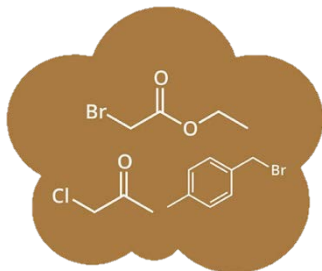




Chemical Agent Word Bank: VX / Tear Gases / Chlorine / Phosgene & Diphosgene / Mustard Gas / Tabun / Sarin / Soman / Cyclosarin / VG

Instructions: Identify the chemical agent by common name which can be found in the word bank above. You may use the timeline depicting the agents' first synthesized date or first use date on this side as well as the agents' descriptions on the backside to assist you. ANSWER KEY <http://bit.ly/ChemAgents>

1914

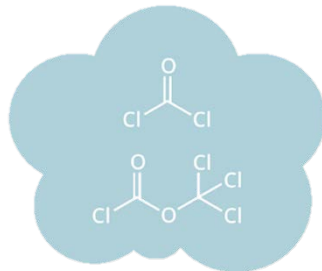


(ethyl bromoacetate, chloroacetone & xylol bromide)

1915

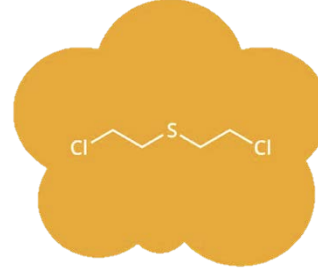


1915



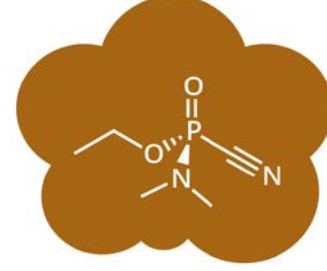
(carbonyl dichloride & trichloromethane chloroformate)

1917



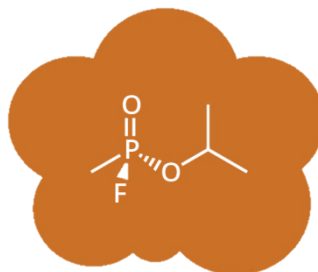
(bis(2-chloroethyl) sulfide)

1936



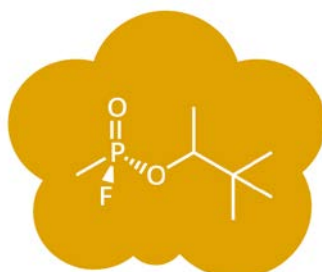
(ethyl dimethylphosphoramidocyanidate)

1938



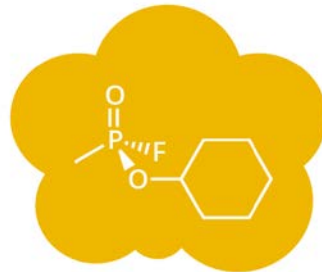
(isopropyl methylphosphonofluoridate)

1944



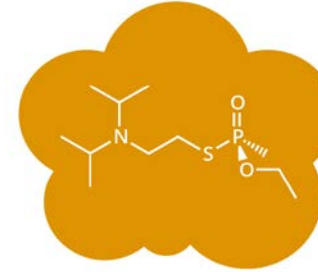
(3,3-dimethylbutan-2-yl methylphosphonofluoridate)

1949



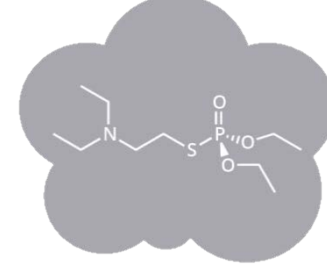
(cyclohexyl methylphosphonofluoridate)

1952



(O-Ethyl-S-[2(diisopropylamino)ethyl] methylphosphonothioate)

1954



O,O-Diethyl-S-[2-(diethylamino)ethyl] phosphorothioate



Chemical Agent Word Bank: VX / Tear Gases / Chlorine / Phosgene & Diphosgene / Mustard Gas / Tabun / Sarin / Soman / Cyclosarin / VG

Instructions: Use the descriptions below that include historical facts, smell, appearance, effects, and lethality to complete the blanks on the reverse side.

Tabun was discovered accidentally by German Chemist Gebhardt Shrader while investigating organophosphates as pesticides. It may have a faint fruity odor due to impurities. Median lethal concentration is 400 milligram-minutes per cubic meter and median lethal dose is 4000 mg per person for skin exposure.

Tear Gases are colorless to light yellow with fruity pungent odors and were first used to incapacitate rather than kill opposing armies in WWI by French Forces. The effects caused irritation of mucous membranes in the eyes, mouth, throat, and lungs leading to crying, coughing, and temporary blindness.

Phosgene is a colorless gas with a musty odor similar to newly mowed grass and **Diphosgene** is a colorless odorless oily liquid. **Phosgene & Diphosgene** were first used in WWI by German Forces at Ypres. These chemical agents caused coughing, breathing difficulty, and irritation to throat and eyes with delayed effects up to 48 hours, including fluid in the lungs and death. It is estimated that 85% of all gas related fatalities in WWI resulted from these chemical agents which were used to fill artillery shells.

VG is a nerve agent that was synthesized in the United Kingdom and was originally sold as an insecticide under the name "Amitron" until human toxicity became apparent. The effects of nerve agents like this one are not pleasant as they inhibit breakdown of acetylcholine, cause excessive mucus, tears, saliva and sweat. In addition, nerve agents like this one cause nausea, gastrointestinal pain, vomiting, chest tightness, spasms, convulsions, loss of bowel control, coma, and eventual death.

Chlorine gas is a yellow-green gas with a strong bleach like odor and was described by soldiers as a distinct mix of pepper and pineapple. It was used first by German Forces in Ypres in WWI and then later by British Forces in Loos. It is estimated that over 1,100 lost their lives due to the use of chlorine gas in Ypres. When chlorine reacts with water in the lungs, it forms hydrochloric acid. At low concentrations it causes irritations and rapid death at 1000 parts per million.

Sarin a nerve gas was synthesized in before WWII by a team of scientists: Schrader, Ambros, Ritter & Van der Linde. It is clear, colorless liquid in its pure form as well as a volatile liquid. Median lethal concentration is 100 milligram-minutes per cubic meter and median lethal dose is 1700 mg per person for skin exposure.

Soman is a nerve agent that is a clear colorless and tasteless liquid with a faint odor when pure, but when impure has a yellow brown color with a strong camphorous odor. It was first synthesized during WWII by German Forces while researching the pharmacology of other nerve agents that were synthesized in the years prior. It has a median lethal concentration is 70 milligram-minutes per cubic meter and a median lethal dose of 300 mg per person for skin exposure.

Mustard Gas is a colorless /odorless gas when pure and when impure it is yellow-brown in color with an odor resembling garlic or horseradish. It was first used during WWI by German Forces against the British at Ypres. This chemical agent is a powerful irritant and vesicant (blistering agent) that can cause damage to the eyes, skin, and respiratory tract. It eventually forms intermediates that react with DNA leading to cell death. It is estimated that the mortality rate for this chemical agent was low around 3% but the effects were debilitating and patients required elaborate care.

VX is a colorless liquid when pure and when impure it is amber colored and odorless. It was first synthesized in the United Kingdom after WWII and was traded to the US in exchange for information on building a thermonuclear device. The production of this nerve agent was banned in the US in 1969 and production and stockpiling was outlawed worldwide in 1993. Median lethal concentration is 15 milligram-minutes per cubic meter and median lethal dose is 10 mg per person for skin exposure and due to its low volatility the primary method of exposure is often through skin contact rather than inhalation.

Cyclosarin is a colorless liquid with a sweet musty smell likened to peaches. It was synthesized after WWII by German scientists. Median lethal concentration is 50 milligram-minutes per cubic meter and median lethal dose is 350 mg per person for skin exposure.