

ENTRANCE EXAMINATION – 2019**M.Sc. (5- Year Integrated) Sciences****(Mathematical Sciences, Physics, Chemical Sciences, Systems Biology and Applied Geology)**

Time: 2 Hours

Max. Marks: 100

Hall Ticket Number:

Please read the following instructions carefully:

1. (a) Write your Hall ticket Number in the above box AND on the OMR sheet without fail.
(b) Fill in the OMR sheet, the **Booklet Code** given above at the top left corner of this sheet. Candidates should also read and follow the other instructions given in the OMR sheet.
2. All answers should be marked clearly in the OMR answer sheet only.
3. There are 100 questions in this paper. Questions 1-25 are in Biology, 26-50 are in Chemistry, 51-75 are in Mathematics and 76-100 are in Physics.
4. **There is negative marking. Every correct answer carries 1 (one) mark and for every wrong answer 0.33 mark will be deducted.** Each question has only one correct option.
5. The appropriate answer should be coloured with either a blue or a black ball point pen.
DO NOT USE A PENCIL.
6. Handover the **OMR answer sheet** at the end of the examination to the invigilator.
7. Use of non-programmable calculator and log-tables is allowed.
8. Use of mobile phone is NOT allowed inside the hall.
9. **No additional sheets will be provided.** Rough work can be done in the question paper itself/space provided at the end of the booklet.
10. This paper contains 26 pages including this page and the pages for the rough work.
Please check that your paper has all the pages before answering.
11. All the symbols used in the text have their usual meanings.

BIOLOGY

1. Which one of the following has been sequentially arranged to depict the events of meiosis?
(i) Synapsis (ii) Disjunction of Chromosomes (iii) Crossing over (iv) Terminalization

- [A] iii, ii, i, iv
- [B] i, iii, ii, iv
- [C] ii, i, iii, iv
- [D] ii, iv, i, iii

2. Most of the members of Vitamin B complex act as _____ in enzyme reaction

- [A] coenzyme
- [B] apoenzyme
- [C] cofactor
- [D] prosthetic group

3. Which one of the following is fastest in animal kingdom?

- [A] peregrine falcon
- [B] cheetah
- [C] giraffe
- [D] spur-winged goose

4. Which pair of hormone and its function is *wrongly* stated?

- [A] Glucagon – Decreases blood sugar level
- [B] Thyroxine – Regulation of basal metabolic rate, growth and development
- [C] Progesterone – Gestation, inhibition of ovulation
- [D] Parathormone- Increases blood calcium level

5. Who developed polio vaccine for the first time?

- [A] Albert Sabin
- [B] Jonas Salk
- [C] Louis Pasteur
- [D] Edward Jenner

6. Which one is *incorrect* about photosynthesis?

- [A] Carbon dioxide is fixed in dark reaction
- [B] Light reaction produces ATP and reduced NADP
- [C] Oxygen is released from lysis of carbon dioxide
- [D] Light reaction takes place in thylakoid

7. Which one of the following is *odd-one out*?

- [A] Zebrafish
- [B] Goldfish
- [C] Silverfish
- [D] Dragonfish

8. Complete aerobic oxidation of glucose is coupled to the synthesis of as many as _____ molecules of ATP.

- [A] 38
- [B] 36
- [C] 32
- [D] 34

9. Which cellular organelle is an immediate indicator of cellular injury?

- [A] Mitochondria
- [B] Nucleus
- [C] Golgi Complex
- [D] Ribosome

10. Amplification of DNA *cannot* be achieved through

- [A] Polymerase chain reaction
- [B] Cloning of DNA insert in a vector or plasmid
- [C] Action of DNA polymerase
- [D] Gel electrophoresis with blotting

11. Which one of the following is a venomous fish?

- [A] Manta rays
- [B] Eel
- [C] Stonefish
- [D] Puffer fish

12. Bacterial cell divides into two every one minute. It takes an hour to get filled in 100 ml beaker. How much time it takes to fill 50 ml?

- [A] 59 minutes
- [B] 49 minutes
- [C] 29 minutes
- [D] 39 minutes

13. Which statement is *incorrect* about cell cycle

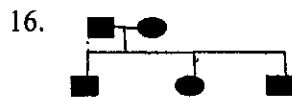
- [A] diseases due to altered number of chromosomes happen due to impaired chromosome segregation in Metaphase
- [B] cancer is a disease of impaired cell cycle
- [C] all somatic cells can divide throughout their life cycle
- [D] exchange of DNA between homologous chromosome pair occurs during meiosis

14. White fluffy edible mass in maize is morphologically _____

- [A] endosperm
- [B] pulp
- [C] seed
- [D] pericarp

15. Typically in an ecosystem, the population size of a predator will

- [A] increase linearly with time
- [B] fluctuate with its prey population
- [C] increase exponentially with time
- [D] will depend upon genetic diversity and nature of food chain



One boy and one girl born in the above pedigree have O blood group with Rh positive. The other sibling boy has B blood group with Rh positive. What are the blood group genotypes of the parents?

- [A] Father is homozygous for blood group B while mother is heterozygous for B and both are Rh positive
- [B] Both father and mother are heterozygous for blood group B but father is Rh positive while mother is Rh negative
- [C] Both father and mother are homozygous for B with Rh positive
- [D] Father is heterozygous for blood group B while mother is homozygous for B and both are Rh positive

17. Which one of the following group of living organisms given below is a link of a food chain between grass plants and Eagle?

- [A] grains, insects, rat and snake
- [B] grains, grass hopper, hen and rat
- [C] grains, insects, frog and hen
- [D] grains, earthworm, hen and mice

18. Testosterone is secreted by _____ cells of testis in human beings.

- [A] Sertoli
- [B] Leydig
- [C] Primordial germ
- [D] Spermatoocyte

19. Which one of the following is extremely important for ovulation to release egg

- [A] LH surge
- [B] FSH surge
- [C] Estradiol surge
- [D] Progesterone surge

20. What is interferon?

- [A] hormone
- [B] gene
- [C] protein
- [D] enzyme

21. Most modern breed of pet animals have been developed using _____

- [A] Artificial selection
- [B] Natural selection
- [C] Sexual isolation
- [D] Reproductive selection

22. A cell will shrink if

- [A] the concentration of water molecules in the cell is higher than the concentration of water molecules of surrounding medium
- [B] the concentration of water molecules in surrounding medium is higher than concentration of water molecules in the cell.
- [C] the concentration of water molecules is same in the cell as well as the surrounding medium
- [D] the concentration of water molecules does not matter

23. Hemophilia is a genetic disorder resulting in impaired blood clotting. It occurs only in males, not in females because the

- [A] mutation is present in Y-chromosome of hemophilic males
- [B] mutation is present in X-chromosome of hemophilic males
- [C] hemophilic females need to be homozygous for mutant gene, which is rare
- [D] both b and c

24. Anticodons are found in

- [A] mRNA
- [B] rRNA
- [C] tRNA
- [D] cRNA

25. Aristotle's lantern is characteristic of

- [A] star fish
- [B] sea lily
- [C] brittle star
- [D] sea urchin

CHEMISTRY

26. Silver forms a *ccp* lattice and X-ray studies of its crystal shows that the edge length of its unit cell is 410 pm. Given that the atomic mass of silver is 108 u, its density is:
- [A] 9.2 g cm^{-3}
[B] 10.4 g cm^{-3}
[C] 11.0 g cm^{-3}
[D] 11.8 g cm^{-3}
27. The vapour pressure of benzene at 25°C is 639.7 mm Hg and the vapour pressure of a solution of a compound in benzene at the same temperature is 631.9 mm Hg. Assuming that the solution follows Raoult's law, Molality of the solution is:
- [A] $0.200 \text{ mol kg}^{-1}$
[B] $0.103 \text{ mol kg}^{-1}$
[C] $0.156 \text{ mol kg}^{-1}$
[D] $0.250 \text{ mol kg}^{-1}$
28. 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. The freezing point depression constant of benzene is $5.12 \text{ K kg mol}^{-1}$. Molar mass of the solute is
- [A] 256 g mol^{-1}
[B] 236 g mol^{-1}
[C] 276 g mol^{-1}
[D] 296 g mol^{-1}
29. A solution of CuSO_4 is electrolyzed for 5 min with a current of 1.5 A. Given that the atomic mass of Cu is 63 u, the mass of copper deposited on the cathode is:
- [A] 0.1260 g
[B] 0.1469 g
[C] 0.1660 g
[D] 0.1880 g
30. 1.00 g of a radioactive material is reduced to 0.125 g in 200 h. Time taken after this, for it to reduce to 0.01 g is:
- [A] 302 h
[B] 202 h
[C] 282 h
[D] 243 h

31. The specific rate constant for a reaction increases by a factor of 4 if the temperature is changed from 27 °C to 47 °C. Activation energy for the reaction is:
- [A] 14.00 k cal / mol
 - [B] 12.82 k cal / mol
 - [C] 13.62 k cal / mol
 - [D] 13.22 k cal / mol
32. Given that the Bohr radius is 52.9 pm and $m_e = 9.11 \times 10^{-31}$ kg, the speed of an electron in the innermost orbit of a hydrogen atom is:
- [A] 2.189×10^6 ms⁻¹
 - [B] 2.482×10^6 ms⁻¹
 - [C] 1.911×10^6 ms⁻¹
 - [D] 1.799×10^6 ms⁻¹
33. The structure of ClF₃ predicted by VSEPR theory is:
- [A] planar triangular
 - [B] T-shaped
 - [C] pyramidal
 - [D] Square planar
34. The spin only magnetic moment of Ni²⁺ (3d⁸) ion is:
- [A] 2.84 BM
 - [B] 3.87 BM
 - [C] 1.73 BM
 - [D] 4.90 BM
35. A common test for identifying a nitrate ion is a "brown ring" test. Composition of the complex formed is:
- [A] [Fe(H₂O)₃(NO₂)₃]
 - [B] [Fe(H₂O)₆](NO)₂
 - [C] [Fe(H₂O)₄(SO₄)₂](NO₂)
 - [D] [Fe(H₂O)₅(NO)]SO₄
36. Laughing gas is:
- [A] Dinitrogen trioxide
 - [B] Nitric oxide
 - [C] Nitrous oxide
 - [D] Nitrogen dioxide

37. The bond order of peroxide ion $(O_2)^{2-}$ is:
- [A] 0
 - [B] +1
 - [C] -1
 - [D] +2
38. The total number of stereoisomers including enantiomeric pairs of Ma_4bc octahedron (where a, b and c are monodentate ligands) is:
- [A] 2
 - [B] 1
 - [C] 3
 - [D] 4
39. A transition metal ion forms a complex $[MX_4]$ involving dsp^2 hybrid orbitals. The angle between the adjacent hybrid orbitals is:
- [A] 109.28°
 - [B] 180°
 - [C] 90°
 - [D] 120°
40. A molecule having an unpaired electron is:
- [A] NO
 - [B] CO
 - [C] $[CN]^-$
 - [D] O_2
41. When a lead storage battery is discharged:
- [A] SO_2 gas is evolved
 - [B] lead is formed
 - [C] lead sulphate is consumed
 - [D] sulfuric acid is consumed
42. The compound having the highest boiling point among the following is:
- [A] Isooctane
 - [B] *n*-octane
 - [C] 2,2,3,3-tetramethylbutane
 - [D] *n*-butane

43. The IUPAC name for the compound $\text{CH}_2=\text{CH}-\text{CH}(\text{CH}_3)_2$ is:
- [A] 1,1-dimethylprop-2-ene
 - [B] 3-methylbut-1-ene
 - [C] 2-vinylpropene
 - [D] 1-isopropylethane
44. A hydrocarbon (A) decolourises Baeyer's reagent. It also reacts with conc. H_2SO_4 to form an alkyl hydrogen sulphate which on hydrolysis gives 2-butanol. Ozonolysis of A forms formaldehyde and propanaldehyde. A is:
- [A] $\text{H}_2\text{C}=\text{CHCH}_2\text{CH}_3$
 - [B] $\text{H}_3\text{CCH}=\text{CHCH}_3$
 - [C] $(\text{H}_3\text{C})_2\text{C}=\text{CHCH}_3$
 - [D] $(\text{H}_3\text{C})_2\text{C}=\text{C}(\text{CH}_3)_2$
45. The test that can be used to distinguish acetophenone from propanaldehyde is:
- [A] Baeyer test
 - [B] Iodoform test
 - [C] Nessler's test
 - [D] Lucas test
46. The Hell-Volhard-Zelinsky reaction is used to synthesize:
- [A] aldehydes
 - [B] ketones
 - [C] α -halo carboxylic acids
 - [D] nitriles
47. Alkyl fluorides are obtained by heating an alkyl chloride / bromide with metallic fluorides such as AgF or SbF_3 . The name reaction used for this synthetic protocol is:
- [A] Swarts reaction
 - [B] Finkelstein reaction
 - [C] Sandmeyer reaction
 - [D] Friedel-Crafts reaction

48. Among the following orbital combinations, the electronegativity of carbon would be the maximum in:

- [A] sp^3
- [B] sp^2
- [C] sp
- [D] p

49. Among the following, the optically active compound is:

- [A] 1-bromobutane
- [B] 2-bromobutane
- [C] 2-bromo-2-methylpropane
- [D] 1-bromo-2-methylpropane

50. The product obtained on heating *n*-heptane with Cr_2O_3 supported on alumina at $600^\circ C$ is:

- [A] benzene
- [B] cyclohexane
- [C] xylene
- [D] toluene

MATHEMATICS

51. $\{\arg z - \arg(-z) : z \in \mathbb{C}\} =$
- A. $\{\pi\}$
 - B. $\{-\pi\}$
 - C. $\{\pm\pi\}$
 - D. $[-\pi, \pi]$
52. If p and q are distinct primes such that the roots of $x^2 - (2p + 1)x + pq = 0$ are distinct primes, then $p + q =$
- A. 12
 - B. 9
 - C. 8
 - D. 5
53. If a_1, a_2, \dots, a_n are in A.P. with the common difference $d \neq 0$, then $\sin(d)[\operatorname{cosec}(a_1)\operatorname{cosec}(a_2) + \operatorname{cosec}(a_2)\operatorname{cosec}(a_3) + \dots + \operatorname{cosec}(a_{n-1})\operatorname{cosec}(a_n)] =$
- A. $\sec(a_1) - \sec(a_n)$
 - B. $\operatorname{cosec}(a_1) - \operatorname{cosec}(a_n)$
 - C. $\tan(a_1) - \tan(a_n)$
 - D. $\cot(a_1) - \cot(a_n)$
54. If $6^{\log_x 6} < x$, then x lies in
- A. $(0, \infty)$
 - B. $\left(\frac{1}{6}, 1\right) \cup (6, \infty)$
 - C. $(1, \infty)$
 - D. $(1, 2)$

55. The number of ways of arranging the letters of the word MATHEMATICS so that H and C appear together is
- A. $\frac{11!}{4}$
B. $\frac{11!}{8}$
C. $\frac{10!}{4}$
D. $\frac{10!}{8}$
56. The interval in which $x(> 0)$ must lie so that the numerically greatest term in the expansion of $(1 + x)^{2n}$ has the greatest binomial coefficient is
- A. $\left(\frac{n-1}{n}, \frac{n}{n-1}\right)$
B. $\left(\frac{n}{n+1}, \frac{n+1}{n}\right)$
C. $\left(\frac{n}{n+2}, \frac{n+2}{n}\right)$
D. $\left(\frac{n+1}{n+2}, \frac{n+2}{n+1}\right)$
57. If A is a symmetric matrix with real entries, then
- A. A^{-1} is symmetric if it exists
B. A^{-1} always exists and is symmetric
C. A^{-1} is skew symmetric if it exists
D. A^{-1} always exists and is skew symmetric
58. The equation $\cos(2x) + a \sin x = 2a - 7$ admits a solution if
- A. $a < 2$
B. $2 \leq a \leq 6$
C. $a > 6$
D. a is any integer

59. In a triangle with one angle $\frac{2\pi}{3}$, the lengths of the sides form an arithmetic progression. If the length of the smallest side is 3cm, then the area of the triangle is (in cm^2)
- A. $\frac{13\sqrt{3}}{4}$
 B. $\frac{14\sqrt{3}}{4}$
 C. $\frac{15\sqrt{3}}{4}$
 D. $\frac{16\sqrt{3}}{4}$
60. If $\frac{\pi}{2} < x < \pi$, then the value of $\sin^{-1}\{\cos\{\cos^{-1}(\cos x) + \sin^{-1}(\sin x)\}\}$ is
- A. $-\frac{\pi}{2}$
 B. $\frac{\pi}{2}$
 C. 0
 D. π
61. If $p \neq a, q \neq b, r \neq c$ and the system of equations $px + ay + az = 0$,
 $bx + qy + bz = 0, cx + cy + rz = 0$ has a non-trivial solution, then the value of
 $\frac{p}{p-a} + \frac{q}{q-b} + \frac{r}{r-c}$ is
- A. 1
 B. 2
 C. 3
 D. 4
62. If the line joining the points $A(b \cos \alpha, b \sin \alpha)$ and $B(a \cos \beta, a \sin \beta)$ is produced to the point $M(x, y)$ so that $AM : MB = b : a$, then $x \cos \left(\frac{\alpha+\beta}{2}\right) + y \sin \left(\frac{\alpha+\beta}{2}\right) =$
- A. -1
 B. 0
 C. 1
 D. $a^2 + b^2$

63. Orthocentre of the triangle with vertices $(0, 0)$, $(1, 2)$ and $(-1, -1)$ is
- A. $(6, -12)$
 - B. $(6, -9)$
 - C. $(9, -6)$
 - D. $(9, -12)$
64. If a circle passes through the point (a, b) and cuts the circle $x^2 + y^2 = k^2$ orthogonally, then the equation of the locus of its centre is
- A. $2ax + 2by = a^2 + b^2 + k^2$
 - B. $ax + by = a^2 + b^2 + k^2$
 - C. $x^2 + y^2 + 2ax + 2by + k^2 = 0$
 - D. $x^2 + y^2 - 2ax - 2by + a^2 + b^2 - k^2 = 0$
65. If $x = 9$ is the equation of the chord of contact of the hyperbola $x^2 - y^2 = 9$, then the equation of corresponding pair of tangents is
- A. $9x^2 - 8y^2 + 18x - 9 = 0$
 - B. $9x^2 - 8y^2 - 18x + 9 = 0$
 - C. $9x^2 - 8y^2 - 18x - 9 = 0$
 - D. $9x^2 - 8y^2 + 18x + 9 = 0$
66. A point moves so that the sum of the squares of its distances from the six faces of the cube given by $x = \pm 1, y = \pm 1, z = \pm 1$ is 20 units. The locus of the point is
- A. $x^2 + y^2 + z^2 = 2$
 - B. $x^2 + y^2 + z^2 = 7$
 - C. $x + y + z = 2$
 - D. $x + y + z = 7$

67. Suppose X follows the binomial distribution with parameters n and p , where $0 < p < 1$. If $\frac{P(X=r)}{P(X=n-r)}$ is independent of n for every value of r , then $p =$
- A. $\frac{1}{2}$
 - B. $\frac{1}{3}$
 - C. $\frac{1}{4}$
 - D. $\frac{1}{5}$
68. Let $A = \mathbb{R} \setminus \{2\}$, $B = \mathbb{R} \setminus \{a\}$ for some $a \in \mathbb{R}$. Let $f : A \rightarrow B$ be a function defined by $f(x) = \frac{x+1}{x-2}$. Then f is onto if and only if
- A. $a = 0$
 - B. $a = 1$
 - C. $a = 2$
 - D. $a = 3$
69. $\lim_{x \rightarrow -1} \frac{\tan \pi x}{x+1} + \lim_{x \rightarrow \infty} \left(1 + \frac{1}{x^2}\right)^x =$
- A. $\pi - 1$
 - B. $\pi + 1$
 - C. $\pi - e$
 - D. $\pi + e$
70. If $\sin^{-1} \left(\frac{x-y}{x+y} \right) = c$ for some constant $c \in \mathbb{R}$, then $\frac{dy}{dx} =$
- A. $\frac{y}{x}$
 - B. $\frac{x}{y}$
 - C. $\frac{x^2}{y^2}$
 - D. $\frac{y^2}{x^2}$

71. The equation of the common tangent to the curves $y^2 = 8x$, $xy = -1$ is

A. $3y = 9x + 2y$

B. $y = 2x + 1$

C. $2y = x + 8$

D. $y = x + 2$

72. $\int \frac{\tan x}{\sqrt{1 + 2 \tan^2 x}} dx =$

A. $\sin^{-1}(\sqrt{1 + 2 \tan^2 x}) + c$

B. $\cos^{-1}(\sqrt{1 + 2 \tan^2 x}) + c$

C. $\tan^{-1}(\sqrt{1 + 2 \tan^2 x}) + c$

D. $\tan^{-1}\left(\frac{1}{\sqrt{1 + 2 \tan^2 x}}\right) + c$

73. $\int_{\pi}^{2\pi} |x \cos x| dx =$

A. π

B. 2π

C. 3π

D. 4π

74. The general solution of the differential equation $\frac{dy}{dx} = \frac{4x - 3y + 2}{4x - 3y + 1}$ is

A. $\log(4x - 3y - 1) = (x - y)^2 + c$

B. $\log(4x - 3y - 1) = y - x + c$

C. $\log(4x - 3y - 2) = (x - y)^2 + c$

D. $\log(4x - 3y - 2) = y - x + c$

75. If $\mathbf{a}, \mathbf{b}, \mathbf{c}$ are three unit vectors such that $\mathbf{a} \times (\mathbf{b} \times \mathbf{c}) = \frac{1}{2}\mathbf{b}$, where \mathbf{b} and \mathbf{c} are non-parallel. Then the angle between \mathbf{a} and \mathbf{c} is

- A. $\frac{\pi}{2}$
- B. $\frac{\pi}{3}$
- C. $\frac{\pi}{4}$
- D. $\frac{\pi}{5}$

PHYSICS

76. Out of the following pairs, which one does not have identical dimensions?
- [A] Angular momentum and Planck's constant
 - [B] Moment of inertia and moment of force
 - [C] Work and torque
 - [D] Impulse and momentum
77. From a tower of height H , a particle is thrown vertically upwards with a speed u . The time taken by the particle to hit the ground is n times that taken by it to reach the highest point of its path. The relation between H , u and n is
- [A] $2gH = nu^2(n-2)$
 - [B] $gH = (n-2)^2u^2$
 - [C] $2gH = (n-2)^2u^2$
 - [D] $gH = n^2u^2(n-2)$
78. A particle is moving Eastwards with a velocity of 10 m/s. In 5 seconds, the velocity changes to 10 m/s Northwards. The average acceleration in this time is
- [A] 2 ms^{-2} towards North-East
 - [B] Zero
 - [C] $2\sqrt{2} \text{ ms}^{-2}$ towards North-West
 - [D] $\sqrt{2} \text{ ms}^{-2}$ towards North
79. If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between A and B is
- [A] π
 - [B] $\pi/2$
 - [C] $\pi/3$
 - [D] $\pi/4$
80. The time period of a satellite of earth is 5 h. If the separation between the earth and the satellite is increased to 4 times the previous value, the new time period will become
- [A] 20 h
 - [B] 40 h
 - [C] 80 h
 - [D] 10 h

81. Two identical cars are travelling with speeds of u and $3u$. If the retardation applied at same instant brings both the cars to a halt, the ratio of the respective distances at which the two cars are stopped is

- [A] 1:3
- [B] 1:4
- [C] 1:9
- [D] 1:1

82. A block of mass 0.5 kg is moving with a speed of 2 m/s on a smooth surface. It strikes another mass of 1 kg at rest and then both move together as a single body. The energy loss during the collision is

- [A] 0.34 J
- [B] 0.16 J
- [C] 0.75 J
- [D] 0.67 J

83. A particle is moving with a uniform speed in a circular orbit of radius R in a central force inversely proportional to the n th power of R . If the period of rotation of the particle is T , then:

- [A] $T \propto R^{2n/3}$
- [B] $T \propto R^{(n+1)/2}$
- [C] $T \propto R^{n/2}$
- [D] $T \propto R^{(n+2)/3}$

84. A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same, which one of the following will not be affected?

- [A] Angular momentum
- [B] Rotational kinetic energy
- [C] Moment of inertia
- [D] Angular velocity

85. A satellite is revolving in a circular orbit at a height h from the Earth's surface. Assume radius of Earth is R and $h \ll R$. Neglecting the effect of atmosphere, the minimum increase in its orbital velocity of the satellite to escape from the Earth's gravitational field is

- [A] $\sqrt{2gR}$
- [B] $(\sqrt{2} - 1)\sqrt{gR}$
- [C] $\sqrt{gR/2}$
- [D] \sqrt{gR}

86. An external pressure p is applied on a cube at 0°C so that it is equally compressed from all sides. K is the bulk modulus of the material of the cube and α is its coefficient of linear expansion. The temperature of the cube needs to be raised by what amount to bring the cube to its original size by heating

- [A] $p/\alpha K$
- [B] $p/3\alpha K$
- [C] $3\alpha/pK$
- [D] α/pK

87. A sonometer wire of length 150 cm is made of steel. The tension in it produces an elastic strain of 1%. If the density and elasticity of steel are $7.7 \times 10^3 \text{ kg/m}^3$ and $2.2 \times 10^{11} \text{ N/m}^2$ respectively, what is the fundamental frequency of steel?

- [A] 770.5 Hz
- [B] 188.5 Hz
- [C] 178.2 Hz
- [D] 200.5 Hz

88. A copper ball of mass 100 g is at a temperature T . It is dropped in a copper calorimeter of mass 100 g, filled with 170 g of water at room temperature of 30°C . Subsequently, the temperature of the system is found to be 75°C . If specific heat of copper is $0.1 \text{ Cal/g}^\circ\text{C}$, T is:

- [A] 825°C
- [B] 785°C
- [C] 885°C
- [D] 800°C

89. A spherical shell of radius R is at a temperature T . The blackbody radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume $u = \frac{U}{V} \propto T^4$ and pressure $p = \frac{1}{3} \left(\frac{U}{V} \right)$. If the shell now undergoes an adiabatic expansion, the relation between T and R is

- [A] $T \propto e^{-R}$
- [B] $T \propto 1/R^3$
- [C] $T \propto e^{-3R}$
- [D] $T \propto 1/R$

90. A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of 10^{12} per second. Given the molecular weight of silver = 108, and Avogadro number = 6.02×10^{23} gmol^{-1} , what is the force constant of the bonds connecting one atom with the other?

- [A] 5.5 N/m
- [B] 7.1 N/m
- [C] 2.2 N/m
- [D] 6.4 N/m

91. Three concentric metal shells A, B and C of respective radii a , b and c with $a < b < c$ have surface charge densities $+\sigma$, $-\sigma$ and $+\sigma$, respectively. The potential of the shell B is

- [A] $\frac{\sigma}{\epsilon_0} \left[\frac{a^2 - b^2}{a} + c \right]$
- [B] $\frac{\sigma}{\epsilon_0} \left[\frac{b^2 - c^2}{b} + a \right]$
- [C] $\frac{\sigma}{\epsilon_0} \left[\frac{a^2 - b^2}{b} + c \right]$
- [D] $\frac{\sigma}{\epsilon_0} \left[\frac{b^2 - c^2}{c} + a \right]$

92. Let C be the capacitance of a capacitor discharging through a resistor R . Suppose t_1 is the time taken for the energy stored in the capacitor to reduce to half of its initial value and t_2 is the time taken for the charge to reduce to one-fourth its initial value. Then, the ratio of t_1/t_2 is

- [A] 2
- [B] 1/2
- [C] 1
- [D] 1/4

93. Two insulating plates are uniformly charged in such a way that the potential difference between them is $V_2 - V_1 = 20\text{V}$. The plates are separated by 10 cm and can be treated as infinitely large. If an electron is released from rest on the inner surface of plate 1, with what speed it will hit the plate 2? Consider the charge and rest mass of electron are 1.6×10^{-19} C and 9.11×10^{-31} kg, respectively.

- [A] $7.02 \times 10^{12} \text{ms}^{-1}$
- [B] $1.87 \times 10^6 \text{ms}^{-1}$
- [C] $2.65 \times 10^6 \text{ms}^{-1}$
- [D] $3.20 \times 10^{18} \text{ms}^{-1}$

94. A diverging lens with a focal length 25 cm is placed at a distance of 15 cm from a converging lens of focal length 20 cm. A beam of parallel light falls on the diverging lens. The image formed is

- [A] virtual and at a distance of 40 cm from converging lens
- [B] real and at a distance of 40 cm from converging lens
- [C] real and at a distance of 10 cm from converging lens
- [D] real and at a distance of 40 cm from diverging lens.

95. The resistance of a wire is 5Ω at 50°C and 6Ω at 100°C . The resistance of the wire at 0°C is

- [A] 2Ω
- [B] 1Ω
- [C] 4Ω
- [D] 3Ω

96. When monochromatic red light is used instead of blue light in a convex lens, its focal length will

- [A] remain same
- [B] decrease
- [C] not depend on colour of light
- [D] increase

97. An electromagnetic wave of frequency 30 MHz passes from vacuum into a dielectric medium with permittivity $\epsilon = 4.50$. Then

- [A] wavelength is doubled and the frequency remains unchanged
- [B] wavelength is doubled and the frequency becomes half
- [C] wavelength is halved and the frequency remains unchanged
- [D] wavelength and frequency both remain unchanged

98. Unpolarized light intensity I passes through an ideal polarizer A . Another ideal polarizer B is placed behind A . The intensity of the light beyond B is found to be $I/2$. Now, another ideal polarizer C is placed between A and B . The intensity beyond B is now found to be $I/8$. The angle between polarizer A and C is

- [A] 45°
- [B] 30°
- [C] 0°
- [D] 60°

99. An electron, a proton and an alpha particle having the same kinetic energy are moving in circular orbits of radii R_e , R_p , R_α respectively, in a uniform magnetic field B . The relation between R_e , R_p , R_α is

- [A] $R_e > R_p = R_\alpha$
- [B] $R_e < R_p < R_\alpha$
- [C] $R_e < R_p = R_\alpha$
- [D] $R_\alpha < R_p < R_e$

100. Two batteries with emf 12 V and 13 V are connected in parallel across a load resistor of 10Ω . The internal resistances of the two batteries are 1Ω and 2Ω , respectively. The voltage across the load lies between

- [A] 11.6 V and 11.7 V
- [B] 11.5 V and 11.6 V
- [C] 11.7 V and 11.8 V
- [D] 11.4 V and 11.5 V

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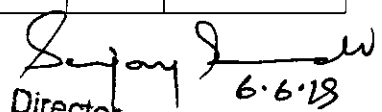
Entrance Examinations - 2019

School/Department/Centre : CIS

Course/Subject : Int. Masters Sciences: Booklet Code- A

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	B	26	B	51	C	76	B
2	C	27	C	52	D	77	A
3	A	28	A	53	D	78	C
4	A	29	B	54	B	79	A
5	B	30	D	55	C	80	B
6	C	31	D	56	B	81	C
7	C	32	A	57	A	82	D
8	B	33	B	58	B	83	B
9	A	34	A	59	C	84	A
10	D	35	D	60	A	85	B
11	C	36	C	61	B	86	B
12	A	37	B	62	B	87	C
13	A or C*	38	A	63	C	88	C
14	A	39	C	64	A	89	D
15	B	40	A	65	B	90	B
16	B	41	D	66	B	91	C
17	A	42	B	67	A	92	D
18	B	43	B	68	B	93	C
19	A	44	A	69	B	94	B
20	C	45	B	70	A	95	C
21	A	46	C	71	D	96	D
22	A	47	A	72	C	97	C
23	D	48	C	73	C	98	A
24	C	49	B	74	D	99	C
25	D	50	D	75	B	100	B

Note/Remarks: * 01(one) mark to be given to all candidates.


 Director
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 6.6.18
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