WARNING	Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.

PAPER – I PHYSICS & CHEMISTRY

Version Code	A4	Question Booklet Serial Number :

Time : 150 Minutes	Number of Questions : 120	Maximum Marks : 480

Name of Candidate	
Roll Number	
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INSTRUCTIONS TO THE CANDIDATE

1. **Please ensure that the VERSION CODE shown at the top of this Question Booklet is the same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different Version Code, please get it replaced with a Question Booklet with the same Version Code as that of the OMR Answer Sheet from the Invigilator. **THIS IS VERY IMPORTANT.**
2. Please fill the items such as Name, Roll Number and Signature in the columns given above. Please also write Question Booklet Serial No. given at the top of this page against item 4 in the OMR Answer Sheet.
3. This Question Booklet contains 120 questions. For each question, five answers are suggested and given against (A), (B), (C), (D) and (E) of which only one will be the **Most Appropriate Answer**. Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either **Blue or Black ball-point pen only**.
4. **Negative Marking:** In order to discourage wild guessing, the score will be subjected to penalization formula based on the number of right answers actually marked and the number of wrong answers marked. Each correct answer will be awarded FOUR marks. ONE mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.
5. Please read the instructions given in the OMR Answer Sheet for marking answers. Candidates are advised to strictly follow the instructions contained in the OMR Answer Sheet.

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PLEASE ENSURE THAT THIS QUESTION BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120.
PRINTED PAGES : 32

1. The speed of an electromagnetic wave in a material medium of permeability μ and permittivity ε is

(A) $\frac{1}{\mu\varepsilon}$ (B) $\frac{1}{2\mu\varepsilon}$ (C) $\frac{1}{\sqrt{\mu\varepsilon}}$ (D) $\frac{1}{\sqrt{2\mu\varepsilon}}$ (E) $\frac{2}{\mu\varepsilon}$

2. The energy of infrared waves is greater than that of

(A) visible light
(B) ultraviolet waves
(C) *x*-rays
(D) gamma rays
(E) micro waves

3. An object is kept at a distance of 60 cm from a concave mirror. For getting a magnification of $\frac{1}{2}$, focal length of the concave mirror required is

(A) 20 cm (B) 40 cm (C) – 20 cm (D) 30 cm (E) 10 cm

4. In Young's double slit experimental setup, if the wavelength alone is doubled, the band width β becomes

(A) $\frac{\beta}{2}$ (B) 2β (C) 3β (D) β (E) 4β

Space for rough work

5. If the speed of light in material A is 1.25 times its speed in material B, then the ratio of the refractive indices of these materials is

(A) 1.50 (B) 1.00 (C) 0.800 (D) 1.25 (E) 0.90

6. The resolving power of a microscope is

(A) inversely proportional to numerical aperture

(B) directly proportional to wavelength

(C) directly proportional to square of the wavelength

(D) directly proportional to numerical aperture

(E) independent of numerical aperture

7. Which one of the following statements is correct?

(A) Monochromatic light is never coherent

(B) Monochromatic light is always coherent

(C) Two independent monochromatic sources are coherent

(D) Coherent light is sometimes monochromatic

(E) Coherent light is always monochromatic

Space for rough work

8. If alpha particle, proton and electron move with the same momentum, then their respective de Broglie wavelengths λ_α, λ_p, λ_e are related as

(A) $\lambda_\alpha = \lambda_p = \lambda_e$ (B) $\lambda_\alpha < \lambda_p < \lambda_e$

(C) $\lambda_\alpha > \lambda_p > \lambda_e$ (D) $\lambda_p > \lambda_e > \lambda_\alpha$

(E) $\lambda_p < \lambda_e < \lambda_\alpha$

9. The ratio between the radii of nuclei with mass numbers 27 and 125 is

(A) 5 : 3 (B) 3 : 5 (C) 27 : 125 (D) 125 : 27 (E) 1 : 1

10. A freshly prepared radioactive sample of half-life 4 hours emits radiation of intensity which is 64 times the safe level. The minimum hours after which it would be safe to work with it is

(A) 4 (B) 6 (C) 12 (D) 16 (E) 24

11. A radioactive decay can form an isotope of the original nucleus with the emission of particles

(A) one α and four β

(B) one α and two β

(C) one α and one β

(D) four α and one β

(E) two α and one β

12. The logic gates giving output '1' for the inputs of '1' and '0' are

(A) AND and OR

(B) OR and NOR

(C) NAND and NOR

(D) NAND and OR

(E) AND and NOR

Space for rough work

13. Identify the mismatch of the following

(A) Photo diode – optical signal

(B) LED – spontaneous emission

(C) Diode laser – stimulated emission

(D) Solar cell – electrical energy into light

(E) Photo conducting cell – photo detector

14. If a PN junction diode of depletion layer width W and barrier height V_0 is forward biased, then

(A) W increases, V_0 decreases

(B) W decreases, V_0 increases

(C) both W and V_0 increase

(D) both W and V_0 decrease

(E) both W and V_0 remain the same

15. The heavily and lightly doped regions of a bipolar junction transistor are respectively

(A) base and emitter (B) base and collector

(C) collector and base (D) collector and emitter

(E) emitter and base

Space for rough work

16. A television tower of height 140 m can broadcast its signal upto a maximum area of (Radius of earth = 6.4×10^6 m)

(A) 1.56×10^6 km^2 (B) 5.6×10^3 km^2

(C) 5.6×10^{10} km^2 (D) 1.56×10^9 km^2

(E) 1.56×10^4 km^2

17. The waves that are bent down by the ionosphere are

(A) ground waves (B) surface waves (C) direct waves

(D) space waves (E) sky waves

18. A ground receiver in line-of-sight communication cannot receive direct waves due to

(A) its low frequency

(B) curvature of earth

(C) its high intensity

(D) smaller antenna

(E) both its low frequency and high intensity

19. In an amplitude modulation with modulation index 0.5, the ratio of the amplitude of the carrier wave to that of the side band in the modulated wave is

(A) 4 :1 (B) 1 : 1 (C) 1 : 2 (D) 2 : 1 (E) 1 : 4

Space for rough work

20. The displacement of a particle moving along x-axis with respect to time t is $x = at + bt^2 - ct^3$. The dimensions of c are

(A) T^{-3} (B) LT^{-2} (C) LT^{-3} (D) LT^3 (E) LT^2

21. If the time period of oscillation of a pendulum is measured as 2.5 second using a stop watch with the least count $\frac{1}{2}$ second, then the permissible error in the measurement is

(A) 10 % (B) 30 % (C) 15 % (D) 25 % (E) 20 %

22. A particle moving along a straight line covers half of the distance with a speed of 3 ms^{-1}. The other half of the distance is covered in two equal time intervals with speed of 4.5 ms^{-1} and 7.5 ms^{-1}. The average speed of the particle (in ms^{-1}) is

(A) 5.0 (B) 5.5 (C) 5.8 (D) 4.0 (E) 4.8

23. Two cars started moving with initial velocities v and $2v$. For the same deceleration, their respective stopping distances are in the ratio

(A) 1 : 1 (B) 1 : 2 (C) 1 : 4 (D) 2 : 1 (E) 4 : 1

Space for rough work

24. The distances traversed during equal intervals of time by a freely falling body from rest are in the ratio

(A) 1 : 3 : 5 : 7... (B) 2 : 4 : 6 : 8 ... (C) 1 : 4 : 9 : 25 ...

(D) 1 : 9 : 25 : 49 ... (E) 1 : 2 : 3 : 4...

25. In the entire path of a projectile, the quantity that remains unchanged is

(A) vertical component of velocity

(B) horizontal component of velocity

(C) kinetic energy

(D) potential energy

(E) linear momentum

26. The sum of magnitudes of two forces acting at a point is 16 N and their resultant $8\sqrt{3}$ N is at 90° with the force of smaller magnitude. The two forces (in N) are

(A) 11, 5 (B) 9, 7 (C) 6, 10 (D) 4, 12 (E) 2, 14

27. Among the following, the vector quantity is

(A) pressure

(B) gravitation potential

(C) stress

(D) impulse

(E) distance

Space for rough work

28. A block of mass 10 kg is moving horizontally with a speed of 1.5 ms^{-1} on a smooth plane. If a constant vertical force 10 N acts on it, the displacement of the block from the point of application of the force at the end of 4 seconds is

(A) 5 m (B) 20 m (C) 12 m (D) 10 m (E) 18 m

29. A block of weight 4 kg is resting on a smooth horizontal plane. If it is struck by a jet of water at the rate of 2 kgs^{-1} and at the speed of 10 ms^{-1}, then the initial acceleration of the block is

(A) 15 ms^{-2} (B) 10 ms^{-2} (C) 2.5 ms^{-2} (D) 1 ms^{-2} (E) 5 ms^{-2}

30. A ball is hung by a string from the ceiling of a car moving on a straight and smooth road. If the string is inclined towards the front side of the car making a small constant angle with the vertical, then the car is moving with

(A) constant velocity

(B) constant acceleration

(C) constant retardation

(D) increasing acceleration

(E) decreasing retardation

31. A girl in a swing is 2.5 m above ground at the maximum height and at 1.5 m above the ground at the lowest point. Her maximum velocity in the swing is (g = 10 ms^{-2})

(A) $5\sqrt{2}$ ms^{-1} (B) $2\sqrt{5}$ ms^{-1} (C) $2\sqrt{3}$ ms^{-1}

(D) $3\sqrt{2}$ ms^{-1} (E) $4\sqrt{2}$ ms^{-1}

Space for rough work

32. The position of a particle of mass 4 g, acted upon by a constant force is given by $x = 4t^2 + t$, where x is in metre and t in second. The work done during the first 2 seconds is

(A) 128 mJ (B) 512 mJ (C) 576 mJ (D) 144 mJ (E) 288 mJ

33. The shape of the curve representing the relation between the speed and kinetic energy of a moving object is

(A) parabola

(B) ellipse

(C) straight line with positive slope

(D) straight line with negative slope

(E) exponential

34. A billiard ball of mass m and radius r, when hit in a horizontal direction by a cue at a height h above its centre, acquired a linear velocity v_0. The angular velocity ω_0 acquired by the ball is

(A) $\frac{5v_0 r^2}{2h}$ (B) $\frac{2v_0 r^2}{5h}$ (C) $\frac{2v_0 h}{5r^2}$

(D) $\frac{5v_0 h}{2r^2}$ (E) $\frac{5v_0 h^2}{2r^2}$

Space for rough work

35. A carpet of mass m made of inextensible material is rolled along its length in the form of a cylinder of radius r and kept on a rough floor. The decrease in the potential energy of the system, when the carpet is unrolled to a radius $\frac{r}{2}$ without sliding is (g = acceleration due to gravity)

(A) $\frac{3}{4}mgr$ (B) $\frac{5}{8}mgr$ (C) $\frac{7}{8}mgr$ (D) $\frac{1}{2}mgr$ (E) $\frac{1}{8}mgr$

36. The radius of gyration of a solid cylinder of mass M and radius R about its own axis is

(A) $\frac{R}{\sqrt{2}}$ (B) $\frac{R}{2}$ (C) $\frac{R}{\sqrt{3}}$ (D) $\frac{R}{3}$ (E) $\frac{R}{4}$

37. An artificial satellite moving in a circular orbit at a distance h from the centre of the earth has a total energy E_0. Its potential energy is

(A) $-E_0$ (B) $1.5\,E_0$ (C) E_0 (D) $2\,E_0$ (E) $\frac{E_0}{2}$

38. Two identical spheres of radius R made of the same material are kept at a distance d apart. Then the gravitational attraction between them is proportional to

(A) d^{-2} (B) d^{2} (C) d^{4} (D) d (E) d^{-4}

Space for rough work

39. An astronaut experiences weightlessness in a space satellite. It is because

(A) the gravitational force is small at that location in space

(B) the gravitational force is large at that location in space

(C) the astronaut experiences no gravity

(D) the gravitational force is infinitely large at that location in space

(E) the astronaut experiences an upthrust

40. Choose the wrong statement

(A) The bulk modulus for solids is much larger than for liquids

(B) Gases are least compressible

(C) The incompressibility of the solids is due to the tight coupling between neighbouring atoms

(D) The reciprocal of the bulk modulus is called compressibility

(E) For a system in equilibrium, the value of bulk modulus is always positive

41. If two capillary tubes of radii r_1 and r_2 in the ratio 1 : 2 are dipped vertically in water, then the ratio of capillary rises in the respective tubes is

(A) 1 : 4 (B) 4 : 1 (C) 1 : 2 (D) 2 : 1 (E) $1 : \sqrt{2}$

42. If the excess pressure inside a soap bubble of radius r_1 in air is equal to the excess pressure inside air bubble of radius r_2 inside the soap solution, then $r_1 : r_2$ is

(A) 2 : 1 (B) 1 : 2 (C) 1 : 4 (D) $\sqrt{2} : 1$ (E) $1 : \sqrt{2}$

Space for rough work

43. The pressure at depth h below the surface of a liquid of density ρ open to the atmosphere is

(A) greater than the atmospheric pressure by ρgh

(B) less than the atmospheric pressure by ρgh

(C) equal to the atmospheric pressure

(D) decreases exponentially with depth

(E) increases exponentially with depth

44. 1 cc of water becomes 1681 cc of steam when boiled at a pressure of 10^5 Nm^{-2}. The increasing internal energy of the system is

(L.T. of steam is 540 cal g^{-1}, 1 calorie = 4.2 J)

(A) 300 cal (B) 500 cal (C) 225 cal (D) 600 cal (E) 1000 cal

45. A partition wall has two layers of different materials A and B in contact with each other. They have the same thickness but the thermal conductivity of layer A is twice that of layer B. At steady state if the temperature difference across the layer B is 50 K, then the corresponding difference across the layer A is

(A) 50 K (B) 12.5 K (C) 25 K (D) 60 K (E) 6.25 K

Space for rough work

46. Identify the wrong statement

(A) For isothermal process, $\Delta T = 0$

(B) For isochoric process, $\Delta V = 0$

(C) For isobaric process, $\Delta P = 0$

(D) For adiabatic process, $\Delta Q = 0$

(E) For cyclic process, $\Delta W = 0$

47. If the pressure and the volume of certain quantity of ideal gas are halved, then its temperature

(A) is doubled

(B) becomes one-fourth

(C) remains constant

(D) is halved

(E) become four times

48. Two pendulums of lengths 1.44 m and 1 m start to swing together. The number of vibrations after which they will again start swinging together is

(A) 4 (B) 3 (C) 6 (D) 2 (E) 5

49. The average total energy in one time period of a particle of mass m executing SHM of amplitude a and angular velocity ω is

(A) $\frac{1}{2}m\omega^2a^2$ (B) $\frac{1}{4}m\omega^2a^2$ (C) 0

(D) $m\omega^2a^2$ (E) $\frac{1}{8}m\omega^2a^2$

Space for rough work

50. Which one of the following is simple harmonic?

(A) Rotation of earth around the sun

(B) Rotation of earth about its own axis

(C) Revolving motion of a top

(D) Motion of a steel ball in a viscous medium

(E) Motion of oscillating liquid column in U tube

51. If a closed organ pipe of length L_1 in its fundamental mode resonates with an open organ pipe of length L_2, then $L_1 : L_2$ is

(A) 1 : 2 (B) 2 : 1 (C) 1 : 4 (D) 4 : 1 (E) 1 : 8

52. The physical quantity that remains unchanged when a sound wave goes from one medium to another is

(A) amplitude (B) speed (C) wavelength

(D) frequency (E) phase

53. The beat frequency observed when two sound waves $y_1 = 0.5 \sin (410\, t)$ and $y_2 = 0.5 \sin (454\, t)$ travel in the same direction is

(A) 5 (B) 3 (C) 7 (D) 2 (E) 4

Space for rough work

54. Two identical thin rings, each of radius 10 cm carrying charges 10 C and 5 C are coaxially placed at a distance 10 cm apart. The work done in moving a charge q from the centre of the first ring to that of the second is

(A) $\frac{q}{8\pi\varepsilon_0}\left(\frac{\sqrt{2}+1}{\sqrt{2}}\right)$ (B) $\frac{q}{8\pi\varepsilon_0}\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)$ (C) $\frac{q}{4\pi\varepsilon_0}\left(\frac{\sqrt{2}+1}{\sqrt{2}}\right)$

(D) $\frac{q}{4\pi\varepsilon_0}\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)$ (E) $\frac{q}{4\pi\varepsilon_0}\left(\frac{\sqrt{3}+1}{\sqrt{2}}\right)$

55. The electric potential V at any point (x, y, z) in space is given by $V = 3x^2$ where x, y, z are all in metre. The electric field at the point (1 m, 0, 2 m) is

(A) 6 V m^{-1} along negative x-axis

(B) 6 V m^{-1} along positive x-axis

(C) 12 V m^{-1} along negative x-axis

(D) 12 V m^{-1} along positive x-axis

(E) 8 V m^{-1} along negative x-axis

56. Choose the correct statement

(A) Polar molecules have permanent electric dipole moment

(B) CO_2 molecule is a polar molecule

(C) H_2O is a non-polar molecule

(D) The dipole field at large distances falls of as $\frac{1}{r^2}$

(E) The dipole moment is a scalar quantity

Space for rough work

57. The electric field between two infinitely charged plates with air medium in between, in terms of the surface charge density σ is

(A) $4\pi\varepsilon_0$ (B) $\frac{\sigma}{4\pi\varepsilon_0}$ (C) $\frac{\sigma}{\varepsilon_0}$ (D) $\frac{4\pi\sigma}{\varepsilon_0}$ (E) $\frac{\sigma}{4\pi r^2}$

58. Two equal point charges each of 3 μC are separated by a certain distance in metres. If they are located at $(\hat{i}+\hat{j}+\hat{k})$ and $(2\hat{i}+3\hat{j}+\hat{k})$, then the electrostatic force between them is

(A) 9×10^{3} N (B) 9×10^{-3} N (C) 10^{-3} N
(D) 9×10^{-2} N (E) 3×10^{-3} N

59. Three identical bulbs connected in series across an accumulator consumes 20 W power. If the bulbs are connected in parallel to the same source, the power consumed is

(A) 20 W (B) 60 W (C) 90 W (D) 120 W (E) 180 W

60. A galvanometer connected with an unknown resistor and two identical cells in series each of emf 2 V shows a current of 1 A. If the cells are connected in parallel, it shows 0.8 A. Then the internal resistance of the cell is

(A) 1 Ω (B) 0.5 Ω (C) 0.25 Ω (D) 0.33 Ω (E) 0.66 Ω

Space for rough work

61. The resistances in the four arms of a Wheatstone network in cyclic order are 5 Ω, 2 Ω, 6 Ω and 15 Ω. If a current of 2.8 A enters the junction of 5 Ω and 15 Ω, then the current through 2 Ω resistor is

(A) 1.5 A (B) 2.8 A (C) 0.7 A (D) 1.4 A (E) 2.1 A

62. Pick out the wrong feature about carbon resistors

(A) Compact

(B) Inexpensive

(C) Relatively sensitive to temperature

(D) Mostly used for higher resistor values

(E) Colour codes express their resistor values

63. The number of electrons per second flowing through any cross section of the wire carrying current of 1 ampere is

(A) 3.12×10^{16} (B) 1.6×10^{18} (C) 6.25×10^{16}

(D) 3.12×10^{18} (E) 6.25×10^{18}

64. The shunt resistance required to allow 4% of the main current through the galvanometer of resistance 48 Ω is

(A) 1 Ω (B) 2 Ω (C) 3 Ω (D) 4 Ω (E) 5 Ω

Space for rough work

65. A straight wire carrying current I is made into a circular loop. If M is the magnetic moment associated with the loop, then the length of the wire is

(A) $\sqrt{\frac{4\pi M}{I}}$ (B) $\sqrt{\frac{2\pi M}{I}}$ (C) $\sqrt{\frac{\pi M}{I}}$ (D) $\sqrt{\frac{\pi M}{2I}}$ (E) $\sqrt{\frac{\pi M}{4I}}$

66. A magnet takes a minute to make 30 oscillations in a magnetic field. If the field strength is doubled, then the time period of oscillation (in s) is

(A) $\sqrt{2}$ (B) $2\sqrt{2}$ (C) $\frac{\sqrt{3}}{2}$ (D) $\sqrt{3}$ (E) 2

67. The magnetic flux linked with a coil of N turns of area of cross section A held with its plane parallel to the field B is

(A) $\frac{NAB}{2}$ (B) NAB (C) $\frac{NAB}{4}$ (D) 0 (E) 2NAB

68. The ferromagnetic core of electromagnets should have

(A) a broad hysteresis loop

(B) high permeability and high retentivity

(C) low permeability and low retentivity

(D) low permeability and high retentivity

(E) high permeability and low retentivity

Space for rough work

69. A transformer is used to light a 100 W and 110 V lamp using a 220 V main supply. If the supply current is 0.5 A, then the efficiency of the transformer is

(A) 100 % (B) 99 % (C) 90.1 % (D) 87.7% (E) 85 %

70. Two identical coaxial coils P and Q carrying equal amount of current in the same direction are brought nearer. The current in

(A) P increases while in Q decreases

(B) Q increases while in P decreases

(C) both P and Q increases

(D) both P and Q decreases

(E) both P and Q remains constant

71. The self inductance of a long solenoid cannot be increased by

(A) increasing its area of cross section

(B) increasing its length

(C) changing the medium with greater permeability

(D) increasing the number of turns in it

(E) increasing the current through it

72. The power factor of LCR circuit at resonance is

(A) 0 (B) $\frac{1}{2}$ (C) $\frac{1}{\sqrt{2}}$ (D) 1 (E) – 1

Space for rough work

73. The decreasing order of boiling points of alkyl halides is

(A) RF > RCl > RBr > RI

(B) RBr > RCl > RI > RF

(C) RI > RBr > RCl > RF

(D) RCl > RF > RI > RBr

(E) RI > RF > RCl > RBr

74. The correct order of ease of cleavage of ether linkage by hydrogen halide follows

(A) HI > HBr > HCl

(B) HBr > HI > HCl

(C) HCl > HBr > HI

(D) HCl > HI > HBr

(E) HI > HCl > HBr

75. What are the starting materials to get 2-methylpropene as the major product?

(A) Sodium methoxide and *sec*-butyl bromide

(B) Sodium ethoxide and *sec*-butyl bromide

(C) Sodium *tert*-butoxide and ethyl bromide

(D) Sodium methoxide and *tert*-butyl bromide

(E) Sodium *tert*-butoxide and methyl bromide

76. Which one of the following is the correct order of increasing basic strength of nitrogen compounds in aqueous solution?

(A) $NH_3 < C_2H_5NH_2 < C_6H_5NH_2 < (C_2H_5)_2NH < C_6H_5CH_2NH_2$

(B) $C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$

(C) $(C_2H_5)_2NH < C_6H_5CH_2\ NH_2 < NH_3 < C_2H_5NH_2 < C_6H_5NH_2$

(D) $C_6H_5CH_2NH_2 < C_2H_5NH_2 < NH_3 < C_6H_5NH_2 < (C_2H_5)_2NH$

(E) $C_2H_5NH_2 < C_6H_5NH_2 < NH_3 < (C_2H_5)_2NH < C_6H_5CH_2NH_2$

Space for rough work

77. Ethanoic acid on heating with ammonia forms compound A which on treatment with bromine and sodium hydroxide gives compound B. Compound B on treatment with $NaNO_2$/dil.HCl gives compound C. The compounds A, B and C respectively are

(A) ethanamide, methanamine, methanol

(B) propanamide, ethanamine, ethanol

(C) N-ethylpropanamide, methaneisonitrile, methanamine

(D) ethanamine, bromoethane, ethanediazoniumchloride

(E) methanamine, ethanamide, methanol

78. Which one of the following forms the constituent of cell wall of plant cells?

(A) Starch (B) Glycogen (C) Cellulose (D) Amylose (E) Amylopectin

79. A thermoplastic among the following is

(A) bakelite (B) polystyrene

(C) terylene (D) urea-formaldehyde resin

(E) nylon

80. Consider the following antibiotics i) erythromycin ii) ofloxacin iii) chloramphenicol iv) penicillin v) tetracycline. The pair of bactericidal antibiotics is

(A) i-iii (B) ii-iv (C) iii-v (D) i-iv (E) ii-v

81. The maximum prescribed concentration of cadmium in drinking water in ppm is

(A) 0.05 (B) 3 (C) 2 (D) 5 (E) 0.005

82. The gas emitted by supersonic jet planes that slowly depletes the concentration of ozone layer is

(A) CO (B) NO (C) SO_2 (D) O_2 (E) HF

Space for rough work

83. A 100 % pure sample of a divalent metal carbonate weighing 2 g on complete thermal decomposition releases 448 cc of carbon dioxide at STP. The equivalent mass of the metal is

(A) 40 (B) 20 (C) 28 (D) 12 (E) 56

84. The ratio of the frequency corresponding to the third line in Lyman series of hydrogen atomic spectrum to that of the first line in Balmer series of Li^{2+} spectrum is

(A) $\frac{4}{5}$ (B) $\frac{5}{4}$ (C) $\frac{4}{3}$ (D) $\frac{3}{4}$ (E) $\frac{3}{8}$

85. Among the following, the molecule of highest dipole moment is

(A) CCl_4 (B) NH_3 (C) H_2O (D) $CHCl_3$ (E) BF_3

86. The incorrectly matched pair, among the following is

Molecule	Shape
(A) BrF_5	trigonal bipyramidal
(B) SF_4	see saw
(C) ClF_3	T-shape
(D) NH_4^+	tetrahedral
(E) NH_3	trigonal pyramidal

87. The gas with the highest critical temperature is

(A) H_2 (B) He (C) N_2 (D) O_2 (E) CO_2

Space for rough work

88. Molecules / ions and their magnetic properties are given below.

Molecule / ion		Magnetic property
i)	C_6H_6	1) antiferromagnetic
ii)	CrO_2	2) ferrimagnetic
iii)	MnO	3) ferromagnetic
iv)	Fe_3O_4	4) paramagnetic
v)	Fe^{3+}	5) diamagnetic

The correctly matched pairs in the above is

(A)	i-5	ii-3	iii-2	iv-1	v-4
(B)	i-3	ii-5	iii-1	iv-4	v-2
(C)	i-5	ii-3	iii-1	iv-2	v-4
(D)	i-5	ii-3	iii-1	iv-4	v-2
(E)	i-4	ii-5	iii-1	iv-2	v-3

89. Among the following, the element of highest first ionisation enthalpy is

(A) C (B) F (C) Be (D) N (E) Ne

90. Which one of the following has the shortest bond length?

(A) C–H (B) C–N (C) C–O (D) C–C (E) C–F

91. Among the following compounds, the one that gets hydrolysed to form metallic hydroxide, hydrogen peroxide and oxygen is

(A) Na_2O (B) Na_2O_2 (C) Li_2O (D) Li_2O_2 (E) KO_2

Space for rough work

92. The alkaline earth metal with the least density value is

(A) Mg (B) Be (C) Sr (D) Ca (E) Ba

93. Choose the weak monobasic acid, among the following

(A) H_3BO_3 (B) H_3PO_3 (C) H_3PO_4 (D) HNO_3 (E) $H_4P_2O_7$

94. Pick out the wrong statement

(A) Nitrogen has the ability to form $p\pi$-$p\pi$ bonds with itself

(B) Bismuth forms metallic bonds in elemental state

(C) Catenation tendency is higher in nitrogen when compared with other elements of the same group

(D) Nitrogen has higher first ionisation enthalpy when compared with other elements of the same group

(E) Arsenic forms $d\pi$-$d\pi$ bonds with transition metals

95. The wrong statement about the interstitial compounds is

(A) they retain metallic conductivity

(B) they are chemically inert

(C) they are very hard

(D) their bonds are neither ionic nor covalent

(E) their melting points are lower than those of pure metals

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96. Which one of the following is an amphoteric oxide?

(A) Mn_2O_7 (B) CrO (C) V_2O_4 (D) Cr_2O_3 (E) V_2O_3

97. Choose the reaction in which ΔH is not equal to ΔU

(A) $C_{(gr)} + O_{2(g)} \rightarrow CO_{2(g)}$

(B) $C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_{6(g)}$

(C) $2C_{(gr)} + H_{2(g)} \rightarrow C_2H_{2(g)}$

(D) $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$

(E) $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$

98. The standard enthalpies of combustion of $C_6H_{6(l)}$, $C_{(graphite)}$ and $H_{2(g)}$ are respectively -3270 kJ mol^{-1} , -394 kJ mol^{-1} and -286 kJ mol^{-1}. What is the standard enthalpy of formation of $C_6H_{6(l)}$ in kJ mol^{-1}?

(A) -48 (B) $+48$ (C) -480 (D) $+480$ (E) -72

99. In the reaction: $A_{2(g)} + 3B_{2(g)} \rightarrow 2AB_{3(g)}$

the standard entropies (in JK^{-1} mol^{-1}) of $A_{2(g)}$, $B_{2(g)}$ and $AB_{3(g)}$ are respectively 190, 130 and 195 and the standard enthalpy change for the reaction is -95 kJ mol^{-1}. The temperature (in K) at which the reaction attains equilibrium is
(assuming both the standard entropy change and standard enthalpy change for this reaction are constant over a wide range of temperature)

(A) 500 (B) 400 (C) 300 (D) 600 (E) 700

Space for rough work

100. In the following equilibrium reaction

$$2A \rightleftharpoons B + C,$$

the equilibrium concentrations of A, B and C are 1×10^{-3} M, 2×10^{-3} M and 3×10^{-3} M respectively at 300 K. The value of K_c for this equilibrium at the same temperature is

(A) $\frac{1}{6}$ (B) 6 (C) $\frac{1}{36}$ (D) 36 (E) $\frac{1}{24}$

101. Which one of the following is the correct statement?

(A) HCO_3^- is the conjugate base of CO_3^{2-}

(B) NH_2^- is the conjugate acid of NH_3

(C) H_2SO_4 is the conjugate acid of HSO_4^-

(D) NH_3 is the conjugate base of NH_2^-

(E) H_2CO_3 is the conjugate base of HCO_3^-

102. The mole fraction of methanol in its 4.5 molal aqueous solution is

(A) 0.250 (B) 0.125 (C) 0.100 (D) 0.075 (E) 0.055

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103. Freezing point of an aqueous solution is – 0.186°C. If the values of K_b and K_f of water are respectively 0.52 K kg mol^{-1} and 1.86 K kg mol^{-1}, then the elevation of boiling point of the solution in K is

(A) 0.52 (B) 1.04 (C) 1.34 (D) 0.134 (E) 0.052

104. A weak electrolyte having the limiting equivalent conductance of 400 S cm^2 $g.equiv^{-1}$ at 298 K is 2 % ionized in its 0.1N solution. The resistance of this solution (in ohms) in an electrolytic cell of cell constant 0.4 cm^{-1} at this temperature is

(A) 200 (B) 300 (C) 400 (D) 500 (E) 600

105. Given that the standard reduction potentials for M^+/M and N^+/N electrodes at 298 K are 0.52 V and 0.25 V respectively. Which of the following is correct in respect of the following electrochemical cell?

$$M / M^+ \| N^+ / N$$

(A) The overall cell reaction is a spontaneous reaction

(B) The standard EMF of the cell is – 0.27 V

(C) The standard EMF of the cell is 0.77 V

(D) The standard EMF of the cell is – 0.77 V

(E) The standard EMF of the cell is 0.27 V

106. The rate constant of a first order reaction is doubled when the temperature is increased from 20°C to 25°C. How many times the rate constant will increase if the temperature is raised from 20°C to 40°C?

(A) 4 (B) 8 (C) 16 (D) 32 (E) 64

Space for rough work

107. In the following reaction, the initial concentrations of the reactant and initial rates at 298 K are given:

$2A \rightarrow C + D$

$[A]_0$, mol L^{-1}	Initial rate in mol $L^{-1}s^{-1}$
0.01	5.0×10^{-5}
0.02	2.0×10^{-4}

The value of rate constant of this reaction at 298 K is

(A) 0.01 s^{-1} (B) 5×10^{-3} mol $L^{-1}s^{-1}$ (C) 2.0×10^{-2} mol^{-1} L s^{-1}

(D) 5×10^{-1} mol^{-1} L s^{-1} (E) 5.0×10^{-1} mol $L^{-1}s^{-1}$

108. The disease kalaazar is cured by

(A) colloidal antimony (B) milk of magnesia

(C) argyrols (D) colloidal gold

(E) colloidal silver

109. Which is correct about physical adsorption?

(A) High temperature and high pressure favour adsorption

(B) High temperature and low pressure favour adsorption

(C) Low temperature and high pressure favour adsorption

(D) Low temperature and low pressure favour adsorption

(E) Temperature and pressure have no effect on adsorption

110. Excess of copper in toxic proportions in plants/animals can be removed by chelating with

(A) EDTA (B) ethane-1, 2-diamine

(C) oxalate ion (D) D-penicillamine

(E) cupron

Space for rough work

111. 0.02 mole of $[Co(NH_3)_5Br]Cl_2$ and 0.02 mole of $[Co(NH_3)_5Cl]SO_4$ are present in 200 cc of a solution X. The number of moles of the precipitates Y and Z that are formed when the solution X is treated with excess silver nitrate and excess barium chloride are respectively

(A) 0.02, 0.02 (B) 0.01, 0.02 (C) 0.02, 0.04 (D) 0.04, 0.02 (E) 0.02, 0.01

112. In the estimation of sulphur by Carius method, 0.480 g of an organic compound gives 0.699 g of barium sulphate. The percentage of sulphur in this compound is (Atomic masses: Ba = 137, S = 32, O = 16)

(A) 20 % (B) 15 % (C) 35 % (D) 30 % (E) 40 %

113. The least stable free radical is

(A) $CH_3\dot{C}H_2$ (B) $CH_3CH_2\dot{C}H_2$ (C) $(CH_3)_2\dot{C}H$

(D) $(CH_3)_3\dot{C}$ (E) $\dot{C}H_3$

114. The number of sigma (σ) and pi (π) bonds present in 1, 3, 5, 7-Octatetraene respectively are

(A) 14 and 3 (B) 17 and 4 (C) 16 and 5
(D) 15 and 4 (E) 16 and 3

115. The molecule that contains only sp^2 hybrid carbon atoms is

(A) isoprene (B) acrylonitrile (C) but-1-ene
(D) 1, 3-butadiene (E) isobutene

116. Which will undergo S_N2 reaction fastest among the following halogen compounds?

(A) CH_3CH_2F (B) CH_3CH_2Cl (C) CH_3CH_2Br
(D) CH_3CH_2I (E) $(CH_3)_2CH–Cl$

Space for rough work

117. Which one of the following reactions proceeds through free radical chain mechanism?

(A) Addition of HBr on ethene

(B) Halogenation of benzene in the presence of $FeBr_3$

(C) Photochemical chlorination of methane

(D) Hydrolysis of tert-butyl chloride with aqueous KOH

(E) Addition of $NaHSO_3$ on acetone

118. Which one of the following is the correct statement?

(A) Achiral molecules are superimposable

(B) Alanine is optically inactive amino acid

(C) Glycine is optically active amino acid

(D) Racemic lactic acid is optically active

(E) There is inversion when (-)-2-methylbutan-1-ol is heated with conc. HCl to form (+) -1-chloro-2-methylbutane

119. The α- and β- forms of glucose are

(A) isomers of D(+) glucose and L(–) glucose respectively

(B) diastereoisomers of glucose

(C) anomers of glucose

(D) isomers which differ in the configuration of C-2

(E) isomers which differ in the configuration of C-5

120. When HBr adds on hex-1-ene in the presence of benzoyl peroxide, the product is

(A) 2-bromohexane

(B) 2, 3-dibromohexane

(C) 1, 2-dibromohexane

(D) 2, 4-dibromohexane

(E) 1-bromohexane

Space for rough work

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