distances 16m and 2m from plane OA and OB respectively. All collisions are elastic.



On an average, how many times does the ball bounce on plane OB for each time it bounces on plane OA ?

[g=10 m/s^2,angle made by plane OA with horizontal is $\alpha = \tan^{-1}(2)$]

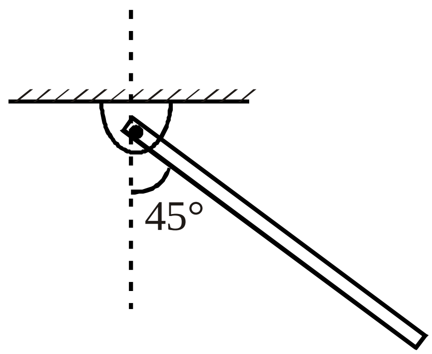
5. The velocities of A and B are marked in the figure. Find the velocity of block C in m/s (assume that the pulleys are ideal and string inextensible).



6. A sphere of radius R carries charge such that its volume charge density is proportional to the square of the distance from the centre. What is the ratio of the magnitude of the electric field at a distance 2R from the centre to the magnitude of the electric field at a distance of R/2 from the centre (i.e. $E_{r=2R} / E_{r=R/2}$)?

7. A table-tennis player moves his bat up and down in such a way that the ball always bounces to a height of 0.45 m from the bat. Coefficient of restitution is 0.5. What is the speed (in m/s) of the bat when hitting the ball? (The mass of the ball is much less than that of the bat and air resistance is also negligible.)

8. A uniform rigid rod hinged at one end is released from rest in the position shown in the vertical plane. Find the magnitude of reaction force (in N) at hinge just after its release. Express your answer after rounding it to nearest integer. (Use : M = 0.8kg., $\theta = 45°$, $g = 10\ m/s^2$)



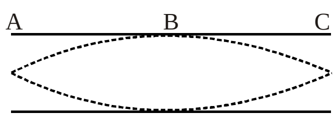
SECTION - III
(MATRIX MATCHING ANSWER TYPE)

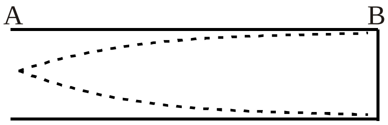
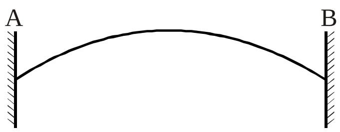
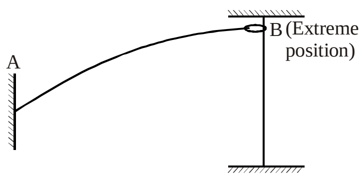
This section contains 4 questions. Each question has four statements (A, B, C and D) given in Column I and four statements (P, Q, R and S) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in Q and R, then for the particular question darken the bubbles corresponding to Q and R in the OMR sheet.

1. An ideal mono atomic gas undergoes different types of processes which are described in column-I. Match the corresponding effects in column-II. The letters have their usual meaning

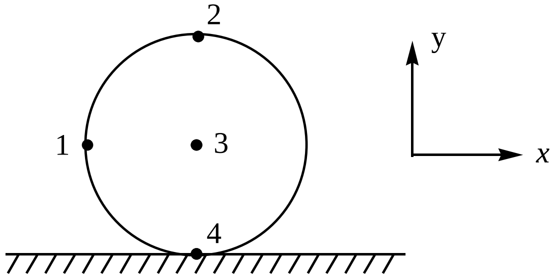
Column – I	Column – II
(a) $C = C_v - 2R$	(p) If volume increases then temperature will also increase
(b) $PV^3 = \text{constant}$	(q) If volume increases then temperature will decrease
(c) $C = C_v + 2R$	(r) For expansion, heat will have to be supplied to the gas
(d) $P = 2V^5$	(s) If volume increases then heat supplied is zero

2.

Column I		Column II	
A)	Graphical representation of pressure variation in both end open organ pipe. 	P)	Maximum kinetic energy at B
B)	Graphical representation of pressure	Q)	Maximum potential energy at B

	variation in one end closed orgon pipe.  		
C)	Snapshot of string fixed at both ends.  	R)	Maximum particle velocity at B
D)	Snap shot of a string fixed at one end and connected to a smooth massless ring that is constrained to move vertically.  	S)	Maximum particle acceleration at B

3. A rigid cylinder is kept on a smooth horizontal surface as shown. If **Column I** indicates velocities of various points (3-centre of cylinder, 2- top point, 4-bottom point, 1- on the level of 3 at the rim) on it shown, choose correct state of motion from **Column II**.



Column I | **Column II**

(A) $\vec{v}_1 = \hat{i} + \hat{j}, \vec{v}_2 = 2\hat{i}$ p) Pure rotation about centre

(B) $\vec{v}_1 = \hat{i} + \hat{j}, \vec{v}_3 = -\hat{i}$ q) Rolling without slipping to left

(C) $\vec{v}_2 = \hat{i}, \vec{v}_3 = 0$ r) Rolling without slipping to right

(D) $\vec{v}_4 = 0, \vec{v}_1 = -\hat{i} - \hat{j}$ s) Not possible

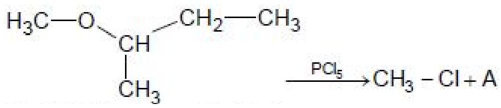
4. **Column I** **Column II**

Column I		Column II	
A)	β-decay	P)	Continuous energy distribution with dark lines in between
B)	γ-decay	Q)	Continuous energy distribution with sharp peaks in between.
C)	Absorption spectrum of Hydrogen	R)	Continuous energy distribution
D)	X-rays	S)	Discrete energy distribution

CHEMISTRY

SECTION – I
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

1. 

A is an organic product. Choose the correct option regarding this reaction?

A) CH_3Cl is formed by S_N1 process.

B) CH_3Cl is formed by S_N2 process

C) A is 2-chloro butane and is formed by S_N2

D) A is 2-chloro butane and is formed by S_N1

2. Which of the following statement(s) is/are incorrect?

A) Gold sol is prepared the way ferric hydroxide sol is prepared.

B) From mixed salt of AgCl and AgI, NH_4OH solution dissolves only AgCl.

C) spondumene is an example of sheet silicate with 2 oxygen atoms shared per tetrahedron

D) On strong heating $Na_2S_2O_3.5H_2O$, a polysulphide is formed.

3. Choose the incorrect statement(s)?

A) The stable allotrope of sulphur at room temperature is orthorhombic and this transforms to monoclinic sulphur when heated above 369K

B) white phosphorous is soluble in water but insoluble in CS_2

C) Sometimes yellow turbidity appears on passing H_2S gas even in the absence of IInd group of basic radicals, which is because of oxidation of H_2S (g) by some acidic radicals

D) IF is thermodynamically least stable among ClF, BrF and IF.

4. Radioactive (Br^{82}—Br^{82}) adds to 1-bromocyclohexene in CCl_4. The product

A) Is 1, 2, 2 – tribromocyclohexane

B) Has radioactive bromine in vicinal position

C) Has radioactive bromine trans to each other

D) On treatment with alc KOH gives 1,2-dibromo cyclohexane as one of the products.

5. $PhNHCOPh + HClO_4 + H_2SO_4 \rightarrow A + B + C$ (only A is organic compound)

In the above balanced equation, if molar mass: A > B > C, then choose correct option(s)

A) Both 'B' & 'C' have sp^3 hybridisation for their central atoms

B) Both 'A' & 'B' are resonance stabilized

C) Both 'A' & 'C' are less acidic than perchloric acid

D) All the three products, A, B and C contain at least one oxygen atom

6. Which of the following solutions have the suitable pH for diazotization of aniline?

A) A solution obtained by adding 80 g of NaOH to 1 L of 2 M $NiCl_2$ sol $\left(K_{sp}\ Ni(OH)_2 = 10^{-16}\right)$

B) A solution obtained after electrolysis of 1 L of 0.1 M CH_3COOK

C) A solution obtained after hydrolysis of 64 g of CaC_2 with enough water

D) Aqueous solution of NaHA, (pK_a1 and pK_a2 of H_2A are 4 and 8)

7. 10g of ammonium chloride is heated in air to obtain a mixture of gases A and B. gas A was dissolved in water to make 1L solution. 250 ml of this is taken out & titrated with 2mL of 3M H_2SO_4. The excess acid found to require 2mL, 1.5 M ferrous oxalate for complete reaction, where by the products are S, CO_2 and Fe^{+3}

A) % purity of NH_4Cl is <25 %

B) The gas released in the question reacts with urea to give melamine, an important polymer.

C) Ferrous oxalate acts as reducing agent.

D) Equivalent weight of H_2SO_4 is same in both the reactions.

8. Which of the following statement(s) is/are correct?

A) The flocculating value of PO_4^{-3} is less than that of SO_4^{-2}

B) Charcoal adsorbs gases with higher critical temperature more than gases with lower critical temperature.

C) Glucose shows muta rotation in a mixed solvent of pyridine and phenol but doesn’t show in any of them when taken alone

D) Both Maltose and Amylose have C1 to C4 glycosidic linkage

SECTION – II
(INTEGER ANSWER TYPE)

This section contains 8 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

1. The osmotic pressure of 0.1 M monobasic acid solution is 0.11 RT at 'T Kelvin', what is its Ph value?

2. How many of the following salts are white and soluble in dilute HNO_3?
$BaCrO_4$, Hg_2CrO_4, ZnS, $BaSO_4$, CH_3COOAg, $AgNO_2$

3. When a strong current of trivalent gaseous boron is passed through a germanium crystal, its density decreases due to part replacement of Ge by B and due to interstitial vacancies created by missing Ge atoms. When one gm of Ge is taken in the above experiment, the percentage of missing vacancies due to germanium, which are filled by B atoms is found to be 2.376 and boron atoms are found to be 150 ppm by weight. Assuming no volume change in lattice, find the percentage decrease in density of Ge crystal. (At. Wt. of Ge = 72.6, B = 11)

4. 10 ml of mixture of CO, CH_4 and N_2 exploded with excess of oxygen gave a contraction of 6.5 ml. There was a further contraction of 7 ml when the residual gas was treated with KOH. What is the volume of CH_4 in the original mixture?

5: One mole of PCl_3 is dissolved in excess of water. Number of moles of NaOH required to neutralise this solution completely is

6. How many of the following have more boiling point than water. Ammonia, phosphine, ethanol, hydrogen sulphide, hydrogen fluoride, hydrogen iodide

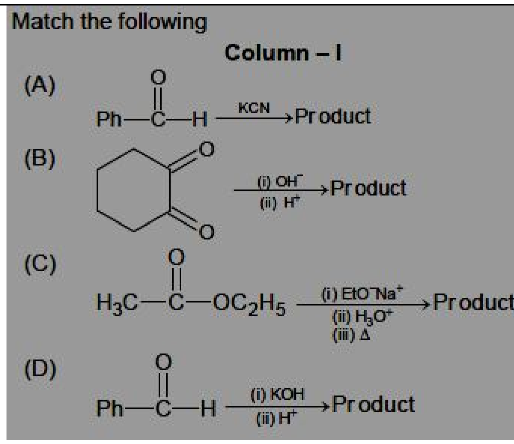
7. 50 ml of a mixture of NaOH and Na_2CO_3 solution titrated with deci normal HCl using phenolphthalein indicator required 50 ml HCl to decolourise phenolphthalein. At this stage methyl orange was added and addition of acid was continued. The second end point was reached after further addition of 10 ml of deci normal HCl. The amount (in grams) of NaOH in the solution is $2a\text{x}10^{-2}$. Value of "a" is?

8. Among the following, the number of compounds which undergo hydrolysis is NCl_3, P_4O_{10}, $SiCl_4$, $BiCl_3$, XeF_4, $POCl_3$ and B_2H_6

SECTION - III
(MATRIX MATCHING ANSWER TYPE)

This section contains 4 questions. Each question has four statements (A, B, C and D) given in Column I and four statements (P, Q, R and S) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in Q and R, then for the particular question darken the bubbles corresponding to Q and R in the OMR sheet.

1.



Column II

(P) final product gives positive Tollen's test

(Q) final product gives coloured derivative with 2,4-DNP

(R) final product liberates CO_2 gas with $NaHCO_3$

(S) final product reacts with Na and liberates H_2 gas which can be seen as bubbles

2.

	Column– I		Column– II
(a)	Pb^{2+}	(p)	Black precipitation with Na_2S solution
(b)	Cu^{2+}	(q)	Highest no of oxides are there for the metal
(c)	Mn^{2+}	(r)	Pseudo inert–gas configuration
(d)	Ag^{+}	(s)	White ppt with NaOH which turns light brown

3.

COLUMN I		COLUMN II	
A	Vapour pressure of binary solution of 2 miscible volatile liquids(containing 1 mole each) when half of liquid sol goes into vapour phase	P	$\frac{P_A^0 - P_A}{p_A} = x_B$
B	Vapour pressure of binary sol of 2 miscible volatile liquids	Q	$P_A^0 + P_B^0$
C	Vapour pressure of binary sol of 2 immiscible volatile liquids	R	$(P_A^0 - P_B^0)x_A + P_B^0$
D	Vapour pressure of binary sol having non volatile solute	S	$\sqrt{P_A^0 P_B^0}$

4.

	Column-I		Column-II
a)		p)	Crystal acquires Colour
b)		q)	Non stoichiometric defect
c)		r)	Density is less than perfect crystal
d)		s)	Stoichiometric defect

ANSWER KEY

MATHEMATICS		PHYSICS		CHEMISTRY	
1	ABCD	1	ACD	1	B
2	AC	2	ABC	2	AC
3	ABD	3	D	3	B
4	ABD	4	AD	4	BC
5	BC	5	ACD	5	ABCD
6	ABCD	6	BCD	6	AD
7	ACD	7	AB	7	AC
8	ABCD	8	ACD	8	ABCD
1	5	1	4	1	2
2	1	2	2	2	2
3	2	3	4	3	4
4	2	4	4	4	2
5	1	5	5	5	5
6	1	6	2	6	0
7	7	7	1	7	8
8	2	8	6	8	7
1	A – Q B – R C – P D – S	1	A – QR B – Q C – PR D – PR	1	A – PQS B – RS C – Q D – RS
2	A –P B –S C –P D –Q	2	A –Q B –Q C –Q D –S	2	A –P B –P C –QS D –PRS
3	A – R B – R C – S D – R	3	A – R B – S C – P D – Q	3	A – S B – R C – Q D – P
4	A – R B – Q C – P D – S	4	A – R B – S C – P D – Q	4	A – RS B – S C – S D – PQ

SOLUTIONS:-

MATHS

1. Assume (i), That is $ABC = AC - CA$. Now

$ABC + A + B + C = AC - CA + (AB + BC + CA) = AC + AB + BC$

Thus $(A-I)(B-I)(C-I) = ABC - AB - BC - AC + A + B + C - I = -I$

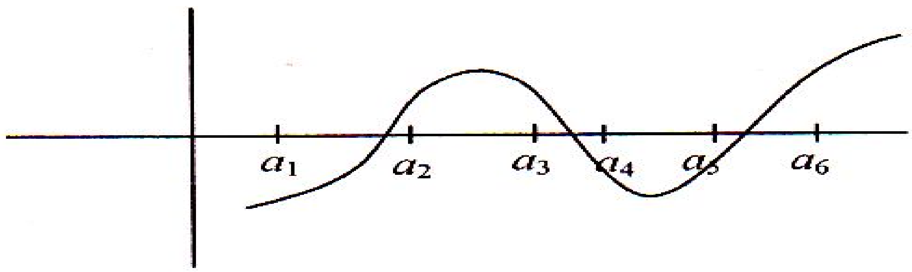
$\therefore$ Inverse of $C - I = -(A-I)(B-I) \Rightarrow (C-I)(A-I)(B-I) = -I$

$CAB - CA - AB - CB + C + A + B - I = -I$

$CAB = CB - BC$

Then i and iii are equivalent. Similarly we get i and ii equivalent

2.



$2x^3 - px^2 + qx - r = 0$

$\Rightarrow (x-a_1)(x-a_3)(x-a_5) + (x-a_2)(x-a_4)(x-a_6) = 0 = f(x)$

$f(a_1) = (a_1 - a_2)(a_1 - a_4)(a_1 - a_6) < 0$

$f(a_2) = (a_2 - a_1)(a_2 - a_3)(a_2 - a_5) > 0$

$\Rightarrow f(x) = 0$ has a root as (a_1, a_2)

& $f(a_3) > 0$ & $f(a_4) < 0$

$\Rightarrow f(x) = 0$ has a root is (a_3, a_4)

3. a) Let $h(x) = f(x) - g(x)$

$h'(x) = f'(x') - g'(x) = 0$

$\Rightarrow h(x) = e$

b) Consider a continuous function defined on [0, 2], g(x)=f(x+1)-f(x)

g(0)=f(1)-f(0)= f(1)-f(2)

g(1)=f(2)-f(1)

$g(0)g(1) < 0$

$g(c) = 0; c \in (0,1)$

$f(c+1) = f(c); c \in (0,1)$

$f(x_1) = f(x_2); x_1 - x_2 = 1$

c) $$f(x) = \begin{cases} \ln(2+x), in[0,1) \\ -\sin x, \quad in\left[1, \frac{\pi}{2}\right) \\ \frac{\ln 3 - \sin 1}{2}, x = 1 \end{cases}$$

4. a) $3^5 - 3_{C_1}.2^5 + 3_{C_2}.1^5 = 150$

b) $7_{C_2} 5! = 2520$

d) $3\left(\frac{5!}{2!2!1!} + \frac{5!}{3!1!1!}\right) = 150$

5. Conceptual

7. a) $ax^2 + 2hxy + by^2 + 2gx + 2fy + 1 = 0$

& $h^2 = ab$ $\therefore 4 =$ order

d) $(ax + by + 1)(bx - ay + c) = 0$

c) $\frac{\left(\frac{ax+by+1}{\sqrt{a^2+b^2}}\right)^2}{p^2} + \frac{\left(\frac{bx-ay+c}{\sqrt{a^2+b^2}}\right)^2}{q^2} = 1$ & relation between p & q is given.

b) $\frac{(x-a)^2}{p^2} + \frac{(y-b)^2}{q^2} = 1$ (a, b are given)

8. $a_{n+1}^2 - 10a_n a_{n+1} + a_n^2 - 1 = 0$

$a_n^2 - 10a_{n-1}a_n + a_{n-1}^2 - 1 = 0$

$\Rightarrow a_{n+1}, a_{n-1}$ are the roots of $t^2 - 10ta_n + a_n^2 - 1 = 0$

$\Rightarrow a_{n+1} + a_{n-1} = 10a_n, \forall n \ge 2,\ \ a_{n+1}.a_{n-1} = a_n^2 - 1\ \forall n \ge 2$

9. a = $\int_0^\infty \frac{dx}{a^2 + \left(x - \frac{1}{x}\right)^2} = \frac{1}{2}\left[\int_0^\infty \frac{2x^2\ \ dx}{x^4 + x^2(a^2-2)+1}\right]$

$= \frac{1}{2}\left[\int_0^\infty \frac{(x^2+1)}{x^4 + x^2(a^2-2)+1} + \int_0^\infty \frac{(x^2-1)}{x^4 + x^2(a^2-2)+1}dx\right]$

$I_1 = \int_0^\infty \frac{x^2+1}{x^4 + x^2(a^2-2)+1}$ divide by x^2 and put $x - \frac{1}{x} = t$

$I_2 = \int_0^\infty \frac{x^2-1}{x^4 + x^2(a^2-2)+1}dx$ divide by x^2 and put $x + \frac{1}{x} = y$

and evaluate

10. (1) Let $\phi(x) = \int_0^x f(t)\,dt, \phi'(x) = f(x)\ \forall\ x \in [0, \infty)$

On differentiating $\frac{1}{2}\int_0^x f^2(t)\,dt = \frac{1}{x}\left[\int_0^x f(t)\,dt\right]^2$

We get $\left(\frac{x\phi'(x)}{\phi(x)}\right)^2 - 4\left(\frac{x\phi'(x)}{\phi(x)}\right) + 2 = 0$

i.e., $\frac{\phi'(x)}{\phi(x)} = \frac{2 \pm \sqrt{2}}{x}$ and on integrating we have

$\phi(x) = c.x^{2\pm\sqrt{2}} \ \Rightarrow\ \phi'(x) = (2 \pm \sqrt{2})c.x^{1\pm\sqrt{2}},\ f(x) = (2 + \sqrt{2})c.x^{1+\sqrt{2}}$

Since $f(x)$ is continuous on $[0,\infty)$ and $f(x) \neq \left(2-\sqrt{2}\right)c.x^{1-\sqrt{2}}$

Since $f(1)=\left(2+\sqrt{2}\right) \Rightarrow c=1$

$$\int_0^1 f(x)dx=\int_0^1 \left(2+\sqrt{2}\right)x^{1+\sqrt{2}}\,dx=1$$

11. $n(S)=5^3=125$

Number of favorable ways.

$\alpha=2,\ \beta=1,\ \gamma=1$

$\alpha=3,\ \beta=1,\ \gamma=2$ (or) $\alpha=3,\ \beta=2,\ \gamma=1$

$\alpha=4,\ \beta=2,\ \gamma=2$ (or) $\alpha=4,\ \beta=1,\ \gamma=3$

(or) $\alpha=4,\ \beta=3,\ \gamma=1$

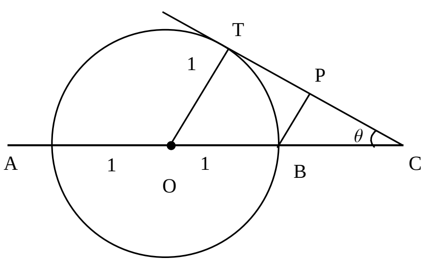
$\alpha=5,\ \beta=2,\ \gamma=3$ (or) $\alpha=5,\ \beta=3,\ \gamma=2$ *or* $\alpha=5,\ \beta=4,\ \gamma=1$

Or $\alpha=5,\ \beta=1,\ \gamma=4$

$\therefore n(E)=10$

$\therefore P(E)={}^{10}\!/_{125}={}^{2}\!/_{25}$

12.



$$\sin\theta=\frac{1}{OC}=\frac{BP}{BC}=1-BP$$

$BP=1-\sin\theta$

$\underline{|ABP}=\frac{\pi}{2}+\theta$

$AP^2=4+(1-\sin\theta)^2+4(1-\sin\theta)\sin\theta$

$=5-3\sin^2\theta+2\sin\theta$

$5-3\left(\sin\theta-\frac{1}{3}\right)^2+\frac{1}{3}\leq\frac{16}{3}$.

$AP\leq\frac{4}{\sqrt{3}}$

13. $|r|=1$

$|p|=|q|$

So, the equation $z^3+|p|z^2+|q|z+|r|=0$

$\Rightarrow (z+1)\left(z^2+(|p|-1)z+1\right)=0$

14. $K_1 = K_4 = K_7 = ... = K_{3n-2} = \frac{\bar{a}+\bar{b}}{\sqrt{2}}$

$K_2 = K_5 = K_8 = ... = K_{3n-1} = \bar{c}$

$K_3 = K_6 = K_9 = ... = K_{3n} = \frac{\bar{b}-\bar{a}}{\sqrt{2}}$

$\therefore \left[\frac{\bar{a}+\bar{b}}{\sqrt{2}}\ \frac{\bar{b}-\bar{a}}{\sqrt{2}}\ \bar{c}\right] = \left(\frac{\bar{a}+\bar{b}}{\sqrt{2}}\right).\left(\frac{\bar{a}+\bar{b}}{\sqrt{2}}\right) = 1$

15. normal at P meets major axis

$G\left(\frac{\left(a^2-b^2\right)\cos\theta}{a}; 0\right)$ and $Q\left(\frac{\left(a^2+b^2\right)\cos\theta}{a}; 2b\sin\theta\right)$

Locus of Q is $\frac{a^2x^2}{\left(a^2+b^2\right)^2} + \frac{y^2}{4b^2} = 1$

$e = \sqrt{1-\frac{12(4)}{49}} = 1/7$ $\qquad \left[\begin{array}{l} e = 1/2 \\ \Rightarrow \frac{b}{a} = \sqrt{3}/2 \end{array}\right]$

16. Then is possible only when $\cos^2\left(\left|\left(\frac{\pi}{4}\right)\left(\sin x + \sqrt{2}\cos^2 x\right)\right|\right) = 1 \qquad (1)$

& $\tan^2\left(\left|x + \frac{\pi}{4}\tan^2 x\right|\right) = 0 \qquad (2)$

Equation (1) $\Rightarrow \frac{\pi}{4}\left(\sin x + \sqrt{2}\cos^2 x\right) = k\pi$

$\Rightarrow \sin x + \sqrt{2}\cos^2 x = 4k$ it is possible only when $k = 0$

$\Rightarrow \sqrt{2}\sin^2 x - \sin x - \sqrt{2} = 0$

$\Rightarrow \sin x = \frac{-1}{\sqrt{2}}, \sqrt{2}$

$\Rightarrow x = 2n\pi - \frac{\pi}{4} \quad (or)\ 2n\pi + \frac{5\pi}{4}$

From equation (2) then only possible solution is $x = 2n\pi - \frac{\pi}{4}$

$\therefore$ Number of solutions is 2

17. a) $p = \dfrac{1 + \frac{9}{10} + \frac{9^2}{10^2} + ... + \frac{9^{999}}{10^{999}}}{10 - 9.\left(\frac{9}{10}\right)^{999}}$

p=1

b) $\boldsymbol{\cos}\left(\boldsymbol{\cos} x - \boldsymbol{\sin} x\right) = \boldsymbol{\cos}\left(\frac{\pi}{2} - \left(\boldsymbol{\sin} x + \boldsymbol{\cos} x\right)\right)$

$$\cos x - \sin x = 2n\pi \pm \left(\frac{\pi}{2} - \sin x - \cos x\right)$$

$$\cos x = n\pi + \frac{\pi}{4} \Rightarrow \cos x = \frac{\pi}{4}$$

$$\Rightarrow \sin x = \frac{\sqrt{16-\pi^2}}{4}$$

(or) $\sin x = \frac{\pi}{4}$

c) discontinuity points are $-4, -3, -2, +1, 3, 4$

d) $\left(a^2 - 2y\right)^2 = 4y^2 - 4x^2$

$$4a^2 \frac{dy}{dx} = 8x$$

$$\frac{d^2y}{dx^2} = \frac{2}{a^2}$$

18.a) $x^2(1-c) + x(a-c) + (b-c) = 0$

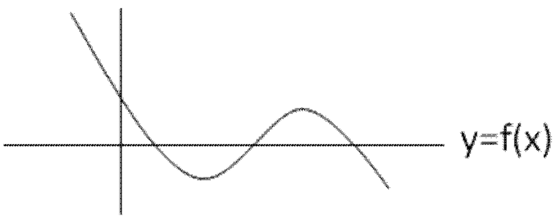
Is an identity $\Rightarrow c = 1$

$a = 1$

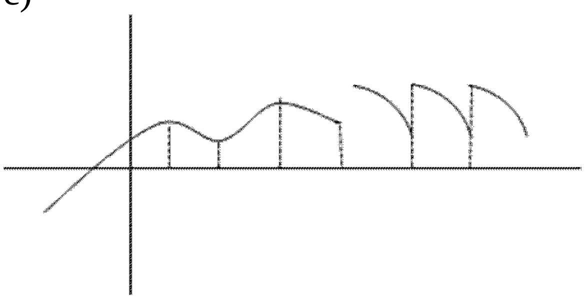
$b = 1$

$\therefore a + b + c = 3$

b) according to the conditions all the roots of $f(x) = 0$ are to be +ve



c)

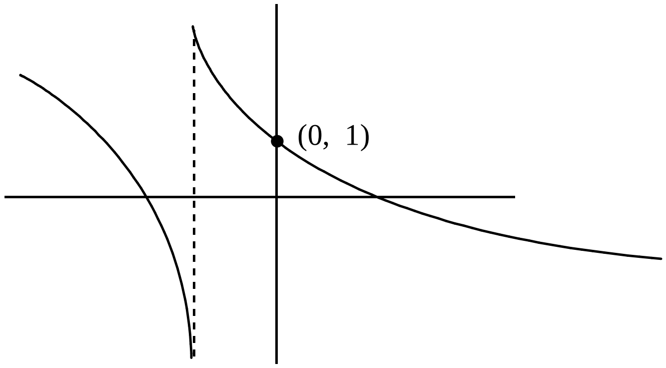


d)

19. a) If line cuts the graph at 6 points then using LMVT there exists atleast 5 points where $f'(x) = p$ (slope of the line)

$\therefore$ using Rolle’s theorem there exists atleast 4 points where $f''(x) = 0$

b)

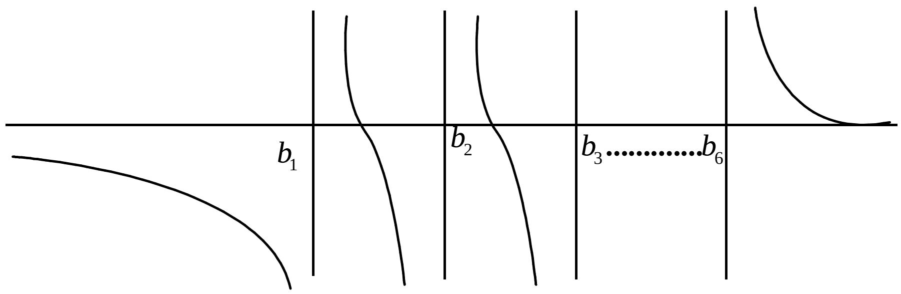


$f'(x) < 0 \ \forall x$ & $\underset{x \to -1^+}{Lt} f(x) = -\infty$, $\underset{x \to -1^-}{Lt} f(x) = \infty$ also as $x \to \infty, f(x) \to -\infty$ and $x \to -\infty, f(x) \to \infty$

$\Rightarrow f(x) = 0$ has one $+ve$ root & one $-ve$ root

c)

y = -c



$f(x) = \sum_{i=1}^{6} \frac{a_i^2}{x - b_i} - c = 0$, $f'(x) = -\left[\sum_{i=1}^{6} \frac{a_i^2}{(x - b_i)^2}\right]$

d) $|B| = |A|^2$

20. a) $e_e = \frac{1}{\sqrt{2}}, e_h = \sqrt{2}$

$x^2 + 2y^2 = p^2$

$x^2 - y^2 = \frac{p^2}{2}$

$\frac{9x^2}{y^2} = 36$

b) $x_1 = 2R\cos A$

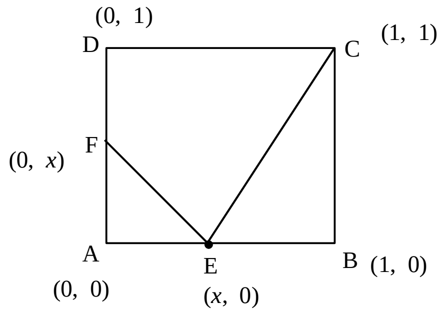
$a = 2R\sin A$

$\frac{dx_1}{da} = -\tan A$

$\Rightarrow -\tan A + (-\tan B) + (-\tan C) \le -3\sqrt{3}$

$\Rightarrow \sqrt{3}\left(\frac{dx_1}{da} + \frac{dy_1}{db} + \frac{dz_1}{dc}\right) + 15 \le 6$

c)

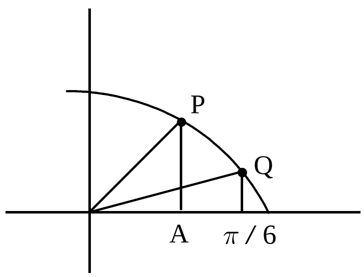


Area $CDFE = 1 - \frac{x^2}{2} - \left(\frac{1-x}{2}\right) = A$

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

"A" is maximum when $x = \frac{1}{2}$ and $A_{max} = \frac{5}{8}$

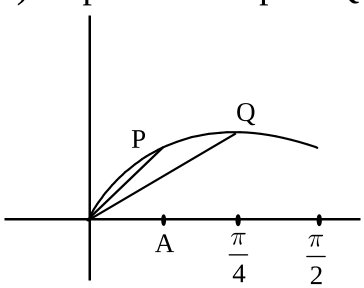
d) i)



Slope of OP > slope OQ

$A \sec A < \frac{\pi}{3\sqrt{3}}$

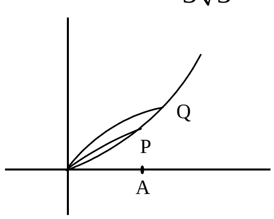
ii) slope OP > slope OQ



$\Rightarrow A \operatorname{cosec} A < \frac{\pi}{2\sqrt{2}}$

iii) slope OQ > slope OP

$\Rightarrow A \cot A > \frac{\pi}{3\sqrt{3}}$



PHYSICS

21. When particle passes through point 2 shown speed is zero and speed is maximum when particle passes through point 4. Frame of trolly in identical and continuously in trolly frame particle is performing uniform circular motion. $T=\frac{mv^2}{l}$; at all the position

22. Slope dy/dx is zero instantaneously that's why instantaneous power transfer in both case is zero. At point 'B' slope remains zero all the time.

23. $P_0V_1 = 2R(200)$ - (I)

$P_0V_1^1 = 2R(300)$ - (II)

$P_0V_2 = 1R(500)$ - (III)

$P_0V_2^1 = 1R(300)$ - (IV)

During process pressure of two gas compartment remains same equals to atmospheric

$V_1+V_2 = V_1^1+V_2^1$; work done by two gas system on surrounding is zero. Net heat trasnfered to gas in compartment $1 = W+\Delta V = 500\,RJ$

24. liq and glass contact angle is accute, so combination is wetting. In gravity free space system will attain least P.E. surface energy of glass, liq and vapour system will be become least.

25. $\rightarrow AR = A+2A\sin 45^0$

$= A\left(1+\sqrt{2}\right)$

$\rightarrow$ Phase of resulting motion differs with both by 1st and last by $\pi/4$

$\rightarrow$ Energy of resultant S.H.M=$\frac{1}{2}mw^2A^2\left(1+\sqrt{2}\right)^2$

26. Density of block = $\frac{1}{3\times10^{-4}}kg/m^3 = \frac{10}{3}\times10^3\,kg/m^3$

Buoyant force B = $3 \times 10^{-4} \times 10^3 \times g = 3$ N

$\therefore$ $T_B = 10 - 3 = 7$ N

Reading of B = 14 + 3 = 17 N

Reading of C = {14 + (10 – 3) + 3}N = 24 N

27. capacitance of system is increased. Charge supplied by battery increases. Potential difference across A is increased.

28. CONCEPTUAL

29. Geometrical path 'd' is equivalent to $d/2$ is medium. At high temp $(T_H = 4T_{Low})$.

So $\frac{d}{2}=\frac{\lambda}{2}=\frac{V}{f}$.

$f_{\min} = 4\,Hz$

30. Very close to conductor at out side point electric field will be perpendicular and always equal to $\frac{\delta}{\varepsilon_0}$; where δ is charge density at that point.

31. When the frame has turned through at angle □,

$\Phi = BA\cos\theta$

where $A = \int_0^y 2x dy = \frac{2}{\sqrt{k}}\int_0^y \sqrt{y}\, dy = \frac{4}{3\sqrt{k}} y^{3/2}$

Since $y = \frac{1}{2}at^2$

$\therefore \Phi = \frac{B}{3}\sqrt{\frac{2}{K}} a^{3/2} t^3 \cos\theta$

By Faraday's law, $E_{ind} = \frac{d\Phi}{dt}$

or $E_{ind} = \frac{Ba^{3/2}}{3}\sqrt{\frac{2}{K}}\left[t^3 \sin\theta\left(\frac{d\theta}{dt}\right) - 3t^2\cos\theta\right]$

When the frame turns through □/4,

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

$R = \lambda 2x = \lambda.2\sqrt{\frac{y}{k}} = \frac{2\lambda}{\sqrt{k}}\sqrt{\frac{a}{2}}t = \sqrt{\frac{2a}{k}}\frac{\lambda\pi}{4\omega}$

$I = \frac{E_{ind}}{R} = \frac{\pi^2(\pi - 12)Ba^{3/2}\sqrt{k}\ \ 4\omega}{192\omega^2\sqrt{k}\sqrt{2a}\ \ \pi\lambda} = \frac{Ba\pi(\pi - 12)}{48\sqrt{2}\ \omega\lambda}$

32. let time taken to hit OB are t_1 & t_2 respectively $a = \frac{1}{2}g\cos\theta\, t_1^2$ $b = \frac{1}{2}g\tan\theta\, t_1^2$ $\frac{t_1}{t_2} = 4$.

33. Relative to 'A' , 'C' goes down with speed 4 m/s. ground frame speed of $c = \sqrt{4^2 + 3^2} = 5\ m/s$.

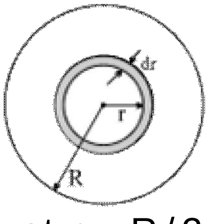
34. $\rho = \alpha r^2$ [where α is a constant]

Charge in the shell (element)

$dq = \rho(4\pi r^2 dr) = \alpha(4\pi)r^4 dr$

$\therefore$ Charge enclosed in sphere of radius r, $q = 4\pi\alpha\int_0^r r^4 dr = \frac{4\pi\alpha r^5}{5}$

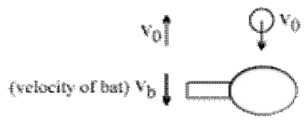
By Gauss's theorem,



at r = R/2

Total charge enclosed, Q = $\frac{4\pi\alpha R^5}{5}$

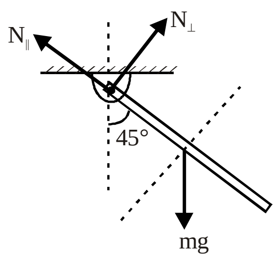
35. Velocity of ball just before striking the bat $v_0 = \sqrt{2gh}$



e = $\frac{v_0 - v_b}{v_0 + v_b}$ $\Rightarrow v_b = \frac{v_0(1-e)}{1+e} = \sqrt{2gh}\frac{(1-e)}{1+e} = 1$

36. $\tau = I\alpha$

mg sin 45° × $\frac{\ell}{2} = \frac{m\ell^2}{3}\alpha$



$\Rightarrow \alpha = \frac{3g}{2\sqrt{2}\ell}$

tangential acceleration of centre of mass (a_t) = $\alpha \times \frac{\ell}{2} = \frac{3g}{4\sqrt{2}}$

radial acceleration of centre of mass (a_r) = $\frac{m\omega^2\ell}{2}$ = 0 (initially ω is 0)

net hing force $\sqrt{N_{\perp}^2 + N_{\parallel}^2} = mg\frac{\sqrt{17}}{4\sqrt{2}} \Rightarrow \sqrt{34}$ = 5.83 = 6 (rounded of to nearest integer)

38. (A) and (B) B is displacement node

$\Rightarrow$ a = 0, v = 0 and E = 0 and deformation maximum $\Rightarrow$ PE max.

(D) B is displacement antinods $\Rightarrow$ a = max, KE = 0, PE = 0, V = 0

40. a) in case of β-decay continuous energy distribution is obtained (with out any peak)

b) in γ-decay energy distribution will be discreate

c) continuous distribution with dark line in between

d) continuous distribution with peak

CHEMISTRY

41. B

Sol: CH_3Cl is formed by SN_2 while $CH_3CHClC_2H_5$ is formed by SNi.

42. AC

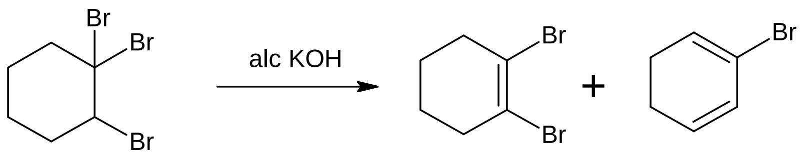
Sol: gold sol is obtained from $AuCl_3$ by reduction while $FeCl_3$ is hydrolysed to obtain ferric hydroxide sol

Spondumene is simple chain silicate

$Na_2S_2O_3.5H_2O \xrightarrow{\Delta} Na_2S_5 + Na_2SO_4 + H_2O$

43. B

44. BC



45. ABCD

It is an example of Sulphonation of aromatic ring; B is perchlorate and C is hydronium ion

46. AD

Diazotization of aniline happens at a pH of around 6

B and C have pH above 7

47. AC

Eq of ferrous oxalate used for excess acid=2X1.5X3=9meq

Eq of excess H_2SO_4 (n_f =6)=9

Eq of H_2SO_4 added for ammonia released from salt=3X2X2=12 (n_f=2)

Eq of excess H_2SO_4 with n_f 2 = 9X2/6=3meq

Eq of H_2SO_4 used up for NH_3 = 12-3 = 9

Meq of ammonia in 1L=9X4=36

So W of ammonium chloride = 0.036X53.5=1.926g

%purity=19.26

48. ABCD

Integer:

49. 2

Sol: $\pi = CRT \times i$

hence i = 1.1; so $\alpha = 0.1$

and [H+] = c α = 0.1 x 0.1 = 10^{-2} M
pH = 2

50. 2
Sol: $BaCrO_4$ – Yellow, soluble in dil HNO_3
Hg_2CrO_4 – Red, soluble in conc. HNO_3
ZnS – White, soluble in Conc. HNO_3
$BaSO_4$ – White, insoluble in all mineral acids
CH_3COOAg and $AgNO_2$ all are white solid and are soluble in dilute HNO_3 solution

51. 4
sol: Let x% be the decrease in density of Ge crystals. Let 'a' be the total no. of Ge atoms missing and 'b' be the no. of boron atoms replacing Ge atoms.

$$\frac{b}{a}\times 100 = 2.376 \qquad ....(i)$$

$$1-\frac{72.6a}{N_{AV}}+\left(\frac{11b}{N_{AV}}\right)=1-0.01x$$

$$\frac{72.6a}{N_{AV}}-\frac{11b}{N_{AV}}=0.01x \qquad ....(ii)$$

Also, $b=\frac{150\,N_{AV}}{10^6\times 11}\times(1-0.01x)$ ....(iii)

$\therefore$ Solving (i), (ii) and (iii)
X = 4%

52. 2

53: 5
Sol:

$$PCl_3+3H_2O\rightarrow H_3PO_3+3HCl$$

Number of moles required to neutralise $H_3PO_3=2$
Number of moles required to neutralise HCl = 3
Total number of moles of NaOH required to neutralise the solution = 5

54. 0

55. 8
Sol: 1st titration
Meq. Of $NaOH\frac{1}{2}+Meq.of\ Na_2CO_3=Meq.\ of\ HCl=50\times\frac{1}{10}=5$
2nd titration

$\frac{1}{2} Meq.of\ Na_2CO_3 = Meq.\ of\ HCl = 10 \times \frac{1}{10} = 1$

$\therefore$Meq. Of NaOH = 5-1 = 4

Wt. of NaOH $= \frac{Meq.of\ NaOH \times Equivalent\ weight}{1000}$

$= \frac{4 \times 40}{1000}$

= 0.16 g

56. 7

Matrix matching:

57. (A $\rightarrow$p, q, s), (B $\rightarrow$ r, s), (C $\rightarrow$ q), (D $\rightarrow$ r, s)

58. A $\rightarrow$ p; B $\rightarrow$ p; C $\rightarrow$ q,s ; D $\rightarrow$ pr

Mn has 6 oxides; MnO, Mn_2O_3, MnO_2, MnO_3, Mn_2O_7, Mn_3O_4

59. A-S; B-R; C-Q; D-P

60. A-RS; B-S; C-S; D-PQ

B shows cation frenkel defect

C shows anion frenkel defect