JEE-2015 JEE ADVANCED-3	Vidyamandir Classes Gurukul for IITJEE Preparation	CODE ACEG

29/06/2014	PAPER - 2	MAX. MARKS : 180
02:00 PM - 05:00 PM		TIMING : 3.0 Hrs

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ROLL NO. : 10p15pj0142

Read the following Instructions very carefully before you proceed.

1. The question paper consists of 3 parts (Part I : Chemistry, Part II : Physics, Part III : Mathematics). Each Part has 3 sections (Section I, Section II & Section III).

2. Section I contains **10 Single Objective type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE Choice is Correct**. Chem - 2 left Phy - 13

3. Section II contains **6 Straight Objective (Paragraph) type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE Choice is Correct**.

4. Section III contains **4 Match the following Objective type Questions**. Each question contains statements given in 2 lists. Statements in the first list have to be matched with statements in the second list and then option with the appropriate code is to be marked in the answer sheet. **The options for the correct match are provided as** (A), (B), (C) and (D) out of which **ONLY ONE Choice is Correct**.

5. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** Properly in the space given in the ANSWER SHEET.

6. For each question in **Section I, II and III**, you will be given **3 Marks** if you have darkened only the bubble corresponding to all correct answers and zero mark if no bubble is darkened. In all other cases, **minus ONE (–1) mark (NEGATIVE MARKING)** will be given.

7. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.

8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.

C P M
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PART - I (CHEMISTRY)	60 MARKS

SECTION - I

SINGLE CORRECT ANSWER TYPE

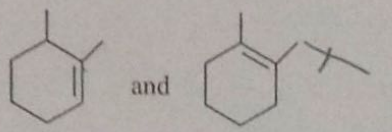
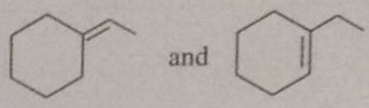
This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

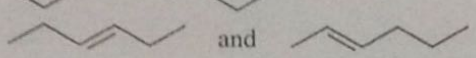
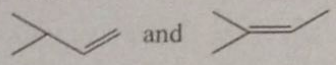
1. Correct order of C – C bond length is :

(A) $C_2H_4 > C_2H_6 > C_6H_6 > C_2H_2$ (B) $C_2H_6 > C_6H_6 > C_2H_2 > C_2H_4$

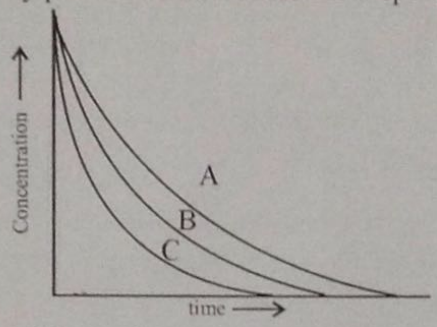
(C) $C_6H_6 > C_2H_6 > C_2H_4 > C_2H_2$ (D) $C_2H_6 > C_6H_6 > C_2H_4 > C_2H_2$

2. In which of the following options, first alkene is more stable than second?

(A)  (B) 

(C)  (D) 

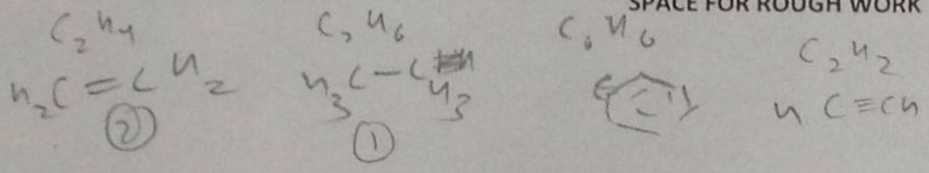
3. The decay profiles of three radioactive species A, B and C are given below:



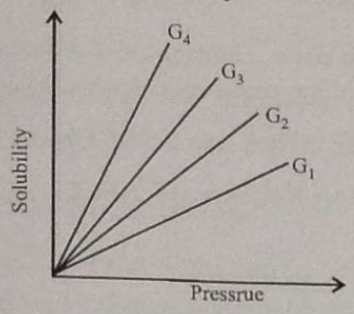
These profiles imply that the decay constants λ_A, λ_B and λ_C follow the order

(A) $\lambda_A > \lambda_B > \lambda_C$ (B) $\lambda_A > \lambda_C > \lambda_B$ (C) $\lambda_B > \lambda_A > \lambda_C$ (D) $\lambda_C > \lambda_B > \lambda_A$

SPACE FOR ROUGH WORK



4. The variation of solubility of four different gases (G_1, G_2, ...etc) in a given solvent with pressure at a constant temperature is shown in the plot.



The gas with the highest value of Henry's Law constant is :

(A) G_4 **(B)** G_2 **(C)** G_3 **(D)** G_1

5. Identify the correct statement for a gas that obeys the equation of state $P(V-nb)=nRT$?

(A) Gas behave as an ideal gas **(B)** Gas can be easily liquefied
(C) Intermolecular forces between gas molecules are negligible
(D) Gas shows negative deviation from ideal behavior

6. For the equilibrium $N_{2(g)}+3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, the equilibrium constant, K_p is expressed as

(A) $3^3 K_p = \dfrac{P_{NH_3}}{P_{N_2}^2}$ **(B)** $3^3 K_p = \dfrac{P_{NH_3}^2}{P_{N_2} P_{H_2}^3}$

(C) $3^3 K_p = \dfrac{P_{NH_3}^2}{P_{N_2}^4}$ **(D)** $3^{3/2} K_p^{1/2} = \dfrac{P_{NH_3}^2}{P_{N_2}^4}$

7. Which of the following reactions result in generating a chiral centre.

(A) Propene + HBr **(B)** Butene + HBr
(C) Cyclohexene + HBr **(D)** Acetone + CH_3 Mg Br

SPACE FOR ROUGH WORK

8. Among the following, the element having maximum inert pair effect is :
Atomic no. of Ge = 30, Pb = 82, Si = 14 and Sn = 50]

(A) Ge **(B)** Pb **(C)** Si **(D)** Sn

9. Among Ar, NH_4Cl, HF and HCl, the strength of interatomic/intermolecular forces follows the order:

(A) $NH_4Cl > HF > HCl > Ar$ **(B)** $HF > HCl > Ar > NH_4Cl$

(C) $HCl > Ar > NH_4Cl > HF$ **(D)** $Ar > NH_4Cl > HF > HCl$

10. The change in entropy for the following transformations is respectively:
(+ indicates increases; –indicates decrease and **0** indicates no change)

I. $SO_2Cl_{2(g)} \xrightarrow{\Delta} SO_{2(g)} + Cl_{2(g)}$

II. $nCH_2 = CH_{2(g)} \xrightarrow{\text{catalyst}} -\left[CH_2-CH_2\right]_{n(s)}-$

III. $I_{2(s)} \xrightarrow[1\text{atmosphere}]{\Delta} I_{2(v)}$

IV. Adiabatic reversible expansion of an ideal gas

The correct choice is :

(A) +, –, 0, + **(B)** +, –, 0, 0 **(C)** –, +, +, 0 **(D)** +, –, +, 0

SPACE FOR ROUGH WORK

HF > HCL > NH_4Cl > Ar

SECTION - II
COMPREHENSION TYPE

This section contains 3 paragraphs, each describing theory, experiments, data etc. Six questions relate to the three paragraphs with two questions on each paragraph. Each question has ONLY ONE Choice Correct among the four given Choices (A), (B), (C) and (D).

Paragraph for Questions 11 - 12

Concrete is produced from a mixture of cement, water, sand and small stones. Cement consists primarily of calcium silicates and calcium aluminates formed by heating and grinding of clay and limestone. In the later steps of cement production of a small amount of gypsum, $CaSO_4.2H_2O$ is added to improve subsequent hardening of the concrete. The use of elevated temperatures during the final production may lead to formation of unwanted hemihydrate, $CaSO_4.\frac{1}{2}H_2O$. Consider the following reaction

$$CaSO_4.2H_2O(s) \longrightarrow CaSO_4.\frac{1}{2}H_2O(s) + 1\frac{1}{2}H_2O(g)$$

The following thermodynamic data apply at 25°C, standard pressure: 1 bar

Compound	H/(kJ mol^{-1}) (ΔH_f°)	S(JK^{-1} mol^{-1})
$CaSO_4.2H_2O(s)$	–2021	194
$CaSO_4.½H_2O(s)$	–1575	130.5
$H_2O(g)$	–241.8	188.6

Gas constant, R = 8.314 J mol^{-1} K^{-1} = 0.08314 L bar mol^{-1} K^{-1}

(Atomic mass : H = 1, O = 16, S = 32, Ca = 40)

11. The reaction mentioned above is :

(A) Exothermic **(B)** Endothermic **(C)** Sublimation **(D)** Disproportionation

12. The standard change in enthalpy for the transformation of 1 kg of $CaSO_4.2H_2O(s)$ to $CaSO_4.\frac{1}{2}H_2O(s)$ is :

(A) –189.6 kJ **(B)** 443.2 kJ **(C)** –214.5 kJ **(D)** 484 kJ

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Paragraph for Questions 13 - 14

A dumb chemist, Kivid, accidently mixed up three anions A^-, B^-, and C^-. To separate them, he used a method in which a solution of 0.1M $AgNO_3$ was added dropwise into the flask containing the mixture of A^-, B^-, and C^-. On the basis of different K_{sp} values of AgA, AgB and AgC respectively, different layers of ppt were deposited at different titration points

Given the K_{sp} of $AgA = 10^{-10}$

$AgB = 10^{-13}$

$AgC = 10^{-16}$

and initial concentration of A^-, B^-, and $C^- = 10^{-5}$ M each.

13. If AgA is white ppt, AgB is red ppt and AgC is black ppt. then what is the colour of bottom most layer?

(A) White **(B)** Red **(C)** Black **(D)** Grey

14. What will be the concentration of B^- and C^- respectively when AgA starts precipitating?

(A) 10^{-8} and 10^{-11} **(B)** 10^{-11} and 10^{-11} **(C)** 10^{-11} and 10^{-8} **(D)** 10^{-8} and 10^{-8}

Paragraph for Questions 15 - 16

A metal carbide A_1 on reaction with water produces a mixture of hydrocarbons B_1 and B_2.

$$\text{white ppt.} \xleftarrow{\text{Ammonical silver nitrate}} B_1(g) \xrightarrow[H_2SO_4, HgSO_4]{H_2O} (D) \xrightarrow[NaOH]{I_2} \text{yellow ppt.}$$

$$B_2(g) + H_2O \xrightarrow{H^+} \underset{\text{unstable}}{(E)} \rightleftharpoons (D)$$

15. Metal carbide A_1 is :

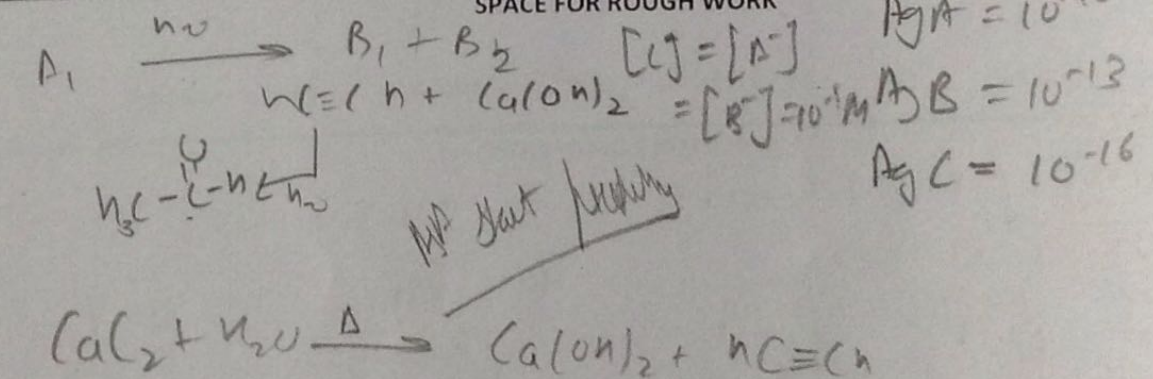
(A) Al_4C_3 **(B)** Mg_2C_3 **(C)** CaC_2 **(D)** SiC

16. Identify the correct statement :

(A) B_1 and B_2 are optical isomers **(B)** B_1 and B_2 are geometrical isomers

(C) B_1 and B_2 are structural isomers **(D)** None of these

SPACE FOR ROUGH WORK

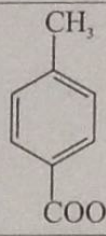
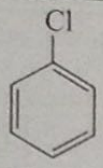
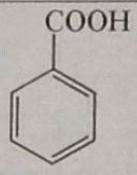
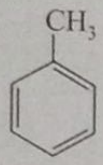
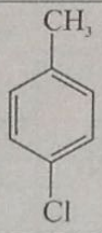
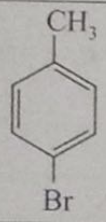
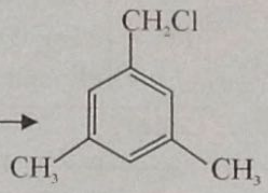


SECTION - III

MATRIX MATCH TYPE

This section contains 4 Single Choice Questions. Each question has matching lists. The codes for the lists have 4 choices (A), (B), (C) and (D) out of which ONLY ONE Choice is Correct.

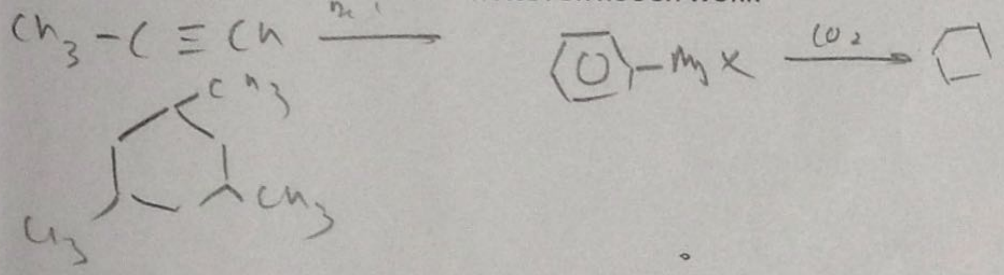
17. Match the starting material (List 1) with proper reaction schemes (List 2) to get appropriate product :

	List 1 (Starting materials)		List 2 (Reaction schemes)
(P)	$CH_3-C\equiv CH$	1.	(i) Mg/dry ether, (ii) CO_2, (iii) H^+ → 
(Q)		2.	(i) excess $Cl_2/h\nu$, (ii) NaOH excess, (iii) H^+ → 
(R)		3.	(i) $CH_3Cl/AlCl_3$ → 
(S)		4.	(i) Red hot Fe; (ii) $Cl_2/h\nu$ → 

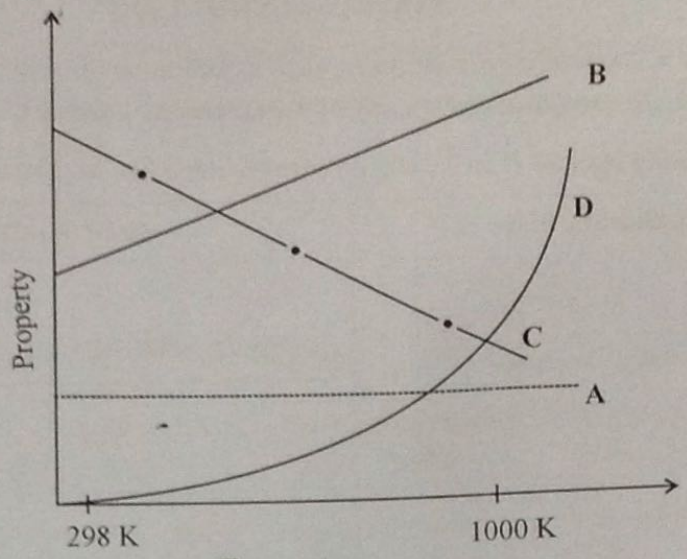
Codes :

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

SPACE FOR ROUGH WORK



18. The following graph represents the dependence of certain properties (List-1) as a function of temperature.



	List 1 (Property)		List 2 (Curve/line)
(P)	The compressibility factor of an ideal gas	1.	Curve 'A'
(Q)	The rate constant of a reaction with $E_a = 100$ kJmol^{-1}	2.	Curve 'B'
(R)	The standard Gibb's free energy of formation of metal oxide	3.	Curve 'D'
(S)	The enthalpy change of a gas phase reaction in which the sum of the number of moles of products is greater than the sum of the number of moles of reactants.	4.	Curve 'C'

Codes :

	P	Q	R	S
(A)	2	1	3	4
(C)	1	3	4	2

	P	Q	R	S
(B)	3	1	2	4
(D)	1	2	4	3

SPACE FOR ROUGH WORK

$PV = 2nRT$ $k = A e^{-\frac{E_a}{RT}}$

19. Consider the following List-1 and List-2 and select the correct answer using the code given below this.

	List 1		List 2
(P)	ICl_4^-	1.	Tetrahedral
(Q)	SCl_4	2.	Sea-Saw
(R)	ICl_3	3.	T-shape
(S)	BCl_4^-	4.	Square planar

Codes :

	P	Q	R	S
(A)	4	2	3	1
(C)	2	3	4	4

	P	Q	R	S
(B)	1	2	3	4
(D)	3	4	1	2

20. Consider the following oxygen containing molecular species (list-1) and interatomic distance O–O (list 2) in these species and select the correct answer using the code given below the lists.

	List 1 (Molecular species)		List 2 (O-O bond distance in pm)
(P)	O_2^-	1.	121
(Q)	O_2	2.	112
(R)	O_2^+	3.	132
(S)	O_2^{2-}	4.	149

Codes :

	P	Q	R	S
(A)	3	2	1	4
(C)	3	1	2	4

	P	Q	R	S
(B)	4	1	2	3
(D)	4	2	1	3

SPACE FOR ROUGH WORK

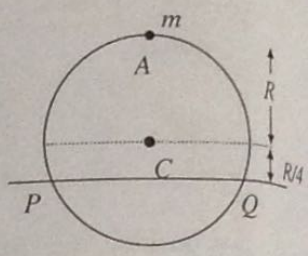
PART - II (PHYSICS) | **60 MARKS**

SECTION - I

SINGLE CORRECT ANSWER TYPE

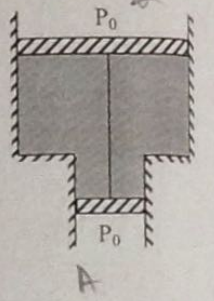
This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

21. A uniform circular disc has radius R and mass m. A particle also of mass m is fixed at a point A on the edge of the disc as shown in figure. The disc can rotate freely about a fixed horizontal chord PQ that is at a distance $R/4$ from the centre C of the disc. The line AC is perpendicular to PQ. Initially the disc is held vertical with the point A at its highest position. It is then allowed to fall so that it starts rotating about PQ. The linear speed of the particle at its lowest position is :



(A) $\sqrt{5gR}$ **(B)** $\sqrt{3gR}$ **(C)** $\sqrt{2.5gR}$ **(D)** $\sqrt{1.5gR}$

22. A smooth vertical tube having two different cross sections is open at both ends and equipped with two pistons having cross-sectional areas $2A$ and A respectively. Each piston slides within a respective tube section. One mole of ideal gas is enclosed between the pistons tied with a non-stretchable thread. The outside pressure is P_0 atm. If the combined mass of the two pistons is m and system is in equilibrium then pressure of the ideal gas will be :



(A) $P = P_0 - \frac{mg}{A}$ **(B)** $P = P_0 + \frac{mg}{2A}$ **(C)** $P = P_0 + \frac{mg}{A}$ **(D)** $P = P_0 + \frac{2mg}{A}$

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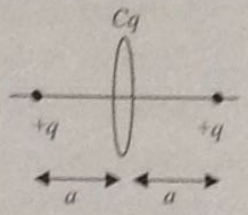
23. Two point charges of charge $+q$ each are placed $2a$ distance apart and a ring of radius a having charge Cq distributed uniformly over its circumference is placed midways between them as shown in figure. If none of them accelerated when released, the value of C will be :

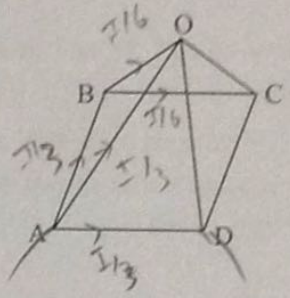


(A) $-\frac{1}{\sqrt{2}}$ (B) $-\sqrt{2}$ (C) $-\frac{1}{2\sqrt{2}}$ (D) $-2\sqrt{2}$

24. The length of a needle floating on water is 2.5 cm. The minimum force in addition to its weight needed to lift the needle above the surface of water will be (surface tension of water is 0.072 N/m)

(A) $3.6\times10^{-3}N$ (B) $10^{-2}N$ (C) $9\times10^{-4}N$ (D) $6\times10^{-4}N$

25. Eight identical resistance r each are connected as shown. If equivalent resistance between AD is :



(A) $\frac{8r}{15}$ (B) $\frac{4r}{15}$

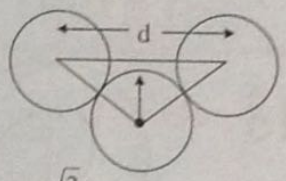
(C) $\frac{4r}{5}$ (D) $\frac{7r}{10}$

26. A galvanometer has a resistance of 20 Ω and reads full scale when 0.1 V is applied across it. To convert it into voltmeter of 10 V range, the galvanometer should have a resistance :

(A) 1980 Ω in series (B) 2080 Ω in series

(C) 980 Ω in series (D) 1980 Ω in parallel

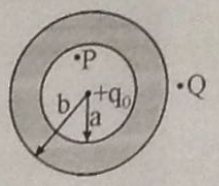
27. Two identical ball of radii r are kept on a horizontal plane with their centres d distance apart. A third identical ball, collides elastically with both the balls symmetrically as shown in the figure. If the third ball comes to rest after the collision, d should be:



(A) $2r$ (B) $2\sqrt{2}r$ (C) $(\sqrt{2}+1)r$ (D) $\sqrt{2}r$

SPACE FOR ROUGH WORK

28. A conducting spherical shell of inner radius a and outer radius b is having charge q_0 at the centre. There are two points P and Q at the locations as shown in figure. If the charge q_0 is shifted to point P then chose the correct statement(s).



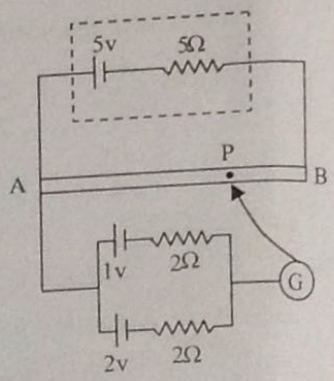
(A) Distribution of induced charge will change on inner surface, the distribution of charge on outer surface will not change but the electric field at point Q will change

(B) Distribution of induced charge will change on the inner surface, the distribution of charge on outer surface as well as electric field at point Q will not change

(C) Distribution of charge on inner and outer surfaces as well as electric field at point Q will change

(D) Distribution of charge on inner and outer surfaces both will change and electric field at point Q remains unchanged

29. A battery of emf $5V$ and internal resistance 5Ω is connected across a long uniform wire AB of length $1\ m$ and resistance per unit length $5\Omega m^{-1}$. Two cells of emf $2V$ and $1V$ and both having internal resistances 2Ω are connected as shown in the figure. The distance of null point P from end A of rod is :



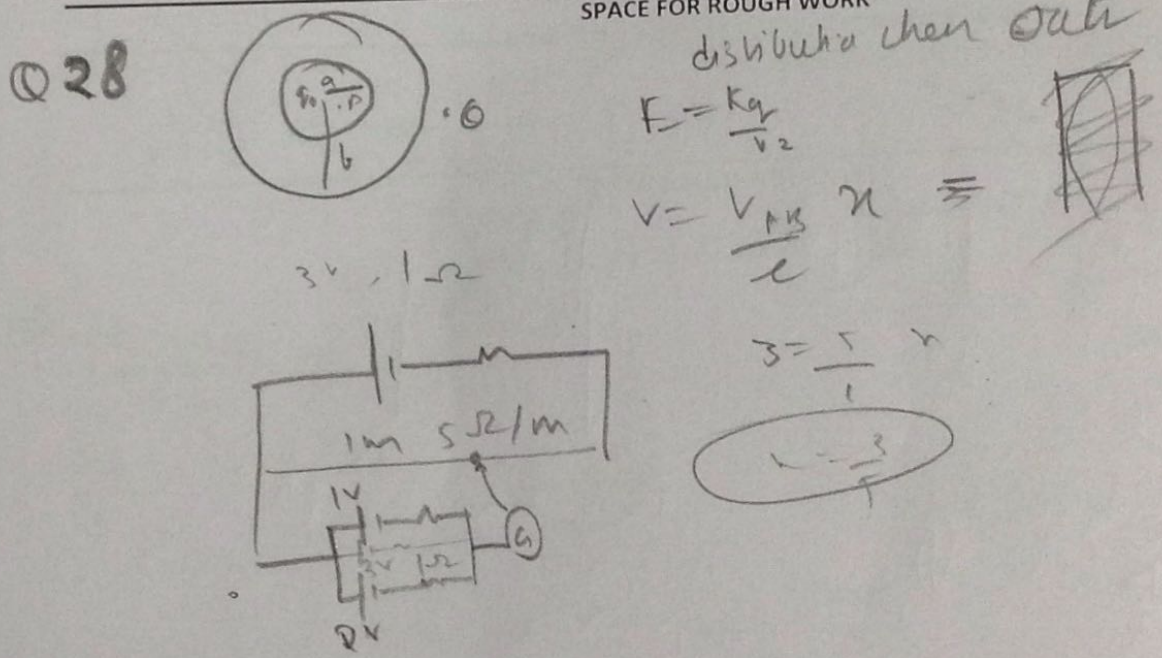
(A) $1m$ **(B)** $\frac{1}{2}m$

(C) $\frac{1}{5}m$ **(D)** $\frac{2}{5}m$

30. There are two pipes each of length $2\ m$, one is closed at one end and other is open at both ends. The speed of sound in air is $340\ m/s$. The frequency at which both can resonate is:

(A) $340\ Hz$ **(B)** $510\ Hz$ **(C)** $42.5\ Hz$ **(D)** None of these

SPACE FOR ROUGH WORK

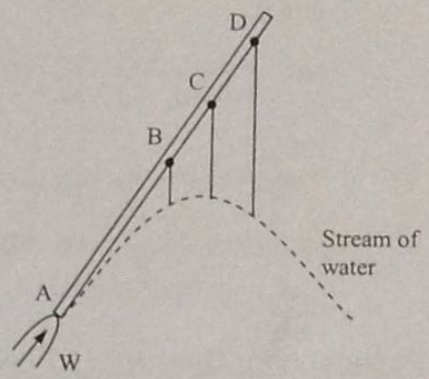


SECTION - II
COMPREHENSION TYPE

This section contains 3 paragraphs, each describing theory, experiments, data etc. Six questions relate to the three paragraphs with two questions on each paragraph. Each question has ONLY ONE Choice Correct among the four given Choices (A), (B), (C) and (D).

Paragraph for Questions 31 - 32

A jet of water is following from a water gun W. a rod $ABCD$ is attached to the water gun W with the end A of the rod fixed to the point where water jet is coming out. Angle made by rod with horizontal is same as the angle of projection of water Jet. Strings are tied to the rod at equal distances so that $AB = BC = CD$. The length of the strings are adjusted so that the lower ends just touch the curved stream of water. If the length of the string at B is $5cm$.



31. The length of the string at C is :

(A) 10 cm (B) 20 cm (C) 25 cm (D) 30 cm

32. The length of the string at D is :

(A) 15 cm (B) 20 cm (C) 45 cm (D) 30 cm

SPACE FOR ROUGH WORK

Paragraph for Questions 33 - 34

When a ball of density d is dropped on to a horizontal solid surface, it bounces elastically from the surface and returns to its original position in time t. Next the ball is released and falls through the same height before striking the surface of a nonviscous liquid of density d_L. (Consider size of ball to be very small) $(d_L > d)$

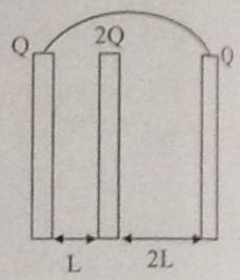
33. Time taken by the ball to come to rest when it enters into the liquid is : (Assume depth of liquid is very large)

(A) $\frac{dt}{2(d_L - d)}$ (B) $\frac{dt}{4(d_L - d)}$ (C) $\frac{dt}{2(d_L + d)}$ (D) $\frac{dt}{4(d_L + d)}$

34. Time taken by the ball to come back to the position from where it was released is :

(A) $\frac{td_L}{d_L - d}$ (B) $\frac{td_L}{d_L + d}$ (C) $\frac{td_L}{2(d_L - d)}$ (D) $\frac{td_L}{2(d_L + d)}$

Paragraph for Questions 35 - 36



Three identical parallel large plates are placed as shown in figure. The outer two plates are given charge Q each and middle plate is given charge $2Q$. The outer plates are connected by a conducting wire.

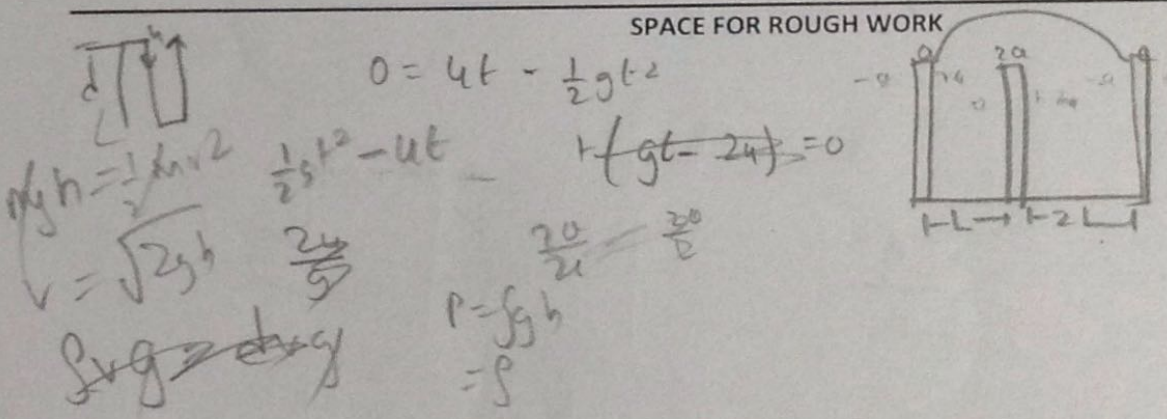
35. The charge appearing at the left surface of the middle plate is :

(A) $-\frac{2Q}{3}$ (B) $-\frac{4Q}{3}$ (C) $\frac{3Q}{4}$ (D) $\frac{5Q}{3}$

36. Now the middle plate is moved by distance L right maintaining the parallelism, the charge flown through the connecting wire is :

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

SPACE FOR ROUGH WORK

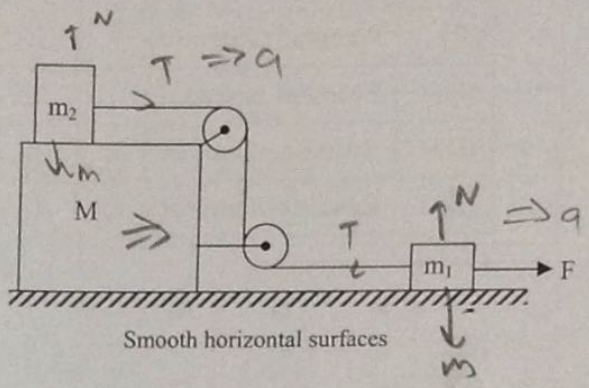


SECTION - III

MATRIX MATCH TYPE

This section contains 4 Single Choice Questions. Each question has matching lists. The codes for the lists have 4 choices (A), (B), (C) and (D) out of which ONLY ONE Choice is Correct.

37. Three blocks of masses m_1, m_2 and M are arranged as shown in figure. All the surfaces are frictionless and string is inextensible. A constant horizontal force of magnitude F is applied on block of mass m_1 as shown. Pulleys and string are light. Part of the string connecting both the pulleys is vertical and part of the string connecting pulleys with masses m_1 and m_2 are horizontal. Match the following:



[Take $m_1 = 2kg$, $m_2 = 4\ kg$, $M = 10\ kg$ and $F = 20\ N$)

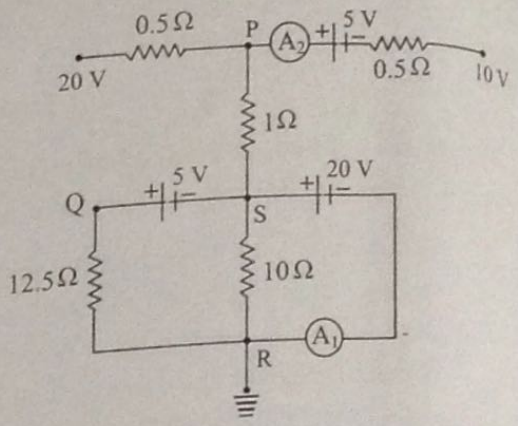
	List 1		List 2
(P)	Acceleration of mass m_1 in m/s^2	1.	5
(Q)	Acceleration of mass m_2 in m/s^2	2.	$\frac{10}{3}$
(R)	Acceleration of mass M in m/s^2	3.	Zero
(S)	Tension in the string in Newton	4.	$\frac{40}{3}$

Codes :

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

SPACE FOR ROUGH WORK

38. In the adjacent circuit shown, all ammeters and batteries are ideal. Internal resistances of all the batteries are negligible. Point R is grounded. Then, match the following.



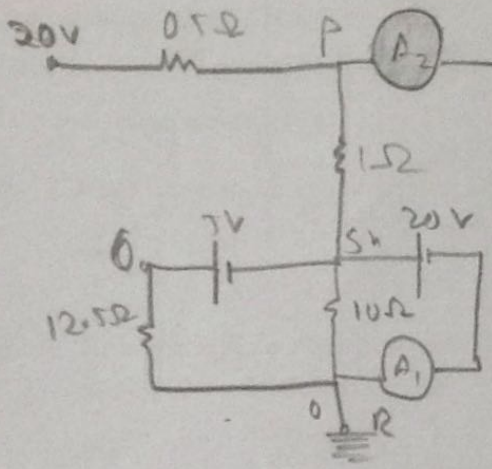
	List 1		List 2
(P)	Potential of point P	1.	6 *SI* unit
(Q)	Potential of point Q	2.	25 *SI* unit
(R)	Reading of ammeter A_1	3.	18 *SI* unit
(S)	Reading of ammeter A_2	4.	64 *SI* unit

Codes :

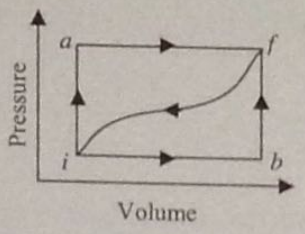
	P	Q	R	S
(A)	4	4	1	3
(C)	2	3	1	1

	P	Q	R	S
(B)	3	2	2	2
(D)	3	2	1	1

SPACE FOR ROUGH WORK



39. When a sample of a gas is taken from state i to state f along path iaf, heat supplied to the gas is 50 cal and work done by the gas is 20 cal. If it is taken by path ibf, then heat supplied is 36 cal.



	List 1		List 2
(P)	Work done by the gas along path ibf is	1.	6 cal
(Q)	If work done upon the gas is 13 cal for the return path fi, then heat rejected by the gas along path fi is	2.	18 cal
(R)	If internal energy of the gas at state i is 10 cal, then internal energy at state f is	3.	40 cal.
(S)	If internal energy at state b is 22 cal and at i is 10 cal then heat supplied to the gas along path ib is	4.	43 cal

Codes :

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

40. A ring, disc, solid sphere and a, hollow sphere all of mass M and radius R are kept on rough horizontal surface after giving its centre a horizontal speed V_0 then :

	List 1		List 2
(P)	Maximum time is taken to attain pure rolling by	1.	Solid sphere
(Q)	Minimum time is taken to attain pure rolling by	2.	Ring
(R)	Maximum velocity of body at time of pure rolling	3.	Disc
(S)	Minimum velocity of body at time of pure rolling	4.	Hollow sphere

Codes :

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

SPACE FOR ROUGH WORK

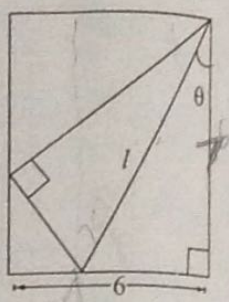
PART - III (MATHEMATICS) | **60 MARKS**

SECTION - I

SINGLE CORRECT ANSWER TYPE

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

41. One side of a rectangular piece of paper is 6 *cm*, the adjacent sides being longer than 6 *cms*. One corner of the paper is folded so that it sets on the opposite longer side. If the length of the crease is l *cms* and it makes an angle θ with the long side as shown, then l is :



(A) $\frac{3}{\sin\theta\cos^2\theta}$ **(B)** $\frac{6}{\sin^2\theta\cos\theta}$

(C) $\frac{3}{\sin\theta\cos\theta}$ **(D)** $\frac{3}{\sin^3\theta}$

42. The minimum value of the quantity $\frac{(a^2+3a+1)(b^2+3b+1)(c^2+3c+1)}{abc}$, where a, b, and c are positive real the numbers is :

(A) $\frac{11^3}{2^3}$ **(B)** 125 **(C)** 25 **(D)** 27

43. Two numbers X and Y are chosen simultaneously from the set $\{1,2,3,.....,5N\}$ where N is an even integer. The total number of ways X and Y can be chosen so that $X^4 - Y^4$ is divisible by 5 is :

(A) $\left({}^{4N+1}C_2 + {}^{N-1}C_2\right)\times 2!$ **(B)** $\left({}^{4N-1}C_2 + {}^{N}C_2\right)\times 2!$

(C) $\left({}^{4N}C_2 + {}^{N}C_2\right)\times 2!$ **(D)** None of these

44. If $p = \frac{1}{z} + \frac{2}{z^2} + \frac{3}{z^3} + ...\infty$ where $z = 1-2i$, can be written in the form of $a+ib$ then the value of $\left|\frac{b}{a}\right|$ where $a,b \in R$

(A) 1 **(B)** 2 **(C)** 4 **(D)** 6

SPACE FOR ROUGH WORK

45. Consider the circle $x^2+y^2=a^2$. A and B are extremities of a variable chord that always subtends an angle $\frac{\pi}{3}$ at the center 'O' of the circle. If a parallelogram $OACB$ is completed, then the locus of C is :

(A) $x^2+y^2=4a^2$ (B) $x^2+y^2=6a^2$ (C) $x^2+y^2=2a^2$ (D) $x^2+y^2=3a^2$

46. If for any non–zero real number x, $\prod_{n=1}^{\infty}\cos\left(\frac{x}{2^n}\right)=\frac{\lambda\sin x+\mu\cos x}{x}$, then

(A) $\lambda=0,\mu=1$ (B) $\lambda=1,\mu=0$ (C) $\lambda=1,\mu=1$ (D) None of these

47. If point A is (1, 1) and AB is any line through A intercepting $Y-$ axis at B. If AC is perpendicular to AB and meets X-axis at C, then the locus of mid point P of BC is :

(A) $x+y=2xy$ (B) $x+y=1$ (C) $x-y=2xy$ (D) $x+y=1-xy$

48. The value of $\lim_{x\to 0}\frac{\sqrt{1+x^3}-\left(1-x+\frac{x^2}{2}\right)e^x}{\tan x-x}$ is equal to :

(A) $\frac{1}{6}$ (B) $\frac{2}{3}$ (C) $\frac{1}{3}$ (D) 1

SPACE FOR ROUGH WORK

49. Arun and Mahesh solve a problem on "How to count without actually counting" given in the text book as follows :

Find the number of ways in which a selection of 5 books can be done out of 3 physics, 3 chemistry and 3 mathematics books by taking at least one book of each subject, books of same subject being different.

Arun's Solution :

One book of each subject can be taken in ${}^3C_1 \cdot {}^3C_1 \cdot {}^3C_1$ ways

Balance 2 books from remaining 6 books can be taken in ${}^6C_2$ ways

Hence, total number of ways using fundamental principle of counting = ${}^3C_1 \cdot {}^3C_1 \cdot {}^3C_1 \cdot {}^6C_2$ ways

Mahesh's Solution :

Number of ways in which atleast one Physics book can be selected = $(2^3 - 1)$

Similarly, one chemistry in $\left(2^3 - 1\right)$ ways and one mathematics is $(2^3 - 1)$ ways

Hence, total number of ways using fundamental principle of counting = $\left(2^3 - 1\right)\left(2^3 - 1\right)\left(2^3 - 1\right)$

Which one of the following options is correct?

(A) Arun is correct and Mahesh is wrong

(B) Mahesh is correct and Arun is wrong.

(C) Both Arun and Mahesh are wrong and their answers are higher than the actual answer

(D) Both Arun and Mahesh are wrong and their answers are lower than the actual answer.

50. Let $f(x) = \begin{cases} \dfrac{e^{x^2} - \frac{2}{\pi}\sin^{-1}\sqrt{1-x}}{\ln\left(1+\sqrt{x}\right)} & ; \quad x \in (0,1) \\ k & ; \quad x \le 0 \end{cases}$. If $f(x)$ is continuous at $x = 0$, then the value of k is :

(A) $1+\frac{2}{\pi}$ **(B)** $1-\frac{2}{\pi}$ **(C)** $\frac{2}{\pi}$ **(D)** $\frac{-2}{\pi}$

SPACE FOR ROUGH WORK

SECTION - II
COMPREHENSION TYPE

This section contains 3 paragraphs, each describing theory, experiments, data etc. Six questions relate to the three paragraphs with two questions on each paragraph. Each question has ONLY ONE Choice Correct among the four given Choices (A), (B), (C) and (D).

Paragraph for Questions 51 - 52

Let x_1, x_2, x_3, x_4 be the roots (real or complex) of the equation $x^4 + ax^3 + bx^2 + cx + d = 0$. If $x_1 + x_2 = x_3 + x_4$ and $a, b, c, d \in R$ then.

51. If $a = 2$ then the value of $b - c$ is :

(A) -1 **(B)** 1 **(C)** -2 **(D)** 2

52. If $b + c = 1$ and $a \neq -2$ then for real values of 'a', c belongs to :

(A) $\left(-\infty, \frac{1}{4}\right)$ **(B)** $(-\infty, 3)$ **(C)** $(-\infty, 1)$ **(D)** $(-\infty, 4)$

Paragraph for Questions 53 - 54

Let $f(x)$ be a cubic polynomial which has local maximum at $x = -1$ and $f'(x)$ has a local minimum at $x = 1$. If $f(-1) = 10$ and $f(0) = 5$.

53. The distance between two horizontal tangents is :

(A) 12 **(B)** 22 **(C)** 32 **(D)** 10

54. If x_1, x_2, x_3 are the real roots of $f(x) = 0$ then $[x_1]^2 + [x_2]^2 + [x_3]^2$ is equal to :

[**Note :** $[k]$ denotes the greatest integer less than or equal to k]

(A) 20 **(B)** 6 **(C)** 22 **(D)** 25

SPACE FOR ROUGH WORK

$x^4 + 2x^3 + 4bx^2 + cx + d$

Paragraph for Questions 55 - 56

A circle C whose radius is 1 unit touches X-axis at point A. the centre Q of C lies in 1st quadrant. The tangent from O to circle touches it at T and a point P lies on it such that ΔOAP is a right angled triangle at A and its perimeter is 8 unit.

55. The length of QP is :

(A) $\frac{1}{2}$ **(B)** $\frac{4}{3}$ **(C)** $\frac{5}{3}$ **(D)** None of these

56. Equation of circle C is :

(A) $(x-2)^2+(y-1)^2=1$ **(B)** $(x-1)^2+(y-1)^2=1$

(C) $(x-2)^2+(y-2)^2=1$ **(D)** $(x-1)^2+(y-3)^2=1$

SPACE FOR ROUGH WORK

SECTION - III
MATRIX MATCH TYPE

This section contains 4 Single Choice Questions. Each question has matching lists. The codes for the lists have 4 choices (A), (B), (C) and (D) out of which ONLY ONE Choice is Correct.

57. Let $\beta+\beta^2+\beta^4$ and $\beta^3+\beta^5+\beta^6$, (where β is the non-real complex root of the equation $z^7=1$) are the roots of the equation $z^2+az+b=0$ where $a,b\in R$; then :

	List 1		List 2
(P)	a is equal to	1.	$\frac{1}{8}$
(Q)	b is equal to	2.	2
(R)	$16\left(\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}\cos\frac{6\pi}{7}\right)$ is equal to	3.	1
(S)	$\left(\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{8\pi}{7}\right)$ is equal to	4.	$-\frac{1}{2}$

Codes :

	P	Q	R	S
(A)	2	3	4	2
(C)	3	2	2	4

	P	Q	R	S
(B)	3	2	1	4
~~(D)~~	3	2	4	2

P – 3 Q – 2 R – 4

SPACE FOR ROUGH WORK

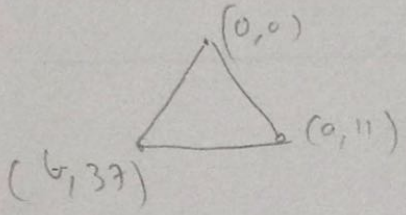
58. **MATCH THE FOLLOWING :**

	List 1		List 2
(P)	If $f(x)=\lim_{h\to 0}\frac{1}{h}\left(\lim_{t\to 0}\frac{1}{t}\left(\sin(x+h+t)-\sin(x+h)-\sin(x+t)+\sin x\right)\right.$ then $\lim_{x\to 0}1-\frac{f(x)}{x}$ is divisible by	1.	2
(Q)	If $\left(1+\tan 1^\circ\right)\left(1+\tan 2^\circ\right).....\left(1+\tan 45^\circ\right)=2^n$ then $(n+1)$ is divisible by	2.	3
(R)	The points $(0, 0)$, $(a, 11)$ and $(b, 37)$ are the vertices of an equilateral triangle then ab is divisible by	3.	5
(S)	$\tan\cos^{-1}\sin\tan^{-1}\left(\frac{1}{42}\right)$ is divisible by	4.	7

Codes :

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

SPACE FOR ROUGH WORK



$\sqrt{a^2+11^2}=\sqrt{b^2+37^2}$

59. **MATCH THE FOLLOWING :**

	List 1		List 2
(P)	If $f(x)=\sqrt{\frac{1+\sin^{-1}x}{1-\tan^{-1}x}}$; then $f'(0)$ equals to	1.	0
(Q)	Let $g(x)=\lim_{t\to\infty} t\,\ell n\left(\frac{\tan\left(x+\frac{1}{t}\right)}{\tan x}\right)$ then $\frac{3}{2}\lvert g'(\pi/6)\rvert$ equals to	2.	1
(R)	Let $h(x)=2\sin^{-1}\sqrt{1-x}+\sin^{-1}\left(2\sqrt{x(1-x)}\right)$ then $h'(1/4)$ equals to	3.	2
(S)	Let $k(x)=x+\tan x+2$ and $\ell(x)$ be the inverse of $k(x)$ then $2\ell'(2)$ equals to	4.	4

Codes :

	P	Q	R	S
(A)	4	4	1	3
(C)	1	2	3	2

	P	Q	R	S
(B)	2	4	1	2
(D)	2	1	3	4

SPACE FOR ROUGH WORK

60. MATCH THE FOLLOWING :

	List 1		List 2
(P)	Number of five digit numbers of the form $d_1d_2d_3d_4d_5$ where d_i are digits $\forall$, $i = 1, 2, 3, 4, 5$ and satisfying $d_1 < d_2 \le d_3 < d_4 \le d_5$	**1.**	5
(Q)	$256\left(\cos 12^\circ \cos 24^\circ \cos 36^\circ \cos 48^\circ \cos 60^\circ \cos 72^\circ \cos 84^\circ\right)$ is divisible by	**2.**	2
(R)	A badminton team has to be selected comprising of 5 students out of 10 students for inter school tournament. Number of ways this can be done if a particular players is to be always included or always excluded from the team, is a multiple of	**3.**	7
(S)	Let $y = \sin^2 x + \cos x$ for $0 \le x \le \frac{2\pi}{3}$. The ratio of the maximum and minimum value of y is	**4.**	3

Codes :

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

SPACE FOR ROUGH WORK

Always in $^9C_4$ $2\times \frac{9\times 8\times 7\times 6}{5\times 4\times 3\times 2\times 1}$

excl de $^9C_5$

$d_1 d_2 d_3 d_4 d_5 \quad i = 1, 2, 3, 4, 5$

$d_1 < d_2 \le d_3 < d_4 \le d_5$

3,2,1 4,3,2 4,3,2 1,4,3 5,4,3

3 4 4 5 5
2 3 4 5 5
2 3 3 4 5
1 2 3 4 5
2 3 3 4 4
1 2 3 4 4
2 3 4