WARNING : Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.			
PAPER – I PHYSICS & CHEMISTRY – 2014			
Version Code	**A2**	**Question Booklet Serial Number :**	6236219
Time : 150 Minutes		**Number of Questions : 120**	**Maximum Marks : 480**
Name of Candidate			
Roll Number			
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INSTRUCTIONS TO THE CANDIDATE

1. Please ensure that the **VERSION CODE shown at the top of this Question Booklet is the same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different **VERSION CODE**, please get it replaced with a Question Booklet with the same VERSION CODE as that of the OMR Answer Sheet from the invigilator. **THIS IS VERY IMPORTANT.**
2. Please fill 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 5 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 for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.

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.

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

If a body of mass m has to be taken from the surface of earth to a height h = R, then the amount of energy required is (R: radius of earth)

(A) mgR (B) $\frac{mg\text{R}}{3}$ (C) $\frac{mg\text{R}}{2}$

(D) $\frac{mg\text{R}}{12}$ (E) $\frac{mg\text{R}}{9}$

The total energy of an artificial satellite of mass m revolving in a circular orbit around the earth with a speed v is

(A) $\frac{1}{2}mv^2$ (B) $\frac{1}{4}mv^2$ (C) $-\frac{1}{4}mv^2$

(D) $-mv^2$ (E) $-\frac{1}{2}mv^2$

Two soap bubbles each with radius r_1 and r_2 coalesce in vacuum under isothermal conditions to form a bigger bubble of radius R. Then R is equal to

(A) $\sqrt{r_1^2+r_2^2}$ (B) $\sqrt{r_1^2-r_2^2}$ (C) r_1+r_2

(D) $\frac{\sqrt{r_1^2+r_2^2}}{2}$ (E) $2\sqrt{r_1^2+r_2^2}$

The ratio of hydraulic stress to the corresponding strain is known as

(A) Compressibility (B) Bulk modulus

(C) Young's modulus (D) Rigidity modulus

(E) Expansion coefficient

Space for rough work

5. A boy can reduce the pressure in his lungs to 750 mm of mercury. Using a straw he can drink water from a glass upto the maximum depth of (atmospheric pressure = 760 mm of mercury; density of mercury = 13.6 gcm^{-3})

(A) 13.6 cm (B) 9.8 cm (C) 10 cm

(D) 76 cm (E) 1.36 cm

6. A spring stores 1 J of energy for a compression of 1 mm. The additional work to be done to compress it further by 1 mm is

(A) 1 J (B) 2 J (C) 3 J (D) 4 J (E) 0.5 J

7. If m represents the mass of each molecule of a gas and T, its absolute temperature, then the root mean square velocity of the gaseous molecule is proportional to

(A) $m\,T$ (B) $m^{1/2}\,T^{1/2}$ (C) $m^{-1/2}\,T$

(D) $m^{-1/2}\,T^{1/2}$ (E) $m\,T^{-1/2}$

8. A Carnot engine operating between temperatures T_1 and T_2 has efficiency 0.2. When T_2 is reduced by 50 K, its efficiency increases to 0.4. Then T_1 and T_2 are respectively

(A) 200 K, 150 K (B) 250 K, 200 K (C) 300 K, 250 K

(D) 300 K, 200 K (E) 300 K, 150 K

9. A molecule of a gas has six degrees of freedom. Then the molar specific heat of the gas at constant volume is

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

Space for rough work

Total number of degrees of freedom of a rigid diatomic molecule is

(A) 3 (B) 6 (C) 5 (D) 2 (E) 7

If the differential equation for a simple harmonic motion is $\frac{d^2y}{dt^2}+2y=0$, the time-period of the motion is

(A) $\pi\sqrt{2}$ s (B) $\frac{\sqrt{2}}{\pi}$ s (C) $\frac{\pi}{\sqrt{2}}$ s (D) 2π s (E) $\frac{\sqrt{\pi}}{2}$ s

Identify the wrong statement from the following

(A) If the length of a spring is halved, the time period of each part becomes $\frac{1}{\sqrt{2}}$ times the original

(B) The effective spring constant K of springs in parallel is given by $\frac{1}{K}=\frac{1}{K_1}+\frac{1}{K_2}+.....$

(C) The time period of a stiffer spring is less than that of a soft spring

(D) The spring constant is inversely proportional to the spring length

(E) The unit of spring constant is Nm^{-1}

The total energy of the particle executing simple harmonic motion of amplitude A is 100 J. At a distance of 0.707 A from the mean position, its kinetic energy is

(A) 25 J (B) 50 J (C) 100 J (D) 12.5 J (E) 70 J

Space for rough work

14. Two travelling waves, $y_1 = A \sin [\, k\,(x + ct)\,]$ and $y_2 = A \sin [\, k\,(x - ct)\,]$ are superposed on a string. The distance between adjacent antinodes is

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

(D) $\frac{k}{\pi}$ (E) $\frac{\pi}{k}$

15. If a stretched wire is vibrating in the second overtone, then the number of nodes and antinodes between the ends of the string are respectively

(A) 2 and 2 (B) 1 and 2 (C) 4 and 3

(D) 2 and 3 (E) 3 and 4

16. Pick out the correct statement in the following with reference to stationary wave pattern

(A) In a tube closed at one end, all the harmonics are present

(B) In a tube open at one end, only even harmonics are present

(C) The distance between successive nodes is equal to the wavelength

(D) In a stretched string, the first overtone is the same as the second harmonic

(E) Reflection of a wave from a rigid wall changes the phase by 45°

17. A plane square sheet of charge of side 0.5 m has uniform surface charge density. An electron at 1 cm from the centre of the sheet experiences a force of 1.6×10^{-12} N directed away from the sheet. The total charge on the plane square sheet is

($\epsilon_0 = 8.854 \times 10^{-12}\ C^2 m^{-2} N^{-1}$)

(A) 16.25 μC (B) – 22.15 μC (C) – 44.27 μC

(D) 144.27 μC (E) 8.854 μC

Space for rough work

. The energy stored in a capacitor of capacitance C having a charge Q under a potential V is

(A) $\frac{1}{2}Q^2V$ (B) $\frac{1}{2}C^2V$ (C) $\frac{1}{2}\frac{Q^2}{V}$ (D) $\frac{1}{2}QV$ (E) $\frac{1}{2}CV$

. The electrostatic force between two point charges is directly proportional to the

(A) sum of the charges

(B) distance between the charges

(C) permittivity of the medium

(D) square of the distance between the charges

(E) product of the charges

The time period of revolution of a charge q_1 and of mass m moving in a circular path of radius r due to Coulomb force of attraction with another charge q_2 at its centre is

(A) $\sqrt{\frac{16\pi\,\varepsilon_0 mr^3}{q_1 q_2}}$ (B) $\sqrt{\frac{8\pi^2\,\varepsilon_0 mr^3}{q_1 q_2}}$ (C) $\sqrt{\frac{\varepsilon_0 mr^3}{16 q_1 q_2}}$

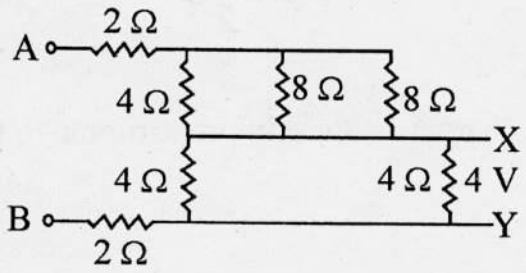
(D) $\sqrt{\frac{16\pi^3\,\varepsilon_0 mr^3}{q_1 q_2}}$ (E) $\sqrt{\frac{\pi^2\,\varepsilon_0 mr^3}{8 q_1 q_2}}$

A point charge of 2 C experiences a constant force of 1000 N when moved between two points separated by a distance of 2 cm in a uniform electric field. The potential difference between the two points is

(A) 12 V (B) 8 V (C) 10 V (D) 16 V (E) 5 V

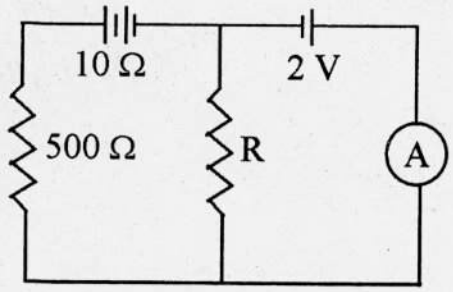
Space for rough work

22. In the network shown below, if potential across XY is 4 V, then the input potential across AB is



(A) 16 V (B) 20 V (C) 8 V (D) 12 V (E) 24 V

23. If the ammeter A shows a zero reading in the circuit shown below, the value of resistance R is



(A) 500 Ω (B) 125 Ω (C) 100 Ω (D) 41.5 Ω (E) 4 Ω

Space for rough work

4. Five cells each of emf E and internal resistance r send the same amount of current through an external resistance R whether the cells are connected in parallel or in series. Then the ratio $\left(\frac{R}{r}\right)$ is

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

5. The power dissipated in the transmission cables carrying current I and voltage V is inversely proportional to

(A) V (B) V^2 (C) $\sqrt{V}$ (D) $\sqrt{I}$ (E) I

6. A rigid container with thermally insulated walls contains a gas and a coil of resistance 50 Ω, carrying a current of 1 A. The change in internal energy of the gas after 2 minutes will be

(A) 6 kJ (B) 10 kJ (C) 3 kJ (D) 12 kJ (E) 1.5 kJ

7. The magnitude of the magnetic field inside a long solenoid is increased by

(A) decreasing its radius

(B) decreasing the current through it

(C) increasing its area of cross-section

(D) introducing a medium of higher permeability

(E) decreasing the number of turns in it

Space for rough work

28. A bar magnet of moment of inertia 9×10^{-5} kg m^2 placed in a vibration magnetometer and oscillating in a uniform magnetic field $16\pi^2 \times 10^{-5}$ T makes 20 oscillations in 15 s. The magnetic moment of the bar magnet is

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

29. Identify the correctly matched pair

Material		Example
(A) Diamagnetic	-	Gadolinium
(B) Soft ferromagnetic	-	Alnico
(C) Hard ferromagnetic	-	Copper
(D) Paramagnetic	-	Sodium
(E) Permanent magnet	-	Aluminum

30. If the radius of the dees of cyclotron is r, then the kinetic energy of a proton of mass m accelerated by the cyclotron at an oscillating frequency v is

(A) $4\pi^2 m^2 v^2 r^2$ (B) $4\pi^2 m v^2 r^2$ (C) $2\pi^2 m v^2 r^2$
(D) $\pi^2 m v^2 r^2$ (E) $\pi^2 m^2 v^2 r^2$

31. If a magnetic dipole of moment M situated in the direction of a magnetic field B is rotated by 180°, then the amount of work done is

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

Space for rough work

The polarity of induced emf is given by

(A) Ampere's circuital law

(B) Biot-Savart law

(C) Lenz' law

(D) Fleming's right hand rule

(E) Fleming's left hand rule

In an LCR series circuit, at resonance

(A) the current and voltage are in phase

(B) the impedance is maximum

(C) the current is minimum

(D) the quality factor is independent of R

(E) the current leads the voltage by $\frac{\pi}{2}$

A conducting ring of radius 1 m kept in a uniform magnetic field B of 0.01 T, rotates uniformly with an angular velocity 100 rad s^{-1} with its axis of rotation perpendicular to B. The maximum induced emf in it is

(A) 1.5πV (B) πV (C) 2πV (D) 0.5πV (E) 4πV

A step down transformer increases the input current 4 A to 24 A at the secondary. If the number of turns in the primary coil is 330, the number of turns in the secondary coil is

(A) 60 (B) 50 (C) 65 (D) 45 (E) 55

Space for rough work

36. In a plane electromagnetic wave, the electric field of amplitude 1 V m^{-1} varies with time in free space. The average energy density of magnetic field is (in Jm^{-2})

(A) 8.86×10^{-12} (B) 4.43×10^{-12} (C) 17.72×10^{-12}

(D) 2.21×10^{-12} (E) 1.11×10^{-12}

37. Which one of the following is the property of a monochromatic, plane electromagnetic wave in free space?

(A) Electric and magnetic fields have a phase difference of $\pi/2$

(B) The energy contribution of both electric and magnetic fields are equal

(C) The direction of propagation is in the direction of electric filed E

(D) The pressure exerted by the wave is the product of energy density and the speed of the wave

(E) The speed of the wave is B/E

38. The apparent flattening of the sun at sunset and sunrise is due to

(A) refraction

(B) diffraction

(C) total internal reflection

(D) interference

(E) polarization

39. The polarising angle for a medium is found to be 60°. The critical angle of the medium is

(A) $\sin^{-1}\left(\frac{1}{2}\right)$ (B) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (C) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (D) $\sin^{-1}\left(\frac{1}{4}\right)$ (E) $\sin{-1}\left(\frac{2}{\sqrt{3}}\right)$

Space for rough work

. Identify the mismatch in the following

(A) Myopia - Concave lens

(B) For rear view - Concave mirror

(C) Hypermetropia - Convex lens

(D) Astigmatism - Cylindrical lens

(E) Reflecting telescope - Convex mirror

. In Young's double slit experiment, to increase the fringe width

(A) the wavelength of the source is increased

(B) the source is moved towards the slit

(C) the source is moved away from the slit

(D) the slit separation is increased

(E) the screen is moved towards the slit

. Light of wavelength 5000 Å is incident normally on a slit of width 2.5×10^{-4} cm. The angular position of second minimum from the central maximum is

(A) $\sin^{-1}\left(\frac{1}{5}\right)$ (B) $\sin^{-1}\left(\frac{2}{5}\right)$ (C) $\left(\frac{\pi}{3}\right)$

(D) $\left(\frac{\pi}{6}\right)$ (E) $\left(\frac{\pi}{4}\right)$

Space for rough work

3. An electron of mass m_e and a proton of mass m_p are accelerated through the same potential. Then the ratio of their de Broglie wavelengths is

(A) 1 (B) $\sqrt{\frac{m_e}{m_p}}$ (C) $\frac{m_e}{m_p}$

(D) $\frac{m_p}{m_e}$ (E) $\sqrt{\frac{m_p}{m_e}}$

4. The half-life of a radioactive substance is 20 minutes. The time taken between 50% decay and 87.5% decay of the substance will be

(A) 20 minutes (B) 30 minutes (C) 40 minutes

(D) 25 minutes (E) 10 minutes

5. The ratio of the surface area of the nuclei $_{52}Te^{125}$ to that of $_{13}Al^{27}$ is

(A) $\frac{5}{3}$ (B) $\frac{125}{17}$ (C) $\frac{1}{4}$

(D) $\frac{25}{9}$ (E) $\frac{3}{5}$

6. If the frequency of incident light falling on a photosensitive metal is doubled, the kinetic energy of the emitted photoelectron is

(A) unchanged

(B) halved

(C) doubled

(D) more than twice its initial value

(E) reduced to $\frac{1}{4}$ th

Space for rough work

7. The significant result deduced from the Rutherford's scattering experiment is that

(A) whole of the positive charge is concentrated at the centre of atom

(B) there are neutrons inside the nucleus

(C) α-particles are helium nuclei

(D) electrons are embedded in the atom

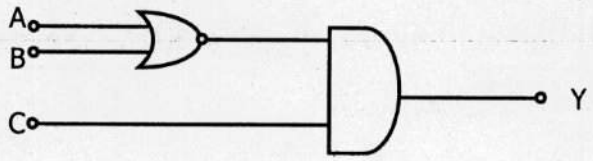
(E) electrons are revolving around the nucleus

8. On an average, the number of neutrons and the energy of a neutron released per fission of a uranium atom are respectively

(A) 2.5 and 2 keV (B) 3 and 1 keV (C) 2.5 and 2 MeV

(D) 2 and 2 keV (E) 1 and 2 MeV

9. The inputs A, B and C to be given in order to get an output Y = 1 from the following circuit are



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

10. The collector resistance and the input resistance of a CE amplifier are respectively 10 kΩ and 2 kΩ. If β of the transistor is 49, the voltage gain of the amplifier is

(A) 125 (B) 150 (C) 175 (D) 200 (E) 245

Space for rough work

51. The light emitting diode (LED) is

(A) a heavily doped p-n junction with no external bias

(B) a heavily doped p-n junction with reverse bias

(C) a heavily doped p-n junction with forward bias

(D) a lightly doped p-n junction with no external bias

(E) a lightly doped p-n junction with reverse bias

52. A point-to-point communication mode is seen in

(A) Satellite cable communication

(B) Television transmission

(C) FM radio transmission

(D) AM radio transmission

(E) Fax transmission

53. If the heights of transmitting and the receiving antennas are each equal to h, the maximum line-of-sight distance between them is (R is the radius of earth)

(A) $\sqrt{2Rh}$ (B) $\sqrt{4Rh}$ (C) $\sqrt{6Rh}$

(D) $\sqrt{8Rh}$ (E) $\sqrt{Rh}$

54. The ionospheric layer acts as a reflector for the frequency range

(A) 1 kHz to 10 kHz (B) 3 to 30 MHz (C) 3 to 30 kHz

(D) 100 kHz to 1 MHz (E) 3 GHz to 30 GHz

Space for rough work

. In a simple pendulum experiment, the maximum percentage error in the measurement of length is 2% and that in the observation of the time-period is 3%. Then the maximum percentage error in determination of the acceleration due to gravity g is

(A) 5% (B) 6% (C) 7% (D) 8% (E) 10%

. The pitch and the number of circular scale divisions in a screw gauge with least count 0.02 mm are respectively

(A) 1 mm and 100
(B) 0.5 mm and 50
(C) 1 mm and 50
(D) 0.5 mm and 100
(E) 1 mm and 200

A ball is dropped from the top of a tower of height 100 m and at the same time another ball is projected vertically upwards from ground with a velocity 25 ms^{-1}. Then the distance from the top of the tower, at which the two balls meet is

(A) 68.4 m (B) 48.4 m (C) 18.4 m
(D) 28.4 m (E) 78.4 m

The ratio of distances traversed in successive intervals of time when a body falls freely under gravity from certain height is

(A) 1 : 2 : 3 (B) 1 : 5 : 9 (C) 1 : 3 : 5
(D) $\sqrt{1} : \sqrt{2} : \sqrt{3}$ (E) 1 : 4 : 9

A particle starting with certain initial velocity and uniform acceleration covers a distance of 12 m in first 3 seconds and a distance of 30 m in next 3 seconds. The initial velocity of the particle is

(A) 3 ms^{-1} (B) 2.5 ms^{-1} (C) 2 ms^{-1}
(D) 1.5 ms^{-1} (E) 1 ms^{-1}

Space for rough work

60. A ball of mass 10 g moving perpendicular to the plane of the wall strikes it and rebounds in the same line with the same velocity. If the impulse experienced by the wall is 0.54 Ns, the velocity of the ball is

(A) $27\ ms^{-1}$ (B) $3.7\ ms^{-1}$ (C) $54\ ms^{-1}$

(D) $37\ ms^{-1}$ (E) $5.4\ ms^{-1}$

61. A particle has the position vector $\vec{r} = \hat{i} - 2\hat{j} + \hat{k}$ and the linear momentum $\vec{p} = 2\hat{i} - \hat{j} + \hat{k}$. Its angular momentum about the origin is

(A) $-\hat{i} + \hat{j} - 3\hat{k}$ (B) $-\hat{i} + \hat{j} + 3\hat{k}$ (C) $\hat{i} - \hat{j} + 3\hat{k}$

(D) $\hat{i} - \hat{j} - 5\hat{k}$ (E) $\hat{i} - \hat{j} + 5\hat{k}$

62. The vertical component of velocity of a projectile at its maximum height (u – velocity of projection, θ – angle of projection) is

(A) $u\sin\theta$ (B) $u\cos\theta$ (C) $\frac{u}{\sin\theta}$

(D) 0 (E) $\frac{u}{\cos\theta}$

63. The coordinates of a particle moving in x-y plane at any instant of time t are $x = 4t^2$; $y = 3t^2$. The speed of the particle at that instant is

(A) 10 t (B) 5 t (C) 3 t (D) 2 t (E) $\sqrt{13}$ t

64. A cyclist bends while taking turn in order to

(A) reduce friction

(B) provide required centripetal force

(C) reduce apparent weight

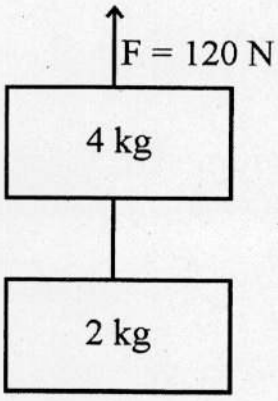
(D) reduce speed

(E) sit comfortably

Space for rough work

Two blocks of masses 2 kg and 4 kg are attached by an inextensible light string as shown in the figure. If a force of 120 N pulls the blocks vertically upward, the tension in the string is

(take $g = 10\ ms^{-2}$)



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

The total energy of a solid sphere of mass 300 g which rolls without slipping with a constant velocity of 5 ms^{-1} along a straight line is

(A) 5.25 J (B) 3.25 J (C) 0.25 J

(D) 1.25 J (E) 0.625 J

A bullet when fired into a target loses half of its velocity after penetrating 20 cm. Further distance of penetration before it comes to rest is

(A) 6.66 cm (B) 3.33 cm (C) 12.5 cm

(D) 10 cm (E) 5 cm

In elastic collision

(A) both momentum and kinetic energy are conserved

(B) neither momentum nor kinetic energy is conserved

(C) only momentum is conserved

(D) only kinetic energy is conserved

(E) forces involved in the interaction are non-conservative

Space for rough work

69. Two discs rotating about their respective axis of rotation with angular speeds 2 $rads^{-1}$ and 5 $rad\,s^{-1}$ are brought into contact such that their axes of rotation coincide. Now, the angular speed of the system becomes 4 $rads^{-1}$. If the moment of inertia of the second disc is 1×10^{-3} kg m^2, then the moment of inertia of the first disc (in kg m^2) is

(A) 0.25×10^{-3} (B) 1.5×10^{-3} (C) 1.25×10^{-3}

(D) 0.75×10^{-3} (E) 0.5×10^{-3}

70. A wheel is rotating at 1800 rpm about its own axis. When the power is switched off, it comes to rest in 2 minutes. Then the angular retardation in $rad\,s^{-1}$ is

(A) 2π (B) π (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$ (E) $\frac{\pi}{6}$

71. If the angular momentum of a particle of mass m rotating along a circular path of radius r with uniform speed is L, the centripetal force acting on the particle is

(A) $\frac{L^2}{mr^3}$ (B) $\frac{L^2}{mr}$ (C) $\frac{L}{mr^2}$

(D) $\frac{L^2m}{r}$ (E) $\frac{Lm}{r^2}$

72. Pick out the wrong statement from the following

(A) The SI unit of universal gravitational constant is Nm^2kg^{-2}

(B) The gravitational force is a conservative force

(C) The force of attraction due to a hollow spherical shell of uniform density on a point mass inside it is zero

(D) The centripetal acceleration of the satellite is equal to acceleration due to gravity

(E) Gravitational potential energy = $\frac{\text{gravitation potential}}{\text{mass of the body}}$

Space for rough work

. Which one of the following statements is not true in respect of properties of interhalogen compounds?

(A) They are all covalent compounds

(B) They are volatile solids or liquids except ClF

(C) IF_5 has square pyramidal structure

(D) They are all paramagnetic in nature

(E) BrF_3 is used in the preparation of UF_6 in the enrichment of ^{235}U

. Which one of the following is an incorrect statement?

(A) O_3 oxidises PbS to $PbSO_4$

(B) O_3 oxidises nitric oxide to nitrogen dioxide

(C) O_3 oxidises aqueous KI at pH = 9.2

(D) The two oxygen–oxygen bond lengths in O_3 are different

(E) O_3 is used as an oxidizing agent in the manufacture of $KMnO_4$

. The correct descending order of oxidizing power of the following is

(A) $Cr_2O_7^{2-} > MnO_4^- > VO_2^+$

(B) $MnO_4^- > Cr_2O_7^{2-} > VO_2^+$

(C) $VO_2^+ > MnO_4^- > Cr_2O_7^{2-}$

(D) $MnO_4^- > VO_2^+ > Cr_2O_7^{2-}$

(E) $Cr_2O_7^{2-} > VO_2^+ > MnO_4^-$

. The number of electrons that are involved in the reduction of permanganate to manganese(II) salt, manganate and manganese dioxide respectively are

(A) 5, 1, 3 (B) 5, 3, 1 (C) 2, 7, 1

(D) 5, 2, 3 (E) 2, 3, 1

Space for rough work

77. The calculated magnetic moment of a divalent ion of an atom with atomic number 24 in aqueous solution is

(A) 4.90 BM (B) 5.92 BM (C) 3.87 BM

(D) 2.84 BM (E) 1.73 BM

78. The entropy of vaporization of a liquid is 58 $JK^{-1}mol^{-1}$. If 100 g of its vapour condenses at its boiling point of 123°C, the value of entropy change for the process is

(Molar mass of the liquid = 58 g mol^{-1})

(A) $-100\ JK^{-1}$ (B) $100\ JK^{-1}$ (C) $-123\ JK^{-1}$

(D) $123\ JK^{-1}$ (E) $1230\ JK^{-1}$

79. The values of limiting ionic conductance of H^+ and $HCOO^-$ ions are respectively 347 and 53 S cm^2 mol^{-1} at 298 K. If the molar conductance of 0.025M methanoic acid at 298 K is 40 S cm^2 mol^{-1}, the dissociation constant of methanoic acid at 298 K is

(A) 1×10^{-5} (B) 2×10^{-5} (C) 1.5×10^{-4} (D) 2.5×10^{-5} (E) 2.5×10^{-4}

80. In a closed cylinder of capacity 24.6 L the following reaction occurs at 27°C

$A_2(s) \rightleftharpoons B_2(s) + 2C(g)$. At equilibrium 1 g of $B_2(s)$ (molar mass = 50 g mol^{-1}) is present. The equilibrium constant K_p for the equlibrium in atm^2 unit is

(R = 0.082 L atm K^{-1} mol^{-1})

(A) 1.6×10^{-2} (B) 1.6×10^{-5} (C) 1.6×10^{-3}

(D) 1.6×10^{-4} (E) 1.6×10^{-1}

Space for rough work

. The pH of a saturated solution of a metal hydroxide of formula $X(OH)_2$ is 12.0 at 298 K. What is the solubility product of the metal hydroxide at 298 K (in $mol^3\ L^{-3}$)?

(A) 2×10^{-6} (B) 1×10^{-7} (C) 5×10^{-5}

(D) 2×10^{-5} (E) 5×10^{-7}

. An aqueous solution containing 3 g of a solute of molar mass 111.6 g mol^{-1} in a certain mass of water freezes at –0.125 °C. The mass of water in grams present in the solution is (K_f = 1.86 K kg mol^{-1})

(A) 300 (B) 600 (C) 500 (D) 400 (E) 250

. A sample of sea water contains 5×10^{-3} g of dissolved oxygen in 1 kilogram of the sample. The concentration of O_2 in that sea water sample in ppm is

(A) 5×10^{-4} (B) 5×10^{-3} (C) 5×10^{-2} (D) 5×10^{-1} (E) 5

. The change in potential of the half-cell $Cu^{2+}|Cu$, when aqueous Cu^{2+} solution is diluted 100 times at 298 K? $\left(\frac{2.303RT}{F} = 0.06\right)$

(A) increases by 120 mV (B) decreases by 120 mV (C) increases by 60 mV

(D) decreases by 60 mV (E) no change

. Consider the following electrolytic cells

(i) $M(s) \mid M^{2+}(aq), 0.1M \parallel X^{2+}(aq), 0.01M \mid X(s)$

(ii) $M(s) \mid M^{2+}(aq), 0.1M \parallel X^{2+}(aq), 0.1M \mid X(s)$ and

(iii) $M(s) \mid M^{2+}(aq), 0.01M \parallel X^{2+}(aq), 0.1M \mid X(s)$

The cell EMF of the above cells are E_1 , E_2 and E_3 respectively. Which one of the following is true?

(A) $E_1 > E_2 > E_3$ (B) $E_2 > E_3 > E_1$ (C) $E_3 > E_1 > E_2$

(D) $E_1 > E_3 > E_2$ (E) $E_3 > E_2 > E_1$

Space for rough work

86. In a reaction $2A + B \rightarrow 3C$, the concentration of A decreases from 0.5 mol L^{-1} to 0.3 mol L^{-1} in 10 minutes. The rate of production of 'C' during this period is

(A) 0.01 mol L^{-1} min^{-1} (B) 0.04 mol L^{-1} min^{-1} (C) 0.05 mol L^{-1} min^{-1}

(D) 0.03 mol L^{-1} min^{-1} (E) 0.02 mol L^{-1} min^{-1}

87. Ammonium ion (NH_4^+) reacts with nitrite ion (NO_2^-) in aqueous solution according to the equation

$$NH_4^+(aq) + NO_2^-(aq) \rightarrow N_2(g) + 2H_2O(l)$$

The following initial rates of reaction have been measured for the given reactant concentrations.

Expt. No.	$[NH_4^+]$, (M)	$[NO_2^-]$, (M)	Rate (M/hr)
1	0.010	0.020	0.020
2	0.015	0.020	0.030
3	0.010	0.010	0.005

Which of the following is the rate law for this reaction?

(A) rate = $k\,[NH_4^+]\,[NO_2^-]^4$ (B) rate = $k\,[NH_4^+]\,[NO_2^-]$

(C) rate = $k\,[NH_4^+]\,[NO_2^-]^2$ (D) rate = $k\,[NH_4^+]^2\,[NO_2^-]$

(E) rate = $k\,[NH_4^+]^{1/2}\,[NO_2^-]^{1/4}$

88. Gold sol can be prepared by

(A) hydrolysis of gold(III) chloride

(B) oxidation of gold by aqua regia

(C) peptization

(D) treating gold(III) chloride with metallic zinc

(E) reduction of gold(III) chloride with formalin solution

89. The IUPAC name of the complex $[Co(NH_3)_2(H_2O)_4]Cl_3$ is

(A) Diaminetetraaquacobalt(III) trichloride

(B) Diaminetetraaquacobalt(II) chloride

(C) Diaminetetraaquacobalt(III) chloride

(D) Tetraaquadiaminecobalt(III) trichloride

(E) Tetraaquadiaminecobalt(II) chloride

Space for rough work

The products obtained by the ozonolysis of 2-ethylbut-1-ene are

(A) propanone and ethanal

(B) ethanal and 3-pentanone

(C) butanal and ethanal

(D) methanal and 2-pentanone

(E) methanal and 3-pentanone

When but-2-yne is treated with Na in liquid ammonia

(A) *cis*-2-butene is obtained

(B) *trans*-2-butene is formed

(C) *n*-butane is the major product

(D) it rearranges to but-1-yne

(E) there is no reaction

The correct decreasing order of reactivity for a given alkyl (R) group in both S_N1 and S_N2 reaction mechanisms is

(A) R-I > R-Br > R-Cl > R-F

(B) R-I > R-Cl > R-Br > R-F

(C) R-F > R-Cl > R-Br > R-I

(D) R-F > R-I > R-Cl > R-Br

(E) R-Br > R-I > R-F > R-Cl

The compound of molecular formula $C_5H_{10}O$(A) reacts with Tollen's reagent to give silver mirror but does not undergo aldol condensation. The compound A is

(A) 3-pentanone

(B) 2,2-dimethylpropanal

(C) 3-hydroxy-2-pentene

(D) 3-methylbutanal

(E) 3-methyl-2-butanone

Space for rough work

94. When *n*-hexane is heated with anhydrous $AlCl_3$ and HCl gas, the major product obtained is

(A) 1-chlorohexane

(B) 2-chlorohexane

(C) 3-chlorohexane

(D) hex-3-ene

(E) mixture of 2-methylpentane and 3-methylpentane

95. How many monochloro structural isomers are expected in free radical monochlorination of 2-methylbutane?

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

96. Chloroform reacts with oxygen in the presence of light to give

(A) carbon tetrachloride

(B) carbonyl chloride

(C) methyl chloride

(D) methylene dichloride

(E) acetaldehyde

97. Which one of the following is not expected to undergo iodoform reaction?

(A) Propan-2-ol (B) 1-Phenylethanol (C) 2-Butanol

(D) Ethanol (E) Diphenyl methanol

98. Identify the combination of compounds that undergo Aldol condensation followed by dehydration to produce but-2-enal

(A) methanal and ethanal

(B) two moles of ethanal

(C) methanal and propanone

(D) ethanal and propanone

(E) two moles of ethanol

Space for rough work

The correct increasing order of the acid strength of benzoic acid(I), 4-nitrobenzoic acid(II), 3,4-dinitrobenzoic acid(III) and 4-methoxybenzoic acid(IV) is

(A) I < II < III < IV (B) II < I < IV < III (C) IV < I < II < III

(D) IV < II < I < III (E) I < IV < II < III

. An organic compound with the molecular formula C_8H_8O forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives1,2-benzenedicarboxylic acid. The organic compound is

(A) 2-ethylbenzaldehyde

(B) 2-methylbenzaldehyde

(C) acetophenone

(D) 3-methylbenzaldehyde

(E) phenylacetaldehyde

. Phenyl isocyanide is prepared from aniline by

(A) Rosenmund's reaction

(B) Kolbe's reaction

(C) Reimer-Tiemann reaction

(D) Wurtz reaction

(E) Carbylamine reaction

. Choose the correct order of decreasing basic strength of the following compounds in aqueous solution

(i) $C_6H_5NH_2$ (ii) $C_2H_5NH_2$ (iii) NH_3 (iv) $(CH_3)_2NH$

(A) (i) > (ii) > (iii) > (iv)

(B) (iv) > (ii) > (iii) > (i)

(C) (ii) > (i) > (iii) > (iv)

(D) (iv) > (iii) > (ii) > (i)

(E) (ii) > (iv) > (iii) > (i)

Space for rough work

103. Gabriel's phthalimide synthesis can be used to prepare

(A) ethanamine
(B) N-methylmethanamine
(C) benzeneamine
(D) N,N-dimethylmethanamine
(E) p-toluidine

104. The sugar moiety present in RNA molecule is

(A) β-D-2-deoxyribose
(B) β-D-galactose
(C) β-D-fructofuranose
(D) β-D-ribose
(E) β-D-glucopyranose

105. Novlac, the linear polymer used in paints is

(A) copolymer of 1,3-butadiene and styrene
(B) obtained by the polymerization of methyl methacrylate
(C) initial product obtained in the condensation of phenol and formaldehyde in the presence of acid catalyst
(D) obtained by the polymerization of caprolactam
(E) copolymer of melamine and formaldehyde

106. The carbohydrate used as storage molecules in animals is

(A) sucrose
(B) glycogen
(C) maltose
(D) glucose
(E) fructose

107. Green chemistry deals with

(A) study of plant physiology
(B) study of extraction of natural products from plants
(C) detailed study of reactions involved in the synthesis of chlorophyll
(D) utilization of existing knowledge base for reducing the chemical hazards along with developmental activities
(E) synthesis of chemical compounds using green light

Space for rough work

A 250 W electric bulb of 80% efficiency emits a light of 6626 Å wavelength. The number of photons emitted per second by the lamp is ($h = 6.626 \times 10^{-34}$ Js)

(A) 1.42×10^{17} (B) 2.18×10^{16} (C) 6.66×10^{20}

(D) 2.83×10^{16} (E) 4.25×10^{16}

The shortest wavelength of the line in hydrogen atomic spectrum of Lyman series when $R_H = 109678\ cm^{-1}$ is

(A) 1002.7 Å (B) 1215.67 Å (C) 1127.30 Å

(D) 911.7 Å (E) 1234.7 Å

The work function of a metal is 5 eV. What is the kinetic energy of the photoelectron ejected from the metal surface if the energy of the incident radiation is 6.2 eV? ($1\ eV = 1.6 \times 10^{-19}$ J)

(A) 6.626×10^{-19} J (B) 8.01×10^{-19} J (C) 1.92×10^{-18} J

(D) 8.010×10^{-18} J (E) 1.92×10^{-19} J

The lattice energy of NaCl is 788 kJ mol^{-1}. This means that 788 kJ of energy is required

(A) to separate one mole of solid NaCl into one mole of Na(g) and one mole of Cl(g) to infinite distance

(B) to separate one mole of solid NaCl into one mole of $Na^+(g)$ and one mole of $Cl^-(g)$ to infinite distance

(C) to convert one mole of solid NaCl into one mole of gaseous NaCl

(D) to convert one mole of gaseous NaCl into one mole of solid NaCl

(E) to separate one mole of gaseous NaCl into one mole of $Na^+(g)$ and one mole of $Cl^-(g)$ to infinite distance

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Space for rough work

112. Arrange the following species in the correct order of their stability

C_2 , Li_2 , O_2^+ , He_2^+

(A) $Li_2 < He_2^+ < O_2^+ < C_2$ (B) $C_2 < O_2^+ < Li_2 < He_2^+$

(C) $He_2^+ < Li_2 < C_2 < O_2^+$ (D) $O_2^+ < C_2 < Li_2 < He_2^+$

(E) $C_2 < Li_2 < He_2^+ < O_2^+$

113. Molecular formulae and shapes of some molecules are given below. Choose the incorrect match

Formula		Shape
(A) NH_3	–	Trigonal pyramidal
(B) SF_4	–	Tetrahedral
(C) ClF_3	–	T-shaped
(D) PCl_5	–	Trigonal bipyramidal
(E) BF_3	–	Trigonal planar

114. Potassium dichromate belongs to which crystal system?

(A) Tetragonal (B) Orthorhombic (C) Triclinic

(D) Hexagonal (E) Monoclinic

115. If two moles of an ideal gas at 500 K occupies a volume of 41 litres, the pressure of the gas is ($R = 0.082$ L atm K^{-1} mol^{-1})

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

Space for rough work

116. At 273 K, the density of a certain gaseous oxide at 2 atmosphere is same as that of dioxygen at 5 atmosphere. The molecular mass of the oxide (in $g\ mol^{-1}$) is

(A) 80 (B) 64 (C) 32

(D) 160 (E) 70

117. The reaction of H_2 is given below

$$H_2 + CO + R\text{–}CH{=}CH_2 \rightarrow R\text{–}CH_2\text{–}CH_2\text{–}CHO$$

is specifically called as

(A) hydrogenation (B) reduction (C) hydroformylation

(D) dehydration (E) formylation

118. Which of the following are isoelectronic species?

(i) NH_3 (ii) CH_3^+ (iii) NH_2^- (iv) NH_4^+

Choose the correct answer from the codes given below

(A) (i) , (ii) , (iii) (B) (ii) , (iii) , (iv) (C) (i) , (ii) , (iv)

(D) (i), (iii), (iv) (E) (ii), (iii)

119. The salt of an alkali metal gives violet colour in the flame test. Its aqueous solution gives a white precipitate with barium chloride in hydrochloric acid medium. The salt is

(A) K_2SO_4 (B) KCl (C) Na_2SO_4

(D) K_2CO_3 (E) Li_2SO_4

120. In which one of the following the central atom is sp^3 hybridized?

(A) NH_4^+ (B) BF_3 (C) SF_6

(D) PCl_5 (E) XeF_4

Space for rough work

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