

**PHYSICS, CHEMISTRY & MATHEMATICS****CMT – 4****QP Code:****ONLINE****Time Allotted: 3 Hours****Maximum Marks: 186**

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

**INSTRUCTIONS**

Caution: Question Paper CODE as given above **MUST** be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

**A. General Instructions**

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts: Part-A & B** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

**B. Filling of OMR Sheet**

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with **Blue/Black Ball Point Pen** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

**C. Marking Scheme For All Two Part.**

- (i) **Part-A (01-08)** – Contains eight (08) multiple choice questions which have **One or More** correct answer.  
**Full Marks: +4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.  
**Partial Marks: +1** For darkening a bubble corresponding to **each correct option**, provided **NO** incorrect option is darkened.  
**Zero Marks: 0** If none of the bubbles is darkened. **Negative Marks: -1** In all other cases.
- (ii) **Part-A (09-12)** – This section contains Two (02) List-Match Sets, each List-Match set has Two (02) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. **FOUR** options are given in each Multiple Choice Question based On List-I and List-II and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question. Each question carries **+3 Marks** for correct combination chosen and **-1 marks** for wrong options chosen.
- (iii) **Part-B (01-06)** contains six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+3 marks** for correct answer. **There is no negative marking.**

Name of the Candidate : \_\_\_\_\_

Batch : \_\_\_\_\_ Date of Examination : \_\_\_\_\_

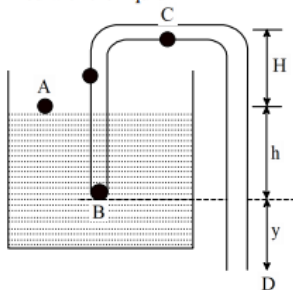
Enrolment Number : \_\_\_\_\_

**BATCHES – 2022**

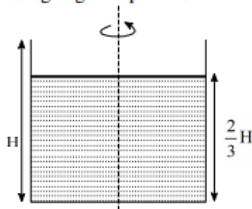
**PHYSICS****PART – I****SECTION – A****(One or More Than One Options Correct Type)**

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

- Which of the following is/are correct statement?
  - The fraction of volume submerged of any floating body in any liquid is equal to its relative density w.r.t. water
  - If a floating body absorbs some water the fraction of volume submerged will increase
  - If only liquid expands due to heating the fraction of volume submerged of a body decreases
  - If only floating body expands due to heating the fraction of volume submerged of the body decreases.
- A Siphon tube is used to remove liquid from a container as shown in figure. In order to operate the Siphon tube it must initially be filled with the liquid

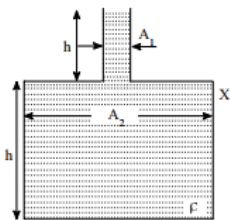


- Speed of the liquid through the Siphon is  $\sqrt{2g(h+y)}$
  - Pressure at C is  $= P_{\text{atm}} - \rho g(h+H+y)$
  - Pressure at  $P_A$  is less than  $P_D$
  - Pressure at  $P_A$  equal to  $P_D$
- A circular cylinder of radius  $R$  and height  $H$  is filled with water to a height  $\frac{2}{3}H$ . It starts rotating about its axis with constantly increasing angular speed. Choose the correct alternatives

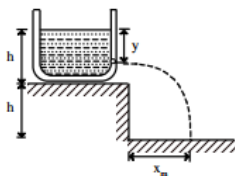


- At all speed, shape of the free surface is paraboloid
- The free surface touches first the brim of cylinder and then the base of the cylinder
- The free surface cannot touch the base without spilling water
- The free surface touches the brim as well as base at the same instant

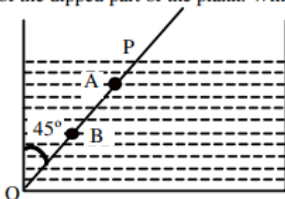
4. The vessel shown in figure has two sections of areas of cross-section  $A_1$  and  $A_2$ . A liquid of density  $\rho$  fills both the sections, up to a height  $h$  in each. Neglect atmospheric pressure



- (a) The pressure at the base of the vessel is  $2h\rho A_2$   
 (b) The force exerted by the liquid on the base of the vessel is  $2h\rho g A_2$   
 (c) The weight of the liquid is  $< 2h\rho g A_2$   
 (d) The walls of the vessel at the level X exert a downward force  $h\rho g (A_2 - A_1)$  on the liquid.
5. A tank is filled upto a height  $h$  with a liquid and is placed on a platform of height  $h$  from the ground. To get maximum range  $x_m$  a small hole is punched at a distance of  $y$  from the free surface of the liquid. Then



- (a)  $x_m = 2h$       (b)  $x_m = 1.5h$       (c)  $y = h$       (d)  $y = 0.75h$
6. A wooden plank of length 1m and uniform cross-section is hinged at one end to the bottom of a tank. The tank is filled with water upto a height of 0.5 m. The specific gravity of the plank is 0.5. The plank makes an angle of  $45^\circ$  with the vertical in the equilibrium position. A is the mid-point of the plank. B is the middle point of the dipped part of the plank. Which of the following is correct?



- (a) The weight of the plank acts downwards at A  
 (b) The buoyant force acts through B  
 (c)  $OB = \frac{1}{\sqrt{2}} \text{ m}$   
 (d) Both (b) and (c)

7. A uniform capillary tube of inner radius  $r$  is dipped vertically into a beaker filled with water. The water rises to a height  $h$  in the capillary tube above the water surface in the beaker. The surface tension of water is  $\sigma$ . The angle of contact between water and the wall of the capillary tube is  $\theta$ . Ignore the mass of water in the meniscus. Which of the following statements is (are) true?
- For a given material of the capillary tube,  $h$  decreases with increase in  $r$
  - For a given material of the capillary tube,  $h$  is independent of  $\sigma$
  - If this experiment is performed in a lift going up with a constant acceleration, then  $h$  decreases.
  - $h$  is proportional to contact angle  $\theta$
8. An object is floating in a liquid, kept in a container. The container is placed in a lift. Choose the correct option(s)
- Buoyant force increases as lift accelerates up
  - Buoyant force decreases as lift accelerates up
  - Buoyant force remains constant as lift accelerates
  - The fraction of solid submerged into liquid does not change.

**(Matching type - Single Correct Option)**

This section contains **FOUR** questions of matching type. The section contains **TWO** tables (each having 3 columns and 4 rows). Based on each table, there are **THREE** questions. Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct.

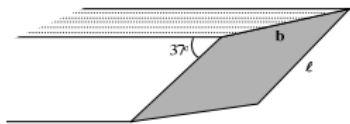
If a fluid is kept in a vessel,  $\theta$  is angle of contact,  $F_c$  is force of cohesion, and  $F_a$  is force of adhesion.

List I		List II	
(I)	Glass-water	(P)	$\theta < 90^\circ$
(II)	Glass-milk	(Q)	$\theta = 90^\circ$
(III)	Glass - Hg	(R)	$\theta > 90^\circ$
(IV)	Silver-water	(S)	$F_c < \sqrt{2} F_a$
		(T)	$F_c > \sqrt{2} F_a$
		(U)	$F_c = \sqrt{2} F_a$

9. Angle of contact ( $\theta$ ) is given by
- I - P, II - P, III - R, IV - Q
  - I - R, II - R, III - P, IV - Q
  - I - P, II - R, III - R, IV - Q
  - I - P, II - P, III - R, IV - P
10. Force of cohesion ( $F_c$ ) and force of adhesion are related as
- I - S, II - S, III - T, IV - S
  - I - S, II - T, III - T, IV - U
  - I - T, II - T, III - S, IV - U
  - I - S, II - S, III - T, IV - U

The shaded wall of the dam is inclined at an angle  $37^\circ$  with the horizontal and its dimensions are as shown in the figure. Liquid completely fills the dam. If density of liquid is  $\rho$ , then the horizontal force acting on shaded wall is 'x'.

List - I gives the density of liquid and List - II magnitude of some quantity



List I		List II	
(I)	Liquid ( $\rho$ )	(p)	x
(II)	Liquid ( $\frac{4\rho}{3}$ )	(q)	$\frac{x}{4}$
(III)	Liquid ( $\frac{\rho}{3}$ )	(r)	$\frac{4x}{3}$
(IV)	Liquid ( $\frac{\rho}{4}$ )	(s)	$\frac{x}{3}$
		(t)	$\frac{4}{9}x$
		(u)	$\frac{16}{9}x$

11. Find horizontal force on shaded surface

(a) I – P, II – T, III – R, IV – U

(b) I – T, II – S, III – Q, IV – U

(c) I – P, II – R, III – S, IV – Q

(d) I – T, II – Q, III – U, IV – S

12. Find vertical force on shaded surface

(a) I – T, II – Q, III – S, IV – U

(b) I – R, II – U, III – T, IV – S

(c) I – P, II – R, III – S, IV – U

(d) I – T, II – R, III – U, IV – P

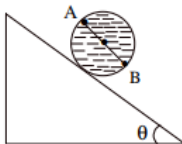
**SECTION – B****Numerical Type**

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded - off to the **second decimal place**; e.g. XXXX.XX).

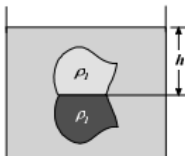
1. A uniform shell of mass  $M$  and radius  $R$  having a non viscous liquid of same mass  $M$  is rolling without slipping on a fixed incline plane as shown in the figure. Acceleration due to gravity is  $g$  downward.  $\Delta P$  is the pressure difference between point A & B, these points are present inside the

$$\text{liquid } \Delta P = \frac{\lambda M g \sin \theta}{\beta \pi R^2}, \frac{\beta}{\lambda} = \text{---}$$

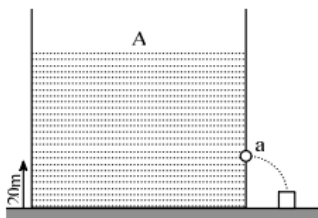
(Neglect the thickness of the shell)



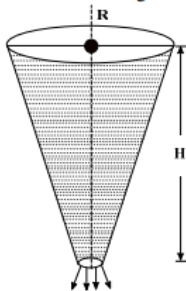
2. Two objects of equal volume  $V = 1.0 \text{ m}^3$  and densities  $\rho_1 = 400 \text{ kg/m}^3$  and  $\rho_2 = 600 \text{ kg/m}^3$  have identical flat portions of area  $S = 100 \text{ cm}^2$  on their surface. These flat portions are glued to each other. The composite body thus formed, floats fully submerged in a liquid with the common flat portion horizontal as shown in the figure. If the glue can withstand a maximum force  $F = 500 \text{ N}$ , at what minimum depth  $h$  in the liquid can the common flat portion be in equilibrium keeping the object intact? Acceleration of free fall is  $g$



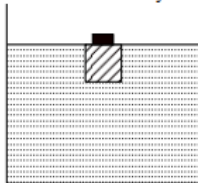
3. Water is filled in a uniform container of area of cross section  $A$ . A hole of cross section area  $a$  ( $a \ll A$ ) is made in the container at a height of 20 m above the base. Water streams out and hits a small block placed at some distance from container. With what speed (in  $\text{ms}^{-1}$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



4. A conical container of radius  $R = 1 \text{ m}$  and height  $H = 5 \text{ m}$  is filled completely with liquid. There is a hole at the bottom of container of area  $\pi \times 10^{-3} \text{ m}^2$  (see figure). Time taken to empty the conical container is  $n \times 10^2$  sec. then find the value of 'n'. Take  $g = 10 \text{ m/s}^2$ .



5. A cube of wood supporting a 200 g mass just floats in the water. When the mass is removed the cube rises by 2 cm. Length of side is  $n \times 10^1 \text{ cm}$ . Find n. Density of water in ( $1 \text{ g/cc}$ )



6. A cube floating in a liquid contained in a beaker has one-third of its volume submerged in mercury. Water is poured into the beaker till the cube is completely covered. What fraction of the volume of the cube is now submerged in mercury? If the fraction is  $\frac{1}{x}$ , find x. The relative density of mercury = 9

**CHEMISTRY****PART – II****SECTION – A****(One or More Than One Options Correct Type)**

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

- For the reaction  $A + B \rightarrow C$  the rate constant for the second-order forward reaction is  $k_2 = 10.00 \exp\left(-\frac{90500}{RT}\right) \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ . The pre-exponential factor and activation energy are, respectively  
 (a)  $10^{10} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$  and  $-90.50 \text{ kJ mol}^{-1}$  (b)  $\log 10 \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$  and  $-45.25 \text{ kJ mol}^{-1}$   
 (c)  $10 \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$  and  $90.50 \text{ kJ mol}^{-1}$  (d)  $10 \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$  and  $-90.25 \text{ kJ mol}^{-1}$
- Which of the following on reaction with water will produce polyprotic acid?  
 (a)  $\text{B}_2\text{O}_3$  (b)  $\text{N}_2\text{O}_5$  (c)  $\text{P}_4\text{O}_{10}$  (d) Maleic anhydride
- Arrhenius equation is represented as:  $k = Ae^{-E_a/RT}$ . Which of the following options is/are correct?  
 (a) Graph plotted between  $k$  and  $1/T$  is a straight line  
 (b) Graph plotted between  $\log k$  and  $1/T$  is a straight line with a positive slope  
 (c) Intercept of the graph between  $\log k$  and  $1/T = \log A$   
 (d) Slope of the graph between  $\log k$  and  $1/T = -E_a / 2.303R$
- Which of the following is true about boron?  
 (a) It is symmetrical solid with icosahedral shape  
 (b) There are 20 faces (equilateral triangle)  
 (c) It has unusual three centre bonding  
 (d) All statements are correct
- Which of the following is/are incorrect about the most acidic halide among boron halide?  
 (a) It is volatile halide (b) It is most thermally stable halide  
 (c) It form strong  $\text{P}\pi - \text{P}\pi$  back bond (d) It can form  $[\text{BX}_4^-]$
- A white precipitate (B) is formed when a mineral colemanite (A) is boiled with  $\text{Na}_2\text{CO}_3$  solution. The precipitate is filtered and the filtrate contains two compounds (C) and (D). The compound (C) is removed by crystallization and  $\text{CO}_2$  is passed through the mother liquor, where compound (D) changes to compound (C). Compound (C) on strong heating gives two compounds (D) and (E). The compounds (A) and (D) are respectively  
 (a)  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{B}_2\text{O}_3$  (b)  $\text{FeCl}_3$ ,  $\text{KCN}$   
 (c)  $\text{Ca}_2\text{B}_6\text{O}_{11}$ ,  $\text{NaBO}_2$  (d)  $\text{FeCl}_3$ ,  $\text{Fe}(\text{CNS})_3$
- Which of the following reactions is/are correct?  
 (a)  $\text{PCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_3 + 3\text{HCl}$   
 (b)  $\text{NCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{NH}_3 + 3\text{HOCl}$   
 (c)  $\text{SbCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{H}_3\text{SbO}_3 + 3\text{HCl}$   
 (d)  $\text{BiCl}_3 + \text{H}_2\text{O} \rightarrow \text{BiOCl} + 2\text{HCl}$



8. Compound (X) on reduction with  $\text{LiAlH}_4$  gives a hydride (Y) along with other products. The compound (Y) reacts with air explosively resulting in boron trioxide. Which of the following is/are correct? ( $M_r = 27.62$ )
- (a) % of Hydrogen in (Y) is 21.72 %  
 (b) compound (X) is borazine  
 (c) compound (Y) has maximum of 6 atoms in a plane  
 (d) None is correct

## (Matching type - Single Correct Option)

This section contains **FOUR** questions of matching type. The section contains **TWO** tables (each having 3 columns and 4 rows). Based on each table, there are **THREE** questions. Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct.

For the first order reaction  $A \rightarrow B$  (rate constant  $K = 6.93 \times 10^{-2} \text{ min}^{-1}$ ) and  $t_{1/2} = 10 \text{ min}$

List I		List II	
(I)	$t_{1/2}$ (50%)	(P)	5 min
(II)	$t$ 75%	(Q)	10 min
(III)	$t$ 87.5%	(R)	15 min
(IV)	$t$ 100%	(S)	30 min
		(T)	45 min
		(U)	$\infty$

9. If the reactions first order becomes  $2A \rightarrow B$  (with rate constant is  $6.93 \times 10^{-2} \text{ min}^{-1}$ ) then
- (a) I – Q, II – P, III – T, IV – U      (b) I – P, II – Q, III – R, IV – U  
 (c) I – R, II – T, III – S, IV – U      (d) I – R, II – U, III – T, IV – S
10. If the first order reaction become  $5A \rightarrow B$  (with rate constant  $9.24 \times 10^{-3} \text{ min}^{-1}$ ) then
- (a) I – R, II – S, III – T, IV – U      (b) I – P, II – S, III – U, IV – T  
 (c) I – R, II – T, III – S, IV – U      (d) I – R, II – U, III – T, IV – S

The elements of Gr-13 and Gr-14 show inert pair effect due to which stability of lower oxidation state increases and higher oxidation state decreases

List I		List II	
(I)	$\text{PbCl}_4$	(p)	+4
(II)	$\text{GaCl}_3$	(q)	+3
(III)	$\text{SnCl}_2$	(r)	+2
(IV)	$\text{TlH}_3$	(s)	+1
		(t)	Oxidising property
		(u)	Reducing property
		(v)	Strong polarising power
		(w)	Strong polarisability

11.

12. Property / characteristics of the compound

(a) I - v, II - t, III - r, IV - s

(b) I - u, II - w, III - v, IV - t

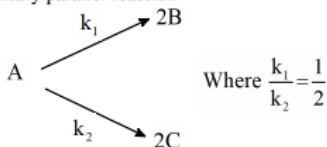
(c) I - v, II - u, III - t, IV - w

(d) I - u, II - t, III - v, IV - w

**SECTION - B****Numerical Type**

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded - off to the **second decimal place**; e.g. XXXXX.XX).

1. For given hypothetical elementary parallel reaction



Initially only 2 moles of A are present. The total no. of moles of A, B and C at the end of 75% reaction are

2. Find the number of reagents which would lead to unsymmetrical cleavage of diborane

 $\text{CH}_3\text{NH}_2, \text{NH}_3, (\text{CH}_3)_2\text{NH}, (\text{CH}_3)_3\text{N},$ 


, NaH

3. Consider thermal decomposition given below  $\text{Pb}(\text{NO}_3)_2 \xrightarrow{\Delta} \text{A(s)} + \text{B(g)} + \text{C(g)}$  when gas (B) is allowed to cool down below  $-11^\circ\text{C}$ , then it is solidified and exists as ion pair, what is the bond order of anion?
4. 3 moles of  $\text{SiF}_4$  are reacted with water, then calculate how many total number of moles of hexa fluoride silicic acid are formed in product.
5. For this reaction  $\text{H}_3\text{BO}_3 \xrightarrow[\text{hot}]{\text{Red}} \text{B}_2\text{O}_3$ , how much gms of  $\text{B}_2\text{O}_3$  formed starting from 2 gm of  $\text{H}_3\text{BO}_3$ . (Assume yield to be 100%)
6. The half-life of first order decomposition of  $\text{NH}_4\text{NO}_2(\text{aq}) \xrightarrow{\Delta} \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\ell)$  is 13.86 minute at  $293\text{K}$ . If 10 g of  $\text{NH}_4\text{NO}_2$  is allowed to decompose then the time in minute required to decompose 90% of  $\text{NH}_4\text{NO}_2$  is.

**MATHEMATICS****PART – III****SECTION – A****(One or More Than One Options Correct Type)**

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

- Let  $S_n$  denotes the sum of first  $n$  terms of an arithmetic progression whose first term is  $-4$  and common difference is  $1$ . If  $V_n = 2S_{n+2} - 2S_{n+1} + S_n$  ( $n \in \mathbb{N}$ ), then
 

(A)  $V_n = \frac{-9n^2 + 5n - 12}{2}, n \in \mathbb{N}$  (B)  $V_n = \frac{n^2 + 5n + 12}{2}, n \in \mathbb{N}$

(C) Minimum value of  $V_n$  is  $-9$  (D) Minimum value of  $V_n$  is  $-\frac{73}{8}$
- If a variable chord of the hyperbola  $x^2 - y^2 = 9$  touches the parabola  $y^2 = 12x$ , then; locus of middle points of these chords is expressed as  $x^3 + \lambda_1 xy^2 + \lambda_2 y^2 = 0$  ( $\lambda_1, \lambda_2 \in \mathbb{I}$ ), then-
 

(A)  $\lambda_1 + \lambda_2 = 2$  (B)  $\lambda_1^2 + \lambda_2^2 = 10$

(C) Number of divisors of  $(\lambda_1^2 + \lambda_2^2)$  is  $4$  (D) Number of divisors of  $(\lambda_1^2 + \lambda_2^2)$  is  $6$
- The locus of a point which is equidistant from a circle and a point in the plane not lying on the circle can be-
 

(A) a parabola (B) an ellipse

(C) both branches of hyperbola (D) only one branch of hyperbola
- Let  $a_1, a_2, a_3, \dots, a_n$  are different numbers in A.P. and  $a_3, a_5, a_8, b_1, b_2, b_3, \dots$  are in G.P and  $a_9 = 40$ , then-
 

(A)  $\sum_{i=1}^9 a_i^2 = 6144$  (B)  $\sum_{i=1}^{\infty} \frac{1}{b_i} = \frac{1}{18}$  (C)  $\sum_{i=1}^9 a_i^2 = 6278$  (D)  $\sum_{i=1}^9 \frac{1}{b_i} = \frac{1}{28}$
- Let the eccentricity of the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  be reciprocal to that of the ellipse  $x^2 + 4y^2 = 4$ . If the hyperbola passes through a focus of the ellipse, then
 

(A) the equation of the hyperbola  $\frac{x^2}{3} - \frac{y^2}{2} = 1$

(B) a focus of the hyperbola is  $(2, 0)$

(C) the eccentricity of the hyperbola is  $\sqrt{\frac{5}{3}}$

(D) the equation of the hyperbola is  $x^2 - 3y^2 = 3$
- Consider the sequence  $a_n$  given by  $a_1 = \frac{1}{2}, a_{n+1} = a_n^2 + a_n$ , Let  $S_n = \frac{1}{a_1+1} + \frac{1}{a_2+1} + \dots + \frac{1}{a_n+1}$  then find the value of  $[S_{2012}]$ , where  $[.]$  denotes greatest integer function
 

(a)  $1$  (b)  $[e/2]$  (c)  $[e]$  (d)  $[\pi-1]$

7. An arithmetic sequence consists of ten positive integers, the sum of the terms in the sequence lies in the interval (180, 190). If the fifth term in the sequence is 17. Then which of the following statement(s) is/are correct  
 (a) Common difference of sequence equals 3  
 (b) Second term in the sequence is 8  
 (c) Number of prime numbers in the sequence is 5  
 (d) No term in the sequence is perfect square
8. If least numerical value of slope of line which is tangent to hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{(a^3 + a^2 + a)^2} = 1$  is  $\frac{3}{4}$ ,  $a \in \mathbb{R}$  is obtained at  $a = k$ . For this value of 'a', which of the following is/are true  
 (a)  $a = -\frac{1}{2}$  (b)  $a = \frac{1}{2}$  (c)  $LR = \frac{9}{16}$  (d)  $e = \frac{5}{4}$

## (Matching type - Single Correct Option)

This section contains **FOUR** questions of matching type. The section contains **TWO** tables (each having 3 columns and 4 rows). Based on each table, there are **THREE** questions. Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct.

If  $e_1$  and  $e_2$  are the roots of the equation,  $x^2 - ax + 2 = 0$ , then match the following Column-I with Column-II

Column-I		Column-II	
(A)	If $e_1$ and $e_2$ are the eccentricities of the ellipse, and hyperbola, respectively then the value of 'a' are	(P)	6
(B)	If both $e_1$ and $e_2$ are the eccentricities of the hyperbolas, then values of a are	(Q)	$\frac{5}{2}$
(C)	If $e_1$ and $e_2$ are eccentricities of hyperbola and conjugate hyperbola, then values of a are	(R)	$2\sqrt{2}$
(D)	If $e_1$ is the eccentricity of the hyperbola for which there exist infinite points from which perpendicular tangents can be drawn and $e_2$ is the eccentricity of the hyperbola in which no such points exists then the values of a are	(S)	5

9. Which of the following options has correct combination considering Column - I and Column - II?  
 (a) A  $\rightarrow$  p (b) B  $\rightarrow$  s (c) C  $\rightarrow$  q (d) D  $\rightarrow$  r
10. Which of the following options has incorrect combination considering Column - I and Column - II?  
 (a) A  $\rightarrow$  s (b) B  $\rightarrow$  p (c) C  $\rightarrow$  r (d) D  $\rightarrow$  p

$S_n$  denotes of  $n$  terms of the series and  $T_n$  denotes  $n$ th term of the given series

List I		List II	
(A)	In an A.P., $S_p = a$ , $S_q = b$ , $S_r = c$ , then $\frac{a}{p}(q-r) + \frac{b}{q}(r-p) + \frac{c}{r}(p-q)$ is	(p)	3
(B)	In G.P., $T_r = R$ , $T_s = S$ , $T_t = T$ , then $R^{st}, S^{tr}, T^{rs}$ is	(q)	2
(C)	If $x, y, z$ are both in A.P. and G.P., $T_m = x$ , $T_n = y$ , $T_p = z$ , then $x^{yz}, y^{zx}, z^{xy}$ is	(r)	1
(D)	If $a, b, c$ are both in G.P. and H.P., $T_p = 0$ , $T_q = b$ , $T_r = c$ , then $a(b-c) \log a + b(c-a) \log b + c(a-b) \log c$	(s)	0
		(t)	4

11. Which of the following options has correct combination considering Column – I and Column – II ?  
 (a) A  $\rightarrow$  p (b) B  $\rightarrow$  t (c) C  $\rightarrow$  q (d) D  $\rightarrow$  s
12. Which of the following options has incorrect combination considering Column – I and Column – II?  
 (a) A  $\rightarrow$  s (b) B  $\rightarrow$  r (c) C  $\rightarrow$  q (d) D  $\rightarrow$  p

## SECTION – B

### Numerical Type

This section contains 06 questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded off to the **second decimal place**; e.g. XXXX.XX).

- Let  $A_1$  and  $A_2$  are the vertices of the conic  $C_1 : 4(x-3)^2 + 9(y-2)^2 - 36 = 0$  and a point  $P$  is moving in the plane such that  $|PA_1 - PA_2| = 3\sqrt{2}$ , then locus of  $P$  is another conic  $C_2$ . If  $D_1$  denotes distance between foci of conic  $C_2$ ,  $D_2$  denotes product of the perpendicular from the point  $A_1, A_2$  upon any tangent drawn to conic  $C_2$  and  $D_3$  denotes length of the tangent drawn from any point on auxiliary circle of conic  $C_1$  to the auxiliary circle of the conic  $C_2$ , then  $\left(\frac{D_1 D_2}{D_3^2}\right)^2$  is equal to
- If AM, GM and HM of the first and last terms of series 100, 101, 102, .....  $(n-1)$ ,  $n$  are the terms of series itself, then value of  $n$  ( $100 < n \leq 500$ ) is
- Consider the sum,  $S = \sum_{n=0}^{\infty} \frac{a_n}{5^{2n}}$  where  $\langle a_n \rangle$  is a sequence defined by recurrence relation  $a_{n+2} = 2a_{n+1} + a_n \quad \forall \quad n \in \mathbb{W}$  and  $a_0 = a_1 = 1$  if  $S = \frac{599 + \alpha}{574}$  (where  $\alpha \in \mathbb{N}$ ) then  $\alpha$  is equal to
- The tangent at a point  $R$  on the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  ( $a, b \in \mathbb{R}^+$ ) passes through the point  $(0, -b)$  and the normal at the point  $R$  passes through the point  $(2\sqrt{2}a, 0)$ . If 'e' denotes the eccentricity of the hyperbola then 'e<sup>2</sup>' is

5. Consider an A.P. whose first term is maximum value of sum of roots and common difference is minimum value of product of roots of quadratic (in x)

$x^2 - (6 \sin \theta + 8 \cos \theta)x + (\tan^2 \phi + 4 \cot^2 \phi) = 0$ , then  $\frac{S_{10}}{56}$  is (where  $S_{10}$  is sum of first 10 terms of above A.P. and  $\theta, \phi \in \mathbb{R}$ )

6. Let 'e' be the eccentricity of hyperbola and  $f(e)$  be the eccentricity of its conjugate hyperbola.

If  $\int_2^6 f(f(\dots f(e)))de = k$  (n is odd), if the value of  $76k^2 - k^4$  is  $2^p$ , then p is