### 6.21 Alcohols and Phenols (Class 10)

#### Definition

An alcohol or phenol \( 1 \) has a substituent \(-\text{XH} \) (\( \text{X} = \text{O, S, Se, Te} \)) at a \( \text{C} \) or \( \text{Si} \) atom of a molecular-skeleton parent. In the following, the term alcohol is employed as a general expression for all chalcogeno replacement analogs \( 1 \) (\( \text{X} = \text{O, S, Se, Te} \)).

\[
\text{XH} \quad \text{R}^1\text{C}\text{R}^2\text{R}^3\text{R}^4 \quad \text{or} \quad \text{XH} \quad \text{R}^1\text{Si}\text{R}^2\text{R}^3\text{R}^4 \quad \text{or} \quad \text{aren} - \text{XH}
\]

\( \text{R}, \text{R}', \text{R}'' = \text{H, alkyl, aryl} \)

1 an alcohol or phenol (\( \text{X} = \text{O} \))
   - a thiol (\( \text{X} = \text{S} \))
   - a selenol (\( \text{X} = \text{Se} \))
   - a tellurol (\( \text{X} = \text{Te} \))

According to the degree of substitution, an alcohol is designated generally as:

- primary alcohol \( \text{RCH}_2\text{OH} \) (\( \text{R} \neq \text{H} \))
- secondary alcohol \( \text{RCH}('\text{R})\text{OH} \) (\( \text{R}, \text{R}' \neq \text{H} \))
- tertiary alcohol \( \text{RC}('\text{R})('\text{R})\text{OH} \) (\( \text{R}, \text{R}', \text{R}'' \neq \text{H} \))

#### Notice

- If possible, conjunctive nomenclature according to § 3.2.2 must be employed, see 11, 27, 28, 34, 40, 73, 75, 76, and 78 – 80.
- Hemiacetals \( \text{RC}('\text{R})('\text{R})\text{XH} \) (\( \text{X} = \text{O, S, Se, Te}; \text{R}'' \neq \text{H} \)) are designated as alcohols, see 41 and 42.
- Alcohols \( \text{R} - \text{X} \) are described in (c) of § 6.4.2.2 and ethers \( \text{R} - \text{X} - \text{R}' \) (\( \text{X} = \text{O, S, Se, Te} \)) in § 6.30 and 6.31.

Instructions are given for:

- (a) alcohols and phenols with the substituent \(-\text{XH} \) (\( \text{X} = \text{O, S, Se, Te} \)) at a \( \text{C} \) or \( \text{Si} \) atom: suffixes and substituent prefixes (exception: 'phenol'; trivial names 'ethylene glycol', 'glycerol', 'pentaerythritol', 'pinacol', 'cresol', 'carvacrol', 'thymol', 'pyrocatechol', 'resorcinol', 'hydroquinone', 'picric acid', 'naphthol', 'anthrol', 'phenanthrol');
- (b) nontraditional alcohols with the substituent \(-\text{HX} \) (\( \text{X} = \text{O, S, Se, Te} \)) at a heteroatom (\( \neq \text{Si} \)): substituent prefixes;
- (c) nontraditional esters with the substituent acyl–\(-\text{XH} \) (\( \text{X} = \text{O, S, Se, Te} \)) at a heteroatom (\( \neq \text{Si} \)): ester names;
- (d) ether substituents \( \text{R} - \text{X} - \text{R}' \) (\( \text{X} = \text{O, S, Se, Te} \); \( \text{R} = \text{alkyl, aryl, silyl} \)): substituent prefixes.

#### Instructions

**Alcohols and phenols**

The name of an alcohol or phenol \( \text{R} - \text{X} \) (\( \text{X} = \text{O, S, Se, Te}; \text{R} = \text{alkyl, aryl, silyl} \)), i.e., with \(-\text{XH} \) at a \( \text{C} \) or \( \text{Si} \) atom, consists of:

**parent name** of the molecular-skeleton parent \( \text{R} - \text{H} \), by § 4.2–4.10

+ **suffix**

  - 'ol' (–\( \text{OH} \))
  - 'thiol' (–\( \text{SH} \))
  - 'selenol' (–\( \text{SeH} \))
  - 'tellurol' (–\( \text{TeH} \))

If necessary, multiplying affixes are employed, e.g., ‘ethane-1,2-dio1’ (\( \text{HOCH}_2\text{CH}_2\text{OH} \)).

Aromatic alcohols **arene-\( \text{OH} \) and chalcogen analogs are also designated as alcohols, e.g., 16–26, except for 'phenol' (2) and its derivatives. Hemiacetals \( \text{RC}('\text{R})('\text{R})\text{OH} \) and chalcogen analogs are substituted alcohols, see 41 and 42.

The prefix for an alcohol substituent 

- **prefix**

  - 'hydroxy-' (–\( \text{HO} \))
  - 'mercapto-' (–\( \text{HS} \))
  - 'selenyl-' (–\( \text{HSe} \))
  - 'telluryl-' (–\( \text{HTe} \))

#### Exception (a)

\[
\begin{align*}
\text{H} & \quad \text{OH} \\
\text{C} & \quad \text{H}
\end{align*}
\]

2 'phenol'

\( \text{H} \) at \( \text{C} \) substitutable, but not by \( \text{Ph} \) (see ring assemblies, § 4.10); e.g., \( \text{Ph}-\text{CH}2\text{OH} \) is \([1,1'-\text{biphenyl}]-4-\text{ol} \).

IUPAC accepts for alcohols with \(-\text{XH} = \text{–OH} \) also functional-class nomenclature (§ 3.2.6), see 3–11 (for trivial substituent prefixes, see § 4.2 and 4.4–4.6).

The following trivial names are still accepted: 'ethylene glycol' (12), 'glycerol' (13), 'pentaerythritol' (14), 'pinacol' (15), 'cresol' (16), 'carvacrol' (17), 'thymol' (18), 'pyrocatechol' (19), 'resorcinol' (20), 'hydroquinone' (21), 'picric acid' (22), 'naphthol' (see 23), 'anthrol' (see 24), and 'phenanthrol' (see 25). However, since 1978, the **carbinol** nomenclature has no longer been accepted (IUPAC C-201.1; see 28), and the affixes 'thio-', 'seleno-', and 'telluro-' in connection with trivial names are no longer employed (IUPAC R-5.5.1.2, cf. C-511.2; see 26). Instead of the formerly recommended substituent prefixes 'mercapto-' (–\( \text{HS} \); C-511.1) and (–\( \text{hydroxyl} \))- (–\( \text{HSe} \); C-701), the prefixes 'sulfany1- (–\( \text{HS} \)). 'se1any1- (–\( \text{HSe} \)). and 'tellany1- (–\( \text{HTe} \)) are proposed (IUPAC R-5.5.1.2).

IUPAC derives the names of **a-aminocarboxylic acids**, e.g.,

- 'l-alanin1' (–\( \text{CH}2\text{CH}2\text{CH}2\text{NH}2\))
- 'l-glutamin1' (–\( \text{CH}2\text{CH}2\text{CH}2\text{NH}2\))

**Examples (a)**

Me –\( \text{OH} \)

3 'methanol'

IUPAC: also 'methyl alcohol'; substitutable
<table>
<thead>
<tr>
<th>Compound Name</th>
<th>IUPAC Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>Ethanol</td>
</tr>
<tr>
<td>1-propan-2-ol</td>
<td>1-propan-2-ol</td>
</tr>
<tr>
<td>2-methylpropan-2-ol</td>
<td>2-methylpropan-2-ol</td>
</tr>
<tr>
<td>Butan-2-ol</td>
<td>Butan-2-ol</td>
</tr>
<tr>
<td>2-methylpropan-1-ol</td>
<td>2-methylpropan-1-ol</td>
</tr>
<tr>
<td>Etheneol</td>
<td>Etheneol</td>
</tr>
<tr>
<td>Prop-2-en-1-ol</td>
<td>Prop-2-en-1-ol</td>
</tr>
<tr>
<td>Benzenemethanol</td>
<td>Benzenemethanol</td>
</tr>
<tr>
<td>Ethane-1,2-diol</td>
<td>Ethane-1,2-diol</td>
</tr>
<tr>
<td>Propane-1,2,3-triol</td>
<td>Propane-1,2,3-triol</td>
</tr>
<tr>
<td>2,2-bis(hydroxymethyl)propane-1,3-diol</td>
<td>2,2-bis(hydroxymethyl)propane-1,3-diol</td>
</tr>
<tr>
<td>2,3-dimethylbutane-2,3-diol</td>
<td>2,3-dimethylbutane-2,3-diol</td>
</tr>
<tr>
<td>4-methylphenol</td>
<td>4-methylphenol</td>
</tr>
<tr>
<td>2-methyl-5-(1-methylethyl)phenol</td>
<td>2-methyl-5-(1-methylethyl)phenol</td>
</tr>
<tr>
<td>5-methyl-2-(1-methylethyl)phenol</td>
<td>5-methyl-2-(1-methylethyl)phenol</td>
</tr>
<tr>
<td>Benzene-1,2-diol</td>
<td>Benzene-1,2-diol</td>
</tr>
<tr>
<td>Benzene-1,3-diol</td>
<td>Benzene-1,3-diol</td>
</tr>
<tr>
<td>Benzene-1,4-diol</td>
<td>Benzene-1,4-diol</td>
</tr>
<tr>
<td>2,4,6-trinitrophenol</td>
<td>2,4,6-trinitrophenol</td>
</tr>
<tr>
<td>Naphthalen-1-ol</td>
<td>Naphthalen-1-ol</td>
</tr>
</tbody>
</table>
24 'anthracen-9-ol'
   IUPAC: also 9-anthrol; substitutable

25 'phenanthren-2-ol'
   IUPAC: also 2-phenanthrol; substitutable

26 'benzenethiol'
   formerly 'thiophenol'

27 '2-hydroxybenzenemethanol'
   • conjunctive name
   • choice of the molecular-skeleton parent by (e) of § 3.3
   • trivially 'salicyl alcohol'

28 'α,α-diphenylbenzenemethanol'
   • conjunctive name
   • IUPAC: also 'trityl alcohol'; H at rings substitutable
   • not 'triphenylcarbinol'

29 [1,1′,4′,1″-terphenyl]-2′-ol'
   not '2,5-diphenylphenol'

30 'thiophene-2-ol'
   CA: 'thiophene-2-ol'; no elision of 'e' to avoid confusion with the formerly used trivial name 'thiophenol' (PhSH; 26)

31 'selenophene-3-ol'
   CA: 'selenophene-3-ol'; no elision of 'e' to avoid confusion with the formerly used trivial name 'selenophenol' (PhSeH); analogously for 'tellurophene-3-ol'

32 'pent-3-ene-2-thiol'

33 'butane-2-tellurol'

34 'benzenemethaneselenol'
   conjunctive name

35 '2,6,9-trioxa-12-thiapentadecan-4-ol'

36 'propane-1,1-diol'
   an aldehyde hydrate

37 'trisilan-2-ol'

38 '1-methylsilacyclobutan-1-ol'

39 '2,3-dimercaptopropan-1-ol'
   IUPAC: also '2,3-bis(sulfanyl)propan-1-ol'

40 '4-(2-mercaptoethyl)piperazine-1-ethanol'
   • conjunctive name
   • IUPAC: also '4-(2-sulfanyl)ethyl piperazine-1-ethanol'

41 '1-methoxypropan-1-ol'
   • a hemiacetal
   • IUPAC: also 'propanal methyl hemiacetal'

42 '1-(methylthio)propane-1-thiol'
   • a dithiohemiacetal
   • IUPAC: also '1-(methylsulfanyl)propane-1-thiol' or 'propanal methyl dithiohemiacetal'
43 '4-selenylbenzoic acid'
IUPAC: '4-selenylbenzoic acid'

44 '2-tellurylbenzonitrile'
IUPAC: '2-tellurylbenzonitrile

(b) Nontraditional alcohols
A substituent HX– (X = O, S, Se, Te) attached at a heteroatom different from an Si atom of a heterochain or heterocycle Y–H is treated as a nontraditional alcohol. Its name consists of:

- **Prefix**
  - 'hydroxy'-
  - 'mercapto'-
  - 'selenyl'-
  - 'telluryl'-

- **Parent name** of the heterochain or heterocycle Y–H, by § 4.3 or 4.5–4.10

The senior compound class (not necessarily an alcohol!) is then determined by possibly present other substituents, see 52 or 94. Note that HX– groups which are part of an acid function are not concerned (see acids of the Classes 5e–g, 5f, and 5k in Tab. 3.2, e.g., 'methanesulfonic acid' (Me–S(=O)2–OH), 'sulfuric acid' (HO–S(=O)2–OH), 'phosphonic acid' (HP(=O)(OH)3)), 'phosphinous acid' (H2P–OH)).

Nontraditional alcohols are also described in § 6.25–6.29 dealing with the N, P, As, Sb, Bi, B, Ge, Sn, and Pb compounds of the Classes 14–20 (see Tab. 3.2).

**Exceptions (b)**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2N–OH</td>
<td>'hydroxylamine'</td>
</tr>
<tr>
<td>H2N–SH</td>
<td>'thiohydroxylamine'</td>
</tr>
</tbody>
</table>

- Compound of Class 14 (§ 6.25): 45 is now a substitutive functional parent compound, i.e., a nontraditional alcohol; an O-aryl or O-alkyl derivative R–O–NH2 is denoted by a prefix (with locant 'O'); an O-acyl derivative Ac–O–NH2 is an azanyl ester (see (b) and (c) of § 6.14); an N-alkylidene derivative R=N–OH is an oxime (see § 6.19 and 6.20); an N-aryl or N-alkyl derivative R–NH–OH is an amine (see § 6.23); an N-acyl derivative Ac–NH–OH is an amide (see § 6.16); see § 6.25 for some derivatives of 45

<table>
<thead>
<tr>
<th>Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2N–SH</td>
<td>'thiohydroxylamine'</td>
</tr>
</tbody>
</table>

- Compound of Class 14 (§ 6.25): 46 is now a substitutive functional parent compound; see 45 for derivatives; however, an S-alkyl or S-aryl derivative R–S–NH2 is a sulfenamide (see § 6.16)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2N–SH</td>
<td>'thiohydroxylamine'</td>
</tr>
</tbody>
</table>

(c) Nontraditional esters
A substituent acyl–X– (X = O, S, Se, Te) attached at a heteroatom different from an Si atom of a heterochain or heterocycle Y–H is treated as a nontraditional ester acyl–X–Y according to (b) and (c) of § 6.14, similarly to a nontraditional alcohol (see (b)).

Nontraditional esters are also described in § 6.25–6.29 dealing with the N, P, As, Sb, Bi, B, Ge, Sn, and Pb compounds of the Classes 14–20 (see Tab. 3.2).
E.g.,

57 ‘acetic acid 2,2,6,6-tetramethylpiperidin-1-yl ester’/2,2,6,6-tetramethylpiperidin-1-yl acetate’ ester; see ester definition in (b) and (c) of § 6.14, i.e., ester of a common acid and a nontraditional alcohol

58 ‘cyclopentanecarboxylic acid 1,1’-(1,1,3,3-tetramethyldistannathiane-1,3-diy) ester’/‘1,1’-(1,1,3,3-tetramethyldistannathiane-1,3-diy) bis[cyclopentanecarboxylate]’ ester; see ester definition in (b) and (c) of § 6.14, i.e., ester of an exotic acid and a nontraditional alcohol

(d) Ether-substituent prefixes

The prefix of a substituent R–X– (X = O, S, Se, Te; R = alkyl, aryl, silyl) is a composite prefix and built according to § 5.8 (cf. (c); see § 6.30 and 6.31). Note that the trivial names ‘methoxy’ (MeO–), ‘ethoxy’ (EtO–), ‘propoxy’ (MeCH₂CH₂O–), ‘butoxy’ (MeCH₂CH₂CH₂O–), and ‘phenoxy’ (PhO–) are used.

Additional Examples

59 ‘but-2-en-1-ol’  • by (a)  • formerly trivially ‘crotyl alcohol’

60 ‘(2E)-3,7-dimethylocta-2,6-dien-1-ol’  • by (a)  • ‘(2E)’ by § A.6.3  • trivially ‘geraniol’

61 ‘(2E,7R,11R)-3,7,11,15-tetramethylhexadec-2-en-1-ol’  • by (a)  • ‘(2E,7R,11R)’ by § A.6.3  • trivially ‘phytol’

62 ‘(1R,2S,5R)-5-methyl-2-(1-methylethyl)cyclohexanol’  • by (a)  • ‘(1R,2S,5R)’ by § A.6.3  • trivially ‘(1R)-menthol’

63 ‘1,7,7-trimethylbicyclo[2.2.1]heptan-2-ol’  • by (a)  • trivially ‘borneol’

64 ‘[1,1’-biphenyl]-2-ol’  • by (a)  • not ‘2-phenylphenol’

65 ‘1,1,1,3,4,4,4-heptafluorobutane-2,2-diol’  • by (a)  • a ketone hydrate

66 ‘1,4-dimercaptobutane-2,3-diol’  • by (a)

67 ‘4-[3-hydroxypropyl]telluro]butan-1-ol’  • by (a)  • C₄ chain > C₃ chain

68 ‘2-(hydroxymethyl)butane-1,2,3,4-tetrol’  • by (a)

69 ‘benzene-1,2,3-triol’  • by (a)  • formerly trivially ‘pyrogallol’

70 ‘benzene-1,3,5-triol’  • by (a)  • formerly trivially ‘phloroglucinol’ or ‘phloroglucin’

71 ‘benzene-1,2,3,4,5,6-hexol’  • by (a)

72 ‘2,4,6-trinitrobenzene-1,3-diol’  • by (a)  • formerly trivially ‘styphnic acid’

73 ‘benzeneethanol’  • by (a)  • conjunctive name  • IUPAC: also ‘phenethyl alcohol’, only H at ring substitutable
6 Compound classes

74 '3-phenylprop-2-en-1-ol'
   - by (a)
   - a conjunctive name is not possible because of the unsaturation in the chain
   - IUPAC: also 'cinnamyl alcohol'; only H at ring substitutable; not 'cinnamic alcohol'

75 'α-phenylbenzenemethanol'
   - by (a)
   - conjunctive name
   - IUPAC: also 'benzhydryl alcohol'; only H at rings substitutable; trivially 'benzhydrol'

76 'α-ethenylcyclohexanepropanol'
   - by (a)
   - conjunctive name

77 '1-(3-hydroxyprop-1-yn-1-yl)cyclohexanol'
   - by (a)
   - a conjunctive name is not possible because of the unsaturation in the chain

78 '5-hydroxy-6-methylpyridine-3,4-dimethanol'
   - by (a)
   - conjunctive name
   - trivially 'pyridoxine' or 'pyridoxol', a 'vitamin B₆'

79 'α-cyclohexyl-1,3,5-trioxane-2-methanol'
   - by (a)
   - conjunctive name
   - heterocycle > carbocycle

80 '4-(2-hydroxyphenyl)-α-pyridin-3-ylpiperazine-1-ethanol'
   - by (a)
   - conjunctive name

81 '1,3,3-triethoxydisiloxane-1,1,3-triol'
   - by (a)

82 'disilane-1,1,1,2,2,2-hexaselenol'
   - by (a)

83 '3-methyl-3-silabicyclo[3.2.1]octan-3-ol'
   - by (a)

84 '2,2-dihydroxy-1H-indene-1,3(2H)-dione'
   - by (a)
   - indicated H atom by (h) of §A.5, 'added' indicated H atom by (i) of §A.5
   - trivially 'ninhydrin'

85 '2-hydroxybenzoic acid'
   - by (a)
   - trivially 'salicylic acid'

86 '2-mercaptobenzoic acid'
   - by (a)
   - trivially 'thiosalicylic acid'

87 '2-hydroxy-1,1-dimethylhydrazine'
   - by (b)

88 '1,1ʹ-[1,1ʹ-biphenyl]-4,4ʹ-diylbis[3-hydroxy-3-phenyltriazl-1-ene]'
   - by (b)
   - multiplicative name

89 '1-(1,1-dimethylethyl)-2-fluoro-2-mercapto-1-phenyl-diphosphine 2-sulfide'
   - by (b)
   - additive name (=S at P III); cf. (d) of § 6.20

90 'hydroxytrimethylplumbane'
   - by (b)

91 '1,1,1,3,3-pentachloro-3-hydroxydigermoxane'
   - by (b)
92 \(\text{acetic acid} \ 1,1,3,3\text{-tetrabutyl}-3\text{-hydroxydistannoxan}-1\text{-yl ester}^{\cdot}/1,1,3,3\text{-tetrabutyl}-3\text{-hydroxydistannoxan}-1\text{-yl acetate}\)
- by (c)
  - ester; see ester definition in (b) and (c) of §6.14, i.e., ester of a common acid and a nontraditional alcohol

93 '2-hydroxy-2-azabicyclo[2.2.1]heptane'
(b)

94 '1-hydroxy-1\text{-H}-benzotriazol-4-ol'
- by (b)
  - indicated H atom by (a) and (d) of §A.5

95 '1-hydroxy-1\text{-H}-pyrazole 2-oxide'
- by (b)
  - additive name (=O at N\(^\text{III}\)), cf. (d) of §6.20
  - indicated H atom by (a) and (d) of §A.5

96 '4-hydroxythiomorpholine 1,1-dioxide'
- by (b)
  - additive name (=O at S\(^\text{II}\)), cf. (d) of §6.20

97 '2-hydroxy-1,3,2-dioxaborinane'
(b)

98 '2,2\text{-oxo}b[4\text{-hydroxy-1,3,2,4-dioxadiboretane}]
- by (b)
  - multiplicative name

99 '5,5\text{-dimethyl-2-selenyl-1,3,2-dioxaphosphorinane 2-oxide}'
- by (b)
  - additive name (=O at P\(^\text{III}\)), cf. (d) of §6.20

100 'acetic acid 2-hydroxy-1,2-diphenylhydrazinyl ester'/
  '2-hydroxy-1,2-diphenylhydrazinyl acetate'
- by (c)
  - ester; see ester definition in (b) and (c) of §6.14, i.e., ester of a common acid and a nontraditional alcohol