

Entrance Examination - 2021
M.Sc. (5-Year Integrated) Sciences
(Chemistry, Mathematics, Physics, Systems Biology and Applied Geology)

Time: 2 hours

Max. Marks: 100

Hall Ticket No.							
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Instructions

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 on 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 Mathematics and 76-100 are in Physics.
4. **There is negative marking. Each 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. Hand over the **OMR answer sheet** at the end of the examination to the invigilator.
7. Use of non-programmable calculators 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 question booklet contains 30 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.
12. Candidate should write and darken the correct Booklet Code in the OMR Answer Sheet, without which the OMR will not be evaluated. The candidates defaulting in marking the Booklet Code in the OMR shall not have any claim on their examination and University shall not be held responsible.

BIOLOGY

1. The cell wall of fungi is made of complex sugar called

[A] Cellulose

[B] Chitin

[C] Pectin

[D] Lignin

2. Mitochondria and chloroplasts are similar because

[A] Both have nuclei

[B] Both have 80s ribosomes

[C] Both have DNA

[D] Both have single membrane envelope

3. Antibodies are complex

[A] Lipoproteins

[B] Steroids

[C] Prostaglandins

[D] Globulin proteins

4. According to origin, identify the secondary air pollutant.

[A] Sulfuric acid

[B] Ash

[C] Smoke

[D] Radioactive compound

5. Human Bone matrix is rich primarily in

- [A] Fluoride and calcium
- [B] Calcium and phosphorus
- [C] Calcium and potassium
- [D] Phosphorus and potassium

6. In taxonomic hierarchy *family* comes between

- [A] Class and Order
- [B] Genus and Species
- [C] Order and Genus
- [D] Division and Class

7. A molecule *cannot* act as a genetic material if

- [A] it is able to replicate
- [B] it is stable chemically and structurally
- [C] it does not pass from one generation to another
- [D] it can express itself in the form of 'Mendelian characters'

8. An example of a Detritivore is

- [A] Millipede
- [B] Beetle
- [C] Rat
- [D] Ant

9. The trigger for activation of toxin of *Bacillus thuringiensis* (eg., Cry) is

- [A] acidic pH of insect larvae stomach
- [B] high temperature
- [C] mechanical action in the insect larvae gut
- [D] alkaline pH of gut

10. The amino acid attaches to the tRNA at its

- [A] 3' - end
- [B] 5' - end
- [C] anticodon site
- [D] DHUloop

11. Select the correct arrangement of the types of ultraviolet radiation according to the intensity of their effect on human skin.

- [A] UV-B > UV-C > UV-A
- [B] UV-A > UV-B > UV-C
- [C] UV-C > UV-B > UV-A
- [D] UV-A > UV-C > UV-B

12. The following organ produces hormones without being a major endocrine gland

- [A] Kidneys
- [B] Thymus
- [C] Pituitary
- [D] Pancreas

13. The % of CO₂ in biomethane (biogas) is

[A] 25-35

[B] 35-45

[C] 30-40

[D] 55-65

14. Caloric values per gram for carbohydrates, proteins and fats are

[A] 40 cal, 80 cal and 100 cal respectively

[B] 5.68 cal, 10 cal and 30 cal respectively

[C] 4.1 cal, 5.65 cal and 9.45 cal respectively

[D] 4.68 cal, 50 cal and 80 cal respectively

15. During prolonged fasting, the energy stores are utilized by the body in the following order

[A] Proteins, lipids, carbohydrates

[B] Carbohydrates, proteins, lipids

[C] Lipids, carbohydrates, proteins

[D] Carbohydrates, lipids, proteins

16. ____ is found in plants but not in animals

[A] Asexual Reproduction

[B] Sexual Reproduction

[C] Metabolism

[D] Autotrophy

17. A cell committed to a particular fate is said to be

- [A] Totipotent
- [B] Determined
- [C] Differentiated
- [D] Pluripotent

18. If an organism is hexaploid with 42 number of chromosome, then what is number of chromosomes in its gamete:

- [A] 42
- [B] 21
- [C] 18
- [D] 7

19. What part of a neuron is sometimes myelinated?

- [A] Soma
- [B] Dendrite
- [C] Axon
- [D] Synapse

20. Which of the following statements is *INCORRECT*?

- [A] C4 plants respond to even higher concentration of CO₂ than C3 plants
- [B] C3 plants respond to even higher concentration of CO₂ than C4 plants
- [C] Yield of C3 plants can be increased by increasing CO₂ concentration
- [D] The current availability of CO₂ levels is limiting to the C3 plants.

21. Synapsis occurs between

- [A] a male and female gamete
- [B] axon and dendrite of two neurons
- [C] spindle fibres and centromere
- [D] two homologous chromosomes

22. Which plant growth regulator helps to overcome the apical dominance

- [A] Auxin
- [B] Gibberellin
- [C] Ethylene
- [D] Cytokinin

23. The dominant [in terms of population size] strains of SARS-CoV2 have been changing since early 2020. This change can be explained by

- [A] change in host immunity
- [B] random variation in viral genome
- [C] fitness of individual strains
- [D] lack of mutations

24. A vaccine developed by Astrazeneca against SARS-CoV2 uses recombinant adenovirus. The word "recombinant" implies that

- [A] the adenovirus capsid is made of combination of viral proteins
- [B] it is a cross between SARS-CoV2 and adenovirus genome
- [C] a foreign gene is present in complete/partial adenovirus genome
- [D] the adenovirus genome is combination of DNA and RNA

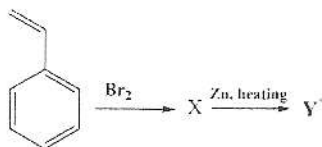
25. Which of the following statement is *INCORRECT* regarding partial pressures of oxygen and carbon dioxide in alveoli, systemic veins and arteries

- [A] The partial pressure of CO₂ is highest in alveoli
- [B] The partial pressure of oxygen is highest in alveoli
- [C] The partial pressure of oxygen in systemic veins is lower than the arteries
- [D] The partial pressure of carbon dioxide is higher in systemic veins than the arteries

CHEMISTRY

26. The number of sigma and pi bonds present in the $\text{CH}_3\text{CH}=\text{C}=\text{CHCH}_3$ are, respectively:
- [A] 12 and 2
 - [B] 9 and 2
 - [C] 12 and 4
 - [D] 9 and 4
27. In the sodium fusion test (Lassaigne's test) for nitrogen in an organic compound, the blue color is obtained due to the formation of:
- [A] $\text{Fe}_3[\text{Fe}(\text{CN})_6]_4 \cdot x\text{H}_2\text{O}$
 - [B] $\text{Na}_4[\text{Fe}(\text{CN})_6]_3 \cdot x\text{H}_2\text{O}$
 - [C] $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3 \cdot x\text{H}_2\text{O}$
 - [D] $\text{Na}_3[\text{Fe}(\text{CN})_6]_4 \cdot x\text{H}_2\text{O}$
28. The number of possible isomers for the alkene of formula C_4H_8 is:
- [A] 2
 - [B] 4
 - [C] 3
 - [D] 5
29. The products obtained by the addition reaction of HBr to hex-1-ene in the presence and in the absence of benzoyl peroxide are, respectively:
- [A] 2-bromohexane and 1-bromohexane
 - [B] 1, 2-dibromohexane and 2-bromohexane
 - [C] 2, 2-dibromohexane and 1-bromohexane
 - [D] 1-bromohexane and 2-bromohexane
30. Among the following, the compound which will undergo nitration most readily is:
- [A] toluene
 - [B] benzene
 - [C] 1,2-dinitrobenzene
 - [D] phenol
31. The most acidic molecule among the following is:
- [A] benzoic acid
 - [B] 4-nitrophenol
 - [C] 2-hydroxybenzoic acid
 - [D] 4-methylphenol

32.



The product Y of the above reaction is:

- [A] phenylacetylene
 - [B] styrene
 - [C] benzaldehyde
 - [D] 2-Phenylethanol
33. Benzene reacts with ethyl chloride in the presence of AlCl₃ gives compound A. The compound A on reaction with alkaline KMnO₄ gives B. Heating B with CaO gives C. The molecular formula of the product C is:
- [A] C₆H₆
 - [B] C₇H₈
 - [C] C₇H₆O
 - [D] C₆H₆O
34. The INCORRECT statement about Buckminster fullerene is:
- [A] It consists 20 six membered and twelve five membered rings.
 - [B] All the carbon atoms are sp² hybridized.
 - [C] It has only single bonds.
 - [D] It is made by heating graphite in an electric arc in the presence of inert gas.
35. The order of stability of the following hydride is:
- [A] NH₃ > PH₃ > AsH₃ > SbH₃
 - [B] AsH₃ > PH₃ > NH₃ > SbH₃
 - [C] PH₃ > NH₃ > AsH₃ > SbH₃
 - [D] SbH₃ > AsH₃ > PH₃ > NH₃
36. The order of ionic radii of the following ions is:
- [A] O²⁻ > F⁻ > Na⁺ > Mg²⁺
 - [B] Mg²⁺ > Na⁺ > F⁻ > O²⁻
 - [C] F⁻ > Na⁺ > O²⁻ > Mg²⁺
 - [D] Na⁺ > O²⁻ > F⁻ > Mg²⁺
37. The geometrical shapes of PCl₅ and BrF₅ are, respectively:
- [A] Square pyramidal and trigonal bipyramidal.
 - [B] Trigonal bipyramidal and square pyramidal.
 - [C] Both are trigonal bipyramidal.
 - [D] Both are square pyramidal.

38. The decreasing order of bond angle around the central atom of the following molecules is:
- [A] $\text{H}_2\text{O} > \text{CO}_2 > \text{H}_2\text{S} > \text{H}_2\text{Se}$
 - [B] $\text{H}_2\text{S} > \text{H}_2\text{O} > \text{CO}_2 > \text{H}_2\text{Se}$
 - [C] $\text{CO}_2 > \text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se}$
 - [D] $\text{CO}_2 > \text{H}_2\text{S} > \text{H}_2\text{O} > \text{H}_2\text{Se}$
39. Among the following anions, the one that does not undergo disproportionation reaction is:
- [A] ClO_4^-
 - [B] ClO^-
 - [C] ClO_2^-
 - [D] ClO_3^-
40. The FALSE statement about hard water is:
- [A] It contains many dissolved salts.
 - [B] It readily gives lather with very little amount of soap.
 - [C] It forms scale on boiling.
 - [D] It is not suitable for laundry.
41. The compound which is NOT a coordination complex among the following is:
- [A] $\text{Ni}(\text{CO})_4$
 - [B] $\text{K}_3[\text{Fe}(\text{CN})_6]$
 - [C] $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$
 - [D] $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_3$
42. Weight of an empty LPG cylinder is 15 kg and that of a full cylinder is 30 kg. The pressure in the full cylinder is 3 atm. If the weight of the cylinder reduces to 20 kg after some use, then the pressure of the cylinder will be:
- [A] 1 atm
 - [B] 9 atm
 - [C] 2 atm
 - [D] 3 atm
43. The maximum work done is obtained in
- [A] irreversible change.
 - [B] reversible change.
 - [C] both reversible and irreversible changes.
 - [D] neither reversible nor irreversible changes.

44. If the heat of formation (in kcal/mol) of CO_2 , H_2O and $\text{C}_2\text{H}_5\text{OH}$ are -90, -70 and 60, respectively then the heat of combustion (in kcal/mol) of $\text{C}_2\text{H}_5\text{OH}$ is:
- [A] 330
[B] -330
[C] 450
[D] -450
45. If the equilibrium constant (K_p) for the reaction $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$ is 2 atm., then the pressure (in atm) required to obtain 50 % dissociation of PCl_5 is:
- [A] 4
[B] 3.5
[C] 6
[D] 2.5
46. If pH of a solution containing 0.001 M acetic acid and 0.1 M sodium acetate is 5, then the pK_a of the acid is:
- [A] 3
[B] 7
[C] 8
[D] 2
47. The structure that has maximum packing efficiency is:
- [A] BCC
[B] HCP
[C] SC
[D] Both BCC and SC
48. If the osmotic pressure of a 1L solution in which 300 g of sugar is dissolved at 0°C is 20 atm, then the calculated molar mass of the sugar is close to:
- [A] 450
[B] 336
[C] 342
[D] 192
49. The molar conductance at infinite dilution (in $\text{S cm}^2\text{mol}^{-1}$) of KCl , NaCl and K_2SO_4 are 150, 130 and 160, respectively. The molar conductance at infinite dilution of Na_2SO_4 is:
- [A] 240
[B] 340
[C] 140
[D] 120

50. The unit of rate constant of a second order reaction is:

- [A] $\text{mol L}^{-1} \text{s}^{-1}$
- [B] $\text{mol}^{-1} \text{L s}^{-1}$
- [C] $\text{mol}^{-1} \text{L}^{-1} \text{s}^{-1}$
- [D] s^{-1}

MATHEMATICS

51. If $Y \subseteq X'$, where X' is the complement of X , then which of the following sets is equal to X'
- [A] $(X \cap Y) \cup Y$
 [B] $(X \cap Y) \cup X'$
 [C] $(X \cup Y) \cap X'$
 [D] $(X \cup Y) \cap Y$
52. Let \mathbb{Z} be the set of integers. For $x, y \in \mathbb{Z}$, define $(x, y) \in R$ if and only if $|x - y| < 1$. Then
- [A] R is not symmetric
 [B] R is not reflexive
 [C] R is not an equivalence relation
 [D] $R = \{(x, x) : x \in \mathbb{Z}\}$
53. The number of real solutions of the equation $\sum_{k=1}^{2021} k^3 |x^2 + (k-1)x - 3k - 6| = 0$ is
- [A] 0
 [B] 1
 [C] 2
 [D] infinite
54. Let g be a function satisfying $3g(x) + 2g(1/x) = x^2$, for any $x \neq 0$, then the value of $g(2)$ is
- [A] $\frac{23}{10}$
 [B] $\frac{-4}{5}$
 [C] $\frac{-5}{4}$
 [D] $\frac{10}{23}$
55. Let $z = a(\cos \frac{\pi}{4} + i \sin \frac{\pi}{4})$, $a \in \mathbb{R}$, $|a| < 1$ then $S = z^{2020} + z^{2021} + z^{2022} + \dots$ equals to
- [A] $\frac{z^{2020}}{1-z}$
 [B] $\frac{a^{2020}}{1-z}$
 [C] $\frac{z^{2020}}{z-1}$
 [D] $\frac{a^{2020}}{z-1}$

56. If A and B are two matrices such that $AB = B$ and $BA = A$ then $A^{2021} + B^{2021}$ is

- [A] AB
- [B] BA
- [C] $A + B$
- [D] $A^2 + B^2$

57. The sum of the rational terms in the expansion of $(2^{\frac{1}{3}} + 3^{\frac{1}{2}})^6$ is equal to

- [A] 13
- [B] 31
- [C] 23
- [D] 32

58. Let $n(A) = 5$ and $n(B) = 8$. Then the number of one-one functions from A to B is

- [A] 7620
- [B] 6702
- [C] 6720
- [D] 7260

59. The number of distinct real roots of the equation $(x + 2)^4 + (x + 4)^4 = 16$ is

- [A] 4
- [B] 3
- [C] 1
- [D] 2

60. The length of a tangent drawn from the point $(-3, -4)$ to the circle $x^2 + y^2 - 2x + 4y - 4 = 0$ is

- [A] $\sqrt{12}$
- [B] $\sqrt{11}$
- [C] $\sqrt{13}$
- [D] $\sqrt{14}$

61. If the system of equations $x - y + z = 2$, $x + 2y - 3z = 3$ and $2x - y + \lambda z = 1$ has a unique solution then

[A] $\lambda = \frac{2}{3}$

[B] $\lambda \neq \frac{2}{3}$

[C] $\lambda \neq \frac{3}{2}$

[D] $\lambda = \frac{3}{2}$

62. The number of solutions of the equation $\sin^4 2x + \cos^4 2x + 3 \cos^2 x \sin^2 x = 0$ is

[A] 0

[B] 1

[C] 2

[D] 4

63. The value of $\lim_{x \rightarrow 0} \frac{x^2 \sin(\frac{1}{x})}{\sin x}$ is

[A] 1

[B] 0

[C] $\frac{1}{2}$

[D] 2

64. If $f(a) = 3$, $f'(a) = -1$, $g(a) = 1$ and $g'(a) = 4$ then $\lim_{x \rightarrow a} \frac{g(x)f(a) - f(x)g(a)}{x - a}$ is

[A] 12

[B] 13

[C] 14

[D] 15

65. If $g(1) = 1$, $g'(1) = 4$ then the derivative of $y = g(g(g(g(x))))$ at $x = 1$ is

[A] 256

[B] 8

[C] 4

[D] 16

66. The value of $f(0)$ so that the function $f(x) = \frac{1 - \cos(1 - \cos x)}{x^4}$ is continuous at $x = 0$ is
- [A] 2
 - [B] $\frac{1}{8}$
 - [C] $\frac{1}{2}$
 - [D] $\frac{1}{4}$
67. If A and B are coefficients of x^n in the expansions of $(1+x)^{2n}$ and $(1+x)^{2n-1}$ respectively, then B/A is equal to
- [A] $\frac{1}{2}$
 - [B] 2
 - [C] $2n$
 - [D] $\frac{1}{2n}$
68. If the lines $x + 2ay + a = 0$, $x + 3by + b = 0$ and $x + 4cy + c = 0$ are concurrent then a, b, c are in
- [A] Arithmetic progression
 - [B] Geometric progression
 - [C] Harmonic progression
 - [D] none of the above
69. If $h(x) = \int_0^x \cos^4 t dt$ then $h(x + \pi)$ is equal to
- [A] $h(x) + h(\pi)$
 - [B] $h(x)h(\pi)$
 - [C] $h(x) - h(\pi)$
 - [D] $\frac{h(x)}{h(\pi)}$
70. The number of continuous functions $f: \mathbb{R} \rightarrow \mathbb{R}$ which satisfy $(f(x))^2 = x^2$, for all $x \in \mathbb{R}$ is
- [A] 1
 - [B] 2
 - [C] 4
 - [D] 8

71. A letter is taken at random from the letters of the word 'MATHEMATICS' and another letter is taken at random from the letters of the word 'STATISTICS'. The probability that they are the same letter is

[A] $\frac{7}{55}$

[B] $\frac{4}{55}$

[C] $\frac{9}{55}$

[D] $\frac{1}{22}$

72. If \vec{a}, \vec{b} are two unit vectors such that $\vec{a} + 2\vec{b}$ and $5\vec{a} - 4\vec{b}$ are perpendicular to each other then the angle between \vec{a} and \vec{b} is

[A] 45°

[B] 60°

[C] 30°

[D] 75°

73. If $\frac{2 \sin A}{1 + \cos A + \sin A} = x$ then $\frac{1 - \cos A + \sin A}{1 + \sin A}$ is equal to

[A] x

[B] $\frac{1}{x}$

[C] $1 - x$

[D] $1 + x$

74. The value of λ , so that the lines $\frac{x-1}{2} = \frac{y+2}{-3} = \frac{z+\lambda}{1}$ and $\frac{x+1}{1} = \frac{y-1}{3} = \frac{z-2}{2}$ are coplanar, is

[A] -3

[B] 3

[C] 2

[D] -2

75. The number of circular permutations of 5 dissimilar things (taken all at a time) is

[A] $4!$

[B] $5!$

[C] $6!$

[D] 25

PHYSICS

76. Two balls of masses m_1 and m_2 have the same kinetic energy. If $m_1 > m_2$, which of the following is true about their momenta p_1 and p_2

[A] $p_1 = p_2$

[B] $|p_1| < |p_2|$

[C] $|p_1| > |p_2|$

[D] $p_1 = -p_2$

77. A particle moves with velocity $\vec{v} = K(y\hat{i} + x\hat{j})$, where K is a constant. The general equation for its path is (c =constant)

[A] $y = x^2 + c$

[B] $y^2 = x^2 + c$

[C] $y^2 = x + c$

[D] $xy = c$

78. The ratio of the weight of a body on the earth's surface to the weight of the body on a planet's surface is 9:4. If the mass of the planet is $1/9$ that of the earth, and if R is the radius of the earth, the radius of the planet is

[A] $R/9$

[B] $R/2$

[C] $R/3$

[D] $R/4$

79. The density of a material in SI units is 128 kg m^{-3} . In certain units in which the unit of length is 25 cm and the unit of mass is 50 g, the numerical value of the density of the material is

[A] 40

[B] 640

[C] 16

[D] 410

80. If speed (V), acceleration (A) and force (F) are considered to be fundamental units, then the dimension of Young's Modulus will be

[A] $V^{-2}A^2F^2$

[B] $V^{-4}A^{-2}F$

[C] $V^{-4}A^2F$

[D] $V^{-2}A^2F^{-2}$

81. A simple harmonic motion is represented by $y = 5[\sin(3\pi t) + \sqrt{3}\cos(3\pi t)]$. The amplitude and time period of its motion are respectively

[A] 10 cm, $2/3$ s

[B] 5 cm, $2/3$ s

[C] 5 cm, $3/2$ s

[D] 10 cm, $3/2$ s

82. Consider an object performing simple harmonic oscillations. If v_1 and v_2 are the velocity of the object measured at distances of x_1 and x_2 respectively from the equilibrium position, the angular frequency of the oscillation is

[A] $\frac{v_2^2 - v_1^2}{x_1^2 - x_2^2}$

[B] $\frac{v_1^2 - v_2^2}{x_2^2 - x_1^2}$

[C] $\sqrt{\frac{v_2^2 - v_1^2}{x_1^2 - x_2^2}}$

[D] $\sqrt{\frac{v_1^2 - v_2^2}{x_2^2 - x_1^2}}$

83. In a homogeneous medium of density ρ a stable longitudinal standing wave given by $z = y \cos(kx) \cos(\omega t)$ is created. The potential energy density variation due to this standing wave in the medium is

[A] $\frac{1}{2} y^2 k^2 \sin^2(kx) \cos^2(\omega t)$

[B] $\frac{1}{2} \rho y^2 \cos^2(kx) \cos^2(\omega t)$

[C] $\frac{1}{2} k y^2 \omega^2 \cos^2(kx) \cos^2(\omega t)$

[D] $\frac{1}{2} \rho y^2 \omega^2 \sin^2(kx) \cos^2(\omega t)$

84. The ratio of two consecutive harmonics in two pipes A and B are respectively 1.20 and 1.40. The number of open ends in pipe A and pipe B are respectively

[A] 2, 1

[B] 1, 2

[C] 2, 2

[D] 1, 1

85. A ball of mass 0.1 Kg and heat capacity $400 \text{ J Kg}^{-1} \text{ K}^{-1}$ is heated to a temperature of 500°C and dropped into a vessel of heat capacity 800 J K^{-1} containing 0.5 Kg water of heat capacity 4200 J Kg^{-1} . If the initial temperature of the water and the vessel is 30°C , the final temperature of the water is

[A] 35.5°C

[B] 36.4°C

[C] 40.0°C

[D] 25.1°C

86. One mole of an ideal gas passes through a process where the pressure and volume obey the relation $P = P_0 \left[1 - \frac{1}{2} \frac{V_0^2}{V^2} \right]$, where P_0 and V_0 are constants. The change in temperature when the volume changes from V_0 to $2V_0$ is

[A] $\frac{3 P_0 V_0}{4 R}$

[B] $\frac{5 P_0 V_0}{4 R}$

[C] $\frac{1 P_0 V_0}{2 R}$

[D] $\frac{1 P_0 V_0}{4 R}$

87. A thin wire ring of radius r has an electric charge q . If a point charge q_0 is placed at the center of the ring, the increment of the force stretching the wire will be

[A] $\frac{q q_0}{8 \pi^2 \epsilon_0 r^2}$

[B] $\frac{q q_0}{4 \pi \epsilon_0 r}$

[C] $\frac{q q_0}{8 \pi \epsilon_0 r}$

[D] $\frac{q q_0}{4 \pi^2 \epsilon_0 r^2}$

88. Two infinitely large plane parallel sheets are kept in the XY plane, separated by a distance d . If the lower and upper sheets have uniform surface charge density of $+\sigma$ and $-\sigma$ respectively the electric field between the two sheets, above the upper sheet and below the lower sheets respectively are

[A] $-\left(\frac{\sigma}{2\epsilon_0}\right)\hat{j}, 0, 0$

[B] $+\left(\frac{\sigma}{\epsilon_0}\right)\hat{j}, 0, 0$

[C] $0, +\left(\frac{\sigma}{\epsilon_0}\right)\hat{j}, -\left(\frac{\sigma}{\epsilon_0}\right)\hat{j}$

[D] $0, -\left(\frac{\sigma}{\epsilon_0}\right)\hat{j}, +\left(\frac{\sigma}{\epsilon_0}\right)\hat{j}$

89. *Task:* You have to suspend freely a straight, horizontal copper wire in a magnetic field.
Given: Linear density of the copper wire is 46 g/m and current through the wire is 28 A.
 The minimum magnetic field needed to achieve the task is

[A] 16 T

[B] 1.6 mT

[C] 16 mT

[D] 0.16 mT

90. A Tesla coil, used as high-voltage generator, consists of a long solenoid of length l and cross-sectional area A , closely wound with N_1 turns of wire. At its center another coil with N_2 turns surround it. If now the amount of wire used in the solenoid is doubled, the mutual inductance of the Tesla coil

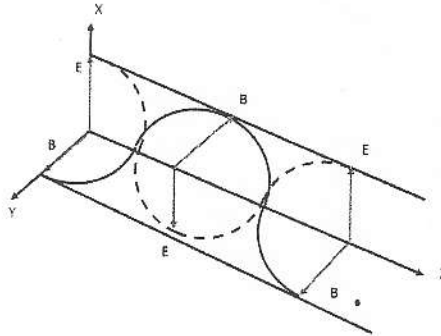
[A] is halved.

[B] is doubled.

[C] remains the same.

[D] becomes 4 times.

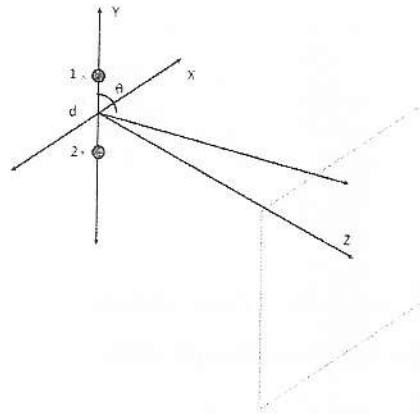
91. One wavelength of an electromagnetic wave at time $t = 0$ sec is shown in the figure below. For what values of Z between $Z = 0$ and $Z = \lambda$ is the energy density of the wave is (i) a maximum and (ii) a minimum



- [A] (i) $\lambda/4, 3\lambda/4$ (ii) $0, \lambda$
 [B] (i) $\lambda/4, 3\lambda/4$ (ii) $0, \lambda/2, \lambda$
 [C] (i) $0, \lambda$ (ii) $\lambda/2$
 [D] (i) $0, \lambda/2, \lambda$ (ii) $\lambda/4, 3\lambda/4$
92. A 40 cm diameter hole was made on the flat floor of a joy ride boat and is fixed with a transparent glass window to enable passengers to observe marine life below. Assuming the diameter of the hole is larger than the thickness of the glass window and the depth of the sea floor is 5 m, the area of the field-of-view up to which one can observe the sea floor is approximately [refractive index of water = 1.33, refractive index of glass = 1.50]

- [A] 102 cm^2
 [B] 13 cm^2
 [C] 13 m^2
 [D] 102 m^2

93. Consider two coherent point sources 1 and 2 kept in the YZ plane as shown in the figure. If the sources are separated by a distance d and the wavelength of the emitted radiation is λ , the angle θ at which the radiation intensity is a maximum at a distant plane, if one considers that the oscillations from the source 2 lags in phase by ϕ with respect to the source 1 oscillations, is $[k = 0, \pm 1, \pm 2, \dots]$



- [A] $\cos^{-1} \left[\left(k - \frac{\phi}{2\pi} \right) \frac{\lambda}{d} \right]$
 [B] $\cos^{-1} \left[k \frac{\lambda}{d} \right]$
 [C] $\cos \left(\frac{2\pi\phi\lambda}{d} \right)$
 [D] $\cos \left[\left(k - \frac{\phi}{\lambda} \right) d \right]$
94. The electron in a Hydrogen atom jumps from the third excited state to the second excited state and subsequently to the first excited state. The wavelengths of the photons emitted are λ_1 and λ_2 respectively. The ratio λ_1/λ_2 is
- [A] $22/5$
 [B] $7/5$
 [C] $9/7$
 [D] $20/7$

95. In photoelectric effect experiment, the threshold wavelength of light is 380 nm. If the wavelength of incident light is 260 nm, the maximum kinetic energy of the emitted electrons will be (given $E = \frac{1237}{\lambda (nm)}$)

- [A] 3.0 eV
- [B] 1.5 eV
- [C] 4.5 eV
- [D] 15.1 eV

96. Two radioactive materials A and B have decay constants 10λ and λ respectively. If they have the same number of initial nuclei, then the ratio of the number of A to the number of B after a time will be

- [A] $1/10\lambda$
- [B] $11/10\lambda$
- [C] $1/9\lambda$
- [D] $1/11\lambda$

97. An electron, proton and an alpha particle having the same kinetic energy are placed in a magnetic field \vec{B} and revolve with orbital radii R_e, R_p and R_α respectively. The ratio of the orbital radii is

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

98. Consider an unknown non-relativistic particle that moves at a speed three times more than that of the electron. If the ratio of de Broglie wavelength of the particle to the electron is 1.8×10^{-4} , the mass of the unknown particle is

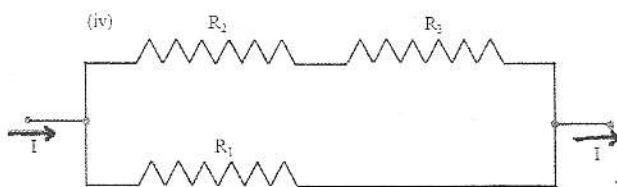
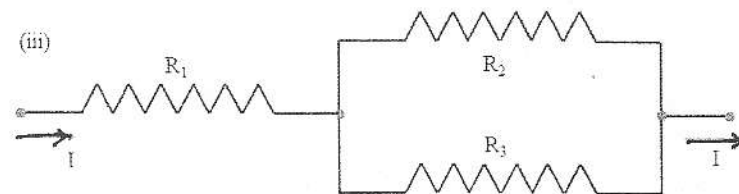
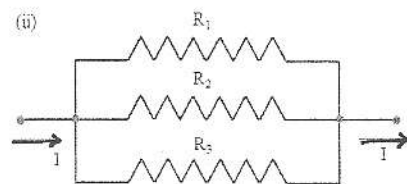
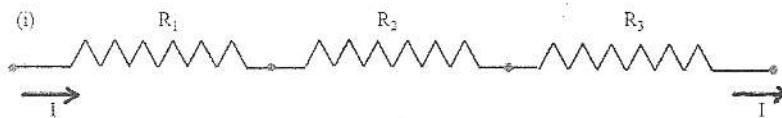
[A] 1.68×10^{-27} Kg

[B] 5.06×10^{-27} Kg

[C] 15.07×10^{-27} Kg

[D] 1.68×10^{-35} Kg

99. If three resistors R_1 , R_2 and R_3 of same resistance are connected as shown in the figure (i) – (iv) below, their equivalent resistance, from lowest to highest, is in the order



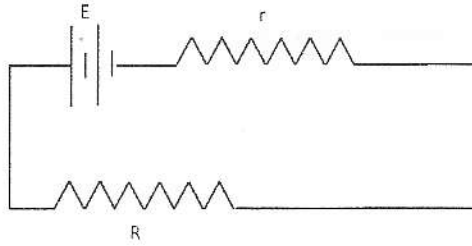
[A] (ii), (iv), (iii), (i)

[B] (i), (iii), (iv), (ii)

[C] (ii), (iii), (iv), (i)

[D] (i) (iv), (iii), (ii)

100. Consider a battery of constant emf E and internal resistance r connected to a load resistor R as shown in the figure:



If a load of 4.8Ω and 9.8Ω respectively draws a current of 2 A and 1 A , the maximum current obtainable from the battery is

- [A] 0.5 A
- [B] 5 A
- [C] 50 A
- [D] 50 mA

University of Hyderabad
Entrance Examinations - 2021

School/Department/Centre : CIS / IMSc
Course/Subject : Systems Biology / Chemistry / Mathematics / Physics
Booklet Code : A

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

Note/Remarks:

1. For Question No. 8, options A & B are correct; Q# 9: Option D is correct; Q# 11: Option A is correct.
2. For Question No. 49, the correction option is D – earlier wrong option was given
3. For Question No. 55, the options A & D are correct.
4. For Question No. 56, the options C & D are correct.
5. For Question No. 82, the options C & D are correct.

P. V. Sharma

Signature of the Head/Dean
School/Department/Centre