

PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIIB	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	INERT GASES		
1 H 1.00797														1 H 1.00797	2 He 4.0026		
3 Li 6.939	4 Be 9.0122										5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183	
11 Na 22.9898	12 Mg 24.312										13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948	
19 K 39.102	20 Ca 40.00	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9300	26 Fe 55.047	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	†89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ? (271)	111 ? (272)	112 ? (277)						

Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

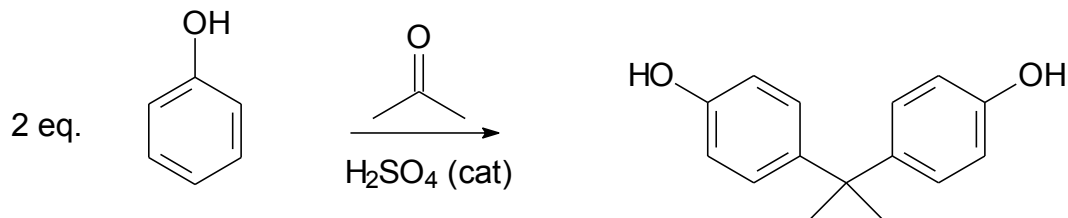
* Lanthanide Series

58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm (147)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97
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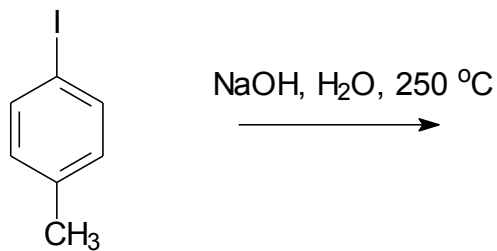
† Actinide Series

90 Th 232.038	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (256)	103 Lr (257)
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1. (15 pts) Treatment of phenol with acetone in the presence of a catalytic amount of sulfuric acid results in formation of Bisphenol A. Propose a complete, stepwise mechanism for the following reaction scheme, **including resonance structures**.



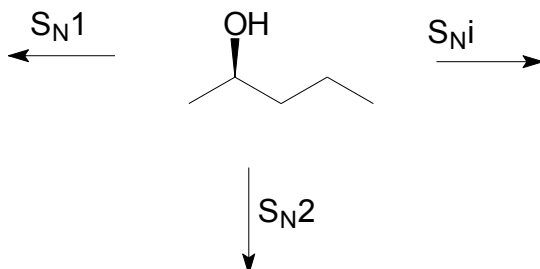
2. (15 pts) Treatment of 4-iodotoluene with sodium hydroxide in water at 250 °C results in formation of a single product in 97% yield. (*J. Am. Chem. Soc.* **1957**, 79, 1458.) Draw the structure of the product, and propose a complete, stepwise mechanism which would account for their formation, **including resonance structures**.



3. Reaction of (*R*)-2-pentanol under different reaction conditions can generate (*S*)-2-chloropentane, (*R*)-2-chloropentane, or (\pm)-2-chloropentane.

A) (5 pts) Draw the structures of the products in the scheme below; provide all necessary reagents to accomplish the transformations.

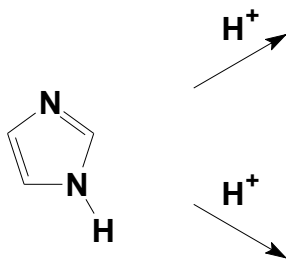
B) (15 pts) Propose a complete, stepwise mechanism for each transformation.



4. (10 pts) Draw a "generic" E2 reaction mechanism (including the Transition State). Use Wedges and Dashes where appropriate to show substrate stereochemistry. **Briefly** discuss the following topics, as they relate to the E2 pathway. **Be brief.**

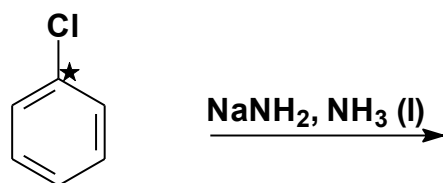
- Substrate structure (and rate of reaction).
- Stereochemistry.

5. (5 pts) Imidazole (below), an aromatic heterocycle, is a common base. Draw the structures of both conjugate acids that could be formed by protonation of Nitrogen. Include all reasonable resonance structures where applicable.



6. (5 pts) Which conjugate acid in problem 5 is more stable. Give a brief answer.

7. (15 pts.) When carbon 14 labeled chlorobenzene (C-14 indicated with ★) is treated with sodium amide in liquid ammonia, two products are formed in about a 1:1 ratio. Draw the structures of the two products (*worth 5 of the 15 points*). Propose a reasonable mechanism which would account for the formation of both products.



8. (15 pts) Fluorene (below) has a pK_a of about 22 in DMSO (H's in Bold). Draw all 13 resonance contributors of the Fluorenyl anion.

