

CHEM 241 — TEST

Inorganic Chemistry

Tuesday 8 September 2009, Room Laws108

Time: 7:30 pm to 8:30 pm

Time allowed: 60 minutes

Answer ALL questions. There are 50 marks available.

Start each question on a new page.

A periodic table is attached.

1. (15 marks)

- (a) Illustrate a cyclosilicate, and provide its formula.
- (b) Illustrate a pyroxene (silicate chain), and provide its formula.
- (c) Illustrate the silicate structure of a fibrous material such as asbestos, and provide its formula.
- (d) Describe two types of layered aluminosilicates.

2. (10 marks)

- (a) Describe or draw structures of the following molecules (show your working):
 - (i) $C_2B_5H_7$
 - (ii) $N_2B_4H_6$
 - (iii) $[Te_6]^{4+}$
- (b) How many isomers could compound (i) in part (a) have?

3. (5 marks)

List the following pairs of molecules in order of increasing hydrogen-bond bond enthalpy, and explain your chosen order:

- (a) $H_2O \cdots HOH$
- (b) $H_2O \cdots HNH_3^+$
- (c) $HCCH \cdots OH_2$

4. (10 marks)

Below is a list of ionisation energies and electron affinities for the Group 1, 2 and 13 elements.

	Li	Na	K	Rb	Cs
IE	513	496	419	403	376
EA	60	53	44	47	45
	Be	Mg	Ca	Sr	Ba
IE	899	738	590	549	503
EA	-18	-21	-186	-146	-46
	B	Al	Ga	In	Tl
IE	801	578	579	558	589
EA	23	44	36	34	30

IA = Ionisation energy: the energy (kJ/mole) required to remove a single electron from the neutral atom; EA = Electron Affinity: the energy change (kJ/mole) when a single electron is added to a neutral atom.

- The ionisation energies within a given Group all decrease as the atomic number increases. Discuss the role of atomic radius and effective nuclear charge (Z^*) in these changes.
- The electron affinities of the elements in Groups 1 and 13 indicate that the ease with which an electron can be transferred to a neutral atom in these Groups is about the same. On the other hand for Group 2 the EA's are negative, indicating that for this group, addition of an electron to the neutral atom is more difficult than that for the other two groups. Explain why this should be so.
- Which element in the periodic table has the highest electron affinity and why?

5. (10 marks)

- Discuss how you would expect the properties of BaH_2 and $\text{HfH}_{2,10}$ to differ.
- Explain why HI is a strong acid but KH is a strong base.
- List FOUR criteria for an ideal hydrogen storage medium.

Periodic Table

1 H 1.008																	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.8	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.9	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (99)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57-71 see below	72 Hf 178.5	73 Ta 181.0	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89-103 see below	104 Rf (257)	105 Db (260)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110	111	112						

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (147)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
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89 Ac (227)	90 Th 232.0	91 Pa (231)	92 U 238.1	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (245)	98 Cf (251)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (254)	103 Lr (257)
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