# PAPER – II

***For the benefit of 11th/12th Studying students, we have (*) marked the questions which are from 11th syllabus. You are advised to solve these questions in 90 minutes.***

## Physics

### SECTION – I

### *Straight Objective Type*

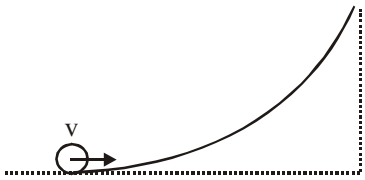
***This section contains 9 multiple choice questions numbered 1 to 9. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.***

1*. In the experiment to determine the speed of sound using a resonance column,
(A) prongs of the tuning fork are kept in a vertical plane
(B) prongs of the tuning fork are kept in a horizontal plane
(C) in one of the two resonances observed, the length of the resonating air column is close to the wavelength of sound in air
(D) in one of the two resonances observed, the length of the resonating air column is close to half of the wavelength of sound in air

2*. A student performs an experiment to determine the Young's modulus of a wire, exactly 2 m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of ± 0.05 mm at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of ± 0.01 mm. Take g = 9.8 m/s$^2$ (exact). The Young's modulus obtained from the reading is
(A) $(2.0 \pm 0.3) \times 10^{11}$ N/m$^2$ (B) $(2.0 \pm 0.2) \times 10^{11}$ N/m$^2$
(C) $(2.0 \pm 0.1) \times 10^{11}$ N/m$^2$ ] (D) $(2.0 \pm 0.05) \times 10^{11}$ N/m$^2$

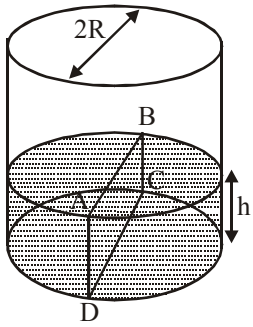
3*. A particle moves in the X–Y plane under the influence of a force such that its linear momentum is $\vec{p}(t) = A\left[\hat{i}\cos(kt) - \hat{j}\sin(kt)\right]$, where A and k are constants. The angle between the force and the momentum is
(A) 0° (B) 30°
(C) 45° (D) 90°

4*. A small object of uniform density rolls up a curved surface with an initial velocity v. It reaches up to a maximum height of $\frac{3v^2}{4g}$ with respect to the initial position. The object is




(A) ring
(B) solid sphere
(C) hollow sphere
(D) disc

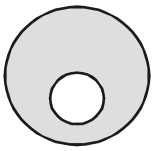
5*. Water is filled upto a height h in a beaker of radius R as shown in the figure. The density of water is ρ, the surface tension of water is T and the atmospheric pressure is $P_0$. Consider a vertical section ABCD of the water column through a diameter of the beaker. The force on water on one side of this section by water on the other side of this section has magnitude




(A) $|2P_0 Rh + \pi R^2 \rho gh - 2RT|$ (B) $|2P_0 Rh + R\rho gh^2 - 2RT|$

(C) $|P_0 \pi R^2 + R\rho gh^2 - 2RT|$ (D) $|P_0 \pi R^2 + R\rho gh^2 + 2RT|$

6. A spherical portion has been removed from a solid sphere having a charge distributed uniformly in its volume as shown in the figure. The electric field inside the emptied space is



(A) zero everywhere (B) non–zero and uniform

(C) non–uniform (D) zero only at its centre

7. Positive and negative point charges of equal magnitude are kept at $\left(0,0,\frac{a}{2}\right)$ and $\left(0,0,\frac{-a}{2}\right)$, respectively. The work done by the electric field when another positive point charge is moved from (– a, 0,0) to (0,a,0) is

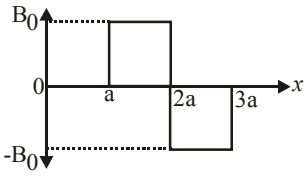
(A) positive

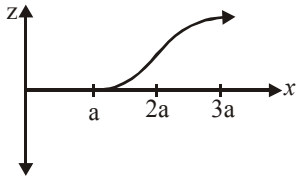
(B) negative

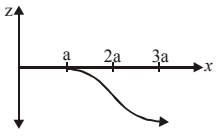
(C) zero

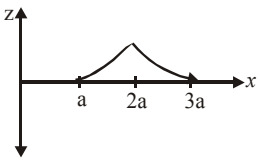
(D) depends on the path connecting the initial and final positions

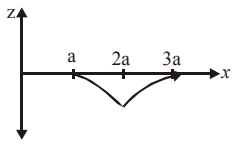
8. A magnetic field $\vec{B} = B_0\hat{j}$ exists in the region a < $x$ < 2a and $\vec{B} = -B_0\hat{j}$, in the region 2a < $x$ < 3a, where $B_0$ is a positive constant. A positive point charge moving with a velocity $\vec{v} = v_0\hat{i}$, where $v_0$ is a positive constant, enters the magnetic field at $x$ = a. The trajectory of the charge in this region can be like




(A)



(B)



(C)



(D)


9. Electrons with de–Broglie wavelength $\lambda$ fall on the target in an X–ray tube. The cut–off wavelength of the emitted X–rays is

(A) $\lambda_0 = \frac{2mc\lambda^2}{h}$ (B) $\lambda_0 = \frac{2h}{mc}$

(C) $\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$ (D) $\lambda_0 = \lambda$

## SECTION – II

### *Assertion – Reason Type*

***This section contains 4 questions numbered 10 to 13. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.***

10*. STATEMENT – 1

If there is no external torque on a body about its centre of mass, then the velocity of the centre of mass remains constant.

**Because**

STATEMENT–2

The linear momentum of an isolated system remains constant

(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

11*. STATEMENT–1

A cloth covers a table. Some dishes are kept on it. The cloth can be pulled on it without dislodging the dishes from the table.

**Because**

STATEMENT–2

For every action there is an equal and opposite reaction.

(A) Statement–1 is True, Statement–2 is True; Statement–2 **is** a correct explanation for Statement–1

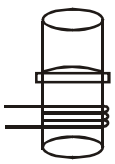
(B) Statement–1 is True, Statement–2 is True; Statement–2 **is NOT** a correct explanation for Statement–1

(C) Statement–1 is True, Statement–2 is False

(D) Statement–1 is False, Statement–2 is True

12. STATEMENT–1

A vertical iron rod has a coil of wire wound over it at the bottom end. An alternating current flows in the coil. The rod goes through a conducting ring as shown in the figure. The ring can float at a certain height above the coil.



**Because**

STATEMENT–2

In the above situation, a current is induced in the ring which interacts with the horizontal component of the magnetic field to produce an average force in the upward direction.

(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

13*. STATEMENT–1
The total translational kinetic energy of all the molecules of a given mass of an ideal gas is 1.5 times the product of its pressure and its volume.

**Because**

STATEMENT–2

The molecules of a gas collide with each other and the velocities of the molecules change due to the collision.

(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

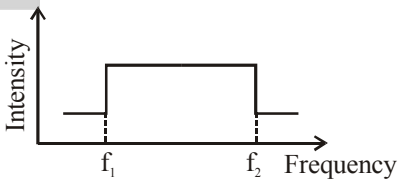
## SECTION – III
## *Linked Comprehension Type*

***This section contains 2 paragraphs $C_{14\text{-}16}$ and $C_{17\text{-}19}$. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.***



***$P_{14–16}$: Paragraph for Question Nos. 14 to 16**

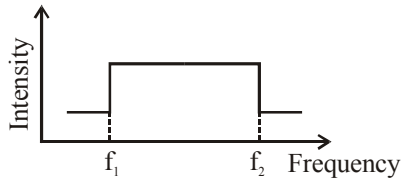
Two trains A and B are moving with speeds 20 m/s and 30 m/s respectively in the same direction on the same straight track, with B ahead of A. The engines are at the front ends. The engine of trains A blows a long whistle.

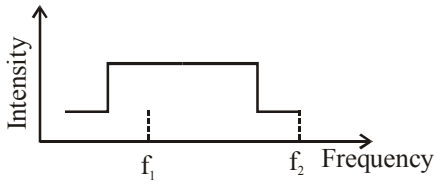


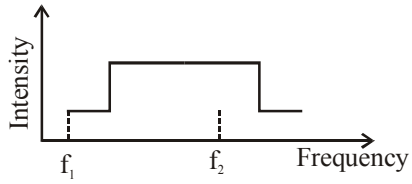

Assume that the sound of the whistle is composed of components varying in frequency from $f_1$ = 800 Hz to $f_2$ = 1120 Hz, as shown in the figure. The spread in the frequency (highest frequency – lowest frequency) is thus 320 Hz. The speed of sound in still air is 340 m/s.

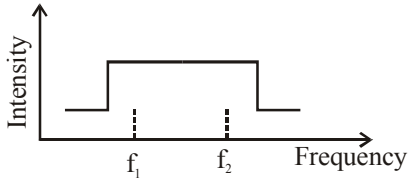
14. The speed of sound of the whistle is
(A) 340 m/s for passengers in A and 310 m/s for passengers in B.
(B) 360 m/s for passengers in A and 310 m/s for passengers in B.
(C) 310 m/s for passengers in A and 360 m/s for passengers in B.
(D) 340 m/s for passengers in both the trains.

15. The distribution of the sound intensity of the whistle as observed by the passengers in train A is best represented by

(A) 


(B) 

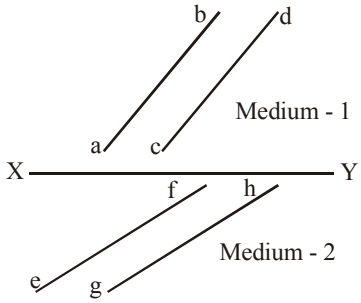

(C) 


(D) 


16. The spread of frequency as observed by the passengers in train B is
(A) 310 Hz (B) 330 Hz
(C) 350 Hz (D) 290 Hz.

**$P_{17-19}$ : Paragraph for Question Nos. 17 to 19**

The figure shows a surface XY separating two transparent media, medium – 1 and medium – 2. The lines ab and cd represent wavefronts of light wave traveling in medium – 1 and incident on XY. The lines ef and gh represents wavefronts of the light wave in medium – 2 after refraction.




17. Light travels as a
(A) parallel beam in each medium
(B) convergent beam in each medium
(C) divergent beam in each medium
(D) divergent beam in one medium and convergent beam in the other medium.

18. The phase of the light wave at c, d, e and f are $\phi_c$, $\phi_d$, $\phi_e$ and $\phi_f$ respectively. It is given that $\phi_c \neq \phi_f$.
(A) $\phi_c$ cannot be equal to $\phi_d$ (B) $\phi_d$ can be equal to $\phi_c$
(C) $(\phi_d - \phi_f)$ is equal to $(\phi_c - \phi_e)$ (D) $(\phi_d - \phi_c)$ is not equal to $(\phi_f - \phi_e)$.

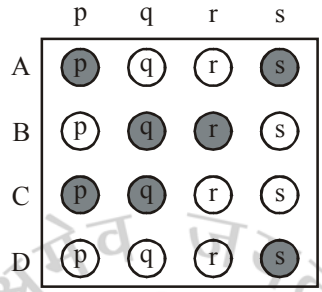
19. Speed of light is
(A) the same in medium – 1 and medium – 2
(B) larger in medium – 1 than in medium – 2
(C) larger in medium – 2 than in medium – 1
(D) different at b and d.

## SECTION – IV

### *Matrix-Match Type*

***This section contains 3 questions. Each questions 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.***

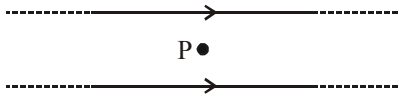
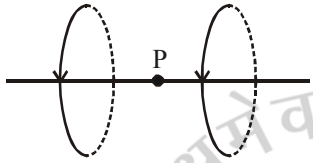
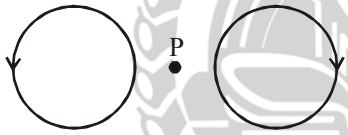
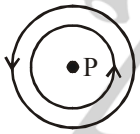
If the correct matches are A–p, A–s, B–q, B–r, C–p, C–q and D–s, then the correctly bubbled 4 × 4 matrix should be as follows :




20*. **Column I** describes some situations in which a small object moves. **Column II** describes some characteristic of these motions. Match the situations in **Column I** with the characteristics in **Column II** and indicate your answer by darkening appropriated bubbles in the 4 × 4 matrix given in the ORS.

| **Column I** | **Column II** |
|---|---|
| (A) The object moves on the x–axis under a conservative force in such a way that its speed and position satisfy $v = c_1\sqrt{c_2 - x^2}$, where $c_1$ and $c_2$ are positive constants. | (p) The object executes a simple harmonic motion. |
| (B) The object moves on the x–axis in such a way that its velocity and its displacement from the origin satisfy $v = -kx$, where k is a positive constant. | (q) The object does not change its direction. |
| (C) The object is attached to one end of a mass–less spring of a given spring constant. The other end of the spring is attached to the ceiling of an elevator. Initially everything is at rest. The elevator starts going upwards with a constant acceleration a. The motion of the object is observed from the elevator during the period it maintains this acceleration. | (r) The kinetic energy of the object keeps on decreasing. |
| (D) The object is projected from the earth's surface vertically upwards with a speed $2\sqrt{GM_e/R_e}$, where $M_e$ is the mass of the earth and $R_e$ is the radius of the earth. Neglect forces from objects other than the earth. | (s) The object can change its direction only once. |

21. Two wires each carrying a steady current I are shown in four configurations in **Column I**. Some of the resulting effects are described in **Column II**. Match the statements in **Column I** with the statements in **Column II** and indicate your answer by darkening appropriated bubbles in the $4 \times 4$ matrix given in the ORS.

| **Column I** | **Column II** |
|---|---|
| (A) Point P is situated midway between the wires.   | (p) The magnetic field (B) at P due to the currents in the wires are in the same direction. |
| (B) Point P is situated at the mid–point of the line joining the centers of the circular wires, which have same radii.   | (q) The magnetic fields (B) at P due to the currents in the wires are in opposite directions. |
| (C) Point P is situated at the mid–point of the line joining the centers of the circular wires, which have same radii.   | (r) There is no magnetic field at P. |
| (D) Point P is situated at the common center of the wires.   | (s) The wires repel each other. |

22. **Column I** gives some devices and **Column II** gives some process on which the functioning of these devices depend. Match the devices in **Column I** with the process in **Column II** and indicate your answer by darkening appropriated bubbles in the $4 \times 4$ matrix given in the ORS.

| **Column I** | **Column II** |
|---|---|
| (A) Bimetallic strip | (p) Radiation from a hot body |
| (B) Steam engine | (q) Energy conversation |
| (C) Incandescent lamp | (r) Melting |
| (D) Electric fuse | (s) Thermal expansion of solids |

# Chemistry

## SECTION – I

### *Straight Objective Type*

**This section contains 9 multiple choice questions numbered 23 to 31. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.**

23*. Consider a titration of potassium dichromate solution with acidified Mohr's salt solution using diphenylamine as indicator. The number of moles of Mohr's salt required per mole of dichromate is

(A) 3 (B) 4
(C) 5 (D) 6

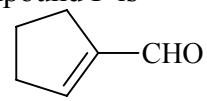
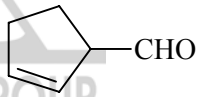
24. Among the following metal carbonyls, the C-O bond order is lowest in

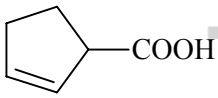
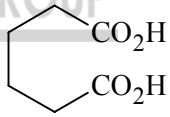
(A) $[Mn(CO)_6]^+$ (B) $[Fe(CO)_5]$
(C) $[Cr(CO)_6]$ (D) $[V(CO)_6]^-$

25. A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess KI to give a colourless solution. Moreover, the solution of metal ion on treatment with a solution of cobalt(II) thiocyanate gives rise to a deep blue crystalline precipitate. The metal ion is

(A) $Pb^{2+}$ (B) $Hg^{2+}$
(C) $Cu^{2+}$ (D) $Co^{2}$

26. Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound E. Compound E on further treatement with aqueous KOH yields compound F. Compound F is

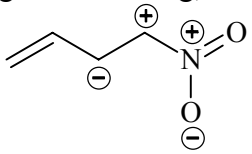
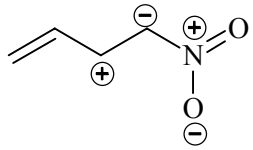
(A)  (B) 

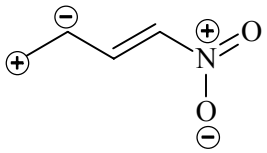
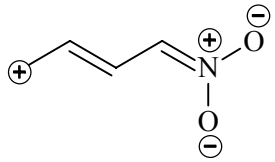
(C)  (D) 

27*. The number of stereoisomers obtained by bromination of trans-2-butene is

(A) 1 (B) 2
(C) 3 (D) 4

28*. Among the following, the least stable resonance structure is

(A)  (B) 

(C)  (D) 

29*. A positron is emited from $^{23}_{11}Na$. The ratio of the atomic mass and atomic number of the resulting nuclide is

(A) 22/10 (B) 22/11
(C) 23/10 (D) 23/12

30. For the process $H_2O(l)$ (1 bar, 273 K) $\rightarrow$ $H_2O(g)$ (1 bar, 373 K), the correct set of thermodynamic parameters is

(A) $\Delta G = 0, \Delta S = +ve$ (B) $\Delta G = 0, \Delta S = -ve$
(C) $\Delta G = +Ve, \Delta S = 0$ (D) $\Delta G = -ve, \Delta S = +ve$

31*. Consider a reaction aG + bH $\rightarrow$ Products. When concentration of both the reactants G and H is doubled, the rate increases by eight times. However, when concentration of G is doubled keeping the concentration of H fixed, the rate is doubled. The overall order of the reaction is

(A) 0 (B) 1
(C) 2 (d) 3

## SECTION – II
## *Assertion – Reason Type*

**This section contains 4 questions numbered 32 to 35. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.**

32. STATEMENT-1 : Alkali metals dissolve in liquid ammonia to give blue solutions.
**because**
STATEMENT-2 : Alkali metals in liquid ammonia give solvated species of the type $[M(NH_3)_n]^+$ (M = alkali metals).

(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

33. STATEMENT-1 : Glucose gives a reddish-brown precipitate with Fehling's solution.
**because**
STATEMENT-2 : Reaction of glucose with Fehling's solution gives CuO and gluconic acid.

(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

34. STATEMENT-1: Molecules that are not superimposable on their mirror images are chiral.
**because**
STATEMENT-2: All chiral molecules have chiral centres.

(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

35. STATEMENT-1 : Band gap in germanium is small.
**because**
STATEMENT-2 : The energy spread of each germanium atomic energy level is infinitesimally small.
(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

## SECTION – III

### *Linked Comprehension Type*

**This section contains 2 paragraphs $C_{36-38}$ and $C_{39-41}$. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.**

**$C_{36-38}$: Paragraph for Questions Nos. 36 to 38**

Redox reaction play a pivotal role in chemistry and biology. The values of standard redox potential (E°) of two half-cell reactions decide which way the reaction is expected to proceed. A simple example is a Daniel cell in which zinc goes into solution and coper gets deposited. Given below are a set of half-cell reactions (acidic medium) along with their E° (V with respect to normal hydrogen electrode) values. Using this data obtain the correct explanations to Questions 36-38.

| | |
|---|---|
| $I_2 + 2e^- \rightarrow 2I^-$ | E° = 0.54 |
| $Cl_2 + 2e^- \rightarrow 2Cl^-$ | E° = 1.36 |
| $Mn^{3+} + e^- \rightarrow Mn^{2+}$ | E° = 1.50 |
| $Fe^{3+} + e^- \rightarrow Fe^{2+}$ | E° = 0.77 |
| $Q_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ | E° = 1.23 |

36. Among the following, identify the correct statement.
(A) Chloride ion is oxidized $O_2$ (B) $Fe^{2+}$ is oxidized by iodine
(C) Iodide ion is oxidized by chlorine (D) $Mn^{2+}$ is oxidized by chlorine

37. While $Fe^{3+}$ is stable, $Mn^{3+}$ is not stable in acid solution because
(A) $O_2$ oxidises $Mn^{2+}$ to $Mn^{3+}$
(B) $O_2$ oxidises both $Mn^{2+}$ to $Mn^{3+}$ and $Fe^{2+}$ and $Fe^{3+}$
(C) $Fe^{3+}$ oxidizes $H_2O$ to $O_2$
(D) $Mn^{3+}$ oxidizes $H_2O$ to $O_2$

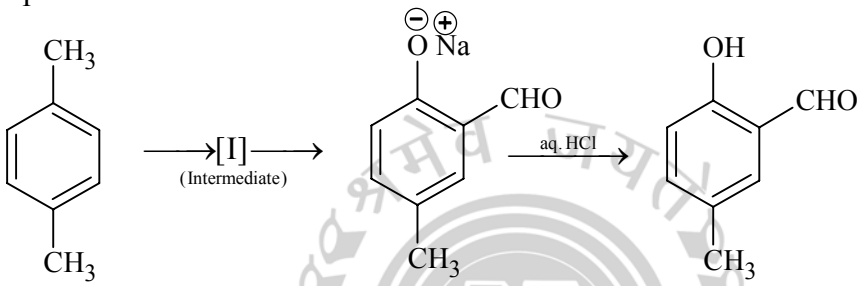
38. Sodium fusion extract, obtained from aniline, on treatment with iron (II) sulphate and $H_2SO_4$ in presence of air gives a Prussian blue precipitate. The blue colour is due to the formation of

(A) $Fe_4[Fe(CN)_6]_3$ (B) $Fe_3[Fe(CN)_6]_2$

(C) $Fe_4[Fe(CN)_6]_2$ (D) $Fe_3[Fe(CN)_6]_3$

**$C_{39-41}$ : Paragraph for Questions Nos. 39 to 41**

Riemer-Tiemann reaction introduces an aldehyde group, on to the aromatic ring of phenol, ortho to the hydroxyl group. This reaction involves electophilic aromatic substitution. This is a general method for the synthesis of substituted salicylaldehydes as depicted below.




(I) (II) (III)

39. Which one of the following reagents is used in the above reaction?

(A) aq. NaOH + $CH_3Cl$ (B) aq. NaOH + $CH_2Cl_2$

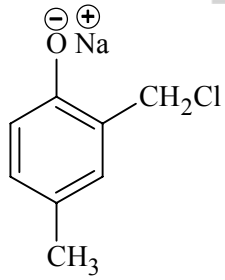
(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + $CCl_4$

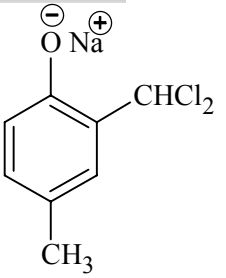
40. The electrophile in this reaction is

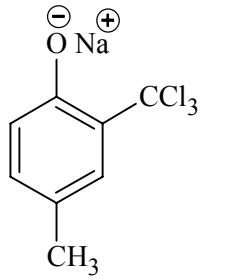
(A) :CHCl (B) $^{+}CHCl_2$

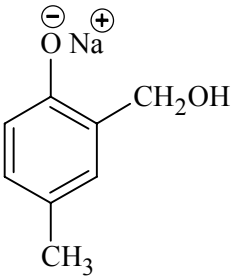
(C) $:CCl_2$ (D) $.CCl_3$

41. The structure of the intermediate I is

(A) 


(B) 


(C) 

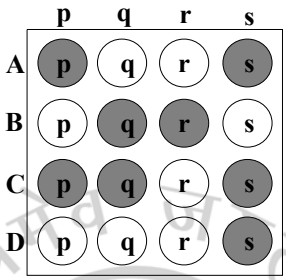

(D) 

## SECTION – IV

### *Matrix-Match Type*

***This section contains 3 questions. Each questions 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-p, A-s, B-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4 × 4 matrix should be as follows:




42*. Match the complexes in **Column I** with their properties listed in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.

| **Column I** | | **Column II** | |
|---|---|---|---|
| (A) | $O_2^- \rightarrow O_2 + O_2^{2-}$ | (p) | redox reaction |
| (B) | $CrO_4^{2-} + H^+ \rightarrow$ | (q) | one of the products has trigonal planar structure |
| (C) | $MnO_4^- + NO_2^- + H^+ \rightarrow$ | (r) | dimeric bridged tetrahedral metal ion |
| (D) | $NO_3^- + H_2SO_4 + Fe^{2+} \rightarrow$ | (s) | disproportionation |

43. Match the chemical substances in **Column I** with type of polymers/type of bonds in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.

| **Column I** | | **Column II** |
|---|---|---|
| (A) | $C_6H_5CHO$ | (p) gives precipitate with 2, 4-dinitrophenylhydrazine |
| (B) | $CH_3C{\equiv}CH$ | (q) gives precipitate with $AgNO_3$ |
| (C) | $CN^-$ | (r) is a nucleophile |
| (D) | $I^-$ | (s) is involved in cyanohydrin formation |

44. Match gases under specified conditions listed in **Column I** with their properties/laws in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.

| **Column I** | | **Column II** | |
|---|---|---|---|
| (A) | simple cubic and face-centered cubic | (p) | have these cell parameters a = b = c and $\alpha = \beta = \gamma$ |
| (B) | cubic and rhombohedral | (q) | are two crystal systems |
| (C) | cubic and tetragonal | (r) | have only two crystallographic angles of 90° |
| (D) | hexagonal and monoclinic | (s) | belong to same crystal system |

# Mathematics

## SECTION – I

***This section contains 9 multiple choice questions numbered 45 to 53. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.***

45*. Let O(0, 0), P(3, 4), Q(6, 0) be the vertices of the triangle OPQ. The point R inside the triangle OPQ is such that the triangles OPR, PQR, OQR are of equal area. The coordinates of R are

(a) $\left(\frac{4}{3}, 3\right)$ (b) $\left(3, \frac{2}{3}\right)$

(c) $\left(3, \frac{4}{3}\right)$ (d) $\left(\frac{4}{3}, \frac{2}{3}\right)$

46*. If $|z| = 1$ and $z \neq \pm 1$, then all the value of $\frac{z}{1-z^2}$ lie on

(a) a line not passing through the origin (b) $|z| = \sqrt{2}$

(c) the x-axis (d) the y-axis

47. Let $E^C$ denote the complement of an E. Let E, F, G be pairwise independent events with $P(G) > 0$ and $P(E \cap F \cap G) = 0$. Then $P(E^C \cap F^C \mid G)$ equals

(a) $P(E^C) + P(F^C)$ (b) $P(E^C) - P(F^C)$

(c) $P(E^C) - P(F)$ (d) $P(E) - P(F^C)$

48. $\frac{d^2x}{dy^2}$ equals

(a) $\left(\frac{d^2y}{dx^2}\right)^{-1}$ (b) $-\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-3}$

(c) $\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-2}$ (d) $-\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-3}$

49. The differential equation $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$ determines a family of circles with

(a) variable radii and fixed centre at (0, 1)

(b) variable radii and a fixed centre at (0, –1)

(c) fixed radius 1 and variable centres along the x-axis

(d) fixed radius 1 and variable centres along the y-axis

50. Let $\vec{a}, \vec{b}, \vec{c}$ be unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Which one of the following is correct?

(a) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a} = \vec{0}$

(b) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a} \neq \vec{0}$

(c) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{a} \times \vec{c} \neq \vec{0}$

(d) $\vec{a} \times \vec{b}, \vec{b} \times \vec{c}, \vec{c} \times \vec{a}$ are mutually perpendicular

51*. Let ABCD be a quadrilateral with area 18, with side AB parallel to the side CD and AB = 2CD. Let AD be perpendicular to AB and CD. If a circle is drawn inside the quadrilateral ABCD touching all the sides, then its radius is

(a) 3 (b) 2

(c) $\frac{3}{2}$ (d) 1

52. Let $f(x)=\frac{x}{(1+x)^{1/n}}$ for $n \geq 2$ and $g(x)=\underbrace{(fofo...of)}_{f \text{ occurs n times}}(x)$. Then $\int x^{n-2}g(x)dx$ equals

(a) $\frac{1}{n(n-1)}(1+nx^n)^{1-\frac{1}{n}}+K$ (b) $\frac{1}{n-1}(1+nx^n)^{1-\frac{1}{n}}+K$

(c) $\frac{1}{n(n+1)}(1+nx^n)^{1+\frac{1}{n}}+K$ (d) $\frac{1}{n+1}(1+nx^n)^{1+\frac{1}{n}}+K$

53*. The letters of the word COCHIN are permuted and all the permutations are arranged in an alphabetical order as in an English dictionary. The number of words that appear before the word COCHIN is

(a) 360 (b) 192

(c) 96 (d) 48

## SECTION – II

### *Assertion – Reason Type*

***This section contains 4 questions numbered 54 to 57. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.***

54. Consider the planes $3x - 6y - 2z = 15$ and $2x + y - 2z = 5$.

STATEMENT-1 : The parametric equations of the line of intersection of the given planes are

$x = 3 + 14t$, $y = 1 + 2t$, $z = 15t$.

Because

STATEMENT-2 : The vector $14\hat{i}+2\hat{j}+15\hat{k}$ is parallel to the line of intersection of given planes

(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

55*. STATEMENT-1 : The curve $y=\frac{-x^2}{2}+x+1$ is symmetric with respect to the line $x = 1$.

Because

STATEMENT-2 : A parabola is symmetric about its axis.

(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

56. Let $f(x) = 2 + \cos x$ for all real x.
STATEMENT-1 : For each real t, there exists a point c in $[t, t + \pi]$ such that $f'(c) = 0$.
Because
STATEMENT-2 : $f(t) = f(t + 2\pi)$ for each real t.
(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

57*. Lines $L_1 : y - x = 0$ and $L_2 : 2x + y = 0$ intersect the line $L_3 : y + 2 = 0$ at P and Q, respectively. The bisector of the acute angle between $L_1$ and $L_2$ intersects $L_3$ at R.
STATEMENT-1 : The ratio PR : RQ equals $2\sqrt{2} : \sqrt{5}$.
Because
STATEMENT-2 : In any triangle, bisector of an angle divides the triangle into two similar triangles.
(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



## SECTION – III

### *Linked Comprehension Type*

**This section contains 2 paragraphs $C_{58-60}$ and $C_{61-63}$. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.**

**$M_{58-60}$ : Paragraph for Question Nos. 58 to 60**

Let $A_1$, $G_1$, $H_1$ denote the artithmetic, geometric and harmonic means, respectivley, of two distinct positive numbers. For $n \geq 2$, let $A_{n-1}$ and $H_{n-1}$ have arithmetic, geometric and harmonic means as $A_n$, $G_n$, $H_n$ respectively.

58*. Which one of the following statements is correct?
(A) $G_1 > G_2 > G_3 > ...$ (B) $G_1 < G_2 < G_3 < ...$
(C) $G_1 = G_2 = G_3 = ...$ (G) $G_1 < G_3 < G_5 < ...$ and $G_2 > G_4 > G_6 > ...$

59*. Which one of the following statements is correct?
(A) $A_1 > A_2 > A_3 > ...$ (B) $A_1 < A_2 < A_3 <$
(C) $A_1 > A_3 > A_5 > ...$ and $A_2 < A_4 < A_6 < ...$ (D) $A_1 < A_3 < A_5 < ...$ and $A_2 > A_4 > A_6 > ...$

60*. Which one of the following statements is correct?
(A) $H_1 > H_2 > H_3 > ...$
(B) $H_1 < H_2 < H_3 < ...$
(C) $H_1 > H_3 > H_5 > ...$ and $H_2 < H_4 < H_6 < ...$
(D) $H_1 < H_3 < H_5 < H_2 > H_4 > H_6 > ...$

**$M_{61\text{-}63}$ : Paragraph for Question Nos. 61 to 63**

If a continuous function f defined on the real line R, assumes positive and negative values in R then the equation f(x) = 0 has a root in R. For example, if it is known that a continuous function f on R is positive at some point and its minimum value is negative then the equation f(x) = 0 has a root in R.
Consider $f(x) = ke^x - x$ for all real x where k is a real constant.

61. The line y = x meets $y = ke^x$ for $k \le 0$ at
(A) no point (B) one point
(C) two points (D) more than two points

62. The positive value of k for which $ke^x - x = 0$ has only one root is
(A) $\frac{1}{e}$ (B) 1
(C) e (D) $\log_e 2$

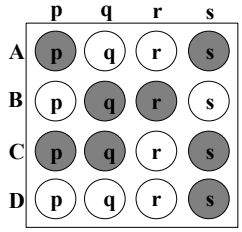
63. For k > 0, the set of all values of k for which $ke^x - x = 0$ has two distinct roots is
(A) $\left(0, \frac{1}{e}\right)$ (B) $\left(\frac{1}{e}, 1\right)$
(C) $\left(\frac{1}{e}, \infty\right)$ (D) (0, 1)

## SECTION – IV

## *Matrix-Match Type*

***This section contains 3 questions. Each questions 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-p, A-s, B-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4 × 4 matrix should be as follows:




64. Let $f(x) = \frac{x^2 - 6x + 5}{x^2 - 5x + 6}$

Match the expression/statements in Column I with expression/statements in Column II and indicate your answer by darkening the appropriate bubbles in the 4 × 4 matrix given in the ORS.

| | Column I | | Column II |
|---|---|---|---|
| (A) | If $-1 < x < 1$, then f(x) satisfied | (p) | $0 < f(x) < 1$ |
| (B) | If $1 < x < 2$, then f(x) satisfies | (q) | $f(x) < 0$ |
| (C) | If $3 < x < 5$, then f(x) satisfies | (r) | $f(x) > 0$ |
| (D) | If $x > 5$, then f(x) satisfies | (s) | $f(x) < 1$ |

65*. Let (x, y) be such that

$$\sin^{-1}(ax) + \cos^{-1}(y) + \cos^{-1}(bxy) = \frac{\pi}{2}$$

Match the statements in Column I with statements in Column II and indicate your answer by darkening the appropriate bubbles in the 4 × 4 matrix given in the ORS.

| | Column I | | Column II |
|---|---|---|---|
| (A) | If $a = 1$ and $b = 0$, then (x, y) | (p) | lies on the circle $x^2 + y^2 = 1$ |
| (B) | If $a = 1$ and $b = 1$, then (x, y) | (q) | lies on $(x^2 - 1)(y^2 - 1) = 0$ |
| (C) | If $a = 1$ and $b = 2$, then (x, y) | (r) | lies on $y = x$ |
| (D) | If $a = 2$ and $b = 2$, then (x, y) | (s) | lies on $(4x^2 - 1)(y^2 - 1) = 0$ |

66*. Match the statements in Column I with properties in Column II and indicate your answer by darkening the appropriate bubbles in the 4 × 4 matrix given in the ORS.

| | Column I | | Column II |
|---|---|---|---|
| (A) | Two intersecting circles | (p) | have a common tangent |
| (B) | Two mutually external circles | (q) | have a common normal |
| (C) | Two circles, one strictly inside the other | (r) | do not have a common tangent |
| (D) | Two branches of a hyperbola | (s) | do not have a common normal |

# Answer Key

**PHYSICS**

| | |
|---|---|
| 1. | (A) |
| 2. | (B) |
| 3. | (D) |
| 4. | (D) |
| 5. | (B) |
| 6. | (B) |
| 7. | (C) |
| 8. | (A) |
| 9. | (A) |
| 10. | (D) |
| 11. | (B) |
| 12. | (A) |
| 13. | (B) |
| 14. | (B) |
| 15. | (A) |
| 16. | (A) |
| 17. | (A) |
| 18. | (C) |
| 19. | (B) |
| 20. | (A) – (p)<br>(B) – (q, (r)<br>(C) – (p)<br>(D) – (q, (r) |
| 21. | (A) – (q), (r)<br>(B) – (p)<br>(C) – (q), (r)<br>(D) – (q) |
| 22. | (A) – (s)<br>(B) – (q)<br>(C) – (p, q)<br>(D) – (q, r) |

**CHEMISTRY**

| | |
|---|---|
| 23. | (D) |
| 24. | (D) |
| 25. | (B) |
| 26. | (A) |
| 27. | (A) |
| 28. | (A) |
| 29. | (C) |
| 30. | (A) |
| 31. | (D) |
| 32. | (B) |
| 33. | (C) |
| 34. | (C) |
| 35. | (B) |
| 36. | (C) |
| 37. | (D) |
| 38. | (A) |
| 39. | (C) |
| 40. | (C) |
| 41. | (B) |
| 42. | (A) → (p), (s)<br>(B) → (r)<br>(C) → (p), (q)<br>(D) → (p), (s) |
| 43. | (A) → (p), (s)<br>(B) → (r)<br>(C) → (q), (r), (s)<br>(D) → (q), (r) |
| 44. | (A) → (p), (s)<br>(B) → (p), (q)<br>(C) → (q)<br>(D) → (q), (r) |

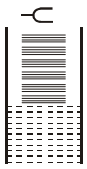
**MATHEMATICS**

| | |
|---|---|
| 45. | (C) |
| 46. | (D) |
| 47. | (C) |
| 48 | (D) |
| 49 | (C) |
| 50 | (B) |
| 51 | (B) |
| 52 | (A) |
| 53 | (C) |
| 54 | (D) |
| 55 | (A) |
| 56 | (B) |
| 57 | (C) |
| 58. | (C) |
| 59. | (A) |
| 60. | (B) |
| 61. | (B) |
| 62. | (A) |
| 63. | (A) |
| 64. | (A) → (p, (s)<br>(B) → (q)<br>(C) → (q)<br>(D) → (p) |
| 65. | (A) → (p)<br>(B) → (q)<br>(C) → (p)<br>(D) → (s) |
| 66. | (A) → (p), (q)<br>(B) → (p), (q)<br>(C) → (q), (r)<br>(D) → (q), (r) |

# Solutions

## Physics

1. **(A)**



2. **(B)** $Y = \dfrac{4MgL}{\pi d^2 l}$

$$\frac{\delta Y}{Y} = 2\frac{\delta d}{d} + \frac{\delta \ell}{\ell} = \frac{2}{40} + \frac{5}{80} = \frac{9}{80}$$

$$\delta Y = 2 \times \frac{9}{80} \simeq 0.2 .$$

3. **(D)** $\vec{P}_t = A\cos kt\hat{i} - A\sin kt\,\hat{j}$

$$\vec{F_t} = \frac{d\vec{P}}{dt} = -Ak\sin kt\,\hat{i} - Ak\cos kt\,\hat{j}$$

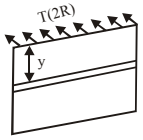
$\vec{P_t} \cdot \vec{F_t} = -A^2 k\sin kt\cos kt + A^2 k\sin kt\cos kt = 0$ ; So, $\vec{P_t}$ is perpendicular to $\vec{F_t}$ .

4. **(D)** $mgh = \frac{1}{2}I\left(\frac{V}{r}\right)^2 + \frac{1}{2}mV^2$ ; But $h = \frac{3V^2}{4g}$

$\therefore \quad mg\frac{3V^2}{4g} = \frac{1}{2}\frac{IV^2}{r^2} + \frac{mV^2}{2} \Rightarrow \frac{mV^2}{4} = \frac{1}{2}I\frac{V^2}{r^2} \Rightarrow I = \frac{mr^2}{2}$(Disc)

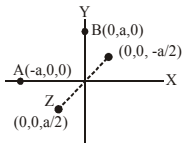
5. **(B)** $F_T = 2RT$ ; $dF_P = (P_0 + \rho gy)2Rdy \Rightarrow F_P = 2R\int_0^h (P_0 + \rho gy)\, dy = 2R\left(P_0h + \frac{\rho gh^2}{2}\right)$

$F_{net} = F_P - F_T = 2R\left(P_0h + \frac{\rho gh^2}{2} - T\right)$ ; $F_{net} = 2P_0Rh + R\rho gh^2 - 2RT$




6. **(B)** Electric field inside a cavity (non-concentric with sphere) is uniform.

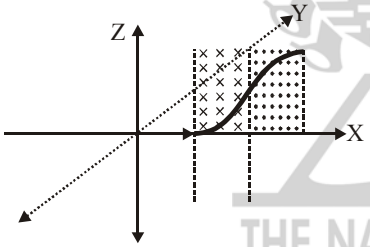
7. **(C)** $V_A = V_B$. So work done is zero.




8. **(A)** When $a < x < 2a$

$\vec{F_m}$ acts along positive z-direction.

When $2a < x < 3a$ $\vec{F_m}$ acts along negative z-direction.




9. **(A)** For electrons $p = \frac{h}{\lambda}$. So KE of electrons $= \frac{p^2}{2m} = \frac{h^2}{2m\lambda^2}$

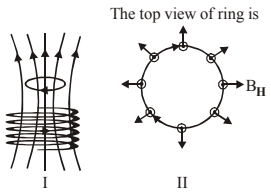
Now for cut off wavelength

$(KE)_{\text{of electrons}} = \frac{hc}{\lambda_{min}} \Rightarrow \frac{h^2}{2m\lambda^2} = \frac{hc}{\lambda_{min}}$ ; $\lambda_{min} = \frac{c2m\lambda^2}{h}$

10. **(D)** If external force acting on a body passes through centre of mass then torque acting on body about centre of mass is zero but velocity of centre of mass keeps on changing.

11. **(B)** The statement-I : Law of inertia of rest
Statement II : Newton's third law of motion

12. **(A)**




$\rightarrow$ Represents horizontal component of magnetic field

⊙ Represents vertical component of magnetic field

From diagram it is clear that horizontal component of magnetic field will interact with induced current. The resulting magnetic force will act opposite to weight of ring.

13. **(B)** According to kinetic theory of gases

Translational kinetic energy of an ideal gas $= \frac{3}{2}nRT = \frac{3}{2}PV$ .

14. **(B)** The speed of sound in air is 340 m/s; the passengers in A are moving at 20 m/s against the direction of propagation while those in B are moving at 30 m/s in the direction of propagation.

15. **(A)** The engine as well as the passengers in train A are moving with the same velocity, therefore the distribution of sound intensity in the whistle remains unchanged.

16. **(A)** The spread in frequency (as observed by passengers in B)

$$= \Delta f.\frac{1-\frac{30}{340}}{1-\frac{20}{340}} = 320\times\frac{310}{320} = 310 \text{ Hz.}$$

17. **(A)** Light travels as a parallel beam as the wavefronts are plane and parallel to each other.

18. **(C)** The phase remains unchanged over a wavefront i.e.

$\phi_c = \phi_d$ and $\phi_e = \phi_f$

$\therefore$ $\phi_d - \phi_f = \phi_c - \phi_e$.

19. **(B)** As the wavefront propagates into medium – 2 light bends towards the normal.

20. (A) – (p), (B) – (q, r) , (C) – (p), (D) – (q, r)

21. (A) – (r, q), (B) – (p), (C) – (q), (r), (D) – (q)

22. (A) – (s), (B) – (q), (C) – (p, q), (D) – (q, r)

# Chemistry

23. **(D)** Mohr salt is $\overset{II}{Fe}SO_4\cdot(NH_4)_2SO_4\cdot 6H_2O$

$\underset{n-factor=1}{Fe^{2+}} \longrightarrow Fe^{3+} + e$ (oxidation)

The number of mole of $Fe^{2+}$ per mole of Mohr salt = 1

So, n-factor of Mohr salt = 1 × 1 = 1

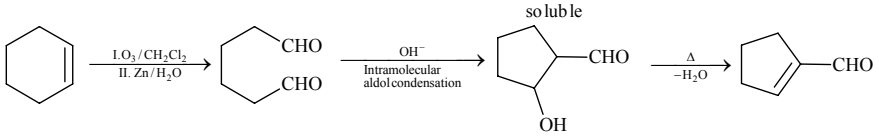
$\underset{n-factor=6}{Cr_2O_7^{2-}} + 14H^+ + 6e \longrightarrow 2Cr^{3+} + 7H_2O$ (reduction)

Mole ratio is inverse of n-factor ratio

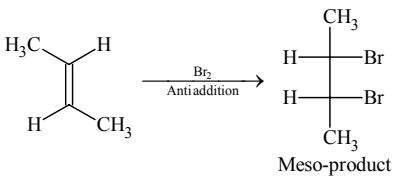
24. **(D)** $V^-$ ion carrying –ve charge will form most stable $d_\pi - p_\pi$ bonding (called back bonding) with C-atom of carbonyl ligand reducing thereby the C – O bond order.

25. **(B)** $Hg^{2+} + 2I^- \longrightarrow HgI_2$ ; $HgI_2 + 2I^- \longrightarrow [HgI_4]^{2-}$

26. **(A)**




27. **(A)**




Meso-product

28. **(A)** +ve charges occur at the consecutive carbon atoms and –ve charge on carbon compared to that on oxygen is less likely.

29. **(C)** $^{23}_{11}Na \longrightarrow ^{23}_{10}Ne + ^{0}_{+1}e$

$$\frac{\text{Mass number}}{\text{Atomic number}} = \frac{23}{10}$$

30. **(A)** The given change is the change occurring at boiling point where there is equilibrium between liquid and vapour phase at a given P and T, and hence $\Delta G = 0$. Also due to absorption of heat as latent heat of vaporization, or due to change from liquid to gas there is increase in disorderness and $\Delta S$ = +ve.

31. **(D)** Rate law = Rate $\propto [G][H]^2$

32. **(B)** The blue colouration is due to the ammoniation of electron $[e_{(NH_3)_x}]^-$

33. **(C)** Glucose reduces Fehling solution to give $Cu_2O$ rather than CuO and is itself oxidized to gluconic acid

34. **(C)** Alenes, O, O′ substituted biphenyl is etc. though do not contain chiral carbon yet these molecules are chiral.

35. **(B)**

36. **(C)** $I_2, I^- \| Cl^- | Cl_2$ (1 atm)

Cell reaction

$2I^- + Cl_2 \longrightarrow I_2 + 2Cl^-$

$E^0_{cell} = E^0_{right\ (redn)} - E^0_{left\ (redn)}$

$= 1.36 - 0.54$

$= 0.82V$

$E^0_{cell}$ is +ve so the atoms cell reaction is possible.

37. **(D)** $Mn^{3+} + e^- \longrightarrow Mn^{2+}$ ] × 4

$2H_2O \longrightarrow 4H^+ + O_2 + 4e^-$

$4Mn^{2+} + 2H_2O \longrightarrow 4Mn^{2+} + 4H^+ + O_2\uparrow$

$E^0_{cell} = 1.50 - 1.23$

$= 0.27V$

$E^0_{cell}$ is +ve hence it is feasible

38. **(A)** $Na + C + N \longrightarrow \underset{(Na-extract)}{NaCN}$

$Fe^{2+} + 6CN^- \longrightarrow [Fe(CN)_6]^{4-}$

$4Fe^{3+} + 3[Fe(CN)_6]^{4-} \longrightarrow \underset{\text{Prussian blue}}{Fe_4(Fe(CN)_6]_3}$

39. **(C)**

40. **(C)**

41. **(B)**

42. **(A)** → (p), (s), **(B)** → (r), **(C)** → (p), (q), **(D)** → (p), (s)

$Fe^{++} + NO_3^- + H_2O \longrightarrow Fe^{+++} + NO + SO_4^{--} + H_2O$

$Fe^{++} + NO + 5H_2O \longrightarrow [Fe(H_2O)_5NO]^{++}$

43*. **(A)** → (p), (s), **(B)** → (r), **(C)** → (q), (r), s), **(D)** → (q), (r)

* Ammonical $AgNO_3$ solution will only react with $C_6H_5CHO$ and with $CH_3C \equiv CH$

44. **(A)** → (p), (s)

**(B)** → (p), (q)

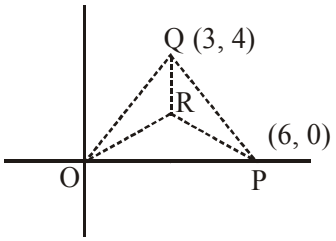
**(C)** → (q)

**(D)** → (q), (r)

# Mathematics

45. **(C)** R is centroid $= \left(\frac{0+3+6}{3}, \frac{0+4+0}{3}\right)$

$= \left(3, \frac{4}{3}\right)$

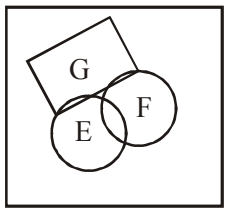



46. **(D)** $|z| = 1,\ z \neq \pm 1$

$$\frac{z}{1-z^2} = \frac{z}{|z|^2 - z^2} = \frac{z}{z\bar{z} - z^2} = \frac{1}{\bar{z} - z} = \text{purely imaginary.}$$

Hence $\frac{z}{1-z^2}$ lie on the y-axis.

47. **(C)** $P(E^c \cap F^C / G) = \frac{P(E^C \cap F^C \cap G)}{P(G)}$




$$= \frac{P(G) - P(E \cap G) - P(F \cap G)}{P(G)}$$

$= 1 - P(E) - P(F)$

$= P(E^C) - P(F)$

48. **(D)** $\frac{dx}{dy} = \frac{1}{\frac{dy}{dx}}$

$$\frac{d^2x}{dy^2} = -\frac{1}{\left(\frac{dy}{dx}\right)^2} \frac{d}{dy}\left(\frac{dy}{dx}\right)$$

$$\frac{d^2x}{dy^2} = -\left(\frac{dy}{dx}\right)^{-3} \frac{d^2y}{dx^2}$$

49. **(C)** We have

$$\int \frac{ydy}{\sqrt{1-y^2}} = \int dx$$

$\Rightarrow \quad -\sqrt{1-y^2} = x + c$

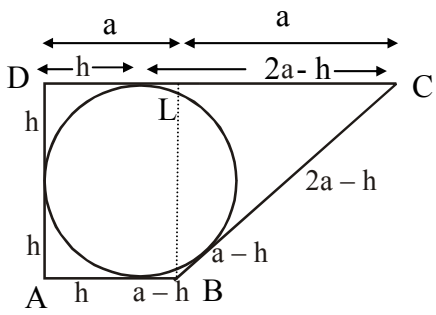
$\Rightarrow (x + c)^2 + y^2 = 1$

50. **(B)** $\vec{a} + \vec{b} + \vec{c} = 0$

$\Rightarrow \quad \vec{a}, \vec{b}, \vec{c}$ are coplanar

$\Rightarrow \quad \vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}$

51. **(B)** Let AB = a and AD = 2h




In triangle BCL ,

$a^2 + 4h^2 = (3a - 2h)^2$

$a = \frac{3h}{2}$

$\frac{1}{2}\times 3a\times 2h = 18$

$h = 2$

Radius = 2 unit.

52. **(A)** $f(x) = \frac{x}{(1+x^n)^{\frac{1}{n}}}$

Clearly, $fof = \frac{x}{(1+2x^n)^{\frac{1}{n}}}$

$g(x) = \frac{fof....f}{n \text{ times}} = \frac{x}{(1+nx^n)^{\frac{1}{n}}}$

$I = \int x^{n-2}g(x)dx = \int \frac{x^{n-1}}{(1+nx^n)^{\frac{1}{n}}}dx$

Put $1 + nx^n = t^n$

$I = \frac{1}{n}\int t^{n-1}\frac{dt}{t}$

$= \frac{1}{n(n-1)}(1+nx^n)^{\frac{n-1}{n}} + c$

53. **(C)** COCHIN

CH – 24

CI – 24

CC – 24

CN – 24 Ans. 96

54. **(D)** Line of intersection in $3x - 6y - 2z - 15 = 0 = 2x + y - 2z = 5$

Dr's of line are parallel to $(3\hat{i}-6\hat{j}-2\hat{k})\times(2\hat{i}+\hat{j}-2\hat{k}) = 14\hat{i}+2\hat{j}+15\hat{k}$

Statement:2 is true

Now since none of the plane is parallel to xy plane

Put z = 0,

$\Rightarrow \quad 3x - 6y - 15 = 0$

$2x + y - 5 = 0$

On solving x = 3, y = –1

Parametric equation of line is

$\frac{x-3}{14} = \frac{y+1}{2} = \frac{z-0}{15} = t$

$\Rightarrow$ Statement 1 is false

55. **(A)** $2y = -x^2 + 2x + 2$

$$2\left(y - \frac{3}{2}\right) = -(x-1)^2$$

Axis is $x = 1$

Parabola is symmetric about $x = 1$

56. **(B)** Statement – 1 :

$\Rightarrow f'(x) = -\sin x$

Now $f'(t) \times f'(t+\pi) = -\sin^2 t < 0$

$\Rightarrow$ $f'(x) = 0$ in $[t, t+\pi]$ $\Rightarrow$ True

Statement – 2:

$\Rightarrow$ True, because f(x) is periodic with period $2\pi$.

But Statement 1 and 2 are not related.

57. **(C)** Bisector of acute angle $\frac{x-y}{\sqrt{2}} = -\frac{2x+y}{\sqrt{5}}$

Statement:-1

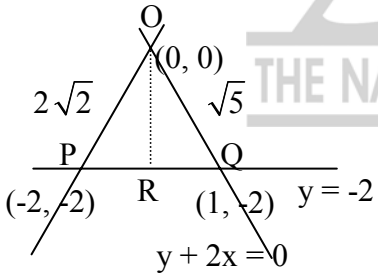
$$L \equiv \left(\frac{1}{\sqrt{2}} + \frac{2}{\sqrt{5}}\right)x - \left(\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{5}}\right)y = 0$$

$$L(-2, -2) = -\frac{6}{\sqrt{5}}$$

$$L(1, -2) = \frac{3}{\sqrt{2}} \quad \Rightarrow \quad \frac{PR}{RQ} = -\frac{\left(-\frac{6}{\sqrt{5}}\right)}{\frac{3}{\sqrt{2}}} = 2\sqrt{2} : \sqrt{5}$$

Statement:-2 Clearly, false .

**Alternate:**




$$\frac{PR}{RQ} = \frac{OP}{OQ} = \frac{2\sqrt{2}}{\sqrt{5}}$$

58 **(C)** $A_n = \frac{A_{n-1} + H_{n-1}}{2}$

$G_n = \sqrt{A_{n-1} H_{n-1}}$

$H_n = \frac{2H_{n-1} A_{n-1}}{A_{n-1} + H_{n-1}}$

$\Rightarrow G_n^2 = A_n H_n \Rightarrow A_n H_n = A_{n-1} H_{n-1}$

$\Rightarrow A_n H_n = ab$

$\Rightarrow G_1 = G_2 = G_3 \ldots\ldots = G_n = \sqrt{ab}$

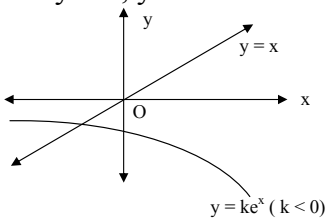
59. **(A)** Consider $A_n - A_{n-1} = \frac{A_{n-1} + H_{n-1}}{2} - A_{n-1}$

$= \frac{H_{n-1} - A_{n-1}}{2} < 0$ (as $A_{n-1} > H_{n-1}$) $\Rightarrow A_n - A_{n-1} < 0 \Rightarrow A_1 > A_2 > A_3 ..... > A_n$

60. **(B)** As $H_n = \frac{ab}{A_n}$

$\Rightarrow H_1 < H_2 < H_3 .... < H_n$

61. **(B)** Let $y = x$, $y = ke^x$




62. **(A)** Let $f(x) = xe^{-x} - k$ & $g(x) = k$

$f(x) = xe^{-x}$

$f'(x) = e^{-x}(1 - x) = 0 \Rightarrow x = 1$

$1/e = k$

The value of k for which f(x) has one root.

**Alternate:**

Consider $y = ke^x$ and $y = x$

$\frac{dy}{dx} = ke^x \Rightarrow \left.\frac{dy}{dx}\right|_{x_1} = ke^{x_1} \Rightarrow ke^{x_1} = 1 \Rightarrow k = \frac{1}{e^{x_1}}$

and $x_1 = k\, e^{x_1} \Rightarrow x_1 = 1 \Rightarrow k = \frac{1}{e}$

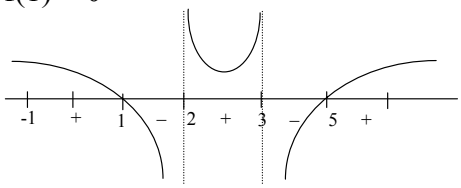
63. **(A)**

64. **(A – p,s; B-q; C-q; D-p)**

$f(x) = \frac{(x-1)(x-5)}{(x-2)(x-3)}$

$f(-1) = 1$

$f(1) = 0$




65. **(A-p; B-q; C-p; D-s)**

$\sin^{-1} ax + \cos^{-1} bxy = \sin^{-1} y$

$ax.bxy + \sqrt{1-a^2x^2}\sqrt{1-b^2x^2y^2} = y$

$(1 - a^2x^2)(1 - b^2x^2y^2) = y^2(1 - abx^2)^2$

(A) $a = 1, b = 0$ then $1 - x^2 = y^2 \Rightarrow x^2 + y^2 = 1$

(b) $a = 1, b = 1$ then $(1 - x^2)(1 - x^2y^2) = y^2(1 - x^2)^2$

$\Rightarrow (1 - x^2)(1 - y^2) = 0$

(c) $a = 1, b = 2$ then $(1 - x^2)(1 - 4x^2y^2) = y^2(1 - 2x^2)^2$

$\Rightarrow x^2 + y^2 = 1$

(d) $a = 2, b = 2$ then $(1 - 4x^2)(1 - 4x^2y^2) = y^2(1 - 4x^2)^2$

$\Rightarrow (1 - 4x^2)(1 - y^2) = 0$

66. **(A-p, q; B-p, q; C-q, r; D-q, r)**

## MARKGING SCHEME

1. For each question in **Section I,** you will be **awarded 3 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (–1)** mark will be awarded.

2. For each question in **Section II,** you will be **awarded 3 marks** if you darken only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (–1)** mark will be awarded.

3. For each question in **Section III,** you will be awarded 4 marks if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, **minus one (–1)** mark will be awarded.

4. For each question in **Section IV**, you will be **awarded 6 marks** if you darken All the bubbles corresponding ONLY to the correct answer. **No negative mark will be awarded for an incorrectly bubbled answer.**

# CODE CHART

## CODE WISE SHUFFLING OF QUESTIONS [IIT 0 7] [PAPER - 2]

| CODE 0 Q. NO. | CODE 0 KEY | CODE 1 | CODE 2 | CODE 3 | CODE 4 | CODE 5 | CODE 6 | CODE 7 | CODE 8 | CODE 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | (A) | 3 | 6 | 5 | 8 | 9 | 2 | 9 | 7 | 4 |
| 2 | (B) | 1 | 4 | 3 | 6 | 8 | 1 | 7 | 5 | 2 |
| 3 | (D) | 5 | 8 | 7 | 9 | 7 | 4 | 8 | 9 | 6 |
| 4 | (D) | 2 | 2 | 1 | 4 | 6 | 3 | 5 | 3 | 1 |
| 5 | (B) | 7 | 9 | 9 | 7 | 5 | 6 | 6 | 8 | 8 |
| 6 | (B) | 4 | 1 | 2 | 2 | 4 | 5 | 3 | 1 | 3 |
| 7 | (C) | 9 | 7 | 8 | 5 | 3 | 8 | 4 | 6 | 9 |
| 8 | (A) | 6 | 3 | 4 | 1 | 2 | 7 | 1 | 2 | 5 |
| 9 | (A) | 8 | 5 | 6 | 3 | 1 | 9 | 2 | 4 | 7 |
| 10 | (D) | 12 | 12 | 13 | 10 | 11 | 11 | 10 | 11 | 13 |
| 11 | (B) | 10 | 13 | 12 | 12 | 10 | 10 | 11 | 13 | 11 |
| 12 | (A) | 13 | 10 | 11 | 11 | 13 | 13 | 12 | 10 | 12 |
| 13 | (B) | 11 | 11 | 10 | 13 | 12 | 12 | 13 | 12 | 10 |
| 14 | (B) | 14 | 17 | 14 | 17 | 14 | 17 | 14 | 17 | 17 |
| 15 | (A) | 15 | 18 | 15 | 18 | 15 | 18 | 15 | 18 | 18 |
| 16 | (A) | 16 | 19 | 16 | 19 | 16 | 19 | 16 | 19 | 19 |
| 17 | (A) | 17 | 14 | 17 | 14 | 17 | 14 | 17 | 14 | 14 |
| 18 | (C) | 18 | 15 | 18 | 15 | 18 | 15 | 18 | 15 | 15 |
| 19 | (B) | 19 | 16 | 19 | 16 | 19 | 16 | 19 | 16 | 16 |
| 20 | (A) (p)<br>(B) (q), (r)<br>(C) (p)<br>(D) (q), (r) | 22 | 20 | 20 | 22 | 20 | 21 | 20 | 20 | 20 |
| 21 | (A) (r), (q)<br>(B) (p)<br>(C) (q), (r)<br>(D) (p) | 20 | 22 | 21 | 20 | 22 | 20 | 22 | 21 | 22 |
| 22 | (A) (s)<br>(B) (q)<br>(C) (p), (q)<br>(D) (q), (r) | 21 | 21 | 22 | 21 | 21 | 22 | 21 | 22 | 21 |
| 23 | (D) | 25 | 28 | 27 | 30 | 31 | 24 | 31 | 29 | 26 |
| 24 | (D) | 23 | 26 | 25 | 28 | 30 | 23 | 29 | 27 | 24 |
| 25 | (B) | 27 | 30 | 29 | 31 | 29 | 26 | 30 | 31 | 28 |
| 26 | (A) | 24 | 24 | 23 | 26 | 28 | 25 | 27 | 25 | 23 |
| 27 | (A) | 29 | 31 | 31 | 29 | 27 | 28 | 28 | 30 | 30 |
| 28 | (A) | 26 | 23 | 24 | 24 | 26 | 27 | 25 | 23 | 25 |
| 29 | (C) | 31 | 29 | 30 | 27 | 25 | 30 | 26 | 28 | 31 |
| 30 | (A) | 28 | 25 | 26 | 23 | 24 | 29 | 23 | 24 | 27 |
| 31 | (D) | 30 | 27 | 28 | 25 | 23 | 31 | 24 | 26 | 29 |
| 32 | (B) | 34 | 34 | 35 | 32 | 33 | 33 | 32 | 33 | 35 |
| 33 | (C) | 32 | 35 | 34 | 34 | 32 | 32 | 33 | 35 | 33 |
| 34 | (C) | 35 | 32 | 33 | 33 | 35 | 35 | 34 | 32 | 34 |
| 35 | (B) | 33 | 33 | 32 | 35 |  | 34 | 35 | 34 | 32 |

| CODE 0 Q. NO. | CODE 0 KEY | CODE 1 | CODE 2 | CODE 3 | CODE 4 | CODE 5 | CODE 6 | CODE 7 | CODE 8 | CODE 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 36 | (C) | 36 | 39 | 36 | 39 | 36 | 39 | 36 | 39 | 39 |
| 37 | (D) | 37 | 40 | 37 | 40 | 37 | 40 | 37 | 40 | 40 |
| 38 | (A) | 38 | 41 | 38 | 41 | 38 | 41 | 38 | 41 | 41 |
| 39 | (C) | 39 | 36 | 39 | 36 | 39 | 36 | 39 | 36 | 36 |
| 40 | (C) | 40 | 37 | 40 | 37 | 40 | 37 | 40 | 37 | 37 |
| 41 | (B) | 41 | 38 | 41 | 38 | 41 | 38 | 41 | 38 | 38 |
| 42 | (A) (p), (s)<br>(B) (r)<br>(C) (p), (s)<br>(D) (p), (s) | 44 | 42 | 43 | 44 | 42 | 43 | 44 | 42 | 44 |
| 43 | (A) (p), (s)<br>(B) (r)<br>(C) (q), (r), (s)<br>(D) (q), (r) | 42 | 44 | 44 | 42 | 44 | 42 | 43 | 43 | 43 |
| 44 | (A) (p), (s)<br>(B) (p), (q)<br>(C) (q)<br>(D) (q), (r) | 43 | 43 | 42 | 43 | 43 | 44 | 42 | 44 | 42 |
| 45 | (C) | 47 | 50 | 49 | 52 | 53 | 46 | 53 | 51 | 48 |
| 46 | (D) | 45 | 48 | 47 | 50 | 52 | 45 | 51 | 49 | 46 |
| 47 | (C) | 49 | 52 | 51 | 53 | 51 | 48 | 52 | 53 | 50 |
| 48 | (D) | 46 | 46 | 45 | 48 | 50 | 47 | 49 | 47 | 45 |
| 49 | (C) | 51 | 53 | 53 | 51 | 49 | 50 | 50 | 52 | 52 |
| 50 | (B) | 48 | 45 | 46 | 46 | 48 | 49 | 47 | 45 | 47 |
| 51 | (B) | 53 | 51 | 52 | 49 | 47 | 52 | 48 | 50 | 53 |
| 52 | (A) | 50 | 47 | 48 | 45 | 46 | 51 | 45 | 46 | 49 |
| 53 | (C) | 52 | 49 | 50 | 47 | 45 | 53 | 46 | 48 | 51 |
| 54 | (D) | 56 | 56 | 57 | 54 | 55 | 55 | 54 | 55 | 57 |
| 55 | (A) | 54 | 57 | 56 | 56 | 54 | 54 | 55 | 57 | 55 |
| 56 | (B) | 57 | 54 | 55 | 55 | 57 | 57 | 56 | 54 | 56 |
| 57 | (C) | 55 | 55 | 54 | 57 | 56 | 56 | 57 | 56 | 54 |
| 58 | (C) | 58 | 61 | 58 | 61 | 58 | 61 | 58 | 61 | 61 |
| 59 | (A) | 59 | 62 | 59 | 62 | 59 | 62 | 59 | 62 | 62 |
| 60 | (B) | 60 | 63 | 60 | 63 | 60 | 63 | 60 | 63 | 63 |
| 61 | (B) | 61 | 58 | 61 | 58 | 61 | 58 | 61 | 58 | 58 |
| 62 | (A) | 62 | 59 | 62 | 59 | 62 | 59 | 62 | 59 | 59 |
| 63 | (A) | 63 | 60 | 63 | 60 | 63 | 60 | 63 | 60 | 60 |
| 64 | (A) (p), (r), (s)<br>(B) (q), (s)<br>(C) (q), (s)<br>(D) (p), (r), (s) | 66 | 64 | 65 | 66 | 64 | 65 | 66 | 64 | 66 |
| 65 | (A) (p)<br>(B) (q)<br>(C) (p)<br>(D) (s) | 64 | 66 | 66 | 64 | 66 | 64 | 65 | 65 | 65 |
| 66 | (A) (p), (q)<br>(B) (p), (q)<br>(C) (q), (r)<br>(D) (q), (r) | 65 | 65 | 64 | 65 | 65 | 60 | 64 | 66 | 64 |

*Note: However, verify with original paper and zero code paper*