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	A3	Question Booklet Serial Number :
Time : 150 Minutes	Number of Questions : 120	Maximum Marks : 480
Name of Candidate		
Roll Number		
Signature of Candidate		

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 in the items such as Name, Roll Number and Signature in the columns given above. Please also write Question Booklet Sl. 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.

IMMEDIATELY AFTER OPENING THIS QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

DO NOT OPEN THE SEAL UNTIL THE INVIGILATOR ASKS YOU TO DO SO.

SEAL

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

1. The tolerance level of a resistor with the colour code red, blue, orange, gold is
   (A) ± 5 % (B) ± 10 % (C) ± 20 %
   (D) ± 40 % (E) ± 30 %

2. An electron moving around the nucleus with an angular momentum l has a magnetic moment
   (A) $\frac{e}{m} l$ (B) $\frac{e}{2m} l$ (C) $\frac{2e}{m} l$
   (D) $\frac{e}{2\pi m} l$ (E) $\frac{e}{4\pi m} l$

3. The force between two parallel current carrying wires is independent of
   (A) their distance of separation
   (B) the length of the wires
   (C) the magnitude of currents
   (D) the radii of the wires
   (E) the medium in which they are placed

4. A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60°. The torque required to keep the needle in this position will be
   (A) 2 W (B) W (C) $\frac{W}{\sqrt{2}}$
   (D) $\frac{W}{\sqrt{3}}$ (E) $\sqrt{3}$ W

5. Two identical magnetic dipoles of magnetic moment 2 Am^2 are placed at a separation of 2 m with their axis perpendicular to each other in air. The resultant magnetic field at a midpoint between the dipoles is
   (A) $4\sqrt{5} \times 10^{-5}$ T (B) $2\sqrt{5} \times 10^{-5}$ T (C) $4\sqrt{5} \times 10^{-7}$ T
   (D) $2\sqrt{5} \times 10^{-7}$ T (E) $4\sqrt{2} \times 10^{-7}$ T

Space for rough work

6. A proton, a deuteron and an α-particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles then

(A) $r_\alpha = r_d > r_p$ (B) $r_\alpha = r_d = r_p$ (C) $r_\alpha < r_d < r_p$

(D) $r_\alpha = r_p < r_d$ (E) $r_\alpha > r_d > r_p$

7. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 rad. s^{-1}. If the horizontal component of earth's magnetic field is 0.2×10^{-4} T, then the emf developed between the ends of the conductor is

(A) 5 μV (B) 5 mV (C) 50 μV (D) 50 mV (E) 0.5 mV

8. If E = 100 sin (100 t) volt and I = 100 sin $(100\,t + \frac{\pi}{3})$ mA are the instantaneous values of voltage and current, then the rms values of voltage and current are respectively

(A) 70.7 V, 70.7 mA (B) 70.7 V, 70.7 A

(C) 141.4 V, 141.4 mA (D) 141.4 V, 141.4 A

(E) 100 V, 100 mA

9. The core of a transformer is laminated to reduce

(A) flux leakage (B) output power (C) hysteresis

(D) copper loss (E) eddy current

10. If E_0 is the peak emf, I_0 is the peak current and ϕ is the phase difference between them, then the average power dissipation in the circuit is

(A) $\frac{1}{2} E_0 I_0$ (B) $\frac{E_0 I_0}{\sqrt{2}}$ (C) $\frac{1}{2} E_0 I_0 \sin \phi$

(D) $\frac{1}{2} E_0 I_0 \cos \phi$ (E) $\frac{1}{2} E_0 I_0 \tan \phi$

Space for rough work

11. The electric field of an electromagnetic wave travelling through vacuum is given by the equation $E = E_0 \sin(kx - \omega t)$. The quantity that is independent of wavelength is

(A) $\frac{k}{\omega}$ (B) $k\omega$ (C) ω (D) k (E) $k^2\omega$

12. The electric field of a plane electromagnetic wave varies with time of amplitude 2 Vm^{-1} propagating along z-axis. The average energy density of the magnetic field is (in Jm^{-3})

(A) 13.29×10^{-12} (B) 8.86×10^{-12} (C) 17.72×10^{-12}
(D) 4.43×10^{-12} (E) 2.22×10^{-12}

13. In a Young's double slit experiment, the intensity at a point where the path difference is $\frac{\lambda}{6}$ (λ–wavelength of the light) is I. If I_0 denotes the maximum intensity, then $\frac{I}{I_0}$ is equal to

(A) $\frac{1}{2}$ (B) $\frac{\sqrt{3}}{2}$ (C) $\frac{1}{\sqrt{2}}$ (D) $\frac{3}{4}$ (E) $\frac{1}{\sqrt{3}}$

14. The focal length of the lens of refractive index ($\mu = 1.5$) in air is 10 cm. If air is replaced by water of $\mu = \frac{4}{3}$, its focal length is

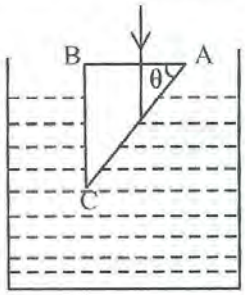
(A) 20 cm (B) 30 cm (C) 40 cm (D) 25 cm (E) 35 cm

15. A beam of natural light falls on a system of 5 polaroids, which are arranged in succession such that the pass axis of each polaroid is turned through 60° with respect to the preceding one. The fraction of the incident light intensity that passes through the system is

(A) $\frac{1}{64}$ (B) $\frac{1}{32}$ (C) $\frac{1}{256}$
(D) $\frac{1}{128}$ (E) $\frac{1}{512}$

Space for rough work

16. A glass prism of refractive index 1.5 is immersed in water ($\mu = \frac{4}{3}$). Refer figure.



A light beam incident normally on the face AB is totally reflected to reach the face BC if

(A) $2/3 < \sin\theta < 8/9$ (B) $\sin\theta \leq 2/3$ (C) $\cos\theta \geq 8/9$

(D) $\sin\theta > 8/9$ (E) $\cos\theta \leq 8/9$

17. A narrow slit of width 2 mm is illuminated by monochromatic light of wavelength 500 nm. The distance between the first minima on either side on a screen at a distance of 1 m is

(A) 5 mm (B) 0.5 mm (C) 1 mm

(D) 10 mm (E) 2.5 mm

18. If e/m of electron is 1.76×10^{11} C kg^{-1} and the stopping potential is 0.71 V, then the maximum velocity of the photoelectron is

(A) 150 km s^{-1} (B) 200 km s^{-1}

(C) 500 km s^{-1} (D) 250 km s^{-1}

(E) 100 km s^{-1}

Space for rough work

19. A radioactive sample at any instant has its disintegration rate 5000 disintegrations per minute. After 5 minutes, the rate becomes 1250 disintegrations per minute. Then, its decay constant (per minute) is

(A) $0.8 \log_e 2$ (B) $0.4 \log_e 2$ (C) $0.2 \log_e 2$

(D) $0.1 \log_e 2$ (E) $0.6 \log_e 2$

20. The distance of closest approach of an α-particle fired towards a nucleus with momentum p, is r. If the momentum of the α-particle is $2p$, the corresponding distance of closest approach is

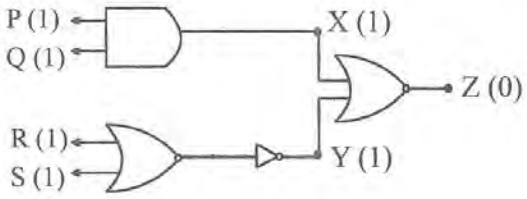
(A) $\frac{r}{2}$ (B) $2r$ (C) $4r$ (D) $\frac{r}{8}$ (E) $\frac{r}{4}$

21. If the binding energy per nucleon of deuteron is 1.115 MeV, its mass defect in atomic mass unit is

(A) 0.0048 (B) 0.0024 (C) 0.0012

(D) 0.0006 (E) 2.230

22. The circuit diagram shows a logic combination with the states of outputs X, Y and Z given for inputs P, Q, R and S all at state 1. When inputs P and R change to state 0 with inputs Q and S still at 1, the states of outputs X, Y and Z change to



(A) 1, 0, 0 (B) 1, 1, 1 (C) 0, 1, 0

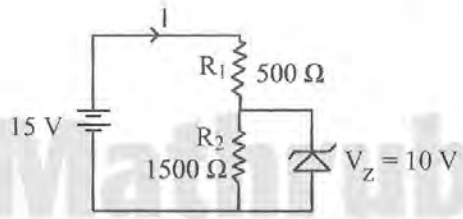
(D) 0, 0, 1 (E) 0, 1, 1

Space for rough work

23. In a common emitter transistor amplifier, the output resistance is 500 KΩ and the current gain β = 49. If the power gain of the amplifier is 5×10^6, the input resistance is

(A) 325 Ω (B) 165 Ω (C) 198 Ω
(D) 225 Ω (E) 240 Ω

24. In the circuit given the current through the zener diode is



(A) 10 mA (B) 6.67 mA (C) 5 mA
(D) 3.33 mA (E) 0 mA

25. A transistor oscillator is (i) an amplifier with positive feedback (ii) an amplifier with reduced gain (iii) the one in which dc supply energy is converted into ac output energy. Then

(A) all (i), (ii) and (iii) are correct
(B) only (i) and (ii) are correct
(C) only (i) and (iii) are correct
(D) only (ii) and (iii) are correct
(E) only (ii) is correct

26. The distance of coverage of a transmitting antenna is 12.8 km. Then, the height of the antenna is
(Given that radius of earth = 6400 km)

(A) 6.4 m (B) 12.8 m (C) 3.2 m
(D) 16 m (E) 25.6 m

Space for rough work

27. If $E_c = 20 \sin 10^5 \pi t$ and $E_m = 10 \sin 400 \pi t$ are carrier and modulating signals, the modulation index is
(A) 56 %
(B) 30 %
(C) 50 %
(D) 48 %
(E) 60 %

28. Which one of the following is INCORRECT statement in the transmission of electromagnetic waves?
(A) Ground wave propagation is for high frequency transmission
(B) Sky wave propagation is facilitated by ionospheric layers
(C) Space wave is of high frequency and is suitable for line of sight communication
(D) Space wave is used for satellite communication
(E) Very high frequency waves cannot be reflected by the ionospheric layers

29. 1000 kHz carrier wave is amplitude modulated by the signal frequency 200 – 4000 Hz. The channel width of this case is
(A) 8 kHz
(B) 4 kHz
(C) 7.6 kHz
(D) 3.8 kHz
(E) 400 kHz

Space for rough work

30. The mass and volume of a body are found to be 5.00 ± 0.05 kg and 1.00 ± 0.05 m^3 respectively. Then the maximum possible percentage error in its density is

(A) 6% (B) 3% (C) 10%

(D) 5% (E) 7%

31. If F denotes force and t time, then in the equation $F = at^{-1} + bt^2$, the dimensions of a and b respectively are

(A) LT^{-4} and LT^{-1}

(B) LT^{-1} and LT^{-4}

(C) MLT^{-4} and MLT^{-1}

(D) MLT^{-1} and MLT^{-4}

(E) MLT^{-3} and MLT^{-2}

32. A car moves a distance of 200 m. It covers first half of the distance at speed 60 km h^{-1} and the second half at speed v. If the average speed is 40 km h^{-1}, the value of v is

(A) 30 km h^{-1}

(B) 13 km h^{-1}

(C) 60 km h^{-1}

(D) 40 km h^{-1}

(E) 20 km h^{-1}

33. A bus begins to move with an acceleration of 1 ms^{-2}. A man who is 48 m behind the bus starts running at 10 ms^{-1} to catch the bus. The man will be able to catch the bus after

(A) 6 s (B) 5 s (C) 3 s

(D) 7 s (E) 8 s

Space for rough work

34. A particle is moving with constant acceleration from A to B in a straight line AB. If u and v are the velocities at A and B respectively then its velocity at the midpoint C will be

(A) $\left(\frac{u^2+v^2}{2u}\right)^2$ (B) $\frac{u+v}{2}$

(C) $\frac{v-u}{2}$ (D) $\sqrt{\frac{u^2+v^2}{2}}$

(E) $\sqrt{\frac{v^2-u^2}{2}}$

35. An aircraft is flying at a height of 3400 m above the ground. If the angle subtended at a ground observation point by the aircraft positions 10 s apart is 30°, then the speed of the aircraft is

(A) 19.63 ms^{-1} (B) 1963 ms^{-1} (C) 108 ms^{-1}

(D) 196.3 ms^{-1} (E) 10.8 ms^{-1}

36. Two projectiles A and B thrown with speeds in the ratio 1: $\sqrt{2}$ acquired the same heights. If A is thrown at an angle of 45° with the horizontal, the angle of projection of B will be

(A) 0° (B) 60° (C) 30°

(D) 45° (E) 15°

37. A particle crossing the origin of co-ordinates at time $t = 0$, moves in the xy-plane with a constant acceleration 'a' in the y-direction. If its equation of motion is $y = bx^2$ (b is a constant), its velocity component in the x-direction is

(A) $\sqrt{\frac{2b}{a}}$ (B) $\sqrt{\frac{a}{2b}}$ (C) $\sqrt{\frac{a}{b}}$ (D) $\sqrt{\frac{b}{a}}$ (E) $\sqrt{ba}$

Space for rough work

38. A stationary bomb explodes into three pieces. One piece of 2 kg mass moves with a velocity of 8 ms^{-1} at right angles to the other piece of mass 1 kg moving with a velocity of 12 ms^{-1}. If the mass of the third piece is 0.5 kg, then its velocity is

(A) 10 ms^{-1} (B) 20 ms^{-1} (C) 30 ms^{-1} (D) 40 ms^{-1} (E) 50 ms^{-1}

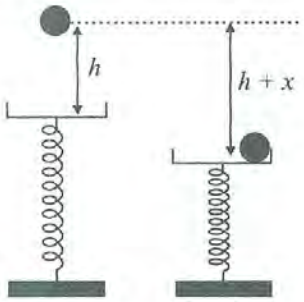
39. A block at rest slides down a smooth inclined plane which makes an angle 60° with the vertical and it reaches the ground in t_1 seconds. Another block is dropped vertically from the same point and reaches the ground in t_2 seconds. Then the ratio of $t_1 : t_2$ is

(A) 1:2 (B) 2:1 (C) 1:3 (D) $1:\sqrt{2}$ (E) 3:1

40. A bridge is in the form of a semi-circle of radius 40 m. The greatest speed with which a motor cycle can cross the bridge without leaving the ground at the highest point is (g =10 ms^{-2})
(frictional force is negligibly small)

(A) 40 ms^{-1} (B) 20 ms^{-1} (C) 30 ms^{-1} (D) 15 ms^{-1} (E) 25 ms^{-1}

41. A ball of mass m is dropped from a height h on a platform fixed at the top of a vertical spring, as shown in figure. The platform is depressed by a distance x. Then the spring constant is



(A) $\frac{mg}{(h+x)}$ (B) $\frac{mg}{(h+2x)}$ (C) $\frac{2mg(h+x)}{x^2}$ (D) $\frac{mg}{(2h+x)}$ (E) $\frac{2mg}{(h+x)}$

Space for rough work

42. A ball dropped from a height of 2 m rebounds to a height of 1.5 m after hitting the ground. Then the percentage of energy lost is

(A) 25 (B) 30 (C) 50

(D) 100 (E) 200

43. A particle of mass m is moving in a horizontal circle of radius r, under a centripetal force $F = \frac{k}{r^2}$, where k is a constant

(A) The potential energy of the particle is zero

(B) The potential energy of the particle is $\frac{k}{r}$

(C) The total energy of the particle is $-\frac{k}{2r}$

(D) The kinetic energy of the particle is $-\frac{k}{r}$

(E) The potential energy of the particle is $-\frac{k}{2r}$

44. A ring starts to roll down the inclined plane of height h without slipping. The velocity with which it reaches the ground is

(A) $\sqrt{\frac{10gh}{7}}$ (B) $\sqrt{\frac{4gh}{7}}$ (C) $\sqrt{\frac{4gh}{3}}$

(D) $\sqrt{2gh}$ (E) $\sqrt{gh}$

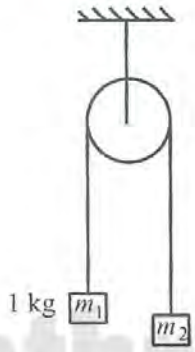
45. The angular momentum of a particle describing uniform circular motion is L. If its kinetic energy is halved and angular velocity doubled, its new angular momentum is

(A) 4L (B) $\frac{L}{4}$ (C) $\frac{L}{2}$

(D) 2L (E) $\frac{L}{8}$

Space for rough work

46. Two masses $m_1 = 1$ kg and $m_2 = 2$ kg are connected by a light inextensible string and suspended by means of a weightless pulley as shown in the figure.



Assuming that both the masses start from rest, the distance travelled by the centre of mass in two seconds is (take $g = 10\ ms^{-2}$)

(A) $\frac{20}{9}$ m (B) $\frac{40}{9}$ m (C) $\frac{2}{3}$ m

(D) $\frac{1}{3}$ m (E) 4 m

47. The average depth of Indian ocean is about 3000 m. The fractional compression, $\frac{\Delta V}{V}$ of water at the bottom of the ocean (given that the bulk modulus of the water = $2.2 \times 10^9\ Nm^{-2}$ and $g = 10\ ms^{-2}$) is

(A) 0.82% (B) 0.91% (C) 1.36% (D) 1.24% (E) 1.52%

48. A satellite is launched into a circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius 4 R. The ratio of their respective periods is

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

Space for rough work

49. A body is projected with a velocity of 2×11.2 km s^{-1} from the surface of earth. The velocity of the body when it escapes the gravitational pull of earth is

(A) $\sqrt{3} \times 11.2$ km s^{-1} (B) 11.2 km s^{-1} (C) $\sqrt{2} \times 11.2$ km s^{-1}

(D) 0.5×11.2 km s^{-1} (E) 2×11.2 km s^{-1}

50. The terminal speed of a sphere of gold (density = 19.5 kg m^{-3}) is 0.2 ms^{-1} in a viscous liquid (density = 1.5 kg m^{-3}). Then the terminal speed of a sphere of silver (density 10.5 kg m^{-3}) of the same size in the same liquid is

(A) 0.1 ms^{-1} (B) 1.133 ms^{-1} (C) 0.4 ms^{-1}

(D) 0.2 ms^{-1} (E) 0.3 ms^{-1}

51. A large open tank has two holes in its wall. One is a square hole of side 'a' at a depth of x from the top and the other is a circular hole of radius 'r' at a depth $4x$ from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then r is equal to

(A) $2\pi a$ (B) a (C) $\frac{a}{2\pi}$

(D) $\frac{a}{\pi}$ (E) $\frac{a}{\sqrt{2\pi}}$

52. Ice pieces are floating in a beaker A containing water and also in a beaker B containing miscible liquid of specific gravity 1.2. When ice melts, the level of

(A) water increases in A

(B) water decreases in A

(C) liquid in B decreases

(D) liquid in B increases

(E) water in A and liquid in B remains unaltered

Space for rough work

53. Identify the INCORRECT statement.
(A) Young's modulus and shear modulus are relevant only for solids.
(B) Bulk modulus is relevant for solids, liquids and gases.
(C) Alloys have larger values of Young's modulus than metals.
(D) Metals have larger values of Young's modulus than elastomers.
(E) Stress is not a vector quantity.

54. A Carnot engine whose efficiency is 40%, receives heat at 500 K. If the efficiency is to be 50%, the source temperature for the same exhaust temperature is
(A) 900 K (B) 600 K (C) 700 K
(D) 800 K (E) 550 K

55. The ratio of the molar heat capacities of a diatomic gas at constant pressure to that at constant volume is
(A) $\frac{7}{2}$ (B) $\frac{3}{2}$ (C) $\frac{3}{5}$ (D) $\frac{7}{5}$ (E) $\frac{5}{2}$

56. The thermodynamic process in which no work is done on or by the gas is
(A) isothermal process
(B) adiabatic process
(C) cyclic process
(D) isobaric process
(E) isochoric process

57. A lead bullet strikes against a steel plate with a velocity 200 ms^{-1}. If the impact is perfectly inelastic and the heat produced is equally shared between the bullet and the target, then the rise in temperature of the bullet is (specific heat capacity of lead = 125 $J\ kg^{-1}\ K^{-1}$)
(A) 80° C (B) 60° C (C) 160° C
(D) 40° C (E) 120° C

Space for rough work

58. A body of mass 4.9 kg hangs from a spring and oscillates with a period 0.5 s. On the removal of the body, the spring is shortened by (take $g = 10\ ms^{-2}$, $\pi^2 = 10$)

(A) 6.3 m (B) 0.63 m (C) 6.25 cm
(D) 63 cm (E) 0.625 cm

59. The amplitude of a damped oscillator becomes $\left(\frac{1}{3}\right)$rd in 2 seconds. If its amplitude after 6 seconds is $\frac{1}{n}$ times the original amplitude, the value of n is

(A) 3^2 (B) $\sqrt[3]{2}$ (C) $\sqrt[3]{3}$
(D) 2^3 (E) 3^3

60. If two springs A and B with spring constants $2k$ and k, are stretched separately by same suspended weight, then the ratio between the work done in stretching A and B is

(A) 1 : 2 (B) 1 : 4 (C) 1 : 3
(D) 4 : 1 (E) 2 : 1

61. Tube A has both ends open while tube B has one end closed. Otherwise they are identical. Their fundamental frequencies are in the ratio

(A) 4 : 1 (B) 2 : 1 (C) 1 : 4
(D) 1 : 2 (E) 2 : 3

62. The speed of sound in a gas of density ρ at a pressure P is proportional to

(A) $\left(\frac{P}{\rho}\right)^2$ (B) $\left(\frac{P}{\rho}\right)^{\frac{3}{2}}$ (C) $\sqrt{\frac{\rho}{P}}$
(D) $\sqrt{\frac{P}{\rho}}$ (E) $\left(\frac{\rho}{P}\right)^2$

Space for rough work

63. A tuning fork of frequency 330 Hz resonates with an air column of length 120 cm in a cylindrical tube, in the fundamental mode. When water is slowly poured in it, the minimum height of water required for observing resonance once again is (velocity of sound 330 ms^{-1})

(A) 75 cm (B) 60 cm (C) 50 cm (D) 30 cm (E) 45 cm

64. Electric charge is uniformly distributed along a long straight wire of radius 1 mm. The charge per cm length of the wire is Q coulomb. Another cylindrical surface of radius 50 cm and length 1 m symmetrically encloses the wire. The total electric flux passing through the cylindrical surface is

(A) $\frac{Q}{\epsilon_0}$ (B) $\frac{100Q}{\epsilon_0}$ (C) $\frac{10Q}{\pi\epsilon_0}$ (D) $\frac{100Q}{\pi\epsilon_0}$ (E) $\frac{Q}{100\epsilon_0}$

65. A charged particle q is shot towards another charged particle Q which is fixed, with a speed v. It approaches Q upto a closest distance r and then returns. If q is shot with speed $2v$, the closest distance of approach would be

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

66. A dipole of electric dipole moment p is placed in a uniform electric field of strength E. If θ is the angle between positive directions of p and E, then the potential energy of the electric dipole is largest when θ is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$ (C) π (D) zero (E) $\frac{2}{3}\pi$

67. Two conducting spheres of radii 3 cm and 1 cm are separated by a distance of 10 cm in free space. If the spheres are charged to same potential of 10 V each, the force of repulsion between them is

(A) $\left(\frac{1}{3}\right) \times 10^{-9}$ N (B) $\left(\frac{2}{9}\right) \times 10^{-9}$ N

(C) $\left(\frac{1}{9}\right) \times 10^{-9}$ N (D) $\left(\frac{4}{3}\right) \times 10^{-9}$ N

(E) $\left(\frac{2}{3}\right) \times 10^{-9}$ N

Space for rough work

68. If $q_1 + q_2 = q$, then the value of the ratio $\frac{q_1}{q}$, for which the force between q_1 and q_2 is maximum is

(A) 0.25 (B) 0.75 (C) 1
(D) 0.5 (E) 1.5

69. The resistance of a 10 m long wire is 10 Ω. Its length is increased by 25% by stretching the wire uniformly. Then the resistance of the wire will be

(A) 12.5 Ω (B) 14.5 Ω (C) 15.6 Ω (D) 16.6 Ω (E) 18.6 Ω

70. If 2A of current is passed through $CuSO_4$ solution for 32 seconds, then the number of copper ions deposited at the cathode will be

(A) 4×10^{20} (B) 2×10^{20} (C) 4×10^{19}
(D) 2×10^{19} (E) 1.6×10^{19}

71. In a potentiometer experiment, when three cells A, B and C are connected in series the balancing length is found to be 740 cm. If A and B are connected in series balancing length is 440 cm and for B and C connected in series that is 540 cm. Then the emf of E_A, E_B and E_C are respectively (in volts)

(A) 1, 1.2 and 1.5
(B) 1, 2 and 3
(C) 1.5 , 2 and 3
(D) 1.5, 2.5 and 3.5
(E) 1.2, 1.5 and 3.5

72. Find the TRUE statement

(A) Ohm's law is applicable to all conductors of electricity
(B) In an electrolyte solution, the electric current is mainly due to the movement of electrons
(C) The resistance of an incandescent lamp is lesser when the lamp is switched on
(D) Specific resistance of a wire depends upon its dimension
(E) The resistance of carbon decreases with the increase of temperature

Space for rough work

73. A weak monobasic acid is 1 % ionized in 0.1M solution at 25°C. The percentage of ionization in its 0.025M solution is

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

74. Consider the following statements in respect of zero order reaction

I. The rate of the reaction is independent of reactant concentration.
II. The rate of the reaction is independent of temperature.
III. The rate constant of the reaction is independent of temperature.
IV. The rate constant of the reaction is independent of reactant concentration.

Choose the correct statement/s

(A) I only
(B) I and II only
(C) III and IV only
(D) I and III only
(E) I and IV only

75. The complex ion which has the highest magnetic moment among the following is

(A) $[CoF_6]^3$
(B) $[Co(NH_3)_6]^{3+}$
(C) $[Ni(NH_3)_4]^{2+}$
(D) $[Ni(CN)_4]^{2-}$
(E) $[Fe(CN)_6]^{4-}$

76. The standard redox potentials for the reactions $Mn^{2+} + 2e^- \rightarrow Mn$ and $Mn^{3+} + e^- \rightarrow Mn^{2+}$ are –1.18 V and 1.51 V respectively. What is the redox potential for the reaction $Mn^{3+} + 3e^- \rightarrow Mn$?

(A) 0.33 V
(B) 1.69 V
(C) – 0.28 V
(D) – 0.85 V
(E) 0.85 V

Space for rough work

77. The limiting molar conductivities of HCl, CH_3COONa and NaCl are respectively 425, 90 and 125 mho cm^2 mol^{-1} at 25°C. The molar conductivity of 0.1M CH_3COOH solution is 7.8 mho cm^2 mol^{-1} at the same temperature. The degree of dissociation of 0.1M acetic acid solution at the same temperature is

(A) 0.10 (B) 0.02 (C) 0.15
(D) 0.03 (E) 0.20

78. When 0.01 mole of a cobalt complex is treated with excess silver nitrate solution, 4.305 g of silver chloride is precipitated. The formula of the complex is

(A) $[Co(NH_3)_3Cl_3]$ (B) $[Co(NH_3)_5Cl]Cl_2$ (C) $[Co(NH_3)_6]Cl_3$
(D) $[Co(NH_3)_4Cl_2]NO_3$ (E) $[Co(NH_3)_4Cl_2]Cl$

79. The IUPAC name of the compound $CH_3–CH(CH_3)–CO–CH_3$, is

(A) 3-Methyl 2-butanone
(B) 2-Methyl 3-butanone
(C) Isopropyl methyl ketone
(D) Methyl isopropyl ketone
(E) 1,1-Dimethyl acetone

80. Two organic compounds X and Y on analysis gave the same percentage composition, namely, C = (12/13) × 100 % and H = (1/13) × 100 %. However, compound X decolourises bromine water while compound Y does not. The two compounds X and Y may be respectively

(A) Acetylene and ethylene
(B) Acetylene and benzene
(C) Ethylene and benzene
(D) Toluene and benzene
(E) Benzene and styrene

81. The correct order of boiling points of 2, 2-dimethylpropane, 2-methylbutane and *n*-pentane is

(A) *n*-pentane > 2,2-dimethylpropane > 2-methylbutane
(B) *n*-pentane > 2-methylbutane > 2,2-dimethylpropane
(C) 2,2-dimethylpropane > 2-methylbutane > *n*-pentane
(D) 2-methylbutane > *n*-pentane > 2,2-dimethylpropane
(E) 2-methylbutane > 2,2-dimethylpropane > *n*-pentane

Space for rough work

82. For preparing an alkane, a saturated solution of sodium or potassium salt of a carboxylic acid is subjected to

(A) Hydrolysis (B) Oxidation (C) Hydrogenation

(D) Hydration (E) Electrolysis

83. The stablest radical among the following is

(A) $C_6H_5CH_2-\dot{C}H_2$

(B) $CH_3\dot{C}H_2$

(C) $C_6H_5-\dot{C}H-CH_3$

(D) $CH_3-\dot{C}H-CH_3$

(E) $CH_3-CH_2-\dot{C}H_2$

84. The temporary effect in which there is complete transfer of a shared pair of pi-electrons to one of the atoms joined by a multiple bond on the demand of an attacking reagent is called

(A) inductive effect

(B) positive resonance effect

(C) negative resonance effect

(D) hyperconjugation

(E) electromeric effect

85. Among the following pairs, the pair that illustrates stereoisomerism is

(A) 1-butanol and 2-butanol

(B) cis-2-butene and trans-2-butene

(C) dimethyl ether and ethanol

(D) acetone and propanal

(E) ethanol and ethanal

Space for rough work

86. The compound CHCl=CHCHOHCOOH with molecular formula $C_4H_5O_3Cl$ can exhibit
(A) geometric, optical, position and functional isomerism
(B) geometric, optical and functional isomerism only
(C) position and functional isomerism only
(D) geometric and optical isomerism only
(E) geometric isomerism only

87. Which of the following is the correct method of preparation of methyl fluoride?
(A) $CH_4 + HF \rightarrow$
(B) $CH_3OH + HF \rightarrow$
(C) $CH_4 + F_2 \rightarrow$
(D) $CH_3Br + AgF \rightarrow$
(E) $CH_3NH_2 + HF \rightarrow$

88. When 3-phenylpropene reacts with HBr in the presence of peroxide, the major product formed is
(A) 2-bromo 1-phenylpropane
(B) 1,2-dibromo 3-phenylpropane
(C) 3-(*o*-bromophenyl)propene
(D) 1-bromo 3-phenylpropane
(E) 3-(*p*-bromophenyl)propene

89. Reaction of butanone with methylmagnesium bromide followed by hydrolysis gives
(A) 2-methyl-2-butanol (B) 2-butanol (C) 3-methyl-2-butanol
(D) 2,2-dimethyl-1-butanol (E) 2-pentanol

90. The hydroxyl compound that gives a precipitate immediately when treated with concentrated hydrochloric acid and anhydrous zinc chloride is
(A) 3-methyl-2-butanol
(B) 3-methyl-1-butanol
(C) 1-butanol
(D) 2-methyl-2-butanol
(E) 2,3-dimethyl-1-butanol

Space for rough work

91. Phenol can be converted to *o*-hydroxybenzaldehyde by
(A) Kolbe's reaction
(B) Reimer–Tiemann reaction
(C) Wurtz reaction
(D) Cannizzaro reaction
(E) Sandmeyer's reaction

92. *n*-Butylamine(I), diethylamine(II) and N,N-dimethylethylamine(III) have the same molar mass. The increasing order of their boiling point is
(A) III < II < I
(B) I < II < III
(C) II < III < I
(D) II < I < III
(E) III < I < II

93. Choose the incorrect statement
(A) Primary amines show intermolecular hydrogen bonds
(B) Tert-butylamine is a primary amine
(C) Tertiary amines do not show intermolecular hydrogen bonds
(D) Isopropylamine is a secondary amine
(E) Amines have lower boiling points as compared to those of alcohols of comparable molecular mass

94. The monomers used for the preparation of nylon 2-nylon 6 is/are
(A) caprolactam
(B) alanine and amino caproic acid
(C) glycine and amino caproic acid
(D) hexamethylenediamine and adipic acid
(E) glycine and amino valeric acid

Space for rough work

95. Zeigler–Natta catalyst is used in the preparation of
(A) Low density polythene
(B) High density polythene
(C) Dacron
(D) Teflon
(E) PVC

96. The cationic detergent that is used in hair conditioners is
(A) sodium dodecylbenzene sulphonate
(B) sodium lauryl sulphate
(C) tetramethyl ammonium chloride
(D) sodium stearyl sulphate
(E) cetyltrimethyl ammonium bromide

97. Salts of sorbic acid and propionic acid are used as
(A) Antioxidants
(B) Flavouring agents
(C) Food preservatives
(D) Nutritional supplements
(E) Detergents

Space for rough work

98. Arrange the following in the order of increasing mass (atomic mass: O=16, Cu=63, N=14)

I. one atom of oxygen

II. one atom of nitrogen

III. 1×10^{-10} mole of oxygen

IV. 1×10^{-10} mole of copper

(A) II < I < III < IV

(B) I < II < III < IV

(C) III < II < IV < I

(D) IV < II < III < I

(E) II < IV < I < III

99. Which transition in the hydrogen atomic spectrum will have the same wavelength as the transition, n=4 to n=2 of He^+ spectrum?

(A) n=4 to n=3 (B) n=3 to n=2

(C) n=4 to n=2 (D) n=3 to n=1

(E) n=2 to n=1

100. Which of the following is not correct with respect to bond length of the species?

(A) $C_2 > C_2^{2-}$ (B) $B_2^+ > B_2$

(C) $Li_2^+ > Li_2$ (D) $N_2^+ > N_2$

(E) $O_2 > O_2^-$

101. Intramolecular hydrogen bond is present in

(A) water (B) *o*-nitrophenol (C) *p*-nitrophenol

(D) methylamine (E) ethanol

102. A mixture of ethane and ethene occupies 41 L at 1 atm and 500 K. The mixture reacts completely with $\frac{10}{3}$ mole of O_2 to produce CO_2 and H_2O. The mole fractions of ethane and ethene in the mixture are (R = 0.082 L atm K^{-1} mol^{-1}) respectively

(A) 0.50, 0.50 (B) 0.75, 0.25 (C) 0.67, 0.33

(D) 0.25, 0.75 (E) 0.33, 0.67

Space for rough work

103. Substance which is weakly repelled by a magnetic field is
(A) O_2
(B) H_2O
(C) CrO_2
(D) Fe_3O_4
(E) $ZnFe_2O_4$

104. The correct decreasing order of first ionisation enthalpies of five elements of the second period is
(A) Be > B > C > N > F
(B) N > F > C > B > Be
(C) F > N > C > Be > B
(D) N > F > B > C > Be
(E) F > C > N > B > Be

105. In the reaction $H_2S + H_2O_2 \rightarrow S + 2H_2O$
(A) H_2S is an acid and H_2O_2 is a base
(B) H_2S is a base and H_2O_2 is an acid
(C) H_2S is an oxidizing agent and H_2O_2 is a reducing agent
(D) H_2S is a reducing agent and H_2O_2 is an oxidising agent
(E) H_2S is hydrolysed to S

106. Be and Al exhibit diagonal relationship. Which of the following statements about them is/are not true?
(i) Both react with HCl to liberate H_2
(ii) They are made passive by HNO_3
(iii) Their carbides give acetylene on treatment with water
(iv) Their oxides are amphoteric

(A) (iii) and (iv)
(B) (i) and (iii)
(C) (i) only
(D) (ii) and (iii)
(E) (iii) only

Space for rough work

107. Which one of the following on hydrolysis, gives the corresponding metallic hydroxide, H_2O_2 and O_2?
(A) Li_2O
(B) Na_2O_2
(C) NaO_2
(D) Na_2O
(E) BeO

108. The least stable hydride of 15^{th} group elements is
(A) NH_3
(B) PH_3
(C) AsH_3
(D) SbH_3
(E) BiH_3

109. Which one of the following oxides of nitrogen dimerises into a colourless solid/liquid on cooling?
(A) N_2O
(B) NO
(C) N_2O_3
(D) NO_2
(E) N_2O_5

110. The bonds present in the structure of dichromate ion are
(A) four equivalent Cr–O bonds only
(B) six equivalent Cr–O bonds and one O–O bond
(C) six equivalent Cr–O bonds and one Cr–Cr bond
(D) eight equivalent Cr–O bonds
(E) six equivalent Cr–O bonds and one Cr–O–Cr bond

Space for rough work

111. Consider the following statements

(I) $La(OH)_3$ is the least basic among hydroxides of lanthanides

(II) Zr^{4+} and Hf^{4+} possess almost the same ionic radii

(III) Ce^{4+} can act as an oxidizing agent

Which of the above is/are true?

(A) (I) and (III)
(B) (II) and (III)
(C) (II) only
(D) (I) and (II)
(E) (I) only

112. Molar heat capacity of aluminium is 25 $JK^{-1}mol^{-1}$. The heat necessary to raise the temperature of 54 g of aluminium (Atomic mass 27 g mol^{-1}) from 30°C to 50°C is

(A) 1.5 kJ (B) 0.5 kJ (C) 1.0 kJ
(D) 2.5 kJ (E) 2.0 kJ

113. The solubility product (K_{sp}) of the following compounds are given at 25°C

Compound	K_{sp}
AgCl	1.1×10^{-10}
AgI	1.0×10^{-16}
$PbCrO_4$	4.0×10^{-14}
Ag_2CO_3	8.0×10^{-12}

The most soluble and least soluble compounds are

(A) AgCl and $PbCrO_4$
(B) AgI and Ag_2CO_3
(C) AgCl and Ag_2CO_3
(D) Ag_2CO_3 and AgI
(E) Ag_2CO_3 and $PbCrO_4$

Space for rough work

114. A solution containing 1.8 g of a compound (empirical formula CH_2O) in 40 g of water is observed to freeze at – 0.465°C. The molecular formula of the compound is (K_f of water = 1.86 kg K mol^{-1})

(A) $C_2H_4O_2$

(B) $C_3H_6O_3$

(C) $C_4H_8O_4$

(D) $C_5H_{10}O_5$

(E) $C_6H_{12}O_6$

115. In the disproportionation reaction $3HClO_3 \rightarrow HClO_4 + Cl_2 + 2O_2 + H_2O$, the equivalent mass of the oxidizing agent is (molar mass of $HClO_3$ = 84.45)

(A) 16.89

(B) 32.22

(C) 84.45

(D) 28.15

(E) 29.7

116. The rate of the reaction A $\rightarrow$ products, at the initial concentration of 3.24×10^{-2} M is nine times its rate at another initial concentration of 1.2×10^{-3} M. The order of the reaction is

(A) $\frac{1}{2}$

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

(C) $\frac{3}{2}$

(D) $\frac{2}{3}$

(E) $\frac{1}{3}$

Space for rough work

117. Associated colloid among the following is
(A) enzymes
(B) proteins
(C) cellulose
(D) starch
(E) sodium stearate

118. The correct statement with respect to the complexes $Ni(CO)_4$ and $[Ni(CN)_4]^{2-}$ is
(A) Nickel is in the same oxidation state in both
(B) Both have tetrahedral geometry
(C) Both have square planar geometry
(D) Have square planar and tetrahedral geometry respectively
(E) Have tetrahedral and square planar geometry respectively

119. Four moles of PCl_5 are heated in a closed 4 dm^3 container to reach equilibrium at 400 K. At equilibrium 50 % of PCl_5 is dissociated. What is the value of K_C for the dissociation of PCl_5 into PCl_3 and Cl_2 at 400 K?
(A) 0.50
(B) 1.00
(C) 1.25
(D) 0.05
(E) 0.25

120. At 25°C, a 5 % aqueous solution of glucose (molecular weight=180 g mol^{-1}) is isotonic with a 2 % aqueous solution containing an unknown solute. What is the molecular weight of the unknown solute?
(A) 60 (B) 80 (C) 72
(D) 63 (E) 98

Space for rough work