JEE Main 25 Jan 2023(First Shift)

Total Time: 180

Total Marks: 300.0

Physics

Q.No.1: A message signal of frequency 5 kHz is used to modulate a carrier signal of frequency 2 MHz. The bandwidth for amplitude modulation is:

A. 5 kHz

B. 2.5 kHz

C. 10 kHz

D. 20 kHz

Marks:[4.00]

Q.No.2: Electron beam used in an electron microscope, when accelerated by a voltage of 20 kV, has a de-Broglie wavelength of λ_0. If the voltage is increased to 40 kV, then the de-Broglie wavelength associated with the electron beam would be

A. $9\lambda_0$

B. $\frac{\lambda_0}{2}$

C. $\frac{\lambda_0}{\sqrt{2}}$

D. $3\lambda_0$

Marks:[4.00]

Q.No.3: The root mean square velocity of molecules of gas is

A. Proportional to square root of temperature $\left(\sqrt{T}\right)$

B. Inversely proportional to square root of temperature $\left(\sqrt{\frac{1}{T}}\right)$

C. Proportional to temperature (T)

D. Proportional to square of temperature (T^2)

Marks:[4.00]

Q.No.4: In Young's double slits experiment, the position of 5th bright fringe from the central maximum is 5 cm. The distance between slits and screen is 1 m and wavelength of used monochromatic light is 600 nm.
The separation between the slits is:

A. 12 μm

B. 60 μm

C. 48 μm

D. 36 μm

Marks:[4.00]

Q.No.5: Match List I with List II

List I	List II
A. Surface tension	I. kg m^{-1} s^{-1}
B. Pressure	II. kg ms^{-1}
C. Viscosity	III. kg $m^{-1}s^{-2}$
D. Impulse	IV. kg s^{-2}

Choose the correct answer from the options given below:

A. A-III, B-IV, C-I, D-II

B. A-II, B-I, C-III, D-IV

C. A-IV, B-III, C-I, D-II

D. A-IV, B-III, C-II, D-I

Marks:[4.00]

Q.No.6: A bowl filled with very hot soup cools from 98°C to 86°C in 2 minutes when the room temperature is 22°C. How long it will take to cool from 75°C to 69°C?

A. 2 minutes

B. 1.4 minutes

C. 0.5 minute

D. 1 minute

Marks:[4.00]

Q.No.7: *T* is the time period of simple pendulum on the earth's surface. Its time period becomes *xT* when taken to a height *R* (equal to earth's radius) above the earth's surface. Then, the value of x will be:

A. 4

B. $\frac{1}{2}$

C. 2

D. $\frac{1}{4}$

Marks:[4.00]

Q.No.8: A Camot engine with efficiency 50% takes heat from a source at 600 K. In order to increase the efficiency to 70%, keeping the temperature of sink same, the new temperature of the source will be :

A. 360 K

B. 300 K

C. 900 K

D. 1000 K

Marks:[4.00]

Q.No.9: The ratio of the density of oxygen nucleus $\left(\begin{matrix}16\\8\end{matrix}\mathrm{O}\right)$ and helium nucleus $\left(\begin{matrix}4\\2\end{matrix}\mathrm{He}\right)$ is

A. 2 : 1

B. 8 : 1

C. 1 : 1

D. 4 : 1

Marks:[4.00]

Q.No.10: A car is moving with a constant speed of 20 m/s in a circular horizontal track of radius 40 m. A bob is suspended from the roof of the car by a massless string. The angle made by the string with the vertical will be : (Take g = 10 m/s^2)

A. $\frac{\pi}{2}$

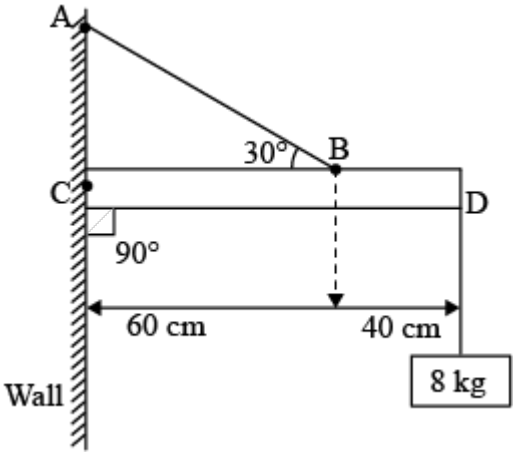
B. $\frac{\pi}{3}$

C. $\frac{\pi}{6}$

D. $\frac{\pi}{4}$

Marks:[4.00]

Q.No.11: An object of mass 8 kg is hanging from one end of a uniform rod CD of mass 2 kg and length 1 m pivoted at its end C on a vertical wall as shown in figure. It is supported by a cable AB such that the system is in equilibrium. The tension in the cable is : (Take g = 10 m/s^2)



A. 240 N

B. 90 N

C. 300 N

D. 30 N

Marks:[4.00]

Q.No.12: A car travels a distance of 'x' with speed v_1 and then same distance 'x' with speed v_2 in the same direction. The average speed of the car is

A. $\frac{v_1+v_2}{2}$

B. $\frac{v_1v_2}{2(v_1+v_2)}$

C. $\frac{2v_1v_2}{v_1+v_2}$

D. $\frac{2x}{v_1+v_2}$

Marks:[4.00]

Q.No.13: An electromagnetic wave is transporting energy in the negative *z* direction. At a certain point and certain time the direction of electric field of the wave is along positive *y* direction. What will be the direction of the magnetic field of the wave at that point and instant?

A. Negative direction of *x*

B. Negative direction of *y*

C. Positive direction of *z*

D. Positive direction of x

Marks:[4.00]

Q.No.14: A uniform metallic wire carries a current 2 A. When 3.4 V battery is connected across it. The mass of uniform metallic wire is 8.92×10^{-3} kg, density is 8.92×10^{3} kg/m^3 and resistivity is 1.7×10^{-8} Ω –m.
The length of wire is:

A. l = 100 m

B. I = 6.8 m

C. l = 10 m

D. l = 5 m

Marks:[4.00]

Q.No.15: In an LC oscillator, if values of inductance and capacitance become twice and eight times, respectively, then the resonant frequency of oscillator becomes x times its initial resonant frequency ω_0. The value of x is:

A. $\frac{1}{16}$

B. $\frac{1}{4}$

C. 4

D. 16

Marks:[4.00]

Q.No.16: A solenoid of 1200 turns is wound uniformly in a single layer on a glass tube 2 m long and 0.2 m in diameter. The magnetic intensity at the center of the solenoid when a current of 2 A flows through it is:

A. A m^{-1}

B. 2.4×10^{-3} A m^{-1}

C. 1.2×10^{3} A m^{-1}

D. 2.4×10^{3} A m^{-1}

Marks:[4.00]

Q.No.17: Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R
Assertion A: Photodiodes are used in forward bias usually for measuring the light intensity.
Reason R: For a p-n junction diode, at applied voltage V the current in the forward bias is more than the current in the reverse bias for $|V_z| > \pm V \geq |V_0|$ where V_0 is the threshold voltage and V_z is the breakdown voltage.
In the light of the above statements, choose the ***correct*** answer from the options given below

A. A is false but R is true

B. Both A and R are true and R is correct explanation of A

C. Both A and R are true but R is NOT the correct explanation of A

D. A is true but R is false

Marks:[4.00]

Q.No.18: Assume that the earth is a solid sphere of uniform density and a tunnel is dug along its diameter throughout the earth. It is found that when a particle is released in this tunnel, it executes a simple harmonic motion. The mass of the particle is 100 g.
The time period of the motion of the particle will be (approximately)
(Take g = 10 m s^{-2}, radius of earth = 6400 km)

A. 1 hour 40 minutes

B. 12 hours

C. 24 hours

D. 1 hour 24 minutes

Marks:[4.00]

Q.No.19: A parallel plate capacitor has plate area 40 cm^2 and plates separation 2 mm. The space between the plates is filled with a dielectric medium of a thickness 1 mm and dielectric constant 5. The capacitance of the system is :

A. $\frac{3}{10}\varepsilon_0$ F

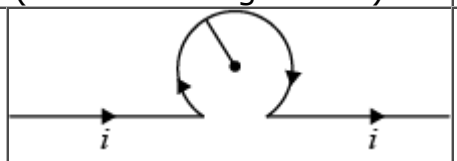
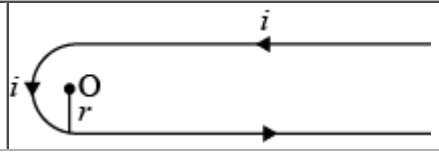
B. $\frac{10}{3}\varepsilon_0$ F

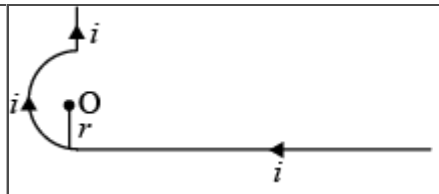
C. $10\varepsilon_0$ F

D. $24\varepsilon_0$ F

Marks:[4.00]

Q.No.20: Match List I with List II

List I (Current configuration)		List II (Magnitude of Magnetic	
A.		I.	$B_0 = \frac{\mu_0 I}{4\pi r}[\pi + 2]$
B.		II.	$B_0 = \frac{\mu_0}{4}\frac{I}{r}$

C.		III.	$B_0 = \frac{\mu_0 I}{2\pi r}[\pi - 1]$
D.		IV.	$B_0 = \frac{\mu_0 I}{4\pi r}[\pi + 1]$

Choose the correct answer from the options given below:

A. A–III, B–IV, C–I, D–II

B. A–I, B–III, C–IV, D–II

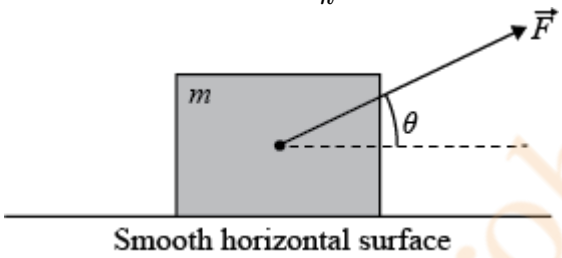
C. A–III, B–I, C–IV, D–II

D. A–II, B–I, C–IV, D–III

Marks:[4.00]

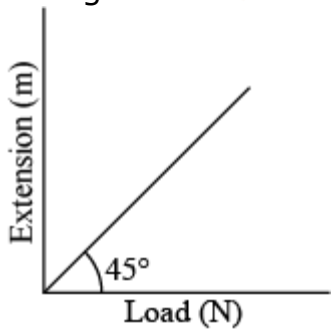
Q.No.21: An object of mass 'm' initially at rest on a smooth horizontal plane starts moving under the action of force F = 2N. In the process of its linear motion, the angle θ (as shown in figure) between the direction of force and horizontal varies as θ = *kx*, where *k* is a constant and *x* is the distance covered by the object from its initial position. The expression of kinetic energy of the object will be $E = \frac{n}{k}\sin\theta$, the value of n is _____.

Marks:[4.00]



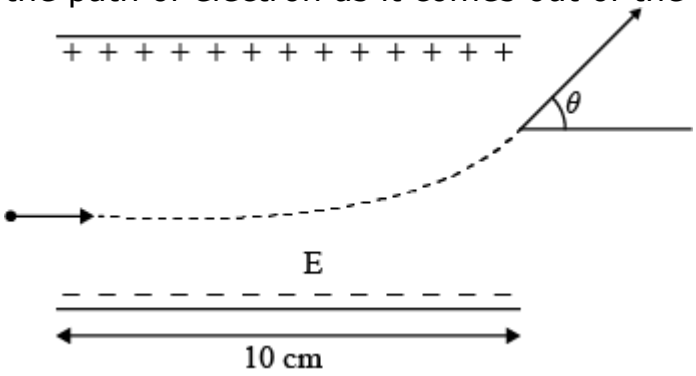
Q.No.22: As shown in the figure, in an experiment to determine Young's modulus of a wire, the extension-load curve is plotted. The curve is a straight line passing through the origin and makes an angle of 45° with the load axis. The length of wire is 62.8 cm and its diameter is 4 mm. The Young's modulus is found to be $x \times 10^4$ Nm^{-2}. The value of *x* is _____.

Marks:[4.00]



Q.No.23: A uniform electric field of 10 N/C is created between two parallel charged plates (as shown in figure). An electron enters the field symmetrically between the plates with a kinetic energy 0.5 eV. The length of each plate is 10 cm. The angle (θ) of deviation of
the path of electron as it comes out of the field is _____ (in degree).

Marks:[4.00]

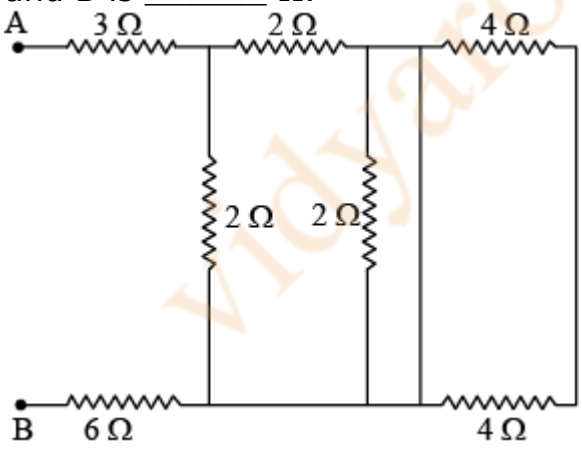


Q.No.24: An LCR series circuit of capacitance 62.5 nF and resistance of 50 Ω, is connected to an A.C. source of frequency 2.0 kHz. For maximum value of amplitude of current in circuit, the value of inductance is _____mH. (Take π^2 = 10)

Marks:[4.00]

Q.No.25: In the given circuit, the equivalent resistance between the terminal A and B is _____ Ω.

Marks:[4.00]

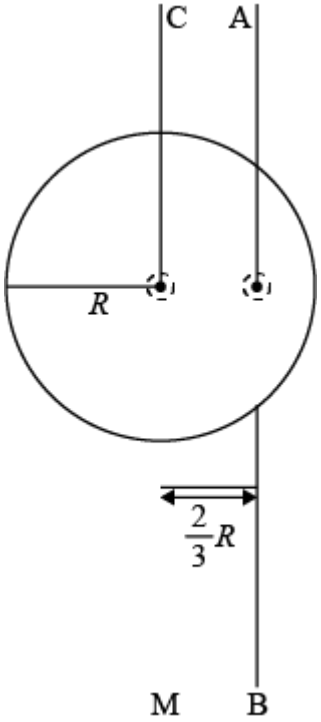


Q.No.26: The distance between two consecutive points with phase difference of 60° in a wave of frequency 500 Hz is 6.0 m. The velocity with which wave is traveling is _____ km/s

Marks:[4.00]

Q.No.27: I_{CM} is the moment of inertia of a circular disc about an axis (CM) passing through its center and perpendicular to the plane of disc. I_{AB} is it's moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance $\frac{2}{3}R$ from center. Where R is the radius of the disc. The ratio of I_{AB} and I_{CM} is x : 9. The value of x is_____.

Marks:[4.00]



Q.No.28: A ray of light is incident from air on a glass plate having thickness $\sqrt{3}$ cm and refractive index $\sqrt{2}$. The angle of incidence of a ray is equal to the critical angle for glass-air interface. The lateral displacement of the ray when it passes through the plate is _____ × 10^{-2} cm. (given sin 15° = 0.26)

Marks:[4.00]

Q.No.29: If

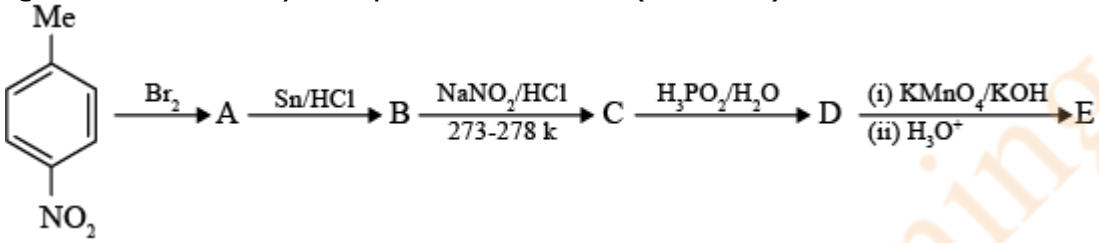
$\overrightarrow{P} = 3\hat{i} + \sqrt{3}\hat{j} + 2\hat{k}$ and $\overrightarrow{Q} = 4\hat{i} + \sqrt{3}\hat{j} + 2.5\hat{k}$, then, the unit vector in th

Marks:[4.00]

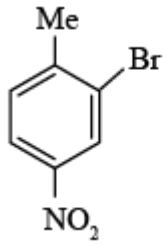
Q.No.30: The wavelength of the radiation emitted is λ_0 when an electron jumps from the second excited state to the first excited state of hydrogen atom. If the electron jumps from the third excited state to the second orbit of the hydrogen atom, the wavelength of the radiation emitted will be $\frac{20}{x}\lambda_0$. The value of *x* is _____. **Marks:[4.00]**

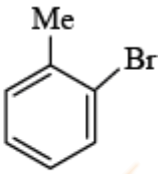
Chemistry

Q.No.31: Identify the product formed (A and E)

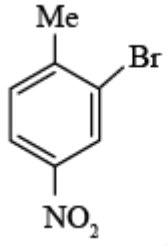


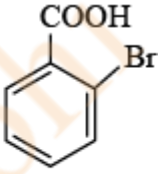
A.

A = 

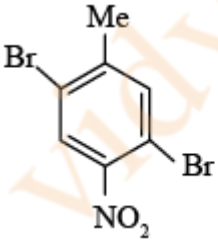
, E = 

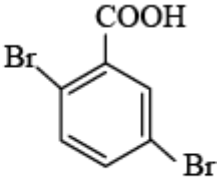
B.

A = 

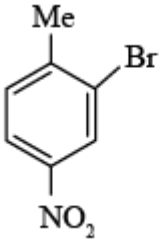
, E = 

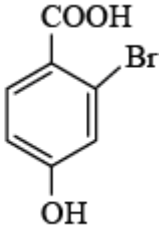
C.

A = 

, E = 

D.

A = 

, E = 

Marks:[4.00]

Q.No.32:

A cubic solid is made up of two elements X and Y, Atoms of X are present on every alternate corner and one at the center of cube. Y is at $\frac{1}{3}\text{rd}$ of the total faces. The empirical formula of the compound is

A. $XY_{2.5}$

B. $X_{1.5}Y_2$

C. $X_2Y_{1.5}$

D. $X_{2.5}Y$

Marks:[4.00]

Q.No.33: Reaction of thionyl chloride with white phosphorus forms a compound [A], which on hydrolysis gives [B], a dibasic acid. [A] and [B] are respectively

A. $POCl_3$ and H_3PO_4

B. PCl_3 and H_3PO_3

C. PCl_5 and H_3PO_4

D. P_4O_6 and H_3PO_3

Marks:[4.00]

Q.No.34: '25 volume' hydrogen peroxide means

A. 1 L marketed solution contains 250 g of H_2O_2.

B. 100 mL marketed solution contains 25 g of H_2O_2.

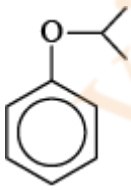
C. 1 L marketed solution contains 25 g of H_2O_2.

D. 1 L marketed solution contains 75 g of H_2O_2.

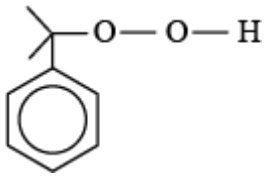
Marks:[4.00]

Q.No.35: In the cumene to phenol preparation in presence of air, the intermediate is

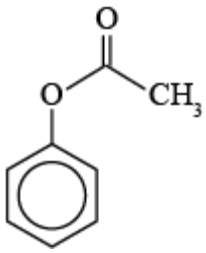
A.



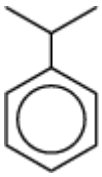
B.



C.



D.



Marks:[4.00]

Q.No.36: The radius of the 2nd orbit of Li^{2+} is *x*. The expected radius of the 3rd orbit of Be^{3+} is

A. $\frac{9}{4}x$

B. $\frac{16}{27}x$

C. $\frac{27}{16}x$

D. $\frac{4}{9}x$

Marks:[4.00]

Q.No.37: Which one of the following reactions does not occur during extraction of copper?

A. $CaO + SiO_2 \rightarrow CaSiO_3$

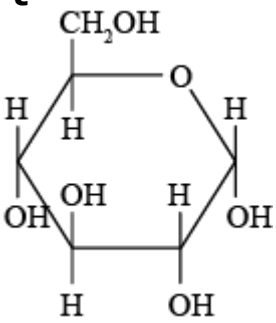
B. $FeO + SiO_2 \rightarrow FeSiO_3$

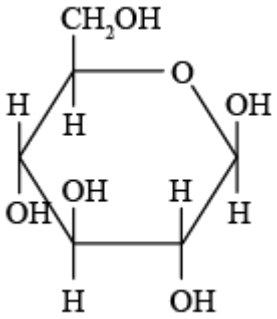
C. $Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

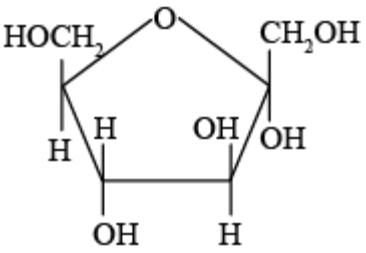
D. $2FeS + 3O_2 \rightarrow 2\ FeO + 2SO_2$

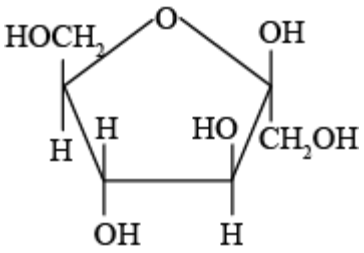
Marks:[4.00]

Q.No.38: Match items of Row I with those of Row II. Row I :









Row II :
(i) α-D-(−)-Fructofuranose
(ii) β-D-(−)-Fructofuranose
(iii) α-D-(−) Glucopyranose,
(iv) β-D-(−)-Glucopyranose

A. A → iii, B → iv, C → i, D → ii
B. A → i, B → ii, C → iii, D → iv
C. A → iii, B → iv, C → ii, D → i
D. A → iv, B → iii, C → i, D → ii

Marks:[4.00]

Q.No.39: Which of the following statements is incorrect for antibiotics?

A. An antibiotic should promote the growth or survival of microorganisms.
B. An antibiotic is a synthetic substance produced as a structural analogue of naturally occurring antibiotic.
C. An antibiotic should be effective in low concentrations.
D. An antibiotic must be a product of metabolism.

Marks:[4.00]

Q.No.40: Match List I with List II

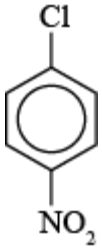
List I Elements		**List II Colour imparted to flame**	
A.	K	I.	Brick Red
B.	Ca	II.	Violet
C.	Sr	III.	Apple Green
D.	Ba	IV.	Crimson Red

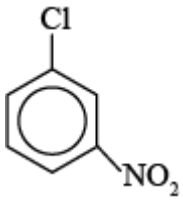
Choose the correct answer from the options given below:

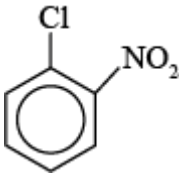
A. A-II, B-I, C-IV, D-III
B. A-IV, B-III, C-II, D-I
C. A-II, B-IV, C-I, D-III
D. A-II, B-I, C-III, D-IV

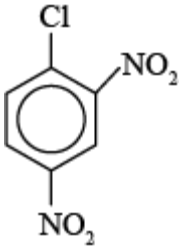
Marks:[4.00]

Q.No.41: The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with OH^- is

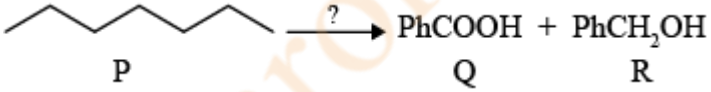
A. 

B. 

C. 

D. 

Marks:[4.00]



Q.No.42:
The correct sequence of reagents for the preparation of Q and R is:

A. (i) $KMnO_4$ OH^- (ii) $MO_2O_3\Delta$; (iii) NaOH; (iv) H_3O^+

B. (i) Cr_2O_3 770 K, 20 atm; (ii) CrO_2Cl_2, H_3O^+ (iii) NaOH; (iv) H_3O^+

C. (i) CrO_2Cl_2, H_3O^+; (ii) Cr_2O_3, 770 K, 20 atm; (iii) NaOH; (iv) H_3O^+

D. (i) Mo_2O_3,Δ; (ii) $Mo_2O_3\Delta$; (iii) NaOH; (iv) H_3O^+

Marks:[4.00]

Q.No.43: Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**:
Assertion A: Acetal/Ketal is stable in basic medium.
Reason R: The high leaving tendency of alkoxide ion gives the stability to acetal/ketal in basic medium.
In the light of the above statements, choose the correct answer from the options given below:

A. Both A and R are true but R is NOT the correct explanation of A

B. Both A and R are true and R is the correct explanation of A

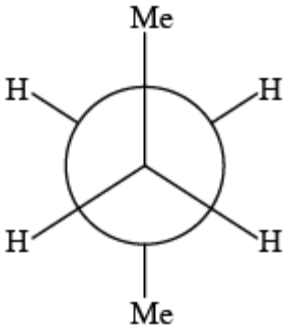
C. A is false but R is true

D. A is true but R is false

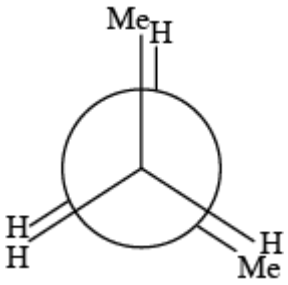
Marks:[4.00]

Q.No.44: Which of the following conformations will be the most stable?

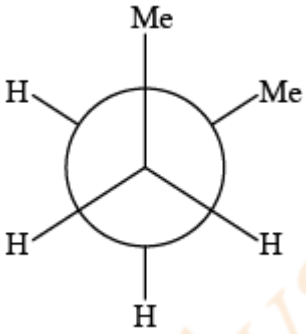
A.



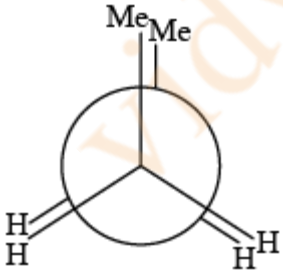
B.



C.



D.



Marks:[4.00]

Q.No.45: The correct order in aqueous medium of basic strength in case of methyl substituted amines is:

A. $Me_2NH > MeNH_2 > Me_3N > NH_3$

B. $Me_3N > Me_2NH > MeNH_2 > NH_3$

C. $NH_3 > Me_3N > MeNH_2 > Me_2NH$

D. $Me_2NH > Me_3N > MeNH_2 > NH_3$

Marks:[4.00]

Q.No.46: Compound A reacts with NH_4Cl and forms a compound B. Compound B reacts with H_2O and excess of CO_2 to form compound C which on passing through or reaction with saturated NaCl solution forms sodium hydrogen carbonate.
Compound A, B and C, are respectively

A. $Ca(OH)_2$, $\mathrm{NH_4^{\oplus}}$, $(NH_4)_2CO_3$

B. $Ca(OH)_2$, NH_3, NH_4HCO_3

C. $CaCl_2$, $\mathrm{NH_4^{\oplus}}$, $(NH_4)_2CO_3$

D. $CaCl_2$, NH_3, NH_4HCO_3

Marks:[4.00]

Q.No.47: Match the List-I with List-II :

List-I Cations		List Group reagents
A. Pb^{2+}, Cu^{2+}	(i)	H_2S gas in presence of dilute HCl
B. Al^{3+}, Fe^{3+}	(ii)	$(NH_4)_2CO_3$ in presence of NH_4OH
C. Co^{2+}, Ni^{2+}	(iii)	NH_4OH in presence of NH_4Cl
D. Ba^{2+}, Ca^{2+}	(iv)	H_2S in presence of NH_4OH

A. A → i; B → iii; C → iv; D → ii

B. A → i; B → iii; C → ii; D → iv

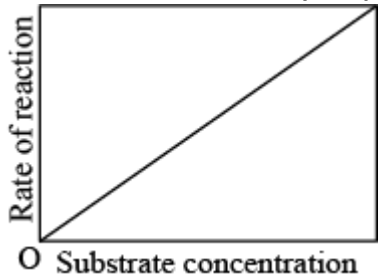
C. A → iv; B → ii; C → iii; D → i

D. A → iii; B → i; C → iv; D → ii

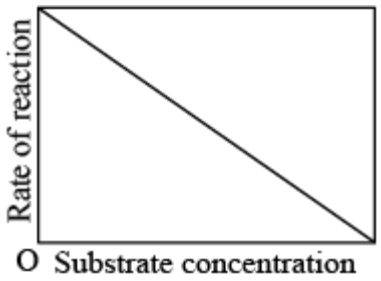
Marks:[4.00]

Q.No.48: The variation of the rate of an enzyme catalyzed with substrate concentration is correctly represented by graph

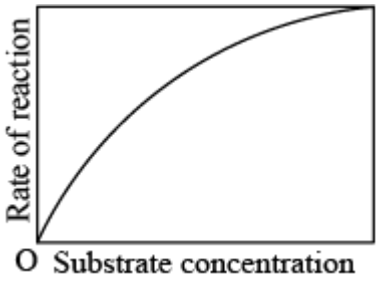
A.



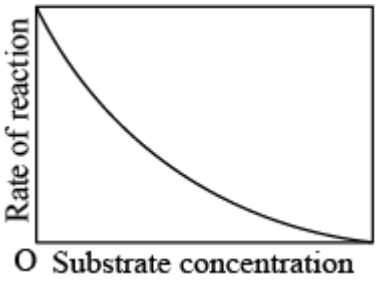
B.



C.



D.



Marks:[4.00]

Q.No.49: Some reactions of NO_2 relevant to photochemical smog formation are

$$NO_2 \xrightarrow{\text{Sunlight}} X + Y$$
$$\downarrow A$$
$$B$$

Identify A, B, X and Y.

A. $X = NO,\ Y = [O],\ A = O_2,\ B = N_2O_3$

B. $X = [O],\ Y = NO,\ A = O_2,\ B = O_3$

C. $X = \frac{1}{2}O_2,\ Y = NO_2,\ A = O_3,\ B = O_2$

D. X = N_2O, Y = [O], A = O_3, B = NO

Marks:[4.00]

Q.No.50: Inert gases have positive electron gain enthalpy. Its correct order is

A. He < Xe < Kr < Ne

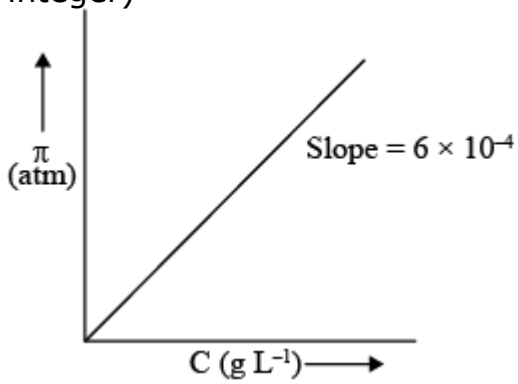
B. Xe < Kr < Ne < He

C. He < Kr < Xe < Ne

D. He < Ne < Kr < Xe

Marks:[4.00]

Q.No.51: The osmotic pressure of solutions of PVC in cyclohexanone at 300 K are plotted on the graph. The molar mass of PVC is _____ g mol^{-1} (Nearest integer)



(Given : R = 0.083 L atm K^{-1} mol^{-1})

Marks:[4.00]

Q.No.52: The density of a monobasic strong acid (Molar mass 24.2 g/mol) is 1.21 kg/L. The volume of its solution required for the complete neutralization of 25 mL of 0.24 M NaOH is _____ × 10^{-2} mL (Nearest integer)

Marks:[4.00]

Q.No.53: A litre of buffer solution contains 0.1 mole of each of NH_3 and NH_4Cl. On the addition of 0.02 mole of HCl by dissolving gaseous HCl, the pH of the solution is found to be _____ × 10^{-3} (Nearest integer)

[Given : $pK_b(NH_3)$ = 4.745

log 2 = 0.301

log 3 = 0.477

T = 298 K

Marks:[4.00]

Q.No.54: The number of paramagnetic species from the following is _____.
$[Ni(CN)_4]^{2-}$, $[Ni(CO)_4]$, $[NiCl_4]^{2-}$,
$[Fe(CN)_6]^{4-}$, $[Cu(NH_3)_4]^{2+}$
$[Fe(CN)_6]^{3-}$ and $[Fe(H_2O)_6]^{2+}$ **Marks:[4.00]**

Q.No.55: In sulphur estimation, 0.471 g of an organic compound gave 1.4439 g of barium sulphate. The percentage of sulphur in the compound is _____ (Nearest Integer) (Given: Atomic mass Ba: 137 u, S: 32 u, O:16 u)
Marks:[4.00]

Q.No.56: For the first order reaction A → B, the half life is 30 min. The time taken for 75% completion of the reaction is_____ min. (Nearest integer)
Given : log 2 = 0.3010
log 3 = 0.4771
log 5 = 0.6989 **Marks:[4.00]**

Q.No.57: How many of the following metal ions have similar value of spin only magnetic moment in gaseous state? _____
(Given : Atomic number : V, 23; Cr, 24; Fe, 26; Ni, 28) V^{3+}, Cr^{3+}, Fe^{2+}, Ni^{3+}
Marks:[4.00]

Q.No.58: Consider the cell Pt(s) | H_2(g) (1 atm) | H^+ (aq, [H^+] = 1)|| Fe^{3+} (aq), Fe^{2+}(aq) | Pt(s)
Given $E^0_{Fe^{3+}/Fe^{2+}} = 0.771\ V$ and $E^0_{H^+/\frac{1}{2}H_2} = 0\ V$,
$T = 298\ K$
If the potential of the cell is 0.712 V, the ratio of concentration of Fe^{2+} to Fe^{3+} is _____ (Nearest integer) **Marks:[4.00]**

Q.No.59: The total number of lone pairs of electrons on oxygen atoms of ozone is_____ **Marks:[4.00]**

Q.No.60: An athlete is given 100 g of glucose ($C_6H_{12}O_6$) for energy. This is equivalent to 1800kJ of energy. The 50% of this energy gained is utilized by the athlete for sports activities at the event. In order to avoid storage of energy, the weight of extra water he would need to perspire is_____ g (Nearest

integer) Assume that there is no other way of consuming stored energy. Given : The enthalpy of evaporation of water is 45 kJ mol^{-1}
Molar mass of C, H & O are 12, 1 and 16 g mol^{-1} **Marks:[4.00]**

Mathematics

Q.No.61: The mean and variance of the marks obtained by the students in a test are 10 and 4 respectively. Later, the marks of one of the students is increased from 8 to 12. If the new mean of the marks is 10.2, then their new variance is equal to :

A. 4.08
B. 3.92
C. 3.96
D. 4.04

Marks:[4.00]

Q.No.62: The statement $(p \wedge (\sim q)) \Rightarrow (p \Rightarrow (\sim q))$ is

A. a contradiction
B. equivalent to $p \vee q$
C. equivalent to $(\sim p) \vee (\sim q)$
D. a tautology

Marks:[4.00]

Q.No.63: The points of intersection of the line $ax + by = 0$, $(a \neq b)$ and the circle $x^2 + y^2 - 2x = 0$ are $A(\alpha, 0)$ and $B(1, \beta)$. The image of the circle with AB as a diameter in the line $x + y + 2 = 0$ is:

A. $x^2 + y^2 + 5x + 5y + 12 = 0$
B. $x^2 + y^2 + 3x + 5y + 8 = 0$
C. $x^2 + y^2 - 5x - 5y + 12 = 0$
D. $x^2 + y^2 + 3x + 3y + 4 = 0$

Marks:[4.00]

Q.No.64: Consider the lines L_1 and L_2 given by

$L_1 : \frac{x-1}{2} = \frac{y-3}{1} = \frac{z-2}{2}$

$L_2 : \frac{x-2}{1} = \frac{y-2}{2} = \frac{z-3}{3}$.

A line L_3 having direction ratios, 1, –1, –2, intersects L_1 and L_2 at the points P and Q respectively. Then the length of line segment PQ is

A. $3\sqrt{2}$
B. $2\sqrt{6}$

C. $4\sqrt{3}$

D. 4

Marks:[4.00]

Q.No.65: Let $f : (0, 1) \to R$ be a function defined by

$f(x) = \frac{1}{1-e^{-x}}$, and $g\left(x\right) = \left(f\left(-x\right) - f\left(x\right)\right)$. Consider two statements

(I) g is an increasing function in (0, 1)

(II) g is one-one in (0, 1)

Then,

A. Only (I) is true

B. Both (I) and (II) are true

C. Only (II) is true

D. Neither (I) nor (II) is true

Marks:[4.00]

Q.No.66: Let S_1 and S_2 be respectively the sets of $a \in \mathbb{R} - \{0\}$ for which the system of linear equations

$ax + 2ay - 3az = 1$

$(2a + 1)x + (2a + 3)y + (a + 1)z = 2$

$(3a + 5)x + (a + 5)y + (a + 2)z = 3$

has unique solution and infinitely many solutions.

Then

A. $S_1 = \phi$ and $S_2\, \mathbb{R} - \{0\}$

B. $S_1 = \mathbb{R} - \{0\}$ and $S_2 = \phi$

C. S_1 is an infinite set and $n(S_2) = 2$

D. $n(S_1) = 2$ and S_2 is an infinite set

Marks:[4.00]

Q.No.67: The minimum value of the function $f(x) \int_0^2 e^{|x-t|} dt$ is

A. $e(e - 1)$

B. $2e - 1$

C. $2(e - 1)$

D. 2

Marks:[4.00]

Q.No.68: Let $y(x) = (1 + x)(1 + x^2)(1 + x^4)(1 + x^8)(1 + x^{16})$. Then $y' - y'$ at $x = -1$ is equal to :

A. 496

B. 944

C. 976

D. 464

Marks:[4.00]

Q.No.69: Let $x = 2$ be a local minima of the function $f(x) = 2x^4 - 18x^2 + 8x + 12$, $x \in -(4, 4)$. If M is local maximum value of the function f in $(-4, 4)$, then $M =$

A. $12\sqrt{6} - \frac{33}{2}$

B. $12\sqrt{6} - \frac{31}{2}$

C. $18\sqrt{6} - \frac{31}{2}$

D. $18\sqrt{6} - \frac{33}{2}$

Marks:[4.00]

Q.No.70: The value of $\lim\limits_{n\to\infty} \frac{1+2+3+4+5-6+...+(3n-2)+(3n-1)-3n}{\sqrt{2n^4+4n+3}-\sqrt{n^4+5n+4}}$ is

A. $3\left(\sqrt{2}+1\right)$

B. $\frac{3}{2}\left(\sqrt{2}+1\right)$

C. $\frac{\sqrt{2}+1}{2}$

D. $\frac{3}{2\sqrt{2}}$

Marks:[4.00]

Q.No.71: The distance of the point $\left(6, \ -2\sqrt{2}\right)$ from the common tangent $y = mx + c$, $m > 0$, of the curves $x = 2y^2$ and $x = 1 + y^2$ is

A. $\frac{14}{3}$

B. $\frac{1}{3}$

C. $5\sqrt{3}$

D. 5

Marks:[4.00]

Q.No.72: Let *x, y, z* > 1 and $A = \begin{bmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 2 & \log_y z \\ \log_z x & \log_z y & 3 \end{bmatrix}$

Then |adj(adj A^2)| is equal to

A. 2^4

B. 6^4

C. 2^8

D. 4^8

Marks:[4.00]

Q.No.73:

Let $f(x) = \int \frac{2x}{(x^2+1)(x^2+3)}dx$. If $f(3) = \frac{1}{2}(\log_e 5 - \log_e 6)$, then $f(4)$ is equal to

A. $\log_e 17 - \log_e 18$

B. $\log_e 19 - \log_e 20$

C. $\frac{1}{2}(\log_e 17 - \log_e 19)$

D. $\frac{1}{2}(\log_e 19 - \log_e 17)$

Marks:[4.00]

Q.No.74: The distance of the point *P* (4. 6, –2) from the line passing through the point (–3, 2, 3) and parallel to a line with direction ratios 3, 3, –1 is equal to

A. 3

B. $2\sqrt{3}$

C. $\sqrt{6}$

D. $\sqrt{14}$

Marks:[4.00]

Q.No.75: Let *M* be the maximum value of the product of two positive integers when their sum is 66. Let the sample space *S* = $S = \left\{x \in \mathbb{Z} : x\left(66 - x\right) \geq \frac{5}{9}M\right\}$ and the event *A* = {*x* ∈ *S* : *x* is a multiple of 3}. Then *P(A)* is equal to

A. $\frac{7}{22}$

B. $\frac{1}{3}$

C. $\frac{1}{5}$

D. $\frac{15}{44}$

Marks:[4.00]

Q.No.76: Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non zero vectors such that $\vec{b} . \vec{c} = 0$ and $\vec{a} \times \left(\vec{b} \times \vec{c} \right) = \frac{\vec{b} - \vec{c}}{2}$. If $\vec{d}$ be a vector such that $\vec{b} . \vec{d} = \vec{a} . \vec{b}$, then $\left(\vec{a} \times \vec{b} \right) . \left(\vec{c} \times \vec{d} \right)$ is equal to

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. $-\frac{1}{4}$

D. $\frac{3}{4}$

Marks:[4.00]

Q.No.77: If a_r is the coefficient of x^{10-r} in the Binomial expansion of $(1+x)^{10}$, then $\sum_{r-1}^{10} r^3 \left(\frac{a_r}{a_{r-1}} \right)^2$ is equal to

A. 1210

B. 5445

C. 3025

D. 4895

Marks:[4.00]

Q.No.78: Let $y = y(x)$ be the solution curve of the differential equation $\frac{dy}{dx} = \frac{y}{x} \left(1 + xy^2 \left(1 + \log_e x \right) \right),\ x > 0,\ y(1) = 3$. Then $\frac{y^2(x)}{9}$ is equal to

A. $\frac{x^2}{7 - 3x^3 (2 + \log_e x^2)}$

B. $\frac{x^2}{2x^3 (2 + \log_e x^3) - 3}$

C. $\frac{x^2}{5 - 2x^3 (2 + \log_e x^3)}$

D. $\frac{x^2}{3x^3 (1 + \log_e x^2) - 2}$

Marks:[4.00]

Q.No.79: Let $z_1 = 2 + 3i$ and $z_2 = 3 + 4i$. The set

$S = \{z \in \mathbb{C} :\} \; z - z_1 \,|^2 - |z - z_2 \,|^= |z_1 - z_2|^2\}$ represents a

A. straight line with the sum of its intercepts on the coordinate axes equals –18

B. hyperbola with eccentricity 2

C. straight line with the sum of its intercepts on the coordinate axes equals 14

D. hyperbola with the length of the transverse axis 7

Marks:[4.00]

Q.No.80: The vector $\overrightarrow{a} = -\hat{i} + 2\hat{j} + \hat{k}$ is rotated through a right angle, passing through the *y*-axis in its way and the resulting vector is $\overrightarrow{b}$. Then the projection of $3\overrightarrow{a} + \sqrt{2\overrightarrow{b}}$ on $\overrightarrow{c} = 5\hat{j} + 4\hat{j} + 3\hat{k}$ is

A. $\sqrt{6}$

B. $2\sqrt{3}$

C. 1

D. $3\sqrt{2}$

Marks:[4.00]

Q.No.81: Let the equation of the plane passing through the line $x - 2y - z - 5 = 0 = x + y + 3z - 5$ and parallel to the line $x + y + 2z - 7 = 0 = 2x + 3y + z - 2$ be $ax + by + cz = 65$. Then the distance of the point (a, b, c) from the plane $2x + 2y - z + 16 = 0$ is _____ **Marks:[4.00]**

Q.No.82:

The vertices of hyperbola *H* are $(\pm 6,\ 0)$ and its eccentricity is $\frac{\sqrt{5}}{2}$. Let *N* be the normal to *H* at point in the first quadrant and parallel to the line $\sqrt{2x} + y = 2\sqrt{2}$. If *d* is the length of the line segment of *N* between *H* and the *y*-axis then d^2 is equal to _____.

Marks:[4.00]

Q.No.83: Let $s = \left\{a \;:\; \log_2\left(9^{2a-4} + 13\right) - \log_2\left(\frac{5}{2}.3^{2a-4} + 1\right) = 2\right\}$ Then the maximum value of β for which the equation $x^2 - 2\left(\sum_{a \in s} a\right)^2 x + \sum_{a \in s} (a+1)^2 \beta = 0$ has real roots, is _____.

Marks:[4.00]

Q.No.84: For some *a*, *b*, *c*

$\in N,\ \text{let}\ f(x) = ax - 3\ and\ g(x) = x^b + c,\ x \in R.\ \text{If}\ (\text{fog})^{-1}(\text{x}) = \left(\frac{\text{x}-7}{2}\right)^{\frac{1}{3}},\ \text{tl}$

Marks:[4.00]

Q.No.85: Let *x* and *y* be distinct integers where $1 \leq x \leq 25$ and $1 \leq y \leq 25$. Then, the number of ways of choosing *x* and *y*, such that *x* + *y* is divisible by 5, is _____. **Marks:[4.00]**

Q.No.86: The constant term in the expansion of $\left(2x + \frac{1}{x^7} + 3x^2\right)^5$ is _____. **Marks:[4.00]**

Q.No.87: Let *S* = {1, 2, 3, 5, 7, 10, 11}. The number of non-empty subsets of *S* that have the sum of all elements a multiple of 3, is **Marks:[4.00]**

Q.No.88: If the sum of all the solutions of $\tan^{-1}\left(\frac{2x}{1-x^2}\right) + \cot^{-1}\left(\frac{1-x^2}{2x}\right) = \frac{\pi}{3},\ -1 < x < 1,\ x \neq 0,$ **Marks:[4.00]**

$\text{is}\ \alpha - \frac{4}{\sqrt{3}},\ \text{then}\ \alpha\ \text{is equal to}$_____.

Q.No.89: Let A_1 , A_2, A_3 be the three A.P. with the same common difference *d* and having their first terms as *A*, *A* + 1, *A* + 2, respectively. Let *a*, *b*, *c* be the 7^{th} , 9^{th}, 17^{th} terms of A_1 , A_2 , A_3 , respectively such that

$$\begin{vmatrix} a & 7 & 1 \\ 2b & 17 & 1 \\ c & 17 & 1 \end{vmatrix} + 70 = 0.$$

If *a* = 29, then the sum of first 20 terms of an AP whose first term is *c* – *a* – *b* and common difference is $\frac{d}{12},\ \text{is equal to}$ ____. **Marks:[4.00]**

Q.No.90: In the area enclosed by the parabolas $P_1 : 2y = 5x^2$ and $P_2 : x^2 - y + 6 = 0$ is equal to the area enclosed by P_1 and $y = ax$, $a > 0$, then a^3 is equal

to _____. **Marks:[4.00]**