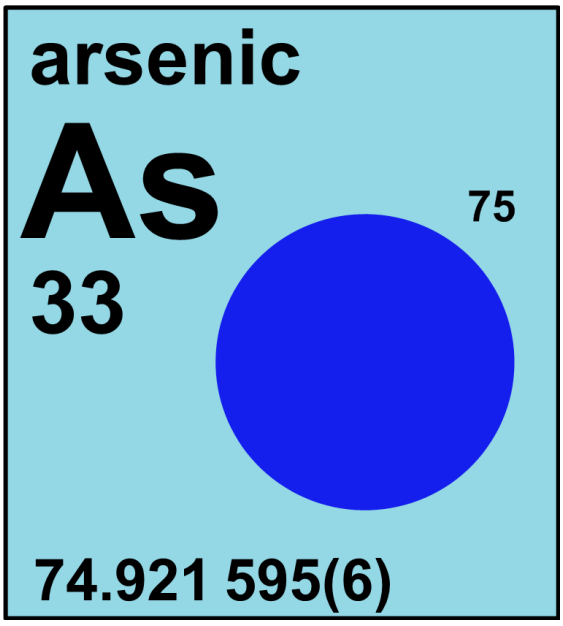
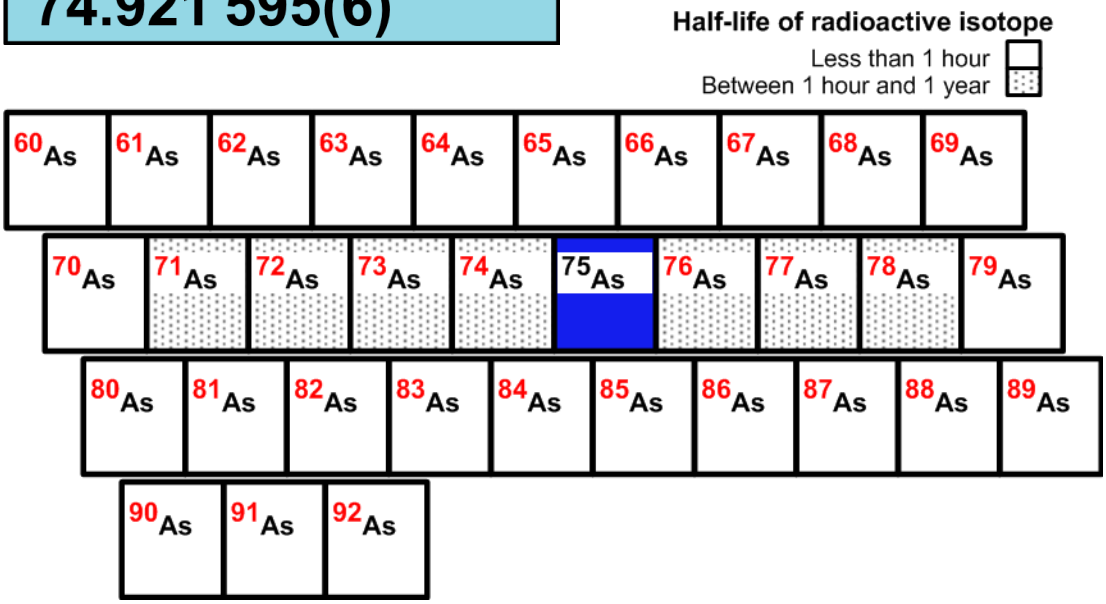
4.33 arsenic



Stable isotope	Relative atomic mass	Mole fraction
^{75}As	74.921 595	1



4.33.1 Arsenic isotopes in biology

^{73}As and ^{76}As (with **half-lives** of 80.3 days and 1.1 days, respectively) are important radioactive **tracers** used in environmental and biomedical studies to quantify arsenic uptake [267]. ^{74}As (with a half-life of 17.8 days) has been used to investigate the biotransformation (modification of a chemical compound by an organism) of arsenate by mammals. In one study rabbits were injected with ^{74}As-labeled arsenate. After a given amount of time, blood and blood products were sampled and tested for the presence and quantity of labeled arsenate metabolites [267]. Inhalation of dust or smoke containing ^{74}As is thought to be a causal agent of lung cancer. In one study [268], the "absorption rate from the bronchial tree (a respiratory tract, which conducts air

into the lungs) was rapid for the first several days and then tapered off slowly. In three patients an average of 45 percent of the inhaled arsenic was eliminated in the urine in 10 days and ~0.5 percent in the stools. The remainder must be assumed to have been deposited in the body, exhaled, and/or eliminated in body secretions and excreta over a long period of time." See Figure 4.33.1.

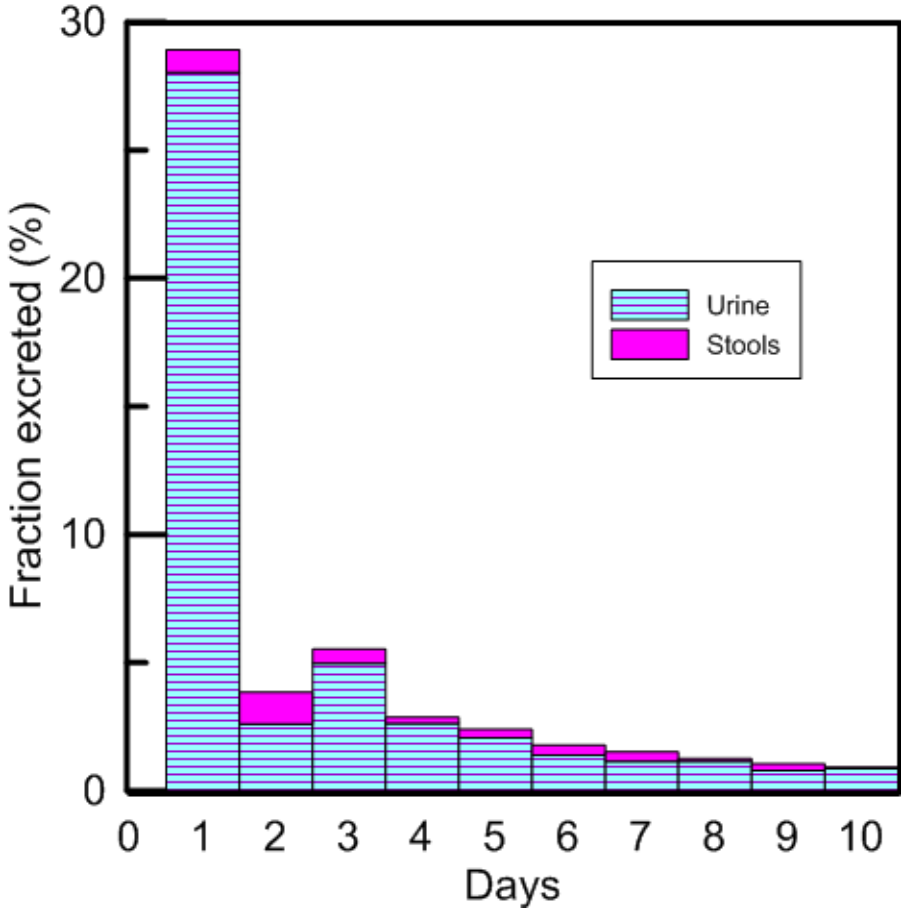


Fig. 4.33.1: Combined urine and fecal elimination of inhaled ^{74}As over a 10-day period. The ratio of urine to fecal elimination was approximately 30 to 1 (modified from [268]).

4.33.2 Arsenic isotopes in medicine

^{72}As (with a half-life of 26 hours) and ^{74}As are useful in molecular imaging because they are **radioactive isotopes** that emit **positrons** that can be designed to bind to **monoclonal antibodies** (moAb), which accumulate in tumors and then ^{72}As- or ^{74}As-labeled **ligands** will bind to the moAbs. Once the ^{72}As- or ^{74}As-labeled ligand binds to the moAb, **positron emission tomography** (**PET**) is used to visualize the exact location of the tumor [269]. A specific example of using **radiolabeled** antibodies for better imaging of tumors is the combination of ^{74}As with bavituximab, which is an antibody that binds strongly to unique lipids on the surface of tumors. When a **thiol** group is introduced to bavituximab, arsenic is able to bind **covalently**,

creating a simple and elegant radio-label for targeting cancerous tumors [266].