Chem 157

FIRST

DEPARTMENT OF CHEMISTRY , UNIVERSITY OF IBADAN
SEMESTER EXAMINATIONS. 2006 \ 2007 SESSION

CHE 157 ; PHYSICAL SEMESTER,

Matric no---------- Surname ---------- Dept.----------

Attempt all questions, Write the letter to the correct answer in the box provided. Time allowed: 1 1\2 hours.

1. Calculate the in internal energy ΔE for the combustion of 1 mole of liquid benzene when reaction is run in a Paar Bomb at 298K . Enthalpy of reaction H, at 298K is –3264.6 KJ. (4mks)
(a) 451.758 J (b) –3261KJ (c) –2531KJ (d) –451.78J

2. The vapour pressure of water at a particular temperature is 3.16mmHg . When 9.21g of a particular compound is dissolved in 50g of water , the vapour pressure reduces to 3.10mmHg . Calculate the molecular weight of the compound.
(a) 171gmol^{-1} (b) 164gmol^{-1} (c) 120gmol^{-1} (d) 132gmol^{-1} (3mks)

2. Calculate Heat of formation of liquid ethanol (C_2H_5OH) . Given that its combustion evolves -1420gmol^{-1} and that H_20 and CO_2 are exothermic compounds with heats of formation of –285.8Kjmol^{-1} and –346.415Kjmol^{-1} respectively.
(a) - 346.415J (b) –264.28J (c) –224.415J (d) 346.415J (3mks)

3. $CH_4(g) + Cl_2 (g) \rightarrow CH_3Cl(g) + HCl (g)$
The enthailpy for the reaction above is –104KJ . If the bond energies C-H = 411Kjmol^{-1} , Cl – Cl = 243Kjmol^{-1} , C – Cl = 327Kjmol^{-1} , calculate the H – Cl bond energy. (3mks)
(a) 223.Kjmol^{-1} (b) 431Kjmol^{-1} (c) 328Kjmol^{-1} (d) 123Kjmol^{-1}

4. The production of Ammonia from its elements at 25^{0}C is given by
$N_2 (g) + 3H_2 – 2NH_3 (g)$, H = -940Kjmol^{-1}
If Gr NH_3 = -16.9Kjmol^{-1} , calculate Kc for the process .
(a) 8.41 X 10^{5}dm^{6}mol^{-2} (b) 1.37 X 10^{-1} dm^{6}mol^{-2} (c) 2.4 X 10^8 dm^{6}mol^{-2} (d) 5.19X 10^{12} dm^{6}mol^{-2}

5. The solubility of silver Chloride at 180C is $1.58 \times 10^{3} gdm^{-3}$. Calculate the solubility product of the salt at this temperature.
(a) $1.2 \times 10^{-10} mol^{2}dm^{-6}$ (b) $2.496 \times 10^{-6} mol^{2}dm^{-6}$ (c) $2.496 \times 10^{6} mol^{2}dm^{-6}$ (d) $1.256 \times 10^{-6} mol^{2}dm^{-6}$

7. If $100cm^{3}$ of an aqueous solution of panadol containing 60mg is shaken with $10cm^{3}$ of diethyl ether , at 293K, what weight of panadol will remain undissolved in the aqueous layer when equilibrium is reached . Given the distribution coefficient of panadol in diethyl ether relative to when is 50 (3mks)
(a) 10.00mg (b) 18.80mg (c) 41.2mg (d) 50.0mg

8. 0.1124g of compound X was dissolved in 15.00g of a sample of camphor and the solution froze at $174.9^{0}C$. If the pure sample froze at $177^{0}C$ and the cryoscopic constant is 0.83 per ^{0}C . Calculate the molarity of compound X (2mks)
(a) 3.4 Molar (b) 2.5 Molar (c) 3.4 Molar (d) 2.5 Molar

9. Determine the number of vibrational degrees of freedom that $BeCl_2$ possesses (2 mks)
(a) 1 (b) 4 (c) 2 (d) 3

10. Calculate the mean speed of a molecule of methane gas at $27^{0}C$
(a) 21 ms^{-1} (b) 19.9 ms^{-1} (c) 29.8 ms^{-1} (d) 27.46ms^{-1} (3mks)

11. Calculate the degree of dissociation , α of Carbon (IV) oxide into CO and O_2 , If its heat capacity at constant volume is 25 \ 8 R (4mks)
(a) 1 \ 2 (b) 1 \ 4 (c) 2 \ 7 (d)) 2 \ 5

12. In the question above , Calculate the specific heat capacity of CO_2 at constant pressure . (3 mks)
(a) 33 \ 8 R (b) 33 \ 352 R (c) 8 \ 33 R (d) 17 \ 33 R

13. Calculate the mean free path of 10 moles of a particle of molecular diameter 6×10^{-8}cm at S.T.P (4mks)
(a) 2.32×10^{-8}m (b) 2.32×10^{-6} m (c) 2.32×10^{-12} m
(d) 2.32×10^{-9}m

14. Deviation from ideal bahaviour of a gas occurs at

(a) Low pressure and high temperature (b) high pressure and high temperature (c) high pressure and low temperature (d) low pressure and low temperature (2 mks)

15. Determine the excluded volume of a gas whose molecular radius 2.9 X 10^{-8}cm (4mks)
(a)2.6 X $10^{-4}m^3$ (b)5.12 X 10^{-7} m^3 (c) 3.2 X 10^{-4} m^3 (d) 5.219 X 10^{-7} m^3

16. Calculate the velocity of sound in an ideal uon – linear gas having a pressure of 40Nm^{-2} and density of 49kgm^{-3}
(a) 1.07ms^{-1} (b) 1.13ms^{-1} (c) 1.24ms^{-1} (d) 1.03ms^{-1}

17. A reaction undergoing 1st order kinetic energy of activation of 140$Kjmol^{-1}$ and a frequency factor A of 2.05 X 10^3 per second . If the half life of the reaction is 100seconds , what will be the corresponding temperature of the processs.
(a) 199.7^{0}C (b) 130.0^{0}C (c) 472.7^{0}C (d) 125^{0}C

18. The reaction A + 2B →3C has a rate of 1.28 X 10^{-3} Ms^{-1} . What is the rate of formation of C (2mks)

19. The unit of the specific rate constant of 3rd order reactions are
(a) $dm^9mol^{-3}s^{-1}$ (b) $dm^9mol^2s^{-1}$ (c) $mol^2dm^{-6}s^{-1}$ (d) $mol^3dm^{-9}s^{-1}$ (2mks)

20 In a 1st order reaction , the graph of log (a – x) is against time t on the abscissa . If the slope and the intercept of the reaction are –4.5 and 0.25 respectively , find the value of the specific rate constant (3mks)
(a) 10.363s (b) 8.263s^{-1} (c) 12.35s^{-1} (d) 10.363s^{-1}

21 Find the value of the initial concentration in the question above
(a) 1.23$moldm^{-3}$ (b) 1.778 $moldm^{-3}$ (c) 2.6 $moldm^{-3}$ (d) 1.50 9 3mks)

22. A 1st order reaction is 40% complete after 8 minutes , how long will it take for 1 \ 4 of the reactant to be used up
(a) 730s (b) 740s (c) 737s (d) 728s (3mks)

23. If the decomposition of N_2O_5 to its product is a second order kinetics with respect to the reactants and the concentration of N_2O_5 decreases from 3.00$moldm^{-3}$ to 1.5 $moldm^{-3}$ in 10 minutes , what is the final concentraton (4mks)

(a) 2.0 moldm^{-3} (b) 3.5moldm^{-3} (c) 1.0moldm^{-3} (d) 1.5moldm^{-3}

24 By what factor does the reaction rate increases on addition of a catalyst, if the activation energy is reduced from 200KJ to 150KJ and the temperature is maintained at 77^{0}F. (4mks)
(a) 5.08 X 10^8 (b) 2.25 X 10^4 (c) 3.2 X 10^4 (d) 1.08 X 10^4

25 If the average atomic mass of the two isotopes of lead , ^{211}Pb and ^{207}Pb was 209.32 , the exact mass of ^{211} Pb is 210.979 and the exact mass of ^{207}Pb is 206.973. Calculate the isotope ratio of the latter to the former
(a) 0.58 (b) 0.72 (c) 0.42 (d) 1.39 (3mks)

26 . Given that Bohr's radius for Hydrogen atom = 0.529A , Calculate the velocity of an electron in the 1st Bohr orbit of the Lithium atom (4mks)
(a) 2.28 X 10^{6}ms^{-1} (b) 3.28 X 10^{5}ms^{-1} ms^{-1} (c) 3.28X 10^6 ms^{-1}
(d) 2.28 X 10^5 ms^{-1}

27. Calculate the frequency of the second line in the Lyman series of the hydrogen atom (3 mks)
(a) 2.9 X 10^{15}s (b) 2.5 X 10^{15}s^{-1} (c) 3.08 X 10^{15}s (d) 2.9 X 10^{15}s^{-1}

28. The ratio of the magnitude of charge to electron mass was determined by (2 mks)
(a) J.J Thompson (b) R. A Millikan (c) Chadwick (d) Moseley

29. The hybridization of SF_6 is (2mks)
(a) dsp^3 (b) d^{2}sp^3 (c) sp^3 (d) sp^2

30. The shape of water molecule is (2 mks)
(a 0 regular tetrahedral (b) non linear (c) linear (d) skewed tetrahedral

31. In the following , the highest electronegativity value belongs to (2 mks)
(a) Francium (b) Caesium (c) Sodium (d) Pottasium

32 . Calculate the binding energy of $^{59}_{27}$Co . Given that the mass of Cobalt 59 when determined with mass spectrometer is 58.95182. Assume that the mass of a hydrogen atom is 1.008142 and that of the neutron is 1.008982 (4mks)
(a) 8.3 X 10^{-11}J (b) 6.9 X 10^{-13}J (c) 2.4 X 10^{-13}J (d) 3.2 X 10^{-14}J