Chem 41c Midterm Exam

Stoltz, Spring 2005, May 2, 2005

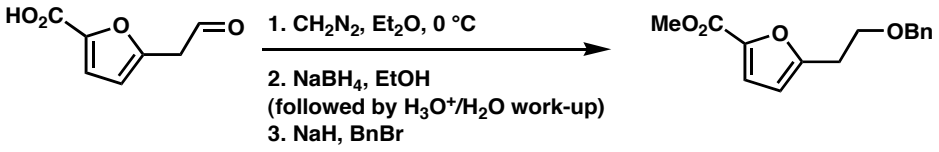
The exam begins when you turn to page 2. You have 55 minutes to complete the exam. This is a closed note and closed book exam with no collaboration. You may use the periodic table at the front of the room or the one on the last page of this packet. You may not use any other materials. The exam has a total of 135 points. You're grade will be calculated based on 120 points (i.e., you have 15 bonus points built-in). (Also, remember that your midterm counts 60 points toward your final grade, e.g., 5 quiz points = 10 points here). Good luck.

There are 9 pages in this exam packet.

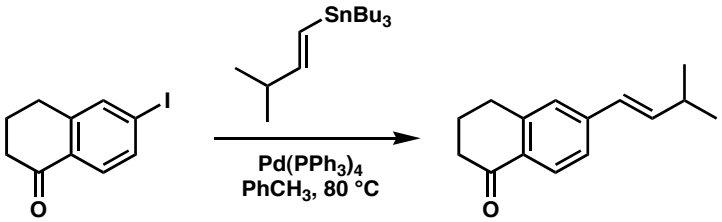
*Name:*_____

1. Predict the major non-volatile products (if any) of the following reactions or sequences. (5 points each)

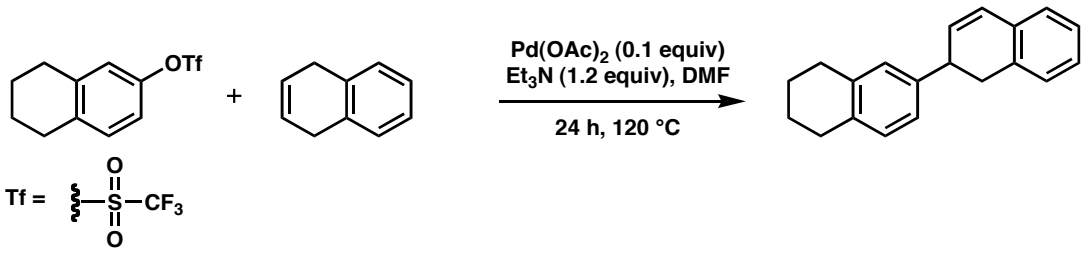
a.



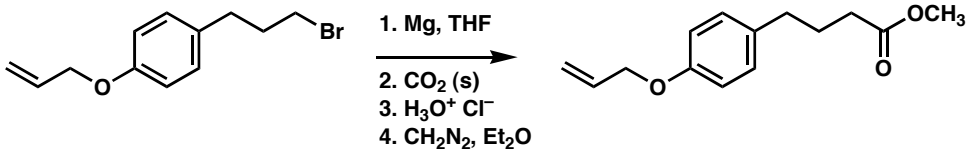
b.



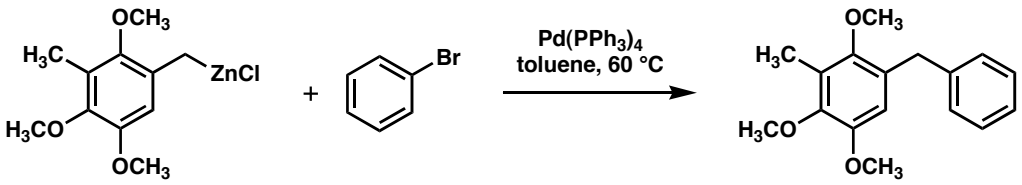
c.



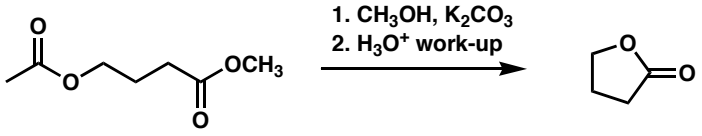
d.



e.

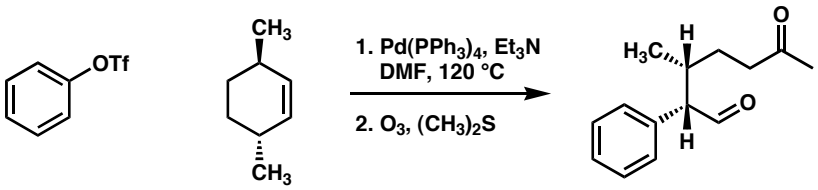


f.

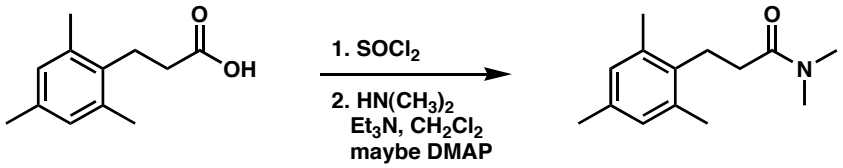


2. Provide reagents for the following transformations. They may be multistep processes (none are longer than 5 steps). (5 points each)

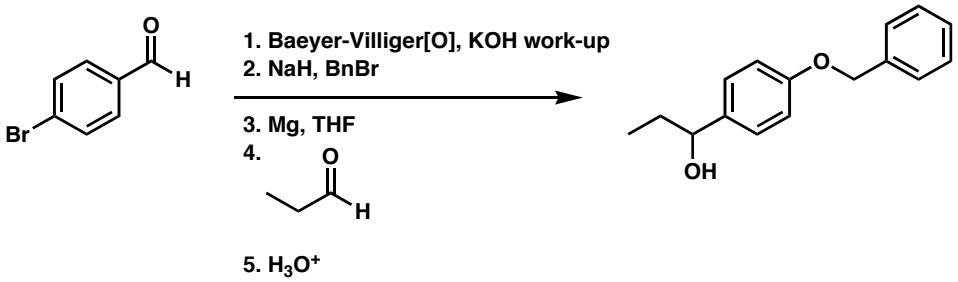
a.



b.

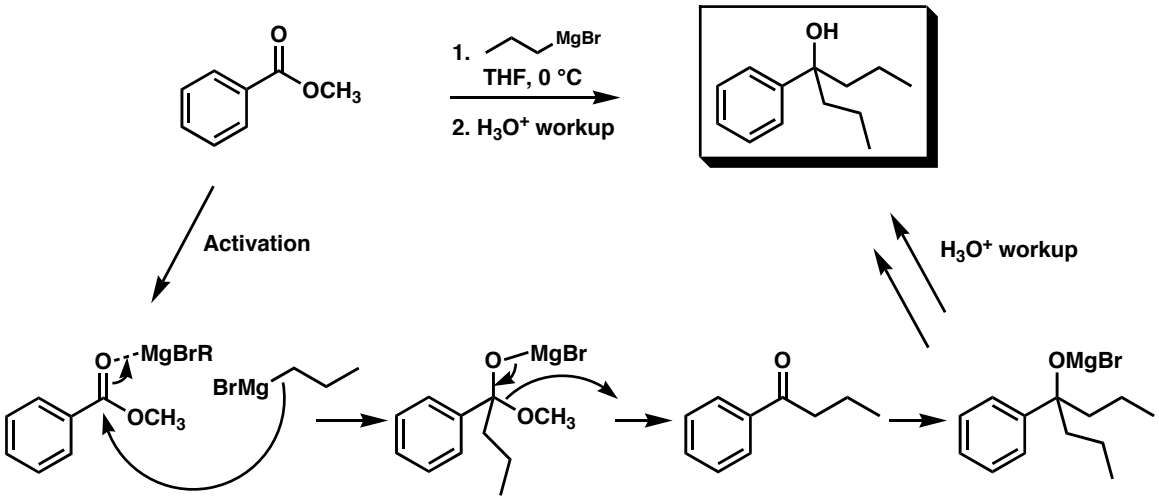


c.

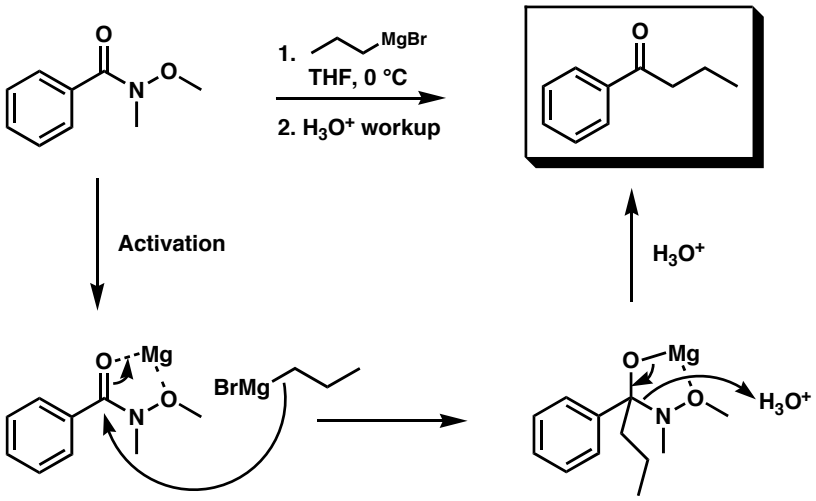


3. Provide the product of the following reactions and give a mechanistic rationale complete with curved arrows for the formation of two different products. Be sure to clearly indicate at which stage the work-up begins. (20 points)

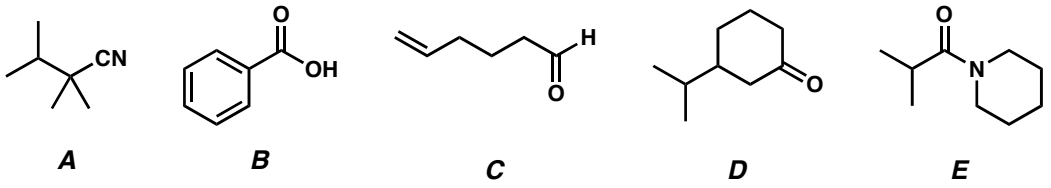
a)



b)



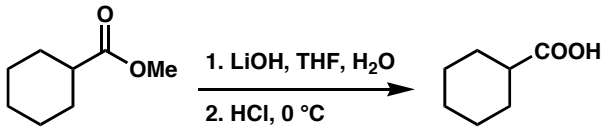
4. Rank the following compounds in order of reactivity with MeMgBr. (5 points)



A ***B*** ***C*** ***D*** ***E***

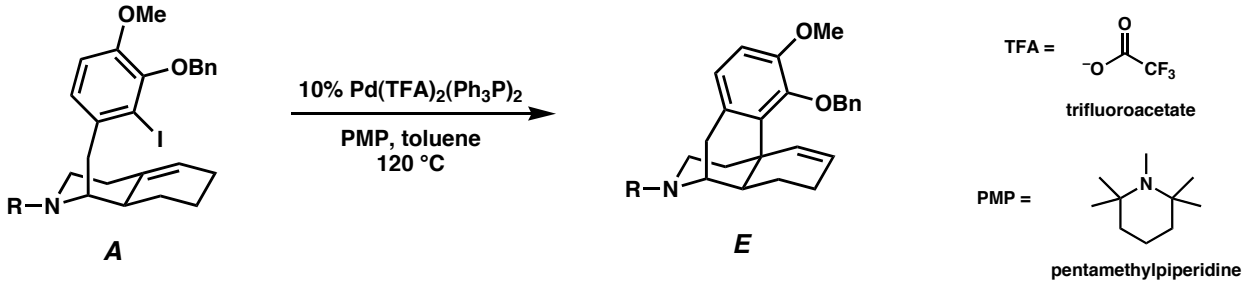
□ > □ > □ > □ > □ **BCDEA**

5. Provide a detailed curved arrow mechanism for the following reaction. What drives the equilibrium to the product side? (10 points)

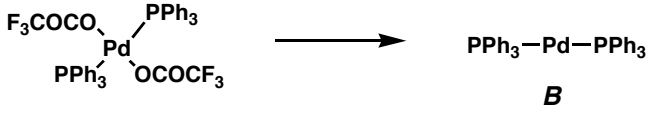


1 ***2***

6. Recently, an asymmetric synthesis of (–)-Morphine was reported utilizing the Palladium-catalyzed reaction described below as the key step.

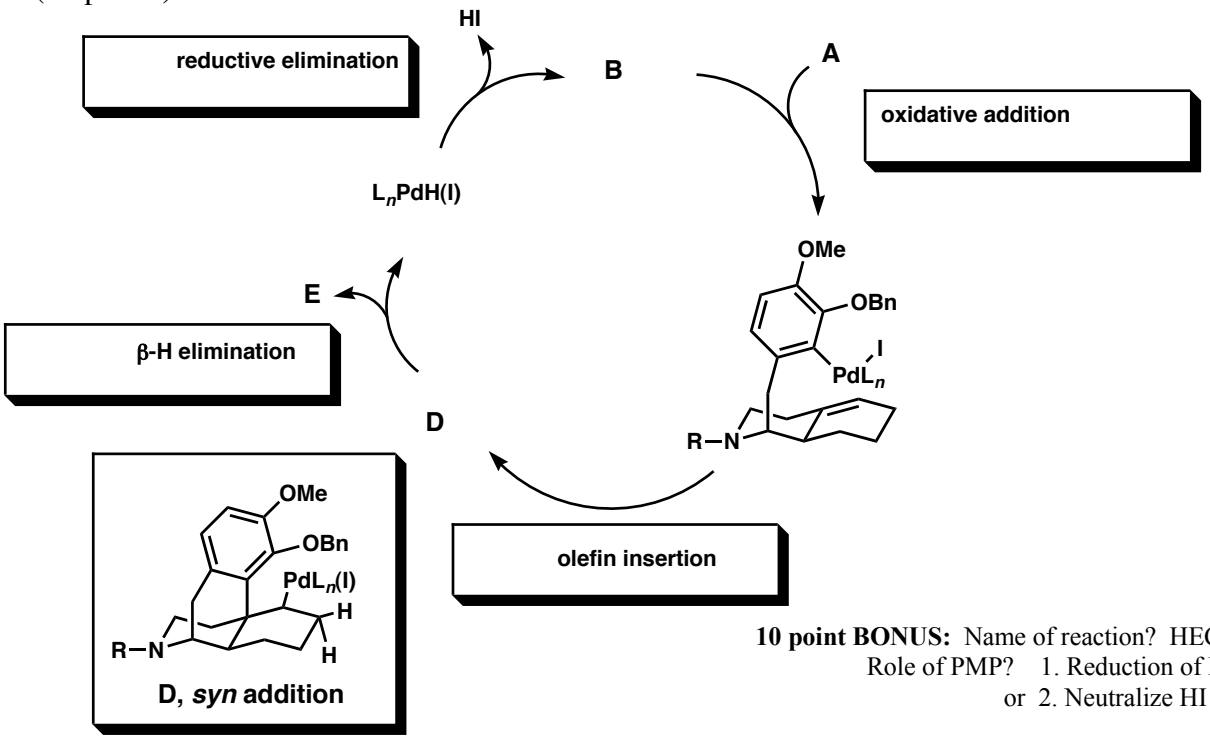


a) The active catalyst for the reaction is believed to be **B**, not $Pd(TFA)_2(Ph_3P)_2$. Give the formal oxidation state, d^n descriptor, and electron count for each complex. Also, what is a general name for the process to get to **B** from $Pd(TFA)_2(Ph_3P)_2$? (HINT: oxidation, reduction, or ligand exchange) (10 points)



formal oxidation state:	Pd(II)	Pd(0)
d^n descriptor:	d^8	d^{10}
electron count:	16	14
type of process:	reduction	

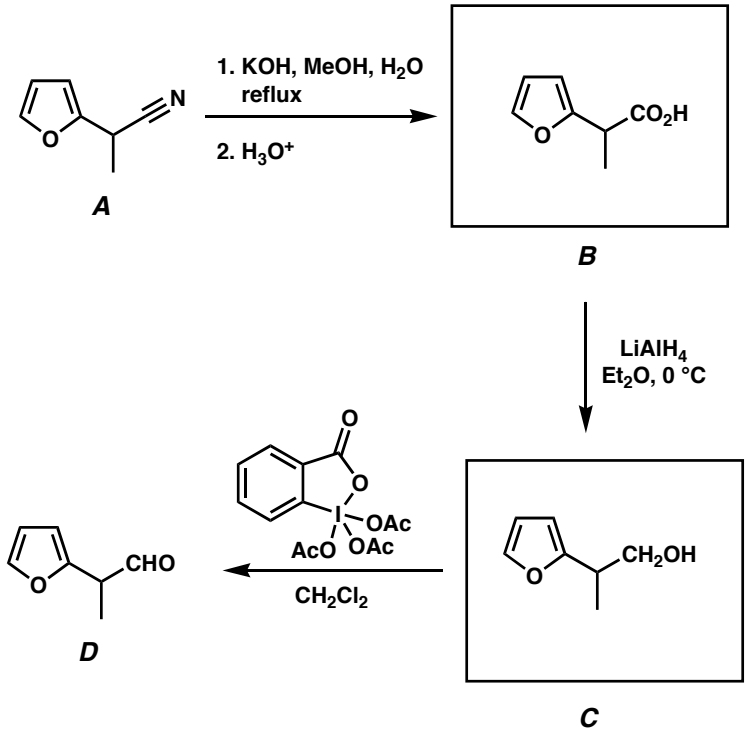
b) Label each of the boxes below describing the key steps in the catalytic cycle. Also, what is the structure of **D**? (10 points)



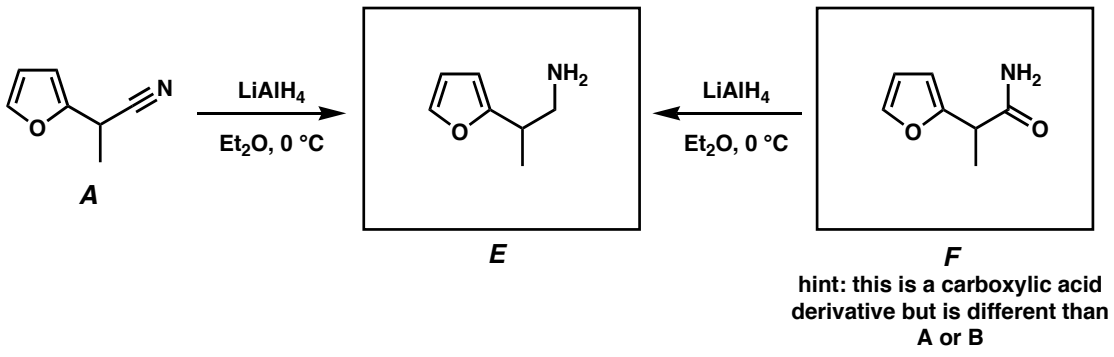
10 point BONUS: Name of reaction? HECK
Role of PMP? 1. Reduction of Pd(II)
or 2. Neutralize HI

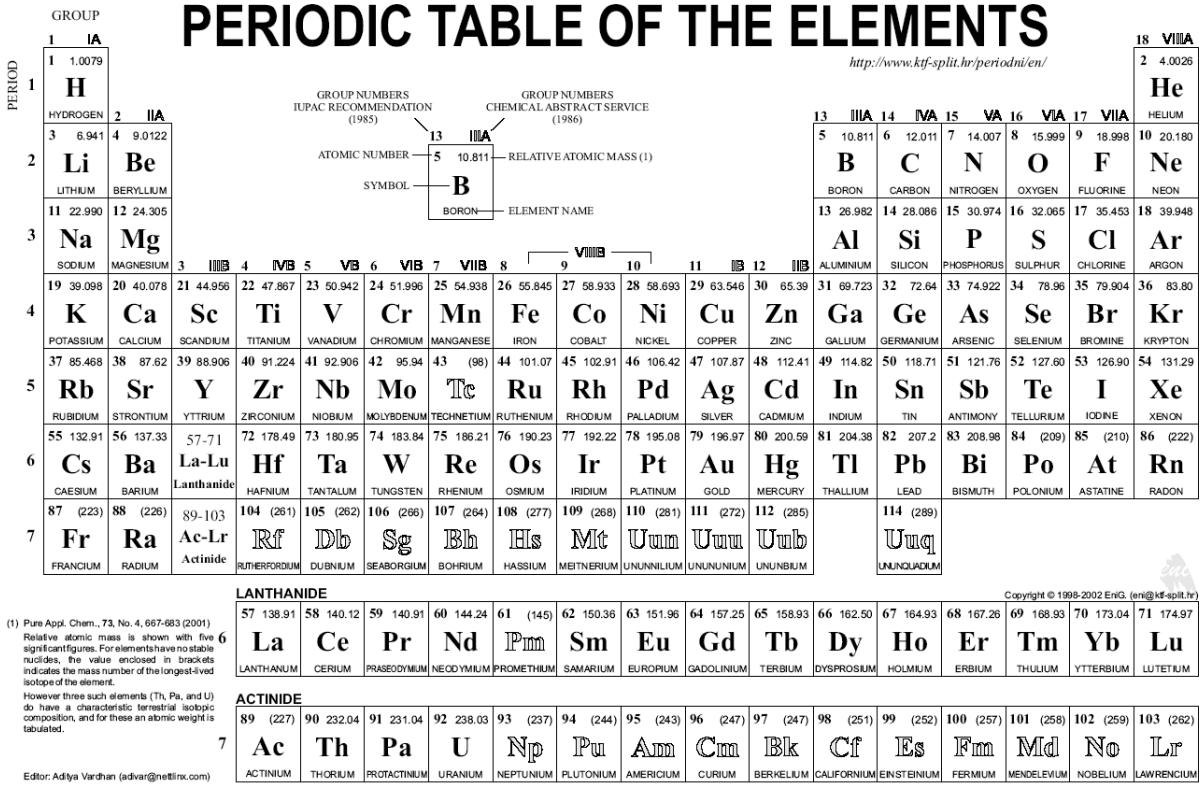
7. Imagine yourself as a graduate student in a famous laboratory working on a complex synthetic problem. After a long day of frustrating chemistry at the "cutting edge", you decide to rattle off some easy chemistry for the synthesis of compounds needed for simpler work (i.e., **A→B→C→D**). After a few hours of this "sophomore" organic chemistry, you return to your desk to realize that you have not labeled your IR spectra for compouinds **B** through **D**.

(a) Draw compounds **B** and **C** into the boxes below
(b) Looking at your three IR spectra, you take note of a key peak in each. These key peaks fall at 3200 (broad), 1725 and 1710 cm^{-1}. (hint: the spectrum that has a strong peak at 1710 cm^{-1} also has a large, broad peak from 2400-3600 cm^{-1}). Assign your spectra to compounds **B**-**E** below by writing the key frequency below the corresponding compound.(25 points total)



b) Since the chemistry was so simple, you decide to scale up the process. Unfortunately, as a result of this somewhat rushed series of experiments and your general sleepiness, you completely forget the first step and mistakenly treat compound **A** with $LiAlH_4$. What is the structure of your product **E**? Fortunately, your labmate happens to need this compound, but usually synthesizes it from an alternative carboxylic acid derivative. Please provide the structure of **E** from your mistake and predict the compound that your lab-mate uses as starting material (i.e., **F**).




PERIODIC TABLE OF THE ELEMENTS
http://www.ktf-split.hr/periodni/en/
GROUP
PERIOD
GROUP NUMBERS IUPAC RECOMMENDATION (1985)
GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)
ATOMIC NUMBER
SYMBOL
RELATIVE ATOMIC MASS (1)
ELEMENT NAME
1 IA
18 VIIIA
13 IIIA
14 IVA
15 VA
16 VIA
17 VIIA
2 IIA
3 IIIB
4 IVB
5 VB
6 VIB
7 VIIB
8
9
10
VIIIB
11 IB
12 IIB
1 1.0079 H HYDROGEN
2 4.0026 He HELIUM
3 6.941 Li LITHIUM
4 9.0122 Be BERYLLIUM
5 10.811 B BORON
6 12.011 C CARBON
7 14.007 N NITROGEN
8 15.999 O OXYGEN
9 18.998 F FLUORINE
10 20.180 Ne NEON
11 22.990 Na SODIUM
12 24.305 Mg MAGNESIUM
13 26.982 Al ALUMINIUM
14 28.086 Si SILICON
15 30.974 P PHOSPHORUS
16 32.065 S SULPHUR
17 35.453 Cl CHLORINE
18 39.948 Ar ARGON
19 39.098 K POTASSIUM
20 40.078 Ca CALCIUM
21 44.956 Sc SCANDIUM
22 47.867 Ti TITANIUM
23 50.942 V VANADIUM
24 51.996 Cr CHROMIUM
25 54.938 Mn MANGANESE
26 55.845 Fe IRON
27 58.933 Co COBALT
28 58.693 Ni NICKEL
29 63.546 Cu COPPER
30 65.39 Zn ZINC
31 69.723 Ga GALLIUM
32 72.64 Ge GERMANIUM
33 74.922 As ARSENIC
34 78.96 Se SELENIUM
35 79.904 Br BROMINE
36 83.80 Kr KRYPTON
37 85.468 Rb RUBIDIUM
38 87.62 Sr STRONTIUM
39 88.906 Y YTTRIUM
40 91.224 Zr ZIRCONIUM
41 92.906 Nb NIOBIUM
42 95.94 Mo MOLYBDENUM
43 (98) Tc TECHNETIUM
44 101.07 Ru RUTHENIUM
45 102.91 Rh RHODIUM
46 106.42 Pd PALLADIUM
47 107.87 Ag SILVER
48 112.41 Cd CADMIUM
49 114.82 In INDIUM
50 118.71 Sn TIN
51 121.76 Sb ANTIMONY
52 127.60 Te TELLURIUM
53 126.90 I IODINE
54 131.29 Xe XENON
55 132.91 Cs CAESIUM
56 137.33 Ba BARIUM
57-71 La-Lu Lanthanide
72 178.49 Hf HAFNIUM
73 180.95 Ta TANTALUM
74 183.84 W TUNGSTEN
75 186.21 Re RHENIUM
76 190.23 Os OSMIUM
77 192.22 Ir IRIDIUM
78 195.08 Pt PLATINUM
79 196.97 Au GOLD
80 200.59 Hg MERCURY
81 204.38 Tl THALLIUM
82 207.2 Pb LEAD
83 208.98 Bi BISMUTH
84 (209) Po POLONIUM
85 (210) At ASTATINE
86 (222) Rn RADON
87 (223) Fr FRANCIUM
88 (226) Ra RADIUM
89-103 Ac-Lr Actinide
104 (261) Rf RUTHERFORDIUM
105 (262) Db DUBNIUM
106 (266) Sg SEABORGIUM
107 (264) Bh BOHRIUM
108 (277) Hs HASSIUM
109 (268) Mt MEITNERIUM
110 (281) Uun UNUNNILIUM
111 (272) Uuu UNUNUNIUM
112 (285) Uub UNUNBIUM
114 (289) Uuq UNUNQUADIUM
LANTHANIDE
57 138.91 La LANTHANUM
58 140.12 Ce CERIUM
59 140.91 Pr PRASEODYMIUM
60 144.24 Nd NEODYMIUM
61 (145) Pm PROMETHIUM
62 150.36 Sm SAMARIUM
63 151.96 Eu EUROPIUM
64 157.25 Gd GADOLINIUM
65 158.93 Tb TERBIUM
66 162.50 Dy DYSPROSIUM
67 164.93 Ho HOLMIUM
68 167.26 Er ERBIUM
69 168.93 Tm THULIUM
70 173.04 Yb YTTERBIUM
71 174.97 Lu LUTETIUM
ACTINIDE
89 (227) Ac ACTINIUM
90 232.04 Th THORIUM
91 231.04 Pa PROTACTINIUM
92 238.03 U URANIUM
93 (237) Np NEPTUNIUM
94 (244) Pu PLUTONIUM
95 (243) Am AMERICIUM
96 (247) Cm CURIUM
97 (247) Bk BERKELIUM
98 (251) Cf CALIFORNIUM
99 (252) Es EINSTEINIUM
100 (257) Fm FERMIUM
101 (258) Md MENDELEVIUM
102 (259) No NOBELIUM
103 (262) Lr LAWRENCIUM
(1) Pure Appl. Chem., 73, No. 4, 667-683 (2001)
Relative atomic mass is shown with five significant figures. For elements have no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.
However three such elements (Th, Pa, and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.
Editor: Aditya Vardhan (adivar@netlinx.com)
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The End