2017

Time: 3 Hours **Max.Marks: 180**

MATHEMATICS

NOTE:-

1. Attempt all questions. *2. Rough work must be enclosed with answer book.*

3. There is no negative marking. *4. Answer each of Sections A, B, C at one place.*

5. Use of calculators, slide rule, graph paper and logarithmic, trigonometric and statistical tables is not permitted.

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. Exactly one of them is the correct answer. Indicate the correct answer by A, B, C, D. (4x3=12 MARKS)

1. The digit in the units place of $2017^{28} + 28^{2017}$ is
   A) 2 B) 5 C) 9 D) 8

2. Two circles having different radii are touching each other. A common tangent $\overleftrightarrow{PQ}$ is touching one circle at P and the other at Q. If PQ = 12 then the product of their radii is equal to
   A) 36 B) 24 C) 12 D) 8/3

3. If a, b, c and d are four real numbers such that $a^2 + 2b^2 + 13c^2 + 5d^2 - 2ab + 4bc - 12cd - 6d + 9 = 0$ then $2a + b + 11c + 2d$ is equal to
   A) 0 B) 16 C) –28 D) 2017

4. On a level ground there is a tree and a building. A girl standing in front of the tree started backing until she could see just the top edge of the building from above the tree top. She marked her place and measured it from the tree and it was 5m. If tree height is 2.8m, her eyes at a height of 1.6m and distance between the tree and the building is 30m, height of the building in meters is
   A) 20/3 B) 28 C) 14 D) 10

SECTION-B

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

5. If $98765^2 = 9754525225$ then $98766^2 =$ _____

6. Two chords AB and CD of a circle are intersecting in a point P. A relation between the lengths of all the line segments PA, PB, PC and PD is _____

7. The number of real solutions (a, b) of the equation $\frac{a+b}{a} = \frac{b}{a+b}$ is _____

8. ABC is an equilateral triangle of side 'a' units. Midpoint of the side BC is D. D is also the midpoint of the side PQ of a rectangle PQRS having its side PQ along BC. Also P is the midpoint of the line segment BD. If the vertex A of the triangle lies on the side RS of the rectangle, the area of the rectangle is _____

SECTION-C

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

9. If a and b are two positive integers greater than 20172017 and $b - a > 4034$ then there exist at least one pair a, b such that the product $(a - 2017)(b + 2017)$ is greater than the product $(a + 2017)(b - 2017)$

10. There is a diagram of a triangle ABC right angled at A and the perpendicular drawn from A onto the side BC is meeting the side BC in D. There are exactly two similar triangles in the diagram.

11. There is at least one system of linear equations $ax + by = c$, $dx + ey = f$, in variable x, y, having exactly 2017 solutions.

12. r_1, r_2 are the radii of two circles passing through the centres of one another. If $3r_1 + r_2 = 15$ then r_1 is equal to 15/4

SECTION-D (4x6=24 MARKS)

13. Write $2ab^3 + a^2c^2 + b^2c^2 - a^2b^2 - 2abc^2 - b^4$ as a product of linear factors

14. ABCD is a square of area 64 sq. units. AEFG is another square of area 25 sq. units such that E, G lie on the line segments AB, AD respectively. If the line segments ED and FG meet in N, then find the ratio of the area of the region EBCDGNE to the area of the region AGNE

15. Two functions f, g are defined on the set of real numbers **R**, such that $f(x) = |x|$, $g(x) = [x]$, for all $x \in \mathbf{R}$. (where [x] denotes the greatest integer less than or equal to x). Draw the graphs of the functions fog(x), gof(x).

16. A year is called a prime year if that year number is a prime number. For example, 2017 is a prime year. Assume that a person born in 2017 graduates, turns 21 years in the same year. What is the sum of all the prime years starting from the year of his birth to the year of his graduation?

PHYSICS

Attempt all questions **(10 × 6 = 60 Marks)**

17. A body 'A' floats with 50% of volume submerged in a liquid B and 75% of its volume submerged in a liquid C. What is the ratio of the densities of A, B and C? What fraction of the body A will be seen above the surface of a homogenous mixture of equal volumes of the liquids B and C?

18. A particle is moving along a straight line with constant acceleration. If the distance travelled by the body in n^{th} and $(n+1)^{th}$ seconds is 100 m, find it's velocity at the end of n^{th} second.

19. Two particles A and B are moving around a circular path of radius 35 m at 2.2 m/s and 4.4 m/s respectively and are located as shown (Figure A, below) at a certain moment. Find the time elapsed before they meet. Also find the angle covered by A in this duration.

20. A block of 100g of ice at 0˚C is added to some water at 40˚C contained in a vessel of negligible water equivalent. What should be the least amount of water for entire block to melt? If the amount of water (at 40˚C) is twice the required amount to just melt the block, what is the final temperature of the mixture?

21. A bright object is fixed at a distance of 100 cm from a wall. A convex lens placed between the object and the wall at position A forms a sharp image of the object magnified 4 times on the wall. Find the focal length of the lens. The lens is moved to a new position B to obtain sharp image again. Find the distance between positions A and B.

22. A ray of light incident at the boundary of two media travels along the path shown (figure B, below) . Find the angle in the denser medium if the angle in the rarer medium is doubled.

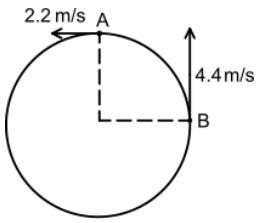

Figure A

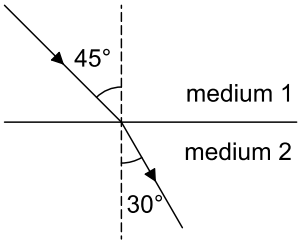

Figure B

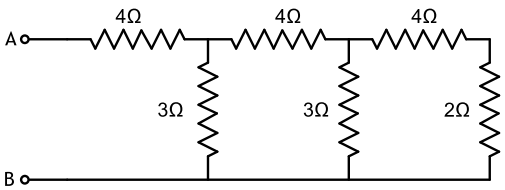

Figure C

23. A uniform wire of resistance 6Ω is bent to form a regular hexagon. Find the least and largest resistance possible between any two corners of the hexagon.

24. Find the equivalent resistance between A and B.(Figure C, above)
Some current enters the terminal A and leaves through B. This current splits at various junctions and flows through different resistances. If the current in the 2Ω resistance is 1 A, find the potential difference between A to B.

25. A long horizontal conductor carries a current eastward. A moving positively charged particle is located vertically above the conductor at a given moment. Find the direction of the force acting on it if its velocity is directed (i) downward (ii) westward (iii) northward

26. A 1000 MW thermal power plant burns 10^6 kg of coal in one hour. How many kg of coal is burnt to produce the energy required to provide electrical energy to a 2000 W water heater for 2 hours a day in a month (Assume 30 days to a month).

CHEMISTRY

Attempt all questions. No partial marking. Each question carries 3 marks.

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.

27. Consider the following ionization enthalpies of two elements 'A' and 'B'

Element	Ionisation enthalpy Kj/mol		
	1^{st}	2^{nd}	3^{rd}
A	899	1757	14847
B	737	1450	7731

Which of the following statements is/are correct?
A) both A and B belong to group-2, where 'A' comes below 'B'
B) both A and B belong to group-2, where 'B' comes below 'A'
C) both A and B belong to group-1, where 'B' comes below 'A'
D) both A and B belong to group-1 where 'A' comes below 'B'

28. Which electron is associated with least energy
A) n=3, l=2, m= –2, s=+½ B) n=4, l=0, m=0, s=+½
C) n=4, l=1, m= 1, s=+½ D) n=5, l=0, m=0, s=+½

29. The periodic table consists of 18 groups. An isotope of copper on bombardment with protons undergoes a nuclear reaction yielding element 'x' as shown below. To which group, the element X-belongs in the period table $^{63}_{29}Cu + ^{1}_{1}H \rightarrow 6\,^{1}_{0}n + \alpha + 2\,^{1}_{1}H + X$
A) 10^{th} group B) 18^{th} group C) 8^{th} group D) 11^{th} group

30. Which of the following pairs carry same no.of electrons, but electronic configuration is not same
A) Cr^{+}, Mn^{+2} B) Fe^{+3}, Mn^{+2} C) Co^{+3}, Ni^{+4} D) Cu^{+1}, Ni

31. The correct order of anions present for the following CaC_2, Al_4C_3, Mg_2C_3
A) C^{-4}, C_2^{-2}, C_3^{-} B) C_2^{-2}, C_3^{-4}, C_3^{-2} C) C_2^{-2}, C^{-4}, C_3^{-4} D) C^{-4}, C_2^{-2}, C_3^{-4}

32. 80% of a first order chemical reaction completed in 100 sec, what time it will take for the completion of 99.2%
A) 200 sec B) 400 sec C) 300 sec D) 150 sec

33. A metal M reacts with nitrogen gas to afford M_3N. M_3N on heating at high temperature gives back M and on reaction with water produces gas B. Gas B reacts with aqueous solution of $CuSO_4$ to form a deep blue compound. M and B respectively
A) Li and NH_3 B) Al and N_2 C) Ba and N_2 D) Na and NH_3

34. Match the fuel gases with main component present in them

	List-I (fuel gases)		List-II (main component gas)
A)	LPG	p)	N_2
B)	Natural gas	q)	n-butane
C)	Coal gas	r)	CH_4
D)	Producer gas	s)	H_2

A) A→r, B→q, C→p, D→s B) A→s, B→r, C→p, D→q
C) A→q, B→r, C→s, D→p D) A→p, B→q, C→r, D→s

35. Match the List-I with List-II

	List-I (type of velocity)	List-II (equation)	
A)	Root mean square velocity	p)	$\sqrt{\frac{3p}{d}}$
B)	Average velocity	q)	$\sqrt{\frac{3RT}{m}}$
C)	Most probable velocity	r)	$\sqrt{\frac{8P}{\pi d}}$
D)	Velocity possessed by maximum fraction of molecules	s)	$\sqrt{\frac{2RT}{m}}$

A) A→r, B→p,q, C→s, D→s B) A→s, B→s, C→p,q, D→r
C) A→s, B→r, C→s, D→p,q D) A→p,q, B→r, C→s, D→s

36. The molality and mole fraction of the solute in an aqueous solution containing 6 gm of urea per 500 gm of water (mol.wt. of urea=60)
A) 0.1 M, 0.001 B) 0.2 M, 0.00359 C) 0.3 M, 0.2 D) 0.01, 0.0012

SECTION–B: In each question a blank or blanks are left. Fill in the blank(s) with relevant answer(s).

37. Complete the decomposition reaction of
(i) $LiNO_3 \xrightarrow{\Delta}$ _____ (ii) $NaNO_3 \xrightarrow{\Delta}$ _____

38. Give the hybridization and no.of lone pairs over the central atom

Molecule	Hybridisation	No.of of lone pairs
XeO_2F_2	_____	_____
$ICl_2^{(-)}$	_____	_____
CO_2	_____	_____

39. Give the nature of oxides i.e. acidic, basic neutral (or) amphoteric

Oxide	nature of oxide
CO	_____
Al_2O_3	_____
SiO_2	_____

40. Write structural formula of all the isomeric alcohols having the molecular formula $C_4H_{10}O$
(i) _____
(ii) _____
(iii) _____
(iv) _____

41. Complete the reactions
(i) $CaO + C \xrightarrow{\Delta} A+B$
(ii) $A + N_2 \xrightarrow[furnace]{electric} D + \text{graphite}$
(iii) $D + H_2O \rightarrow E + NH_3$
Identify the compound A _____, B _____, D _____, E _____

42. The concentration of $H^{(+)}$ ions in 0.10 M solution of a weak acid is $1x10^{-5}$ $mol.lit^{-1}$. Calculate the dissociation constant of the acid _____ [Note:- [HA] can be taken as 0.1 M as $1x10^{-5}$ is very small]

43. If one mole of electrons per sec are passing through a point across metallic wire, calculate the charge in coloumbs passing in one sec. _____

44. Out of the given metals Zn, Mg, Al, Be which will give H_2 gas on reaction with NaOH solution _____

45. Exactly 2 gm of NaOH is dissolved in water to makeup 1 litre of solution. The pH of the solution found to be higher than 7. The HCl gas is then bubbled through this solution at the rate of 1 gm/min. After how many minutes will the pH become 7? _____

46. The two elements A and B form the compounds A_2B_3 and AB_2. If 0.5 mole of A_2B_3 weighs 15.9 grams and 0.15 mole of AB_2 weighs 9.3 gm. Find the atomic weights of A and B _____