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CODE

Time : 3 hrs | **MM : 180**

MOCK TEST-2
for JEE (Advanced) - 2022
Paper - I

Mock Test on Complete Syllabus

General Instructions:

1. Read each question carefully.
2. It is mandatory to use blue/black ballpoint pen to darken the appropriate circle in the answer sheet.
3. Mark should be dark and should completely fill the circle.
4. Rough work must not be done on the answer sheet.
5. Do not use white-fluid or any other rubbing material on answer sheet.
6. Student cannot use log table and calculator or any other material in the examination hall.
7. Before attempting the question paper, student should ensure that the test paper contains all pages and no page is missing.
8. Before handing over the answer sheet to the invigilator, candidate should check that Roll No., Centre Code and Date of Birth have been filled and marked correctly.
9. Immediately after the prescribed examination time is over, the answer sheet is to be returned to the invigilator.
10. **Pattern of the questions are as under:**
    (i) The question paper consists of **3** parts **(Physics, Chemistry and Mathematics)**. Each part has **3** sections.
    (ii) **Section-1:** This section contains **6** multiple choice questions which have one or more correct answer(s). Each question carries **+4 marks** for correct answer and **–2 marks** for wrong answer. Partial **+1 mark** is given for darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened.
    (iii) **Section-2:** This section contains **8** questions. The answer to each of the questions is a **double-digit integer**, ranging from 00 to 99 (both inclusive) without being given any option. Each question carries **+3 marks** for correct answer and there is **no negative mark** for wrong answer.
    (iv) **Section-3:** This section contains **2** paragraphs. Based upon each paragraph, **2** multiple choice questions have to be answered. Each question has **only one** correct answer and carries **+3 marks** for correct answer and **–1 mark** for wrong answer.

PART - I : PHYSICS

SECTION - 1

One or More Options Correct Type

This section contains 6 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **one or more than one is/are correct**.

1. A car is moving with speed 108 km/h on a large uniform horizontal pavement perpendicularly towards a wall. To avoid collision, the driver takes a turn and finally runs the car parallel to the wall with the same speed. Coefficient of friction between the tyres and the pavement is 0.6, acceleration of free fall is 10 m/s^2 and all the load of the car is concentrated on the front axle. If the turning process is the fastest one on this pavement, check validity of the following statements.

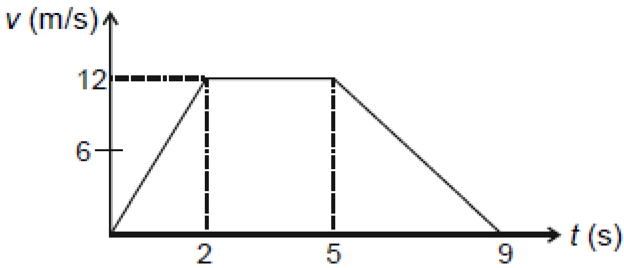
(A) The car follows a circular path during the turn

(B) The car follows a parabolic path during the turn

(C) Minimum radius of curvature of the path is 75 m

(D) Initial distance of the wall must be greater than $75\sqrt{2}$ m

2. The diagram represents the straight line motion of a car. Which of the following statements is false?



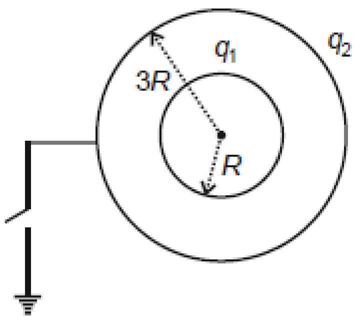
(A) The car accelerates, stops, and reverses

(B) The car accelerates at 6 m/s^2 for the first 2 sec

(C) The car is moving uniformly for a total time of 9 sec

(D) The car decelerates at 12 m/s^2 for the last 4 s

3. Two concentric shells have radii R and $3R$, charges q_1 and q_2 and potentials $2V$ and V respectively. Now outer shell is earthed and let charges on them becomes q'_1 and q'_2 respectively, then



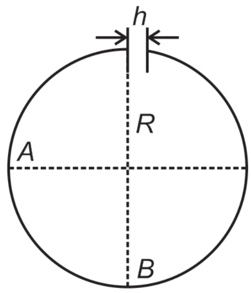
(A) $\frac{q_1}{q_2} = 1$

(B) $\frac{q_1}{q_2} = \frac{1}{3}$

(C) $\frac{q'_1}{q'_2} = -\frac{1}{3}$

(D) $\frac{q'_1}{q'_2} = -1$

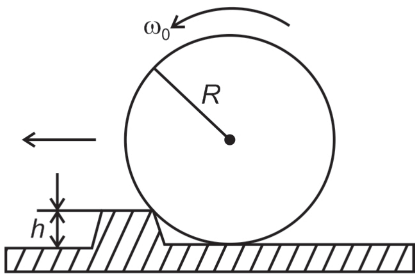
4. A current I flows along a lengthy thin-walled tube of radius R with longitudinal slit of width h ($h << R$) as shown. Two points A and B are taken just inside the tube, then



Cross-sectional view

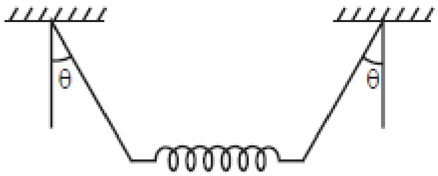
(A) Magnetic field at point A is $\frac{\mu_0 Ih}{4\sqrt{2}\pi^2 R^2}$
(B) Magnetic field at point A is $\frac{\mu_0 Ih}{4\pi^2 R^2}$
(C) Magnetic field at point B is $\frac{\mu_0 Ih}{4\pi^2 R^2}$
(D) Magnetic field at point B is $\frac{\mu_0 Ih}{8\pi^2 R^2}$

5. A solid ball of mass M and radius R is rolling without slipping on a flat horizontal surface at an initial angular velocity ω_0. It hits a small bump of height h. Assume that the ball pivots about the tip of the bump during and after impact. Which of the following statements are TRUE?



(A) The angular velocity of the ball immediately after impact is $\omega = \omega_0\left(1-\frac{5h}{7R}\right)$
(B) The minimum initial angular velocity so that the ball just makes it over the bump is $\omega = \frac{7}{(7R-5h)}\sqrt{\frac{10gh}{7}}$
(C) The angular velocity of the ball immediately after impact is $\omega = \omega_0\left(1-\frac{3h}{7R}\right)$
(D) Angular momentum of ball about the bump is conserved just before and just after collision

6. A stiff horizontal spring of weight W and force constant k is suspended in a horizontal position by two light strings attached to its two ends. Each string makes an angle θ with the vertical. Then

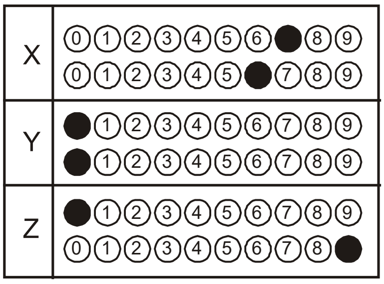


(A) The extension of the spring is $\left(\frac{W}{4k}\right)\tan\theta$
(B) The extension of the spring is $\left(\frac{W}{2k}\right)\tan\theta$
(C) Tension is string is $W\tan\theta$
(D) Tension in string is $\frac{W}{2\cos\theta}$

SECTION - 2

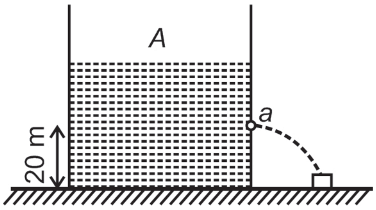
Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively.



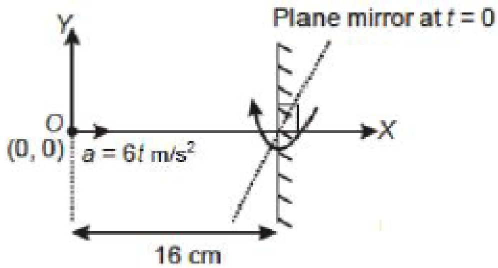
7. A sound source of frequency f_0 = 130 Hz is dropped from a height slightly greater than 250 m above the ground. At the same time a detector is thrown upwards with velocity u = 50 ms^{-1} along the same line. Speed of sound is v = 300 ms^{-1}. If the frequency (in Hz) detected by the detector after t = 5 s is 39 × n. Find the value of n. (Take g = 10 ms^{-2})

8. Water is filled in a uniform container of area of cross-section A. A hole of cross-section area a (<< A) is made in the container at a height of 20 m above the base. Water streams out and hits a small block placed at some distance from container. With what speed (in ms^{-1}) the block should be moved such that water streams always hit the block. (Given $\frac{a}{A}=\frac{1}{20}$). (Take g = 10 ms^{-2})

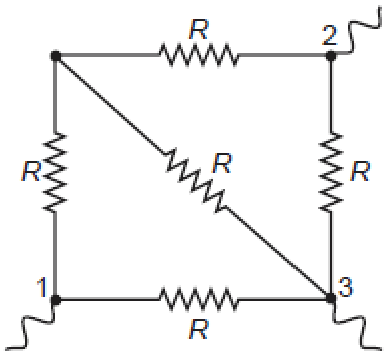


9. From the top of a tower, two particles 'A' and 'B' are projected simultaneously with speed of 3 m/s and 4 m/s, respectively, in horizontally opposite directions at time t = 0. At time $t=\frac{\sqrt{3}}{5}$ sec, find the angles (in degree) between their velocities. (Take g = 10 m/s^2)

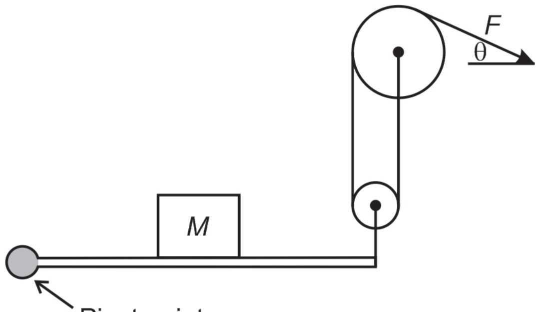
10. A point object starts moving from rest at t = 0 with an acceleration 6t m/s^2 (t is time in sec) from point O in front of a plane mirror parallel to the Y-Z plane at a distance of 16 m from O. At t = 0, the plane mirror also starts rotating with constant angular velocity about an axis passing through the point of intersection of the mirror with X-axis and perpendicular to the X-Y plane. If at time t = t_0 s, co-ordinates of image formed by mirror are (16 m, – 8 m) then value of t_0 is



11. The resistances in a burner of an electric stove are connected together in an arrangement shown in figure. This arrangement is connected to the supply mains at points 1 and 2, and after a certain time, 15 kg of water are heated to the boiling. How much water (in kg) can be heated to the boiling point in the same time interval when the arrangement of resistances is connected to the supply mains at points 1 and 3? The initial temperature of the water is the same in both cases. Neglect all heat loses



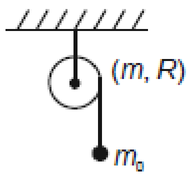
12. A pulley system is attached to a massless board as shown below. The board pivots only at the pivot point. A 10 kg mass M sits exactly in the middle of the board.



If the angle θ is 60°. The force F (in N) necessary to hold the board in the position shown is

13. Neutrons in thermal equilibrium with matter at 27°C can be thought to behave like ideal gas. Assuming them to have a speed of V_{rms}, what is their de Broglie wavelength λ (in nm)? Fill 156λ (in nearest integer) in the OMR sheet. (Take $m_n = 1.69 \times 10^{-27}$ kg, $k = 1.44 \times 10^{-23}$ J/K, $h = 6.60 \times 10^{-34}$ J sec)

14. A uniform solid cylinder of mass m can rotate freely about its axis which is kept horizontal. A particle of mass m_0 hangs from the end of a light string wound round the cylinder. When the system is allowed to move, the acceleration with which the particle descends is Xg where g is acceleration due to gravity. If $m = 4m_0$ then find $\frac{1}{X}$.



SECTION - 3

Paragraph Type

This section contains **2 paragraphs**, each describing theory, experiment, data etc. **Four questions** relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should have **only one correct answer** among the four given choices (A), (B), (C) and (D).

Paragraph for Q. Nos. 15 and 16

A region in space contains a total positive charge Q that is distributed spherically such that the volume charge density $\rho(r)$ is given by

$$\rho(r) = \alpha \text{ for } r \le \frac{R}{2}$$

$$\rho(r) = 2\alpha\left(1 - \frac{r}{R}\right) \text{ for } \frac{R}{2} \le r \le R$$

$\rho(r) = 0$ for $r \ge R$

Here α is a positive constant having units of C/m^3.

15. Mark the correct option.

(A) Electric field in the region $r \le \frac{R}{2}$ is $\frac{11Qr}{15\pi\varepsilon_0 R^3}$

(B) Electric field inside the entire spherical volume is linearly dependent on r

(C) Electric field in the region $r > R$ is $\frac{Q}{4\pi\varepsilon_0 r^2}$

(D) Electric field in the region $r > R$ is $\frac{Q}{4\pi\varepsilon_0 R^2}$

16. Mark the correct option.

(A) $E = 0$, at $r = R/2$

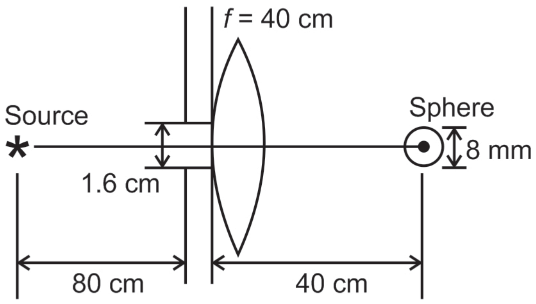
(B) For points at $r > R$ the electric field of given charge distribution is not identical to a point charge

(C) For points at $r > R$ the electric field of given charge distribution is identical to a point charge

(D) Electric field at the centre of given spherical charge distribution is $\frac{Q}{4\pi\varepsilon_0 R^2}$

Paragraph for Q. Nos. 17 and 18

Consider an arrangement shown in the figure. The width of the slit is 1.6 cm. The convex lens placed in contact with the slit transmits 80% of the light incident on it. The diameter of the sphere is 8 mm and the efficiency of photoelectric emission of the sphere is 10^{-4}. The power of the source is 3.2 W and the energy of the photons of the radiation emitted by the source is 5 eV.



17. Photoelectric current from the sphere is

(A) 1.28×10^{-9} A
(B) 2.4×10^{-10} A
(C) 5×10^{-11} A
(D) 6×10^{-12} A

18. Amount of radiation falling on lens per unit time is

(A) 4×10^{-6} W
(B) 8×10^{-5} W
(C) 5×10^{-6} W
(D) 4×10^{-7} W

PART - II : CHEMISTRY

SECTION - 1

One or More Options Correct Type

This section contains 6 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **one or more than one is/are correct**.

19. The decomposition of N_2O into N_2 and O_2 follows second order kinetics with $k = 5 \times 10^{11} e^{-29000K/T}$ L mole^{-1} sec^{-1}. It suggests that (E_a = activation energy, P = steric factor, Z = collision frequency)

(A) $E_a = \frac{29000K}{RT}$

(B) E_a = 29000 KR

(C) $E_a = \frac{29000}{R}$

(D) PZ = 5 × 10^{11} L mole^{-1} sec^{-1}

20. In an experiment to determine the formula of an ionic bromide of known relative molecular mass, 0.1 mole of the bromide was dissolved in 500 cm^3 of water and 50 cm^3 of this solution reacted exactly with 300 cm^3 of 0.1 M $AgNO_3$(aq). If the other element present in the compound is denoted by letter Z, the most probable formula for the ionic bromide is

(A) ZBr_4

(B) ZBr_2

(C) ZBr

(D) ZBr_3

21. Colloidal solution can be purified by

(A) Dialysis

(B) Electrodialysis

(C) Electrophoresis

(D) Ultrafiltration

22. The non-protein part which some enzymes require for their activity are called

(A) Cofactors

(B) Apoenzyme

(C) Coenzyme

(D) Holoenzyme

23. 1.93 A direct current is passed for 5 × 10^4 second in pure water and electrolysis of water takes place. Select the correct statement(s) about the process. [1 F = 96500 C]

(A) Equal moles of H_2 and O_2 are liberated at cathode and anode respectively

(B) Total volume of all gases liberated at S.T.P is 16.8 L

(C) Volume of O_2 liberated at anode is 2 times the volume of H_2 liberated at cathode under S.T.P. condition

(D) pH of solution remains same during the electrolysis

24. Consider the given 1st order reactions at 25°C

	Activation energy (kJ/mol)	**Rate**
Reaction I : $\underset{(1\text{ M})}{A} \rightarrow B$	x	R_1
Reaction II : $\underset{(1\text{ M})}{A} \rightarrow B$	y	R_2

(Given x > y)

Assume activation energy and pre exponential factor are temperature independent

Select the correct statement(s). (assume pre exponential factor is same for both the reactions)

(A) Rate of reaction II is more than reaction I at temperature T if T < 25° C

(B) Rate of reaction II is less than reaction I at temperature T if T < 25°C

(C) Rate of reaction II is more than reaction I at temperature T if T > 25°C

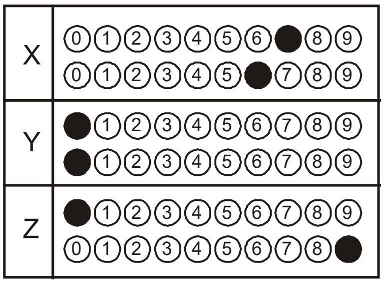
(D) Rate of reaction I is more than reaction II at temperature T if T > 25°C

SECTION - 2

Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows.

Examples- If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively.

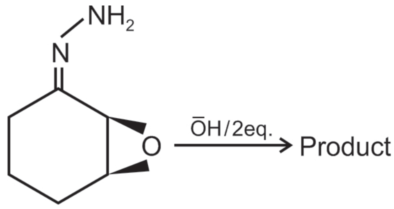


25. Ethanol C_2H_5OH, is the substance commonly called “alcohol”. The density of liquid ethanol is 0.784 g ml^{-1} at 20ºC. If 1.7 mole of ethanol are needed for a particular experiment. The volume (in ml) of ethanol should be measured out is x ml. The value of $\frac{x}{100}$ to the closest integer is

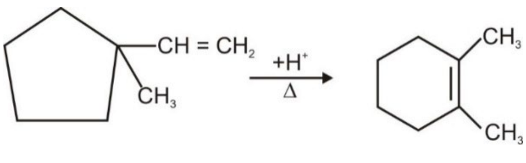
26. A vessel contains a gas and few drops of water. The pressure in the vessel is 81 mm Hg. The temperature of the vessel is reduced by 1%. The vapour pressure of water at two temperature are 1 and 0.8 mm Hg. The new pressure of the vessel is P then $\frac{P}{10}$ is approximately equal to

27. Out of following, how many gases are odourless and colourless?
CH_4, Cl_2, NH_3, O_2, PH_3, H_2S, NO_2, SO_2

28. How many stereoisomers are produced as the major product of the given reaction?



29. Consider the following acid catalysed isomerization reaction



How many reactive intermediates are formed in the given reaction?

30. If the osmotic pressure of 0.1 molar solution of $MgCl_2$ at 300 K is found to be 4.80 atm.The percentage ionisation of salt is x. The value of $\frac{x}{10}$ is [take R = 0.08 atm LK^{-1} mol^{-1}]

31. Total number of stereoisomers of the compound $[Pt (Py) (NH_3) (H_2O) Cl Br I]^+$ is X, calculate the value of $\frac{X}{5}$.

32. The vapour pressure of a 10^{-2} molal solution of a weak base BOH in water at 300 K is 18.496 mm Hg. If the value of K_b for the base is x × 10^{-4} what will be the value of x? Aqueous tension at 300 K = 18.5 mm Hg. [Assume molarity is equal to molality for solute and molality of water = 55.5]

SECTION - 3

Paragraph Type

This section contains **2 paragraphs**, each describing theory, experiment, data etc. **Four questions** relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should have **only one correct answer** among the four given choices (A), (B), (C) and (D).

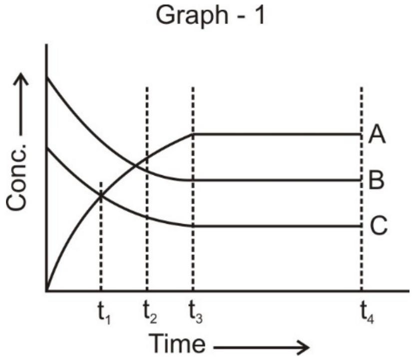
Paragraph for Q. Nos. 33 and 34

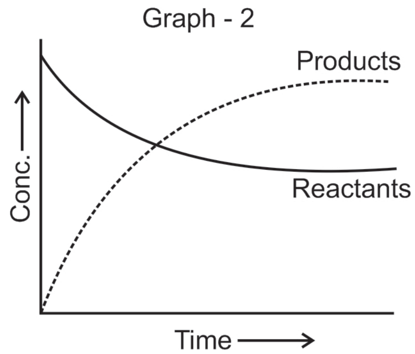
In a reversible chemical reaction, the rate of forward reaction decreases and that of backward reaction increases with the passage of time; at equilibrium the rate of forward and backward reactions become same.

Let us consider the formation of SO_3 in the following reversible reaction:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Following graphs are plotted for this reaction:





33. In the graph (1), the equilibrium state is reached at:

(A) t_1 (B) t_2

(C) t_3 (D) t_4

34. The graph (2) tells us that:

(A) Equilibrium is never achievable

(B) When Equilibrium is achieved, the concentrations of reactants and products are equal

(C) When Equilibrium is achieved the concentrations of reactants and products are unequal

(D) None of these

Paragraph for Q. Nos. 35 and 36

Among the halogens chlorine has high negative electron gain enthalpy. Though the electron affinity of chlorine is the highest, it is not the strong oxidising agent. The oxidising power of halogen depends on the energy terms :- free energy of fusion, evaporation, dissociation of molecules, electron affinity and energy of hydration.

Table : Free energy (ΔG^o) values of $\frac{1}{2}X_2 \rightarrow X_{(hydrated)}$ (in kJ/mole)

Halogens	$\left(\frac{1}{2}\right)$ **Free energy of fusion**	$\left(\frac{1}{2}\right)$ **Free energy of evaporation**	$\left(\frac{1}{2}\right)$ **Free energy of dissociation**	**Electron affinity**	**Free energy of hydration**	**Sum of ΔG°**
F_2	-	-	+126/2	–333	–460	–730
Cl_2	-	-	+210/2	–349	–348	–592
Br_2	-	+31/2	+158/2	–325	–318	–548.5
I_2	+15/2	+44/2	+118/2	–296	–279	–486.5

35. The main reasons for high oxidising power of fluorine are
   (A) High enthalpy of dissociation
   (B) Higher negative electron gain enthalpy than chlorine
   (C) High free energy of hydration
   (D) It is gas at room temperature

36. For which of the following reaction the free energy change (ΔG^{o}) is positive?
   (A) $F_2 + 3H_2O \rightarrow 2H_3O^{+} + 2F^{-} + \frac{1}{2}O_2$
   (B) $Cl_2 + H_2O \rightarrow HCl + HOCl$
   (C) $Br_2 + H_2O \rightarrow HBr + HOBr$
   (D) $I_2 + H_2O \rightarrow 2H^{+} + 2I^{-} + \frac{1}{2}O_2$

PART - III : MATHEMATICS

SECTION - 1

One or More Options Correct Type

This section contains 6 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **one or more than one is/are correct**.

37. If $\int \frac{4e^{x} + 6e^{-x}}{9e^{x} - 4e^{-x}} \, dx = Ax + B\ell n \, |9e^{2x} - 4| + C$, then
   (A) $A + 18B = 16$
   (B) $18B - A = 19$
   (C) $A - 18B = 17$
   (D) $A + 18B = 32$

38. Let C be a curve such that the normal at any point P on it meets x-axis and y-axis at A and B respectively. If $BP : PA = 1 : 2$ (internally) and the curve passes through the point (0, 4), then which of the following alternative(s) is/are correct?
   (A) The curve passes through $\left(\sqrt{10}, -6\right)$
   (B) The equation of tangent at $\left(4, \ 4\sqrt{3}\right)$ is $2x + \sqrt{3}\,y = 20$
   (C) The differential equation for the curve is $yy' + 2x = 0$
   (D) The curve represent a hyperbola

39. Given three vectors

   $\vec{U} = 2\hat{i} + 3\hat{j} - 6\hat{k}$; $\quad \vec{V} = 6\hat{i} + 2\hat{j} + 3\hat{k}$; $\quad \vec{W} = 3\hat{i} - 6\hat{j} - 2\hat{k}$

   Which of the following hold good for the vectors $\vec{U}$, $\vec{V}$ and $\vec{W}$?
   (A) $\vec{U}$, $\vec{V}$ and $\vec{W}$ are linearly dependent
   (B) $(\vec{U} \times \vec{V}) \times \vec{W} = \vec{0}$
   (C) $\vec{U}$, $\vec{V}$ and $\vec{W}$ form a triplet of mutually perpendicular vectors
   (D) $\vec{U} \times (\vec{V} \times \vec{W}) = \vec{0}$

40. If A and B are two 3 × 3 matrices such that their product AB is a null matrix then
   (A) det. $A \neq 0 \Rightarrow B$ must be a null matrix
   (B) det. $B \neq 0 \Rightarrow A$ must be a null matrix
   (C) If none of A and B are null matrices then both of the matrices must be singular
   (D) If neither det. A nor det. B is zero then the given statement is not possible

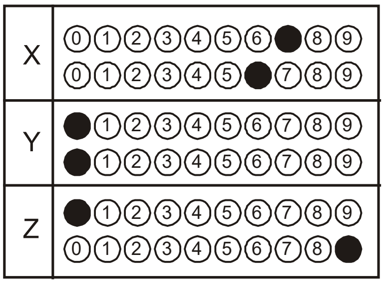
41. Which of the following statement(s) is(are) correct ?
(A) If $A = 130°$ and $S = \sin A + \cos A$, then $S > 0$
(B) If $\operatorname{cosec}^2 30° + k(\cos 36° - \sin 18°) = 5$, then k equals 2
(C) The minimum value of $27\tan^2\theta + 3\cot^2\theta$ is 18
(D) If a, b are constant real numbers such that $a^2 < b$, then $x^2 + 2ax + b$ is always positive $\forall\ x \in R$

42. The position vectors of the vertices A, B and C of a tetrahedron are (1, 1, 1), (1, 0, 0) and (3, 0, 0) respectively. The altitude from the vertex D to the opposite face ABC meets the median line through A of the ΔABC at a point E. If the length of side AD is 4 and volume of the tetrahedron is $\frac{2\sqrt{2}}{3}$ then the correct statement(s) is/are
(A) The altitude from the vertex D is 2
(B) There is exactly one position for the point E
(C) There can be two positions for the point E
(D) Vector $\hat{j} - \hat{k}$ is normal to the plane ABC

SECTION - 2

Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows.
Examples- If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively.



43. Let U denotes the value of the expression $2x^4 - 30x^2 + 8x + 10$ where $x = \tan\left(\frac{5\pi}{12}\right)$ and V denotes the value of p for which the expression $2x^2 + 2xy - 7x - 3y + p$ can be resolved into two linear factors. Find the value of (UV).

44. Given $f(z)$ = the real part of a complex number z. For example, $f(3 - 4i) = 3$. If $a \in N$, $n \in N$ and $f(a) = \sum_{n=1}^{6a} \log_2\left|f\left(\left(1 + i\sqrt{3}\right)^n\right)\right|$ then the value of $\frac{1}{5}\cdot f(5)$ =

45. Let α_1, β_1 are the roots of $x^2 - 6x + p = 0$ and α_2, β_2 are the roots of $x^2 - 54x + q = 0$. If α_1, β_1, α_2, β_2 form an increasing G.P., then find the value of $\frac{1}{10}(q - p)$.

46. If the points of intersection of curves $C_1 = 4y^2 - \lambda x^2 - 2xy - 9x + 3$ and $C_2 = 2x^2 + 3y^2 - 4xy + 3x - 1$ subtends a right angle at origin, then find the value of λ.

47. Let L denotes the number of surjective functions $f : A \to B$, where set A contains 4 elements and set B contains 3 elements. M denotes number of elements in the range of the function $f(x) = \sec^{-1}(\operatorname{sgn} x) + \operatorname{cosec}^{-1}(\operatorname{sgn} x)$ where $\operatorname{sgn} x$ denotes signum function of x. And N denotes coefficient of t^5 in $(1 + t^2)^5(1 + t^3)^8$. Find the value of $(LM + N)$.

48. There is a point (p, q) on the graph of $f(x) = x^2$ and a point (r, s) on the graph of $g(x) = \frac{-8}{x}$ where $p > 0$ and $r > 0$. If the line through (p, q) and (r, s) is also tangent to both the curves at these points respectively, then find the value of $(p + r)$.

49. Number of non-empty subsets of {1, 2, 3, 4, 5, 6, 7, 8} having exactly k elements and do not contain the element k for some k = 1, 2, ….., 8 is N. The value of $\left[\frac{N}{10}\right]$ is (where [.] denotes greatest integer function)

50. If the distance between the centres of the hyperbolas : $x^2 - 16xy - 11y^2 - 12x + 6y + 21 = 0$ and $9x^2 - 16y^2 - 18x - 32y - 151 = 0$ is d then $125d^2$ =

SECTION - 3

Paragraph Type

This section contains **2 paragraphs**, each describing theory, experiment, data etc. **Four questions** relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should have **only one correct answer** among the four given choices (A), (B), (C) and (D).

Paragraph for Q. Nos. 51 & 52

Tangents are drawn to the parabola $y^2 = 4x$ from the point $P(6, 5)$ to touch the parabola at Q and R (abscissa of Q is lesser than abscissa of R). C_1 is a circle which touches the parabola at Q and C_2 is a circle which touches the parabola at R. Both the circles C_1 and C_2 pass through the focus of the parabola.

51. Area of the ΔPQR equals

(A) $\frac{1}{2}$ (B) 1

(C) 2 (D) $\frac{1}{4}$

52. Radius of the circle C_2 is

(A) $5\sqrt{5}$ (B) $5\sqrt{10}$

(C) $10\sqrt{2}$ (D) $\sqrt{210}$

Paragraph for Q. Nos. 53 & 54

Consider a function $y = f(x)$. Let the functional rule for $y = f(x)$ is same as the functional rule for the height h (dependent variable) of a triangle ABC from the vertex A to the base BC (where angle A is independent variable). The triangle ABC is inscribed in a circle of radius 6 and the area of the triangle ABC is 12.

53. If $g(x) = f(\sin^{-1}x)$ then $g'\left(\frac{4}{5}\right)$ is equal to

(A) $\frac{-25}{4}$ (B) $\frac{-25}{8}$

(C) $\frac{25}{8}$ (D) $\frac{25}{4}$

54. If $h(x) = \sec^{-1}\left(\frac{1}{2}f(x)\right)$ then $\lim_{x\to\left(\frac{\pi}{2}\right)^-} \frac{e^{2h(x)} - 2e^{\left(\frac{\pi}{2}-x\right)} + \sin x}{h(x)\cos x}$ is equal to

(A) $\frac{1}{2}$ (B) 2

(C) $\frac{3}{2}$ (D) 0

❒ ❒ ❒

B
CODE

Aakash + BYJU'S

Corporate Office **:** Aakash Tower, 8, Pusa Road, New Delhi-110005. Ph.011-47623456

Time : 3 hrs **MM : 180**

MOCK TEST-2

for JEE (Advanced) – 2022

Paper - 2

Mock Test on Complete Syllabus

General Instructions:

1. Read each question carefully.
2. It is mandatory to use blue/black ballpoint pen to darken the appropriate circle in the answer sheet.
3. Mark should be dark and should completely fill the circle.
4. Rough work must not be done on the answer sheet.
5. Do not use white-fluid or any other rubbing material on answer sheet.
6. Student cannot use log table and calculator or any other material in the examination hall.
7. Before attempting the question paper, student should ensure that the test paper contains all pages and no page is missing.
8. Before handing over the answer sheet to the invigilator, candidate should check that Roll No., Centre Code and Date of Birth have been filled and marked correctly.
9. Immediately after the prescribed examination time is over, the answer sheet is to be returned to the invigilator.
10. **Pattern of the questions are as under:**

    (i) The question paper consists of **3** parts **(Physics, Chemistry and Mathematics)**. Each part has **3** sections.

    (ii) **Section-1:** This section contains **6** multiple choice questions which have one or more correct answer(s). Each question carries **+4 marks** for correct answer and **–2 marks** for wrong answer. Partial **+1 mark** is given for darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened.

    (iii) **Section-2:** This section contains **8** questions. The answers to each of the questions is a **double-digit integer**, ranging from 00 to 99 (both inclusive) without being given any option. Each question carries **+3 marks** for correct answer and there is **no negative mark** for wrong answer.

    (iv) **Section-3:** This section contains **4** multiple choice questions. Each question has two matching lists : (List-I and List-II). In general, four options are given representing matching of elements from List-I and List-II. Only ONE of these four options corresponds to a correct matching. For each question, choose the option corresponding to the correct matching. Each question carries **+3 marks** for correct answer and **–1 mark** for wrong answer.

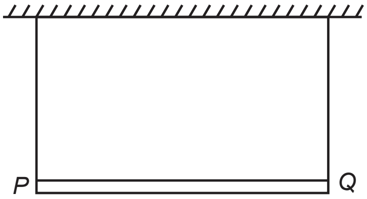
PART - I : PHYSICS

SECTION - 1

One or More Options Correct Type

This section contains 6 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **one or more than one is/are correct**.

1. A horizontal rod of mass 'M' and length 'L' is tied to two vertical strings symmetrically as shown in the figure. One of the strings at end Q is cut at t = 0 and the rod starts rotating about the other end P. Then



(A) At t = 0, angular acceleration of rod about P is $3g/2L$

(B) At t = 0, angular acceleration of rod about C.M. of rod is $3g/2L$

(C) At t = 0, acceleration of C.M. of rod is $3g/4$ in downward direction

(D) At t = 0, tension in the string at P is $Mg/4$

2. Three bodies A, B and C have equal surface area and thermal emissivities in the ratio $e_A : e_B : e_C : 1 : \frac{1}{2} : \frac{1}{4}$. All the three bodies are radiating at same rate. Their wavelengths corresponding to maximum intensity are λ_A, λ_B and λ_C respectively and their temperatures are T_A, T_B and T_C on kelvin scale, then select the incorrect statement.

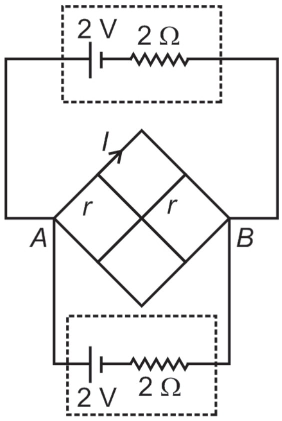
(A) $\sqrt{T_A T_C} = T_B$

(B) $\sqrt{\lambda_A \lambda_C} = \lambda_B$

(C) $\sqrt{e_A T_A}\sqrt{e_C T_C} = e_B T_B$

(D) $\sqrt{e_A \lambda_A T_A . e_B \lambda_B T_B} = e_C \lambda_C T_C$

3. Each branch in the following circuit has a resistance $r = \frac{4}{3}\ \Omega$. Two identical batteries each having internal resistance 2 Ω are connected between points A and B as shown.



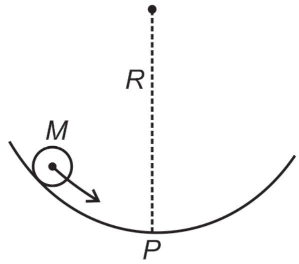
(A) Equivalent resistance of circuit between point A and B is 2 Ω

(B) Equivalent resistance of circuit between point A and B is 4 Ω

(C) Value of current I is $\frac{1}{6}$ A

(D) Value of current I is $\frac{1}{3}$ A

4. A sphere of mass M and radius r rolls without slipping on a rough concave surface of large radius R. It makes small oscillation about lowest point. Then



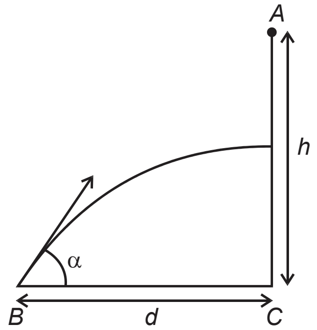
(A) Time period of oscillation is $2\pi\sqrt{\frac{(R-r)}{5g}}$

(B) Time period of oscillation is $2\pi\sqrt{\frac{7(R-r)}{5g}}$

(C) When sphere is at lowest point then magnitude of acceleration of all points on the surface are same

(D) When sphere is at lowest point then magnitude of acceleration of all points on the surface are not same

5. A body A is dropped from a height h above the ground. At the same time another body B at a horizontal distance d from the line AC from the ground is fired at an angle α to the horizontal as shown in figure. If the two collide at the highest point of the trajectory of B. Then



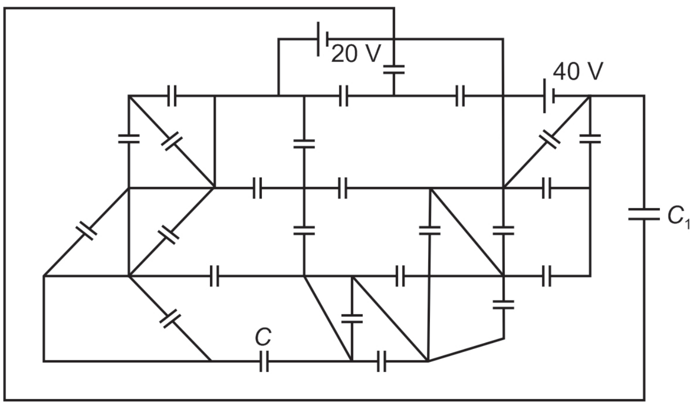
(A) Trajectory of B as seen from A is parabola

(B) Trajectory of B as seen from A is straight line

(C) The angle of projection is $\alpha = \tan^{-1}\left(\frac{h}{d}\right)$

(D) The angle of projection is $\alpha = \cos^{-1}\left(\frac{h}{d}\right)$

6. All capacitors in the network given below are identical with capacitance of each being 1 μF. If charges on the capacitors marked as C, C_1 are Q, Q_1 respectively, then



(A) $Q = 40\ \mu C$

(B) $Q_1 = 40\ \mu C$

(C) $Q = 20\ \mu C$

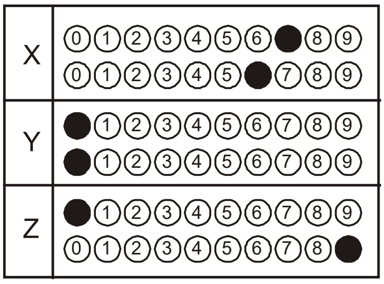
(D) $Q_1 = 20\ \mu C$

SECTION - 2

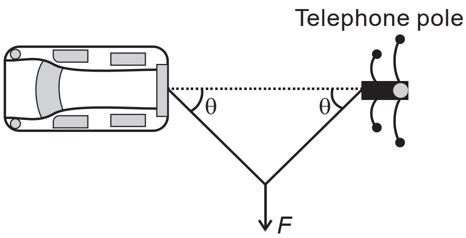
Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows.

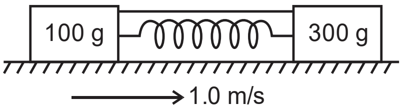
Examples- If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively.



7. Your car is stuck in a mud hole. You are alone, but you have a long, strong rope. Having studied Physics, you tie the rope tautly to a telephone pole and pull on it sideways, as shown in figure. Find the force exerted by the rope on the car (in 10^3 N) when angle θ is 3° and you are pulling with a force of 314 N but the car does not move



8. The carts in figure are sliding to the right at 1.0 m/s on a smooth level ground. The spring between them has a spring constant of 120 N/m and is compressed by 40 cm. The carts slide past a flame that burns the string holding them together. The cart are not tied to the spring. Finally, what is the speed (in m/s) of 300 g cart after it loses contact with the spring?

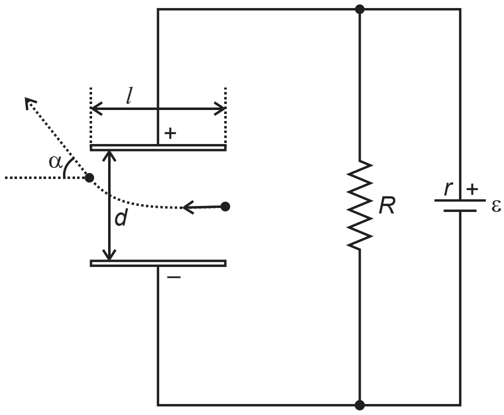


9. You pour some quantity of flour of volume V = 225 cm^3 onto a board, where it forms a conical pile. The coefficient of static friction between flour grains is $\mu_s = \sqrt{1.60}$. Find the maximum height (in cm) of the pile. (Take π = 3.15)

10. A piece of –10°C ice is heated to –1°C using a certain amount of energy. Then another 19 times as much energy is necessary to finally convert entire ice to water at 0°C. Using that the specific heat of ice is 4.2 kJ/(kg°C). The heat of fusion of ice (in kJ/kg) from the above measurement data comes out to be $X \times 10^2$ kJ/kg. Find the value of x in nearest integer.

11. A parallel plate capacitor with plates of length l is included in a circuit as shown in figure. Given are the emf of the current source, its internal resistance r and the distance d between the plates. An electron with a velocity u flies into the capacitor, so that the electron flies out of the capacitor at an angle of 37° to the plates. Find the value of R in ohm. (Assume that circuit is in steady state and neglect relativistic effect).

(Take l = 91 cm, ε = 3 V, r = 2 Ω, $d = \frac{1}{3}$ mm, $u = 4 \times 10^7$ m/s, $m_e = 9.1 \times 10^{-31}$ kg and $e = 1.6 \times 10^{-19}$ C)



12. A certain species of ionized atoms (hydrogen like) produces an emission line spectrum according to Bohr model. A group of lines in the spectrum form a series in which the smallest energy is 4.896 eV and the maximum energy is 13.6 eV. The atomic number of atom is

13. Two converging lens have focal length f = 10 cm and f' = 20 cm. The optical axes of the lenses coincide. This lens system is used to from an image of an object kept at a certain distance from the first lens. In this situation, the size of the final image does not depend on the distance of the object from the first lens. What is the distance (in cm) between the two lens?

14. A thin spherical shell of radius R lying on a rough horizontal surface is hit sharply and horizontally by a cue. The height from the ground where should shell be hit so that shell does not slip on the surface is $\frac{x+2}{x}R$. Find x.

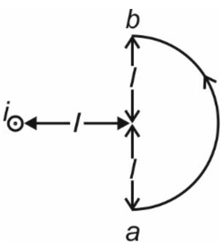
SECTION - 3

Matching List Type

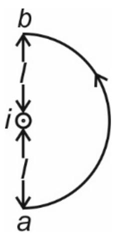
This section contains 4 multiple choice questions. Each question has two matching lists : (List-I and List-II). In general, four options are given representing matching of elements from List-I and List-II. **Only ONE of these four options corresponds to a correct matching.** For each question, choose the option corresponding to the correct matching.

15. Elements in List-I contains infinitely long straight conductor(s) carrying current i normally outwards from the paper and the paths shown with arrows. List-II contains the values of $\int \vec{B}\cdot\vec{dl}$ along the shown paths. Match the List-I with List-II.

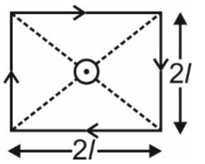
List-I **List-II**

(P) 

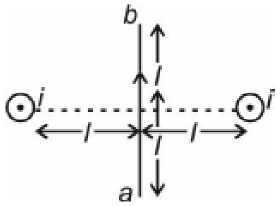
(1) 0

(Q) 

(2) $\mu_0 i$

(R) 

(3) $\frac{\mu_0 i}{2}$

(S) 

(4) $\frac{\mu_0 i}{4}$

Codes :

(A) P $\rightarrow$ 4; Q $\rightarrow$ 3; R $\rightarrow$ 2; S $\rightarrow$ 1

(B) P $\rightarrow$ 3; Q $\rightarrow$ 3; R $\rightarrow$ 2; S $\rightarrow$ 1

(C) P $\rightarrow$ 4; Q $\rightarrow$ 3; R $\rightarrow$ 2; S $\rightarrow$ 4

(D) P $\rightarrow$ 3; Q $\rightarrow$ 4; R $\rightarrow$ 2; S $\rightarrow$ 3

16. We have 4 solid bodies of same material; *A* $\rightarrow$ *a* solid cube of edge length '*r*'; *B* $\rightarrow$ *a* solid sphere of radius '*r*'; *C* $\rightarrow$ *a* solid hemisphere of radius '*r*'; and *D* $\rightarrow$ *a* solid right circular cone of radius '*r*' and height '*r*'. In List-I, certain situations related to these 4 bodies are given. Match the appropriate outcome indicated in List-II.

List-I	**List-II**
(P) All 4 bodies are heated to same temperature of 350 K and kept in a room at 300 K. Then rate of fall of temperature with time	(1) For *C* is highest
(Q) All 4 bodies are kept on a level ground (*C* and *D* are kept with base on ground). Height of centre of mass from ground	(2) For *B* is highest
(R) All 4 bodies are rotated about an axis passing through their respective centre of mass. The axis for cube hemisphere and cone is perpendicular to the face and bases respectively. Moment of inertia	(3) For *C* is lowest
(S) Heat capacities of body	(4) For *D* is highest
	(5) For one of the body is half of another body

Codes:

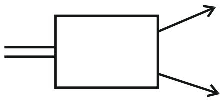
(A) P $\rightarrow$ 2, 3, 5; Q $\rightarrow$ 4, 5; R $\rightarrow$ 2, 5; S $\rightarrow$ 2, 5

(B) P $\rightarrow$ 3, 5; Q $\rightarrow$ 4, 5; R $\rightarrow$ 2, 5; S $\rightarrow$ 1, 5

(C) P $\rightarrow$ 4, 5; Q $\rightarrow$ 2, 5; R $\rightarrow$ 2, 5; S $\rightarrow$ 2, 5

(D) P $\rightarrow$ 4, 5; Q $\rightarrow$ 2, 5; R $\rightarrow$ 1, 5; S $\rightarrow$ 3, 5

17. List-I gives an incident parallel beam entering a box containing one unknown optical instrument given in List-II. Match the following for all possible options. Assume that all the optical instruments are made of glass $\left(\mu = \frac{3}{2}\right)$. The surrounding medium is vacuum the box and have any dimensions

List-I	**List-II**
(P) 	(1) Converging lens
(Q) 	(2) Diverging lens
(R) 	(3) Prism
(S) 	(4) Glass slab
	(5) Convexo-concave lens

Codes:

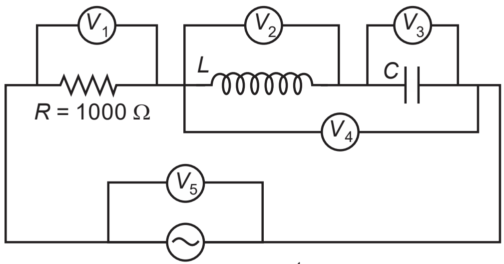
(A) P → 1, 5; Q → 1, 5; R → 3; S → 4

(B) P → 1, 5; Q → 4; R → 3; S → 4, 5

(C) P → 2, 5; Q → 4, 5; R → 3, 5; S → 3

(D) P → 1, 2, 5; Q → 1, 5; R → 3; S → 4, 5

18. In the circuit shown in figure, V_1, V_2, V_3, V_4 and V_5 are ideal ac voltmeters. The List-I gives a condition and the List-II gives the corresponding value, match the following



$E = (2000\text{ V})\sin(1000\text{ s}^{-1})t$

List-I	**List-II**
(P) When L = 1 H and C = 1 μF, reading is 1414 V for	(1) V_1
(Q) When L = 2 H and C = 1 μF, reading is 1000 V for	(2) V_2
(R) When L = 1 H and C = 0.5 μF, reading is 1000 V for	(3) V_3
(S) When L = 2 H and C = 0.5 μF, reading is non-zero for	(4) V_4
	(5) V_5

Codes:

(A) P → 1, 2, 3, 5; Q → 1, 3, 4; R → 1, 2, 4; S → 1, 2, 3, 5

(B) P → 1, 3, 5; Q → 1, 2, 4; R → 1, 2, 5; S → 1, 3, 5

(C) P → 1, 2, 3, 5; Q → 1, 3, 5; R → 1, 2, 5; S → 1, 2, 4

(D) P → 1, 2, 3, 4; Q → 1, 4, 5; R → 2, 3, 5; S → 4, 5

PART - II : CHEMISTRY

SECTION - 1

One or More Options Correct Type

This section contains 6 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **one or more than one is/are correct**.

19. The correct expression (s) for a reversible adiabatic process is/are

(A) $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$ (B) $\frac{P_2}{P_1} = \left(\frac{T_1}{T_2}\right)^{\frac{\gamma-1}{\gamma}}$

(C) $P_1V_1^{\gamma} = P_2V_2^{\gamma}$ (D) $P_1V_1^{\gamma-1} = P_2V_2^{\gamma-1}$

20. A colourless salt (X) is soluble in water and alcohol. On strong heating (X) gives a brown gas (Y) and a grey solid. (X) dissolves in NH_3(aq) to give a solution (Z), which gives silver mirror with aldehydes. A solution of (X) is easily reducible by ferrous salt. A solution of (X) gives a brick-red precipitate (T) with K_2CrO_4 solution. Identify the correct statement(s).

(A) (X) is $Pb(NO_3)_2$ (B) (X) is $AgNO_3$

(C) (T) is Ag_2CrO_4 (D) (T) is $PbCrO_4$

21. The sulphides of which one of the following groups of elements are soluble in yellow ammonium sulphide?

(A) As, Sb and Sn (B) As, Cd and Sn

(C) Cd, Cu and Bi (D) Hg, Cu and Cd

22. From the following statements select the correct one(s)

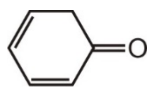
(A) Amongst HCl, HBr, HI and HOCl, HCl is most stable to heat

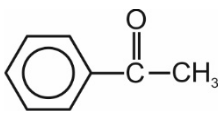
(B) When potassium chlorate is heated strongly, gives O_2 gas

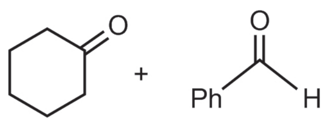
(C) The basicity of F^-, Cl^-, Br^- and I^- follows the order $F^- > Cl^- > Br^- > I^-$

(D) Chlorine is used as a bleaching agent

23. Which of the following can show tautomerism?

(A) $CH_3CH_2NO_2$ (B) 

(C)  (D) HCN

24.  $\xrightarrow[\Delta]{NaOH}$ Condensed cross aldol product (P)

(A) Degree of unsaturation of P is 7

(B) Degree of unsaturation of P is 6

(C) P has 2 geometrical isomer

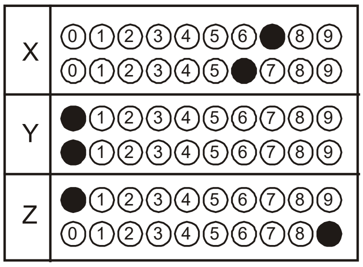
(D) P has no geometrical isomer

SECTION - 2

Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows.

Examples- If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively.



25. One commercial system removes SO_2 from smoke at 95°C by the following set of reactions,

$$SO_{2(g)} + Cl_{2(g)} \longrightarrow SO_2Cl_{2(g)} \text{ (100\% yield)}$$

$$SO_2Cl_2 + 2H_2O \longrightarrow H_2SO_4 + 2HCl \text{ (100\% yield)}$$

$$H_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + 2H_2O \text{ (95\% yield)}$$

How many grams of $CaSO_4$ may be produced from 1.00 g of SO_2? (Round off to the nearest integer)

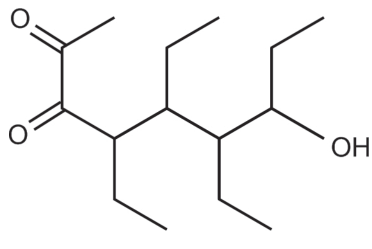
26. A gaseous mixture of hydrogen and oxygen contains 70% hydrogen and 30% oxygen by volume. If the gas mixture at a pressure of 5.0 atm (excluding the vapour pressure of water) is allowed to saturate water at 20°C, then the water is found to contain 31.5 mL (STP) of hydrogen/L. Find the solubility of hydrogen (in ml/L) at 20°C and 1 atm partial pressure of hydrogen.

27. What is the ratio of degrees of unsaturation of compound X and Y?

$\underset{X}{C_{20}H_{30}}$ $\underset{Y}{C_{30}H_{60}O_2}$

28. Let x be the co-ordination number of each atom in 3D ABAB.... packing, y be the co-ordination number of each atom in 3D packing of ABC ABC, z be the co-ordination number of 2 dimensional H.C.P. arrangement and w be the effective number of atoms per unit cell for three dimensional H.C.P. arrangement then find the value of $\frac{xy}{zw}$.

29. As per IUPAC naming, what can be the number given to –OH group in main chain?



30. A mixture of propane and methane is contained in a vessel of unknown volume V at a temperature T and exerts a pressure of 320 mm Hg. The gas is burnt in excess O_2 and all the carbon is recovered as CO_2. The CO_2 is found to have a pressure of 448 mm Hg in a volume V at the same temperature T. The mole fraction of propane in mixture is x. Report the value of 10x.

31. 0.54 g of calcium oxalate was dissolved in dilute acid and the solution was made up to 250 mL. 25 mL of this solution required 8 mL of 0.1 N $KMnO_4$ solution for complete oxidation. The percentage of impurity in calcium oxalate sample is x. Report the value of x to the nearest integer.

32. A water insoluble organic mixture contained following compounds.

(1) Benzoic acid

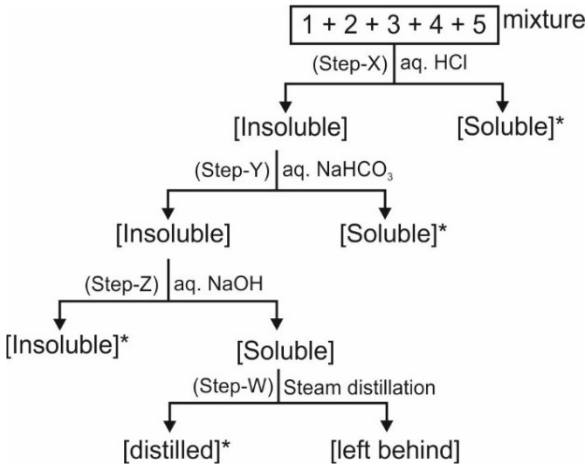
(2) Salicylaldehyde

(3) p-Hydroxybenzaldehyde

(4) α-Naphthylamine

(5) Naphthalene

The following sequence of reagents are used to separate this mixture.



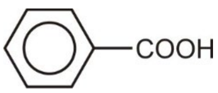
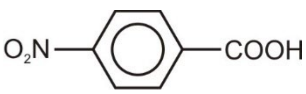
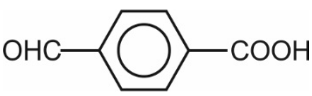
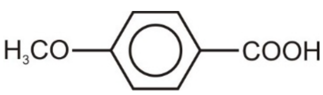
Identify the serial number of starred compound contained in the steps X, Y, Z and W respectively and express your answer as sum of the numbers corresponding to X, Y, Z and W.

SECTION - 3

Matching List Type

This section contains 4 multiple choice questions. Each question has two matching lists : (List-I and List-II). In general, four options are given representing matching of elements from List-I and List-II. **Only ONE of these four options corresponds to a correct matching.** For each question, choose the option corresponding to the correct matching.

33. Match the following.

List-I (Acid)	List-II (K_a value at 25°C)
(P) 	(1) 3.3×10^{-5}
(Q) 	(2) 10.2×10^{-5}
(R) 	(3) 30.6×10^{-5}
(S) 	(4) 6.4×10^{-5}
	(5) K_a value is more than that of acetic acid

(A) P → 3, 5; Q → 4, 5; R → 2; S → 5

(B) P → 5; Q → 1, 5; R → 5; S → 3

(C) P → 4, 5; Q → 3, 5; R → 2, 5; S → 1, 5

(D) P → 4; Q → 5; R → 1, 5; S → 3

34. Match the following.

List-I (Complex)	**List-II (Geometry and Magnetic behaviour)**
(P) $[Ni(CN)_4]^{2-}$	(1) Octahedral (inner)
(Q) $[MnF_6]^{4-}$	(2) Paramagnetic
(R) $[Fe(CN)_6]^{3-}$	(3) Square planar
(S) $[Cr(NH_3)_6]^{3+}$	(4) Octahedral (outer)
	(5) Diamagnetic

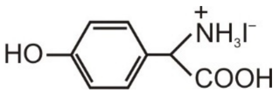
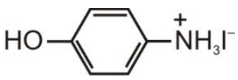
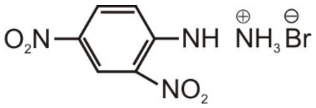
(A) P $\rightarrow$ 3, 5; Q $\rightarrow$ 2, 4; R $\rightarrow$ 1, 2; S $\rightarrow$ 5

(B) P $\rightarrow$ 3, 5; Q $\rightarrow$ 2, 4; R $\rightarrow$ 1, 2; S $\rightarrow$ 1, 2

(C) P $\rightarrow$ 5; Q $\rightarrow$ 2; R $\rightarrow$ 1, 2; S $\rightarrow$ 1, 5

(D) P $\rightarrow$ 5; Q $\rightarrow$ 2, 4; R $\rightarrow$ 1, 2; S $\rightarrow$ 5

35. Match List-I with List-II.

List-I	**List-II**
(P) $H_2N\text{–}\overset{\oplus}{N}H_3\overset{\ominus}{Cl}$	(1) Sodium fusion extract of the compound gives. Prussian blue colour with $FeSO_4$
(Q) 	(2) Gives positive $FeCl_3$ test
(R) 	(3) Gives white precipitate with $AgNO_3$
(S) 	(4) Reacts with aldehydes to form the corresponding hydrazone derivatives
	(5) Acidic in nature

(A) P $\rightarrow$ 3, 4, 5; Q $\rightarrow$ 1, 2, 5; R $\rightarrow$ 1, 2, 5; S $\rightarrow$ 1, 4, 5

(B) P $\rightarrow$ 3, 4; Q $\rightarrow$ 1, 2, 5; R $\rightarrow$ 1, 2; S $\rightarrow$ 3, 4, 5

(C) P $\rightarrow$ 3, 4; Q $\rightarrow$ 1, 2; R $\rightarrow$ 2; S $\rightarrow$ 3, 5

(D) P $\rightarrow$ 3, 5; Q $\rightarrow$ 2, 5; R $\rightarrow$ 1, 2; S $\rightarrow$ 1, 3, 4

36. List-I contains certain species while List-II contains the hybridisation of central atom, number of lone pairs on central atom and property of the central atom. Match List-I with List-II

List-I	**List-II**
(P) IBr_2^-	(1) sp^3d^2,2 lone pairs
(Q) ICl_4^-	(2) sp^3, zero lone pair
(R) SiO_2	(3) sp^3d^3, 1 lone pair
(S) IF_6^-	(4) sp^3d, 3 lone pairs
	(5) Follows octet rule

(A) P $\rightarrow$ 5; Q $\rightarrow$ 1; R $\rightarrow$ 5; S $\rightarrow$ 2

(B) P $\rightarrow$ 4; Q $\rightarrow$ 1; R $\rightarrow$ 2; S $\rightarrow$ 5

(C) P $\rightarrow$ 4; Q $\rightarrow$ 2; R $\rightarrow$ 5; S $\rightarrow$ 3

(D) P $\rightarrow$ 4; Q $\rightarrow$ 1; R $\rightarrow$ 2, 5; S $\rightarrow$ 3

PART - III : MATHEMATICS

SECTION - 1

One or More Options Correct Type

This section contains 6 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **one or more than one is/are correct**.

37. Let α, β, γ be the parametric angles of three points P, Q and R respectively lying on the circle $x^2 + y^2 = 1$. If the lengths of chords AP, AQ and AR are in G.P. where A is (1, 0) then (let $0 \le \alpha, \beta, \gamma \le 2\pi$)

(A) $\sin\frac{\alpha+\gamma}{4}\cos\frac{\alpha-\gamma}{4} \ge \sin\frac{\beta}{2}$

(B) $\sin\frac{\alpha+\gamma}{4}\cos\frac{\alpha-\gamma}{4} \le \sin\frac{\beta}{2}$

(C) $\sin\frac{\alpha}{2}\sin\frac{\gamma}{2} \ge \sin\frac{\beta}{2}$

(D) $\sin\frac{\alpha}{2}\sin\frac{\gamma}{2} \le \sin\frac{\beta}{2}$

38. If tangent of any member of family of hyperbola $xy = 4\sin^2\theta$; $\theta \in (0, 2\pi) - \{\pi\}$ is not a normal to member of family of circles $x^2 + y^2 - 2x - 2y + \mu = 0$, where μ is any real parameter then θ belongs to

(A) $\left(\frac{5\pi}{6}, \frac{7\pi}{6}\right)$

(B) $\left(0, \frac{\pi}{6}\right)$

(C) $\left(\frac{11\pi}{6}, 2\pi\right)$

(D) $\left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$

39. An equilateral triangle of side x has its vertices on the sides of a square of side 1. The correct statements are

(A) At most one of the vertices of the triangle can lie on a side of the square

(B) Two of the vertices of the triangle can lie on a side of the square

(C) One of the vertices of the triangle must coincide with the vertices of the square

(D) x is at least equal to one

40. If y is a function of x given by $2\log(y-1) - \log x - \log(y-2) = 0$, then

(A) Domain is $[4, \infty)$

(B) Domain is $(0, \infty)$

(C) Range is $(2, \infty)$

(D) Range is $(0, \infty)$

41. A function $f(x)$ is defined in the interval [1, 4] as follows $f(x) = \begin{cases} \log_e[x], & 1 \le x < 3 \\ |\log_e x|, & 3 \le x \le 4 \end{cases}$, then the graph of $f(x)$

(A) Is broken at two points

(B) Is broken at exactly one point

(C) Does not have a definite tangent at two points

(D) Does not have a definite tangent at more than two points

42. The triangle formed by the normal to the curve $f(x) = x^2 - ax + 2a$ at the point (2, 4) and the co-ordinate axes lies in second quadrant if its area is 2 sq. units then a can be

(A) 2

(B) $\frac{17}{4}$

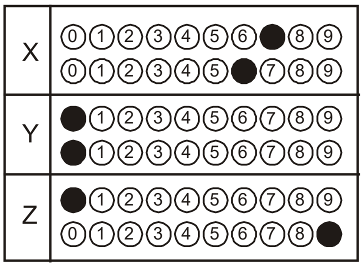
(C) 5

(D) $\frac{19}{4}$

SECTION - 2

Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively.



43. Let $S_n = \sum_{k=0}^{n} (-4)^k \cdot {}^{n+k}C_{2k}$, then value of $S_{2011} + 2.S_{2010} + S_{2009}$ is ___________

44. If $\begin{vmatrix} 2x+3y & 3x+y & x+2y \\ -x+3z & -2x+z & -3x+2z \\ -y-2z & -2y-3z & -3y-z \end{vmatrix} = \lambda(x+y+z)$ for all x, y, $z \in R$, then the value of λ is equal to __________.

45. At a point $A(1, 1)$ on ellipse equation of tangent is $y = x$. If one of the foci of ellipse is $(0, -2)$ and the co-ordinates of centre of ellipse are (α, β), then the value of $\alpha + \beta$ is (Given, length of major axis of ellipse is $4\sqrt{10}$ units)

46. Total number of integral values of 'n' such that $\sin x(2\sin x + \cos x) = n$, has atleast one real solution is

47. Let f be a continuous and differentiable function in (x_1, x_2). If $f(x) \cdot f'(x) \geq x\sqrt{1-(f(x))^4}$ and $\lim_{x \to x_1^+} (f(x))^2 = 1$ and $\lim_{x \to x_2^-} (f(x))^2 = \frac{1}{2}$. Then minimum value of $\left[x_1^2 - x_2^2\right]$ is ____________ (where [.] denotes the greatest integer function)

48. Let 'L' be a line passing through $A(1, 1, 1)$ and intersects lines $x + y = 1$, $z = 0$ and $x - y = 2$, $y + z = 3$. If 'θ' be the acute angle between line L and line $\frac{x}{1} = \frac{y}{2} = \frac{z-1}{3}$ and the value of $\cos\theta$ is $\frac{3\sqrt{n}}{\sqrt{14} \cdot \sqrt{8}}$, then $[n]$ is __________, where [.] denotes the greatest integer function.

49. Let $f(x) = x^4 + px^3 + 3x^2 + qx + 1$, $p, q \in R$. If $f(x) \geq 0 \ \forall \ x \in R$. Then the maximum value of $p^2 + q^2$ is

50. If $\tan^{-1}\alpha = \tan^{-1}(\alpha^2 + k) + \frac{\pi}{4}$ is true for atleast one $\alpha \in [0, 2]$ and $\alpha \in I$, then number of all possible integral values of k is

SECTION - 3

Matching List Type

This section contains 4 multiple choice questions. Each question has two matching lists : (List-I and List-II). In general, four options are given representing matching of elements from List-I and List-II. **Only ONE of these four options corresponds to a correct matching.** For each question, choose the option corresponding to the correct matching.

51. List-I shows some expressions and List-II contains the values of these expressions.

List-I	List-II
(P) $\lim\limits_{n\to\infty}\sum\limits_{r=1}^{n}\frac{1}{n}\sqrt{\frac{n+r}{n-r}}$	(1) $\frac{\pi}{2}$
(Q) $\lim\limits_{x\to\infty}\left[\frac{1}{\sqrt{n^2-1}}+\frac{1}{\sqrt{n^2-2^2}}+\cdots+\frac{1}{\sqrt{n^2-(n-1)^2}}\right]$	(2) $\frac{\pi}{2}+1$
(R) $\lim\limits_{x\to\infty}\left(\frac{n!}{n^n}\right)^{1/n}$	(3) 2π
(S) $\int\limits_0^{2\pi} e^{\cos x}\cos(\sin x)dx$	(4) $\frac{1}{e}$

Mark the option which correctly matches the entries in List-I to entries in List-II.

(A) P $\to$ 3; Q $\to$ 4; R $\to$ 1; S $\to$ 2

(B) P $\to$ 2; Q $\to$ 1; R $\to$ 4; S $\to$ 3

(C) P $\to$ 3; Q $\to$ 1; R $\to$ 4; S $\to$ 2

(D) P $\to$ 2; Q $\to$ 4; R $\to$ 1; S $\to$ 3

52. A fair 4 sided die with faces numbered from 1 to 4 is rolled twice. Let A and B be result of 1st and 2nd roll respectively. If R = {max(A, B) = m} and S = {min(A, B) = 2}, then match the probability $P\left(\frac{R}{S}\right)$ w.r.t. corresponding values of m.

List-I	List-II
(P) $m = 1$	(1) $\frac{1}{5}$
(Q) $m = 2$	(2) $\frac{2}{5}$
(R) $m = 3$	(3) 0
(S) $m = 4$	(4) $\frac{1}{4}$
	(5) $\frac{3}{4}$

Mark the option which correctly matches the entries in List-I to entries in List-II.

(A) P $\to$ 3; Q $\to$ 1; R $\to$ 4; S $\to$ 5

(B) P $\to$ 4; Q $\to$ 3; R $\to$ 2; S $\to$ 2

(C) P $\to$ 3; Q $\to$ 1; R $\to$ 2; S $\to$ 2

(D) P $\to$ 2; Q $\to$ 5; R $\to$ 4; S $\to$ 5

53. Let $f(x) = |x|$, $g(x) = |x - 1|$ and $h(x) = |x + 1|$.

List-I	List-II
(P) Area bounded by min($f(x)$, $g(x)$) and x-axis is	(1) $\frac{1}{8}$ sq. unit
(Q) Area bounded by min($f(x)$, $h(x)$) and x-axis is	(2) $\frac{1}{4}$ sq. unit

(R) Area bounded by min($f(x)$, $g(x)$, $h(x)$) and x-axis is (3) $\frac{1}{2}$ sq. unit

(S) Area bounded by min($f(x)$, $g(x)$, $h(x)$) and $y = \frac{1}{2}$ is (4) $\frac{3}{4}$ sq. unit

Mark the option which correctly matches the entries in List-I to entries in List-II.

(A) P → 2; Q → 2; R → 3; S → 4
(B) P → 2; Q → 3; R → 4; S → 4
(C) P → 3; Q → 4; R → 3; S → 2
(D) P → 4; Q → 2; R → 2; S → 1

54. Consider the fact that $\frac{x}{1+x} < \ln(1+x) < x \ \forall \ x > 0$.

We can deduce $\left(1+\frac{1}{k}\right)^k < e < \left(1+\frac{1}{k}\right)^{k+1} \ \forall \ k \in$ the integer.

Now taking the product for k = 1, 2, …. n – 1, and by induction we can prove that

$$\frac{n^{n-1}}{(n-1)!} < e^{n-1} < \frac{n^n}{(n-1)!}$$

and hence $en^n e^{-n} < n! < en^{n+1}e^{-n}$

so $e < \frac{n!}{n^n e^{-n}} < ne$

$\Rightarrow \ e^{1/n} < \left(\frac{n!}{n^n e^{-n}}\right)^{1/n} < n^{1/n}e^{1/n}$

But $\lim\limits_{n\to\infty} e^{1/n} = \lim\limits_{n\to\infty} n^{1/n} = 1$

$\therefore$ for $n \to \infty$; $n! \approx n^n e^{-n}$

Now match the entries in list-I to their values in List-II.

List-I	List-II
(P) $\lim\limits_{n\to\infty}\left(\frac{3(n!)}{n^{3n}}\right)^{1/n} =$	(1) $e^2/4$
(Q) $\lim\limits_{n\to\infty}\left(\frac{(n!)^3}{n^{3n}e^{-n}}\right)^{1/n} =$	(2) e^{-3}
(R) $\lim\limits_{n\to\infty}\left(\frac{(n!)^2}{n^{2n}}\right)^{1/n} =$	(3) 0
(S) $\lim\limits_{n\to\infty}\left(\frac{n^{2n}}{(2n)!}\right)^{1/n} =$	(4) e^{-2}

Mark the option which correctly matches the entries in List-I to entries in List-II.

(A) P → 1; Q → 4; R → 2; S → 3
(B) P → 3; Q → 2; R → 4; S → 1
(C) P → 3; Q → 4; R → 4; S → 1
(D) P → 1; Q → 2; R → 3; S → 3

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