### Chemicals Commonly Used in Biochemistry and Molecular Biology and Their Properties

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Chemical Name</th>
<th>M.W.</th>
<th>Properties and Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACES</td>
<td>2-[2-amino-2-oxyethyl]amino]ethanesulfonic Acid</td>
<td>182.20</td>
<td>One of the several “Good” buffers.</td>
</tr>
</tbody>
</table>

**ACES, 2-[(2-amino-2-oxyethyl)amino]ethanesulfonic acid**


**Acetaldehyde**


**Acetic Acid**


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**Acetic Anhydride**

\[
\begin{align*}
H_2C & \quad O \\
O & \quad CH_3 \\
O & \quad C \quad O
\end{align*}
\]

Acetic anhydride


**Acetone**

\[
\begin{align*}
H_2C & \quad O \\
O & \quad CH_3
\end{align*}
\]

Acetone


**Acetonitrile**

![Acetonitrile structure](image)


**Acetyl Chloride**

![Acetyl chloride structure](image)


**Acetylcysteine**

![Acetylcysteine structure](image)

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*N*-Acetylimidazole

![N-acetylimidazole](image)


**Acetylsalicylic Acid**

![Acetylsalicylic Acid](image)


**Acrylamide**

2-propenamide 71.08 Monomer unit of polyacrylamide in gels, hydrogels, hard polymers; environmental carcinogen; fluorescence quencher.

- Acrylamide
- Methacrylic acid
- Acrylic acid
- N-isopropylacrylamide
- Methacrylamide


**Gamma (γ)-aminobutyric Acid (GABA)**

4-aminobutanoic acid 103.12 Neurotransmitter.

- Gamma-aminobutyric acid

Amiloride

3,5-diamino-N-(aminoiminomethyl)-6-chloropyrazine-carboxamide

229.63 Sodium ion channel blocker.


2-Aminopyridine

α-aminopyridine 94.12 Precursor for synthesis of pharmaceuticals and reagents; used to derivatize carbohydrates for analysis; blocker of K⁺ channels.


Ammonium Bicarbonate

Acid Ammonium Carbonate

79.06 Volatile buffer salt.

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**ANS**

1-anilino-8-naphthalenesulfonate, ANS

| 1-anilino-8-naphthalenesulfonate | 299.4 | Fluorescent probe for protein conformation; considered a hydrophobic probe; study of molten globules. |


**Arachidonic Acid**

COOH

5,8,11,14(all cis)-eicosatetraenoic Acid

COOH

Arachidonic acid

Essential fatty acid; precursor of prostaglandins, thromboxanes, and leukotrienes.

Ascorbic Acid


Benzaldehyde

Benzamidine HCl

\[ \text{Benzamidine} \]

156.61 Inhibitor of tryptic-like serine proteases.


**Benzene**

\[ \text{Benzene} \]

78.11 Solvent; a xenobiotic.


**Benzidine**

\[ \text{p-benzidine} \]

184.24 Precursor for azo dyes; mutagenic agent; forensic analysis for bloodstains based on reactivity with hemoglobin.


**Biotin**


**Biuret**

![Biuret](image)

Imidodicarbonic acid 103.08 Prepared by heating urea, reaction with cupric ions in base yields red-purple (the biuret reaction); nonprotein nitrogen (NPN) nutritional source.


**Blue Tetrazolium**

Tetrazolium Blue 727.65 Stain for cytotoxicity based on change to formazan on reduction. See nitro blue tetrazolium, which has similar chemistry and higher use.

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Boric Acid

\[ \text{Boric acid} \quad \overset{\text{B(OH)}_3 + 2\text{H}_2\text{O}}{\rightleftharpoons} \text{B(OH)}_4^- + \text{H}_3\text{O}^+ \]


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**Bromoacetic Acid**

p-Bromophenacyl Bromide

2-bromo-1-(4-bromophenyl)ethanone; 4-bromophenacyl Bromide

Modification of various residues in proteins: reagent for identification of carboxylic acids; phospholipase A2 inhibitor.


Bromophenol Blue

Bromophenol Blue

669.97 pH indicator; conformational probe for proteins; histochemical staining for basic proteins; some use as a vital stain.


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Barratt, J.O., Thrombin and calcium chloride in relation to coagulation, *Biochem. J.* 9, 511–543, 1915; Van der Meer, C.,

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Molecular Weight (g/mol)</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cacodylic Acid</td>
<td>138.10</td>
<td>Buffer salt in neutral pH range; largely replaced because of toxicity.</td>
</tr>
<tr>
<td>Dimethylarsinic acid</td>
<td>110.98</td>
<td>Anhydrous form as drying agent for organic solvents, variety of manufacturing uses; meat quality enhancement; therapeutic use in electrolyte replacement and bone cements; source of calcium ions for biological assays.</td>
</tr>
</tbody>
</table>

**Cacodylic Acid**

\[ \text{Cacodylic acid} = \text{H}_3\text{C} \rightarrow \text{As} \rightarrow \text{O} \rightarrow \text{CH}_3 \]

**Dimethylarsinic acid**


**Cetyl Pyridinium Chloride**


**CHAPS**

Chloroform  
Trichloromethane  
177.38  
Used for extraction of lipids, usually in combination with methanol.

Cholesterol  
386.66  
The most common sterol in man and other higher animals. Cholesterol is essential for the synthesis of a variety of compounds including estrogens and vitamin D; also membrane component.

Cholic Acid  
408.57  
Component of bile; detergent.


**Citraconic Anhydride**  
Methylmaleic Anhydride  
Citraconic acid


**Congo Red**  
CI Direct Red 28;  
Sodium Diphenyldiazobis-naphthalaminesulfonate

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**Coomassie Brilliant Blue G-250**

Most often used for the colorimetric determination of protein.


**Coomassie Brilliant Blue R-250**

Most often used for the detection of proteins on solid matrices such as polyacrylamide gels.

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Coomassie Brilliant Blue RL

Cl Acid Blue 92; 695.6

Anazolene

Sodium

Cy2

Fluorescent label used in proteomics and gene expression; use for internal standard.

Cy 3

Fluorescent label used in proteomics and gene expression; in combination with Cy 5 is used for FRET-based assays.


Cy 5

Fluorescent label used in proteomics and gene expression; also used in histochemistry.

Cyanine Dye (See glossary) Cy 2, Cy 3, and Cy 5 are cyanine dye derivatives.

α-Cyano-4-hydroxycinnamic Acid

4-HCCA; Cinnamate 189.2 Used as matrix substance for MALDI; transport inhibitor and enzyme inhibitor.

Alpha-cyano-4-hydroxycinnamic acid

Cyanogen

C₂N₂; Ethanedinitrile 53.03 Protein crosslinking at salt bridges.


Cyanogen Bromide

CNBr; Bromide 105.9 Protein modification; cleavage of peptide bonds; coupled nucleophiles to polyhydroxyl matrices; environmental toxicon derived from monobromamine and cyanide.


**Cyanuric Chloride**

2,4,6-trichloro-1,3,5-triazine

Coupling of carbohydrates to proteins; more recently for coupling of nucleic acid to microarray platforms.


**1,2-Cyclohexylenedinitrilotetraacetic Acid**

Chelating agent suggested to have specificity for manganese ions; weaker for other metal ions such as ferric.


**Dansyl Chloride**

5-(dimethylamino)-1-naphthalene-sulfonyl Chloride

Fluorescent label for proteins; amino acid analysis.


Dicyclohexylcarbodiimide (DCC) activates carboxyl groups to react with hydroxyl groups to form esters and with amines to form an amide bond; used to modify ion-transporting ATPases. Lack of water solubility has presented challenges.

Deoxycholic Acid

Acid

Desoxycholic

Detergent, nanoparticles.

Deuterium Oxide

“Heavy Water” structural studies in proteins, enzyme kinetics; in vivo studies of metabolic flux.


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DFP

**Phenylmethylsulfonyl fluoride (PMSF)**
M.W. 174.2

**3, 4-dichlorocoumarin**

**4-(2-aminoethyl) benzenesulfonyl fluoride**
Pefabloc SC; M.W.

**Diisopropylphosphorofluoridate (DFP)**

Diisopropylphosphorofluoridate; Isofluorophate 184.15 Classic cholinesterase inhibitor; inhibitor of serine proteases, some nonspecific reaction tyrosine.


**Dichloromethane**

**Methylene Chloride**

**Carbon tetrachloride**

**Chloroform**

**Dichloromethane**

Methylene Chloride 84.9 Lipid solvent; isolation of sterols, frequently used in combination with methanol.

**Diethyldithiocarbamate**

Diethyldithiocarbamate, sodium dithiocarb


**Diethylpyrocarbonate (DEPC)**

Diethylpyrocarbonate (DEPC) Ethoxyformic Anhydride 162.1 Reagent for modification of proteins and DNA; used as a sterilizing agent; RNAse inhibitor for RNA purification; preservative for wine and fruit fluids.

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**Dimedone**

5,5-dimethyl-1,3-cyclohexanedione 140.18 Originally described as reagent for assay of aldehydes; used as a specific modifier of sulfenic acid.


**Dimethylformamide (DMF)**

73.09 Solvent.

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**Dimethyl Suberimidate (DMS)**

Crosslinking agent.

Dimethyl Sulfate

126.1 Methylating agent; methylation of nucleic acids; used for a process called footprinting to identify sites of protein–nucleic acid interaction.


Dioxane

1,4-diethylene Dioxide

1,4-Dioxane


---

**Dithiothreitol**

Dithiothreitol/Dithioerythritol

**Dithioerythritol**

Dithiothreitol; DTT; Cleland’s Reducing agent; three-2,3-dihydroxy-1,4-dithiolebutane

---

**Dimethylsulfoxide**

Dimethylsulfoxide 78.13 Solvent; suggested therapeutic use; effect on cellular function; cyroprotective.

---


EDC

1-ethyl-(3-dimethylamino propyl)-carbodiimide; 
N-(3-dimethylamino propyl)-N′-ethyl-carbodiimide

191.7 Water-soluble carbodiimide for the modification of carboxyl groups in proteins; zero-length crosslinking proteins; activation of carboxyl groups for amidation reactions, as for the coupling of amino-nucleotides to matrices for DNA microarrays.


EDTA

292.24 Chelating agent; some metal ion-EDTA complexes (i.e., Fe<sup>2+</sup>-EDTA) function as chemical nucleases.

**Ellman’s Reagent**

5,5′-dithio-bis-[2-nitro-benzoic] Acid

Reagent for determination of sulfydryl groups/ disulfide bonds.


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Ethanolamine


**Ethanol**


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**Ethylene Glycol**

1,2-ethanediol 62.07 Solvent/cosolvent; increases viscosity (visogenic osmolyte); perturbant; cryopreservative.


**Ethyleneimine**

Aziridine 43.07 Modification of sulfhydryl groups to produce amine functions; alkylating agent; reacts with carboxyl groups at acid pH; monomer unit for polyethylene amine, a versatile polymer.

**Ethylene oxide**

[H, C, O]

**Oxirane**

44.05

Sterilizing agent; starting material for ethylene glycol and other products such as nonionic surfactants.

Chemicals Commonly Used in Biochemistry and Molecular Biology and Their Properties

N-Ethylmaleimide

1-ethyl-1H-pyrrole-2,5-dione

Modification of sulfhydryl groups; basic building block for a number of reagents. Mechanism different from alkylating agent in that reaction involves a Michael addition.


Fluorescein

Fluorescent dye that can be combined with a reactive function group such as fluorescein isothiocyanate (FITC); used for fluorescent angiography with emphasis on ophthalmology.


Formaldehyde

Methanal 30.03

Tissue fixation; protein modification; zero-length crosslinking; protein–nucleic acid interactions.

Formaldehyde and higher polymers

“Paraformaldehyde”

### Formic Acid

| Methanoic Acid | 46.03 | Solvent; buffer component. |

![Chemical Structure of Formic Acid](image)


### Glutaraldehyde

| Pentanedia 100.12 | Protein modification; tissue fixation; sterilization agent approved by regulatory agencies; use with albumin as surgical sealant. | Protein modification; tissue fixation; sterilization agent approved by regulatory agencies; use with albumin as surgical sealant. | Pentanedia 100.12 | Protein modification; tissue fixation; sterilization agent approved by regulatory agencies; use with albumin as surgical sealant. |

![Chemical Structure of Glutaraldehyde](image)

**Glutathione**

\[
\text{γ-GluCysGly} \quad 307.32
\]

Reducing agent; intermediate in phase II detoxification of xenobiotics.


**Glycine**

\[
\text{Aminoacidic Acid} \quad 75.07
\]

Buffer component; protein-precipitating agent, excipient for pharmaceutical formulation.

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HEPES 4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid


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Hydrazine  \( \text{N}_2\text{H}_4 \) 32.05 Reducing agent; modification of aldehydes and carbohydrates; hydrazinolysis used for release of carbohydrates from protein; derivatives such as dinitrophenylhydrazine used for analysis of carbonyl groups in oxidized proteins; detection of acetyl and formyl groups in proteins.


Hydrogen Peroxide  \( \text{H}_2\text{O}_2 \) 34.02 Oxidizing agent; bacteriocidal agent.

Hydroxylamine  \( \text{H}_3\text{NO} \) 33.03

8-Hydroxyquinoline  8-quinolinol 145.16 Metal chelator.

Imidazole  1,3-diazole 69.08 Buffer component.

Indole  2,3-benzopyrrole 117.15
Indole-3-acetic Acid


Iodoacetamide


### 2-Iminothiolane

Traut’s Reagent
(earlier as methyl-4-mercaptobutyrimidate)

Introduction of sulfydryl group by modification of amino group; sulfydryl groups could then be oxidized to form cystine, which served as cleavable protein crosslink.


### Isatoic Anhydride

![Isatoic anhydride](image)

| 3,1-benzoxazine-2,4(1H)-dione | 163.13 Fluorescent reagents for amines and sulfhydryl groups; amine scavenger. |


### Isoamyl Alcohol

![Isoamyl alcohol](image)

Isopentyl Alcohol; 3-methyl-1-butanol

| Solvent. |

### Isopropanol

![Isopropyl alcohol](image)

| 2-propanol | 60.10 Solvent; precipitation agent for purification of plasmid DNA; reagent in stability test for identification of abnormal hemoglobins. |

**Isopropyl-β-D-thiogalactoside**

Maleic Anhydride

2,5-furandione 98.06

Modification of amino groups in proteins. The dimethyl derivative (dimethylmaleic anhydride) is used for ribosome dissociation; monomer for polymer.


2-Mercaptoethanol

\[ \beta-mercaptoethanol \] 78.13

Reducing agent; used frequently in the reduction and alkylation of proteins for structural analysis and for preservation of oxidation-sensitive enzymes.

Chemicals Commonly Used in Biochemistry and Molecular Biology and Their Properties


(3-Mercaptopropyl)trimethoxysilane


**MES**

1- Morpholineethanesulfonic Acid; 2- (4-morpholino) Ethane Sulfonate


**Methanesulfonic Acid**

96.11 Protein hydrolysis for amino acid analysis; deprotection during peptide synthesis; hydrolysis of protein substituents such as fatty acids.

![Methanesulfonic acid](image)

Methylsulfonic acid

methanesulfonic acid


**Methanol**

Methyl Alcohol 32.04 Solvent.

**Methylethyl Ketone (MEK)**

2-butanol; 2-butaneone 72.11 Solvent; with acid for cleavage of heme moiety of hemeproteins for preparation of apoproteins.

Methylglyoxal

Methylmethane-thiosulfonate (MMTS)

Methyl Methane-thiosulfonate

S-methyl Methanethiosulfonate

N^6-carboxymethyllysine

N^6-carboxymethyllysine

Methylglyoxal

Pyruvaldehyde; 2-oxopropanal

72.06

Derived from oxidative modification of triose phosphate during glucose metabolism; model for glycation of proteins; reacts with amino groups in proteins and nucleic acids; involved in advanced glycation endproducts.


Methyl Methane-thiosulfonate (MMTS)

S-methyl Methanethiosulfonate

126.2

Modification of sulfydryl groups.

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N-Methylpyrrolidone

![N-Methylpyrrolidone](image)

1-methyl-2-pyrrolidone 99.13 Polar solvent; transdermal transport of drugs.

Chemicals Commonly Used in Biochemistry and Molecular Biology and Their Properties

MOPS

\[
\text{H}_2\text{C} \quad \text{N} \quad \text{C}_2 \quad \text{O}^- \\
\text{H}_2\text{C} \quad \text{CH}_3 \quad \text{O}
\]

Betaine
1-Carboxy-\(N, N, N\)-trimethylamino inner salt

\[
\text{H}_2\text{C} \quad \text{N} \quad \text{C}_2 \quad \text{O}^- \\
\text{H}_2\text{C} \quad \text{CH}_3 \quad \text{O}
\]

3-(1-Pyridino)-1-[propanesulfonate]

MOPS
3-(\(N\)-morpholino)propanesulfonate


NBS

\[
\text{H}_2\text{N} \quad \text{O} \quad \text{Br} \\
\text{H}_2\text{N} \quad \text{O} \quad \text{Br}
\]

Tryptophan

\[
\text{H}_2\text{N} \quad \text{O} \quad \text{Br} \\
\text{H}_2\text{N} \quad \text{O} \quad \text{Br}
\]

Oxindole derivative

\[
\text{H}_2\text{N} \quad \text{O} \quad \text{Br} \\
\text{H}_2\text{N} \quad \text{O} \quad \text{Br}
\]

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Neutral Red

![Neutral Red](image)


NHS

![NHS](image)

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**Ninhydrin**


**Ninhydrin**

1-H-indene-1,2,3-trione Monohydrate

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Biochemistry and Molecular Biology Compendium

**Nitric Acid**

HNO₃ 63.01 Strong acid.

**p-Nitroaniline (PNA)**

4-nitroaniline 138.13 Signal from cleavage of chromogenic substrate.

**2-Nitrobenzylsulfenyl Chloride**

o-nitrophenyl-sulfenyl Chloride 189.6 Modification of tryptophan in proteins.


**p-Nitrophenol**

4-nitrophenol 139.11 Popular signal from indicator enzymes such as alkaline phosphatase.
Nitro Tetrazolium Blue  

NBI, Nitro BT  

817.7  

Cytotoxicity determination based on intracellular reduction to formazan.


*n*-Octanol

1-octanol; Caprylic Alcohol  

130.23  

Partitioning between octanol and water is used to determine lipophilicity; a factor in QSAR studies.

1-Octanoic acid

Octoxynol

\[
\text{O} \quad \text{(CH}_2\text{CH}_2\text{O})_n\text{H}
\]

Triton X-100™; Igepal CA-630™

Nonionic detergent; surfactant.

Octoxynol, n = 5–15

Peroxynitrite

Petroleum Ether

Mixture of Pentanes and Hexanes

N/A

Perchloric Acid

\[
\text{HClO}_4
\]

100.5

Oxidizing agent.

1,10-Phenanthroline Monohydrate

\[
\text{o-phenanthroline}
\]

Hydrate

198.21

Chelating agent; inhibitor for metalloproteinases; use in design of synthetic nucleases and proteases.


Phenol

Hydroxylbenzene; 94.11 Solvent; nucleic acid purification.

Phenylhydrazine

Phenoxyethanol 138.16 Biochemical preservative; preservative in personal care products.


Phenol

Hydroxybenzene; 94.11 Solvent; nucleic acid purification.

Phenylhydrazine

Phenoxyethanol 138.16 Biochemical preservative; preservative in personal care products.

**Phenylglyoxal**

Phenylglyoxal 134.13 Modification of arginine residues.


**Phosgene**

Carbonyl 98.92 Reagent for organic synthesis; preparation of derivatives for analysis.


**Picric Acid**


**Polysorbate**


**Polysorbate**


Pyridine

![Pyridine structure](image)

Azine 79.10 Solvent.


Pyridoxal-5-phosphate (PLP)

![Pyridoxal-5-phosphate structure](image)

Pyridoxal-5-phosphate (dihydrogen phosphate) 247.14 Selective modification of amino groups in proteins; affinity label for certain sites based on phosphate group.
Chemicals Commonly Used in Biochemistry and Molecular Biology and Their Properties 311


Sodium Borohydride NaBH₄ 37.83 Reducing agent for Schiff bases; reduction of aldehydes; other chemical reductions.

Sodium Chloride
Salt; NaCl 58.44 Ionic strength; physiological saline.

Sodium Cholate
430.55 Detergent.


Sodium Cyanoborohydride
NaBH₃ (CN) 62.84 Reducing agent; considered more selective than NaBH₄.


Sodium Deoxycholate
Desoxycholic Acid, Sodium Salt 414.55 Detergent; potential therapeutic use with adipose tissue.

Chemicals Commonly Used in Biochemistry and Molecular Biology and Their Properties


**Sodium Dodecylsulfate**


**Sodium Metabisulfite**

Sodium Bisulfite 190.1 Mild reducing agent; converts unmethylated cytosine residues to uracil residues (DNA methylation).


**Succinic Anhydride**

Butanedioic Anhydride; 2,5-diketotetrahydrofuran


**Sucrose**

342.30 Osmolyte; density gradient centrifugation.


**Sulfuric Acid**

H$_2$SO$_4$ 98.1 Strong acid; component of piranha solution with hydrogen peroxide.

**TES**

H$_2$C

\[
\text{S} \quad \text{O} \quad \text{OH} \quad \text{NH}_2 \quad \text{HO}
\]

TRIS

N-Tris(hydroxymethyl) Methyl-2-aminoethane-sulfonic Acid

229.3 A “Good” buffer.


Tetrabutylammonium Chloride 277.9 Ion-pair reagent for extraction and HPLC.

Tetrahydrofuran Trimethylene Oxide 72.1 Solvent; template for combinatorial chemistry.

**Tetraphenylphosphonium Bromide**

419.3 Membrane-permeable probe; determination of metal ions.


**Thioflavin T**

Basic Yellow 1, CI 49005 Dye for measurement of amyloid in tissue.


**Thionyl Chloride**


**Thiophosgene**

Thiourea (thiocarbamide) is a chaotropic agent; useful for membrane proteins; will react with haloacetyl derivatives such as iodoacetamide; protease inhibitor.

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**TNBS**

Trinitrobenzenesulfonic Acid

293.2

Reagent for the determination of amino groups in proteins; also reacts with sulfhydryl groups and hydrazides; used to induce animal model of colitis.

**TNM**

Tetranitromethane 196.03

Modification of tyrosine residues in proteins; crosslinking a side reaction as a reaction with cysteine; antibacterial and antiviral agent.


**Triethanolamine**

\[
\text{Triethanolamine hydrochloride} \quad \text{pKₐ approx. 9.5}
\]

**Tris(2-hydroxyethyl) Amine**

\[
\text{Tris(2-hydroxyethyl) Amine} \quad 149.2 \quad \text{Buffer; transdermal transfer reagent.}
\]

**Triethylamine**

\[
N,N-\text{diethylethanamine} \quad 101.2 \quad \text{ion-pair reagent; buffer.}
\]

**Trifluoroacetic Acid**

\[
\text{Trifluoroacetic Acid} \quad 114.0 \quad \text{ion-pair reagent; HPLC; peptide synthesis.}
\]


**Tris**

(B-hydroxymethyl)aminomethane

**Triethanolamine**

**Triethanolamine hydrochloride**

**Triethylamine**


**Tris-(2-carboxyethyl) phosphate**

![Tris-(2-carboxyethyl) phosphate](image)

Chemicals Commonly Used in Biochemistry and Molecular Biology and Their Properties

Vinylic Pyridine

Urea

Carbamide

Hydrogen Oxide

Water

Hydrogen Oxide

Solvent