

Booklet Code : D

ENTRANCE EXAMINATION - 2018
M.Sc. (5-Year Integrated) Sciences
(Mathematical Sciences, Physics, Chemical Sciences, and Systems Biology)

Time: 2 hours

Maximum Marks: 100

Hall Ticket Number :

INSTRUCTIONS

Please read the following instructions carefully :

1. (a) Write your **Hall Ticket Number** in the **above box** AND on the **OMR sheet**.
(b) Fill in the OMR Sheet, the **Booklet Code** given above at the top right 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. Each question has only one correct option.**
5. The appropriate answer(s) should be coloured with either a blue or a black ball point or a sketch pen. **DONOT USE PENCIL.**
6. **Hand over 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 pages for the rough work. Please check that your paper has all the pages.

BIOLOGY

1. What is the important function of rough endoplasmic reticulum (RER)?

- A. Stores DNA.
- B. Respiration
- C. Protein synthesis
- D. Digests carbohydrates

2. Breakdown of glucose to pyruvate in a cell is called _____

- A. Gluconeogenesis
- B. Glycolysis
- C. Cytokinesis
- D. Pinocytosis.

3. Cells of adipose tissue are specialised to store _____

- A. Fats
- B. Carbohydrates
- C. Pigments
- D. Minerals

4. What is isogammatous type of reproduction?

- A. Fusion of two gametes similar in size
- B. Fusion of two gametes dissimilar in size
- C. Fragmentation of gametes and developing into a new thallus
- D. Fragmentation of thallus

5. Malpighian tubules of cockroach help in _____

- A. Locomotion
- B. Digestion
- C. Reproduction
- D. Removal of excretory products from haemolymph

6. Polypeptides are made up of _____

- A. nuceotides
- B. Pigments
- C. Amino acids
- D. Fatty acids

7. What is the difference between nucleoside and nucleotide?
- A. Nucleoside with an additional nitrogenous base is nucleotide
 - B. Nucleoside with an additional sugar moiety is a nucleotide
 - C. Nucleoside with a phosphate group is nucleotide
 - D. Nucleoside with an amino acid is nucleotide
8. Most of the enzymes are made of _____
- A. Polyphenols
 - B. Sugars
 - C. Lipids
 - D. Amino acids
9. What is the status of chromosomes in a cell during 'Anaphase' stage of mitosis?
- A. Chromosomes move towards equator
 - B. Chromosomes lose their identity as discrete elements
 - C. Chromosomes of daughter cells move away from the equatorial plate towards poles
 - D. Spindle fibres start to attach to kinetochores of the chromosomes
10. In C3 plants, carbon-di-oxide is fixed into 3-phosphoglycerate using the substrate _____
- A. Deoxy-ribose-triphosphate
 - B. Ribose -5-phosphate
 - C. Pyruvate
 - D. Ribulose-1,5-bisphosphate
11. Auxin is one of the _____
- A. Plant Growth regulators
 - B. Plant proteins
 - C. Plant Enzymes
 - D. Pigments
12. Identify the **CORRECT** statement from the following
- A. RNA has a six-carbon sugar, DNA has a five-carbon sugar
 - B. Both RNA and DNA contain 5 carbon sugars, however, DNA's sugar moiety lacks hydroxyl group on its 2' carbon
 - C. RNA contains an additional phosphate group compared to DNA
 - D. DNA's sugars attached to nitrogenous base whereas RNA's sugars are not attached to nitrogenous base

13. Eustachian tube connects _____

- A. External ear to the ear drum
- B. Lacrimal glands to the nasal cavities
- C. Cornea of eyes with the iris
- D. Cavity of the middle ear with the pharynx.

14. AIDS stands for

- A. Acquired Immuno Deficiency Syndrome
- B. Acquired Iliac Duplicated Syndrome
- C. Aided Immuno Diagnostic Syndrome
- D. Aided Iliac Deprived Syndrome

15. Morphine is predominantly biosynthesised by which of the following plants _____

- A. *Hibiscus rosasinensis*
- B. *Papaver somniferum*
- C. *Datura stramonium*
- D. *Withania somnifera*

16. What is Eutrophication of a lake?

- A. Refers to the natural aging of a lake
- B. Direct measure of number fishes present in that lake
- C. It is a direct measure of industrial waste
- D. Refers to the amount of insecticides sprayed to control mosquitos

17. CPCB stands for

- A. Coffee Plantation Curing Board
- B. Central Pollution Control Board
- C. Central Plantation Control Board
- D. Cotton Plantation Curing Board

18. What are pathogens?

- A. Disease causing microorganisms
- B. Disease causing nano pollutants
- C. Perishing carnivores
- D. Perpetuating omnivores

Booklet Code : D

19. Identify the **CORRECT** statement of the following
- A. Prokaryotes are microorganisms which include bacteria, fungi and archea
 - B. Prokaryotes are microorganisms which do not have organelles
 - C. All microorganisms are unicellular and do not show division of labour
 - D. All microorganisms are symbiotic and require host for their survival
20. Identify the **WRONG** statement regarding 'Sickle-cell anaemia'
- A. It is an autosome linked recessive trait
 - B. It is transmitted from parents to the offspring when both the parents are heterozygous
 - C. It is controlled by a single pair of allele, Hb^A and Hb^S
 - D. Heterozygous individuals are affected by the disease
21. What proportion of the progeny from the cross $AaBb \times aabb$ will be $Aabb$?
(assume that A and B genes are independently assorting)
- A. 12.5%
 - B. 25%
 - C. 37.5%
 - D. 50%
22. Identify the **mismatch**
- A. *E. coli* – fecal contamination
 - B. *Clostridium* – Tetanus
 - C. *Rhizobium* – Root nodule
 - D. *Lactobacillus* – Food poisoning
23. An advantage of sexual reproduction over asexual reproduction is that sexual reproduction:
- A. produces identical offspring.
 - B. allows for less crossing over.
 - C. requires only one nuclear division.
 - D. provides genetic variation in the offspring.
24. Gram staining is used for
- A. staining fungi
 - B. staining algae and fungi
 - C. differentiating bacteria as Gram +ve and Gram -ve
 - D. differentiating bacteria with and without cell wall

25. Which of the following Genera known to produce the largest flower in the plant kingdom _____

- A. *Rafflesia*
- B. *Musa*
- C. *Ficus*
- D. *Potamogeton*

CHEMISTRY

26. The paramagnetism in sulphur at 600 °C is due to the fact that
- A. in vapour state sulphur exists as S_2 molecule which has two unpaired electrons in the antibonding π^* orbital.
 - B. in vapour state sulphur exist as S_2 molecule which has two unpaired electrons in the bonding π orbital.
 - C. in vapour state sulphur exist as S_8 molecule which has two unpaired electrons in the antibonding π^* orbital.
 - D. in vapour state sulphur react with O_2 , which is a paramagnetic molecule.
27. The order of a chemical reaction is defined as
- A. the sum of the powers of the concentration of the reactants in the rate law expression.
 - B. the sum of the powers of the concentration of the products in the rate law expression.
 - C. the number of reacting species (ions or molecules) taking part in an elementary reaction.
 - D. the time in which the concentration of a reactant is reduced to one half of its initial concentration.
28. To a 1000 mL of 0.01 M solution of KCl, another 0.74 g of solid KCl is added (Atomic weight of K = 39, Cl = 35.45). Then the molar conductivity of this solution will
- A. not change.
 - B. be zero.
 - C. increase exponentially.
 - D. decrease.
29. Amount of NaOH required to prepare 500 mL of 0.2 M solution in water is (Atomic weight of Na = 23, S = 16, H = 1)
- A. 0.08 g
 - B. 4.00 g
 - C. 8.00 g
 - D. 40.0 g
30. Colligative property of a solution depends on
- A. the number (concentration) and nature of particles.
 - B. the number (concentration) of solute particles but does not depend on their nature.
 - C. the mass and nature of solute particles.
 - D. the mass of solute particles but does not depend on their nature

31. The rate constants of a reaction at 227 °C and 427 °C are 0.020 s^{-1} and 0.074 s^{-1} (Gas constant, $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$). The activation energy of the reaction is approximately equal to
- A. 0.062 J
B. 3.700 J
C. 5313 J
D. 19150 J
32. E_{cell} of the cell; $\text{Mg}|\text{Mg}^{2+}(0.1 \text{ M})||\text{Ag}^{+}(0.0001 \text{ M})|\text{Ag}$ is close to
[Given: $E_{\text{Mg}^{2+}/\text{Mg}}^{\circ} = -2.36 \text{ V}$ and $E_{\text{Ag}^{+}/\text{Ag}}^{\circ} = +0.80 \text{ V}$]
- A. + 3.16 V
B. + 3.07 V
C. + 2.95 V
D. - 1.56 V
33. The partial pressure of a gas in the vapour phase (in equilibrium with a solution of that gas) is proportional to the mole fraction of the gas in the solution. This statement is known as
- A. Dalton's law.
B. Raoult law.
C. Henry's law.
D. Kohlrausch law.
34. When the intrinsic semiconductor germanium (Ge) is doped with phosphorus
- A. there will be an increase in the conductivity and it will be an n-type semiconductor.
 - B. there will be a decrease in the conductivity and it will be a p-type semiconductor.
 - C. there will be no change in the conductivity.
 - D. the conductivity will increase first and then decrease after a few hours.
35. An element has a body-centered cubic (bcc) structure with a cell edge of 300 pm. The density of the element is 7 g/cm^3 . The number of atoms present in 189 g of the element is
- A. 2×10^{24}
B. 1×10^{24}
C. 6.023×10^{23}
D. 1.138×10^{26}

36. Copper ($Z = 29$) is denser than Titanium ($Z = 22$) because when moving from the left to right in the first row of 'd' block elements in the periodic table
- there is a decrease in metallic radius and decrease in atomic mass.
 - there is a decrease in metallic radius and increase in atomic mass.
 - there is an increase in metallic radius and decrease in atomic mass.
 - there is an increase in metallic radius and increase in atomic mass.

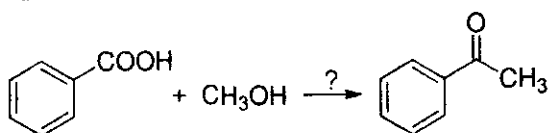
37. The H-P-H bond angle in PH_3 is lesser than that in PH_4^+ because of the presence of

- sp^2 hybridization in P of PH_3
- sp^2 hybridization in P of PH_4^+
- lone pair - bond pair repulsion in PH_3
- lone pair - bond pair repulsion in PH_4^+

38. The intense color (purple) of potassium permanganate is due to

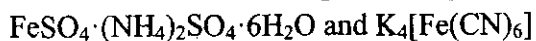
- Metal to ligand charge transfer
- Ligand to metal charge transfer
- $\pi-\pi^*$ transition
- d-d transition

39. Identify the most appropriate catalyst for the following reaction.



- H_2SO_4
- MeNH_2
- CH_3COCH_3
- CH_3CONH_2

40. Choose the correct statement about the following two inorganic compounds.



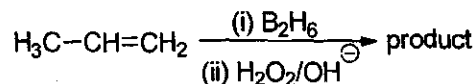
- both are double salts.
- both are coordination compounds.
- $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ is a coordination compound while $\text{K}_4[\text{Fe}(\text{CN})_6]$ is a double salt.
- $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ is a double salt while $\text{K}_4[\text{Fe}(\text{CN})_6]$ is a coordination compound.

41. The spin-only magnetic moment of Fe^{2+} (d^6 , high-spin system) is
- A. 4.47 BM
 - B. 4.90 BM
 - C. 6.48 BM
 - D. 6.93 BM
42. One of the products from the complete hydrolysis of DNA is
- A. RNA.
 - B. Protein.
 - C. Pentose sugar.
 - D. ATP.
43. Soap contains
- A. sodium salt of polyphenols.
 - B. ester of fatty acids.
 - C. calcium salt of fatty acids.
 - D. sodium salt of fatty acids.
44. The reason for higher pK_b value of aniline compared to that of methylamine is
- A. the unshared electron pair in nitrogen atom in aniline is in conjugation with the benzene ring and therefore it is less available for protonation.
 - B. the unshared electron pair in nitrogen atom in aniline is **not** in conjugation with the benzene ring and therefore it is less available for protonation.
 - C. the high electronegativity of $-\text{NH}_2$ group.
 - D. the steric effect in aniline.
45. Cannizzaro reaction involves
- A. the reaction between aldehyde and acid.
 - B. the reduction of ketones using NH_2NH_2 .
 - C. the reaction between an aldehyde that does not have an α - hydrogen atom and NaOH .
 - D. the reaction between an aldehyde that has an α - hydrogen atom and NaOH .

46. Aspirin can be prepared by

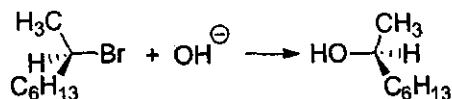
- A. Reimer-Tiemann reaction on phenol.
- B. Friedel-Crafts acylation on benzoic acid.
- C. Esterification of phenol using salicylic acid.
- D. Acylation of salicylic acid using acetic anhydride in the presence of phosphoric acid.

47. The product of the following reaction is



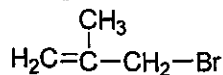
- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- B. $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
- C. $\text{CH}_3\text{CH}_2\text{CH}_3$
- D. $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$

48. The correct statement about the following substitution reaction is



- A. It is an $\text{S}_{\text{N}}2$ reaction yielding products as a racemic mixture.
- B. It is an $\text{S}_{\text{N}}1$ reaction yielding products as a racemic mixture.
- C. It is an $\text{S}_{\text{N}}2$ reaction yielding a product with inversion of configuration.
- D. It is an $\text{S}_{\text{N}}1$ reaction yielding a product with inversion of configuration.

49. The IUPAC name of the following compound is



- A. 1-bromobut-2-ene
- B. 3-bromo-2-methylbut-1-ene
- C. 1-bromo-3-methylprop-2-ene
- D. 3-bromo-2-methylprop-1-ene

50. In the electrolytic refining of copper, the reaction observed at anode is

- A. $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
- B. $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
- C. $\text{Cu}_2\text{O} + \text{C} \rightarrow 2\text{Cu} + \text{CO}$
- D. The evolution of hydrogen gas

MATHEMATICS

51. $\int_{-2}^1 \frac{|x|}{x} dx$ equals

- A. -3
- B. +3
- C. -1
- D. +1

52. $\int \frac{\sin^4 x}{\cos^6 x} dx$ equals

- A. $\left(\frac{\tan^7 x}{7} + C\right)$
- B. $\left(\frac{\sec^7 x}{7} + C\right)$
- C. $\left(\frac{\tan^5 x}{5} + C\right)$
- D. $\left(\frac{\tan(5x)}{5} + C\right)$

53. If $y = x^x \forall x > 0$ then $\frac{d^2y}{dx^2}$ is

- A. $x^x(1 + \log x)^2 + x^{x-1}$
- B. $x^{x-2}(1 + \log x)$
- C. $x(x-1)x^{x-2}$
- D. $x^{x-2}(1 + \log x)^2$

54. If $2x^2 - 4y^2 + 5xy + 3x - 2y + 8 = 0$ then $\frac{dy}{dx} =$

- A. $\left(\frac{4x+5y+3}{8y-5x+2}\right)$
- B. $\left(\frac{4x+5y+3}{5x-8y-2}\right)$
- C. $\left(\frac{4x+5y+3}{5x+8y+2}\right)$
- D. $\left(\frac{4x+5y+3}{-5x+8y-2}\right)$

55. $\lim_{x \rightarrow \infty} \frac{2x^2 - x + \sin x - \cos^2 x}{4x^2 + 2x + \sin^3 x}$ is

- A. 1/2
- B. -1/2
- C. 1
- D. 0

56. If $f(x) = \begin{pmatrix} \cos(x) & -\sin(x) & 0 \\ \sin(x) & \cos(x) & 0 \\ 0 & 0 & 1 \end{pmatrix} \forall x \in \mathbb{R}$ then $\forall x, y \in \mathbb{R}$, $f(x)f(y) =$

- A. zero matrix
- B. $f(x+y)/2$
- C. $f(x+y)$
- D. $2f(x+y)$

57. If $\sin(x) = \sin(y)$ and $\cos(x) = \cos(y)$ then

- A. $x = y$
- B. $x = y + \frac{n\pi}{2}$ for some integer n
- C. $x = y + n\pi$ for some integer n
- D. $x = y + 2n\pi$ for some integer n

58. Range of $(\sin(x) + \cos(x))$ is

- A. $[-1, 1]$
- B. $[-2, 2]$
- C. $[-(\sqrt{3})/2, (\sqrt{3})/2]$
- D. $[-\sqrt{2}, \sqrt{2}]$

59. If ${}^{2n}C_3 = 12({}^nC_2)$ then n is

- A. 2
- B. 3
- C. 4
- D. 5

60. The number of ways a pack of 52 cards be divided equally among 4 players in order is

- A. $\frac{(52)!}{13! 26! 39!}$
- B. $(52!) - (13!)^4$
- C. $\frac{(52)!}{(13!)^4 4}$
- D. $\frac{(52)!}{(13!)^4}$

61. Let $A = \{1,2,3,4\}$. The number of nonbijective maps from A to A is

- A. 222
- B. 232
- C. 242
- D. 256

62. If the area of the triangle in the complex plane formed by z , iz and $(z + iz)$ is 18 then $|z|$ is

- A. 4
- B. 3
- C. 6
- D. 9

63. The smallest positive integer n for which $(1 + i)^{2n} = (1 - i)^{2n}$ is

- A. 2
- B. 3
- C. 4
- D. 8

64. $f: \mathbb{R} \rightarrow \mathbb{R}$ and $g: \mathbb{R} \rightarrow \mathbb{R}$ are given by $f(x) = 2x - 3 \forall x \in \mathbb{R}$ and $g(x) = 3x + 2 \forall x \in \mathbb{R}$ then $f^{-1}(g^{-1}(5))$ is

- A. 1
- B. 2
- C. 3
- D. 4

Booklet Code : D

65. Let $M_3(\mathbb{R})$ be the set of all (3×3) real matrices. The negation of the statement "For every $A \in M_3(\mathbb{R})$, if $\text{rank}(A) = 1$, then $\det(A) = 0$ " is

- A. For every $A \in M_3(\mathbb{R})$ if $\det(A) = 0$, then $\text{rank}(A) = 1$
- B. There exists $A \in M_3(\mathbb{R})$ with $\det(A) \neq 0$ and $\text{rank}(A) \neq 1$
- C. There exists $A \in M_3(\mathbb{R})$ with $\det(A) = 0$ and $\text{rank}(A) = 1$
- D. There exists $A \in M_3(\mathbb{R})$ with $\det(A) \neq 0$ and $\text{rank}(A) = 1$

66. The number of possible orders of a matrix with 60 entries is

- A. 8
- B. 10
- C. 12
- D. 9

67. The number of (3×3) diagonal matrices A for which $A^3 = A$ is

- A. 9
- B. 27
- C. 64
- D. 81

68. A function $f: \mathbb{R} \rightarrow \mathbb{R}$ is given by

$$f(x) = \cos^2(x) + \cos^2\left(x + \frac{\pi}{3}\right) + \sin(x) \sin\left(x + \frac{\pi}{3}\right) \quad \forall x \in \mathbb{R} \text{ then}$$

- A. f is 1-1 but not onto
- B. f is onto but not 1-1
- C. f is neither 1-1 nor onto
- D. f is both 1-1 and onto

69. When two balls are drawn from a bag containing 2 red, 4 black, 3 white and 3 blue balls, the probability that both of them are black is

- A. $5/11$
- B. $1/11$
- C. $6/55$
- D. $8/55$

70. Six faces of an unbiased die are numbered 1,3,4,5,7 and 9. If two such dice are thrown, the probability that the sum on the uppermost faces of the dice is an odd number is

- A. $5/18$
- B. $5/36$
- C. $5/9$
- D. $1/4$

71. If A and B are two independent events with $p(B) = \frac{2}{7}$ and $p(A \cup B^c) = \frac{4}{5}$ then $p(A)$ is

- A. $1/5$
- B. $3/10$
- C. $2/5$
- D. $1/2$

72. The radius of the circle passing through the point (1,1), (2,-1), and (3,2) is

- A. $1/2$
- B. $1/\sqrt{2}$
- C. $\sqrt{5}/\sqrt{2}$
- D. $\sqrt{3}/\sqrt{2}$

73. The equation $x^2 + 5xy + 4y^2 + 3x + 2y + \lambda = 0$ represents a pair of lines if λ equals

- A. $1/3$
- B. $10/9$
- C. $-1/3$
- D. $-10/9$

74. The points (1,-2), (-3,0), (5,6) and (a,b) for a rectangle if (a,b) equals

- A. (1,6)
- B. (1,8)
- C. (5,6)
- D. (5,8)

75. The lines $2x + y - 1 = 0$, $ax + 3y - 3 = 0$ and $3x + 2y - 2 = 0$ are concurrent

- A. For all values of a
- B. For no value of a
- C. Only if $a = 3$
- D. Only if $a = 2$

PHYSICS

76. Four similar particle masses M each, are at equidistant from each other are orbiting in a circle of radius r in the same angular direction due to the action of their mutual gravitational attraction. The velocity of each particle is

- A. $\sqrt{\frac{GM}{r}(1 + 2\sqrt{2})}$
- B. $2\sqrt{\frac{GM}{r}}$
- C. $\sqrt{2\sqrt{2}\frac{GM}{R}}$
- D. $\sqrt{\frac{GM}{4r}(1 + 2\sqrt{2})}$

77. Molar heat capacity of an ideal diatomic gas at constant volume is found to be $5 \text{ cal mol}^{-1} \text{ K}^{-1}$. Find the specific heat of the same system at constant pressure. Molar gas constant $R = 2 \text{ cal mol}^{-1} \text{ K}^{-1}$.

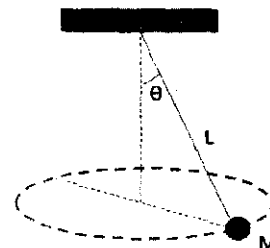
- A. $1.4 \text{ cal mol}^{-1} \text{ K}^{-1}$
- B. $3 \text{ cal mol}^{-1} \text{ K}^{-1}$
- C. $5 \text{ cal mol}^{-1} \text{ K}^{-1}$
- D. $7 \text{ cal mol}^{-1} \text{ K}^{-1}$

78. A radioactive isotope has a half-life of 40 days. What is the time required for the activity of the isotope to fall to $1/8$ th of its original value

- A. 40 days
- B. 120 days
- C. 60 days
- D. 320 days

79. The time period of conical pendulum of mass M suspended with a string of length L with negligible mass is

- A. $T = 2\pi (L/g)^{0.5}$
- B. $T = 2\pi \{(L \sin\theta)/g\}^{0.5}$
- C. $T = 2\pi \{(L \tan\theta)/g\}^{0.5}$
- D. $T = 2\pi \{(L \cos\theta)/g\}^{0.5}$



80. The center of the thin convex lens with radius of curvature of 10 cm on either surfaces is used to image an object place at 2.5 cm from its center (refractive index of the lens material is 1.5). The image of object is
- A. A real, inverted magnified image formed at 6.6 cm on the opposite side of the lens.
 - B. A virtual, inverted and diminished image formed at 3.3 cm on the opposite side of the lens.
 - C. A virtual, erected and magnified image formed at 3.3 cm on the same side of the object.
 - D. A real, crected and diminished image formed at 6.6 cm on the same side of the object.
81. An unpolarized light is incident on a glass surface at the Brewster's angle the reflected light is
- A. perfectly polarized with electric field vector restricted to the plane of incidence and the light must be monochromatic
 - B. perfectly polarized with electric field vector restricted to the plane perpendicular to the plane of incidence and light must he monochromatic.
 - C. partially polarized and when light is monochromatic.
 - D. Perfectly polarized with electric field vector restricted to the plane of incidence and the light need not be monochromatic
82. An electron in the hydrogen atom undergoes de excitation in two steps, first from energy level $n=3$ to $n=2$ and next, from $n=2$ to $n=1$. The ratio of the frequencies of emitted radiation in the two steps is:
- A. $5/27$
 - B. $27/5$
 - C. $6/27$
 - D. $27/6$
83. Which of the following is true about the electron?
- A. It has both electric dipole moment and magnetic moment
 - B. It has electric dipole moment but not magnetic moment
 - C. It has neither electric dipole moment nor magnetic moment
 - D. It is has no electric dipole moment but does have magnetic moment

84. If the electronic energies of the Hydrogen atom were to be equally separated, which of the following is true?
- A. One could not dissociate the electron by electronic excitation of the atom
 - B. One could not excite the atom to very high electronic energy states
 - C. One could excite the atom to high energy states but de-excitation is not possible
 - D. One could dissociate the electron by multi-step excitation of the electron
85. The number of distinct vibrations that are exhibited by the molecules HCl and CO₂ are respectively
- A. 1 and 3
 - B. 2 and 3
 - C. 2 and 2
 - D. 3 and 1
86. If the resistance per cm length of the wire is $2k\Omega$. The length of the wire required to make a heater of 2.5 W, with a current source of 5 mA,
- A. 50 cm
 - B. 25 cm
 - C. 100 cm
 - D. 2.5 cm
87. An ideal gas of oxygen is at temperature 300 K and pressure 10 atm, what is the mean free path of the molecules? Assume the diameter of the molecule to be 290 pm.
($k = 1.38 \times 10^{-23}$ J/K)
- A. 2.2×10^{-7} m
 - B. 1.1×10^{-7} m
 - C. 1.1×10^{-9} m
 - D. 2.2×10^{-9} m
88. Which of the following laws relates induced magnetic field to changing electric flux and to current
- A. Gauss'law of Electricity
 - B. Gauss' law of magnetism
 - C. Faraday's law
 - D. Ampere-Maxwell law

89. A disc with radius R is placed in a constant magnetic field B perpendicular to its surface. It is rotated at a speed of ω about its axis passing through the center along the z axis, the emf produced by the cylinder is
- A. $\frac{1}{2}\omega BR^2$
 B. $\frac{1}{4}\omega BR^2$
 C. ωBR^2
 D. $2\omega BR^2$
90. A straight copper wire of length 1m weighing 50g is carrying a current of 24.5A. It is held horizontally, in magnetic field, the magnitude of the magnetic field required to suspend the wire
- A. 1.0 T
 B. 0.02 T
 C. 0.2 T
 D. 2.0 T
91. A hollow cylinder with inner radius r_1 and outer radius r_2 is connected to battery with a potential V such that the current flows from the inner surface to the outer surface. The resistivity of the material is given as ρ . The current I is
- A. $V/\rho(r_1 - r_2)$
 B. $V/\rho(r_1 + r_2)$
 C. $V2\pi L/(\ln(\frac{r_1}{r_2})\rho)$
 D. $V2\pi L/(\ln(\frac{r_2}{r_1})\rho)$
92. A charge q is placed at the center of a uniformly charged hollow plastic sphere of radius r with charge Q , what is the electric field at a distance $r/2$ from the center.
- A. $\frac{1}{4\pi\epsilon_0} \frac{qQ}{r^2}$
 B. $\frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$
 C. $\frac{1}{\pi\epsilon_0} \frac{q}{r^2}$
 D. $\frac{1}{4\pi\epsilon_0} \frac{q}{4r^2}$

93. In a 2 dimensional space, if the electric field between two large parallel conducting plates is given as E along the positive Y direction centered at the origin, and if an electron is released from the rest from the upper plate, what is the position of the electron after a time t in terms of x and y coordinates.

- A. $x = \frac{1eE}{2m}t^2, y = v_0t$
- B. $x = v_0t, y = 0$
- C. $x = v_0t, y = \frac{1eE}{2m}t^2$
- D. $x = v_0t, y = -\frac{1eE}{2m}t^2$

94. A mechanical watch consisting of balance wheel is made to oscillate by the restoring torque applied by the wheel on the spring with spring constant k . If the moment of inertia of the fly wheel is given as I , the frequency of the flywheel is.

- A. $\frac{1}{2\pi} \sqrt{\frac{I}{k}}$
- B. $\frac{1}{\pi} \sqrt{\frac{k}{I}}$
- C. $\frac{1}{2\pi} \sqrt{\frac{k}{I}}$
- D. $\frac{1}{2\pi} \sqrt{\frac{2k}{I}}$

95. Two waves $y_1 = A \cos(20\pi t)$ and $y_2 = A \cos(22\pi t)$ are superimposed, what is the beat frequency

- A. 1 sec
- B. 2 sec
- C. 1.5 sec
- D. 21 sec

Booklet Code : D

96. What is the magnitude of the net force required to accelerate a rocket sled of mass 500 kg at a constant rate from rest to 1600 km/h in 1.8 sec.
- A. 180 N
 - B. 1.2×10^5 N
 - C. 2.5×10^5 N
 - D. 3.0×10^5 N
97. If a rotating wind power generator with three blades produces a torque of 200N.m on the axel, rotating at 5000 rpm what is the power generated by the generator.
- A. 1046.6 kW
 - B. 104.66 kW
 - C. 10.466 kW
 - D. 1.046 kW
98. In room temperature, number of electrons which take part in thermal excitation in a typical metal is proportional to the absolute temperature and the increase in the average energy due to the thermal excitation for electron, is also proportional to the absolute temperature. Specific heat of typical metal at constant volume in room temperature is
- A. inversely proportional to the absolute temperature
 - B. independent of temperature
 - C. proportional to the square of the absolute temperature
 - D. proportional to the absolute temperature
99. If the ground state energy of the electron in a hydrogen atom is -13.6 eV, then what would be the energy of the electron in 2nd Bohr orbit of a He^+ ion?
- A. -27.2 eV
 - B. -13.6 eV
 - C. -6.8 eV
 - D. -3.4 eV

100. A light of wave length 124.2 nm is used in an experiment on photoelectric effect with a cathode of work function 2.5 eV. What is the maximum kinetic energy of the corresponding photoelectrons?

- A. 2.5 eV
- B. 5.0 eV
- C. 7.5 eV
- D. 1.0 eV