CBRT - 2020
Question Paper Grid

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Assistant Professor(Chemistry(Physical))

Passage:
The Indian economy rests on agricultural base and for decades and generations the picture that India Presented to the world was one of famine and of an unchanging peasantry reluctant to depart from the cultural practices handed down to them by their forefathers. Indian agriculture , it was said, was a gamble on the rains. Some visionaries and civil servants had sought to change all this. Their experiments at rural transformation were watched with amused interest and if their efforts did not meet with more than temporary and isolated success, it was because they were operating individuals and in very limited area within what was basically an inhospitable and unresponsive administrative environment. The scale of effort was enlarged during the Second World War with the launching of the "grow more food campaign". But the administrative structure remained largely unaltered.

It was to change all this, that the Community Development Programme was introduced. There were three problems that had to be tackled. First, if the farmer was to change methods, he had to be educated to see the possibility to change through actual demonstration in his field at no cost to himself. If the farmer tilled the land in the same manner as his father before him, it was because tradition had no optimized risks and the farmer had no margin on the basis of which to gamble on strange new practices and risk not merely a financial loss but his very survival. Second, there was no one agency to whom the farmer could turn for assistance or advice. If he wanted better seeds, he had to go to the Agriculture Department. For irrigation he had to knock at the doors of the Irrigation Department. Roads were the responsibility of the Public Works Department. Land problems had to be taken up with the revenue authorities and so on. In short, the administration was totally fragmented at the point which touched the life of the farmer. Coordination was difficult and the totality of the farmer's problem could never be adequately comprehended, let alone ameliorated, by the administration. Third, even if the administration sought to promote rural transformation and the farmers, were willing, how was the new knowledge to be transmitted not merely to every village but to each

The Community Development Programme sought to provide answers to these three problems. Something in the nature of the single-line administration was established under a chain of command running through the District Development Officer and Block Development Officer to the multipurpose village level worker. Instead of having to go to several departments to get anything done, the farmer could now deal with a single community development authority with which all the executive agencies involved in rural development were associated. The many thousands of field demonstrations laid out under the Community Development Programme demonstrated the possibility of change in a manner that carried conviction and at no risk to the peasant. Once the farmer was persuaded, his alleged age-old conservatism vanished and the next problem was to satisfy his ever-growing demands. Meanwhile, the establishment of a National Extension Service first time created a permanent transmission system for the propagation and demonstration of new ideas and methods, not just in isolated pockets, but over very wide areas.

Itemcode : **CP1071**
Q1 : Which of the following was the objective of launching Community Development Programme?

(a) To eradicate illiteracy of the rural folk
(b) To switch over to me mechanisation in agro sector
(c) To solve the diverse problems of farmers on a single platform
(d) To minimize farmer's financial losses and risks
Key: **C**

Itemcode : **CP1072**
Q2 : For the people in the world , the image of Indian Village is that of

(a) an opponent of traditionalism and conservatism
(b) a rule-bound, conservative and culture-groomed person
(c) a visionary and a perfect gambler
(d) an inhospitable and unresponsive person
Key: **B**

Itemcode : **CP1073**
Q3 : The experiments undertaken by some visionaries were aimed at

(a) Changes in administrative environment
(b) temporary and isolated success
(c) evolution of new operational strategies
(d) upliftment of peasants and rural development
Key: **C**

Itemcode : **CP1074**
Q4 : What was the probable disadvantage of the fragmented administration to the farmers?

(a) Loss of time, money and energy
(b) exposure to novel techniques and strategies
(c) Availability of manures, fertilisers and seeds
(d) Uncertainty of rains during the crop season
Key: **A**

Itemcode : **CP1075**
Q5 : What was the impact of these demonstrations on the farmers?

(a) Their unreasonable demands increased disproportionately
(b) Their tendency to cling to past traditions vanished
(c) National Extension Service was established by them
(d) Their standard of living remained unaltered
Key: **B**

Itemcode : **CP1051**
Q6 : The failure of palm readers to identify the causal connection between the lines on a person's hands and his or her life indicates that the theory of palm reading is:

(a) Internally incoherent.
(b) Inadequate.
(c) Unfruitful.
(d) Dysfunctional.
Key: **A**

Itemcode : **CP1052**

Q7 : As a result of the application of Ockham's razor, naturalistic explanations are preferred to supernatural explanations because:

(a) Naturalistic explanations lead to entirely new ways of viewing the world.
(b) Naturalistic explanations are preferred by atheists.
(c) Supernatural explanations are inconsistent with well confirmed scientific theories.
(d) Supernatural explanations are always contaminated by religious beliefs.
Key: **D**

Itemcode : **CP1053**

Q8 : If January 1st, 2007 is Monday, what was the day on 1st January 1995?

(a) Sunday
(b) Monday
(c) Friday
(d) Saturday
Key: **A**

Itemcode : **CP1054**

Q9 : Statements
I All students are ambitious
II All ambitious persons are hard working
Conclusions:
i. All students are hard-working
ii. All hardly working people are not ambitious
Which of the following is correct?

(a) Only (i) is correct
(b) Only (ii) is correct
(c) Both (i) and (ii) are correct
(d) Neither (i) nor (ii) are correct
Key: **C**

Itemcode : **CP1055**

Q10 : Read the given argument and answer the question that follows.

Argument
Here's another reason to get vaccinated against measles - researchers have found that the measles virus makes kids' immune systems "forget" most of what they have learned, leaving children vulnerable to other diseases for as long as three years. "Our findings suggest that measles vaccines have benefits that extend beyond just protecting against measles itself," said Michael Mina, a medical student at Emory University who worked on the study while doing postdoctoral research at Princeton University.

Which of the following, if true, would most strengthen the argument made in favour of the vaccination against measles?

(a) Studies have suggested that vaccines can have broader benefits than simply protecting against a single disease.
(b) If you get measles, three years later, you could die from something that you would not die from had you not been infected with measles.
(c) Various scientists are working to find out whether reducing measles incidence will cause a drop in deaths from other infectious diseases.
(d) The findings, published in the journal Science, help explain why deaths and illnesses from a range of diseases plummet in countries after they introduced measles vaccine campaigns.
Key: **D**

Itemcode : **CP1056**

Q11 : Read the given argument and answer the question that follows.
Arguments
It's no surprise that, in an era of rapid change, island nations will be among the first to feel the effects of climate change. A common sentiment shared among the islands of the Pacific is that they suffer a great deal from the phenomenon while contributing the least to the problem. These islands are located in a region that's sandwiched by two of the world's largest carbon-emitting countries, the United States and China, which means that any concerns they voice on the global stage often come out as mere whispers.

Which of the following, if true, would support the 'common sentiment' mentioned in the passage?

(a) Plastic pollution in oceans is an enormous problem globally but the island nations suffer the most due to this, as plastic harms the very aquatic life that island nations depend on for their economic progress.
(b) Carbon emissions are directly proportional to the size of the population of a country and the resulting increase in sea-level poses the greatest threat to the low-lying island nations, despite their relatively small populations.
(c) Island nations have banded together in the international arena to call on other countries to limit their emissions in order to curtail the devastating impacts of climate change on their vulnerable nations.
(d) The island nations are more vulnerable to the physical impacts of climate change due to a number of socioeconomic stressors like high population growth, over-pumping of groundwater, pollution, etc.
Key: **B**

Itemcode : **CP1057**

Q12 : The following table shows the information related to population and a few other parameters for 5 states of India for the year 2010.

States	Population (in Lakhs)	Rural Population (in %)	Literacy Rate (in %)	No. of Women per 1000 Men
P	720	40	50	920
Q	400	70	55	914
R	420	55	45	970
S	350	64	44	958
T	640	30	60	990

In rural region of state P, all women i.e. 188 Lakh are literate and all men are illiterate. The literacy rate among urban men in state P is at least?

(a) 40%
(b) 0%
(c) 4%
(d) None of these
Key: **D**

Itemcode : **CP1058**

Q13 :

The following table shows the information related to population and a few other parameters for 5 states of India for the year 2010.

States	Population (in Lakhs)	Rural Population (in %)	Literacy Rate (in %)	No. of Women per 1000 Men
P	720	40	50	920
Q	400	70	55	914
R	420	55	45	970
S	350	64	44	958
T	640	30	60	990

If the literate population, staying in urban area, of each state is maximum possible, then in how many states urban population can be 100% literate?

(a) 4
(b) 3
(c) 2
(d) 1
Key: **B**

Itemcode : **CP1059**

Q14 : The following table shows the information related to population and a few other parameters for 5 states of India for the year 2010.

States	Population (in Lakhs)	Rural Population (in %)	Literacy Rate (in %)	No. of Women per 1000 Men
P	720	40	50	920
Q	400	70	55	914
R	420	55	45	970
S	350	64	44	958
T	640	30	60	990

In each state 10% of rural population migrates to urban areas of the same state. If this migrant population is illiterate then which state will have lowest literacy rates in its urban areas?

(a) Q
(b) R
(c) S
(d) Cannot be determined
Key: **D**

Itemcode : **CP1060**

Q15 : The following table shows the information related to population and a few other parameters for 5 states of India for the year 2010.

States	Population (in Lakhs)	Rural Population (in %)	Literacy Rate (in %)	No. of Women per 1000 Men
P	720	40	50	920
Q	400	70	55	914
R	420	55	45	970
S	350	64	44	958
T	640	30	60	990

If 70% of literate population of each state lives in urban areas, then which state has the lowest percentage of literacy in rural areas?

(a) Q
(b) R
(c) S
(d) Cannot be determined
Key: **C**

Itemcode : **CP1061**

Q16 : The term Ground Stroke is associated with which of the following games?

(a) Cricket
(b) Badminton
(c) Tennis
(d) Draughts
Key: **C**

Itemcode : **CP1062**

Q17 : The saffron colour in the national flag signifies

(a) truth and peace
(b) courage and Sacrifice
(c) faith and chivalry
(d) None of the above
Key: **B**

Itemcode : **CP1063**

Q18 : The significance of the lotus symbol is

(a) culture and civilisation
(b) peace
(c) justice
(d) sign of mourning, in protest
Key: **A**

Itemcode : **CP1064**

Q19 : The Reliance Cup was earlier known by the name of

(a) Benson and Hedges Cup
(b) McDowell's Challenge Cup
(c) Prudential Cup
(d) Rothmans Cup
Key: **C**

Itemcode : **CP1065**

Q20 : 'Apsara' is the name of India's first

(a) Railway Locomotive
(b) Helicopter
(c) Nuclear Reactor
(d) Ground Battle Tank
Key: **C**

Itemcode : **CP1066**

Q21 : Raja Ravi Verma, was famous in which of the fields?

(a) Painting
(b) Politics
(c) Dance
(d) Music
Key: **A**

Itemcode : **CP1067**

Q22 : The first hand glider was designed by...?

(a) Leonardo DaVinci
(b) The Wright brothers
(c) Francis Rogallo
(d) Galileo
Key: **A**

Itemcode : **CP1068**

Q23 : In which Indian state did the game of Polo originate?

(a) Meghalaya
(b) Rajasthan
(c) Manipur
(d) West Bengal
Key: **C**

Itemcode : **CP1069**

Q24 : Which of the following is a Manipuri version of Hockey?

(a) Khong Kangjei
(b) Hiyang Tanaba
(c) Yubi Lakpi
(d) None of above
Key: **A**

Itemcode : **CP1070**

Q25 : Who is to be conferred with the 2020 Swami Vivekananda Karmayogi Award?

(a) Jadav Payeng
(b) Rajendra Singh
(c) Vandana Shiva
(d) Sunita Narain
Key: **A**

Itemcode : **CP1001**

Q26 : The ionic strength of a solution obtained by mixing aqueous solution of 20 mL 0.05 M $MgCl_2$, 30 mL of 0.05 M Na_2SO_4, 25 mL of 0.04 M $AlCl_3$ and 25 mL of 0.01 M glucose is

(a) 0.423
(b) 0.135
(c) 0.345
(d) 0.624
Key: **B**

Itemcode : **CP1002**

Q27 : Using Debye-Huckel limiting law, the mean ionic activity co-efficient of 0.01 M KCl solution at 298 K is [Given A=0.51 for water at 298 K]

(a) 0.89
(b) 0.62
(c) 0.36
(d) 0.43
Key: **A**

Itemcode : **CP1003**

Q28 : The standard reduction potentials $E^0_{Zn2+/Zn}$ and $E^0_{Cu2+/Cu}$ are –0.76 V and 0.34 V, respectively at 25^0C. The equilibrium constant of the reaction $Zn+CuSO_4 = ZnSO_4+Cu$ is [2.303RT/F=0.059 V]

(a) 2.94×10^{34}
(b) 2.94×10^{35}
(c) 3.94×10^{33}
(d) 1.94×10^{37}
Key: **D**

Itemcode : **CP1004**

Q29 : The following arrangement is used to measure the solubility product of AgI at 25^0C.The measured solubility product is(Given: $E^0_{Ag+/Ag} = 0.799$ V , $E^0_{AgI/I-} = -0.151$ V) [2.303RT/F=0.05913 V]

Ag | AgI (satd. Sol) | AgI(s) | Ag

(a) 8.58×10^{-17}
(b) 3.58×10^{-14}
(c) 4.58×10^{-19}

(d) 2.92×10^{-15}

Key: **A**

Itemcode : **CP1005**

Q30 : The potential for the following cell is 0.490 V at 298 K

$$Pb \mid PbCl_2(s) \mid PbCl_2(soln) \mid AgCl(s) \mid Ag$$

The relation between its emf and temperature is given as

$$E = A - (1.86 \times 10^{-4}\ V\ K^{-1})(T - 25K)$$

The ΔH value for the cell reaction at 298 K is [Given: 1F=96500 C mol^{-1}]

(a) $-140\ 265.5\ J\ mol^{-1}$

(b) $-125\ 345.5\ J\ mol^{-1}$

(c) $-105\ 267.6\ J\ mol^{-1}$

(d) $-185\ 254.5\ J\ mol^{-1}$

Key: **C**

Itemcode : **CP1006**

Q31 : A non-volatile hydrocarbon has 94.4% of carbon. When 2 g of this compound is dissolved in 100 g of benzene, the vapour pressure of benzene is lowered from 74.66 Torr to 74.01 Torr. The molecular formula of the hydrocarbon is

(a) $C_{18}H_{14}$

(b) $C_{14}H_{10}$

(c) $C_{16}H_{12}$

(d) $C_{18}H_{10}$

Key: **B**

Itemcode : **CP1007**

Q32 : A solution contains 0.512 g of a solute A (molar mass 128.2 g mol^{-1}) in 50 g of CCl_4 gives a boiling point elevation of 0.402 K. Another solution with a different solute (B) of 0.6216 g in same amount of solvent yields a boiling point elevation of 0.647 K. The molar mass of B is

(a) 96.6 g mol^{-1}

(b) 75.6 g mol^{-1}

(c) 112.6 g mol^{-1}

(d) 82.5 g mol^{-1}

Key: **A**

Itemcode : **CP1008**

Q33 : A solution containing 6.69 g of $Ca(NO_3)_2$ [Mol wt=164] in 100 g of water has vapour pressure of 746.9 Torr at 100^0C. The degree of dissociation of the salt is

(a) 85%

(b) 46%

(c) 38%

(d) 68%

Key: **D**

Itemcode : **CP1009**

Q34 : $2NO + Cl_2 \rightarrow 2NOCl$, for this reaction, it was found that on doubling the concentration of both the reactants the rate increases eight fold, but on doubling the concentration of chlorine alone, the rate only doubles. The overall rate of the reaction is

(a) 1

(b) pseudo first order

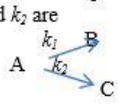
(c) 2

(d) 3

Key: **D**

Itemcode : **CP1010**

Q35 : In the following reaction, 60% decomposition of A takes place in 20 minutes and 75% B and 25% C are present. The values of k_1 and k_2 are



(a) $k_1 = 0.034,\ k_2 = 0.011$

(b) $k_1 = 0.066,\ k_2 = 0.022$

(c) $k_1 = 0.054,\ k_2 = 0.018$

(d) $k_1 = 0.013,\ k_2 = 0.038$

Key: **A**

Itemcode : **CP1011**

Q36 : The rate constant for the decomposition of a certain substance is 2.80×10^{-3} L mol^{-1} s^{-1} at 30.0°C and 1.38×10^{-2} L mol^{-1} s^{-1} at 50.0°C. The activation energy (E_a) and pre-exponential factor (A) values are [R=8.3145 J K^{-1} mol^{-1}]

(a) $E_a = 64.96$ kJ mol^{-1}, $A = 4.37 \times 10^8$ L mol^{-1} s^{-1}

(b) $E_a = 84.96$ kJ mol^{-1}, $A = 4.37 \times 10^{12}$ L mol^{-1} s^{-1}

(c) $E_a = 84.96$ kJ mol^{-1}, $A = 9.37 \times 10^8$ L mol^{-1} s^{-1}

(d) $E_a = 64.96$ kJ mol^{-1}, $A = 9.37\times10^{10}$ L mol^{-1} s^{-1}

Key: **A**

Itemcode : **CP1012**

Q37 : The mole fraction of acetone is 0.53 in a mixture of acetone and chloroform where their partial molar volumes are 74.17 cm^{3}mol^{-1} and 80.24 cm^{3}mol^{-1}, respectively (Mol wt acetone = 58 gmol^{-1}, Mol wt. chloroform= 119.5 gmol^{-1}). The volume of 1 kg of solution will be

(a) 375.4 cm^3
(b) 886.2 cm^3
(c) 462.4 cm^3
(d) 665.6 cm^3

Key: **B**

Itemcode : **CP1013**

Q38 : In a methanol and water mixture the mole fraction of methanol is 0.39 and its partial molar volume is 39.2 cm^{3}mol^{-1}. The partial molar volume of water in the mixture is [Given: density of solution = 0.91 g cm^{-3}, Mol wt. of methanol = 32 g mol^{-1}, Mol. Wt. of water = 18 g mol^{-1})

(a) 17.2 cm^{3}mol^{-1}
(b) 26.2 cm^3 mol^{-1}
(c) 11.2 cm^3 mol^{-1}
(d) 35.2 cm^3 mol^{-1}

Key: **A**

Itemcode : **CP1014**

Q39 : The fugacity coefficient of a certain gas at 200K and 50 bar is 0.72. The difference of its molar Gibbs energy from that of a perfect gas in the same state is (R=8.314 J K^{-1} mol^{-1})

(a) –0.85 kJmol^{-1}
(b) –0.55 kJmol^{-1}
(c) 0.85 kJmol^{-1}
(d) –0.35 kJmol^{-1}

Key: **B**

Itemcode : **CP1015**

Q40 : The mean activity coefficients of HBr in three dilute solutions at 25^{0}C are 0.930 (at 5 mmol kg^{-1}), 0.907 (at 10.0 mmol kg^{-1}) and 0.879 (at 20 mmol kg^{-1}). The value of B in the extended Debye-Huckel law will be same in each case. The value of B is
[Given constants A=0.509, C=0 and the denominator in the expression of extended Debye-Huckel law is $1+B\sqrt{\mu}$ where μ is the ionic strength]

(a) 2.01
(b) 5.01
(c) 4.01
(d) 1.01

Key: **A**

Itemcode : **CP1016**

Q41 : The change in the Gibbs energy of a constant pressure process fits the expression $\Delta G = -73.1+42.8\ T$. The value of ΔS is (Given ΔG in J and T in K)

(a) +42.8 JK^{-1}
(b) +62.8 JK^{-1}
(c) –62.8 JK^{-1}
(d) –42.8 JK^{-1}

Key: **D**

Itemcode : **CP1017**

Q42 : The change in the Gibbs energy of 1.0 dm^3 of benzene when the pressure acting on is increased from 1.0 atm to 100.0 atm is (Given: 1 atm= 1.013×10^5 Pa)

(a) 30 kJ
(b) 10 kJ
(c) 40 kJ
(d) –30 kJ

Key: **B**

Itemcode : **CP1018**

Q43 : The change in Gibbs energy that accompanies the oxidation of $C_6H_{12}O_6$ (s) to carbon dioxide and water vapor at 25°C is 2828 kJ mol^{-1}. The amount of glucose to be consumed by a person of mass 65 kg who needs to climb through 10 m height is (acceleration of gravity, g = 9.81 ms^{-2})

(a) 0.93 g
(b) 0.23 g
(c) 0.82 g
(d) 0.41 g

Key: **D**

Itemcode : **CP1019**

Q44 : The two major components of air nitrogen and oxygen are mixed to form air at 298 K. The mole fractions of N_2 and O_2 are 0.78 and 0.22, respectively. Which one of the following options give correct combination of the (molar) Gibbs energy (ΔG_m) and the(molar) entropy (ΔG_s) of mixing? (R=8.3145 J K^{-1} mol^{-1})

(a) . +2.31 kJ mol^{-1}, –4.38 J K^{-1} mol^{-1}
(b) –1.31 kJ mol^{-1}, +9.38 J K^{-1} mol^{-1}
(c) –1.31 kJ mol^{-1}, +4.38 J K^{-1} mol^{-1}
(d) –4.31 kJ mol^{-1}, +9.38 J K^{-1} mol^{-1}
Key: **C**

Itemcode : **CP1020**

Q45 : The first order reflection from a crystal plane in a cubic crystal occurs at $13^0 41'$. The Miller indices of the plane is [Given: a=5.63 Å, λ = 1.54 Å, $\sin^2\theta = 0.056$]

(a) (1,2,2)
(b) (1,1,0)
(c) (1,1,1)
(d) (1,1,2)
Key: **C**

Itemcode : **CP1021**

Q46 : A metal produces reflection at $2\theta = 47.2^0$ using X-ray of wave length 179 pm. Considering this as a first order reflection from the 110 planes of a bcc lattice, the edge length (in pm) of the cube is

(a) 237.5
(b) 550.5
(c) 340.5
(d) 447.5
Key: **D**

Itemcode : **CP1022**

Q47 : If r represents the radius of spheres constituting unit cells then the edge lengths of the fcc, bcc and simple cubic unit cells are respectively,

(a) $4r/\sqrt{3}$, $2\sqrt{2}\,r$, $2r$
(b) $4r/\sqrt{3}$, $2r$, $2\sqrt{2}\,r$
(c) $2r$, $4r/\sqrt{3}$, $2\sqrt{2}\,r$
(d) $2\sqrt{2}\,r$, $4r/\sqrt{3}$, $2r$
Key: **D**

Itemcode : **CP1023**

Q48 : The radial node (s) of 3s orbital of an H-atom is situated at

[Given for a hydrogenic atom, $R_{n,l} = \frac{2}{243^{1/2}}\left(\frac{Z}{a_0}\right)^{\frac{3}{2}}\left(3 - \frac{2Zr}{a_0} + \frac{2Z^2r^2}{9a_0^2}\right)e^{-Zr/3a_0}$ $where\ a_0 = 52.9\ pm$]

(a) 120 pm, 430 pm
(b) 101 pm, 376 pm
(c) 150 pm, 372 pm
(d) 120 pm, 372 pm
Key: **B**

Itemcode : **CP1024**

Q49 : The radius at which the probability of finding an electron at a point in the H-atom fall to 50% of its maximum value is (given $\psi_{1s} = \frac{1}{\sqrt{\pi a_0^3}}e^{-r/a_0}$)

(a) . $0.35a_0$
(b) $0.17a_0$
(c) $0.53a_0$
(d) $1.06a_0$
Key: **A**

Itemcode : **CP1025**

Q50 : The expectation value of $1/r$ for a hydrogenic 2s orbital is

$\psi_{2s} = \frac{1}{2\sqrt{8\pi}}\left(\frac{Z}{a_0}\right)^{\frac{3}{2}}\left(2 - \frac{Zr}{a_0}\right)e^{-Zr/2a_0}$ [Given: $\int_0^\infty x^n e^{-\alpha x}dx = \frac{n!}{a^{n+1}}$]

(a) $\frac{Z}{2a_0}$
(b) $\frac{Z}{3a_0}$
(c) $\frac{Z}{a_0}$
(d) $\frac{Z}{4a_0}$
Key: **D**

Itemcode : **CP1026**

Q51 : The percentage change in a given energy level of a particle in a cubic box when the length of the edge of the cube is decreased by 10% in each direction is

(a) 52%
(b) 43%
(c) 35%
(d) 23 %

Key: **D**

Itemcode : **CP1027**

Q52 : The vibrations of $^{35}Cl_2$ molecule can be assumed as equivalent to that of harmonic oscillator with force constant k = 329 Nm^{-1}. The zero-point energy of vibration of this molecule is (mass of ^{35}Cl atom is 34.9688 u, 1u= 1.66054×10^{-27} kg, h=6.626×10^{-34}J s).

(a) 9.61×10^{-22} J
(b) 9.61×10^{-23} J
(c) 5.61×10^{-21} J
(d) 5.61×10^{-20} J

Key: **C**

Itemcode : **CP1028**

Q53 : The linear conjugated polyene β-carotene can be considered as particle in one-dimensional box (L=2.94 nm) where 22 π electrons are delocalized over the whole system with 10 single and 11 double bonds. The wavelength (in nm) of the photon which will excite an electron from the highest occupied energy level to the lowest un-occupied energy level is (mass of electron= 9.109×10^{-31}kg, c= 2.998×10^{8} ms^{-1}, h=6.626×10^{-34}J s)

(a) 840
(b) 1240
(c) 440
(d) 640

Key: **B**

Itemcode : **CP1029**

Q54 : The average distance distance of 1s electron from the nucleus of H-atom is

(given $\psi_{1s} = \frac{1}{\sqrt{\pi a_0^3}} e^{-r/a_0}$, $\int_0^\infty x^n e^{-\alpha x} dx = \frac{n!}{a^{n+1}}$]

(a) $1.5a_0$
(b) $3a_0$
(c) $2.5a_0$
(d) $4a_0$

Key: **A**

Itemcode : **CP1030**

Q55 : Which of the following option gives correct expectation values of both x and p^2 (<x> and <p^2>) for particle in a one-dimensional box of length L? [n is the quantum number,

$$\int x \sin^2 bx\, dx = \frac{x^2}{4} - \frac{x}{4b}\sin(2bx) - \frac{1}{8b^2}\cos(2bx)]$$

(a) $\langle x\rangle = L$, $\langle p^2\rangle = \frac{n^2h^2}{2L^2}$
(b) $\langle x\rangle = \frac{L}{4}$, $\langle p^2\rangle = \frac{n^2h^2}{8L^2}$
(c) $\langle x\rangle = \frac{L}{2}$, $\langle p^2\rangle = \frac{n^2h^2}{4L^2}$
(d) $\langle x\rangle = \frac{L}{2}$, $\langle p^2\rangle = \frac{n^2h^2}{16L^2}$

Key: **C**

Itemcode : **CP1031**

Q56 : The probability that an electron described by a H-atom 1s wave function will be found within one bohr radius is [Given $\psi_{1s} = \frac{1}{\sqrt{\pi a_0^3}} e^{-r/a_0}$ and $\int x^2 e^{bx} dx = e^{bx}\left(\frac{x^2}{b} - \frac{2x}{b^2} + \frac{2}{b^3}\right)$]

(a) 0.473
(b) 0.323
(c) 0.213
(d) 0.723

Key: **B**

Itemcode : **CP1032**

Q57 :

We have three operators (i) $(1-x^2)\ d^2/dx^2 - x\ d/dx$ (ii) $x\ d^2/dx^2 + (1-x)\ d/dx$ (iii) $d^2/dx^2 - 2x\ d/dx$ and three Eigen functions (a) $4x^3-3x$ (b) $4x^4-12x^2+3$ (c) x^2-4x+2
Choose the correct combination of operators and their corresponding Eigen functions from the given options:

(a) (i)-(b), (ii)-(c), (iii)-(a)

(b) (i)-(c), (ii)-(a), (iii)-(b)

(c) (i)-(c), (ii)-(b), (iii)-(a)

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

Key: **D**

Itemcode : **CP1033**

Q58 : The energy level $\frac{17h^2}{8mL^2}$ for a particle in a cubic box (of edge length L) has degeneracy

(a) 4-fold

(b) 3-fold

(c) 2-fold

(d) Non-degenerate

Key: **B**

Itemcode : **CP1034**

Q59 : The decomposition of ozone in the reaction $2O_3(g) \rightarrow 3O_2(g)$ follows the mechanism

(i) $O_3 \leftrightharpoons O_2+O$ k_1, k_1'
(ii) $O+O_3 \rightarrow O_2+O_2$ k_2

Choose the correct option

(a) $\frac{d[O_3]}{dt} = \frac{-2k_1 k_2 [O_3]^2}{k_1'[O_2]+k_2[O_3]^2}$

(b) $\frac{d[O_3]}{dt} = \frac{-2k_1 k_2 [O_3]}{k_1'[O_2]+k_2[O_3]}$

(c) $\frac{d[O_3]}{dt} = \frac{-2k_1 k_2 [O_3]^2}{k_1'[O_2]+k_2[O_3]}$

(d) $\frac{d[O_3]}{dt} = \frac{2k_1 k_2 [O_3]^2}{k_1'[O_2]^2+k_2[O_3]}$

Key: **C**

Itemcode : **CP1035**

Q60 : Considering the following mechanism, the rate law for the decomposition $2N_2O_5(g) \rightarrow 4NO_2(g)+O_2(g)$ is

(i) $N_2O_5 \leftrightharpoons NO_2+NO_3$ k_1, k_1'
(ii) $NO_2+NO_3 \rightarrow NO_2+O_2+NO$ k_2
(iii) $NO+NO_3 \rightarrow NO_2+NO_2$ k_3

(a) $Rate = \frac{k_1 k_2}{k_1'+2k_2}[N_2O_5]^2$

(b) $Rate = \frac{k_1 k_2}{k_1'+2k_2}[N_2O_5]$

(c) $Rate = \frac{k_1 k_2}{k_1'}[N_2O_5]$

(d) $Rate = \frac{k_1 k_2}{k_1'}[N_2O_5]^2$

Key: **B**

Itemcode : **CP1036**

Q61 : In a photochemical reaction A→2B+C the quantum efficiency with 500 nm light is 2.1×10^2 mol einstein^{-1}. After exposure of 300 mmol of A to the light, 2.28 mmol of B is formed. Number of photons absorbed by A are (given: 1 einstein = 1mol photon, Avogadro No. 6.023×10^{23})

(a) 4.3×10^{25}

(b) 3.3×10^{18}

(c) 5.3×10^{22}

(d) 4.3×10^{12}

Key: **B**

Itemcode : **CP1037**

Q62 : The photochemical chlorination of chloroform in gas follows the mechanism

(i) $Cl_2+h\nu \rightarrow 2Cl$ I_a
(ii) $Cl+CHCl_3 \rightarrow CCl_3+HCl$ k_2
(iii) $CCl_3+Cl_2 \rightarrow CCl_4+Cl$ k_3
(iv) $2CCl_3+Cl_2 \rightarrow 2CCl_4$ k_4

Choose the correct option from related to this mechanism

(a) $\frac{d[CCl_4]}{dt} = 2I_a + \frac{k_3 I_a^{1/2} [Cl_2]^{1/2}}{k_4^{1/2}}$

(b) $\frac{d[CCl_4]}{dt} = 2I_a + \frac{k_3 I_a^{1/2} [Cl_2]}{k_4^{1/2}}$

(c) $\frac{d[CCl_4]}{dt} = 2I_a + \frac{k_3 I_a^{1/2} [Cl_2]^2}{k_4^{1/2}}$

(d) $\frac{d[CCl_4]}{dt} = 2I_a + \frac{k_3 I_a [Cl_2]^{1/2}}{k_4^{1/2}}$

Key: **A**

Itemcode : **CP1038**

Q63 : The resonance frequency of a photon in a magnetic field of 14.1 T [given g factor 5.5857, nuclear magneton 5.0508×10^{-27} J T^{-1}, Plancks constant (h)= 6.629×10^{-34} J s]

(a) 400 MHz

(b) 600 MHz

(c) 200 MHz

(d) 500 MHz

Key: **B**

Itemcode : **CP1039**

Q64 : ^{14}N has g factor 0.404. Energies of the nuclear spin states in a field of 11.50 T is (nuclear magneton 5.0508×10^{-27} J T^{-1})

(a) -2.35×10^{-26} J, 0, $+2.35 \times 10^{-26}$ J

(b) -1.172×10^{-26} J, $+1.172 \times 10^{-26}$ J

(c) -4.7×10^{-26} J, -2.35×10^{-26} J, 0, $+2.35 \times 10^{-26}$ J, $+4.7 \times 10^{-26}$ J

(d) 0

Key: **A**

Itemcode : **CP1040**

Q65 : There are two equivalent protons in a radical which shows a three line spectrum (intensity distribution 1:2:1). The lines are at 330.2 mT, 332.5 mT and 334.8 mT. Which among the following statements give the correct combination of the hyperfine coupling constant and g-value of the radical (use the centre line) [Given: The spectrophotometer is operating at 9.319 GHz, Bohr Magneton= 9.27402×10^{-24} J T^{-1}, Planck's constant (h)= 6.62608×10^{-34} J Hz^{-1}]

(a) hyperfine coupling constant 3.4 mT and g-value 2.0025

(b) hyperfine coupling constant 3.4 mT and g-value 1.4050

(c) hyperfine coupling constant 2.3 mT and g-value 1.4050

(d) hyperfine coupling constant 2.3 mT and g-value 2.0025

Key: **D**

Itemcode : **CP1041**

Q66 : The benzene radical anion has g-factor 2.0025. The field at which resonance will happen wit spectrophotometer of 33.67 GHz [Given: Bohr Magneton= 9.27402×10^{-24} J T^{-1}, Plancks constant (h)= 6.62608×10^{-34} J Hz^{-1}]

(a) 2.302 T

(b) 1.201 T

(c) 1.920 T

(d) 1.803 T

Key: **B**

Itemcode : **CP1042**

Q67 : Which of the following options give the correct combination of angular momentum (L) and magnetic moment (μ) values for a proton? [Given: (given g factor 5.585, nuclear magneton 5.047×10^{-27} JT^{-1}, Plancks constant (h)= 6.626×10^{-34} Js]

(a) L= 5.9137×10^{-34} Js, μ = 2.441×10^{-26} JT^{-1}

(b) L= 0.9137×10^{-34} Js, μ = 2.441×10^{-26} JT^{-1}

(c) L= 0.9137×10^{-34} Js, μ = 0.441×10^{-26} JT^{-1}

(d) L= 5.9137×10^{-34} Js, μ = 0.441×10^{-26} JT^{-1}

Key: **B**

Itemcode : **CP1043**

Q68 : The frequency at which the chemical shift of chloroform, $\delta = 7.28$ ppm occur relative to TMS on a on a 300 MHz spectrometer is

(a) 2184 Hz
(b) 1500 Hz
(c) 3200 Hz
(d) 2500 Hz
Key: **A**

Itemcode : **CP1044**

Q69 : The mobility of chloride ion is 7.91×10^{-8} $m^2s^{-1}V^{-1}$ in aqueous solution at 25^0C. The molar ionic conductivity is (Given 1 Faraday = 96485 C mol^{-1})

(a) 1.21×10^{-4} S m^2 mol^{-1}
(b) 7.63×10^{-3} S m^2 mol^{-1}
(c) 8.53×10^{-4} S m^2 mol^{-1}
(d) 15.26×10^{-3} S m^2 mol^{-1}
Key: **B**

Itemcode : **CP1045**

Q70 : The limiting molar conductivities of KCl, KNO_3 and $AgNO_3$ are 14.99 mS m^2 mol^{-1}, 14.50 mS m^2 mol^{-1} and 13.34 mS m^2 mol^{-1}, respectively (at 25^0C). The limiting molar conductivity of AgCl at 25^0C is

(a) 12.85 mS m^2 mol^{-1}
(b) 13.83 mS m^2 mol^{-1}
(c) 16.15 mS m^2 mol^{-1}
(d) 42.83 mS m^2 mol^{-1}
Key: **B**

Itemcode : **CP1046**

Q71 : The uncertainty (in m) with which the position of a baseball (0.145 kg) traveling at 45.0 m/s be measured when the uncertainty of its speed is 0.10% is

(a) 5.1×10^{-38} m
(b) 7.8×10^{-45} m
(c) 9.2×10^{-25} m
(d) 8.1×10^{-33} m
Key: **D**

Itemcode : **CP1047**

Q72 : The vibrational wave number of oxygen molecule in the ground electronic state is 1580 cm^{-1} and that in its first electronic excited state (to which an allowed electronic transition happens) is 700 cm^{-1}. The wave number of the lowest energy transition originating from the v=0 vibrational state of the ground electronic state to the excited state ($\tilde{\nu}_{00}$) is
[Given: the separation between the minima of the potential energy curves of these electronic states is 6.175 eV, ignore any rotational structure or anharmonicity, 1 eV=8065.5 cm^{-1}]

(a) . 49364 cm^{-1}
(b) 52354 cm^{-1}
(c) 32345 cm^{-1}
(d) 24567 cm^{-1}
Key: **A**

Itemcode : **CP1048**

Q73 :

Consider the electronic transition (Schumann-Runge bands) between the ground state of O_2 and the excited state designated as *B* state. The ground state O_2 dissociates into two ground-state O atoms. On the other hand, the O_2 *B* state dissociates into one ground-state O atom and an O atom in an excited state 1.970 eV above the O ground state. The v'=0 to v''=0 band of the Schumann-Runge bands is at 202.60 nm and the bands converge to a continuous absorption beginning at 175.05 nm. The D_0 value of the O_2 ground state is [Given: 1 eV=8065.5 cm^{-1}]

(a) 4.35 eV

(b) 6.02 eV

(c) 5.11 eV

(d) 4.88 eV

Key: **C**

Itemcode : **CP1049**

Q74 : The spectral line corresponding to the transition J=3 to J=4 in the rotational spectrum of HCl appears at 83 cm^{-1}. If the centrifugal distortion constant (D) of the molecule is 5.32 × 10^{-4} cm^{-1} then the wave number then the wave number of the above transition is

(a) 83.46 cm^{-1}

(b) 82.86 cm^{-1}

(c) 81.52 cm^{-1}

(d) 80.56 cm^{-1}

Key: **B**

Itemcode : **CP1050**

Q75 : The molecule HCl gives a strong IR absorption band at 2991 cm^{-1}. If deuterium is substituted for hydrogen in this molecule then the frequency of absorption will be [Consider that the force constant remains unaffected due to this substitution, m_H=1.008, m_{Cl}=34.969, m_D=2.014, 1 amu=1.661×10^{-27}kg]

(a) 1420.6 cm^{-1}

(b) 3550.5 cm^{-1}

(c) 7170.2 cm^{-1}

(d) 2144.5 cm^{-1}

Key: **D**