Section – I
MATHEMATICS

1. If $\cos^2\theta+2, \sin^2\theta+2$ are roots of $3x^2+2bx+c=0$ whose discriminant is Δ_1, and $\cos^4\theta-3, \sin^4\theta-3$ are roots of $9x^2+2bx+c=0$ whose discriminant is Δ_2 then $\dfrac{\Delta_2}{\Delta_1}=$

   (a) 3   (b) 9

   (c) $\dfrac{1}{3}$ (d) $\dfrac{1}{9}$

2. Consider two positive numbers a,b. If AM of a,b exceeds their GM by $\dfrac{3}{2}$ and GM of a,b exceeds their HM by $\dfrac{6}{5}$, then the value of b^2-a^2 is

   (a) 35   (b) -35 (c) -136 (d) 135

3. Let $S=\sqrt{1+\dfrac{1}{1^2}+\dfrac{1}{2^2}}+\sqrt{1+\dfrac{1}{2^2}+\dfrac{1}{3^2}}+.....+\sqrt{1+\dfrac{1}{2021^2}+\dfrac{1}{2022^2}}$, then the value of $[S]$ is where $[\,.\,]$ is greatest integer function is

   (a) 2019   (b) 2020

   (c) 2021   (d) 2022

4. Positive numbers x,y,z satisfy $xyz=10^{81}$ and $(\log_{10}x)(\log_{10}yz)+(\log_{10}y)(\log_{10}z)=468$. The value of $\sqrt{(\log_{10}x)^2+(\log_{10}y)^2+(\log_{10}z)^2}$ is

   (a) 75   (b) 65   (c) 85   (d) 55

5. The first four terms of an arithmetic sequence are $p, 9, 3p-q$ and $3p+q$. What is the 2022th term of the sequence?

   (a) 7086   (b) 8089

   (c) 9027   (d) 8888

6. The minimum value of $f(x)=|x-1|+|2x-1|+|3x-1|+\cdots+|119x-1|$ is _____.

   (a) 35   (b) 39   (c) 49   (d) 5

7. A regular hexagon has side length 6. Congruent arcs with radius 3 are drawn with the center at each of the vertices, creating circular sectors as shown. The region inside the hexagon but outside the sectors is shaded as shown What is the area of the shaded region?
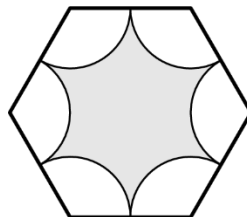
   (a) $27\sqrt{3}-9\pi$ (b) $27\sqrt{3}-6\pi$

   (c) $54\sqrt{3}-18\pi$ (d) $54\sqrt{3}-12\pi$

8. The sum of the digits in the decimal form of the number $10^{2022} - 2023$ is

   (a) 18192
   (b) 18172
   (c) 18156
   (d) 18213

9. Let $f(x) = x^3(1-x)^3$. What is the value of the sum

   $$f\left(\frac{1}{2023}\right) - f\left(\frac{2}{2023}\right) + f\left(\frac{3}{2023}\right) - f\left(\frac{4}{2023}\right) + \cdots + f\left(\frac{2021}{2023}\right) - f\left(\frac{2022}{2023}\right) \text{ is } \_\_\_\_$$

   (a) 0
   (b) 1
   (c) $\dfrac{2021^3}{2023}$
   (d) $\dfrac{2022^3}{2023}$

10. A college awarded 38 medals in Footballs, 15 in Basketball and 20 to Cricket. If these medals went to a total of 58 men and only three men got medals in all the three sports. The number of students who received medals in exactly two of the three sports is

    (a) 18
    (b) 15
    (c) 9
    (d) 6

Section – II
PHYSICS

11. Let the angle between two nonzero vectors $\vec{A}$ and $\vec{B}$ be 120° and resultant be $\vec{C}$

    (a) $\vec{C}$ must be equal to $|\vec{A} - \vec{B}|$
    (b) $\vec{C}$ must be less than $|\vec{A} - \vec{B}|$
    (c) $\vec{C}$ must be greater than $|\vec{A} - \vec{B}|$
    (d) $\vec{C}$ may be equal to $|\vec{A} - \vec{B}|$

12. The vector sum of two forces is perpendicular to their vector differences. In that case, the forces

    (a) Are equal to each other in magnitude
    (b) Are not equal to each other in magnitude
    (c) Cannot be predicted
    (d) Are equal to each other

13. How many minimum number of non-zero coplanar vectors having different magnitudes can be added to give zero resultant

    (a) 2
    (b) 3
    (c) 4
    (d) 5

14. A body sliding on a smooth inclined plane requires 4 seconds to reach the bottom starting from rest at the top. How much time does it take to cover one-fourth distance starting from rest at the top (assume it us uniformly accelerating down)

    (a) 1 s
    (b) 2 s
    (c) 4 s
    (d) 16 s

15. A body thrown vertically upwards with an initial velocity u reaches maximum height in 6 seconds. The ratio of the distances travelled by the body in the first second and the seventh second is

    (a) 1 : 1
    (b) 11 : 1
    (c) 1 : 2
    (d) 1 : 11

16. A very large number of balls are thrown vertically upwards in quick succession in such a way that the next ball is thrown when the previous one is at the maximum height. If the maximum height is $5m$, the number of ball thrown per minute is (take $g = 10 ms^{-2}$)

    (a) 120
    (b) 80
    (c) 60
    (d) 40

17. The coordinates of a moving particle at any time are given by $x = at^2$ and $y = bt^2$. The speed of the particle at any moment is ____.

    (a) $2t(a+b)$
    (b) $2t\sqrt{(a^2 - b^2)}$
    (c) $t\sqrt{a^2 + b^2}$
    (d) $2t\sqrt{(a^2 + b^2)}$

18. A particle starts moving rectilinearly at $t = 0$ such that its velocity as function of time is $v = t^2 - t$, where v is in ms^{-1} and t is in seconds. The time interval in which the particle decelerates is ____

    (a) $t > 1\ s$
    (b) $t < \frac{1}{2}$
    (c) $\frac{1}{2} s < t < 1\ s$
    (d) $t < \frac{1}{2}\ s\ and\ t > 1s$

19. A particle is projected with a velocity v such that its range on the horizontal plane is twice the greatest height attained by it. The range of the projectile is (where g is acceleration due to gravity)

    (a) $\dfrac{4v^2}{5g}$
    (b) $\dfrac{4g}{5v^2}$
    (c) $\dfrac{v^2}{g}$
    (d) $\dfrac{4v^2}{\sqrt{5}g}$

20. A ball of mass m is thrown vertically upwards. Another ball of mass $2\ m$ is thrown at an angle θ with the vertical. Both of them stay in air for same period of time. The heights attained by the two balls are in the ratio of

    (a) $2:1$
    (b) $1:\cos\theta$
    (c) $1:1$
    (d) $\cos\theta:1$

Section – III
CHEMISTRY

21. At low pressure, the Vander waal's equation is written as:

    (a) $\dfrac{PV}{RT} = \left[1 - \dfrac{a}{RTV}\right]$
    (b) $\dfrac{PV}{RT} = \left[1 - \dfrac{RTV}{a}\right]$
    (c) $\dfrac{PV}{RT} = \left[1 + \dfrac{a}{RTV}\right]$
    (d) $\dfrac{PV}{RT} = \left[1 + \dfrac{RTV}{a}\right]$

22. Aspirin has the molecular formula $C_9H_8O_4$. How many atoms of oxygen are there in a tablet weighing 360 mg?

    (a) 1.204×10^{23}
    (b) 1.08×10^{22}
    (c) 1.204×10^{24}
    (d) 4.81×10^{21}

23. One mol. of equimolar mixture of ferric oxalate and ferrous oxalate is to be completed oxidized by $KMnO_4$ solution in acidic medium. Find the volume of 10^{-2} M $KMnO_4$ solution required for this oxidation ____

(a) 90 L
(b) 45 L

(c) 60 L
(d) 30 L

24. In which of the following processes energy is absorbed?

(a) $Cl + e^- \rightarrow Cl^-$
(b) $O^- + e^- \rightarrow O^{2-}$

(c) $O^{2-} - e^- \rightarrow O^-$
(d) $Na^+ + e^- \rightarrow Na$

25. Aspirin contains 35.55% $\left(\dfrac{w}{w}\right)$ of oxygen. If each molecule of oxygen has four oxygen atoms, the mol. mass of aspirin is ___.

(a) 120u
(b) 180u

(c) 240u
(d) 90u

26. What is the volume of water mixed in 500 ml 0.5 M NaOH solution so that its concentration becomes 10 mg NaOH per ml?

(a) 100 ml
(b) 200 ml

(c) 250 ml
(d) 500 ml

27. If 3L of 0.1 M HCl is added to 2 L of 0.5 M HCl, calculate the molarity of resultant solution?

(a) 0.48
(b) 0.26

(c) 0.12
(d) 0.4

28. $FeS + KMnO_4 \longrightarrow Fe_2O_3 + SO_2 + MnO$ in this reaction the equivalent mass of FeS is ___

(a) M/8
(b) M/7

(c) M/6
(d) M/5

29. It requires 40 ml of 0.5 M Ce^{4+} to titrate 10 ml of 1.0M Sn^{2+} to Sn^{4+}. The oxidation state of Ce in the reduction product is ____

(a) +2
(b) +3

(c) +6
(d) +1

30. An isostructural pair is ___

(a) XeO_3, SO_3
(b) CF_4, SF_4

(c) XeO_3, NH_3
(d) PF_5, BrF_5

Section – IV
BIOLOGY

31. Taxonomy is the branch of biology concerned with naming and classifying the diverse forms of life. The person who is considered to be the founder of taxonomy is:

(a) Carolus Linnaeus
(b) Charles Darwin

(c) Alfred Wallace
(d) Ernst Mayr

32. Home canners pressure cook vegetables as a precaution primarily against –

    (a) mycoplasmas   (b) enteric bacteria

    (c) endospore forming bacteria   (d) actinomycetes

33. Plant like photosynthesis that relates O_2 occurs in the –

    (a) chemoautotrophic bacteria   (b) cyanobacteria

    (c) methanogens   (d) both (a) and (b)

34. Which one of the following characters is NOT common to all divisions of vascular plants?

    (a) Alternation of generations   (b) Dominance of diploid generation

    (c) Presence of xylem and phloem tissues (d) Development of seeds

35. Read the two statements given below and choose the correct answer.

    Statement–1: The fruit could be described as a mature ovary.

    Statement–2: Fruits are characteristic feature of angiosperms and gymnosperms.

    (a) Statement–1 and Statement–2 are both correct statements.

    (b) Statement–1 is correct, but Statement–2 is incorrect.

    (c) Statement–1 is incorrect, but Statement–2 is correct.

    (d) Both Statements 1 and 2 are incorrect.

36. 'Gourmet fungi' refer to fungi that are consumed by humans and often used as flavouring agents. These include the –

    (a) morels and truffles   (b) puff balls and mushrooms

    (c) chytrids and bracket fungi   (d) pink moulds and blue moulds

37. Choose the correct pair.

    (a) Cellular grade of organization – Coelenterates

    (b) Water vascular system – Poriferans

    (c) Triploblastic, acoelomate animals – Platyhelminthes

    (d) 2nd largest phylum – Arthropoda

38. Only an animal species with a diaphragm can be expected to have –

    (a) scales   (b) lungs

    (c) moist skin   (d) hair

39. The edible part is stem in all the following except –

    (a) Ginger   (b) Sweet potato

    (c) Colocasia   (d) *Amorphophallus* (Zaminkand)

40. Choose the set of plants that are medicine yielding plants.

    (a) Aloe, Ashwagandha, Muliathi   (b) Belladonna, Sesbania, Asparagus

    (c) Colchicum, Petunia, Trifolium   (d) Indigofera, Belladonna, Gloriosa

Section – V
Aptitude

41. If (i) M is brother of N; (ii) B is brother of N; (iii) M is brother of D, then which of the following statements is definitely true?

(a) N is brother of B   (b) N is brother of D

(c) M is brother of B   (d) D is brother of M

42. In the following questions, a matrix of certain characters is given. These characters follow a certain trend, row-wise or column-wise. Find out this trend and choose the missing character accordingly.

1	7	9
2	14	?
3	105	117

(a) 26   (b) 20   (c) 16   (d) 12

43. In the following questions, a matrix of certain characters is given. These characters follow a certain trend, row-wise or column-wise. Find out this trend and choose the missing character accordingly.

1	2	3
11	7	5
120	45	?

(a) 19   (b) 17   (c) 16   (d) 15

44. Four girls are sitting on a bench to be photographed. Shikha is to the left of Reena. Manju is to the right of Reena. Rita is between Reena and Manju. Who would be second from the left in the photograph?

(a) Reena   (b) Shikha   (c) Manju   (d) Rita

45. In a pile of reading material, there are novels, story-books, dramas and comics.
Every novel has a drama next to it, every story-book has a comic next to it and there is no story-book next to novel. If there be a novel at the top and the number of books be 40, the order of the books in the pile is:

(a) nscd   (b) ndsc   (c) csdn   (d) dncs

46. If 'DELHI' can be coded as 'CCIDD', then how would you code 'BOMBAY'?

(a) AJMTVT   (b) AMJXVS   (c) MJXVSU   (d) WXYZAX

47. A is the son of B. C is wife of A. D is daughter of C. What is D of B?

(a) Son   (b) Daughter   (c) Granddaughter   (d) Grandson

48. B is the South-West of A, C is to the East of B and South-East of A and D is to the North of C in line with B and A, in which direction of A is D located?

(a) North-West   (b) South-West   (c) South-East   (d) North-East

49. Five boys took part in a race. Raj finished before Mohit but behind Garv. Avinash finished before Sumit but behind Mohit. Who finished the race at second position?

(a) Raj   (b) Garv   (c) Mohit   (d) Sumit

50. If A stands for 'plus', B stands for 'minus', C stands for 'multiplied by' and D stands for 'divided by' then 18 C 14 A 6 B 16 D 4 is _____.

(a) 254   (b) 256   (c) 288   (d) 1201

ANSWER KEY

1. B	2. C	3. B	4. A	5. B	6. C	7. C	8. A	9. A	10. C
11. B	12. A	13. B	14. B	15. B	16. C	17. D	18. C	19. A	20. C
21. A	22. D	23. A	24. B	25. B	26. D	27. B	28. B	29. B	30. C
31. A	32. D	33. A	34. B	35. B	36. D	37. B	38. B	39. B	40. C
41. C	42. B	43. B	44. A	45. C	46. B	47. C	48. D	49. A	50. A