IN SR IIT CBSE SC **WTM-23** **DT: 05.09.2022**
Time: 3.00 Hrs **Max. Marks:300**

PHYSICS MAX.MARKS: 100

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

1. The refractive indices of crown glass prism for C, D and F lines of a spectrum are 1.527, 1.530 and 1.535 respectively. The dispersive power of the crown glass prism is
   1) 0.01509 2) 0.05109 3) 0.02108 4) 0.03402
2. A parallel beam of white light falls on a convex lens. Images of blue, yellow and red light are formed on other side of the lens at a distance of 0.20m 0.205m and 0.214m respectively. The dispersive power of the material of the lens will be
   1) $\frac{619}{1000}$ 2) $\frac{9}{200}$ 3) $\frac{14}{208}$ 4) $\frac{5}{214}$
3. A thin prism P_1 with angle 4° and made from glass of refractive index 1.54 is combined with another thin prism P_2 made from glass of refractive index 1.72 to produce dispersion without deviation. The angle of the prism P_2 is
   1) 5.33° 2) 4° 3) 3° 4) 2.6°
4. Two prisms A and B have dispersive powers of 0.012 and 0.018 respectively. The two prisms are in contact with each other. The prism 'A' produces a mean deviation of 1.2°, the mean deviation produced by 'B' if the combination is achromatic is
   1) 3.6° 2) 0.8° 3) 0.4° 4) 1.8°
5. The refractive index of glass is 1.520 for red light and 1.525 for blue light. Let D_1 and D_2 be angle of minimum deviation for red and blue light respectively in a prism of this glass. Then,
   1) $D_1 > D_2$ 2) $D_1 < D_2$ 3) $D_1 = D_2$
   4) D_1 can be less than or greater than depending upon the angle of prism
6. The focal length of convex lens is 10 cm. Its magnifying power when it is used as a magnifying glass to form the image at (i) near point and (ii) far point is
   1) 3.5; 2.5 2) 2.5; 3.5 3) 2.5; 1.5 4) 1.5; 2.5
7. A magnifying glass is made of a combination of a convergent lens of power 20 D and divergent lens of power 4D. If the least distance of distinct vision is 25 cm. The magnifying power is
   1) 4 2) 3 3) 5 4) 2
8. Four lenses A, B, C and D power +100D, -50D, 20D and 5D. Which lenses will you use to design a compound microscope for best magnification?
   1) A and C 2) B and D 3) C and D 4) A and B
9. The objective lens of a compound microscope produces magnification of 10. In order to get an over all magnification of 100 when image is formed at 25 cm from the eye, the focal length of the eye lens should be (in cm)
   1) 4 2) 10 3) $\frac{25}{9}$ 4) 9

10. An astronomical telescope has large aperture to
1) reduce spherical aberration 2) have high resolution
3) increase span of observation 4) have low dispersion

11. A compound microscope is of magnifying power 100. The magnifying power of its eyepiece is 4. Find the magnification of its objective.
1) 25 2) 20 3) 15 4) 30

12. A compound microscope has an objective of focal length 2.0 cm and an eye piece of focal length 6.25 cm separated by 15 cm. If the final image is formed at the least distance of distinct vision (25 cm), the distance of the object from the objective in cm is
1) 3.5 2) 2.5 3) 1.5 4) 2

13. The focal lengths of the objective and eye–piece of a compound microscope are 2 cm and 3 cm respectively. The distance between the objective and eye–piece is 15 cm. The final image formed is at infinity. The distances in cm of object and image from objective are
1) 2.4 and 12 2) 2.4 and 15 3) 2.4 and 3.0 4) 2.3 and 12

14. The focal lengths of the eyepiece and the objective of an astronomical telescope are 2 cm and 100 cm respectively. The magnifying power of the telescope for normal adjustment and the length of the telescope is
1) 50; 102 cm 2) 100; 204 cm 3) 25; 62 cm 4) 75; 125 cm

15. The magnifying power of an astronomical telescope is 5, the focal power of its eye piece is 10 diopters. The focal power of its objective (in diopters) is
1) 4 2) 3 3) 2 4) 1.5

16. The magnifying power of an astronomical telescope for normal adjustment is 10 and the length of the telescope is 110 cm. Find the magnifying power of the telescope when the image is formed at the least distance of distinct vision for normal eye.
1) 14 2) 48 3) 28 4) 52

17. Four convergent lenses have focal lengths 100 cm, 10 cm, 4 cm and 0.3 cm, for a telescope with maximum possible magnification we choose the lenses of following focal lengths
1) 10 cm, 0.3 cm 2) 10 cm, 4 cm 3) 100 cm, 4 cm 4) 100 cm, 0.3 cm

18. The focal length of the objective of an astronomical telescope is 1 m and it is in normal adjustment. Initially the telescope is focused to a heavenly body. If the same telescope is to be focused to an object at a distance of 21 m from the objective, then identify the correct choice
1) eye piece should be displaced by 2 cm away from the objective
2) eye piece should be displaced by 2 cm towards the objective
3) eye piece should be displaced by 5 cm towards from the objective
4) eye piece should be displaced by 5 cm away from the objective

19. The image formed by objective of a compound microscope is
1) virtual and diminished 2) real and diminished
3) real and enlarged 4) virtual and enlarged

20. In a compound microscope, the focal length of two lenses are 1.5 cm and 6.25 cm. An object is placed at 2 cm from the objective and the final image is formed at 25 cm from the eye lens. The distance between the two lenses is …….. (in cm)
1) 6 2) 7.75 3) 9.25 4) 11

SECTION-II
(NUMERICAL VALUE ANSWER TYPE)

This section contains 10 questions. The answer to each question is a Numerical value. If the Answer in the decimals, **Mark nearest Integer only**. **Have to Answer any 5 only out of 10 questions** and question will be evaluated according to the following marking scheme:
Marking scheme: +4 for correct answer, -1 in all other cases.

21. A thin prism P_1 of angle 4° and refractive index 1.54 is combined with another thin prism P_2 of refractive index 1.72 to produce dispersion without deviation. The angle (in degrees) of P_2 is ....
22. A crown glass prism with refracting angle 6° is to be achromatized for red and blue light with flint glass prism. Angle of the flint glass prism should be (Given for crown glass $\mu_r = 1.513, \mu_b = 1.523$, for flint glass $\mu_r = 1.645, \mu_b = 1.665$).....
23. White light is passed through a prism of angle 5°, if the refractive indices of red and blue colours are 1.641 and 1.659 respectively, the angle of dispersion between them is ……..
24. The focal lengths of a convex lens for red, yellow and violet rays are 100 cm, 98 cm and 96 cm respectively. Find the dispersive power (in diopters) of the material of the lens.
25. The minimum deviations suffered by red, yellow and violet beams passing through an equilateral transparent prism are 38.4°, 38.7° and 39.2° respectively. Calculate the dispersive power of the medium.
26. A convergent lens of power 16D is used as a simple microscope. The magnification produced by the lens, when the final image is formed at least distance of distinct vision is
27. A compound microscope has two lenses. The magnifying power of one is 5 and the combined is 100 then the magnifying power of other is
28. A compound microscope has a magnifying power of 100 when the image is formed at infinity. The objective has a focal length of 0.5 cm and the tube length is 6.5 cm. Then the focal length of the eye-piece in cm is
29. Magnifying power of an astronomical telescope for normal adjustment is 10 and length of the telescope is 110 cm. Magnifying power of the same telescope, when the image is formed at the near point is
30. The magnifying power of a telescope with tube length 60 cm is 5. What is the focal length of its eye piece?

CHEMISTRY MAX.MARKS: 100

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(SINGLE CORRECT ANSWER TYPE)

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31. Which of the following is a polysaccharide?
    1) Cellulose 2) Sucrose 3) Galactose 4) Maltose
32. Glucose and fructose are
    1) optical isomers 2) Tautomers
    3) Functional isomers 4) Chain isomers
33. Hydrolysis of sucrose is called
    1) Mutarotation 2) Saphonification 3) Inversion 4) de esterification
34. Essential amino acid among the following is
    1) Glycine 2) Tryptophan 3) Alanine 4) Proline
35. The basic amino acids are
    1) Lysine, arginine 2) Alanine, glutamic acid
    3) Proline, valine 4) Alanine, cysteine
36. The p^H value of a solution in which a polar amino acid does not migrate under the influence of electric field is called
    1) Iso electronic point 2) Iso electric point
    3) Neutralization point 4) All the above
37. Which of the following is a fibrous protein?

1) haemoglobin 2) albumin 3) keratin 4) enzymes

38. Which of the following vitamin is water soluble?
1) K 2) E 3) D 4) B_1

39. Which one of the following is not present in RNA?
1) Uracil 2) Thymine 3) Ribose 4) Phosphate

40. In DNA, the complementary bases are
1) Uracil and adenine : cytosine and guanine
2) Adenine and thymine : guanine and cytosine
3) Adenine and thymine : guanine and uracil
4) Adenine and cytosine : thymine and guanine

41. To convert glucose to saccharic acid the reagent used is
1) Bromine water 2) Fehling's solution
3) Nitric acid 4) Alkaline solution of Iodine

42. Glycoside linkage is an
1) Amide linkage 2) Ether 3) Ester linkage 4) None of these

43. Which is the correct statement?
1) Starch is the polymer of α-glucose 2) Amylose is a component of cellulose
3) Proteins are compounds of only one type of amino acids
4) In cyclic structure of fructose, there are five carbons and one oxygen atom

44. Which of the following α-amino acids does not contain a chiral carbon?
1) Glycine 2) Alanine 3) Phenylalanine 4) Valine

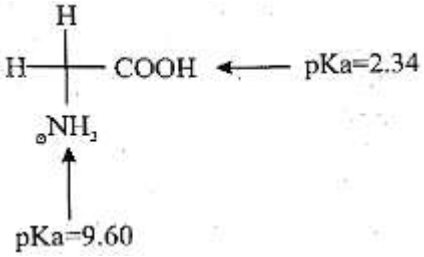
45. Which of the following is optically inactive
1) Glycine 2) Lysine 3) Aspartic acid 4) Isoleucine

46. Which of the following statements is / are incorrect?
I. Glucose is non reducing sugar
II. Sucrose is reducing sugar
III. Maltose is non reducing sugar
IV. Lactose is non reducing sugar
1) I and II only 2) I and III only 3) I and IV only 4) All

47. Which of the following statements is not correct?
1) A peptide bond is – CO – NH -
2) Each polypeptide has one C – terminal and the other N-terminal
3) The amino acid sequence of a protein determines the function of the protein
4) The union of two amino acids produces two peptide linkages

48. Which of the following statements is not correct?
1) Vitamin – A is also known as retinol
2) In carrots a red coloured compound (carotene) in the body breaks into vitamin – C
3) Vitamin – A is essential for growth and vision
4) Vitamin – A is a fat – soluble vitamin

49. What is the pI of glycine? The structure and pKa values are shown below



1) 7.26 2) 5.97 3) 3.63 4) 11.94

50. Which of the following is a globular protein?

1) Collagen 2) Myoglobin & Haemoglobin

3) Myosin 4) Enzymes

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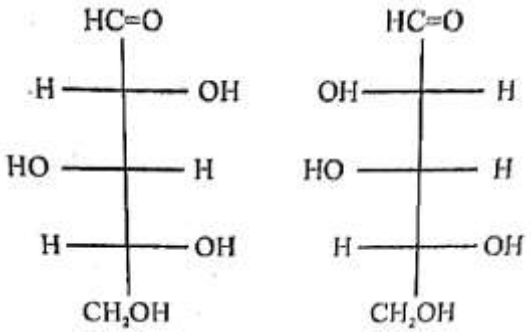
51. For the formation of glucasozone how many phenyl hydrazine molecules react with one molecule of glucose
52. The number of Nucleotide pairs present in one turn of DNA helix
53. To become a carbohydrate, a compound must contain at least
54. Total number of Nitrogens present in glucosazone molecule
55. Number of peptide links in a tripeptide
56. AT / GC ratio in human being is
57. No. of hydrogen bonds present between G and C
58. At which carbon are the following sugars epimers of each other?



59. Number of moles of CH_3OH / $NaOH$ react with one mole of glucose
60. In an amino acid, the carboxylic group ionizes at pK_{a1}=2.34 and ammonium ion at pK_{a2}=9.60. The isoelectric point of the amino acid is at pH.

MATHEMATICS MAX.MARKS: 100

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

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61. In a parallelogram ABCD, $\left|\overrightarrow{AB}\right|=a, \left|\overrightarrow{AD}\right|=b$ and $\left|\overrightarrow{AC}\right|=c$ then $\overrightarrow{DA}.\overrightarrow{AB}$ has the value:

1) $\frac{1}{2}\left(a^2+b^2+c^2\right)$ 2) $\frac{1}{2}\left(a^2-b^2+c^2\right)$ 3) $\frac{1}{2}\left(a^2+b^2-c^2\right)$ 4) $\frac{1}{3}\left(b^2+c^2-a^2\right)$

62. If $\hat{x},\hat{y}$ and $\hat{z}$ are three unit vectors in three – dimensional space, then the minimum value of $\left|\hat{x}+\hat{y}\right|^2+\left|\hat{y}+\hat{z}\right|^2+\left|\hat{z}+\hat{x}\right|^2$

1) $\frac{3}{5}$ 2) 3 3) $3\sqrt{3}$ 4) 6

63. Let $\vec{a}=2\hat{i}-\hat{j}+\hat{k},\ \vec{b}=\hat{i}+2\hat{j}-\hat{k}$ and $\vec{c}=\hat{i}+\hat{j}-2\hat{k}$ be three vectors. A vector of the type $\vec{b}+\lambda\vec{c}$ for some scalar λ, whose projection on $\vec{a}$ is of magnitude $\sqrt{\frac{2}{3}}$ is:

1) $2\hat{i}+\hat{j}+5\hat{k}$ 2) $2\hat{i}+3\hat{j}-3\hat{k}$ 3) $2\hat{i}-\hat{j}+5\hat{k}$ 4) $2\hat{i}+3\hat{j}+3\hat{k}$

64. If the vectors $\vec{a}=\hat{i}-\hat{j}+2\hat{k},\vec{b}=2\hat{i}+4\hat{j}+\hat{k}$ and $\vec{c}=\lambda\hat{i}+\hat{j}+\mu\hat{k}$ are mutually orthogonal, then $(\lambda,\mu)=$

1) (2, -3) 2) (-2, 3) 3) (3, -2) 4) (-3, 2)

65. Let $\bar{u},\bar{v},\bar{w}$ be such that $|\bar{u}|=1,|\bar{v}|=2,|\bar{w}|=3$. If the projection $\bar{v}$ along $\bar{u}$ is equal to that of $\bar{w}$ along $\bar{u}$ and $\bar{v},\bar{w}$ are perpendicular to each other then $|\bar{u}-\bar{v}+\bar{w}|$ equals

1) 14 2) $\sqrt{7}$ 3) $\sqrt{14}$ 4) 2

66. If $\vec{a},\vec{b},\vec{c}$ are vectors such that $\vec{a}+\vec{b}+\vec{c}=0$ and $|\vec{a}|=7,|\vec{b}|=5,|\vec{c}|=3$ then angle between vector $\vec{b}$ and $\vec{c}$ is

1) 60° 2) 30° 3) 45° 4) 90°

67. The position vectors of A, B are $\bar{a},\bar{b}$ respectively. The position vector of C is $\frac{5\bar{a}}{3}-\bar{b}$. Then

1) C is outside the ΔOAB but inside the angle OBA
2) C is outside the ΔOAB but inside the angle BOA
3) C is outside the ΔOAB but inside the angle COA
4) inside the triangle OAB

68. The area (in sq.units) of the parallelogram whose diagonals are along the vectors $8\hat{i}-6\hat{j}$ and $3\hat{i}+4\hat{j}-12\hat{k}$, is:

1) 26 2) 65 3) 20 4) 52

69. If $\hat{u}$ and $\hat{v}$ are unit vectors and θ is the acute angle between them, then $2\hat{u}\times3\hat{v}$ is a unit vector for

1) no value of θ 2) exactly one value of θ
3) exactly two values of θ 4) more than two values of θ

70. For any vector $\vec{a}$, the value of $(\vec{a}\times\hat{i})^2+(\vec{a}\times\hat{j})^2+(\vec{a}\times\hat{k})^2$ is equal to

1) $3\vec{a}^2$ 2) $\vec{a}^2$ 3) $2\vec{a}^2$ 4) $4\vec{a}^2$

71. Let $\vec{u}=\hat{i}+\hat{j},\vec{v}=\hat{i}-\hat{j}$ and $\vec{w}=\hat{i}+2\hat{j}+3\hat{k}$. If $\hat{n}$ is a unit vector such that $\vec{u}.\hat{n}=0$ and $\vec{v}.\hat{n}=0$, then $|\vec{w}.\hat{n}|$ is equal to

1) 3 2) 0 3) 1 4) 2

72. If $\vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}$ then $\vec{a}+\vec{b}+\vec{c}=$

1) abc 2) -1 3) $\bar{0}$ 4) 2

73. $\vec{a}=3\hat{i}-5\hat{j}$ and $\vec{b}=6\hat{i}+3\hat{j}$ are two vectors and $\vec{c}$ is a vector such that $\vec{c}=\vec{a}\times\vec{b}$ then $|\vec{a}|:|\vec{b}|:|\vec{c}|$

1) $\sqrt{34}:\sqrt{45}:\sqrt{39}$ 2) $\sqrt{34}:\sqrt{45}:39$ 3) 34 : 39 : 12 4) 39 : 35 : 34

74. If $\bar{a}=p\bar{i}+3\bar{j}-7\bar{k},\ \bar{b}=p\bar{i}-p\bar{j}+4\bar{k}$ and if the angle between *a* and *b* is acute, then the values of *p* lies in

1) P < -4 or p > 7 2) (-7, 4) 3) P ≤ -4 or p ≥ 7 4) [-7, 4]

75. $\bar{a},\bar{b},\bar{c}$ are three vectors, such that $\bar{a}+\bar{b}+\bar{c}=\bar{0},|\bar{a}|=1,|\bar{b}|=2,|\bar{c}|=3$, then $(\bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a})^2$ is equal to

1) 49 2) 36 3) 15 4) 28

76. $A=(2,3,5), B=(-1,3,2)$ and $C=(\lambda,5,\mu)$ are the vertices of a triangle. If the median AM is equally inclined to the coordinates axes, then

1) $\lambda=10,\mu=7$ 2) $\lambda=-10,\mu=7$ 3) $\lambda=7,\mu=10$ 4) $\lambda=-7,\mu=-10$

77. The ΔABC is defined by the vertices A(1, -2, 2) B(1, 4, 0) and C(-4, 1, 1). Let M be the foot of the altitude drawn from the vertex B to side AC. Then $\overline{BM}=$

1) $\left(\frac{-20}{7},\frac{-30}{7},\frac{10}{7}\right)$ 2) $(-20,-30,10)$ 3) $(2,3,-1)$ 4) $(1,2,3)$

78. If $\bar{p}=\bar{a}+\bar{b},\bar{q}=\bar{a}-\bar{b},|\bar{a}|=|\bar{b}|=r$, then $|\bar{p}\,x\,\bar{q}|=$

1) $\sqrt{r^4-(\bar{a}.\bar{b})^2}$ 2) $2\sqrt{r^4-(\bar{a}.\bar{b})^2}$ 3) $3\sqrt{r^4-(\bar{a}.\bar{b})^2}$ 4) 0

79. The perpendicular distance of the point (6, -4, 4) on to the line joining the points A(2, 1, 2), B(3, -1, 4) is

1) 1 2) 2 3) 3 4) 4

80. The torque about the point $3\bar{i}-\bar{j}+3\bar{k}$ of a force $4\bar{i}+2\bar{j}+\bar{k}$ through the point $5\bar{i}+2\bar{j}+4\bar{k}$, is

1) $\bar{i}+2\bar{j}-8\bar{k}$ 2) $\bar{i}+2\bar{j}+8\bar{k}$ 3) $\bar{i}-2\bar{j}-8\bar{k}$ 4) $-\bar{i}-2\bar{j}-8\bar{k}$

SECTION-II
(NUMERICAL VALUE ANSWER TYPE)

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81. If the projection of the vector $\hat{i}+2\hat{j}+\hat{k}$ on the sum of the two vectors $2\hat{i}+4\hat{j}-5\hat{k}$ and $-\lambda\hat{i}+2\hat{j}+3\hat{k}$ is 1, then λ is equal to _____.

82. If $(\vec{a}+3\vec{b})$ is perpendicular to $(7\vec{a}-5\vec{b})$ and $(\vec{a}-4\vec{b})$ is perpendicular to $(7\vec{a}-2\vec{b})$, then the angle between $\vec{a}$ and $\vec{b}$ (in degrees) is ____.

83. $\vec{a}=\hat{i}+a\hat{j}+3\hat{k}$ and $3\hat{i}-a\hat{j}+\hat{k}$. If the area of the parallelogram whose adjacent orders are represented by the vectors $\vec{a}$ and $\vec{b}$ is $8\sqrt{3}$ square units, then $\vec{a}.\vec{b}$ is equal to _____.

84. If $\vec{a}$ and $\vec{b}$ are unit vectors, then the greatest value of $\sqrt{3}|\vec{a}+\vec{b}|+|\vec{a}-\vec{b}|$ is _____.

85. Let $\vec{a},\vec{b}$ and $\vec{c}$ be three unit vectors such that $|\vec{a}-\vec{b}|^2+|\vec{a}-\vec{c}|^2=8$. Then $|\vec{a}+2\vec{b}|^2+|\vec{a}+2\vec{c}|^2$ is equal to _____.

86. If $\bar{a},\bar{b},\bar{c}$ are unit vectors, then $|\bar{a}-\bar{b}|^2+|\bar{b}-\bar{c}|^2+|\bar{c}-\bar{a}|^2$ does not exceed

87. A particle is acted upon by constant forces $4\bar{i}+\bar{j}-3\bar{k}$ and $3\bar{i}+\bar{j}-\bar{k}$ which displace it from a point $\bar{i}+2\bar{j}+3\bar{k}$ to the point $5\bar{i}+4\bar{j}+\bar{k}$. The work done in standard units by the forces is given by

88. $\bar{a}+2\bar{b}+3\bar{c}=\bar{0}$ and $\bar{a}\,x\,\bar{b}+\bar{b}\,x\,\bar{c}+\bar{c}\,x\,\bar{a}=\ell(\bar{b}\,x\,\bar{c})$ then $\ell=$

89. ABCD is a quadrilateral with $\overline{AB}=\bar{a},\overline{AD}=\bar{b},\overline{AC}=2\bar{a}+3\bar{b}$. If the area of quadrilateral ABCD is p times the area of the parallelogram with AB, AD as adjacent sides, then p is equal to

90. Let $\bar{a}=-\bar{i}-\bar{k},\bar{b}=-\bar{i}+\bar{j}$ and $\bar{c}=\bar{i}+2\bar{j}+3\bar{k}$ be three given vectors. If $\bar{r}$ is a vector such that $\bar{r}\,x\,\bar{b}=\bar{c}\,x\,\bar{b}$ and $\bar{r}.\bar{a}=0$ then $\bar{r}.\bar{b}=$

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