

THE UNIVERSITY OF SYDNEY

Faculties of Science, Engineering and Arts

CHEM2401/2911/2915 MOLECULAR REACTIVITY & SPECTROSCOPY

FIRST SEMESTER EXAMINATION

JUNE 2010

DATA PAGE

A Periodic Table is printed on the other side of this data sheet. Atomic weights are included in the Periodic Table.

Data: 1 eV = 1.602×10^{-19} J = 8065 cm^{-1} = $96.485 \text{ kJ mol}^{-1}$

Constants:

$$h = 6.626 \times 10^{-34} \text{ J s}$$

$$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$$

$$c = 2.998 \times 10^8 \text{ m s}^{-1}$$

$$m_e = 9.11 \times 10^{-31} \text{ kg}$$

$$k/hc = 0.696 \text{ cm}^{-1} \text{ K}^{-1}$$

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

Equations:

$$BO_{AB}^{\pi} = \sum c_A c_B n_e$$

$$\rho_i^{\pi} = \sum c_i^2 n_e$$

$$E = h \nu$$

$$E = hc/\lambda$$

$$\nu = c \bar{\nu}, \quad [c \text{ is in } \text{cm s}^{-1}]$$

$$\nu = c/\lambda$$

$$E = \frac{1}{2}mv^2$$

$$E = mc^2$$

$$p = h/\lambda$$

$$p = mv$$

$$\Delta E \Delta t \approx \hbar/2 \quad [\hbar = h/2\pi]$$

$$\Delta p \Delta x \approx \hbar/2$$

$$E_n = \frac{n^2 h^2}{8mL^2} = \frac{n^2 \pi^2 \hbar^2}{2mL^2}$$

$$\Psi_n \psi = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right)$$

$$\int \psi_n^* \psi_n dx = 1$$

$$\hbar = \frac{h}{2\pi}$$

$$E(v) = (v+1/2) h\nu_e - (v+1/2)^2 h\nu_e x_e$$

$$G(v) = (v+1/2) \omega_e - (v+1/2)^2 \omega_e x_e$$

$$\mu = \frac{m_1 m_2}{m_1 + m_2}$$

$$\nu = \frac{1}{2\pi} \sqrt{\frac{k}{\mu}}$$

$$D_e = \frac{\omega_e^2}{4\omega_e x_e}$$

$$D_0 = D_e - G(0)$$

$$N(E) \propto e^{-E/kT}$$

$$I = I_0 10^{-\epsilon c l}$$

$$n\lambda = 2d \sin\theta$$

$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

PERIODIC TABLE OF THE ELEMENTS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1 HYDROGEN H 1.008												2 HELIUM He 4.003					
	3 LITHIUM Li 6.941	4 BERYLLIUM Be 9.012											5 BORON B 10.81	6 CARBON C 12.01	7 NITROGEN N 14.01	8 OXYGEN O 16.00	9 FLUORINE F 19.00	10 NEON Ne 20.18
	11 SODIUM Na 22.99	12 MAGNESIUM Mg 24.31											13 ALUMINIUM Al 26.98	14 SILICON Si 28.09	15 PHOSPHORUS P 30.97	16 SULFUR S 32.07	17 CHLORINE Cl 35.45	18 ARGON Ar 39.95
	19 POTASSIUM K 39.10	20 CALCIUM Ca 40.08	21 SCANDIUM Sc 44.96	22 TITANIUM Ti 47.88	23 VANADIUM V 50.94	24 CHROMIUM Cr 52.00	25 MANGANESE Mn 54.94	26 IRON Fe 55.85	27 COBALT Co 58.93	28 NICKEL Ni 58.69	29 COPPER Cu 63.55	30 ZINC Zn 65.39	31 GALLIUM Ga 69.72	32 GERMANIUM Ge 72.59	33 ARSENIC As 74.92	34 SELENIUM Se 78.96	35 BROMINE Br 79.90	36 KRYPTON Kr 83.80
	37 RUBIDIUM Rb 85.47	38 STRONTIUM Sr 87.62	39 YTTRIUM Y 88.91	40 ZIRCONIUM Zr 91.22	41 NIObIUM Nb 92.91	42 MOLYBDENUM Mo 95.94	43 TECHNETIUM Tc [98.91]	44 RUTHENIUM Ru 101.07	45 RHODIUM Rh 102.91	46 PALLADIUM Pd 106.4	47 SILVER Ag 107.87	48 CADMIUM Cd 112.40	49 INDIUM In 114.82	50 TIN Sn 118.69	51 ANTIMONY Sb 121.75	52 TELLURIUM Te 127.60	53 IODINE I 126.90	54 XENON Xe 131.30
	55 CAESIUM Cs 132.91	56 BARIUM Ba 137.34	57-71	72 HAFNIUM Hf 178.49	73 TANTALUM Ta 180.95	74 TUNGSTEN W 183.85	75 RHENIUM Re 186.2	76 OSMIUM Os 190.2	77 IRIDIUM Ir 192.22	78 PLATINUM Pt 195.09	79 GOLD Au 196.97	80 MERCURY Hg 200.59	81 THALLIUM Tl 204.37	82 LEAD Pb 207.2	83 BISMUTH Bi 208.98	84 POLONIUM Po [210.0]	85 ASTATINE At [210.0]	86 RADON Rn [222.0]
	87 FRANCIUM Fr [223.0]	88 RADIUM Ra [226.0]	89-103	104 RUTHERFORDIUM Rf [261]	105 DUBNIUM Db [262]	106 SEABORGIUM Sg [266]	107 BOHRNIUM Bh [262]	108 HASSIUM Hs [265]	109 MEITNERIUM Mt [266]									

		57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
LANTHANIDES		LANTHANUM La 138.91	CERIUM Ce 140.12	PRASEODYMIUM Pr 140.91	NEODYMIUM Nd 144.24	PROMETHIUM Pm [144.9]	SAMARIUM Sm 150.4	EUROPIUM Eu 151.96	GADOLINIUM Gd 157.25	TERBIUM Tb 158.93	DYSPROSIUM Dy 162.50	HOLMIUM Ho 164.93	ERBIUM Er 167.26	THULIUM Tm 168.93	YtterBIUM Yb 173.04	LUTETIUM Lu 174.97
ACTINIDES		89 ACTINIUM Ac [227.0]	90 THORIUM Th 232.04	91 PROTACTINIUM Pa [231.0]	92 URANIUM U 238.03	93 NEPTUNIUM Np [237.0]	94 PLUTONIUM Pu [239.1]	95 AMERICIUM Am [243.1]	96 CURIUM Cm [247.1]	97 BERKELIUM Bk [247.1]	98 CALIFORNIUM Cf [252.1]	99 EINSTEINIUM Es [252.1]	100 FERMIUM Fm [257.1]	101 MENDELEVIUM Md [256.1]	102 NOBELIUM No [259.1]	103 LAWRENCIUM Lr [260.1]

(see reverse side for data sheet)