JEE ADVANCED
Model Test Paper

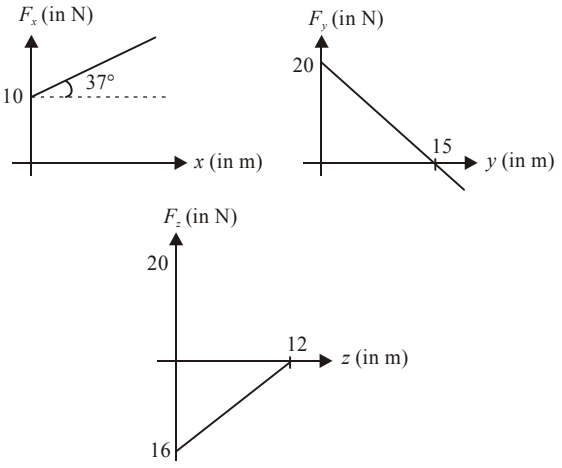
PHYSICS

SECTION - I

Straight Objective Type

(Only one correct answer)

1. The components of a force acting on a particle are varying according to the graphs shown. When the particle moves from (0, 5, 12) to (4, 20, 0) then the work done by this force is



(a) 192 J (b) 400/3 J
(c) 0 (d) none of these

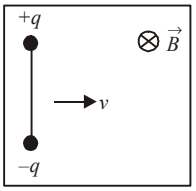
2. A body is projected from a height h from the surface of the moon, directly towards the moon with a speed $v_e/2$. v_e is the escape velocity from the surface of the moon. The body rebounds elastically from the surface of the moon and escapes out of the gravitational field of the moon. The minimum value of h is [R is radius of moon].
(a) $3R$ (b) $2R$
(c) $3R/2$ (d) $R/2$.

3. A heavy body of mass 25 kg is to be dragged along a horizontal plane ($\mu = 1/\sqrt{3}$). The least force required is
(a) 25 kgf (b) 2.5 kgf
(c) 12.5 kgf (d) $25/\sqrt{3}$ kgf.

4. For an element of atomic number, 25, the frequency of K_α X-ray from the atom will be (Rydberg constant $R = 1.1 \times 10^7$ m^{-1} and speed of light $c = 3 \times 10^8$ m/s)
(a) 1.43×10^{18} Hz (b) 1.67×10^{19} Hz
(c) 1.0×10^{17} Hz (d) 2.67×10^{18} Hz

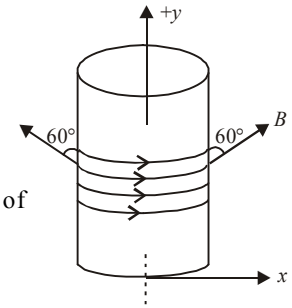
5. A string of mass 2.50 kg is under a tension of 200 N. The length of the stretched string is 20.0 m. If a transverse jerk is struck at one end of the string, the time taken for the disturbance to reach the other end is
(a) 10 s (b) 8 s
(c) 4 s (d) 0.5 s.

6. Two charges $+q$ and $-q$ are attached to the two ends of a light rod of length L, as shown in figure. The system is given a velocity v perpendicular to magnetic field $\vec{B}$. The magnetic force on the system of charges and magnitude of force on one charge by the rod, are respectively
(a) zero, zero
(b) zero, qvB
(c) $2qvB$, 0
(d) $2qvB$, qvB



7. A uniform magnetic field exists in region which forms an equilateral triangle of side a. The magnetic field is perpendicular to the plane of the triangle. A charge q enters into this magnetic field perpendicularly with speed v along perpendicular bisector of one side and comes out along perpendicular bisector of other side. The magnetic induction in the triangle is
(a) $\frac{mv}{qa}$ (b) $\frac{2mv}{qa}$ (c) $\frac{mv}{2qa}$ (d) $\frac{mv}{4qa}$

8. A voice coil in a loudspeaker has 40 turns of wire and loop-diameter 1 cm and the current in the coil is 1 A. Assume that the magnetic field at each of the wire of the coil has constant magnitude 0.2 T and is directed at an angle 60° from the normal to the plane of the coil as shown in figure.
The magnitude and direction of magnetic force on the coil is
(a) $4\pi \times 10^{-2}$ N, $+y$
(b) $4\pi \times 10^{-2}$ N, $-y$
(c) $4\sqrt{3}\,\pi \times 10^{-2}$ N, $+y$ (d) $4\sqrt{3}\,\pi \times 10^{-2}$ N, $-y$



9. The principle of loudspeaker is
(a) it converts mechanical energy into electrical energy
(b) permanent magnet exerts force on the coil
(c) the voice coil carrying current experiences torque due to which cone rotates and sound is produced.
(d) paper cone attached to coil moves air to produce sound when the voice coil is vibrated by an AC current interacting with magnetic field.

10. A uniform rod of mass m and length l is rotating with constant angular velocity ω about an axis which passes through its one end and perpendicular to the length of rod. The area of cross-section of the rod is A and its Young's modulus is Y. Neglect gravity. The strain at the mid point of the rod is

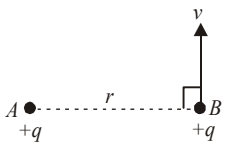
(a) $\frac{m\omega^2 l}{8AY}$ (b) $\frac{3m\omega^2 l}{8AY}$ (c) $\frac{3m\omega^2 l}{4AY}$ (d) $\frac{m\omega^2 l}{4AY}$

11. A black body emits radiation at the rate P when its temperature is T. At this temperature the wavelength at which the radiation has maximum intensity is λ_0. If at another temperature T' the power radiated is P' and wavelength at maximum intensity is $\lambda_0/2$ then

(a) $P'T' = 32PT$ (b) $P'T' = 16PT$
(c) $P'T' = 8PT$ (d) $P'T' = 4PT$.

12. In the figure shown, A is a fixed charged. B (of mass m) is given by a velocity v perpendicular to line AB. At this moment the radius of curvature of the resultant path of B is

(a) 0
(b) ∞ (infinity)
(c) $\frac{4\pi\varepsilon_0 r^2 mv^2}{q^2}$
(d) r.



SECTION - II

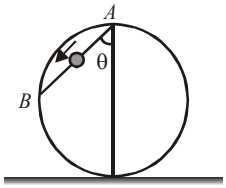
Multiple Correct Answer Type

13. According to Newton, light is
(a) a stream of particles - corpuscular in nature
(b) light is propagated as a mechanical wave
(c) it is electromagnetic wave
(d) Newton studied interference.

14. Formation of rainbow involves
(a) interference of light (b) refraction of light
(c) total internal reflection
(d) dispersion.

15. A particle moving along a straight line with uniform acceleration has velocties 7 m/s at P and 17 m/s at Q. R is the mid point of PQ. Then
(a) the average velocity between R and Q is 15 m/s
(b) the ratio of time to go from P to R and that from R to Q is 3:2
(c) the velocity at R is 10 m/s
(d) the average velocity between P and R is 10 m/s

16. A bead is free to slide down a smooth wire tightly stretched between points A and B on a vertical circle. If the bead starts from rest at A, the highest point on the circle



(a) its velocity v on arriving at B is proportional to $\cos\theta$
(b) its velocity v on arriving at B is proportional to $\tan\theta$
(c) time to arrive at B is proportional to $\cos\theta$
(d) time to arrive at B is independent of θ

17. A particle moves in a straight line with constant acceleration under a constant force F. Select the correct alternative(s).
(a) power developed by this force varies linearly with time
(b) power developed by this force varies parabolically with time
(c) power developed by this force varies linearly with displacement
(d) power developed by this force varies parabolically with displacement

18. A block is suspended by an ideal spring of force constant k. If the block is pulled down by applying a constant force F and if maximum displacement of block from its initial position of rest is x_0 then
(a) increase in energy stored in spring is kx_0^2
(b) $x_0 = 3F/2k$ (c) $x_0 = 2F/k$
(d) work done by applied force F is Fx_0

19. If the prism is set for minimum deviation
(a) the angle of incidence = angle of emergence
(b) one can determine the angle of refraction if the angle of the prism is known
(c) the refracted ray may or may not be parallel to the base
(d) for a given prism, only one angle of incidence is possible for the angle of minimum deviation.

20. Three planets of same density have radii R_1, R_2 and R_3 such that $R_1 = 2R_2 = 3R_3$. The gravitational field at their respective surfaces are g_1, g_2 and g_3 and escape velocities from their surfaces are v_1, v_2 and v_3. Then
(a) $g_1/g_2 = 1/2$ (b) $g_1/g_3 = 3$
(c) $v_1/v_2 = 2$ (d) $v_1/v_3 = 1/3$.

SECTION - III

Reasoning Type Questions

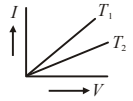
Directions: This section contains 4 reasoning type questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

(a) Statement-1 is true, Statement-2 is true; Statement - 2 is a correct explanation for Statement-1.
(b) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.
(c) Statement-1 is true, Statement-2 is false.
(d) Statement-1 is false, Statement-2 is true.

21. **Statement-1 :** Torque is equal to rate of change of angular momentum.
Statement-2 : Angular momentum depends on moment of inertia and angular velocity.

22. **Statement-1 :** Diffraction is common in sound but not common in light waves.
Statement-2 : Wavelength of light is more than the wavelength of sound.

23. **Statement-1 :** *V-I* graph for a conductor at two different temperatures T_1 and T_2 are shown here $T_1 > T_2$.



Statement-2 : Resistance of a conductor increases with rise in temperature.

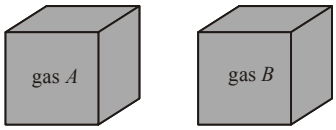
24. **Statement-1 :** Out of galvanometer, ammeter and voltmeter, resistance of ammeter is lowest and resistance of voltmeter is highest.
Statement-2: An ammeter is connected in series and a voltmeter is connected in parallel, in a circuit.

SECTION - IV

Linked Comprehension Type

Paragraph for Q.25 to 29

Two closed identical conducting containers are found in the laboratory of an old scientist. For the verification of the gas some experiments are performed on the two boxes and the results are noted.



Experiment 1. When the two containers are weighed $W_A = 225$ g, $W_B = 160$ g and mass of evacuated container, $W_C = 100$ g.

Experiment 2. When the two containers are given same amount of heat same temperature rise is recorded. The pressure change found are $\Delta P_A = 2.5$ atm. $\Delta P_B = 1.5$ atm.

Required data for unknown gas :

Mono	He	Ne	Ar	Kr	Xe	Rd
(molar mass)	4 g	20 g	40 g	84 g	131 g	222 g
Dia	H_2	F_2	N_2	O_2	Cl_2	
(molar mass)	2 g	19 g	28 g	32 g	71 g	

25. Identify the type of gas filled in container A and B respectively.
(a) mono, mono (b) dia, dia
(c) mono, dia (d) dia, mono.

26. Identify the gas filled in the container A and B.
(a) N_2, Ne (b) He, H_2
(c) O_2, Ar (d) Ar, O_2

27. Total number of molecules in A (here N_A = Avagadro number)
(a) $\frac{125}{64}N_A$ (b) $3.125\ N_A$
(c) $\frac{125}{28}N_A$ (d) $32.25\ N_A$

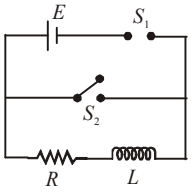
28. The initial internal energy of the gas in container A, If the containers were at room temperature 300 K initially
(a) 1406.25 cal (b) 1000 cal
(c) 2782.3 cal (d) none of these

29. If the gases have initial temperature 300 K and they are mixed in an adiabatic container having the same volume as the previous containers. Now the temperature of the mixture is T and pressure is P. Then
(a) $P > P_A$, $T > 300$ K (b) $P > P_B$, $T = 300$ K
(c) $P < P_A$, $T = 300$ K (d) $P > P_A$, $T < 300$ K

Paragraph for Q.30 to 34

Consider the circuit shown in the figure. When switch S_1 is closed, let i be the current at time t, then applying Kirchhoff's law,

$$E - iR - L\frac{di}{dt} = 0$$



or, $\int_0^i \frac{di}{E - iR} = \frac{1}{L}\int_0^t dt$

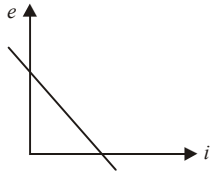
Solving we get,
L/R = time constant of circuit.
When current reaches its steady value ($= i_0$) S_1 is opened and S_2 is closed. The current does not reach to zero instantaneously but decays exponentially. The decay equation is given as $i = i_0 e^{-\frac{R}{L}t}$.

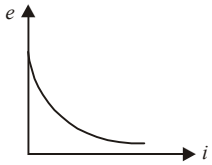
30. A solenoid of inductance 50 mH and resistance 10 Ω is connected to a battery of 6 V. The time elapsed before the current acquires half of its steady state value is approximately equal to
(a) 1.5 ms (b) 2.5 ms
(c) 3.5 ms (d) 4 ms.

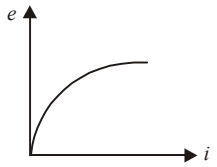
31. An L-R circuit is switched on at $t = 0$. If e.m.f. of battery is E, the charge which passes through battery in one time constant is
(a) $\frac{i_0\tau}{e}$ (b) $i_0\tau$ (c) $\frac{3i_0\tau}{2}$ (d) $\frac{2i_0\tau}{3}$.

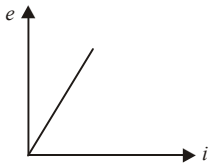
32. When a coil carrying a steady current is short circuited, the current become $1/\eta$ times of initial current in time t_0. The time constant of the circuit is
(a) $t_0 \ln \eta$ (b) $\frac{t_0}{\ln \eta}$ (c) $\frac{t_0}{\eta}$ (d) $\frac{t_0}{\eta - 1}$.

33. In a L-R circuit connected to a battery of emf E, switch S is closed at $t = 0$. If e denotes the induced emf across inductor and i is the current at any time t, then which of the graphs show the variation of induced emf e with i.

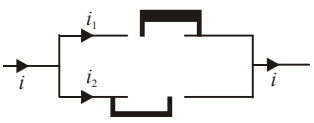
(a) 

(b) 

(c) 

(d) 

34. The ratio of current i_1/i_2 at any time is



(a) $\frac{L_1}{L_2}$ (b) $\frac{L_2}{L_1}$

(c) $\frac{L_1^2}{(L_1+L_2)^2}$ (d) $\frac{L_2^2}{(L_1+L_2)^2}$.

Paragraph for Q.35 & 36

The determination of the magnetic induction due to moving charges and that due to a current in the conductor are very similar in many respects to the calculation of the electric field. Gauss's theorem is used for uniformly charged bodies with the Gaussian surface having the same symmetry as the body. Ampere's theorem is applicable to conductors carrying a current in many cases. $\vec{E}$ and $\vec{B}$ are given by the formula

$$\vec{E}=\frac{1}{4\pi\varepsilon_0}\frac{q_1q_2\cdot\vec{r}}{r^3} \text{ and } \vec{B}=\frac{\mu_0}{4\pi}q\frac{\vec{v}\times\vec{r}}{r^3} \text{ or, } \frac{\mu_0}{4\pi}\int\frac{ids\times\vec{r}}{r^3}$$

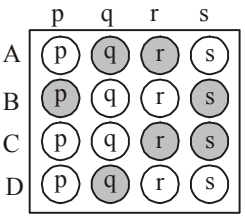
35. The directions of the electric field and magnetic field induction in a very long current carrying conductor are
(a) E parallel to the conductor and B perpendicular to the conductor
(b) E and B parallel to the conductor
(c) E and B perpendicular to the conductor
(d) none of these.

36. What are the cases where the same object, the electric field is zero, directly proportional to the distance r and inversely proportional to the square of the distance?
(a) uniformly charged spherical shell
(b) uniformly charged solid sphere
(c) point charge (d) linear charge.

SECTION - V

Matrix Match Type

This section contains 4 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in Column-I have to be matched with statements (p, q, r, s) in Column-II. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct matches are A-q, A-r, B-p, B-s, C-r, C-s and D-q, then the correctly bubbled matrix will look like as shown.



37.

	Column I		Column II
A.	Pumping out a gas from a cylinder	p.	L-C oscillations
B.	At every stroke, the number of molecules of gas decrease	q.	charge decaying in a capacitor
C.	Conduction of heat through a network of inductors	r.	at every second, the charge goes on decreasing
D.	Mass-spring oscillations	s.	current flowing through a network of resistors

38.

	Column I		Column II
A.	Einstein's photon theory	p.	$E = h\upsilon$
B.	Discovery of X-rays	q.	Louis de Broglie
C.	Determination of the charge of the electron	r.	J.J. Thomson
D.	Theory of matter waves	s.	Roentgen

39.

	Column I		Column II
A.	Uniform circular motion is sustained by	p.	force
B.	Uniform motion in a straight line (without friction) is sustained by	q.	restoring force
C.	Motion in a straight line is caused by	r.	law of conservation of angular momentum
D.	Simple harmonic motion is caused by	s.	law of linear momentum

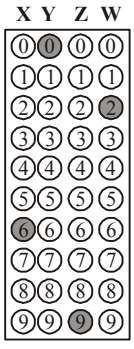
40.

	Column I		Column II
A.	The force of attraction between two masses is	p.	force towards the centre
B.	Force between two negative charges	q.	force away from the centre
C.	The centripetal force is	r.	is positive
D.	The centrifugal force is	s.	is negative

SECTION - VI

Integer Answer Type

In this section the answer to each of the questions is a single-digit integer, ranging from 0 to 9. If the correct answers to question numbers X, Y, Z and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following.



41. Two flywheels A and B are mounted side by side with frictionless bearings on a common shaft. Their moments of inertia about the shaft are 5.0 kgm^2 and 20.0 kgm^2 respectively.

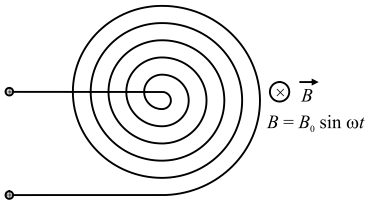
Wheel A is made to rotate at 10 revolution per second. Wheel B, initially stationary, is now coupled to A with the help of a clutch. The rotational speed of the wheels will become

42. The vibration of a string fixed at both ends are given by the following equation:

y = (5 mm) sin (($1.57\ cm^{-1}$)x)·cos [($314\ s^{-1}$)t].

If the length of the string is 10 cm, the number of loops formed in the vibration are

43. A plane spiral with a large number N of turns wound tightly to one another is located in a uniform magnetic field perpendicular to the plane of the spiral. The outside radius of the spiral's turns is equal to a. The magnetic induction varies with time as $B = B_0 \sin \omega t$, where B_0 and ω are constants. The amplitude of induced emf in the spiral is given by $\frac{\pi N a^2 B_0 \omega}{n}$. Find the value of n.



44. A ray of light travelling parallel to the principal axis of a concave mirror strikes the mirror at an angle of incidence θ. If radius of curvature of the mirror is R, then after reflection, the ray meets the principal axis at a distance x from the centre of curvature. Then x is given by $\frac{R}{m\cos\theta}$. Find the value of m.

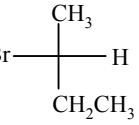
45. A positronium atom is a system that consists of a positron and an electron that orbit each other. The wavelengths in positronium spectral lines are how many times of those of the corresponding lines in the H-spectrum?

CHEMISTRY

SECTION - I

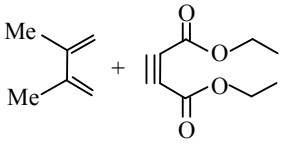
Straight Objective Type

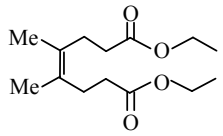
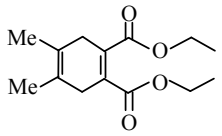
(Only one correct answer)

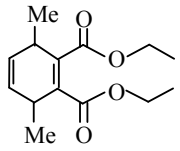
1. When  reacts with KOH in presence of water (through S_N2 reaction mechanism) then stereochemistry of product so formed will be

(a) R (b) S

(c) mixture of R and S (d) partial S + racemic mixture.

2.  P, P will be

(a)  (b) 

(c)  (d) unpredictable.

3. Electrolysis of a solution of HSO_4^- ions produces $S_2O_8^{--}$. Assuming 75% current efficiency, what current should be employed to achieve a production rate of 1 mol of $S_2O_8^{--}$ per hour?

(a) 71.5 A (b) 35.7 A

(c) 142.96 A (d) 285.93 A

4. When a small amount of solid calcium phosphide, Ca_3P_2, is added to water, what are the most likely products?

(a) aqueous Ca^{2+} and OH^- ions and PH_3 gas

(b) aqueous Ca^{2+} and OH^- ions and aqueous H_3PO_3

(c) solid CaH_2 and aqueous H_3PO_3

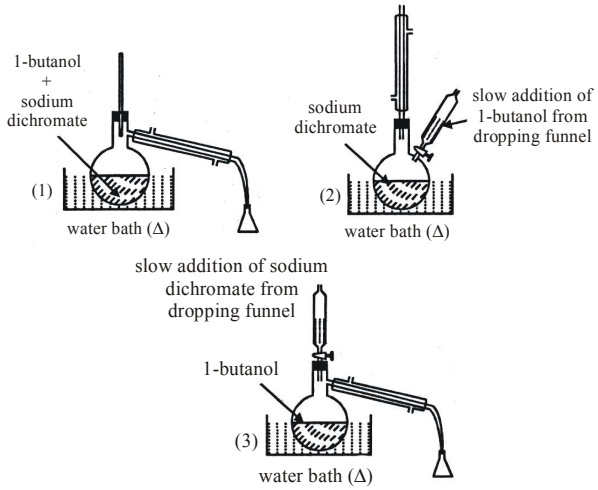
(d) solid CaO and PH_3 gas.

5. Barium ions, CN^- and Co^{2+} form an ionic complex. If this complex is 75% ionised in aqueous solution with van't Hoff factor (i) equal to four and paramagnetic moment is found to be 1.73 BM (due to spin only) then the hybridisation state of Co (II) in the complex will be

(a) sp^3d (b) d^2sp^3

(c) sp^3d^2 (d) dsp^3.

6. Observe the following 1 to 3 reaction conditions.



The correct observation for maximum % yield of butanol and butanoic acid respectively is

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

(c) 3, 2 (d) 3, 1.

7. An organic compound A ($C_4H_{10}O$) has two enantiomeric forms and on dehydration it gives B (major product) and C (minor product). B and C are treated with HBr/peroxide and the compounds so produced were subjected to alkaline hydrolysis then

(a) B will give an isomer of A
(b) C will give an isomer of A
(c) neither of them will give isomer of A
(d) both B and C will give isomer of A.

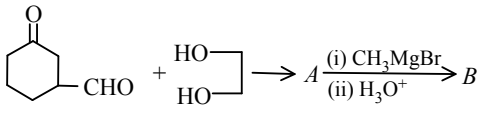
8. Which of the following is correct?

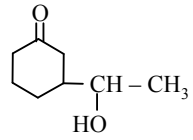
(a) $AgCl_{(s)} + Na_3AsO_3 \rightarrow$ colourless solution
(b) $FeCl_{3\,(aq)} + K_4[Fe(CN)_6]$ (excess) $\rightarrow$ blue ppt.
(c) $FeCl_{3\,(aq)} + K_3[Fe(CN)_6] \xrightarrow{H_2O_2}$ blue ppt.
(d) $CuSO_{4\,(aq)} + KCN$ (excess) $\rightarrow$ Blue coloured solution

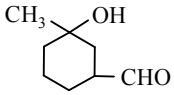
9. Diamond has face-centred cubic lattice. There are two atoms per lattice point, with the atoms at (000) and $\left(\frac{1}{4}\,\frac{1}{4}\,\frac{1}{4}\right)$ coordinates. The ratio of the carbon-carbon bond distance to the edge of the unit cell is

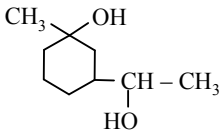
(a) $\sqrt{\frac{3}{16}}$ (b) $\sqrt{\frac{1}{4}}$
(c) $\frac{1}{4}$ (d) $\frac{1}{\sqrt{2}}$.

10. Identify the product (B)



(a) 

(b) 

(c) both A and B formed (d) 

11. The r.m.s. velocity of hydrogen is $\sqrt{7}$ times the r.m.s. velocity of nitrogen. If T is temperature of the gas

(a) $T(H_2) = T(N_2)$ (b) $T(H_2) > T(N_2)$
(c) $T(H_2) < T(N_2)$ (d) $T(H_2) = \sqrt{7}\,T(N_2)$.

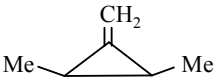
12. Which of the following pairs is not isomorphous?

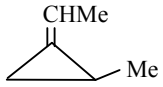
(a) $BaSO_4$, $KMnO_4$
(b) $KClO_4$, KBF_4
(c) $FeSO_4 \cdot 7H_2O$, $MgSO_4 \cdot 7H_2O$
(d) $NaClO_3$, $NaNO_3$.

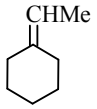
SECTION - II

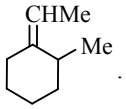
Multiple Correct Answer Type

13. Which will show geometrical isomerism?

(a) 

(b) 

(c) 

(d) 

14. On the basis of structure of graphite, which of the following is/are true for it?

(a) it is a crystalline solid
(b) it behaves like a conductor
(c) it is less dense than diamond
(d) it reacts with F_2 to form a product which is more conducting than graphite.

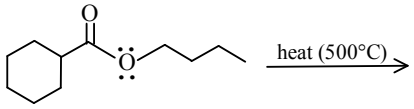
15. Which of the following is/are example of banana bond?

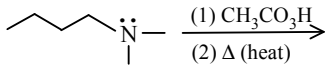
(a) Al_2Cl_6 (b) $Al_2(CH_3)_6$
(c) B_2H_6 (d) I_2Cl_6.

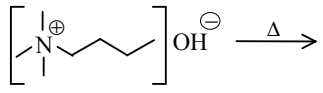
16. When nitrobenzene is treated with Br_2 in presence of $FeBr_3$, the major product formed is *m*-bromonitrobenzene. The statements which are related to obtain the *m*-isomer are

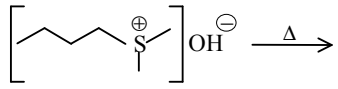
(a) the electron density on *meta* carbon is more than at *ortho* and *para*-positions
(b) the intermediate carbonium ion formed after initial attack of Br^+ at the *meta*-position is least destabilised
(c) loss of aromaticity when Br^+ attacks at the *ortho* and *para* positions and not at *m*-position
(d) easier loss of H^+ to regain aromaticity from the *meta*-position than from *ortho* and *para*-positions.

17. But-1-ene is formed in reaction/s

(a) 

(b) 

(c) 

(d) 

18. Which of the following has/have linear shape?

(a) HCN (b) $(CN)_2$
(c) C_3O_2 (d) CO_2.

19. Which of the following reactions is feasible as per given chemical equations?

(a) $CF_3I + \overline{OH}_{(aq)} \rightarrow CF_3H + IO^-_{(aq)}$

(b) $Rb[ICl_2] \xrightarrow{\Delta} RbCl + ICl$

(c) $R_2SiCl_2 \xrightarrow{\text{hydrolysis}} R_2Si(OH)_2 \longrightarrow R_2Si{=}O$

(d) all the above are feasible reactions.

20. Which about solubility product is correct?
(a) If ionic product > solubility product, precipitation occurs
(b) For $AlCl_3$, $K_{sp} = 27S^4$
(c) If ionic product = solubility product, solution is unsaturated
(d) If ionic product < solubility product, solution is saturated.

SECTION - III

Reasoning Type Questions

Directions: This section contains 4 reasoning type questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

(a) Statement-1 is true, Statement-2 is true; Statement - 2 is a correct explanation for Statement-1.
(b) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.
(c) Statement-1 is true, Statement-2 is false.
(d) Statement-1 is false, Statement-2 is true.

21. **Statement-1 :** The overall order of the reaction is the sum of the exponents of all the reactants in the rate expression.
Statement-2 : There are many higher order reactions.

22. **Statement-1 :** Transition metals are strong reducing agents.
Statement-2 : Transition metals form numerous alloys with other metals.

23. **Statement-1 :** Aldol condensation can be catalysed both by acids and bases.
Statement-2 : β-Hydroxy aldehydes or ketones readily undergo acid catalysed dehydration.

24. **Statement-1 :** The position of an element in periodic table after emission of one α - and two β - particles remains unchanged.
Statement-2 : Emission of one α- and two β - particles give isotope of the element which acquires same position in periodic table.

SECTION - IV

Linked Comprehension Type

Paragraph for Q.25 to 27

A gas bulb of 1 litre capacity contains 2.0×10^{21} molecules of nitrogen, exerting a pressure of 7.57×10^3 Nm^{-2}. The ratio of the most probable speed to the root mean square speed is 0.82.

25. The root mean square speed of the gas molecules is
(a) 300.23 ms^{-1} (b) 494.16 ms^{-1}
(c) 507.45 ms^{-1} (d) 419.27 ms^{-1}.

26. The temperature of the gas molecules is
(a) 200.15 K (b) 173.24 K
(c) 274.13 K (d) 225.10 K.

27. At this temperature, the most probable speed is
(a) 252.38 ms^{-1} (b) 405.2 ms^{-1}
(c) 348.53 ms^{-1} (d) 551.25 ms^{-1}.

Paragraph for Q.28 to 31

All the boron trihalides except BF_3 can be prepared by the treatment of halogens on a mixture of B_2O_3 and carbon at higher temperature. Boron trihalides consist of trigonal-planar BX_3 molecules. Unlike the halides of the other elements in the group, they are monomeric in the gas, liquid and solid states, BF_3 and BCl_3 are gases, BBr_3 is a volatile liquid and BI_3 is a solid. Boron trihalides are Lewis acids because they form Lewis complexes with suitable bases, as in the reaction.

$$\underset{\text{donor (Lewis base)}}{H_3N:} + \underset{\text{acceptor (Lewis acid)}}{BF_3} \longrightarrow [H_3N \rightarrow BF_3]$$

All boron trihalides, except BF_3, are hydrolysed to boric acid.

$$BCl_{3\,(g)} + 3H_2O_{(l)} \rightarrow B(OH)_{3\,(aq)} + 3HCl_{(aq)}$$

It is supposed that the first step in the above reaction is the formation of the complex $Cl_3B \leftarrow OH_2$ which then eleminates HCl and reacts further with water.

28. Which of the following is the best order of Lewis acid strength of BF_3, BCl_3 and BBr_3?
(a) $BF_3 > BCl_3 > BBr_3$ (b) $BF_3 = BCl_3 = BBr_3$
(c) $BF_3 < BCl_3 < BBr_3$ (d) $BBr_3 > BF_3 > BCl_3$.

29. Which is correct about the hydrolysis of BX_3?
(a) all BX_3 undergo hydrolysis to produce $B(OH)_{3\,(aq)}$ and $HX_{(aq)}$
(b) BF_3 does not undergo complete hydrolysis due to formation of HBF_4
(c) BBr_3 does not undergo hydrolysis at all because it cannot form H-bonds with water
(d) all the above are correct.

30. Which of the following reactions is incorrect?
(a) $BF_{3\,(g)} + F^-_{(aq)} \rightarrow [BF_4]^-_{(aq)}$
(b) $BCl_{3\,(g)} + 3EtOH_{(l)} \rightarrow B(OEt)_{3\,(l)} + 3HCl_{(g)}$
(c) $BBr_{3\,(l)} + F_3BN(CH_3)_{3\,(s)} \rightarrow BF_{3\,(g)} + Br_3BN(CH_3)_{3\,(s)}$
(d) $BCl_{3\,(g)} + \underset{\text{excess}}{2C_5H_5N_{(l)}} \rightarrow Cl_3B(C_5H_5N)_{2\,(s)}$.

31. What is true about the hydride which is obtained by the reaction of BCl_3 and $LiAlH_4$?
(a) its formula is BH_3
(b) it is electron rich compound
(c) its molecule contains only banana bonds
(d) it contains three centre as well as two centre bonds.

Paragraph for Q.32 to 34

A mixture of two aromatic compounds (*A*) and (*B*) was separated by dissolving in chloroform followed by extraction with aqueous KOH solution. The organic layer containing (*A*), when heated with alcoholic solution of KOH produces C_7H_5N (*C*) associated with unpleasant odour.

32. What is *A*?
(a) $C_6H_5NH_2$ (b) $C_6H_5CH_3$

(c) C_6H_5CHO (d) none of these.

33. The reaction of (*A*) with alcoholic solution of KOH to produce (*C*) of unpleasant odour is called
(a) Sandmeyer reaction (b) Carbylamine reaction
(c) Ullmann reaction (d) Reimer-Tiemann reaction.

34. The alkaline aqueous layer (*B*) when heated with chloroform and then acidified gave a mixture of isomeric compounds of molecular formula $C_7H_6O_2$. (*B*) is
(a) C_6H_5CHO (b) C_6H_5COOH
(c) $C_6H_5CH_3$ (d) none of these.

Paragraph for Q.35 & 36

Assume that impure copper contains only Fe, Au and Ag as impurities. After passage of 140 ampere for 482.5 sec the mass of anode decreased by 22.260 g and the cathode increased in mass by 22.011 g.

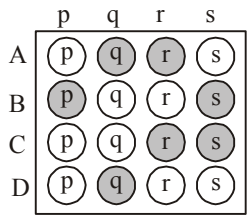
35. Weight of Fe dissolved at anode is
(a) 2.50 g (b) 3.12 g
(c) 2.02 g (d) 0.19 g

36. Percentage of copper originally present is
(a) 75.32% (b) 80.21%
(c) 98.88% (d) 87.27%.

SECTION - V

Matrix Match Type

This section contains 4 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in Column-I have to be matched with statements (p, q, r, s) in Column-II. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct matches are A-q, A-r, B-p, B-s, C-r, C-s and D-q, then the correctly bubbled matrix will look as shown.



37.

	Column I		Column II
(A)	sodium chloride	(p)	molecular crystal
(B)	graphite	(q)	face-centred cubic
(C)	dry ice	(r)	hexagonal close packing
(D)	alpha-iron	(s)	body-centred cubic

38.

	Column I		Column II
(A)	synthesis of NH_3	(p)	Haber
(B)	purification of titanium	(q)	van Arkel
(C)	manufacture of caustic soda	(r)	Castner-Kellner
(D)	synthesis of nitric acid	(s)	Ostwald

39.

	Column I		Column II
(A)	Zeisel method	(p)	estimation of alkoxy groups
(B)	etherates	(q)	reaction of phenol with diethyl sulphate in presence of NaOH
(C)	oxonium salts	(r)	coordination complexes of ethers with Lewis acids
(D)	phenetole	(s)	combination of ethers with inorganic acids

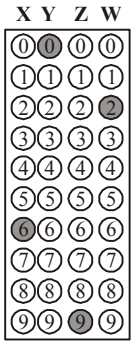
40.

	Column I		Column II
(A)	[He] $2s^1$	(p)	P
(B)	[Ne] $3s^2\ 3p^3$	(q)	Li
(C)	[Ar] $4s^2\ 3d^1$	(r)	Ar
(D)	[Ne] $3s^2\ 3p^6$	(s)	Sc

SECTION - VI

Integer Answer Type

In this section the answer to each of the questions is a single-digit integer, ranging from 0 to 9. If the correct answers to question numbers X, Y, Z and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following.



41. There is a stream of neutrons with a kinetic energy of 0.0327 eV. If the half life of neutrons is 700 seconds, % of neutrons that will decay before they travel a distance of 10 km is $x/10$. Value of x is

42. The principle quantum number 'n' corresponding to the excited state of He^+ ion if on transition to the ground state that ion emits two photons in succession with the wavelengths 108.5 and 30.4 nm, respectively is

43. An aqueous solution of a salt (*A*) gives a white precipitate (*B*) with solidum chloride solution. The filtrate gives a black ppt. (*C*) when H_2S is passed into it. Compound (*B*) dissolves in hot water and the solution gives a yellow ppt.(*D*) on treatment with NaI. The compound (*A*) does not give any gas with dil. HCl but liberates reddish brown gas on heating. The change in the oxidation state of cation when it converts from (*A*) to (*B*) is

44. Monoclinic gypsum $\xrightarrow{\Delta}$ Orthorhombic gypsum $\xrightarrow{\Delta}$ Plaster of Paris $\xrightarrow{200°C}$ Burnt plaster $\xrightarrow[\text{heated}]{\text{strongly}}$ No. of compounds obtained is

45. Compound(X)(C_5H_8O) does not react appreciably with Lucas reagent at room temperature, but gives a precipitate with ammoniacal silver nitrate. With excess of MeMgBr, 0.42 g of (X) gives 224 ml CH_4 at STP. Treatment of (X) with H_2 in presence of Pt catalyst followed by boiling with excess HI gives *n*-pentane. The number of acidic H-atoms in(X) is

MATHEMATICS

SECTION - I

Straight Objective Type
(Only one correct answer)

1. If A, G, H be respectively the A.M, G.M and the H.M between two positive numbers and if $xA = yG = zH$ where x, y, z are non-zero positive real numbers, then x, y, z are in
(a) A.P. (b) G.P.
(c) H.P (d) A.GP.

2. Let $y = \{x\}^{[x]}$ where $\{x\}$ denotes the fractional part of x and $[x]$ denotes greatest integer $\le x$, then $\int_0^3 y\,dx =$
(a) 11/6 (b) 2/3
(c) 1 (d) 5/6.

3. Let $f : R \to \left(0, \frac{\pi}{2}\right]$ be a function defined by
$f(x) = \cot^{-1}(x^2 + 4x + \alpha^2 - \alpha)$,
then complete set of values of α for which $f(x)$ is onto, is
(a) $\left[\frac{1-\sqrt{17}}{2}, \frac{1+\sqrt{17}}{2}\right]$ (b) $\frac{1\pm\sqrt{17}}{2}$
(c) $\left(-\infty, \frac{1-\sqrt{17}}{2}\right] \cup \left[\frac{1+\sqrt{17}}{2}, \infty\right)$
(d) none of these.

4. The number of ordered triplets (p, q, r) where $1 \le p, q, r \le 10$ ($p, q, r \in N$) such that $2^p + 3^q + 5^r$ is a multiple of 4, is
(a) 1000 (b) 500
(c) 250 (d) 125.

5. If A is a square matrix such that
$A(\text{adj}A) = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then $\frac{|\text{Adj}(\text{Adj } A)|}{|\text{Adj } A|}$ is equal to
(a) 256 (b) 64
(c) 32 (d) 16.

6. If $P(e^{i\theta_1})$, $Q(e^{i\theta_2})$, $R(e^{i\theta_3})$ be the vertices of a triangle PQR in the Argand plane, then the orthocentre of the triangle PQR is
(a) $\frac{e^{i\theta_1} + e^{i\theta_2} + e^{i\theta_3}}{3}$ (b) $e^{i\theta_1} + e^{i\theta_2} + e^{i\theta_3}$
(c) $2(e^{i\theta_1} + e^{i\theta_2} + e^{i\theta_3})$ (d) none of these.

7. Let $A(\hat{i})$, $B\left(\frac{1}{2}(-\hat{i} + \sqrt{3}\hat{j})\right)$ and $C\left(-\frac{1}{2}(\hat{i} + \sqrt{3}\hat{j})\right)$ be the vertices of a triangle ABC, then position vector of circumcentre of triangle OBC (where O is origin) is
(a) $\hat{i} + \hat{j}$ (b) $-3\hat{i}$
(c) $-\hat{i}$ (d) none of these.

8. The value of $\int_0^{\pi/4} [\cos x(f(x) - f'(x)) + \sin x(f(x) + f'(x))]dx$ is
(a) $f(0)$ (b) $-f(0)$
(c) $\sqrt{2}f(0)$ (d) $-\sqrt{2}f(0)$.

9. If $f(x) = a_1x + a_2x^3 + a_3x^5 + \ldots\ldots + a_n x^{2n-1}$, where $0 = a_1 < a_2 < a_3 < \ldots. < a_n$, then $f(x)$ has
(a) at least one minima (b) at least one maxima
(c) exactly one minima
(d) neither a maxima nor a minima

10. An ellipse has OB as semi minor axis. F and F' are its foci and the angle FBF' is the right angle. Then the eccentricity of the ellipse is
(a) $1/e$ (b) $1/2e$
(c) e^{-2} (d) 0

11. Between any two real roots of the equation $e^x \sin x = 1$ the equation $e^x \cos x = -1$ has
(a) atleast one root (b) exactly one root
(c) atmost one root (d) no root.

12. If the normals at the end points of a variable chord PQ of the parabola $y^2 - 4y - 2x = 0$ are perpendicular, then the tangents at P and Q will intersect at
(a) $x + y = 3$ (b) $3x - 7 = 0$
(c) $y + 3 = 0$ (d) $2x + 5 = 0$.

SECTION - II

Multiple Correct Answer Type

13. The value(s) of λ ($\lambda > 0$) for which the ellipses $\frac{x^2}{4} + \frac{y^2}{1} = 1$ and $\frac{x^2}{16} + \frac{y^2}{\lambda^2} = 1$ have the same eccentricity, is/ are
(a) 1 (b) 2
(c) 4 (d) 8.

14. Given the points $A(1, 2)$ and $B(5, 6)$, the locus of the point P such that $PA + PB = \lambda$ is
(a) an ellipse for all λ (b) a line segment for $\lambda = 4\sqrt{2}$
(c) an ellipse for $\lambda > 4\sqrt{2}$
(d) a hyperbola for $\lambda < 4\sqrt{2}$.

15. If $f(x)=\begin{cases}3x^2+12x-1, & -1\le x\le 2\\ 37-x, & 2<x\le 3\end{cases}$

Then

(a) $f(x)$ is increasing in [–1, 2]

(b) $f(x)$ is continuous in [–1, 3]

(c) $f'(2)$ doesn't exist

(d) $f(x)$ has the greatest value at $x = 2$.

16. Which of the following is/are true?

(a) $(\ln 2.1)^{\ln 2.2} > (\ln 2.2)^{\ln 2.1}$

(b) $(\ln 4)^{\ln 5} < (\ln 5)^{\ln 4}$

(c) $(\ln 30)^{\ln 31} > (\ln 31)^{\ln 30}$

(d) $(\ln 28)^{\ln 30} < (\ln 30)^{\ln 28}$

17. The function $f(x)=\cos^{-1}\left(\frac{2-|x|}{4}\right)+(\log(3-x))^{-1}$ is defined, if x lies in

(a) [–2, 6] (b) [–6, 2)

(c) (2, 3) (d) (–6, 2) ∪ (2, 3)

18. Let $g(t) = [t[1/t]]$ for $t > 0$. ([·] denotes the greatest integer function). Then $g(t)$ has

(a) Discontinuities at finite number of points

(b) Discontinuities at infinite number of points

(c) $g(1/2) = 1$ (d) $g(3/4) = 1$

19. If $f(x)=\begin{cases}x^2+2, & x<0\\ 3, & x=0\\ x+2, & x>0\end{cases}$, then

(a) $f(x)$ has a maximum at $x = 0$

(b) $f(x)$ is strictly decreasing on the left of 0

(c) $f'(x)$ is strictly increasing on the left of 0

(d) $f'(x)$ is strictly increasing on the right of 0

20. If $x + y = 60$, $x > 0$, $y > 0$, then the expression $x^2(30 - y)^2$ has

(a) least value = 0 (b) greatest value = 15^4

(c) two extrema (d) no greatest value.

SECTION - III

Reasoning Type Questions

Directions: This section contains 4 reasoning type questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

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

(b) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.

(c) Statement-1 is true, Statement-2 is false.

(d) Statement-1 is false, Statement-2 is true.

21. **Statement-1:** If $\sin A=\frac{3}{\sqrt{13}}$, $\cos B=\frac{5}{\sqrt{26}}$ where A is obtuse, B is acute then $A + B = 135°$

Statement-2 : $\sin(A + B) = \sin A \cos B + \cos A \sin B$.

22. **Statement-1 :** The shortest distance between the lines. $\vec{r}=s(\hat{i}-\hat{j}+\hat{k})$ and $\vec{r}=3\hat{j}+t(\hat{i}-\hat{k})$ is $\sqrt{6}$

Statement-2 : The shortest distance between the skew lines

$\vec{r}=\vec{a}+s\vec{b}$ and $\vec{r}=\vec{c}+t\vec{d}$ is

$\left|(\vec{c}-\vec{a})\cdot\vec{n}\right|$ where $\vec{n}=\frac{\vec{b}\times\vec{d}}{\left|\vec{b}\times\vec{d}\right|}$

23. **Statement-1 :** If n is even and $\binom{n}{r}=C_r$, then

$$C_1^2+C_3^2+C_5^2+\ldots+C_{n-1}^2=\binom{2n-1}{n}-(-1)^{n/2}\binom{n-1}{n/2}$$

Statement-2 : For any positive integer n, if $C_r=\binom{n}{r}$, then $C_0^2-C_1^2+C_2^2-C_3^2+\ldots..$ = coefficient of x^n in $(x^2 - 1)^n$.

24. **Statement-1 :** The function $f(x)=\frac{x}{1+|x|}$ is not differentiable at $x = 0$.

Statement-2 : $|x|$ and hence $(1 + |x|)$ is not differentiable at $x = 0$.

SECTION - IV

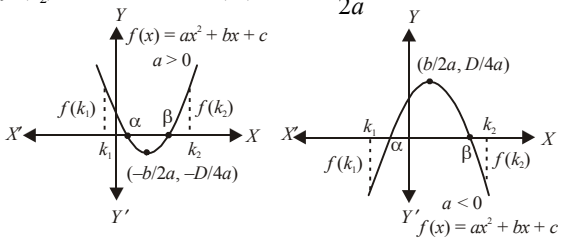
Linked Comprehension Type

Paragraph for Q.25 to 28

If both the roots α and β of a quadratic equation lie between numbers k_1, k_2, then

(i) $D > 0$ (ii) $af(k_1) > 0$

(iii) $af(k_2) > 0$ (iv) $k_1<-\frac{b}{2a}<k_2$



25. If the roots of the equation $(a+1)x^2-3ax+4a=0$ $(a\neq -1)$ are greater than unity, then a belongs to

(a) $\left[-\frac{16}{7}, -1\right]$ (b) $\left[\frac{7}{16}, -1\right]$

(c) $\left[\frac{16}{7}, \frac{7}{16}\right]$ (d) $\left[-\frac{16}{7}, 1\right]$

26. If both the roots of equation $2x^2 + ax + a^2 - 5 = 0$ are less than unity, then a belongs to

(a) $\left(\frac{\sqrt{13}-1}{2}, \sqrt{\frac{40}{7}}\right)\cup\left(-\sqrt{\frac{40}{7}}, \frac{-1-\sqrt{13}}{2}\right)$

(b) $\left(-\sqrt{\frac{40}{7}}, \frac{1+\sqrt{13}}{2}\right)\cup\left(\frac{\sqrt{13}+1}{2}, \sqrt{\frac{40}{7}}\right)$

(c) $\left(-\sqrt{\frac{40}{7}}, \frac{-1-\sqrt{13}}{2}\right)\cup\left(\frac{\sqrt{13}-1}{2}, \sqrt{\frac{40}{7}}\right)$

(d) $\left(\sqrt{\frac{40}{7}}, \frac{-1-\sqrt{13}}{2}\right) \cup \left(\frac{\sqrt{13}-1}{2}, -\sqrt{\frac{40}{7}}\right)$

27. If 6 lies between the roots of the equation $x^2 + 2(a-3)x + 9 = 0$, then a belongs to

(a) $\left(-\infty, \frac{3}{4}\right)$ (b) $\left(\infty, -\frac{3}{4}\right)$

(c) $\left(\infty, \frac{3}{4}\right)$ (d) $\left(-\infty, -\frac{3}{4}\right)$

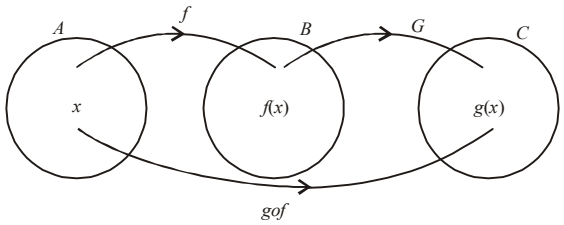
28. If the roots of the equation $(a-3)x^2 - 2ax + 5a = 0$ are positive then a belongs to

(a) $\left(\frac{1}{3}, \frac{15}{4}\right)$ (b) $\left(3, \frac{15}{4}\right)$

(c) $\left(\frac{1}{3}, \frac{4}{15}\right)$ (d) $\left(3, \frac{4}{15}\right)$

Paragraph for Q.29 to 31

Let A, B and C be three non-void sets and let $f : A \to B$, $g : B \to C$ be two functions. Since f is a function from A to B, therefore for each $x \in A$ there exists a unique element $f(x) \in B$. Again, since g is a function from B to C therefore corresponding to $f(x) \in B$ there exists a unique element $g(f(x)) \in C$. Thus for each $x \in A$ there exists a unique element $g(f(x)) \in C$.



Let $f : A \to B$ and $g : B \to C$ be two functions, then a function $gof : A \to C$ defined by

$(gof)(x) = g(f(x))$, for all $x \in A$.

29. If $f(x) = \sin^2 x + \sin^2(x + \pi/3) + \cos x \cos(x + \pi/3)$ and $g(5/4) = 1$, then $gof(x) =$

(a) 1 (b) 0

(c) $\sin x$ (d) none of these.

30. Given $f(x) = \log\left(\frac{1+x}{1-x}\right)$ and $g(x) = \frac{3x + x^3}{1 + 3x^2}$, then $fog(x)$

(a) $-f(x)$ (b) $3f(x)$

(c) $[f(x)]^3$ (d) none of these.

31. Let $f(x) = \frac{ax+b}{cx+d}$. Then $fof(x) = x$ provided that

(a) $d = -a$ (b) $d = a$

(c) $a = b = c = d = 1$ (d) $a = b = 1$.

Paragraph for Q.32 to 34

Let the equation of the circle be $x^2 + y^2 = a^2$ ... (i)

and the equation of the line be $y = mx + c$ ... (ii)

Line may cut a circle in at most two points. The points of intersection are real and distinct, coincident or imaginary according as the roots of the quadratic equation.

32. What is the condition if the equation has two distinct roots when points of intersection are real and distinct.

(a) $a > \left|\frac{c}{\sqrt{1+m^2}}\right|$ (b) $a = \left|\frac{c}{\sqrt{1+m^2}}\right|$

(c) $a < \left|\frac{c}{\sqrt{1+m^2}}\right|$ (d) $a \neq \left|\frac{c}{\sqrt{1+m^2}}\right|$

33. What is the condition if the equation has two equal roots when the points of intersection are coincident?

(a) $a \neq \left|\frac{c}{\sqrt{1+m^2}}\right|$ (b) $a > \left|\frac{c}{\sqrt{1+m^2}}\right|$

(c) $a < \left|\frac{c}{\sqrt{1+m^2}}\right|$ (d) $a = \left|\frac{c}{\sqrt{1+m^2}}\right|$

34. What is the condition if the equation has imaginary roots when the points of intersection are imaginary?

(a) $a = \left|\frac{c}{\sqrt{1+m^2}}\right|$ (b) $a < \left|\frac{c}{\sqrt{1+m^2}}\right|$

(c) $a > \left|\frac{c}{\sqrt{1+m^2}}\right|$ (d) $a \neq \left|\frac{c}{\sqrt{1+m^2}}\right|$

Paragraph for Q.35 & 36

Consider r brackets corresponding to r persons. In each bracket, take an expression given by $x^0 + x^1 + x^2 + ... + x^n$. The various powers of x *viz*; 0, 1, 2, ... n correspond to the number of items each person can have in the distribution.

Since the total number of items is n. So the required number of ways is the coefficient of x^n in the product

$= (x^0 + x + x^2 + ... + x^n)(x^0 + x + x^2 + ... + x^n)$ ....

..... $(x^0 + x + x^2 + ... + x^n)$

Thus, the required number of ways ${}^{n+r-1}C_{r-1}$.

35. How many integral solutions are there to $x + y + z + t = 29$ when $x \geq 1$, $y \geq 2$, $z \geq 3$ and $t \geq 0$?

(a) 2666 (b) 2600

(c) 2606 (d) 2006.

36. Find the number of non-negative solutions of

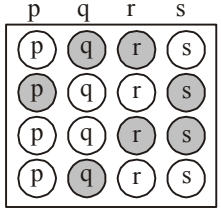
$x_1 + x_2 + x_3 + 4x_4 = 20$.

(a) 563 (b) 635 (c) 365 (d) 536.

SECTION - V

Matrix Match Type

This section contains 4 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in Column-I have to be matched with statements (p, q, r, s) in Column-II. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct matches are A-q, A-r, B-p, B-s, C-r, C-s and D-q, then the correctly bubbled matrix will look like as shown in the figure.



37. Let $f(x) = |\sin x|$, then

	Column I		Column II
(A)	$\lim_{x\to 0}\frac{f(x)}{x} =$	(p)	0
(B)	the number of solutions of the equation $f(x) - [x] = 0$ is ([ ] denotes the greatest integer function)	(q)	does not exist
(C)	the number of solutions of the equation $f(x) = 5^x + 5^{-x}$ is	(r)	2
(D)	$\left(\frac{d}{dx}\lvert\sin x\rvert\right)_{x=0}$ is	(s)	1

38. $f: R \to R$ such that $f(x) = sgn(x)$ whose range is set of numbers $\{-1, 0, 1\}$ for different domain of f.

	Column I		Column II
(A)	the range of $1 + f(x)$ is set of numbers	(p)	removable discontinuity
(B)	the function $\sqrt{1+f(x)}$ is	(q)	$\{-2, -1, 0\}$
(C)	the range of $f(x) - 1$ is	(r)	discontinuous at $x = 0$
(D)	the function $g(x) = 2 + \lvert f(x)\rvert$ has	(s)	$\{0, 1, 2\}$

39. If $C_0, C_1, C_2 ...., C_n$ are binomial coefficient in the expansion of $(1 + x)^n$, then

	Column I		Column II
(A)	the value of $C_0 + 2C_1 + 3C_2 + ... + (x + 1)C_n$	(p)	0
(B)	the value of $C_0 - 2C_1 + 3C_2 + ... + (-1)^n (n + 1)C_n$	(q)	$\frac{(n+1)^n}{n!}$
(C)	the value of $C_0 + (C_0 + C_1) + (C_0 + C_1 + C_2) + ... + (C_0 + C_2 + C_2 + ... C_{n-1})$	(r)	$2^{n-1}(n + 2)$
(D)	if $(C_0 + C_1)(C_1 + C_2) ... (C_{n-1} + C_n) = kC_0C_1C_2 .... C_{n-1}$, then the value of k is	(s)	$n\,2^{n-1}$

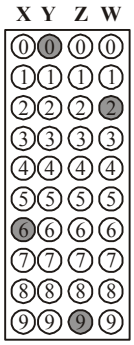
40.

	Column I (Differential Equations)		Column II (degree)
(A)	$y = 1+\frac{dy}{dx}+\frac{\left(\frac{dy}{dx}\right)^2}{2!}+\frac{\left(\frac{dy}{dx}\right)^3}{3!}+...\infty$	(p)	2
(B)	$\frac{dy}{dx}+\frac{1}{3}\left(\frac{d^2y}{dx^2}\right)^2+\left(\frac{dy}{dx}\right)^2=0$	(q)	1
(C)	$x=1+\left(xy\frac{dy}{dx}\right)+\frac{x^2y^2}{2!}\left(\frac{dy}{dx}\right)^2+...\infty$	(r)	4
(D)	$\frac{d^2y}{dx^2}=\left[y+\left(\frac{dy}{dx}\right)^3\right]^{1/4}$	(s)	1

SECTION - VI

Integer Answer Type

In this section the answer to each of the questions is a single-digit integer, ranging from 0 to 9. If the correct answers to question numbers X, Y, Z and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following.



41. The last digit of the number of garlands that can be formed using 3 flowers of 1st kind and 12 flowers of the 2nd kind is

42. Consider the equation $x^3 - ax^2 + bx - c = 0$, where $a, b, c, \in Q$; $(a \neq 1)$. It is given that x_1, x_2 and x_1x_2 are the real roots of the equation then $x_1x_2\left(\frac{a+1}{b+c}\right)$ is equal to

43. If $f(x + y + z) = f(x) + f(y) + f(z)$ with $f(1) = 1$ and $f(2) = 2$ and $x, y, z \in R$, then $\lim_{n\to\infty}\frac{\sum_{r=1}^{n}(4r)f(3r)}{n^3}$ is equal to

44. The value of $c + 2$ for which the area of the figure bounded by the curve $y = 8x^2 - x^5$; the straight lines $x = 1$ and $x = c$ and x-axis is equal to $\frac{16}{3}$, is

45. The system of equations are $\frac{1}{x}+\frac{2}{y}+\frac{1}{z}=1, \frac{3}{x}-\frac{4}{y}-\frac{2}{z}=2, \frac{2}{x}+\frac{5}{y}-\frac{2}{z}=3$ then find the value of y.