

P.G. ENTRANCE EXAMINATION, APRIL 2022

INTEGRATED M.Sc. PHYSICS/INTEGRATED M.Sc. CHEMISTRY

Time : Two Hours

Maximum : 400 Marks

*Each question carries 4 marks.**1 mark will be deducted for each wrong answer.***Section A (Physics)**

- If ϵ_0 and μ_0 are the permittivity and permeability of free space, the dimensions of $\epsilon_0\mu_0$ are :
(A) LT^{-1} . (B) L^2T^{-2} .
(C) $L^{-2}T^2$. (D) LT^{-2} .
- In an experiment, the period of oscillation of a simple pendulum are recorded as 2.56 s, 2.42 s, 2.63 s, 2.71 s and 2.80 s respectively. The mean absolute error is :
(A) 0.01 s. (B) 0.1 s.
(C) 0.11 s. (D) 1.01 s.
- A stone falling from the top of a tower covers half the height of the tower in the last second of its journey. The approximate height of the tower is :
(A) 78.4 m. (B) 57.1m.
(C) 37.6 m. (D) 29.4 m.
- The speed of a boat is 5 km/h in still water. It crosses a river of width 1 km along the shortest path in 15 minutes. The velocity of the flow of river is :
(A) 5 km/h. (B) 3 km/h.
(C) 1 km/h. (D) 4 km/h.
- A ball moving with velocity 2 ms^{-1} collides head on with another ball of double the mass. If the co-efficient of restitution is 0.5, their velocities (in ms^{-1}) after collision will be :
(A) 0, 1. (B) 1, 1.
(C) 1, 0.5. (D) 0, 2.

Turn over

6. A body of volume V and density ρ is raised through a height h in a liquid of density σ . If $\rho < \sigma$, the change in potential energy of the body is :
- (A) $V\rho gh$. (B) $V\sigma gh$.
- (C) $V\left(\frac{\rho}{\sigma}\right)gh$. (D) $V(\rho - \sigma)gh$.
7. The instantaneous angular position of a point on a rotating wheel is given by the equation $\theta(t) = 2t^3 - 6t^2$. The torque on the wheel becomes zero at :
- (A) $t = 0.5$ s. (B) $t = 0.25$ s.
- (C) $t = 0.5$ s. (D) $t = 1$ s.
8. A satellite is launched in to a circular orbit of radius R around earth. A second satellite is launched in to an orbit of radius $1.01R$. The time period of the second satellite is approximately larger than that of the first one by :
- (A) 0.5 %. (B) 1.5 %.
- (C) 1 %. (D) 3 %.
9. Two wires of the same material have their lengths in the ratio 1 : 2 and diameters in the ratio 2 : 1. If they are pulled by the same force, their increase in length will be in the ratio :
- (A) 2 : 1. (B) 1 : 4.
- (C) 1 : 8 (D) 8 : 1.
10. The viscous drag on a spherical body moving with a velocity v is proportional to :
- (A) \sqrt{v} . (B) v .
- (C) $\frac{1}{\sqrt{v}}$. (D) v^2 .
11. An ideal gas ($\gamma = 1.5$) is expanded adiabatically. How many times has the gas to be expanded to reduce the root mean square velocity to half the initial value :
- (A) 4 times. (B) 16 times.
- (C) 8 times. (D) 2 times.

12. The absolute zero is the temperature at which :
- (A) Water freezes. (B) Molecular motion ceases.
(C) All substances exist in solid state. (D) None of the above.
13. Two vessels A and B having equal volume contain equal masses of hydrogen in A and helium in B at 300 K. Then :
- (A) The pressure exerted by hydrogen is half that exerted by helium.
(B) The pressure exerted by hydrogen is equal to that exerted by helium.
(C) The pressure exerted by hydrogen is twice that exerted by helium.
(D) The pressure exerted by helium is $\sqrt{2}$ times that exerted by hydrogen.
14. A particle is performing simple harmonic oscillation with amplitude A and angular velocity ω . The ratio of the maximum velocity to maximum acceleration is :
- (A) ω . (B) $\frac{1}{\omega}$.
(C) ω^2 . (D) $\frac{1}{\omega^2}$.
15. The velocity of sound in a gas depends on :
- (A) Wavelength of sound only.
(B) Intensity of sound only.
(C) Amplitude and frequency of sound wave.
(D) Density and elasticity of gas.
16. The magnitude of electric intensity E is such that an electron placed in it would experience an electrical force balances its weight. The value of electric intensity E is then :
- (A) mge . (B) $\frac{e}{mg}$.
(C) $\frac{mg}{e}$. (D) $\frac{e^2 g}{m^2}$.
17. Two capacitors of capacity $0.3 \mu\text{F}$ and $0.6 \mu\text{F}$ respectively are connected in series. The combination is connected across a potential of 6 volts. The ratio of the energies stored in the capacitors will be :
- (A) 1 : 2. (B) 2 : 1.
(C) 1 : 4. (D) 4 : 1.

Turn over

18. The positive terminal of a 12 V battery is connected to the earth. Then the negative terminal will be at :
- (A) - 12 V. (B) Zero potential.
(C) + 12 V. (D) + 24V.
19. A proton, a deuteron and an α particle are moving in circular trajectories in a constant magnetic field with equal kinetic energies. If r_p , r_d and r_α denote respectively the radii of these particles, then :
- (A) $r_p = r_d = r_\alpha$. (B) $r_p < r_d < r_\alpha$.
(C) $r_\alpha = r_p < r_d$. (D) $r_p < r_d = r_\alpha$.
20. A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60° . The torque required maintain the needle in this position will be :
- (A) 2W. (B) $\sqrt{2}$ W.
(C) W. (D) $\sqrt{3}$ W.
21. A coil having 500 square loops each of side 10 cm is placed normal to a magnetic flux which increases at a rate of 1 tesla per second. The induced e.m.f. is :
- (A) 0.1 volt. (B) 0.5 volt.
(C) 1 volt. (D) 5 volt.
22. An alternating voltage $E = 200\sqrt{2} \sin 100t$ is connected to a one microfarad capacitor through an A.C. ammeter. If E is in volts, the reading of the ammeter is :
- (A) 10 mA. (B) 20 mA.
(C) 40 mA. (D) 80 mA.
23. The electric field associated with an electromagnetic wave in vacuum is given by $E = 40 \cos(kz - 6 \times 10^8 t)$, where E, z and t are in volt/m, metre and second respectively. The value of the wave vector k is :
- (A) 2 m^{-1} . (B) 0.5 m^{-1} .
(C) 6 m^{-1} . (D) 3 m^{-1} .

24. The focal length of a concave mirror is x and the distance from the object to the principal focus is y . The ratio of the size of the image to the size of the object is :
- (A) $\sqrt{\frac{x}{y}}$ (B) $\frac{x}{y}$
(C) $1 + \frac{x}{y}$ (D) $\frac{y}{x}$
25. An object is placed to the left of a glass hemisphere with radius 1 m and index of refraction 1.5. The distance of the object from the plane surface of the hemisphere is 2 m :
- (A) 5 m. (B) 6 m.
(C) 8 m. (D) 12 m.
26. Planck's constant has the dimensions of :
- (A) Force. (B) Energy.
(C) Linear momentum. (D) Angular momentum.
27. The total energy of electron in the ground state of hydrogen atom is -13.6 eV. The potential energy of an electron in the ground state of Li^{2+} is :
- (A) 122.4 eV. (B) -122.4 eV.
(C) -244.8 eV. (D) 244.8 eV.
28. The limit of the Balmer series is 3646 \AA . The wavelength of the first member of this series is :
- (A) 6563 \AA . (B) 3646 \AA .
(C) 1823 \AA . (D) Infinity.
29. In a common base transistor amplifier, the input resistance is 100Ω and the output resistance is 5000Ω . If the current gain is 0.98, the voltage gain is :
- (A) 7. (B) 49.
(C) 5. (D) 25.
30. How many AM broadcast stations can be allotted to in a 120 kHz band width if the highest frequency modulating a carrier is 5 kHz :
- (A) 8. (B) 10.
(C) 12. (D) 24.

Section B (Chemistry)

- 31 The normality of a 1 M solution of H_3PO_4 is _____.
- (A) 0.5. (B) 1.0.
(C) 2.0. (D) 3.0.
- 32 Neutron was discovered by _____.
- (A) J. J. Thomson. (B) Rutherford.
(C) Chadwick. (D) Priestley.
- 33 In the modern periodic table, the number of period of the element is the same as :
- (A) Principal quantum number. (B) Atomic number.
(C) Azimuthal quantum number. (D) Atomic mass.
- 34 The species having pyramidal shape is _____.
- (A) BrF_3 . (B) OSF_2 .
(C) SO_3 . (D) SiO_3^{2-} .
- 35 A gas deviates from ideal behavior at a high pressure because its molecules :
- (A) Attract one another. (B) Show the Tyndall Effect.
(C) Have kinetic energy. (D) Are bound by covalent bonds.
- 36 In a reversible process the system absorbs 600 kJ heat and performs 250 kJ work on the surroundings. What is the increase in the internal energy of the system ?
- (A) 850 kJ. (B) 600 kJ.
(C) 350 kJ. (D) 250 kJ.
37. In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled, then the equilibrium constant will _____.
- (A) Also be doubled. (B) Be halved.
(C) Become one-fourth. (D) Remain the same.
38. The oxidation number of Cr in $\text{K}_2\text{Cr}_2\text{O}_7$ is _____.
- (A) + 6. (B) - 6.
(C) + 2. (D) - 2.

39. Hydrogen peroxide is obtained by the electrolysis of _____.
- (A) Water. (B) Sulphuric acid.
(C) Hydrochloric acid. (D) Fused sodium peroxide.
40. Carnallite is the mineral of _____.
- (A) Sodium. (B) Potassium.
(C) Magnesium. (D) Calcium.
41. The compound formed in a borax bead test is _____.
- (A) Orthoborate. (B) Metaborate.
(C) Double oxide. (D) Tetraborate.
42. The displacement of electrons in a multiple bond in the presence of attacking reagent is called _____.
- (A) Electromeric effect. (B) Resonance.
(C) Hyper conjugation. (D) Inductive effect.
43. The nitration of nitrobenzene with con. nitric acid and conc. sulfuric acid at 370K produces _____.
- (A) 1, 2, 4-Trinitrobenzene. (B) 1, 4-Dinitrobenzene.
(C) 1, 2-Dinitrobenzene. (D) 1, 3-Dinitrobenzene.
44. The most harmful air pollutant produced by automobiles is _____.
- (A) Carbon monoxide. (B) Carbon dioxide.
(C) Sulfur dioxide. (D) Nitrogen monoxide.
45. To get *n*-type of semiconductor, germanium should be doped with :
- (A) Gallium. (B) Arsenic.
(C) Aluminium. (D) Boron.
46. H_2S is a toxic gas used in qualitative analysis. If solubility of H_2S in water at STP is 0.195 m., the value of K_H is _____ bar
- (A) 564. (B) 423.
(C) 282. (D) 141.

Turn over

47. Fused sodium chloride on electrolysis gives _____ on cathode.
- (A) Hydrogen. (B) Oxygen.
(C) Chlorine. (D) Sodium.
48. The rate constant of a reaction depends upon :
- (A) Initial concentration of the reactants.
(B) The time of completion of reaction.
(C) Extent of the reaction.
(D) Temperature of the reaction.
49. The formation of micelles takes place only above _____.
- (A) Kraft temperature. (B) Critical temperature.
(C) Boyle's temperature. (D) Inversion temperature.
50. Heating ore with carbon in the absence of air is known as _____.
- (A) Reduction. (B) Leaching.
(C) Smelting. (D) Roasting.
51. The antiseptic, Tincture of iodine is _____.
- (A) Aqueous solution of iodine.
(B) Alcoholic solution of iodine.
(C) Solution of iodine in potassium iodide.
(D) Aqueous solution of potassium iodide.
52. Lanthanoid contraction is due to increase in :
- (A) Atomic radius. (B) Valence electrons.
(C) Atomic number. (D) Effective nuclear charge.
53. According to Werner's theory of co-ordination compounds :
- (A) Primary valency is ionisable.
(B) Primary and secondary valencies are ionisable.
(C) Neither primary nor secondary valency is ionisable.
(D) Secondary valency is ionisable.

54. Which of the following undergoes nucleophilic substitution exclusively by S_N1 mechanism ?
- (A) Ethyl chloride. (B) Benzyl Chloride.
(C) Chlorobenzene. (D) Isopropyl chloride.
55. An unknown alcohol is treated with "Lucas reagent" to determine whether the alcohol is primary, secondary or tertiary. Which alcohol reacts fastest and by what mechanism ?
- (A) Tertiary alcohol by S_N2 . (B) Secondary alcohol by S_N1 .
(C) Tertiary alcohol by S_N1 . (D) Secondary alcohol by S_N2 .
56. The oxidation of toluene to benzaldehyde by chromyl chloride is called as :
- (A) Etard reaction. (B) Riemer-Tiemann reaction.
(C) Wurtz reaction. (D) Cannizzaro's reaction.
57. The most convenient method to prepare primary (i Amine) amine containing one carbon atom less is _____.
- (A) Gabriel phthalimide synthesis. (B) Reductive amination of aldehydes.
(C) Reduction of isonitriles. (D) Hofmann bromamide reaction.
58. The conversion of maltose into glucose is possible by the enzyme :
- (A) Zymase. (B) Lactase.
(C) Maltase. (D) Diastase.
59. Nylon 6, 6 is obtained by condensation polymerisation of _____.
- (A) Adipic acid and ethylene glycol.
(B) Adipic acid and hexamethylenediamine.
(C) Terephthalic acid and ethylene glycol.
(D) Adipic acid and phenol.
60. The main cause of acidity in the stomach is _____.
- (A) Release of extra gastric acids which decrease the pH level.
(B) Indigestion and pain in the large intestine.
(C) Increase the pH level in the stomach.
(D) Release of extra bile juice which increases alkaline medium in the stomach.

Turn over

Section C (Mathematics)

61. The relation P defined on the set of all real by " $(x, y) \in P$ if and only if $x - y + \sqrt{3}$ is irrational" is :
- (A) Reflexive and transitive.
 (B) Reflexive and symmetric.
 (C) Reflexive but not symmetric and transitive.
 (D) Transitive but not symmetric.
62. Let A be the set of all integral multiples of 3 in between 1 and 50 and B be the collection of all functions from A to A . Then the number of elements in B equal to :
- (A) 16. (B) 2^{16} .
 (C) 256. (D) 16^{16} .
63. The smallest positive integer n for which $(1 - i)^{2n} = (1 + i)^{2n}$ is :
- (A) 4. (B) 5.
 (C) 2. (D) 1.
64. If z_1 and z_2 are two non zero complex numbers such that $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2$. Then :
- (A) $\operatorname{Re}\left(\frac{z_1}{z_2}\right) = 0$. (B) $\operatorname{Im}\left(\frac{z_1}{z_2}\right) = 0$.
 (C) $\operatorname{Re}(z_1 z_2) = 0$. (D) $\operatorname{Im}(z_1 z_2) = 0$.
65. If x, y, z, a, b and c are numbers such that $a^x = b^y = c^z$, then :
- (A) $\log_b a = \log_a c$. (B) $\log_b a = \log_c b$.
 (C) $\log_c b = \log_a c$. (D) $\log_b a = \log_c a$.
66. The sum of all two digit numbers of the form $4m + 1$ for some integer m is :
- (A) 1110. (B) 1610.
 (C) 1197. (D) 1210.

67. The focus of the parabola $y^2 - x - 2y + 2 = 0$ is:

(A) $\left(\frac{1}{4}, 0\right)$.

(B) $\left(\frac{5}{4}, 1\right)$.

(C) $(1, 2)$.

(D) $\left(\frac{3}{4}, 1\right)$.

68. $\lim_{x \rightarrow \infty} \left(1 + \frac{3}{x}\right)^x$ equals:

(A) e^3 .

(B) e .

(C) 1

(D) ∞ .

69. The height of the cylinder of maximum volume that can be inscribed in a sphere of radius a is:

(A) $\frac{a}{\sqrt{3}}$.

(B) $\frac{4}{3}a$.

(C) $\frac{2a}{\sqrt{3}}$.

(D) $\frac{4}{\sqrt{3}}a$.

70. If $2^x + 2^y = 2^{x+y}$, then $\frac{dy}{dx}$ is equal to:

(A) $\frac{2^x + 2^y}{2^x - 2^y}$.

(B) $\frac{2^x - 2^y}{2^x + 2^y}$.

(C) $\frac{2^{x-y}(2^y - 1)}{1 - 2^x}$.

(D) $\frac{2^{x+y} - 2^x}{2^y}$.

71. The value of $\int_0^{\frac{\pi}{2}} \frac{\cos x}{(1 + \sin x)(2 + \sin x)} dx$ is:

(A) $\log\left(\frac{1}{3}\right)$.

(B) $\log\left(\frac{4}{3}\right)$.

(C) $\log\left(\frac{1}{2}\right)$.

(D) $\log(2)$.

Turn over

72. The solution of the differential equation $x \frac{dy}{dx} = y(\log y - \log x + 1)$ is:

(A) $\log\left(\frac{y}{x}\right) = cx.$

(B) $\log\left(\frac{y}{x}\right) = cy.$

(C) $\log\left(\frac{x}{y}\right) = cy.$

(D) $\log\left(\frac{x}{y}\right) = cx.$

73. For what value of a , the points with position vectors $10i + 3j$, $12i - 5j$ and $ai + 11j$ are collinear?

(A) 7.

(B) 12.

(C) 5.

(D) 8.

74. For what value of n for which the co-efficients of x^7 and x^8 in the expansion of $\left(2 + \frac{x}{3}\right)^n$ are equal?

(A) 15.

(B) 56.

(C) 45.

(D) 55.

75. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ then A^{-1} is equal to:

(A) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{1}{2} & 0 \\ 0 & 0 & \frac{1}{3} \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & \frac{1}{3} & 0 \end{bmatrix}$

(D) $\begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{3} \end{bmatrix}$

76. If the letters of the word **REGULATION** be arranged at random, the probability that there will be exactly four letters between **R** and **E** is :
- (A) $\frac{1}{5}$ (B) $\frac{1}{9}$
 (C) $\frac{1}{2}$ (D) $\frac{1}{10}$
77. If A and B are independent events so that $P(A \cup B) = 0.8$ and $P(B) = 0.3$, then $P(A)$ is equal to :
- (A) $\frac{3}{7}$ (B) $\frac{4}{7}$
 (C) $\frac{5}{7}$ (D) $\frac{4}{9}$
78. Angle between the line $\vec{r} = 2\hat{i} - \hat{j} + \hat{k} + \lambda(-\hat{i} + \hat{j} + \hat{k})$ and the plane $\vec{r} \cdot (3\hat{i} + 2\hat{j} - \hat{k}) = 4$ is :
- (A) $\cos^{-1}\left(\frac{2}{\sqrt{42}}\right)$ (B) $\sin^{-1}\left(\frac{2}{\sqrt{42}}\right)$
 (C) $\cos^{-1}\left(\frac{-2}{\sqrt{42}}\right)$ (D) $\sin^{-1}\left(\frac{-2}{\sqrt{42}}\right)$
79. The area of the region bounded by the curve $y = x^2$ and the line $x - y + 2 = 0$ is :
- (A) $\frac{9}{2}$ (B) 4
 (C) $\frac{10}{3}$ (D) 3
80. For what value of k , the circles $x^2 + y^2 + 5x + 3y + 7 = 0$ and $x^2 + y^2 - 8x + 6y + k = 0$ meet orthogonally ?
- (A) 9. (B) -9.
 (C) 18. (D) -18.

Turn over

Section D (Biology)

81. The regions of conservation priority, characterised by high levels of species richness and high degree of endemism are called :
- (A) Biosphere reserves. (B) National parks.
(C) Biodiversity hotspots. (D) Sacred groves.
82. In a population of butterflies, the colour black (B) is dominant over the colour white (b). If 36 % of the butterflies are white, the frequency of homozygous dominant individuals in the population is :
- (A) 0.16. (B) 0.6.
(C) 0.4. (D) 64.
83. Reissner's membrane of the inner ear separates :
- (A) Scala media and Scala vestibuli.
(B) Scala vestibuli and Scala tympani.
(C) Scala tympani and Scala media.
(D) Scala media and Scala basalis.
84. Find out the incorrect combination of enzyme and its substrate, associated with the process of digestion :
- (A) Pepsin : Protein. (B) Lipase : Fat.
(C) Trypsin : Triglycerides. (D) Amylase : Starch.
85. In which of the following options, all belong to the same phylum ?
- (A) Salpa, Doliolum, Dentalium. (B) Taenia, Fasciola, Ancylostoma.
(C) Physalia, Adamsia, Aurelia. (D) Asterias, Antedon, Ascidia.
86. Among the following, one that does NOT follow traditional Eltonian pyramid is :
- (A) Pyramid of parasitic food chain. (B) Pyramid of predatory food chain
(C) Pyramid of energy. (D) Pyramid of biomass.
87. The RIESKE Centre denotes :
- (A) Cyt.b6- f complex. (B) PSII.
(C) Fd= Cyt. b6. (D) Cyt.f- PC.

88. Select the FALSE statement from the following :

- (A) Kinetin induces the formation of interfascicular cambium.
- (B) In plants, reproductive parts contain lower concentration of Gibberellin than vegetative parts.
- (C) Ethylene is commercially used to synchronize flowering and fruit set in pineapple.
- (D) Trans ABA is inactive.

89. Absence of phloem parenchyma in the stem is characteristic of :

- (A) Gymnosperms.
- (B) Pteridophytes.
- (C) Grasses.
- (D) Dicotyledonous trees.

90. Select the ODD one out with respect to the photosynthetic structure :

- (A) Asparagus.
- (B) Ruscus.
- (C) Casuarina.
- (D) Acasia.

Section E (Computer Science)

91. Which is the smallest memory unit in any computer systems ?

- (A) RAM.
- (B) ROM.
- (C) Optical Disk.
- (D) Registers.

92. In C, a pointer variable to an integer can be created by the following declaration :

- (A) `int *p;`
- (B) `int p*;`
- (C) `int &p;`
- (D) `int p&;`

93. What is JavaScript ?

- (A) A scripting language used to make the website interactive.
- (B) An assembly language used to make the website interactive.
- (C) A compiled language used to make the website interactive.
- (D) None of the above.

94. HTML stands for _____.

- (A) High Text Markup Language.
- (B) Hyper Text Markup Language.
- (C) Hyper Tabular Markup Language.
- (D) Hyper Text Makeup Language.

Turn over

95. In C/C++ array index starts with _____.
- (A) - 1. (B) 0.
(C) 1. (D) 2.
96. What is the expansion of SQL ?
- (A) Structured Query List. (B) Simple Query Language.
(C) Structured Query Language. (D) Semi Query Language.
97. Which software prevents the external access to a system ?
- (A) Gateway. (B) Router.
(C) Firewall. (D) Bridge.
98. Which of the following is the property of transaction that protects data from system failure ?
- (A) Atomicity. (B) Isolation.
(C) Consistency. (D) Durability.
99. What is the term for unsolicited Email ?
- (A) News group. (B) UseNet.
(C) Backbone. (D) Spam.
100. A type of memory that holds the computer start-up routine is _____.
- (A) Cache. (B) ROM.
(C) RAM. (D) DRAM.