

NOTE:-

1. Attempt all questions. There is no negative marking. No additional sheets are provided
2. Answer all the questions of the **same subject at one place.**
3. Students may take around 80 minutes for Mathematics, 50 minutes for Physics and 50 minutes for Chemistry.
4. Use of calculators, slide rule, graph paper and logarithmic, trigonometric and statistical tables is not permitted.

PART-A : MATHEMATICS

Note:- All answers to questions in **Section-A, Section-B** and **Section-C** must be supported by mathematical arguments. In each of these sections order of the questions must be maintained.

SECTION-A

This section has Four Questions. Each question is provided with 4 alternative answers. One or more than one of them are correct answers. Indicate the correct answer by A, B, C, D. (4x3=12 MARKS)

1. $x^2 - 507x + 2012 < 0$ if $x \in$
A) (4, 503) B) **R** - (4, 503) C) (1, 2012) D) (10, 201)
2. A circle of radius 14 units is inscribed in a square. And a square is inscribed in the circle such that its sides are parallel to the first square then the area bounded between the two squares is equal to
A) 49 B) 98 C) 196 D) 392
3. If P and Q are two subsets of a set S then $(P-Q) \cup (Q-P)$ is equal to
A) $(P' \cap Q) \cup (P \cap Q')$ B) $(P \cup Q) - (P \cap Q)$ C) $(P \cup Q) \cap (P \cap Q)'$ D) $(P' \cup Q') \cap (P \cup Q)$
4. Let $P(x) = \sum_{r=0}^7 a_r x^r$, where $a_7 = 1$ and $P(k) = k$ for $k = 1, 2, 3, \dots, 7$ then $P(8) =$
A) 5040 B) 5048 C) 5050 D) none of these

SECTION-B

This section has Four Questions. In each question a blank is left. Fill in the blank. (4x3=12 MARKS)

5. Area of the region bounded by $|x| + |y| = 2012$ is _____
6. If $f(n) = n(n+1)$ for all natural numbers n, then the set of values of n such that $f(n+4) = 4f(n) + 4$ is _____
7. Consider a right angled triangle ABC with right angle at A. The radius of its incircle is r. Radius of the circle drawn touching the line segments AB, AC and the incircle of triangle ABC is _____
8. A and B are two different numbers selected from the first forty natural numbers. The largest value that $\frac{A \cdot B}{A - B}$ can have is _____

SECTION-C

State True or False in each of the following statements. (4x3=12 MARKS)

9. $2^{2^{2011}} + 1$ divides $2^{2^{2012}} - 1$
10. If x and y are perfect squares and $y = x+1$ then number of such ordered pairs (x, y) is more than 1
11. $\log_2 13$ is irrational.
12. The number of four digit numbers which are perfect squares and in which the first two digits are equal to each other and the last two digits are equal to each other is 2

SECTION-D

(4x6=24 MARKS)

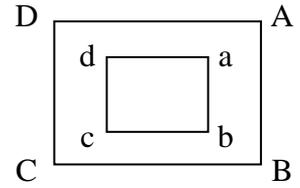
13. If one root of the polynomial equation $Ax^3 + Bx^2 + Cx + D = 0$, $A \neq 0$, is the arithmetic mean of the other two, find a simplest relation between A, B, C and D.
14. Let $f: A \rightarrow B$ be a function defined as $f(x) = (x^2 - 4x + 4)^{1/2}$ where A and B are subsets of **R**. Then find the largest possible subset A of **R**⁺ such that f is bijective and find the corresponding B.
15. In a triangle ABC, if AD is the median through A intersecting the side BC in D then show that $AB^2 + AC^2 = 2(AD^2 + BD^2)$.
16. Find all possible positive integers 'n' such that $n^4 - 4n^3 + 22n^2 - 36n + 18$ is a perfect square.

PART-B : PHYSICS

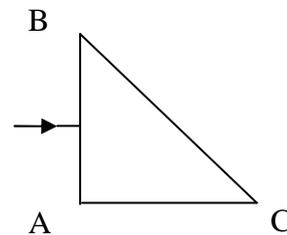
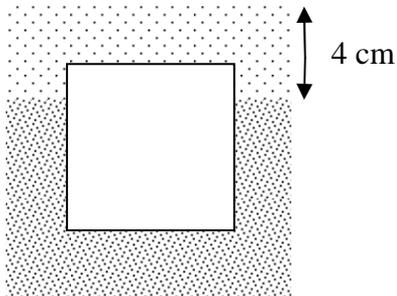
(10x6=60 Marks)

Questions 17 to 19 are based on the following situation.

Narrow square paths ABCD and abcd have sides of 200 m and 100 m. Two persons P and Q are initially located at a and A respectively. They both start walking in a clockwise sense with speeds of 2 m/s simultaneously.



17. When are they farthest from each other?
18. Starting from the same initial positions P and Q walk at 1 m/s and 2 m/s respectively, find the shortest distance between them.
19. With same initial positions as earlier and the speeds of 1 m/s and 2 m/s, if Q were to move anticlockwise along the path, find the largest distance between them.
20. A thin long rod A revolves at 300 rpm about a vertical axis. Another rod B is held vertically with its lower end just above the horizontal plane swept by rod A during its rotation. Find the maximum length of rod B, if it should fall without being hit by the rotating rod after B is released from rest. (Assume $g = 10 \text{ m/s}^2$)
21. Using 3 identical wires each having resistance 30Ω , letter 'B' is formed. Ends of the straight wire are connected to a cell of potential difference 220 V. (i) Find the effective resistance of the circuit (ii) find the rate at which energy is delivered by the cell?
22. A cube of side 10 cm is made of a material of density $d/2$. It is floating in a large vessel containing two immiscible liquids whose densities are d and $3d/2$ (i) Find the depth of immersion of the cube in the denser liquid (ii) Two opposite faces of the cube are pulled apart such that they are 12 cm apart and the resulting cuboid floats vertically in the same vessel, find its depth of immersion in the denser liquid?



23. A ray of light is incident as shown on the face AB an isosceles right angled prism ABC. Find the angle of deviation of the ray emerging through face BC. Ray partially reflected at the face BC emerges through AC. Find the deviation of this ray too. Refractive index of the material of the prism is $\sqrt{2}$.
24. If 2 g of ice at 0°C is added to 2 g of water at 60°C , Find the temperature of resultant mixture? What are the resulting contents?
25. In a nuclear fission reaction 0.01% of the mass of the nucleus undergoing fission is converted in to energy. Find the energy (E) released in the fission of 20 g of fission material, if the energy released per reaction is 200 MeV. A square meter of the earth's surface receives 1400 J every second from the sun. Find the area which receives the same energy E from the sun in one second. (Assume normal incidence)
26. Two rods A and B of lengths 100 m each are joined end to end. Velocity of sound in A is 800 m/s Young's modulus (Y) and density (d) of B are two and eight times of their respective values of A. Find the time taken by sound to travel between the free ends of the rods. (Velocity of sound in the rod is $v = \sqrt{Y/d}$)

PART-C : CHEMISTRY

SECTION-A: Each question is provided with 4 alternative answers. One or more than one of them are correct answers. Indicate the correct answer by A, B, C, D. (5x3=15 MARKS)

27. Identify the mixed anhydride A) NO B) N₂O₃ C) NO₂ D) N₂O₄
28. Aluminium sulphate is treated with excess of caustic soda and ammonium hydroxide separately
A) first white precipitate and then clear solution is resulted by both substances
B) first white precipitate and then clear solution is remitted by caustic soda only
C) first white precipitate and then clear solution is resulted by ammonium hydroxide only
D) first white precipitate and then remains as white precipitate
29. Which statement describes a chemical property?
A) CO₂ gas is passed through aqueous solution to prepare aerated drink
B) ethyl alcohol is added to aqueous solution to prepare liquor
C) magnesium ribbon burns in air to give dazzling UV light
D) acid rain occurs during lightening in atmosphere
30. Equal volumes of 0.5M HCl, 0.25M NaOH and 2.75M NaCl are mixed. The molarity of the Cl⁻ ion and NaCl respectively
A) 1.0M & 1.0M B) 1.0M & 2.0M C) 1.0M & 0.5M D) 2.0M & 1.0M
31. In halogens, which of the following increases from iodine to fluorine?
A) bond length B) electronegativity C) ionization energy D) oxidising power

SECTION-B: In each question a blank is left. Fill in the blank. (5x3=15 MARKS)

32. Silver coating is formed on the walls of the test tube when silver nitrate is added to the organic compound in the presence of ammonia solution. The functional group present is _____.
33. Atoms of elements in a group in the periodic table have similar chemical properties. This similarity is most closely related to _____ electron.
34. A gaseous component X is mixed with gaseous component Y form ideal gaseous solution. Similarly a liquid component A is mixed with another liquid component B form ideal liquid solution. The similarity in both systems _____.
35. The main function cryolite in the extraction of aluminum metal from alumina is _____
36. Though nitrogen acts as an inert gas, it is not used as an inert atmosphere in the extraction of magnesium metal. Coal gas is used as inert atmosphere in the extraction. This is because _____

SECTION-C: Name the compound. (5x3=15 MARKS)

37. The salt which on thermal decomposition leaves a coloured residue, liberated a reddish brown gas and a colourless gas. The residue reacts with caustic soda to give sodium plumbite.
38. The element X(Z=85) combines with element Y(Z=38). The formula of the binary compound.
39. The product formed at the cathode during electrolysis of aqueous potassium chloride solution.
40. Quick-lime is fused with coke. An unsaturated hydrocarbon is resulted on adding cold water to the resulting compound.
41. The reduced product is obtained when ammonia is passed over the heated copper oxide.

SECTION-D (5x3=15 MARKS)

42. Calculate the equilibrium constant, K for the reaction $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$ at 25⁰C temperature. Given that density of water is 1 gm/cc at 25⁰C.
43. The colourless vapours of a colourless liquid are pungent and bring tears in eyes on exposure. The yellowish green flame is resulted on burning vapours in O₂. In the presence of platinum catalyst the same reacts to give colourless gas which turns to reddish brown on explosive to air
(a) write balanced equations (b) calculate the volume of oxygen used separately for these reaction when 300 cc of vapour burn in O₂ at STP.
44. pOH of a base in the range of
Give Balanced Equations for Q.No.45-46
45. An oxidizing agent which reacts with concentrated hydrochloric acid on heating, liberating chlorine gas and forming two metallic chlorides one of which is chromium chloride.
46. A colourless compound decomposes on treatment with dilute HCl with evolution of SO₂ and precipitation of sulphur.