Resonance
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TARGET : JEE (ADVANCED) 2015

Course : VIJETA & VIJAY (JPAD & JRAD) Date : 17-04-2015

PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

NO. 04

TEST INFORMATION

DATE : 19.04.2015 CUMULATIVE TEST (CT) - 01

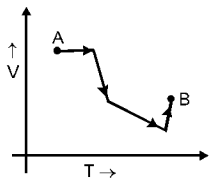
Syllabus : Mole concept, Equivalent Concept, Ionic equilibrium, Electrochemistry, Inorganic Nomenclature, Periodic table, Chemical bonding and Coordination compounds, Organic Nomenclature, Isomerism, Stereoisomerism, GOC, POC, Tautomerism, Acids & Bases.

DPP No. # 04 (JEE-ADVANCED)

Total Marks : 169 **Max. Time : 137 min.**

Single choice Objective (–1 negative marking) Q.1 to Q.15	**(3 marks 2½ min.)**	**[45, 37½]**
Multiple choice objective (–1 negative marking) Q.16 to Q.20	**(4 marks, 3 min.)**	**[20, 15]**
Assertion and Reason ('–1' negative marking) Q.21 to Q.23	**(3 marks 2½ min.)**	**[09, 7½]**
Comprehension (–1 negative marking) Q.24 to Q.32	**(3 marks 2½ min.)**	**[27, 22½]**
Single Digit Subjective Questions (no negative marking) Q.33 to Q.37	**(4 marks 2½ min.)**	**[20, 12½]**
Double Digits Subjective Questions (no negative marking) Q.38 to Q.41	**(4 marks 2½ min.)**	**[16, 10]**
Match the column (4 vs 4) (no negative marking) Q.42 to Q.44	**(8 marks, 8 min.)**	**[24, 24]**
Match the column (4 vs 5) (no negative marking) Q.45	**(8 marks, 8 min.)**	**[08, 08]**

1. For the following V-T plot for a gas undergoing a process from state A to state B, select the correct alternative(s).



(A) Pressure constantly increases (B) Pressure first increases, then decreases
(C) Final pressure is less than initial pressure (D) Pressure first decreases then increases.

2. In which of the following cases, the work done in an ideal gas system with constant moles 'n' be represented by $-nR\Delta T$?
(A) Isochoric reversible heating. (B) Isobaric reversible expansion
(C) Isothermal reversible expansion. (D) Adiabatic irreversible expansion.

3. At temperature above 85 K, decarboxylation of acetic acid becomes a spontaneous process under standard state conditions. What is the standard entropy change **(in J/K-mol)** of the reaction.
$CH_3COOH(aq) \longrightarrow CH_4(g) + CO_2(g)$
Given :

$\Delta H_f^0 [CH_3COOH(aq)] = -484$ kJ/mole

$\Delta H_f^0 [CO_2(g)] = -392$ kJ/mole

$\Delta H_f^0 [CH_4(g)] = -75$ kJ/mole

(A) 100 J/K mole (B) 200 J/K mole (C) 300 J/K mole (D) 400 J/K mole

4. A monoatomic ideal gas at 1200 K is expanded adiabatically from 1 L to 8L, such that its final temperature is 280 K. Which of the following statements is/are true for this process ?

(A) This is free adiabatic expansion. (B) This is reversible adiabatic expansion

(C) This is irreversible adiabatic expansion (D) This is an impossible process

5. The enthalpy of formation of C_2H_6 is –84 kJ/mol. For C_3H_8, it is –105 kJ/mol. What is the enthalpy of formation of n-pentane ?

(A) Date is insufficient (B) –147 kJ/mol (C) – 187 kJ/mol (D) –114 kJ/mol

6. In hcp (ABAB...) and ccp (ABCABC...) structures made up of spheres of equal size, the volume occupied per sphere (including the empty spaces) is (a = radius of sphere) :

(A) 5.66 a^3 (B) 1.33 a^3 (C) 2.66 a^3 (D) 7.40 a^3

7. What is the maximum number of layers of atoms in close packed planes that will lie within two imaginary parallel planes having a distance between them of $13\sqrt{\frac{2}{3}}$ R in the copper crystal (FCC) ? Consider the atoms to be within the parallel planes if their centres are on or within the two parallel planes. [R = radius of sphere]

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

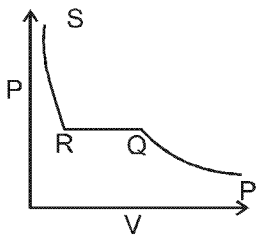
8. The number of atoms in 100 g of an FCC crystal with density d = 10 gcm^{-3} and cell edge of 200 pm is equal to

(A) 3×10^{25} (B) 5×10^{24} (C) 1×10^{25} (D) 2×10^{25}

9. Ionic solid B^+A^- crystallizes in rock salt type of structure. 1.32 gm ionic solid salt B^+A^- is dissolved in water to make one litre solution. The pH of the solution is measured to be 6.0. If the length of face diagonal in the unit cell of B^+A^- be $600\sqrt{2}$ pm. Calculate the density of ionic solid. (T = 298 K), K_b for BOH is 10^{-5}. [Avogadro Number = 6.022×10^{23}, HA = strong acid]

(A) 5 g/cc (B) 4 g/cc (C) 4.5 g/cc (D) 5.5 g/cc

10.



The above isotherm was observed for a monoatomic gas at certain temperature. Which of the following is correct ?

(A) The gas is behaving ideally

(B) The gas is above its critical temperature

(C) In the horizontal QR, the pressure is more than critical pressure

(D) The gas shows negative deviation from ideal gas in PQ and QR.

11. 10 ml of gaseous hydrocarbon is exploded with 100 ml oxygen. The residual mixture on cooling is found to measure 95 ml, of which, 20 ml is absorbed by KOH and remaining by alkaline pyrogallol. It is known that alkaline pyrogallol absorbs O_2 . Predict the formula of hydrocarbon :

(A) C_2H_6 (B) C_2H_4 (C) C_2H_2 (D) C_4H_8

12. If the number of molecules of SO_2 (atomic weight = 64) effusing through an orifice of unit area of cross-section in unit time at 0°C and 1 atm pressure is n, the number of He molecules (atomic weight = 4) effusing under similar conditions at 273°C and 0.25 atm is :

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

13. A gas 'X' undergoes physisorption on charcoal. If the magnitude of enthalpy change and entropy change were observed to be 20 kJ/mol and 75 J/mol–K, then the temperature range at which adsorption takes place spontaneously is :

(A) T= 2875 K (B) T > 287.5 K

(C) T < 287.5 K (D) At any temperature adsorption will be spontaneous

14. At 70 K, the adsorption of N_2 gas at iron surface obeys freundlich adsorption isotherm. The experimental data is :

P(bar)	4	25	64
$\frac{x}{m}$	0.2	0.5	0.8

where $\frac{x}{m}$ is the mass of N_2 in gram, adsorbed per gram of iron at P bar pressure . The mass of N_2 gas adsorbed by 5g of Fe at 36 bar and 70 K is :

(A) 0.6 g (B) 3g

(C) 0.8 g (D) Cannot be found from given data

15. Which of the following statements is not correct ?

(A) Higher is the gold number of a lyophilic sol, lesser is its coagulating power.

(B) An electrolyte can coagulate both positive sol and negative sol.

(C) Impurities present in a colloid makes it more stable.

(D) Dialysis is a process to remove impurities of ions and molecules from a solution colloid.

16. Which of the following are correct statements ?

(A) vander Waals constant 'a' is a measure of attractive force

(B) van der Waals constant 'b' is also called co-volume or excluded volume

(C) 'b' is expressed in L mol^{-1}

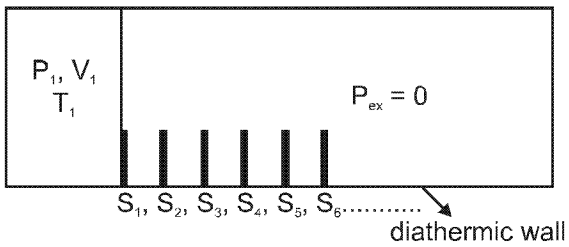
(D) 'a' is expressed in atm L^2 mol^{-2}

17. The origin of charge on colloidal solution is

(A) Self dissociation (in soaps and detergents) (B) Electron capture during Bredig's arc method

(C) Selective adsorption of ion on their surface (D) It is due to addition of protective colloids

18. Consider the process carried out for an ideal gas.



One by one, stoppers S_1, S_2, S_3 ..... are removed slowly and the gas expands to V_2, L with final pressure P_2 and final temperature T_2. Which of the following is/are correct for the above process.

(A) $T_1 = T_2$ (B) $P_1 = P_2$ (C) $U_1 = U_2$ (D) w = 0, q = 0

19. Which of the following statement(s) is/are **false** ?

(A) $\Delta_r S$ for $\frac{1}{2}Cl_2(g) \rightarrow Cl(g)$ is positive

(B) $\Delta E < 0$ for combustion of $CH_4(g)$ in a sealed container with rigid adiabatic system

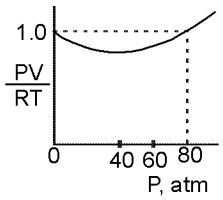
(C) ΔG is always zero for a reversible process in a closed system

(D) ΔG° for an ideal gas reaction is a function of pressure

20. The Vander waal's equation of state for a non-ideal gas can be rearranged to give

$\frac{PV}{RT} = \frac{V}{V-b} - \frac{a}{VRT}$ for 1 mole of gas. The constants a & b are positive numbers.

When applied to H_2 at 80K, the equation gives the curve as shown in the figure.



Which one of the following statements is(are) correct :

(A) The two terms $\frac{V}{(V-b)}$ and $\frac{a}{VRT}$ are never equal

(B) At 80 atm, the two terms $1+\frac{V}{(V-b)}$ & a/VRT are equal.

(C) At a pressure greater than 80 atm, the term V/(V – b) is greater than (a/VRT+1).

(D) At 60 atm, the term V/(V – b) is smaller than $1+\frac{a}{VRT}$.

21. **Statement-1 :** Gases like N_2, O_2 behave as ideal gases at high temperature and low pressure.
Statement-2 : Molecular interaction diminishes at high temperature and low pressure .
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

22. **Statement-1 :** Tyndall effect is due to scattering of light & not shown by true solution
Statement-2 : In a true solution there are no particles of sufficiently large diameter to scatter light & hence the beam is invisible.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

23. **Statement-1 :** In ZnS crystal, Zn^{2+} ions are placed at 50% of tetrahedral voids (at alternate positions) created by S^{2-} ion in c.c.p. lattice.

Statement-2 : Ratio of number of S^{2-} ion and number of tetrahedral voids is 2 : 1 where as ratio of number of S^{2-} ion and number of Zn^{2+} ion is 1 : 1 in zinc blende.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

Comprehension # 1

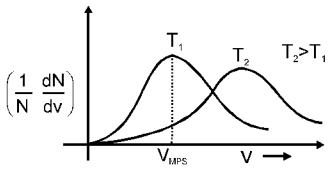
The speed of a molecule of a gas changes continuously as a result of collisions with other molecules and with the walls of the container. The speeds of individual molecules therefore change, but it is expected that the distribution of molecular speeds does not change with time.
A direct consequence of the distribution of speeds is that the average kinetic energy is constant for a given temperature.
The average K.E, is defined as

$$\overline{KE} = \frac{1}{N}\left(\frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2 + ... + \frac{1}{2}mv_N^2\right) = \frac{1}{2N}\, m(v_1^2 + v_2^2 + ... + v_N^2) = \frac{1}{2}\, m\,\overline{V^2}$$

Alternatively it may be defined as $\overline{KE} = \frac{1}{N}\left(\frac{1}{2}m\sum_i dN_i v_i^2\right) = \frac{1}{2}m\left(\sum_i \frac{dN_i}{N}\cdot v_i^2\right)$

where $\frac{dN_i}{N}$ is the fraction of molecules having speeds between v_i and $v_i + dv$ and as proposed by Maxwell

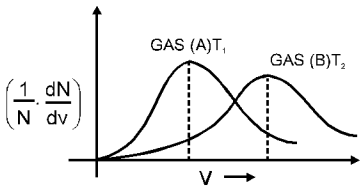
$$\frac{dN}{N} = 4\pi\left(\frac{m}{2\pi KT}\right)^{3/2} \exp(-mv^2/2kT).v^2.dv$$



The plot of $\left(\frac{1}{N}\frac{dN}{dv}\right)$ is plotted for a particular gas at two different temperatures against 'v' as shown.

The majority of molecules have speeds which cluster around v_{MPS} in the middle of the range of v. The area under the curve between any two speeds v_1 and v_2 is the fraction of molecules having speeds between v_1 and v_2. The speed distribution also depends on the mass of the molecule. As the area under the curve is the same (equal to unity) for all gas samples, samples which have the same v_{MPS} will have identical Maxwellian plots. On the basis of the above passage answer the questions that follow.

24. For the following graph drawn for two different samples of gases at two different temperatures T_1 and T_2, which of the following statements is necessarily true :



(A) If $T_2 > T_1$, M_A is necessarily greater than M_B

(B) If $T_1 > T_2$, M_B is necessarily greater than M_A

(C) $\frac{T_2}{M_B} > \frac{T_1}{M_A}$

(D) Nothing can be predicted

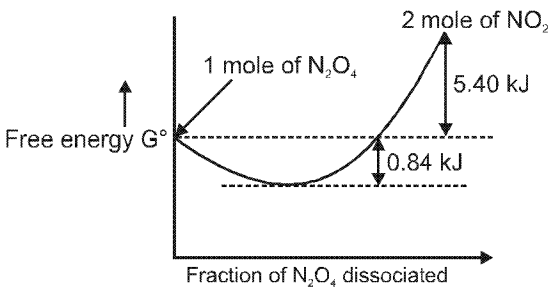
25. If two gases 'A' and 'B' and at temperature T_A and T_B respectively have identical Maxwellian plots, then which of the following statements are true ?

(A) $T_B = T_A$ (B) $M_B = M_A$ (C) $\frac{T_A}{T_B} = \frac{M_B}{M_A}$

(D) Gases A and B may be O_2 and SO_2 at 27°C and 327°C respectively.

Comprehension # 2

A reaction is spontaneous if free energy change, ΔG, for the reaction is negative. The question arises, how we can explain the spontaneity of reversible reactions. Let us take the example of dissociation equilibrium of $N_2O_4 \rightleftharpoons 2NO_2(g)$. The variation of free energy with the fraction of N_2O_4 dissociated under standard conditions is shown in the figure below :



26. The standard free energy change for the conversion of 1 mole of N_2O_4 into 2 moles of NO_2 is :

(A) 5.40 kJ (B) –5.40 kJ (C) (5.40 + 0.84) kJ (D) (5.40 + 2 × 0.84) kJ

27. When 1 mole of N_2O_4 changes into the equilibrium mixture, the value of ΔG is :
(A) 0.84 kJ (B) –0.84 kJ
(C) 5.40 – 0.84 kJ (D) 0.84 – 5.40 kJ

28. When 2 moles of NO_2 change into equilbrium mixture, the value of ΔG is
(A) (5.40 + 0.84) kJ (B) (5.40 – 0.84) kJ
(C) (–5.40 – 0.84) kJ (D) –5.40 kJ

Comprehension # 3

Zeta potential is a scientific term for electrokinetic potential in colloidal dispersions. It is usually denoted by using greek letter zeta (ζ) It is the potential difference between dispersion medium and the stationary layer of fluid attached to the dispersed particle.

29. What does a high value of zeta potential indicate :
(A) High degree of repulsion between colloidal particles and medium
(B) High degree of repulsion between colloidal particles
(C) Easy coagulation
(D) Electrically unstable colloid.

30. Zeta potential approaches zero
(A) in acidic modium (B) basic medium
(C) at pH = 7 (D) at pH of isoelectric point

Comprehension # 4

Minerals having the formula AB_2O_4 and crystallising in cubic system with O^{2-} ion forming fcc and A^{2+} & B^{3+} occupying octahedral & tetrahedral sites are generally termed as spinels.
Spinels are mainly two types : normal and inverse. In normal spinels, A^{2+} occupy one tetrahedral void and B^{3+} occupy two octahedral voids per fcc unit cell of O^{2-}. But in inverse spinel, A^{2+} occupy 1 octahedral void and B^{3+} occupy one tetrahedral and one octahedral void per fcc unit cell of O^{2-} ion.

31. $MgAl_2O_4$ is having normal spinel structure. Mg^{2+} and Al^{3+} are isoelectronic then which of the following statements is correct for $MgAl_2O_4$?
(A) Mg^{2+} being larger in size fits in octahedral void
(B) Al^{3+} being larger in size fits in octahedral void
(C) Al^{3+} occupy tetrahedral and octahedral void equally
(D) Mg^{2+} occupy tetrahdral void irrespective of the larger size than Al^{3+}.

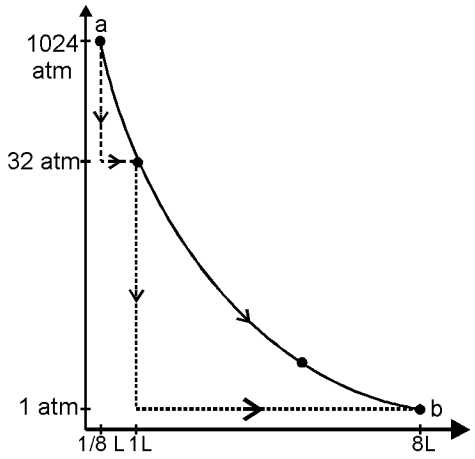
32. Some spinels have distribution of A^{2+} and B^{3+} ions in tetrahedral and octahedral voids . If the formula is $(A_{1-x}B_x)\left(A_{\frac{x}{2}}B_y\right)_2 O_4$ then y is :-

(A) 1 (B) x (C) $1-\frac{x}{2}$ (D) 2–x

33. The density of gas A is twice that of a gas B at the same temperature. The molecular weight of gas B is thrice that of A.The ratio of the pressure acting on A and B will be :

34 KCl has NaCl type face centred cubic crystal structure and CsF has CsCl type cubic crystal structure. Calculate the ratio of densities of CsF and KCl. It is given that the molar mass of CsF is twice that of KCl and edge length of KCl unit cell is 2 times that for CsF.

35. One mole of a monoatomic ideal gas is taken from **a** to **b** by expansion along two paths denoted by the solid and dashed line, as shown in the graph below. If w_A is work done along solid line path and w_B is work done along dotted line path then find $\frac{|w_A|}{|w_B|}$.



36. A cubic unit cell contains 'A^{x+}' ions at the corners and 'B^{y-}' ions at the centre of each face.
(i) The difference of coordination number of A and B = p
(ii) If all atoms along one of the C_4 axis are removed, then the formula becomes A_qB_r
Find p x q/r.

37. 1 g of charcoal adsorbs 100 mL of 0.5 M CH_3COOH to form mono layer and there by the molarity of CH_3COOH reduces to 0.49 M. Calculate the surface area of the charcoal adsorbed by each molecule of CH_3COOH. Surface area of charcoal = 3.01×10^2 m^2/gm. Give your answer by multiplying with 10^{19}.

38. The nonstoichiometric oxide of iron called Wustite has empirical formula Fe_xO. It has a density of 5.75 g/cm^3, a cubic unit cell with cell constant of 431 pm and an FCC arrangement of oxygen atoms.
Find the percentage of occupied iron sites (Fe ≡ 56)

39. The compression factor (compressibility factor) for 1 mole of a van der Waals' gas at 727ºC and100 atmosphere pressure is found to be 0.5. Assuming that the volume of gas molecule is negligible, calculate the van der Waal's constant a. [R = 0.082 atm × litre/mol K]

40. The average energy required to break a P – P bond in P_4 (s) into gaseous atoms is 53.2 kcal mol^{-1}. The bond dissociation energy of H_2(g) is 104.2 kcal mol^{-1} ; ΔH_f^0 of PH_3(g) from P_4(s) is 5.5 kcal mol^{-1}. The P-H bond energy in kcal mol^{-1} is [Neglect presence of Van der Waals forces in P_4(s)]

41. The difference between ΔH and ΔE on a molar and magnitude basis for the combustion of n-octane at 25°C would be :

42. Note : In answering this problem, do not neglect vanderwaal's forces in condensed state of matter.

Column I (X) (Y)	Column II
(A) $\frac{1}{2}H_2(g) \longrightarrow H(g)$	(p) Enthalpy of formation of Y.
(B) C(graphite) $\longrightarrow$ C(Diamond)	(q) X and Y are allotropes
(C) S(rhombic) $\longrightarrow$ S(g)	(r) X and Y are two different phases
(D) $\frac{2}{3}O_3(g) \longrightarrow O_2(g)$	(s) The enthalpy change can be used to calculatebond energy in X (without other data)

43.

Column I	Column II
(A) simple cubic and face-centred cubic	(p) have these cell parameters a = b = c and $\alpha = \beta = \gamma$
(B) cubic and rhombohedral	(q) are two crystal systems
(C) cubic and tetragonal	(r) have only two crystallographic angles of 90°
(D) hexagonal and monoclinic	(s) belong to same crystal system

44.

Column-I	Column-II Name of method by which sol is prepared
(A) $As_2O_3 + H_2S \longrightarrow As_2S_3(sol) + H_2O$	(p) Hydrolysis
(B) $AuCl_3 + HCHO + H_2O \longrightarrow Au(sol) + HCOOH + HCl$	(q) Double decomposition
(C) $FeCl_3 + H_2O \longrightarrow Fe(OH)_3(sol) + HCl$	(r) Reduction
(D) $Fe(OH)_3(\text{Fresh ppt}) \xrightarrow[(\text{little})]{+FeCl_3} Fe(OH)_3(sol)$	(s) Peptization

45. Match the processes given in column-I performed on an ideal gas sample with changes in column-II :

Column-I	Column-II
(A) Isothermal expansion against constant external pressure	(p) $\Delta S_{univ} > 0$
(B) Free expansion against vacuum under isothermal conditions.	(q) $\Delta S_{sys} = 0$
(C) Reversible adiabatic compression	(r) $\Delta S_{surr} = 0$
(D) Free expansion against vacuum under adiabatic conditions.	(s) $\Delta S_{sys} > 0$
	(t) $\Delta G_{sys} < 0$