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	**A1**	**Question Booklet Serial Number**	2114940
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, signature and roll number of the candidate in the columns given above. Please also write the Question Booklet Sl. No. given at the top of this page against item 4 in the OMR Answer Sheet.

3. 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.

4. 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.**

5. Negative Marking: In order to discourage wild guessing, the score will be subject 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 from the total score for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.

[MMEDIATELY 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.

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PLEASE ENSURE THAT THIS BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120 (Printed Pages : 32)

1. The quantity which has the same dimensions as that of gravitational potential is

(A) latent heat
(B) impulse
(C) angular acceleration
(D) specific heat capacity
(E) Planck's constant

2. The percentage error in measuring M, L and T are 1 %, 1.5 % and 3 % respectively. Then the percentage error in measuring the physical quantity with dimensions $ML^{-1}T^{-1}$ is

(A) 1% (B) 3.5% (C) 3 % (D) 4.5 % (E) 5.5%

3. From an elevated point P, a stone is projected vertically upwards. When the stone reaches a distance h below P, its velocity is double of its velocity at a height h above P. The greatest height attained by the stone from the point of projection P is

(A) $\frac{3}{5}h$ (B) $\frac{5}{3}h$ (C) $\frac{7}{5}h$
(D) $\frac{5}{7}h$ (E) $\frac{2}{3}h$

4. The distance x covered by a particle varies with time t as $x^2 = 2t^2 + 6t + 1$. Its acceleration varies with x as

(A) x (B) x^2 (C) x^{-1} (D) x^{-3} (E) x^{-2}

Space for rough work

5. A particle describes uniform circular motion in a circle of radius 2 m, with the angular speed of 2 rad s^{-1}. The magnitude of the change in its velocity in $\frac{\pi}{2}$ s is

(A) 0 ms^{-1} (B) $2\sqrt{2}$ ms^{-1} (C) 8 ms^{-1}
(D) 4 ms^{-1} (E) $4\sqrt{2}$ ms^{-1}

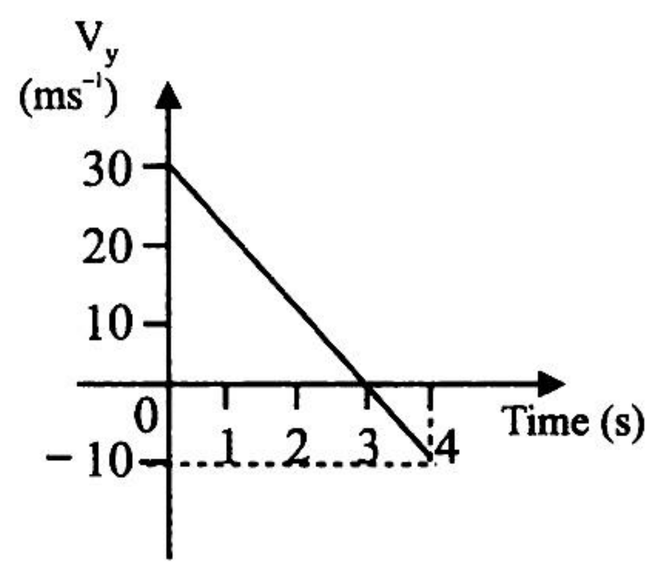
6. A body projected at an angle with the horizontal has a range 300 m. If the time of flight is 6 s, then the horizontal component of velocity is

(A) 30 ms^{-1} (B) 50 ms^{-1} (C) 40 ms^{-1} (D) 45 ms^{-1} (E) $30\sqrt{2}$ ms^{-1}

7. A constant force F acts on a particle of mass 1 kg moving with a velocity v, for one second. The distance moved in that time is

(A) 0 (B) $\frac{F}{2}$ (C) 2 F (D) $\frac{v}{2}$ (E) $v+\frac{F}{2}$

8. The velocity-time graph for the vertical component of the velocity of a body thrown upwards from the ground and landing on the roof of a building is given in the figure. The height of the building is



(A) 50 m (B) 40 m (C) 20 m (D) 30 m (E) 10 m

Space for rough work

9. A spacecraft of mass 100 kg breaks into two when its velocity is 10^4 m s^{-1}. After the break, a mass of 10 kg of the space craft is left stationary. The velocity of the remaining part is

(A) 10^3 m s^{-1}
(B) 11.11×10^3 m s^{-1}
(C) 11.11×10^2 m s^{-1}
(D) 10^4 m s^{-1}
(E) 1100 m s^{-1}

10. A particle tied to a string describes a vertical circular motion of radius r continually. If it has a velocity $\sqrt{3gr}$ at the highest point, then the ratio of the respective tensions in the string holding it at the highest and lowest points is

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

11. In a uniform circular motion, the angle between the velocity and acceleration is

(A) 0° (B) 45° (C) 60° (D) 75° (E) 90°

12. A crate is pushed horizontally with 100 N across a 5 m floor. If the frictional force between the crate and the floor is 40 N, then the kinetic energy gained by the crate is

(A) 200 J (B) 240 J (C) 250 J (D) 300 J (E) 500 J

Space for rough work

13. The potential energy of a conservative system is given by $V(x) = (x^2 - 3x)$ joule, where x is measured in metre. Then its equilibrium position is at

(A) 1.5 m (B) 2 m (C) 3 m (D) 1 m (E) 5 m

14. An engine pumps out water continuously through a hose with a velocity v. If m is the mass per unit length of the water jet, the rate at which the kinetic energy is imparted to water is

(A) $\frac{1}{2}mv^2$ (B) $\frac{1}{2}mv^3$ (C) $\frac{1}{2}m^2v^2$

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

15. A body of mass 1.5 kg rotating about an axis with angular velocity of 0.3 $rads^{-1}$ has the angular momentum of 1.8 $kg\,m^2s^{-2}$. The radius of gyration of the body about an axis is

(A) 2 m (B) 1.2 m (C) 0.2 m (D) 1.6 m (E) 0.8 m

16. In a two-particle system with particle masses m_1 and m_2, the first particle is pushed towards the centre of mass through a distance d, the distance through which second particle must be moved to keep the centre of mass at the same position is

(A) $\frac{m_2 d}{m_1}$ (B) d (C) $\frac{m_1 d}{(m_1 + m_2)}$

(D) $\frac{(m_1 + m_2)d}{m_1}$ (E) $\frac{m_1 d}{m_2}$

Space for rough work

17. The principle involved in the performance of a spinning-chair circus acrobat is

(A) conservation of angular momentum
(B) conservation of linear momentum
(C) conservation of energy
(D) principle of moments
(E) work-energy principle

18. Two bodies of masses 4 kg and 9 kg are separated by a distance of 60 cm. A 1 kg mass is placed in between these two masses. If the net force on 1 kg is zero, then its distance from 4 kg mass is

(A) 26 cm (B) 30 cm (C) 28 cm (D) 32 cm (E) 24 cm

19. The total energy and kinetic energy of an Earth's satellite are respectively

(A) positive and negative
(B) negative and positive
(C) positive and positive
(D) negative and negative
(E) zero and positive

20. If the earth is one-fourth of its present distance from the sun, the duration of the year will be changed to

(A) half of the present year
(B) $\frac{1}{4}^{th}$ of the present year
(C) $\frac{1}{8}^{th}$ of the present year
(D) $\frac{7}{8}^{th}$ of the present year
(E) $\frac{1}{16}^{th}$ of the present year

Space for rough work

21. A ball falling in a lake of depth 400 m has a decrease of 0.2 % in its volume at the bottom. The bulk modulus of the material of the ball is (in Nm^{-2})

(A) 9.8×10^{9} (B) 9.8×10^{10} (C) 1.96×10^{10}
(D) 9.8×10^{11} (E) 1.96×10^{9}

22. Three capillary tubes of same length but internal radii 0.3 mm, 0.45 mm and 0.6 mm are connected in series and a liquid flows steadily through them. If the pressure difference across the third capillary is 8.1 mm of mercury, the pressure difference across the first capillary (in mm of mercury) is

(A) 16.2 (B) 32.4 (C) 129.6 (D) 2.025 (E) 4.05

23. A ring cut with an inner radius 4.85 cm and outer radius 4.95 cm is supported horizontally from one of the pans of a balance so that it comes in contact with the water in a vessel. If surface tension of water is 70×10^{-3} Nm^{-1}, then the extra mass in the other pan required to pull the ring away from water is

(A) 2 g (B) 3 g (C) 4.4 g (D) 15 g (E) 10 g

24. Two spherical rain drops with radii in the ratio 1 : 2 fall from a great height through the atmosphere. The ratio of their momenta after they have attained terminal velocity is

(A) 1:8 (B) 2:1 (C) 1:32 (D) 1:2 (E) 1:16

25. If the temperatures of source and sink of a Carnot engine having efficiency η are each decreased by 100 K, then the efficiency

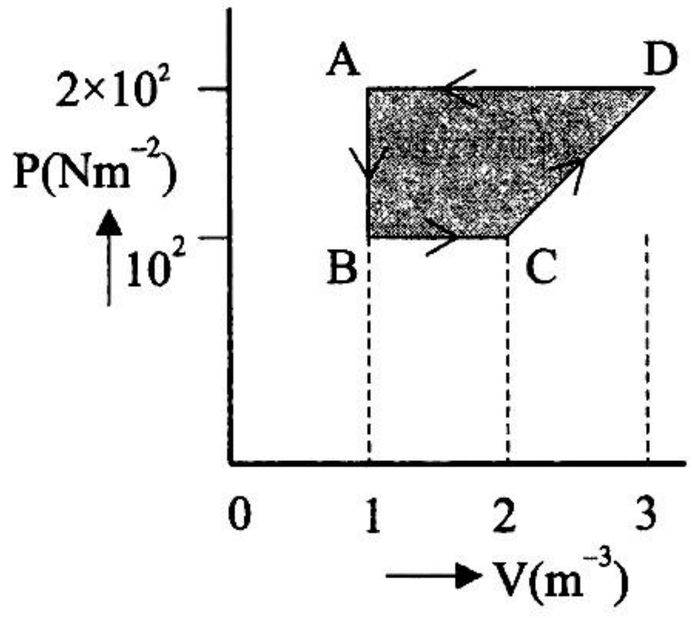
(A) remains constant (B) becomes 1 (C) decreases
(D) increases (E) becomes zero

Space for rough work

26. If the time taken by a hot body to cool from 50°C to 40°C is 10 minutes when the surrounding temperature is 25°C, then the time taken for it to cool from 40°C to 30°C when the surrounding temperature is 15°C, is

(A) 40 min (B) 10 min (C) 5 min
(D) 15 min (E) 20 min

27. The P-V diagram of a gas system undergoing cyclic process is shown here. The work done during isobaric compression is



(A) 100 J (B) 200 J (C) 600 J (D) 500 J (E) 400 J

28. In a cyclic process, the amount of heat given to a system is equal to

(A) net increase in internal energy
(B) net work done by the system
(C) net decrease in internal energy
(D) net change in volume
(E) net change in pressure

Space for rough work

29. A particle is executing simple harmonic motion with amplitude A. When the ratio of its kinetic energy to the potential energy is $\frac{1}{4}$, its displacement from its mean position is

(A) $\frac{2}{\sqrt{5}}$A (B) $\frac{\sqrt{3}}{2}$A (C) $\frac{3}{4}$A

(D) $\frac{1}{4}$A (E) $\frac{2}{5}$A

30. The ratio of amplitudes of two simple harmonic motions represented by the equations $y_1 = 5\sin\left(2\pi t + \frac{\pi}{4}\right)$ and $y_2 = 2\sqrt{2}\left(\sin 2\pi t + \cos 2\pi t\right)$ is

(A) 1 : 1 (B) 2 : 1 (C) 5 : 2 (D) 5 : 4

31. The displacement of a particle in SHM is $x = 10\ \sin\left(2t - \frac{\pi}{6}\right)$ metre. When its displacement is 6 m, the velocity of the particle (in ms^{-1}) is

(A) 8 (B) 24 (C)

(D) 10 (E) 12

32. The bulk modulus of a liquid of density 8000 kgm^{-3} is 2×10^9 Nm^{-2}. The speed of sound in that liquid is (in ms^{-1})

(A) 200 (B) 250 (C) 100

(D) 350 (E) 500

Space for rough work

33. The vibrations of a string of length 60 cm fixed at both the ends are represented by the equation $y = 2\sin\left(\frac{4\pi x}{15}\right)\cos(96\pi t)$ where x and y are in cm. The maximum number of loops that can be formed in it is

(A) 6 (B) 16 (C) 5 (D) 15 (E) 8

34. The pressure variations in the propagation of sound waves are

(A) isobaric
(B) isochoric
(C) isobaric and isochoric
(D) adiabatic
(E) isothermal

35. An uncharged parallel plate capacitor filled with a dielectric of dielectric constant K is connected to an air filled identical parallel capacitor charged to potential V_1. If the common potential is V_2, the value of K is

(A) $\frac{V_1 - V_2}{V_1}$ (B) $\frac{V_1}{V_1 - V_2}$ (C) $\frac{V_2}{V_1 - V_2}$

(D) $\frac{V_1 - V_2}{V_2}$ (E) $\frac{V_1 - V_2}{V_1 + V_2}$

36. When a comb rubbed with dry hair attracts pieces of paper. This is because the

(A) comb polarizes the piece of paper
(B) comb induces a net dipole moment opposite to the direction of field
(C) electric field due to the comb is uniform
(D) comb induces a net dipole moment perpendicular to the direction of field
(E) paper acquires a net charge

Space for rough work

37. If the electric flux entering and leaving a closed surface are 6×10^6 and 9×10^6 S.I. units respectively, then the charge inside the surface of permittivity of free space ε_0 is

(A) $\varepsilon_0\times10^6$ (B) $-\varepsilon_0\times10^6$ (C) $-2\varepsilon_0\times10^6$

(D) $3\varepsilon_0\times10^6$ (E) $2\varepsilon_0\times10^6$

38. Choose the wrong statement about equipotential surfaces.

(A) It is a surface over which the potential is constant
(B) The electric field is parallel to the equipotential surface
(C) The electric field is perpendicular to the equipotential surface
(D) The electric filed is in the direction of steepest decrease of potential
(E) They are concentric spheres for a point charge

39. Three capacitors connected in series have an effective capacitance of 4 μF. If one of the capacitance is removed, the net capacitance of the capacitor increases to 6 μF. The removed capacitor has a capacitance of

(A) 2 μF (B) 4 μF (C) 10 μF (D) 12 μF (E) 24 μF

40. Resistances of 12 Ω and X Ω are connected in parallel in the left gap and resistances of 9 Ω and 7 Ω are connected in series in the right gap of the meter bridge. If the balancing length is 36 cm, then the value of resistance X is

(A) 72 Ω (B) 54 Ω (C) 36 Ω (D) 64 Ω (E) 42 Ω

41. Ten identical batteries each of emf 2 V are connected in series to a 8 Ω resistor. If the current in the circuit is 2 A, then the internal resistance of each battery is

(A) 0.2 Ω (B) 0.3 Ω (C) 0.4 Ω (D) 0.5 Ω (E) 1 Ω

Space for rough work

42. In a potentiometer of wire length l, a cell of emf V is balanced at a length $\frac{l}{3}$ from the positive end of the wire. For another cell of emf 1.5 V, the balancing length becomes

(A) $\frac{l}{6}$ (B) $\frac{l}{2}$ (C) $\frac{l}{3}$ (D) $\frac{2l}{3}$ (E) $\frac{4l}{3}$

43. The smallest resistance that can be obtained by combining 10 resistors each of resistance 10 Ω is

(A) 10 Ω (B) 0.5 Ω (C) 2 Ω (D) 20 Ω (E) 1 Ω

44. Pick out the wrong statement from the following

(A) The SI unit of conductance is mho.
(B) Conductance of a conductor decreases with increase in temperature.
(C) If the radius of a metallic wire is doubled, its resistance becomes $\left(\frac{1}{4}\right)^{th}$ of original resistance.
(D) If the length of the metallic wire is doubled, its resistivity remains unchanged.
(E) The relation between voltage and current for a non-ohmic conductor is linear.

45. A steel plate of size 6 cm × 6 cm is to be coated by a metal on both sides with a coating thickness of 0.1 mm by electrolysis. If the density and ece of the metal are respectively 10 g cm^{-3} and 0.001g C^{-1}, then the strength of the current to complete the process in one hour is

(A) 1 A (B) 0.5 A (C) 6 A (D) 2 A (E) 3 A

46. The magnetic field at a point midway between two parallel long wires carrying currents in the same direction is 10 μT. If the direction of the smaller current among them is reversed, the field becomes 30 μT. The ratio of the larger to the smaller current in them is

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

Space for rough work

47. The angle of dip at a place where horizontal and vertical components of earth's magnetic field are equal is

(A) 45° (B) 30° (C) 0° (D) 60° (E) 90°

48. An AC source of voltage E = 20 sin 100 t is connected across a resistance 20 Ω. The rms value of current in the circuit is

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

49. A given resistor has the following colour code of the various strips on it: Brown, black, green and silver. The value of its resistance in ohm is

(A) $1.0 \times 10^4 \pm 10\%$ (B) $1.0 \times 10^7 \pm 5\%$ (C) $1.0 \times 10^6 \pm 10\%$

(D) $1.0 \times 10^5 \pm 5\%$ (E) $1.0 \times 10^3 \pm 10\%$

50. In an LCR circuit

(A) the impedance is equal to reactance
(B) the ratio between effective voltage to effective current is called reactance
(C) at resonance the resistance is equal to the reactance
(D) the current flowing is called wattless current
(E) at resonance the net reactance is zero

51. A 100 turns coil of area of cross section 200 cm^2 having 2 Ω resistance is held perpendicular to a magnetic field of 0.1 T. If it is removed from the magnetic field in one second, the induced charge produced in it is

(A) 0.2 C (B) 2 C (C) 0.1 C (D) 1 C (E) 20 C

52. The self-inductance of an air core solenoid of 100 turns is 1 mH. The self-inductance of another solenoid of 50 turns (with the same length and cross-sectional area) with a core having relative permeability 500 is

(A) 125 mH (B) 24 mH (C) 60 mH (D) 30 mH (E) 45 mH

Space for rough work

53. A step-down transformer with an efficiency of 80 % is used on a 1000 V line to deliver 10 A at 100 V at the secondary coil. The current drawn from the line is

(A) 1.5 A (B) 2 A (C) 3 A (D) 1.25 A (E) 1 A

54. Identify the wrong statement

(A) Eddy currents are produced in a steady magnetic field
(B) Eddy currents can be minimized by using laminated core
(C) Induction furnace uses eddy current to produce heat
(D) Eddy current can be used to produce breaking force in moving vehicles
(E) Power meters are working on the principle of eddy currents

55. If the magnetic field of an electromagnetic wave is given as $B_y = 2\times10^{-7} \sin(10^3 x + 1.5\times10^{12} t)$ tesla, the wavelength of the electromagnetic wave is

(A) 0. 314 mm (B) 0.628 mm (C) 6.28 mm
(D) 1.26 mm (E) 0.0628 mm

56. The electromagnetic waves travel with

(A) the same speed in all media
(B) the speed of sound in free space
(C) the speed of light $c = 3\times10^8 ms^{-1}$ in solid medium
(D) the speed of light $c = 3\times10^8 ms^{-1}$ in fluid medium
(E) the speed of light $c = 3\times10^8 ms^{-1}$ in free space

57. The focal lengths of the objective and the eyepiece of the telescope are 225 cm and 5 cm respectively. The magnifying power of the telescope will be

(A) 49 (B) 45 (C) 35 (D) 60 (E) 65

Space for rough work

58. The angle of incidence for an equilateral prism of refractive index $\sqrt{3}$ so that the ray is parallel to the base inside the prism is

(A) 30° (B) 20° (C) 60° (D) 45° (E) 75°

59. If the intensity ratio of two coherent sources used in Young's double slit experiment is 49 : 1, then the ratio between the maximum and minimum intensities in the interference pattern is

(A) 1 : 9 (B) 9 : 16 (C) 25 : 16 (D) 16 : 25 (E) 16 : 9

60. According to Rayleigh scattering law, the amount of scattering is

(A) directly proportional to wavelength of light
(B) directly proportional to square of wavelength of light
(C) independent of wavelength of light
(D) inversely proportional to wavelength of light
(E) inversely proportional to fourth power of wavelength of light

61. The de Broglie wavelength and kinetic energy of a particle is 2000 Å and 1 eV respectively. If its kinetic energy becomes 1 MeV, then its de Broglie wavelength is

(A) 2 Å (B) 1 Å (C) 4 Å (D) 10 Å (E) 5 Å

62. The work functions of two metals are 2.75 eV and 2 eV respectively. If these are irradiated by photons of energy 3 eV, the ratio of maximum momenta of the photoelectrons emitted respectively by them is

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

63. A radioactive material of half-life time of 69.3 days kept in a container. $\frac{2}{3}$rd of the substance remains undecayed after (given, $\ln \frac{3}{2} = 0.4$)

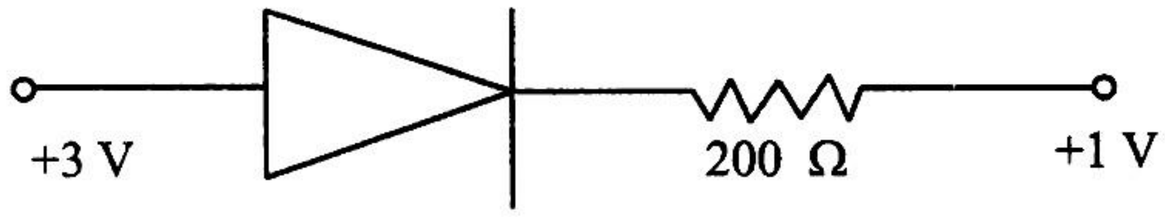
(A) 20 days (B) 25 days (C) 35 days
(D) 40 days (E) 50 days

Space for rough work

The maximum kinetic energy of photoelectrons

(A) depends on collector plate.
(B) is independent of emitter plate material.
(C) is independent of frequency of incident radiation.
(D) depends on the frequency of light source and the nature of emitter plate material.
(E) depends on intensity of incident radiation.

If an ideal junction diode is connected as shown, then the value of the current i is



(A) 0.013 A (B) 0.02 A (C) 0.01 A

(D) 0.1 A (E) 0.2 A

Identify the mismatched pair from the following

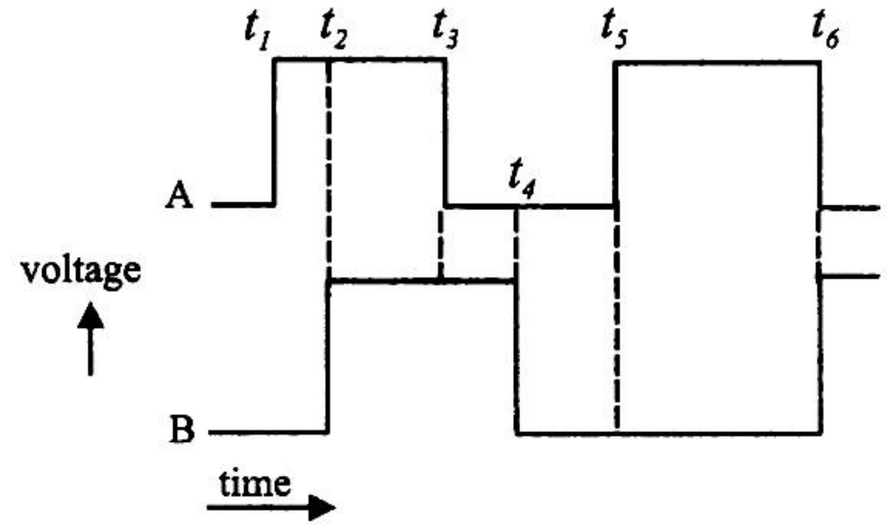
(A) Zener diode	:	voltage regulator
(B) germanium doped with phosphorous	:	*n*-type semiconductor
(C) semiconductor	:	band gap > 3 eV
(D) *pn* junction diode	:	rectifier
(E) silicon doped with aluminum	:	*p*-type semiconductor

Space for rough work

67. In a common emitter configuration, a transistor has $\beta = 50$ and input resistance 1 kΩ. If the peak value of a.c. input is 0.01 V then the peak value of collector current is

(A) 0.01 μA (B) 500 μA (C) 100 μA
(D) 0.5 μA (E) 50 μA

68. The wave forms A and B given below are given as input to a NAND gate. Then its logic output y is



(A) for t_1 to t_2 ; $y = 0$ (B) for t_2 to t_3 ; $y = 1$
(C) for t_3 to t_4 ; $y = 1$ (D) for t_4 to t_5 ; $y = 0$
(E) for t_5 to t_6 ; $y = 0$

Space for rough work

. The radiating power of a linear antenna of length l for a wave of wavelength λ is proportional to

(A) $\frac{l}{\lambda}$ (B) $\frac{l^2}{\lambda^2}$ (C) $\frac{l}{\lambda^2}$ (D) $\frac{l^2}{\lambda}$ (E) $\frac{l}{\sqrt{\lambda}}$

. A signal of 5 kHz frequency modulates a carrier of frequency 1 MHz and peak voltage 25 V. If the amplitude at the sidebands of the amplitude modulated signal is 5 V, then the modulation index is

(A) 0.8 (B) 0.6 (C) 0.5 (D) 0.2 (E) 0.4

. A repeater is a combination of
(A) receiver and modulator
(B) receiver and transducer
(C) receiver and transmitter
(D) receiver and amplifier
(E) amplifier and transmitter

. Find the mismatch

(A) Sky wave communication : Frequency upto 30 MHz
(B) Line-of-sight communication : Frequency greater than 40 MHz
(C) Mobile telephony : Frequency range 800–950 kHz
(D) Facsimile : Static document
(E) Ground wave propagation : Frequency less than a few MHz

Space for rough work

73. The volume of neon gas in cm^3 at STP having the same number of atoms as that present in 800 mg of Ca is (At. mass: Ca = 40 g mol^{-1}, Ne = 20 g mol^{-1})

(A) 56 (B) 896 (C) 224 (D) 112 (E) 448

74. The ionization enthalpy of He^+ ion is 19.60×10^{-18} J $atom^{-1}$. The ionization enthalpy of Li^{+2} ion will be

(A) 84.2×10^{-18} J $atom^{-1}$
(B) 44.10×10^{-18} J $atom^{-1}$
(C) 63.20×10^{-18} J $atom^{-1}$
(D) 21.20×10^{-18} J $atom^{-1}$
(E) 2.17×10^{-19} J $atom^{-1}$

75. How many molecules of CO_2 are formed when one milligram of 100% pure $CaCO_3$ is treated with excess hydrochloric acid?

(A) 6.023×10^{23} (B) 6.023×10^{21} (C) 6.023×10^{20}
(D) 6.023×10^{19} (E) 6.023×10^{18}

76. Molecular shapes of SF_4, CF_4 and XeF_4 and the number of lone pairs on the central atom are respectively

(A) the same, with 1, 2 and 1
(B) the same, with 1, 0 and 1
(C) different, with 0, 1 and 2
(D) different, with 1, 0 and 2
(E) the same, with 0, 0 and 1

Space for rough work

77. Which one of the following is not correct in respect of hybridization of orbitals?

(A) The orbitals present in the valence shell only are hybridized
(B) The orbitals undergoing hybridization have almost equal energy
(C) Promotion of electron is not essential condition for hybridization
(D) It is not always that only partially filled orbitals participate in hybridization; in some cases even filled orbitals in valence shell take part
(E) Pure atomic orbitals are more effective in forming stable bonds than hybrid orbitals

78. Allyl cyanide molecule contains

(A) 9 sigma bonds, 4 pi bonds and no lone pair
(B) 9 sigma bonds, 3 pi bonds and one lone pair
(C) 8 sigma bonds, 5 pi bonds and one lone pair
(D) 8 sigma bonds, 3 pi bonds and two lone pairs
(E) 6 sigma bonds, 2 pi bonds and four lone pairs

79. Two vessels of volumes 16.4 L and 5 L contain two ideal gases of molecular existence at the respective temperature of 27°C and 227°C and exert 1.5 and 4.1 atmospheres respectively. The ratio of the number of molecules of the former to that of the later is

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

Space for rough work

80. When 4 g of an ideal gas A is introduced into an evacuated flask kept at 25°C, the pressure is found to be one atmosphere. If 6 g of another ideal gas B is then added to the same flask, the pressure becomes 2 atm at the same temperature. The ratio of molecular weights $(M_A : M_B)$ of the two gases would be

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

81. Which one of the following statements is correct?

(A) NaCl is a paramagnetic salt
(B) $CuSO_4$ is a diamagnetic salt
(C) MnO is an example of ferromagnetic substance
(D) CrO_2 is an example of antiferromagnetic substance
(E) Ferrimagnetic substance like $ZnFe_2O_4$ becomes paramagentic on heating

82. Which of the following noble gases has the highest positive electron gain enthalpy value?

(A) Helium (B) Krypton (C) Argon (D) Neon (E) Xenon

83. Among the elements B, Mg, Al and K, the correct order of increasing metallic character is

(A) B < Al < Mg < K (B) B < Mg < Al < K (C) Mg < B < Al < K
(D) Mg < Al < B < K (E) K < Mg < Al < B

84. In Solvay process of manufacture of sodium carbonate, the by-product is

(A) NH_4Cl (B) $NaHCO_3$ (C) $CaCl_2$ (D) CO_2 (E) NH_3

Space for rough work

An inorganic salt (A) is decomposed on heating to give two products (B) and (C). Compound (C) is a liquid at room temperature and is neutral to litmus while the compound (B) is a colourless neutral gas. Compounds (A), (B) and (C) are

(A) NH_4NO_3, N_2O, H_2O
(B) NH_4NO_2, NO, H_2O
(C) CaO, H_2O, $CaCl_2$
(D) $Ba(NO_3)_2$, H_2O, NO_2
(E) $Mg(NO_3)_2$, N_2O_5, H_2O

The correct formula of borax is

(A) $Na_2[B_4O_4(OH)_3].9\ H_2O$
(B) $Na_2[B_4O_5(OH)_4].8\ H_2O$
(C) $Na_2[B_4O_6(OH)_5].7\ H_2O$
(D) $Na_2[B_4O_7(OH)_6].6\ H_2O$
(E) $Na_2[B_4O_8(OH)_7].5\ H_2O$

Oxyacids of phosphorous and the starting materials for their preparation are given below.

Oxyacid	-	Materials for preparation
(a) H_3PO_2	-	(i) Red P + alkali
(b) H_3PO_3	-	(ii) $P_4O_{10} + H_2O$
(c) H_3PO_4	-	(iii) $P_2O_3 + H_2O$
(d) $H_4P_2O_6$	-	(iv) White P + alkali

Choose the correct answer from the codes given below

(A) (a) - (iv) ; (b) - (iii) ; (c) - (ii) ; (d) - (i)
(B) (a) - (i) ; (b) - (iii) ; (c) - (ii) ; (d) - (iv)
(C) (a) - (iv) ; (b) - (iii) ; (c) - (i) ; (d) - (ii)
(D) (a) - (ii) ; (b) - (iii) ; (c) - (i) ; (d) - (iv)
(E) (a) - (iii) ; (b) - (i) ; (c) - (ii) ; (d) - (iv)

Space for rough work

88. Which one of the following metals has a different lattice from those of the others?

(A) Fe (B) Co (C) Ni (D) Cu (E) Ag

89. In the dichromate dianion, the nature of bonds are

(A) four equivalent Cr–O bonds
(B) six equivalent Cr–O bonds and one O–O bond
(C) six equivalent Cr–O bonds and one Cr–Cr bond
(D) six nonequivalent Cr–O bonds
(E) six equivalent Cr–O bonds and one Cr–O–Cr bond

90. In neutral or faintly alkaline medium, thiosulphate is quantitatively oxidized by $KMnO_4$ to

(A) SO_3^{2-} (B) SO_4^{2-} (C) SO_2 (D) SO_5^{2-} (E) $S_2O_8^{2-}$

91. At constant external pressure of one atmosphere, 4 moles of a metallic oxide MO_2 undergoes complete decomposition at 227°C in an open vessel according to the equation

$$2MO_{2\,(s)} \rightarrow 2MO_{(s)} + O_{2\,(g)}.$$

The work done by the system in kJ is ($R = 8.3\ JK^{-1}\ mol^{-1}$)

(A) – 16.6 (B) – 24.9 (C) – 8.3 (D) – 4.15 (E) – 33.2

92. A certain reaction has a ΔH of 12 kJ and a ΔS of 40 JK^{-1}. The temperature above which the reaction becomes spontaneous is

(A) 27°C (B) 27 K (C) 300°C (D) 30°C (E) 30 K

Space for rough work

93. The sum of pH and pK_b for a basic buffer solution is 13. The ratio of the concentration of the base to that of the salt is

(A) 10 (B) 1 (C) 0.05 (D) 0.1 (E) 20

94. Two equilibria, $AB \rightleftharpoons A^+ + B^-$ and $AB + B^- \rightleftharpoons AB_2^-$ are simultaneously maintained in a solution with equilibrium constants, K_1 and K_2 respectively. The ratio of $\left[A^+\right]$ to $\left[AB_2^-\right]$ in the solution is

(A) directly proportional to $[B^-]$
(B) inversely proportional to $[B^-]$
(C) directly proportional to the square of $[B^-]$
(D) inversely proportional to the square of $[B^-]$
(E) independent of $[B^-]$

95. If the elevation in boiling point of a solution of non-volatile, non-electrolytic and non-associating solute in a solvent ($K_b = x$ K kg mol^{-1}) is y K, then the depression in freezing point of solution of same concentration would be (K_f of the solvent $= z$ K kg mol^{-1})

(A) $\frac{2xz}{y}$ (B) $\frac{yz}{x}$ (C) $\frac{xz}{y}$ (D) $\frac{yz}{2x}$ (E) $\frac{xz}{2y}$

96. The vapour pressure of pure benzene and toluene at a particular temperature are 100 mm and 50 mm respectively. Then the mole fraction of benzene in vapour phase in contact with equimolar solution of benzene and toluene is

(A) 0.67 (B) 0.75 (C) 0.33 (D) 0.50 (E) 0.20

Space for rough work

97. A current strength of 9.65 amperes is passed through excess fused $AlCl_3$ for 5 hours. How many litres of chlorine will be liberated at STP? (F = 96500 C)

(A) 2.016 (B) 1.008 (C) 11.2 (D) 20.16 (E) 10.08

98. When the total cell emf of a voltaic cell is greater than zero, which of the following is true about the reaction quotient Q and free energy change ΔG for the cell reaction?

(A) Q is less than one and ΔG is greater than zero
(B) Q is greater than one and ΔG is greater than zero
(C) Q is less than one and ΔG is less than zero
(D) Q is zero and ΔG is greater than zero
(E) Q is greater than one and ΔG is less than zero

99. The reaction A + B $\rightarrow$ products is first order with respect to A and second order with respect to B. When 1.0 mol each of A and B were taken in one litre flask, the initial rate of the reaction is 1.0×10^{-2}mol $lit^{-1}s^{-1}$. The rate of the reaction when 50% of the reactants have been converted into products is

(A) 1.00×10^{-3}mol $lit^{-1}s^{-1}$ (B) 0.05×10^{-2}mol $lit^{-1}s^{-1}$
(C) 1.25×10^{-3}mol $lit^{-1}s^{-1}$ (D) 4.00×10^{-2}mol $lit^{-1}s^{-1}$
(E) 2.00×10^{-3}mol $lit^{-1}s^{-1}$

100. For the following reaction: $NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$, the rate law is: Rate = $k[NO_2]^2$. If 0.1 mole of gaseous carbon monoxide is added at constant temperature to the reaction mixture which of the following statements is true?

(A) Both *k* and the reaction rate remain the same
(B) Both *k* and the reaction rate increase
(C) Both *k* and the reaction rate decrease
(D) Only *k* increases, the reaction rate remain the same
(E) Only the reaction rate increases; *k* remains the same

Space for rough work

101. Which one of the following is an example for multimolecular colloid?

(A) Aqueous starch sol
(B) Aqueous enzyme sol
(C) Alcoholic polystyrene sol
(D) Aqueous sol of sodium laurylsulphate
(E) Sulphur sol in water

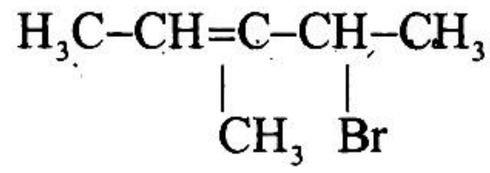
102. Amongst the following ions which one has the highest magnetic moment value? (At. no.: Co = 27, Ni = 28)

(A) $[Co(NH_3)_6]^{3+}$
(B) $[CoF_6]^{3-}$
(C) $[NiCl_4]^{2-}$
(D) $[Ni(CN)_4]^{2-}$
(E) $[Ni(CO)_4]$

103. The colour of the solution/precipitate obtained in the elemental analysis of an organic compound and the molecule/ion responsible for the colour are given below. Choose the incorrectly matched pair

(A) Prussian blue	-	$Fe_4[Fe(CN)_6]_3 \,.\, xH_2O$
(B) Black	-	PbS
(C) Violet colour	-	$[Fe(CN)_5NOS]^{4-}$
(D) Blood red colour	-	$[Fe(SCN)]^{2+}$
(E) Yellow	-	$(NH_4)_2MoO_4$

104. The correct IUPAC name of the following compound



is

(A) 4-bromo-3-methylpent-2-ene
(B) 2-bromo-3-methylpent-4-ene
(C) 3-methyl-4-bromopent-2-ene
(D) 3-methyl-2-bromopent-4-ene
(E) 2-bromo-4-methylpent-2-ene

Space for rough work

105. Which one of the following halogen compounds is difficult to be hydrolysed by S_N1 mechanism?

(A) Tertiary butyl chloride
(B) Isopropyl chloride
(C) Benzyl chloride
(D) Chlorobenzene
(E) Allyl chloride

106. Which one among the following cannot exhibit enantiomerism?

(A) Diphenyl methanol
(B) 1-Bromo-2-chlorobutane
(C) 2-Butanol
(D) Tartaric acid
(E) 1,2-Dichlorobutane

107. The total number of acyclic structural isomers possible for compound with molecular formula $C_4H_{10}O$ is

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

108. Compound 'A' of molecular formula $C_4H_{10}O$ on treatment with Lucas reagent at room temperature gives compound 'B'. When compound 'B' is heated with alcoholic KOH, it gives isobutene. Compound 'A' and 'B' are respectively

(A) 2-methyl-2-propanol and 2-methyl-2-chloropropane
(B) 2-methyl-1-propanol and 1-chloro-2-methylpropane
(C) 2-methyl-1-propanol and 2-methyl-2-chloropropane
(D) butan-2-ol and 2-chlorobutane
(E) butan-1-ol and 1-chlorobutane

Space for rough work

109. Salicylaldehyde can be prepared from phenol by

(A) Schotten-Baumann reaction
(B) Kolbe's reaction
(C) Reimer-Tiemann reaction
(D) Perkin reaction
(E) Cannizaro reaction

110. Which one of the following is not an allylic halide?

(A) 4-Bromopent-2-ene
(B) 3-Bromo-2-methylbut-1-ene
(C) 1-Bromobut-2-ene
(D) 4-Bromobut-1-ene
(E) 3-Bromo-2-methylpropene

111. One mole of alkene on ozonolysis gives 2 moles of butanone. The alkene is

(A) 3,4-dimethylhex-2-ene
(B) 2,3-dimethylhex-3-ene
(C) 3,4-dimethylhex-3-ene
(D) 2,3-dimethylhex-2-ene
(E) 2,5-dimethylhex-3-ene

112. The compound that neither forms semicarbazone nor oxime is

(A) HCHO
(B) CH_3COCH_3
(C) CH_3CHO
(D) $CH_3CH_2CH_2NH_2$
(E) $(CH_3)_2CHCHO$

Space for rough work

113. Isopropylbenzene is oxidized in the presence of air to compound 'A'. When compound 'A' is treated with dilute mineral acid, the aromatic product formed is

(A) phenol (B) benzene (C) benzaldehyde
(D) acetophenone (E) toluene

114. Positive carbylamine test is shown by

(A) N,N-dimethylaniline (B) triethylamine
(C) N-methylaniline (D) *p*-methylbenzylamine
(E) dimethylamine

115. Among the following amines, which one has the highest pK_b value in aqueous solution?

(A) Methanamine (B) N,N-Dimethylaniline
(C) Ethanamine (D) Benzenamine
(E) N,N-Diethylethanamine

116. An organic compound A containing nitrogen, on acid catalysed hydrolysis produces a water soluble organic compound B and a gaseous compound C. When methyl magnesium bromide is slowly added to A in 1 : 1 ratio and hydrolysed, it produces a compound which can be obtained by dry distillation of the calcium salt of B. The compound A is

(A) N-methylmethanamide (B) N-ethylmethanamide
(C) acetonitrile (D) N, N-dimethylmethanamide
(E) methylisocyanide

Space for rough work

117. How many amino acids are present in insulin?

(A) 25 (B) 51 (C) 20 (D) 22 (E) 52

118. The repeating unit present in Nylon 6 is

(A) —[$NH(CH_2)_6NHCO(CH_2)_4CO$] —
(B) —[$CO(CH_2)_5NH$]—
(C) —[$CO(CH_2)_6NH$]—
(D) —[$CO(CH_2)_4NH$]—
(E) —[$NH(CH_2)_4NHCO(CH_2)_6CO$] —

119. Which one of the following is NOT correct?

(A) D(–) Fructose exists in furanose structure
(B) D(+) Glucose exists in pyranose structure
(C) In sucrose the two monosaccharides are held together by peptide linkage
(D) Maltose is a reducing sugar
(E) Pentaacetate of glucose does not react with hydroxylamine

120. How many times oxyhaemoglobin is less stable than carboxyhaemoglobin?

(A) 50 (B) 200 (C) 500 (D) 300 (E) 250

Space for rough work

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