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

PAPER – I   PHYSICS & CHEMISTRY–2016

Version Code	**A2**	Question Booklet Serial Number :	**5237666**

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 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 3 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.

1. The one which does not represent a force in any context is

   (A) friction   (B) impulse   (C) tension

   (D) weight   (E) viscous drag

2. The Work-Energy theorem states that the change in

   (A) kinetic energy of a particle is equal to the work done on it by the net force

   (B) kinetic energy of a particle is equal to the work done by one of forces acting on it

   (C) potential energy of a particle is equal to the work done on it by the net force

   (D) potential energy of a particle is equal to the work done by one of forces acting on it

   (E) total energy of a particle is equal to the work done on it by the net force

3. A car of mass 1500 kg is lifted up a distance of 30 m by crane A in 0.5 minutes. The second crane B does the same job in 1 minute. The ratio of their powers is

   (A) 1 : 2   (B) 2 : 1   (C) 1 : 1

   (D) 1 : 4   (E) 4 : 1

4. Water from a hose pipe of radius 5 cm strikes a wall normally at a speed of 5 ms^{-1}. The force exerted on the wall in newton is

   (A) 13.5π (B) 6.25π (C) 62.5π

   (D) 27π (E) 125π

Space for rough work

5. The position vectors of two identical particles with respect to the origin in three dimensional co-ordinate system are $\vec{r}_1$ and $\vec{r}_2$. The position vector of centre of mass of the system is given by

(A) $\vec{r}_1 + \vec{r}_2$

(B) $\dfrac{\vec{r}_1 - \vec{r}_2}{2}$

(C) $\vec{r}_1 - \vec{r}_2$

(D) $\dfrac{\vec{r}_1 + \vec{r}_2}{2}$

(E) $\dfrac{\vec{r}_1 + \vec{r}_2}{3}$

6. If a body of moment of inertia 2 kg m^2 revolves about its own axis making 2 rotations per second, then its angular momentum (in Js) is

(A) 2π

(B) 4π

(C) 6π

(D) 8π

(E) 10π

7. A rigid body is the one in which

(A) it can have only rotational motion

(B) it can have only translational motion

(C) the distances between all pairs of particles of the body do not change

(D) its shape can be deformed

(E) its centre of mass always lies inside the material of the body

8. A body hanging from a massless spring stretches it by 3 cm on earth's surface. At a place 800 km above the earth's surface, the same body will stretch the spring by (Radius of earth = 6400 km)

(A) $\left(\dfrac{34}{27}\right)$ cm

(B) $\left(\dfrac{64}{27}\right)$ cm

(C) $\left(\dfrac{27}{64}\right)$ cm

(D) $\left(\dfrac{27}{34}\right)$ cm

(E) $\left(\dfrac{35}{81}\right)$ cm

Space for rough work

9. The acceleration due to gravity on the surface of a planet is one-fourth of the value on earth. When a brass ball is brought to this planet, its

(A) mass is halved
(B) weight is halved
(C) mass becomes one-fourth
(D) weight becomes one-fourth
(E) mass and weight remain the same

10. Polar satellites

(A) are high altitude satellites
(B) are widely used for telecommunication
(C) are used for environmental studies
(D) go around the earth in a east-west direction
(E) have time-period of rotation of 24 hours

11. If a capillary tube of radius r is immersed in a liquid, the liquid rises to a height h. The corresponding mass of liquid column is m. The mass of water that would rise in another capillary tube of twice the radius is

(A) $2m$ (B) $5m$ (C) $3m$

(D) $4m$ (E) $\dfrac{m}{2}$

12. In a horizontal pipe of non-uniform cross-section, water flows with a velocity of $1\ ms^{-1}$ at a point where the diameter of the pipe is 20 cm. The velocity of water (in ms^{-1}) at a point where the diameter of the pipe is 5 cm is

(A) 64   (B) 24   (C) 8

(D) 32   (E) 16

Space for rough work

13. A spherical ball of diameter 1 cm and density 5×10^3 kg m^{-3} is dropped gently in a large tank containing viscous liquid of density 3×10^3 kg m^{-3} and coefficient of viscosity 0.1 Ns m^{-2}. The distance, the ball moves in 1 s after attaining terminal velocity is ($g = 10$ ms^{-2})

(A) $\dfrac{10}{9}$ m

(B) $\dfrac{2}{3}$ m

(C) $\dfrac{4}{9}$ m

(D) $\dfrac{4}{5}$ m

(E) $\dfrac{9}{10}$ m

14. A stone of density 2000 kg m^{-3} completely immersed in a lake is allowed to sink from rest. If the effect of friction is neglected, then after 4 seconds. the stone will reach a depth of

(A) 78.4 m

(B) 39.2 m

(C) 19.6 m

(D) 9.8 m

(E) 24.6 m

15. The Zeroth law of thermodynamics leads to the concept of

(A) internal energy

(B) heat content

(C) pressure

(D) temperature

(E) work done

16. If the average kinetic energy of a molecule of a hydrogen gas at 300 K is E, the average kinetic energy of a molecule of a nitrogen gas at the same temperature is

(A) 7E

(B) $\dfrac{E}{14}$

(C) 14E

(D) $\dfrac{E}{7}$

(E) E

Space for rough work

17. The difference between the specific heats of a gas is 4150 J kg^{-1} K^{-1}. If the ratio of specific heats is 1.4, then the specific heat at constant volume of the gas (in J kg^{-1} K^{-1}) is

(A) 1037.5

(B) 2037.5

(C) 8300

(D) 10375

(E) 4150

18. The Carnot cycle of a reversible heat engine consists of

(A) one isothermal and two adiabatic processes

(B) two isothermal and one adiabatic processes

(C) two isothermal and two adiabatic processes

(D) two isobaric and two isothermal processes

(E) two isochoric and two adiabatic processes

19. Two equal masses hung from two massless springs of spring constants k_1 and k_2 have equal maximum velocity when executing simple harmonic motion. The ratio of their amplitudes is

(A) $\left(\dfrac{k_1}{k_2}\right)^{1/2}$

(B) $\left(\dfrac{k_1}{k_2}\right)$

(C) $\left(\dfrac{k_2}{k_1}\right)$

(D) $\left(\dfrac{k_2}{k_1}\right)^{1/2}$

(E) $\left(\dfrac{k_1^2}{k_2^2}\right)$

20. The simple harmonic motion of a particle is given by $x = a \sin 2\pi t$. Then the location of the particle from its mean position at a time $\dfrac{1}{8}$th of a second is

(A) a

(B) $\dfrac{a}{2}$

(C) $\dfrac{a}{\sqrt{2}}$

(D) $\dfrac{a}{4}$

(E) $\dfrac{a}{8}$

Space for rough work

21. The time period of a simple pendulum of length $\sqrt{5}$ m suspended in a car moving with uniform acceleration of 5 ms^{-2} in a horizontal straight road is $(g = 10$ ms$^{-2})$

(A) $\dfrac{2\pi}{\sqrt{5}}$s

(B) $\dfrac{\pi}{\sqrt{5}}$s

(C) 5πs

(D) 4πs

(E) 3πs

22. The apparent change in frequency of sound due to the relative motion between the observer and the source of sound is called

(A) Doppler effect

(B) Phenomenon of beats

(C) Phenomenon of stationary waves

(D) Diffraction of sound waves

(E) Interference of sound waves

23. Pick out the condition which is not required for the formation of stationary waves

(A) The medium on which waves are formed should be bound medium

(B) Both the waves should have same frequency

(C) Both the waves should have same velocity

(D) The waves should travel in same direction

(E) Both the waves should have same wavelength

24. The harmonic mode which resonates with a closed pipe of length 22 cm, when excited by a 1875 Hz source and the number of nodes present in it respectively are (velocity of sound in air = 330 ms^{-1})

(A) 1st, 1   (B) 3rd, 1   (C) 3rd, 2   (D) 5th, 4   (E) 5th, 3

25. The force between two point charges placed in a material medium of dielectric constant ε_r is F. If the material is removed, then the force between them becomes

(A) $\varepsilon_r F$

(B) εF

(C) $\dfrac{F}{\varepsilon_r}$

(D) $\dfrac{\varepsilon}{F}$

(E) $\varepsilon_0 F$

Space for rough work

26. The electric field strength in N C^{-1} that is required to just prevent a water drop carrying a charge 1.6×10^{-19} C from falling under gravity is
($g = 9.8$ ms^{-2}, mass of water drop $= 0.0016$ g)

(A) 9.8×10^{-16} (B) 9.8×10^{16} (C) 9.8×10^{-13}

(D) 9.8×10^{13} (E) 9.8×10^{10}

27. A cylinder of radius r and length ℓ is placed in a uniform electric field of intensity E acting parallel to the axis of the cylinder. The total flux over curved surface area is

(A) $2\pi r$E   (B) $\left(\dfrac{2\pi}{\ell}\right)$E   (C) $2\pi r \ell$E

(D) $\dfrac{E}{2\pi r \ell}$ (E) zero

28. A conductor with a cavity is charged positively and its surface charge density is σ. If E and V represent the electric field and potential, then inside the cavity

(A) $\sigma = 0$ and $V = 0$ (B) $E = 0$ and $V = 0$

(C) $E = 0$ and $\sigma = $ constant   (D) $V = 0$ and $\sigma = $ constant

(E) $E = 0$ and $V = $ constant

29. Electric lines of force about a positive point charge are

(A) radially outwards   (B) circular clockwise

(C) radially inwards   (D) parallel straight lines

(E) circular anticlockwise

30. An ammeter, voltmeter and a resistor are connected in series to a cell and the readings are noted as I and V. If another resistor R is connected in parallel with voltmeter, then

(A) I and V increase   (B) I increases

(C) I and V will remain same   (D) I decreases

(E) I remains constant

Space for rough work

31. One gram of copper is deposited in a copper voltameter when a current of 0.5 A flows for 30 minutes. Then the current required to deposit 2 g of silver in a silver voltameter in the same time is (ece of copper = 3.3×10^{-4} gC^{-1}, ece of silver = 1.1×10^{-4} gC^{-1})

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

32. The amount of charge flowing per second per unit area normal to the flow is called

    (A) electrical conductivity   (B) electrical resistivity

    (C) mobility   (D) current density

    (E) areal current

33. A galvanometer of resistance G is converted into an ammeter using a shunt of resistance R. If the ratio of the heat dissipated through the galvanometer and shunt is 3 : 4, then R equals

    (A) $\frac{4}{3}G$ (B) $\frac{3}{4}G$ (C) $\frac{16}{9}G$

    (D) $\frac{9}{16}G$ (E) G

34. Two bulbs of equal power are connected in parallel and they totally consume 110 W at 220 V. The resistances of each bulb is

    (A) 550 Ω   (B) 440 Ω   (C) 330 Ω

    (D) 880 Ω   (E) 660 Ω

35. The wire of length ℓ is bent into a circular loop of a single turn and is suspended in a magnetic field of induction B. When a current I is passed through the loop, the maximum torque experienced by it is

    (A) $\left(\frac{1}{4\pi}\right)BI\ell^2$ (B) $\frac{1}{4\pi}BI^2\ell$ (C) $\left(\frac{1}{4\pi}\right)BI\ell$

    (D) $\left(\frac{1}{4\pi}\right)B^2I\ell$ (E) $\left(\frac{1}{4\pi}\right)B^2I^2\ell^2$

Space for rough work

36. A particle having charge 10 times that of the electron revolves in a circular path of radius 0.4 m with an angular speed of one rotation per second. The magnetic induction produced at the centre of the circular path is

(A) $4\pi \times 10^{-26}$ T (B) $2\pi \times 10^{-26}$ T (C) $16\pi \times 10^{-26}$ T

(D) $8\pi \times 10^{-25}$ T (E) $9\pi \times 10^{-25}$ T

37. Pick out the **wrong** statement among the following
(A) Time varying magnetic field creates an electric field
(B) Charges in motion can exert force on a stationary magnet
(C) Stationary charges can exert torque on a stationary magnet
(D) A bar magnet in motion can exert force on a stationary charge
(E) Electric fields produced by static charges have different properties from those produced by time varying magnetic fields

38. If a magnet is plunged into a coil, then the magnitude of induced emf does not depend upon
(A) the number of turns in the coil
(B) the medium of the core of the coil
(C) the insertion speed of the magnet
(D) the strength of the magnet
(E) the resistance of the coil

39. A bar magnet has a period of oscillation T. If a similar brass piece of the same mass is placed over it, then the number of oscillations it makes in one second is

(A) $\dfrac{1}{\sqrt{2}T}$ (B) $\dfrac{\sqrt{2}}{T}$ (C) $\dfrac{1}{2T}$

(D) $\dfrac{2}{T}$ (E) $\dfrac{1}{T}$

Space for rough work

40. If 0.1 J of energy is stored for the flow of current of 0.2 A in an inductor, then its inductance value is
   (A) 5 H   (B) 0.5 H   (C) 5 mH
   (D) 50 H   (E) 50 mH

41. The self inductance of a long solenoid carrying current is independent of
   (A) its length   (B) the current
   (C) its cross-sectional area   (D) magnetic permeability of the core
   (E) the number of turns

42. The r.m.s. value of A.C. which when passed through a resistor produces heat, which is twice that produced by a steady current of 1.414 amp in the same resistor is
   (A) 2 A   (B) 3.46 A   (C) 2.818 A
   (D) 1.732 A   (E) 1 A

43. In a series LCR ac circuit, the current is maximum when the impedance is equal to
   (A) the reactance   (B) the resistance   (C) zero
   (D) twice the reactance   (E) twice the resistance

44. γ-rays are detected by
   (A) point contact diodes   (B) thermopiles
   (C) ionization chamber   (D) photocells   (E) bolometers

Space for rough work

45. If the direction of electric and magnetic field vectors of a plane electromagnetic wave are along positive y direction and positive z direction respectively, then the direction of propagation of the wave is along

(A) positive z direction (B) negative z direction
(C) negative y direction (D) positive x direction
(E) negative x direction

46. When an object is viewed with a light of wavelength 6000Å under a microscope its resolving power is 10^4. The resolving power of the microscope when the same object is viewed with a light of wavelength 4000 Å is

(A) 10^4 (B) 2×10^4 (C) $3\sqrt{2} \times 10^4$
(D) 3×10^4 (E) 1.5×10^4

47. Secondary rainbow in the atmosphere is

(A) the result of polarization and dispersion of light
(B) brighter than the primary rainbow
(C) due to the phenomenon of double refraction
(D) formed with red colour on the top
(E) formed due to two reflections in the rain drop

48. For a diffraction from a single slit, the intensity of the central point is

(A) infinite
(B) finite and same magnitude as the surrounding maxima
(C) finite but much larger than the surrounding maxima
(D) finite and substantially smaller than the surrounding maxima
(E) zero

49. If the radius of curvature of the curved surface of a plano-convex lens is 50 cm, its focal length is $(\mu = 1.5)$

(A) 0.5 m (B) 0.75 m (C) 1.25 m
(D) 0.25 m (E) 1 m

Space for rough work

50. The magnification of an image by a convex lens is positive only when the object is placed

(A) at its focus F
(B) between F and 2F
(C) at 2F
(D) between F and optical centre
(E) beyond 2F

51. If the work functions of three photosensitive materials are 1 eV, 2 eV and 3 eV respectively, then the ratio of the respective frequencies of light that produce photoelectrons of maximum kinetic energy of 1 eV from each of them is

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

52. During β^- emission

(A) a neutron in the nucleus decays emitting an electron
(B) an atomic electron is ejected
(C) an electron already present within the nucleus is ejected
(D) a part of the binding energy of the nucleus is converted into an electron
(E) a proton in the nucleus decays emitting an electron

53. The binding energy per nucleon of ^{16}O is 7.97 MeV and that of ^{17}O is 7.75 MeV. The energy in MeV required to remove a neutron from ^{17}O is

(A) 3.52
(B) 3.64
(C) 4.23
(D) 7.86
(E) 1.68

54. If the ratio of the radius of a nucleus with 61 neutrons to that of helium nucleus is 3, the atomic number of this nucleus is

(A) 27
(B) 47
(C) 51
(D) 61
(E) 108

Space for rough work

55. The electron density of intrinsic semi-conductor at room temperature is $10^{16} \, m^{-3}$. When doped with a trivalent impurity, the electron density is decreased to $10^{14} \, m^{-3}$ at the same temperature. The majority carrier density is

(A) $10^{16} \, m^{-3}$ (B) $10^{18} \, m^{-3}$ (C) $10^{21} \, m^{-3}$

(D) $10^{20} \, m^{-3}$ (E) $10^{19} \, m^{-3}$

56. In a Zener diode regulated power supply, unregulated d.c. input of 10 V is applied. If the resistance (R_s) connected in series with a Zener diode is 200 Ω and the Zener voltage $V_z = 5 \, V$, the current across the resistance R_s is

(A) 15 mA   (B) 10 mA   (C) 20 mA

(D) 5 mA   (E) 25 mA

57. The circuit gives the output as that of
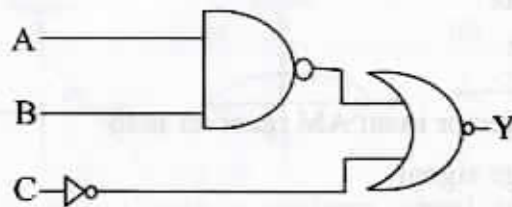
(A) AND gate   (B) OR gate   (C) NAND gate

(D) NOR gate   (E) NOT gate

58. To detect light of wavelength 500 nm, the photodiode must be fabricated from a semiconductor of minimum bandwidth of

(A) 1.24 eV   (B) 0.62 eV   (C) 2.48 eV

(D) 3.2 eV   (E) 4.48 eV

Space for rough work

59. If the height of TV tower is increased by 21%, the transmission range is enhanced by

(A) 10%   (B) 5%   (C) 15%

(D) 25%   (E) 12%

60. The range of a communication system can be extended by a

(A) modulator   (B) transmitter   (C) demodulator

(D) receiver   (E) repeater

61. For commercial telephonic communication, the frequency range for speech signals is

(A) 50 Hz to 1000 Hz

(B) 3000 Hz to 4500 Hz

(C) 1000 Hz to 2000 Hz

(D) 5000 Hz to 6500 Hz

(E) 300 Hz to 3100 Hz

62. The role of envelope detector in an AM receiver is to

(A) retrieve the message signal

(B) rectify the AM signal

(C) modify the AM signal

(D) modulate the message signal

(E) retrieve the AM signal

Space for rough work

Phy-Chy-I-A2/2016

16

63. When the voltage and current in a conductor are measured as (100 ± 4) V and (5 ± 0.2) A, then the percentage of error in the calculation of resistance is

(A) 8%   (B) 4%   (C) 20%

(D) 10%   (E) 6%

64. The set of physical quantities among the following which are dimensionally different is

(A) Terminal velocity, drift velocity, critical velocity

(B) Potential energy, work done, kinetic energy

(C) Pressure, stress, rigidity modulus

(D) Disintegration constant, frequency, angular velocity

(E) Dipole moment, electric flux, electric field

65. The graph which cannot possibly represent one-dimensional motion is
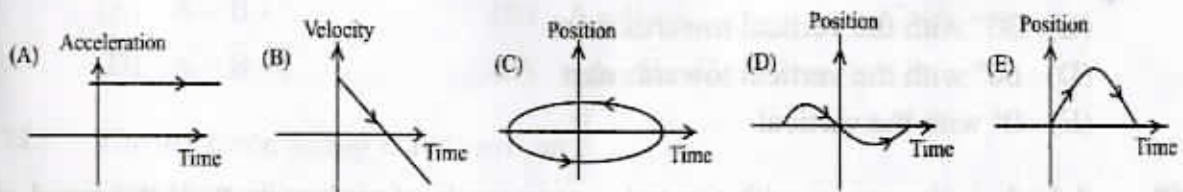
66. An aeroplane is flying with a uniform speed of 150 km hr^{-1} along the circumference of a circle. The change in its velocity in half the revolution (in km hr^{-1}) is

(A) 150   (B) 100   (C) 200

(D) 300   (E) 50

Space for rough work

67. In uniform circular motion, the centripetal acceleration is

(A) towards the centre of the circular path and perpendicular to the instantaneous velocity

(B) a constant acceleration

(C) away from the centre of the circular path and perpendicular to the instantaneous velocity

(D) a variable acceleration making $45°$ with the instantaneous velocity

(E) a variable acceleration, parallel to the instantaneous velocity

68. A man rides a bicycle with a speed of 17.32 ms^{-1} in east-west direction. If the rain falls vertically with a speed of 10 ms^{-1}, the direction in which he must hold his umbrella is

(A) $30°$ with the vertical towards east

(B) $60°$ with the vertical towards west

(C) $30°$ with the vertical towards west

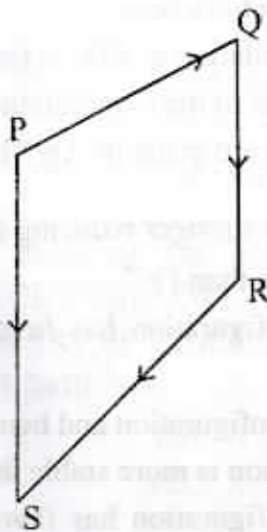(D) $60°$ with the vertical towards east

(E) $0°$ with the vertical

69. A body is thrown up with a speed u, at an angle of projection θ. If the speed of the projectile becomes $\dfrac{u}{\sqrt{2}}$ on reaching the maximum height, the maximum vertical height attained by the projectile is

(A) $\dfrac{u^2}{4g}$ (B) $\dfrac{u^2}{3g}$ (C) $\dfrac{u^2}{2g}$

(D) $\dfrac{u^2}{g}$ (E) $\dfrac{2u^2}{g}$

Space for rough work

70. In the given diagram, if $\vec{PQ} = \vec{A}$, $\vec{QR} = \vec{B}$ and $\vec{RS} = \vec{C}$ then $\vec{PS}$ equals

(A) $\vec{A} - \vec{B} + \vec{C}$ (B) $\vec{A} + \vec{B} - \vec{C}$ (C) $\vec{A} + \vec{B} + \vec{C}$

(D) $\vec{A} - \vec{B} - \vec{C}$ (E) $-\vec{A} - \vec{B} - \vec{C}$

71. The net force acting is not zero on
   (A) a retarding train
   (B) a ball falling with terminal velocity
   (C) a kite held stationary in the sky
   (D) a truck moving with constant velocity
   (E) a book placed on a table

72. An engine of power 58.8 kW pulls a train of mass 2×10^5 kg with a velocity of 36 km h^{-1}. The coefficient of friction is

(A) 0.3   (B) 0.03   (C) 0.003

(D) 0.0003   (E) 0.04

Space for rough work

73. Choose the **wrong** statement in the following

(A) TiO_2 is used in the pigment industry

(B) MnO_2 is used in dry battery cells

(C) V_2O_5 catalyses the oxidation of SO_2 in the manufacture of sulphuric acid

(D) Ziegler catalyst is used in the manufacture of high density polyethylene

(E) The 'silver' UK coins are made of Ag/Ni alloy

74. In aqueous solution, Cr^{2+} is stronger reducing agent than Fe^{2+}. This is because

(A) Cr^{2+} ion is more stable than Fe^{2+}

(B) Cr^{3+} ion with d^3 configuration has favourable crystal field stabilization energy

(C) Cr^{3+} has half-filled configuration and hence more stable

(D) Fe^{3+} in aqueous solution is more stable than Cr^{3+}

(E) Fe^{2+} ion with d^6 configuration has favourable crystal field stabilization energy

75. Choose the correct matching of transition metal ion and magnetic moment from the codes given below   (At. No: Ti = 22, V = 23, Fe = 26)

Transition element	Magnetic moment(BM)
(a) Titanium (III)	(1) 4.9
(b) Vanadium (II)	(2) 1.73
(c) Iron (II)	(3) 3.87

(A) (a) - (2), (b) - (3), c - (1)

(B) (a) - (2), (b) - (1), c - (3)

(C) (a) - (1), (b) - (2), c - (3)

(D) (a) - (1), (b) - (3), c - (2)

(E) (a) - (3), (b) - (2), c - (1)

Space for rough work

76. The standard enthalpy of formation of $H_2O(l)$ and $Fe_2O_3(s)$ are respectively -286 kJ mol^{-1} and -824 kJ mol^{-1}. What is the standard enthalpy change for the following reaction?

$$Fe_2O_3(s) + 3H_2(g) \rightarrow 3H_2O(l) + 2Fe(s)$$

(A) -538 kJ mol^{-1} (B) $+538$ kJ mol^{-1} (C) -102 kJ mol^{-1}

(D) $+34$ kJ mol^{-1} (E) -34 kJ mol^{-1}

77. The correct descending order of the heat liberated (in kJ) during the neutralization of the acids CH_3COOH (W), HF (X), HCOOH (Y) and HCN (Z) under identical conditions (K_a of $CH_3COOH=1.8\times10^{-5}$, $HCOOH=1.8\times10^{-4}$, $HCN=4.9\times10^{-10}$ and $HF=3.2\times10^{-4}$) is

(A) $Y > X > Z > W$ (B) $X > Y > W > Z$

(C) $W > X > Y > Z$ (D) $Z > W > Y > X$

(E) $Z > Y > X > W$

78. How many times a 0.1 M strong monobasic acid solution should be diluted so that pH of the resulting solution is tripled?

(A) 50   (B) 10   (C) 25

(D) 100   (E) 1000

Space for rough work

79. The equilibrium pressure for the reaction $MSO_4.2H_2O(s) \rightleftharpoons MSO_4(s)+2$ $H_2O_{(g)}$ is $\pi/4$ atm at 400 K. The K_p for the given reaction (in atm.^{2}) is

(A) $\pi^2/4$ (B) $\pi/6$ (C) $\pi^2/16$

(D) $\pi/16$ (E) $16/\pi$

80. Calculate the molality of a solution that contains 51.2 g of naphthalene, $(C_{10}H_8)$, in 500 mL of carbon tetrachloride. The density of CCl_4 is 1.60 g/mL

(A) 0.250 m (B) 0.500 m (C) 0.750 m

(D) 0.840 m (E) 1.69 m

81. 31 g of ethylene glycol $(C_2H_6O_2)$ is mixed with 500 g of solvent (K_f of the solvent is 2 K kg mol^{-1}). What is the freezing point of the solution in K? (freezing point of solvent = 273 K)

(A) 272 (B) 271 (C) 270

(D) 274 (E) 275

82. The standard reduction potential for Zn^{2+} / Zn, Ni^{2+} / Ni and Fe^{2+} / Fe are $-0.76, -0.23$ and -0.44 V respectively. The reaction $X + Y^{2+} \rightarrow X^{2+} + Y$ will have more negative ΔG value when X and Y are

(A) X = Ni; Y = Fe (B) X = Ni; Y = Zn (C) X = Fe; Y = Zn

(D) X = Zn; Y = Ni (E) X = Fe; Y = Ni

Space for rough work

83. Thermal decomposition of ammonium dichromate gives

   (A) N_2, H_2O and Cr_2O_3 (B) N_2, NH_3 and CrO

   (C) $(NH_4)_2CrO_4$ and H_2O (D) N_2, H_2O and CrO_3

   (E) N_2, H_2O and CrO

84. An element crystallising in body centred cubic lattice has an edge length of 500 pm. If its density is $4\,g\,cm^{-3}$, the atomic mass of the element (in $g\,mol^{-1}$) is (consider $N_A = 6\times10^{23}$)

   (A) 100   (B) 250   (C) 125

   (D) 150   (E) 50

85. The rate constant of the reaction, $2N_2O_5 \rightarrow 4NO_2 + O_2$ at 300 K is $3 \times 10^{-5}\,s^{-1}$. If the rate of the reaction at the same temperature is $2.4 \times 10^{-5}\,mol\,dm^{-3}\,s^{-1}$, then the molar concentration of N_2O_5 is

   (A) 0.4 M   (B) 0.8 M   (C) 0.04 M

   (D) 0.08 M   (E) 0.6 M

86. In the reaction $A \rightarrow$ Products when the concentration of A was reduced from 2.4×10^{-2} M to 1.2×10^{-2} M the rate decreased 8 times at the same temperature. The order of the reaction is

   (A) 0   (B) 1   (C) 2   (D) 3   (E) 0.5

Space for rough work

87. Enzymatic reactions are given in Column I and enzymes in Column II

Column I	Column II
(a) Maltose → Glucose	(i) Zymase
(b) Sucrose → Glucose + Fructose	(ii) Pepsin
(c) Glucose → Ethyl alcohol + CO_2	(iii) Maltase
(d) Starch → Maltose	(iv) Invertase
(e) Proteins → Amino acids	(v) Diastase

Choose the correct matching of enzymatic reaction and enzyme that catalyses the correct reaction from the codes given below

(A) (a) - (ii), (b) - (iv), (c) - (v), (d) - (iii), (e) - (i)

(B) (a) - (iii), (b) - (iv), (c) - (i), (d) - (v), (e) - (ii)

(C) (a) - (v), (b) - (iv), (c) - (ii), (d) - (i), (e) - (iii)

(D) (a) - (v), (b) - (iii), (c) - (iv), (d) - (ii), (e) - (i)

(E) (a) - (ii), (b) - (iii), (c) - (i), (d) - (v), (e) - (iv)

88. In which one of the following properties, physisorption and chemisorption resemble each other?

(A) Force of attraction

(B) Enthalpy of adsorption

(C) Temperature effect

(D) Effect of surface area

(E) Number of adsorption layers

89. Consider the following two complex ions: $[CoF_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$. Which of the following statement(s) is/are **false**?

(I) Both are octahedral

(II) $[Co(C_2O_4)_3]^{3-}$ is diamagnetic while $[CoF_6]^{3-}$ is paramagnetic

(III) Both are outer orbital complexes

(IV) In both the complexes the central metal is in the same oxidation state

(A) (II) and (III)

(B) (II), (III) and (IV)

(C) (III) only

(D) (III) and (IV)

(E) (I), (II) and (IV)

Space for rough work

90. Chlorophyll is a coordination compound of
    (A) iron   (B) magnesium   (C) manganese
    (D) chromium   (E) zinc

91. Which one of the following is a benzenoid aromatic compound?
    (A) Furan   (B) Thiophene   (C) Pyridine
    (D) Aniline   (E) Cyclopentadienyl anion

92. The major product obtained by the addition reaction of HBr to 4-Methylpent-1-ene in the presence of peroxide is
    (A) 1-Bromo-4-methylpentane   (B) 4-Bromo-2-methylpentane
    (C) 2-Bromo-4-methylpentane   (D) 3-Bromo-2-methylpentane
    (E) 2-Bromo-2-methylpentane

93. Which one of the following involves nucleophilic addition?
    (A) Kolbe's reaction of phenol
    (B) Williamson's synthesis of ethers
    (C) Reimer-Tiemann's reaction of phenol
    (D) Kolbe's electrolytic synthesis of ethane from sodium acetate
    (E) Aldol formation from ethanal

94. The number of possible stereoisomers of the compound $CH_3-CH=CH-CH_3$ is
    (A) 2   (B) 4   (C) 3   (D) 5   (E) 6

Space for rough work

95. Some organic compounds are given in List I and their uses in List II. Choose the correct matching

List I

(a) Triiodomethane

(b) p, p'-Dichlorodiphenyltrichloroethane

(c) Trichloromethane

(d) Dichloromethane

List II

(i) solvent for alkaloids

(ii) propellant in aerosols

(iii) antiseptic

(iv) insecticide

(A) (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii)

(B) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

(C) (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

(D) (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)

(E) (a) - (i), (b) - (iii), (c) - (ii), (d) - (iv)

96. The total number of monohalogenated products formed by halogenation of 2,4,4-Trimethylhexane is

(A) 5   (B) 7   (C) 6   (D) 8   (E) 9

97. Number of acylic structural isomers of the compound having the molecular formula $C_4H_{10}O$ is

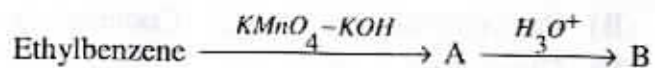(A) 4   (B) 5   (C) 6   (D) 7   (E) 3

98. 375 mg of an alcohol reacts with required amount of methyl magnesium bromide and releases 140 mL of methane gas at STP. The alcohol is

(A) ethanol   (B) n-Butanol   (C) methanol

(D) n-Propanol   (E) phenol

Space for rough work

99. Predict the product (B) in the following sequence of reactions

Ethylbenzene $\xrightarrow{KMnO_4-KOH}$ A $\xrightarrow{H_3O^+}$ B

(A) Benzaldehyde   (B) Benzophenone   (C) Benzene

(D) Acetophenone   (E) Benzoic acid

100. Freon 12 is manufactured from CCl_4 by

(A) Wurtz reaction   (B) Swarts reaction   (C) Fittig reaction

(D) Wurtz-Fittig reaction   (E) Sandmeyer reaction

101. Which one of the following can be prepared by Gabriel phthalimide synthesis?

(A) Aniline   (B) o-Toluidine   (C) Benzylamine

(D) N-Methylethanamine   (E) 4-Bromoaniline

102. 4-Nitrotoluene is treated with bromine to get compound 'P'. 'P' is reduced with Sn and HCl to get compound 'Q'. 'Q' is diazotised and the product is treated with phosphinic acid to get compound 'R'. 'R' is oxidized with alkaline $KMnO_4$ to get compound 'S'. Compound 'S' is

(A) 2-Bromo-4-hydroxybenzoic acid

(B) Benzoic acid

(C) 4-Bromobenzoic acid

(D) 3-Bromobenzoic acid

(E) 2-Bromobenzoic acid

Space for rough work

103. Narcotic analgesic is

(A) Aspirin   (B) Paracetamol   (C) Codeine

(D) Zantac   (E) Cimetidine

104. In double strand helix structure of DNA, heterocyclic base cytosine forms hydrogen bond with

(A) Adenine   (B) Guanine   (C) Purine

(D) Thyamine   (E) Uracil

105. The amino acid containing mercaptan unit is

(A) Leucine   (B) Glutamine   (C) Cysteine

(D) Lysine   (E) Isoleucine

106. Which one of the following is a non-reducing sugar?

(A) Maltose   (B) Lactose   (C) Sucrose

(D) Glucose   (E) Fructose

Space for rough work

107. In the hydrogen atomic spectrum, the emission of the least energetic photon takes place during the transition from $n = 6$ energy level to $n =$ .... energy level.

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

108. If 27 g of water is formed during complete combustion of pure propene (C_3H_6), the mass of propene burnt is

(A) 42 g   (B) 21 g   (C) 14 g   (D) 56 g   (E) 40 g

109. When 2.46 g of a hydrated salt ($MSO_4.x\ H_2O$) is completely dehydrated, 1.20 g of anhydrous salt is obtained. If the molecular weight of anhydrous salt is 120 g mol^{-1} what is the value of x?

(A) 2   (B) 4   (C) 5   (D) 6   (E) 7

110. Identify the T-shaped molecule in the following

(A) BF_3 (B) NH_3 (C) NF_3 (D) ClF_3 (E) PCl_3

111. Which one of the following molecules has the least dipole moment?

(A) H_2O (B) BeF_2 (C) NH_3 (D) NF_3 (E) BF_3

deleted

112. Dipole-dipole interaction energy between polar molecules in solids depends on the radius of the molecule (r) and it is directly proportional to

(A) $(1/r^2)$ (B) $(1/r^6)$ (C) $(1/r)$ (D) $(1/r^5)$ (E) $(1/r^3)$

Space for rough work

113. Critical density of a gas having molecular weight 39 g mol^{-1} is 0.1 g cm^{-3}. Its critical volume in L mol^{-1} is

(A) 0.390   (B) 3.90   (C) 0.039   (D) 39.0   (E) 390

114. The various types of hydrides and examples of each type are given below

Hydride type		Compound
(a) Electron deficient	-	(i) LiH
(b) Saline	-	(ii) CH$_4$
(c) Electron-precise	-	(iii) NH$_3$
(d) Interstitial	-	(iv) B$_2$H$_6$
(e) Electron rich	-	(v) CrH

Choose the correct matching from the codes given below

(A) (a) - (ii), (b) - (iv), (c) - (v), (d) - (iii), (e) - (i)

(B) (a) - (iv), (b) - (i), (c) - (ii), (d) - (v), (e) - (iii)

(C) (a) - (iv), (b) - (iii), (c) - (v), (d) - (ii), (e) - (i)

(D) (a) - (v), (b) - (iii), (c) - (iv), (d) - (ii), (e) - (i)

(E) (a) - (iv), (b) - (v), (c) - (i), (d) - (ii), (e) - (iii)

115. One mole of hydrazine (N$_2$H$_4$) loses 10 moles of electrons in a reaction to form a new compound X. Assuming that all the nitrogen atoms in hydrazine appear in the new compound, what is the oxidation state of nitrogen in X? (Note: There is no change in the oxidation state of hydrogen in the reaction)

(A) –1   (B) –3   (C) +3   (D) +5   (E) +1

Space for rough work

116. The low solubility of LiF and that of CsI in water are respectively due to which of the properties of the alkali metal ions?

(A) higher hydration enthalpy of Li^+, higher lattice enthalpy of Cs^+

(B) smaller hydration enthalpy of Li^+, higher lattice enthalpy of Cs^+

(C) smaller lattice enthalpy of Li^+, higher hydration enthalpy of Cs^+

(D) smaller hydration enthalpy of Li^+, smaller lattice enthalpy of Cs^+

(E) higher lattice enthalpy of Li^+, smaller hydration enthalpy of Cs^+

117. The second ionization enthalphy of which of the following alkaline earth metals is the highest?

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

118. Which one of the following group 16 elements does not exist in –2 oxidation state?

(A) S   (B) Se   (C) O   (D) Po   (E) Te

119. In which one of the following compounds of xenon, highest number of lone pair of electrons is present on xenon?

(A) XeF_6 (B) XeF_4 (C) $XeOF_4$ (D) XeO_3 (E) XeF_2

120. The hybridized state of Al^{3+} in the complex ion formed when $AlCl_3$ is treated with aqueous acid is

(A) sp^3 (B) dsp^2 (C) sp^3d^2 (D) sp^2d (E) sp^2

Space for rough work