## **Time: 3 Hours**

#### <u>NOTE</u>:-

- *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

<u>Note</u>:- 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 isthe correct answer. Indicate the correct answer by A, B, C, D.(4x3=12 MARKS)

- 1. a, b, c, d are digits in 2014 such that {a, b, c, d} = {2, 0, 1, 4}. Then the number of different values  $((a^b)^c)^d$  takes is
  - A) 2 B) 16 C) 8 D) 7
- 2. The maximum value of n such that  $2^n$  divides 21! is A) 20 B) 15 C) 18 D) 7
- 3. A circle C has radius 6. Two circles P and Q having equal radii are touching each other externally and touching C internally. Another circles S is touching the circle C internally and the circles P, Q externally. The radius of the circle S is
  - A) 1 B)  $\sqrt{3}$  C)  $\sqrt{2}$  D) 2
- 4. If f:**R** $\rightarrow$ **R** is a function defined by f(x) =  $\frac{x^2}{x^2+1}$  then the number of integral values taken by f is A) 1 B) 2 C) finitely many D) not finite

#### **SECTION-B**

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

- 5.  $\sqrt[3]{20+14\sqrt{2}} + \sqrt[3]{20-14\sqrt{2}} =$ \_\_\_\_\_
- 6. A circle of radius 1 is concentric with circles of radii a and b with b>a>1. The area of the smallest circle equals the area of the ring with outer radius a and inner radius 1 and also equals the area of the ring with outer radius a. Then a + b is \_\_\_\_\_
- 7. The sides of a cyclic quadrilateral lie along the lines  $a_1x + b_1y = 2013$ ,  $a_2x + b_2y = 2014$ ,  $a_1x+b_1y = 2015$ ,  $a_2x + b_2y = 2018$  then  $a_1a_2 + b_1b_2 =$ \_\_\_\_\_
- 8. Given  $\cos(A-B) = \cos A \cos B + \sin A \sin B$ , the value of  $\cos 15^0 =$

## **SECTION-C**

#### State True or False in each of the following statements.

- 9. There exists a function f from the set of integers  $\mathbf{Z}$  to the set of natural numbers  $\mathbf{N}$  that is an onto function.
- 10. The quadratic equation the sum of whose roots is the sum of the roots of  $5x^2 + 4x 3 = 0$  and the product of the roots is the product of the roots of  $7x^2 + 24x + 2 = 0$  has real roots.
- 11. In a circle if a chord of length  $\sqrt{2}$  subtends an angle of  $45^0$  at a point on the circumference of the circle then the radius of the circle is 1.
- 12. It is not possible to write the polynomial  $x^4 + 1$  as a product of two quadratic polynomials.

#### **SECTION-D**

(4x6=24 MARKS)

- 13. In a circle having A(2, 2) and B(10, 8) as extremities of a diameter if a triangle ABC is inscribed then what is the maximum possible area of the triangle?
- 14. If f:  $\mathbf{R} \rightarrow [0, \infty)$  is defined by  $f(x) = x^2$  and g:  $[0, \infty) \rightarrow \mathbf{R}$  is defined by  $g(x) = \sqrt{x}$  then does the function gof(x) exist? If so what is the value of gof(-4)?

(4x3=12 MARKS)

- 15. A square is inscribed in a sector having angle  $60^{0}$  at its vertex. Find the ratio of the area of the square to that of the sector.
- 16. If [x] denotes the greatest integer less than or equal to x then what is the value of  $\sum_{k=1}^{2014} \left[ \frac{k}{1007} \right]?$



(10x6=60 Marks)

- 17. A car travels between places A and B covering first 1/3 of the distance at 25 kmph and the remaining distance at 40 kmph for some time and 60 kmph for an equal amount of time. Find the average speed of the car.
- 18. A mirror produces inverted twice magnified image of an object at a distance of 30 cm from the object. Find the focal length of the mirror.
- 19. A block is made with equal volumes of two materials whose densities are in the ratio 1:2. This block floats with 3/4 of its volume submerged in a certain liquid. Find the ratio of the volumes of the materials for 2/3 of the volume of the block to be just submerged.
- 20. A ray of light is incident at a height h above the principal axis of a lens (position indicated by dotted line) and deviates through  $30^{\circ}$  as it passes through the lens. Find the focal length of the lens.



- 21. In the figure shown resistance between any two corners connected by short wires is half of the resistance of the wires connected by long wires. Terminals A ,B and C are connected to the corners by resistanceless wires. If the equivalent resistance between A and C is R, find the equivalent resistance between A and B.
- 22. If 4.2 milligram of mass were to be completely converted into heat energy and this heat is used to raise the temperature of a million kg of water, find the temperature raise of water.
- 23. A bullet moving horizontally at v strikes a stationary block lying on a smooth horizontal surface and gets embedded in it. The block moves at V after the bullet strikes it. Find the ratio of masses of the bullet and the block.
- 24. Wavelength of light in a certain medium is  $\lambda$  where its velocity is  $2.5 \times 10^8$  m/s. If the wavelength of this light in some other medium is  $0.6 \lambda$ , find the velocity of light in this medium. What is the ratio of frequencies of the light in the two media.
- 25. A positively charged particle to the east of a long vertical current carrying wire having a velocity directed eastward experiences a vertical upward force. Find the direction of the force on a positively charged particle located south of the conductor and having a velocity directed vertically upward.
- 26. Two small identical charged conducting spheres have charges in the ratio 1:3 and exert a force 'F' on each other when they are some distance apart. The spheres are brought in to contact and then they are arranged at a distance twice the earlier. Knowing that the total charge on the two spheres divides equally between them when they make contact, find the force between them.

# PART-C: CHEMISTRY

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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.	valency electrons in the element is		
	a) 4 b) 3	c) 1	d) 2
28.	Correct set of four quantum numbers a) 5,1,0,+1/2 b) 5,1,1,+1/2		abidium (Z=37) is d) 5,0,0,+1/2
29.	List – I A) $NH_4^+$ B) $H_3O^+$ C) $XeO_3$ D) $SO_3$	List – II 1) $SP^3$ - two lone pairs 2) $SP^2$ - one lone pair 3) $SP^3$ - no lone pairs 4) $SP^3$ - one lone pair 5) $SP^2$ - no lone pairs	
	Correct match is		
	A B C D A B C D   a) 1 2 4 5 b) 2 2 3 5		A B C D d) 4 4 3 5
30.	Alkaline earth metal compounds a compounds, because alkali metals ha a) lower lattice energy	re less soluble in water th	an the corresponding alkali metal
	) Higher covalent character d) Higher ionic character		•••
31.	$NH_4^+$ ion in aqueous solution will behave as. a) a base b) an acid c) both acid and base d) neutral		
SECTION – B: In each question a blank is left. Fill in the blank . (5x3=15 MARKS)			
32.	Here the six transition metal atoms are given Sc, Ti, V, Co, Ni, Cu, Among these how many pairs are having same no of unpaired electrons		
33.	$Bi_{83}^{209}$ is produced from a parent element by the emission of $2\infty$ , $4\beta$ and one positron what will be the parent element		
34.	Alkyl halide used in preparation of n-hexane in Wurtz reaction is.		
35.	The weight percentage of NaCl solution is 10. If the weight of solution is 150 gr. Calculate weight of NaCl		
36.	Number of grms NaOH present in 5 liters of millimolar solution is		
SECTION – C : Name of the compound (5x3=15 MARKS)			
37.	Alkaline hydrolysis is of white phosphorous gives sodium salt of phosphorous and a gas with rotten fishy smell, the gas is.		
38.	Beryllium carbide on hydrolysis produces a gas. The name of the gas is.		
39.	Chemical name of Bleaching powder is.		
40.	Lithium nitrate on decomposition produce two paramagnetic gases one is colourless gas and the other is brown gas. The brown gas is.		
41.	Name of the lead compound used for making protective paint for iron and steel from rusting.		
SECTION – D: (5x3=15 MARKS)			

## **SECTION – D :**

- The hydrogen ion concentration of a solution is 0.001 M at  $25^{\circ}$ c. What will be the hydroxyl ion 42. concentration of solution at same temperature.
- Arrange in the increasing order of hydration energies of Be<sup>+2</sup>, Ca<sup>+2</sup>, Mg<sup>+2</sup>, Ba<sup>+2</sup>, Sr<sup>+2</sup> 43.
- 44. A radioactive element from VII A group emits a  $\alpha$  particle a  $\beta$  particle and a positron. What will be the position of new element in the periodic table.

# Give the balanced equations for Q.NO 45,46.

- 45. Lead nitrate on decomposition produce two paramagnetic gases .
- Sodium bicarbonate on reaction with zinc sulphate gives two metal salts and a colourless gas. 46.