From Long Term Classroom Programs and Medium / Short Classroom Program 4 in Top 10, 10 in Top 20, 43 in Top 100, 75 in Top 200, 159 in Top 500 Ranks & 3542 total selections in IIT-JEE 2012

ALL INDIA TEST SERIES

FIITJEE

JEE (Advanced), 2013

CONCEPT RECAPITULATION TEST
(Set – III)

Paper 2

Time Allotted: 3 Hours **Maximum Marks: 240**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

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-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into three sections: **Section-A, Section-B & Section–C**.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. 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 black pen for each character of your Enrolment No. and write 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 Three Parts.

(i) **Section-A (01 – 08)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (09 – 12) contains 4 multiple choice questions which have more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

(ii) **Section-B (01 – 02)** contains 2 Matrix Match Type questions containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+8 marks** for all correct answer. For each correct row **+2 marks** will be awarded. There may be one or more than one correct choice. No marks will be given for any wrong match in any question. There is no negative marking.

(iii) **Section-C (01 – 06)** contains 6 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer. There is no negative marking.

Name of the Candidate	
Enrolment No.	

Useful Data

PHYSICS

Acceleration due to gravity	$g = 10\ m/s^2$
Planck constant	$h = 6.6 \times 10^{-34}$ J-s
Charge of electron	$e = 1.6 \times 10^{-19}$ C
Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$
Density of water	$\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure	$P_a = 10^5\ N/m^2$
Gas constant	$R = 8.314\ J\ K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	0.0821 Lit atm $K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2$ Cal $K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's constant	h	=	6.625×10^{-34} J·s
		=	6.625×10^{-27} erg·s
1 Faraday		=	96500 coulomb
1 calorie		=	4.2 joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

Atomic masses: H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108, Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.

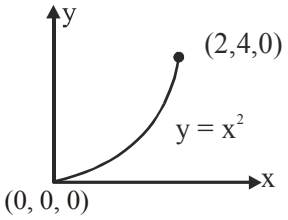
Physics PART – I

SECTION – A

Single Correct Choice Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. A force $\vec{F} = (3xy - 5z)\hat{j} + 4z\hat{k}$ is applied on a particle. The work done by the force when the particle moves from the point (0,0,0) to the point (2,4,0) as shown in the figure is



(A) $\frac{280}{5}$ (B) $\frac{140}{5}$

(C) $\frac{232}{5}$ (D) $\frac{192}{5}$

2. A standing wave is produced in a vapour of an element of atomic mass 127 (g mol^{-1}) at 400 K. Nodes are found to be 6.77 cm apart when frequency of source was 1000 Hz. The vapour used for the experiment is (R = 8.31 $JK^{-1}mol^{-1}$)

(A) monatomic (B) diatomic

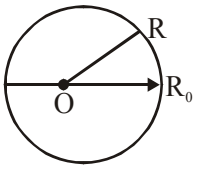
(C) polyatomic (D) can not determine

3. A uniform rod of length 2ℓ is suspended about one of its ends. The time period of oscillation for small angular displacements is

(A) $2\pi\sqrt{\frac{3\ell}{2g}}$ (B) $2\pi\sqrt{\frac{2\ell}{3g}}$

(C) $4\pi\sqrt{\frac{\ell}{3g}}$ (D) $\pi\sqrt{\frac{3\ell}{g}}$

4. A particle is rotating about a vertical axis in the horizontal plane such that the angular velocity of the particle about the axis is constant and is equal to 1 rad/s. Distance of the particle from axis is given by R = R_0- βt where t stands for time. The speed of the particle as a function of time is

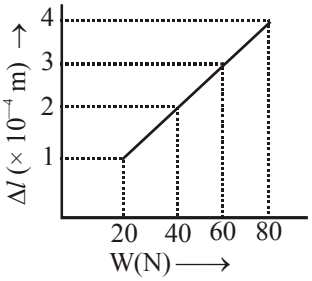


(A) $\sqrt{\beta^2 + 1}$ (B) $(R_0 - \beta t)$

(C) $\sqrt{\beta^2 + (R_0 - \beta t)^2}$ (D) β

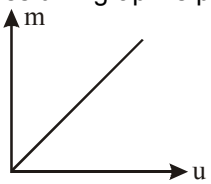
Rough work

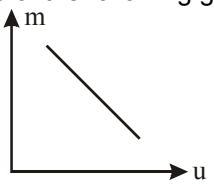
5. The graph shows the extension (Δl) of a wire of length 1 m suspended from the top of a roof at one end and with a load W connected to the other end. If the cross-sectional area of the wire is 10^{-6} m^2, calculate the Young's modulus (i.e., Y) of the material of the wire is S.I. units

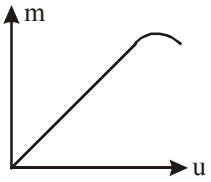


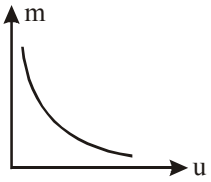
(A) 2×10^6 N/m^2 (B) 5×10^6 N/m^2
(C) 2×10^{11} N/m^2 (D) 5×10^{11} N/m^2

6. The magnification (m) of the real image formed by a convex lens is measured for various object distances u. A graph is plotted between m and u. Which one of the following graph is correct ?

(A) 

(B) 

(C) 

(D) 

7. Moseley's law for characteristic X-rays is $\sqrt{\nu} = a(Z - b)$. In this,
(A) both a and b are independent of the material
(B) a is independent but b depends on the material
(C) b is independent but a depends on the material
(D) both a and b depend on the material

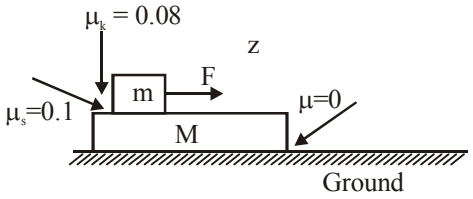
8. A circular coil has 10 turns with an effective radius of 0.5 m and carries a current of 2 amp through it. It is kept in a magnetic field perpendicular to its plane initially, with $\vec{B}$ = 4 Wb/m^2. The amount of work done to turn it by 60° is
(A) 10 π J (B) 5π J
(C) π J (D) – 5πJ

Rough work

Multiple Correct Answer(s) Type

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct**.

9. In the figure, if F = 4 N, m = 2kg, M = 4 kg then



(A) the acceleration of m w.r.t. ground is $\frac{2}{3} m/s^2$

(B) the acceleration of m w.r.t. ground is 1.2 m/s^2

(C) acceleration of M is 0.4 m/s^2

(D) acceleration of m w.r.t. ground is $\frac{2}{3} m/s^2$

10. Velocity of a particle of mass 2 kg changes from $\vec{v}_1 = -2\hat{i} - 2\hat{j}$ m/s to $\vec{v}_2 = (\hat{i} - \hat{j})$ m/s after colliding with a plane surface

(A) the angle made by the plane surface with the positive x–axis is $90^\circ + \tan^{-1}\left(\frac{1}{3}\right)$

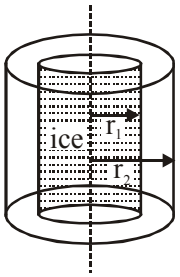
(B) the angle made by the plane surface with the positive x–axis is $\tan^{-1}\left(\frac{1}{3}\right)$

(C) the direction of change in momentum makes an angle $\tan^{-1}\left(\frac{1}{3}\right)$ with the +ve x–axis

(D) the direction of change in momentum makes an angle $90^\circ + \tan^{-1}\left(\frac{1}{3}\right)$ with the plane surface

Rough work

11. A 100 cm long cylindrical flask with inner and outer diameters 2 cm and 4 cm respectively is completely filled with ice as shown in the figure. The constant temperature outside the flask is 40ºC. (Thermal conductivity of the flask is 0.693 W/mºC, L_{ice} = 80 cal/gm).



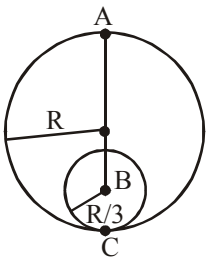
(A) Rate of heat flow from outside to the flask is 80π J/s.

(B) The rate at which ice melts is $\frac{\pi}{4200}$ Kg / s .

(C) The rate at which ice melts is 100π Kg/s.

(D) Rate of heat flow from outside to flask is 40 π J/s.

12. Inside a uniform sphere of mass M and radius R, a cavity of radius R/3 is made in the sphere as shown.



(A) Gravitational field inside the cavity is uniform.

(B) Gravitational field inside the cavity is non–uniform.

(C) The escape velocity of a particle projected from point A is $\sqrt{\frac{88GM}{45R}}$.

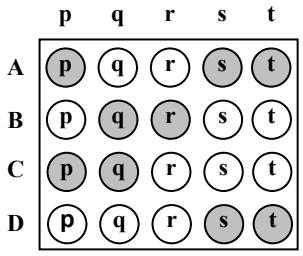
(D) Escape velocity is defined for earth and particle system only.

Rough work

SECTION – B

Matrix – Match Type

*This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II.** The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:*
If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following:

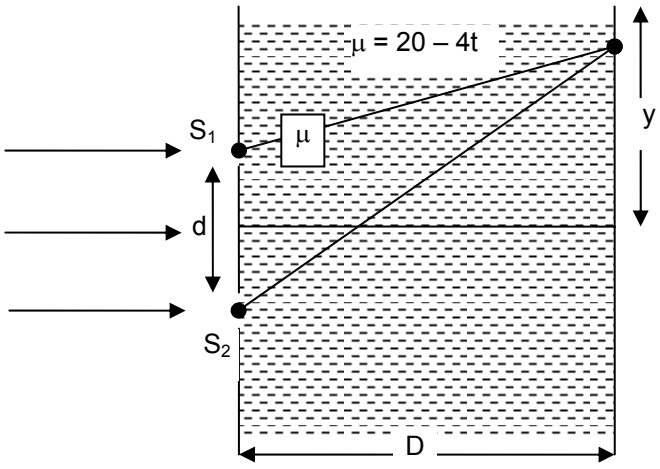


1. A particle with charge Q is moving in fields of combination given below. Then match the following

Column – I	Column – II
(A) Uniform $\vec{E}$ only	(p) A trajectory of charge particle may be straight line
(B) Uniform $\vec{B}$ only	(q) A trajectory of charge particle may be Parabola
(C) Uniform $\vec{E}$ and Uniform $\vec{B}$ parallel to each other	(r) A trajectory of charge particle may be non uniform right circular cylindrical helix
(D) Uniform $\vec{E}$ and Uniform $\vec{B}$ perpendicular to each other	(s) A trajectory of charge particle may be uniform right circular cylindrical helix
	(t) K.E. of charge particle can not be constant

Rough work

2. A parallel beam of monochromatic light of wavelength λ = 100(Å) is incident on the slits separated by distance d = 2mm. There is a screen at a distance D = 1m from slit. If R.I. of the medium between slits and screen is varying with time as μ = 20 – 4t until it becomes 1. A glass slab of R.I. μ = 5 and thickness 0.2 mm is placed infront of one of the slit S_1 as shown in figure. In figure y represent position of central maxima on the screen from its geometrical centre. Then match the column I with column-II with suitable option(s)



Column – I	Column – II
(A) At t = 0, value of |y| in (cm)	(p) 40
(B) At t = 5s value of |y| (in cm)	(q) 7.5
(C) Speed of central maxima when it is at geometrical centre of screen (in cm/s)	(r) 1
(D) Fringe width at time t = 3.75 sec (μm)	(s) 8
	(t) 12

Rough work

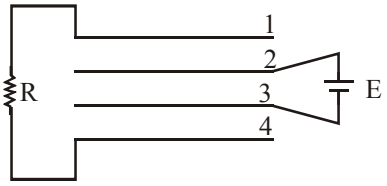
SECTION – C

Integer Answer Type

This section contains **6 questions.** The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

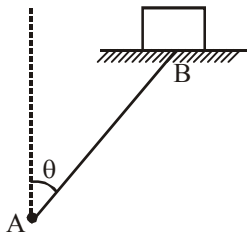
1. A small block of mass 1 kg is moving with constant speed of 10 m/s on a typical path in a x – y vertical plane whose equation is $y = \frac{x^3}{30} - \frac{x^2}{10}$. The coefficient of friction between the block and path is 0.01. Find the magnitude of power dissipated by frictional force in watt at x = 2 m?

2. Four metallic plates, each having a surface area of one side A, are placed at a distance D from each other. The plates are connected as shown in the figure. Find the ratio of the field strength between plates 2 and 3 and that between plates 1 and 2.
Given R = 3Ω, E = 72V,
D = 0.1 mm, A = 4 m^2



Rough work

3. A rod AB of length 2 m is hinged at point A and it's other and B is attached to a platform on which a block of man m is kept. Rod rotates about point A maintaining angle $\theta = 30^\circ$ with the vertical in such a way that platform remains horizontal and revolves on the horizontal circular path. If the coefficient of static friction between the block and platform is $\mu = 0.1$ than find the maximum angular velocity in rad/s of rod so that block does not slip on the platform. [g = 10 m/s^2]



4. A current i flows in a rectangular wire whose centre lies at (x_0, 0, 0) and whose vertices are located at the points A (x_0 + d, –a, –b), B (x_0 – d, a, – b), C (x_0 – d, a, +b) and D (x_0 + d, –a, +b) respectively. Assume that a, b, d << x_0. Find the magnitude of magnetic dipole moment vector of the rectangular wire frame in Tesla. (Given b = 10 m, i = 0.01 A, d = 4 m, a = 3 m)

5. A tritium gas target is bombarded with a beam of monoenergetic protons of kinetic energy K_1 = 3 MeV. The K.E. of the neutron emitted at 30º to the incident beam is K_2? Find the value of K_1/K_2 (approximately in whole number). Atomic masses are
   H^1 = 1.007276 amu
   n^1 = 1.008665 amu
   $_1H^3$ = 3.016050 amu
   $_2He^3$ = 3.016030 amu.

6. A cylinder of mass M radius R is resting on a horizontal platform (which is parallel to x–y plane) with its axis fixed along the y–axis and free to rotate about its axis. The platform is given a motion in X–direction given by X = A cos wt. There is sufficient friction present in the surface of contact that can prevent the slipping between the cylinder and platform. The minimum torque in N-m acting on the cylinder during its motion is.
   [take M = 4 kg , R = 1m, A = 2m, ω = 1 rad/s]

Rough work

Chemistry

PART – II

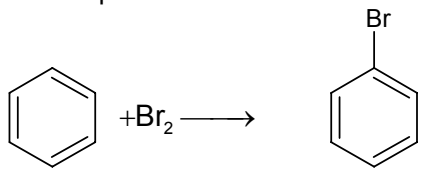
SECTION – A

Straight Objective Type

This section contains 8 multiple choice questions numbered 1 to 8. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. 'D' is vapour density of PCl_5 at initial stage and 'd' is the vapour density of the equilibrium mixture and α is the degree of dissociation (taking temperature as constant), which is the correct statement
   (A) The vapor density of the mixture is increasing until the equilibrium is achieved.
   (B) The 'd' can be changed by performing the experiment with different initial concentration of PCl_5.
   (C) The vapor density 'd' of the mixture is dependent of temperature .
   (D) The vapor density of the mixture is increasing until the equilibrium is achieved and after it, it does not change.

2. In electrophilic aromatic substitution



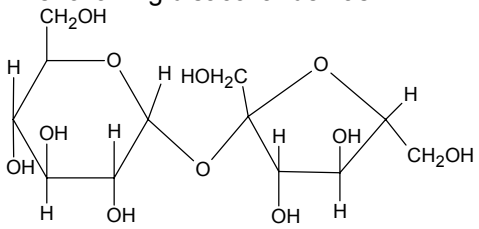
   (A) This reaction can be catalysed by Lewis acid
   (B) This reaction can be catalysed by presence of light
   (C) Both (A) and (B) are correct
   (D) none of these

3. Water is saturated with CO_2, then the fraction of CO_3^{2-} in H_2CO_3, HCO_3^-, and CO_3^{2-} at pH = 5, is $\left[K_{a_1} = 10^{-4}, K_{a_2} = 10^{-7}\right]$
   (A) 0.01 (B) 0.35
   (C) 0.05 (D) none of these

4. The charge of the blast furnace in the extraction of iron is a mixture of oxide ore, coke and 'Y', the 'Y' will be
   (A) Silica (B) Dolomite
   (C) MgO (D) Limestone

Rough Work

5. The following disaccharide has



(A) It has α-Glucosidic linkage and β-fructosidic linkage
(B) It has β -Glucosidic linkage and β-fructosidic linkage
(C) It has α-Glucosidic linkage and α -fructosidic linkage
(D) It has β -Glucosidic linkage and α -fructosidic linkage

6. The temperature coefficient (for E^0) of a cell is –ve.
$Cu^{2+} + H_2 \longrightarrow 2H^+ + Cu$, which is incorrect

(A) on increasing temperature, $E^0_{Cu^{+2}/Cu}$ will decrease.

(B) on increasing temperature, $E^0_{H^+/H_2}$ may decrease or increase.

(C) E^0 of the cell is effected by changing the temperature.
(D) E of the cell can be effected by changing the pH.

7. 30.11×10^{22} unit cells of K_2S is dissolved in 10L water. K_2S has antifluorite structure. The freezing point of the solution becomes
[K_f of water is 1.86°C Kg mol^{-1}, $T_{f,}H_2O$=273.15]
(A) 272.78 K (B) 272.034 K
(C) 272.87 K (D) 272.9 K

8. For the electrolysis, the following reactions are taking places at different electrodes;
At cathode $MPO_4(s) + 3e^- \longrightarrow PO_4^{3-} + M(s)$

At anode $MPO_4(s) + 2H_2O \longrightarrow MO_2(s) + PO_4^{3-}(s) + 4H^+ + e^-$

How much charge is required to form 4 mole of MPO_4?
(A) 3F (B) 1.5F
(C) 2F (D) 6F

Rough Work

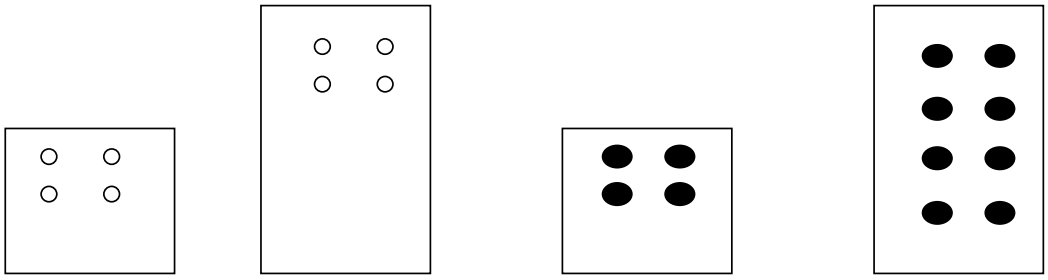
Multiple Correct Choice Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out which **ONE OR MORE** is/are correct.

9. Which is true regarding colloidal solution?
   (A) The boiling point of colloidal solution is smaller than the true solution under similar conditions.
   (B) Colloidal particles can be coagulated by electrophoresis.
   (C) Brownian movement is shown by colloidal particles.
   (D) Sodium salt of fatty acids forms colloids at higher concentration.

10. Which of the following process occurs at interface?
   (A) adsorption (B) heterogeneous catalyses
   (C) homogeneous catalyses (D) corrosion

11. There are four containers. Bigger container has the volume double than that of smaller container. Two types of gases are present, gas A(●) has 20amu and gas B(○) has 40 amu. If the gasses (A) and (B) are filled in the containers as shown below. Which of the following is/ are correct (P=pressure, d=density)



(All are at same temperature,I and III has volume V and II and IV has volume 2V)

   (A) $P_{II} < P_{IV} = P_I = P_{III}$ (B) $(Av.\ KE)_I = (Av.\ KE)_{II} = (Av.\ KE)_{III} = (Av.\ KE)_{IV}$
   (C) $d_{II} < d_I < d_{IV} = d_{III}$ (D) $(RMS)_I = (RMS)_{II} = (RMS)_{III} = (RMS)_{IV}$

12. Which is not correct?
   (A) energy of 1s for Li < energy of 2s for Li (B) shape of all d-orbitals are same
   (C) energy of 3d < energy of 4s (D) energy of 4s < energy of 3d

Rough Work

SECTION-B
(Matrix Type)

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II.** The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:

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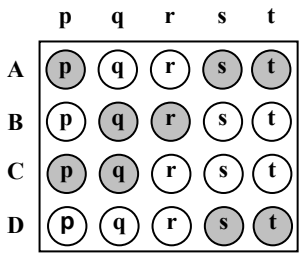
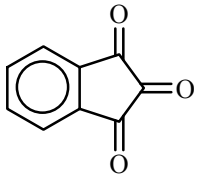
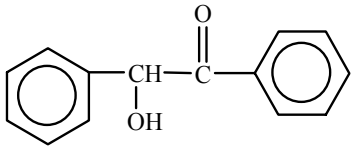
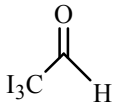
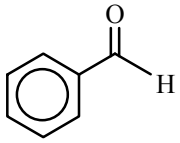


1. Match the following column:

Column-I		Column-II	
(A)		(p)	Positive test with 2, 4-dinitrophenyl hydrazine
(B)		(q)	Positive Tollen's test
(C)		(r)	Positive Fehling Solution Test
(D)		(s)	Form highly stable hydrate
		(t)	Perkin Reaction

2. Match the following

Column – I		Column – II	
(A)	20ml of 0.1 M CH_3COOH + 50 ml of 0.1 M NaOH	(p)	pH > 7
(B)	20 ml of 0.1 M NH_4OH + 50 ml of 0.1 M CH_3COOH	(q)	pH < 7
(C)	50 ml of 0.1 M NaOH + 50 ml of 0.1 M CH_3COOH	(r)	Phenolphthalein is suitable indicator
(D)	20 ml of 0.1 M NH_4OH + 20 ml of 0.1 M H_2SO_4	(s)	Methyl orange is suitable indicator
		(t)	pH = 7

Rough Work

SECTION – C

Integer Answer Type

This section contains **6 questions.** The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

1. 6.4 gm CH_3OH was placed in a 1 lt flask and heated to 250°C to vaporize the methanol. At 250°C, methanol vapour decomposed by

   $CH_3OH(g) \rightleftharpoons CO(g) + 2H_2(g)$

   After the system has reached equilibrium a tiny hole is drilled in the side of the flask allowing gaseous compounds to effuse out of the flask. It was seen that H_2 was effused $2\sqrt{2}$ times faster that of equilibrium mixture. The 100Kc for this reaction at 25°C is

2. The number of oxygen atom/s shared by SiO_4 units in $Sc_2Si_2O_7$ is/are

3. Lactic acid on dehydration forms lactide. The number stereoisomer of lactide is/are

4. $CH_2 = C = CH_2 \xrightarrow{H^+/H_2O}$ P. The number of lone pairs in P is

5. In $Fe_2(CO)_9$, the co–ordination number of Fe is

6. ΔH_f of Hg_2Cl_2 and HgCl are –125 and –640 kj/ mole. The enthalpy of disproportionation of Hg_2Cl_2 is –103 x kj/ mol. Find the value of x.

Rough Work

Mathematics PART – III

SECTION – A

Single Correct Choice Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. Suppose f, f′ and f″ are continuous on [0, e] and f′(e) = f(e) = f(1) = 1 and $\int_1^e \frac{f(x)}{x^2}dx = \frac{1}{2}$, then the value of $\int_1^e f''(x)\ln x\,dx$ equals

(A) $\frac{5}{2}-\frac{1}{e}$ (B) $\frac{3}{2}-\frac{1}{e}$

(C) $\frac{1}{2}-\frac{1}{e}$ (D) $1-\frac{1}{e}$

2. Let A = $\begin{bmatrix} a & b & c \\ p & q & r \\ x & y & z \end{bmatrix}$ and suppose that det. (A) = 2 then the det. (B) equals, where B = $\begin{bmatrix} 4x & 2a & -p \\ 4y & 2b & -q \\ 4z & 2c & -r \end{bmatrix}$

(A) det(B) = –2 (B) det(B) = –8

(C) det(B) = –16 (D) det(B) = 8

3. Let f be a real valued function of real and positive argument such that $f(x)+3xf\left(\frac{1}{x}\right)=2(x+1)$ for all real x > 0. The value of f(10099) is

(A) 550 (B) 505

(C) 5050 (D) 10010

Rough work

4. The equation $(x-1)(x-2)(x-3) = 24$ has the real root equal to 'a' and the complex roots b and c. Then the value of $\frac{bc}{a}$, is

(A) $\frac{1}{5}$ (B) $-\frac{1}{5}$

(C) $\frac{6}{5}$ (D) $-\frac{6}{5}$

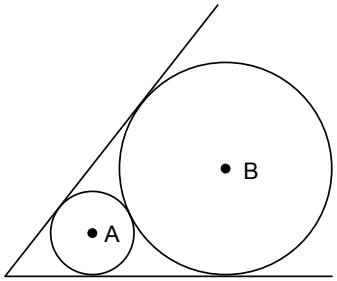
5. A circle with centre A and radius 7 is tangent to the sides of an angle of 60°. A larger circle with centre B is tangent to the sides of the angle and to the first circle. The radius of the larger circle is

(A) $30\sqrt{3}$

(B) 21

(C) $20\sqrt{3}$

(D) 30



6. Consider straight line $ax + by = c$ where $a, b, c \in R^+$ and a, b, c are distinct. This line meets the coordinates axes at P and Q respectively. If area of ΔOPQ, 'O' being origin does not depend upon a, b and c then

(A) a, b, c are in G.P. (B) a, c, b are in G.P.

(C) a, b, c are in A.P. (D) a, c, b are in A.P.

7. Let $C_n = \int_{\frac{1}{n+1}}^{1/n} \frac{\tan^{-1}(nx)}{\sin^{-1}(nx)} dx$, then $\lim_{n\to\infty} n^2 \cdot C_n$ equals

(A) 1 (B) 0

(C) -1 (D) $\frac{1}{2}$

8. Suppose that the domain of the function f(x) is set D and the range is the set R, where D and R are the subsets of real numbers. Consider the functions: f(2x), f(x + 2), 2f(x), $f\left(\frac{x}{2}\right), \frac{f(x)}{2} - 2$. If m is the number of functions listed above that must have the same domain as f and n is the number of functions that must have the same range as f(x), then the ordered pair (m, n) is

(A) (1, 5) (B) (2, 3)

(C) (3, 2) (D) (3, 3)

Rough work

Multiple Correct Answer(s) Type

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct**.

9. An equilateral triangle ABC has its centroid at the origin and the base BC lies along the line x + y = 1

(A) Area of the equilateral ΔABC is $\frac{3\sqrt{3}}{2}$

(B) Area of the equilateral ΔABC is $\frac{3\sqrt{3}}{4}$

(C) Gradient of the other two lines are $2+\sqrt{3}$, $2-\sqrt{3}$

(D) Gradient of the other two lines are $\sqrt{2}+1$, $\sqrt{2}-1$

10. In which of the following cases limit exists at the indicated points

(A) $f(x)=\frac{[x+|x|]}{x}$ at x = 0 where [x] denotes the greatest integer function

(B) $f(x)=\frac{xe^{1/x}}{1+e^{1/x}}$ at x = 0

(C) $f(x) = (x-3)^{1/5}$ Sgn (x – 3) at x = 3, where Sgn stands for signum function

(D) $f(x)=\frac{\tan^{-1}|x|}{x}$ at x = 0

11. Let T be the triangle with vertices (0, 0), (0, c^2) and (c, c^2) and let R be the region between y = cx and y = x^2 where c > 0 then

(A) area (R) = $\frac{c^3}{6}$ (B) area (R) = $\frac{c^3}{3}$

(C) $\lim\limits_{c\to 0^+}\frac{\text{area (T)}}{\text{area (R)}}=3$ (D) $\lim\limits_{c\to 0^+}\frac{\text{area (T)}}{\text{area (R)}}=\frac{3}{2}$

12. Consider the graph of the function $f(x)=e^{\ln\left(\frac{x+3}{x+1}\right)}$. Then which of the following is correct

(A) range of the function is (1, ∞) (B) f(x) has no zeroes

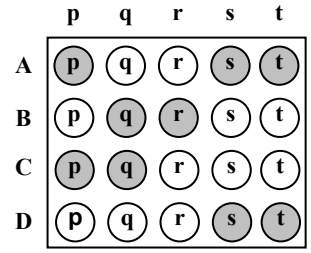
(C) graph lies completely above the x–axis (D) domain of f is $(-\infty, -3)\cup(-1, \infty)$

Rough work

SECTION – B

Matrix – Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II.** The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:
If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following:



1. Match the following column–I with column–II.

	Column–I		Column–II
(A)	$\sin\frac{\pi}{21}\sin\frac{2\pi}{21}\sin\frac{3\pi}{21}.....\sin\frac{9\pi}{21}\sin\frac{10\pi}{21}$	(p)	$\frac{\sqrt{11}}{2^{10}}$
(B)	$\sin\frac{\pi}{22}\sin\frac{2\pi}{22}\sin\frac{3\pi}{22}.....\sin\frac{9\pi}{22}\sin\frac{10\pi}{22}$	(q)	$\frac{1}{2^{10}}$
(C)	$\cos\frac{\pi}{21}\cos\frac{2\pi}{21}\cos\frac{3\pi}{21}.....\cos\frac{9\pi}{21}\cos\frac{10\pi}{21}$	(r)	$\frac{11}{2^{10}}$
(D)	$\cos\frac{\pi}{22}\cos\frac{2\pi}{22}\cos\frac{3\pi}{22}.....\cos\frac{9\pi}{22}\cos\frac{10\pi}{22}$	(s)	$\frac{\sqrt{21}}{2^{10}}$
		(t)	$\frac{\sqrt{11}}{2^{10}}$

2. Match the following column–I with column–II.

	Column–I		Column–II
(A)	ax + by + c = 0 be a variable line where a, b, c are 1^{st}, 4^{th}, 7^{th} terms of an increasing A.P then the Straight line always passes through a fixed point is	(p)	(1, – 2)
(B)	ax + by + c = 0 be a variable line where a, b, c are three consecutive terms of an A.P then the straight line always passes through a fixed point is	(q)	(2, – 3)
(C)	ax + by + c = 0 be a variable line where a, b, c are r, r^2, $2r^2 – r$ terms of an AP then straight line always passes through a fixed point is	(r)	(1, 1)
(D)	ax + by + c = 0 be a variable line where a, b, c are r, r^2, $3r^2 – 2r$ terms of an AP then straight line always passes through a fixed point is	(s)	(1, – 1)
		(t)	(–1, –1)

Rough work

SECTION – C

Integer Answer Type

This section contains **6 questions.** The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

1. Let z_1 and z_2 be two fixed point in argand plane z is a variable point such that $\arg\left(\frac{z-z_1}{z_2-z_1}\right)=\theta_1$ and $\arg\left(\frac{z_1-z_2}{z-z_2}\right)=\theta_2$

   If $\frac{\tan\theta_1/2}{\tan\theta_2/2}=\frac{3}{2}$ then locus of z is branch of hyperbola of eccentricity equal to _____.

2. $\left(\frac{\operatorname{cosec}^2\frac{\pi}{7}+\operatorname{cosec}^2\frac{2\pi}{7}+\operatorname{cosec}^2\frac{3\pi}{7}}{2}\right)$ is equals to _____.

3. Suppose $A=\frac{dy}{dx}$ of $x^2 + y^2 = 4$ at $\left(\sqrt{2}, \sqrt{2}\right)$, $B=\frac{dy}{dx}$ of sin y + sin x = sin x.sin y at (π, π) and $C=\frac{dy}{dx}$ of $2e^{xy} + e^xe^y - e^x - e^y = e^{xy+1}$ at (1, 1) then |A + B + C| has the value equal to _____.

4. The equation of tangent at point P(3, 4) on the parabola whose axis is x-axis is $3x-4y+7=0$, and the distance of the tangent from the focus of the parabola is $\frac{a}{b}$ { where a, b $\in$ N and H.C.F. of a, b is 1} then a – b is equal to _____.

5. If $a_0=0$ and $a_{n+1}=a_n+\sqrt{1+a_n^2}$ $\forall\, n\in I^+$ then $\frac{\pi}{4}\lim_{n\to\infty}\frac{a_n}{2^{n-1}}$ is equals to _____.

6. Let $f(x)=\left(x^2-1\right)^K$ where $K\in N$. The number of different real roots of equation $f^n(x)=0$ are 'm' $\{$ where 'n' denotes for nth derivative$\}$. If 'm' equal to 8 only for one value of 'n' then 'K' is _____.

Rough work