

Test your knowledge of the elements and elemental chemistry!

1. Which is the only letter in the alphabet not to appear in the Periodic Table?
J
2. What is the only element that will not form a solid?
Helium
3. Only two elements are liquids at room temperature and pressure. What are they? Name a third that melts in your hand!
Bromine and mercury are liquids. Gallium melts at 29.8° C.
4. What is the rarest naturally-occurring element in the earth's crust?
Astatine – it is estimated that there is only 28g of it in the earth's crust.
5. The Frank Gehry-designed Guggenheim Museum in Bilbao, Spain is sheathed in 33,000 square meters of what pure element?
Titanium – a metal chosen for its beauty, longevity, and corrosion resistance. The SR-71 “Blackbird” surveillance plane that holds many speed records is also made of titanium.
6. How does a vending machine distinguish between American and Canadian coins (in either country)?
Only three elements are ferromagnetic at room temperature – iron, nickel, and cobalt. No current American coins are magnetic – even the nickel coin contains only 25% nickel, the rest is copper. In contrast, Canadian dimes, quarters, and one and two dollar coins contain mostly nickel and are attracted to a magnet
7. What element is a potential nuclear fuel and almost as plentiful as lead?
Thorium. The thorium fuel cycle claims several potential advantages over a uranium fuel cycle, including thorium's greater abundance, superior physical and nuclear properties, enhanced proliferation resistance, and reduced plutonium and actinide production.
8. In preindustrial times, what was the major source of elemental phosphorus?
While today phosphorus is extracted from ore, with 90% of phosphate rock going towards fertilizer for food production, in preindustrial times it was extracted from human urine. The body is 1.1% phosphorus by mass. Since phosphate is a non-renewable resource, it is worth knowing that in 2000 the global population excreted 3 million tons of phosphorus in urine.

9. The Washington monument (completed in 1884) is capped by 2.84 kg of a precious metal. What metal is it?
The tip was the largest single piece of aluminum cast at the time, when aluminum commanded a price comparable to that of silver. Two years later, the Hall-Héroult process made aluminum easier to produce and the price of aluminum plummeted, making the once-valuable tip nearly worthless, though it still provides a lustrous, non-rusting tip that served as the original lightning rod
10. When archaeologists want to determine if a campsite may have been used by the Lewis and Clark expedition, for what element do they test in the soil?
Lewis and Clark carried mercury laxatives with them on their famous trek, and today archaeologists test the soil for mercury contamination to help identify their campsites.
11. What percentage of U.S. patents are chemistry or chemistry-related?
One in five or 20% of U.S. patents are chemistry or chemistry-related.
12. The first synthesis of an organic molecule from inorganic material marked the beginning of the modern era of organic chemistry. Name the chemist, the product, the starting material, and the year.
Friedrich Wöhler synthesized urea from ammonium cyanate in 1828.
13. Rome's Dio Padre Misericordioso Church, also known as the Jubilee Church, retains its bright white color because of nanostructured titanium dioxide (TiO_2) embedded within the cement binder in the concrete walls. What is the chemistry behind this application?
Ultraviolet light excites the polymorphic anatase form of TiO_2 so that it becomes a catalyst for photooxidizing organic grime. The same photocatalytic chemistry also cleans the air around it, degrading pollutants such as NO_x , SO_x , carbon monoxide, aromatics, ammonia, and aldehydes.
14. Bonus question: During what months is the ozone hole over Antarctica largest, and why?
September and October. The destruction of ozone in the stratosphere by chlorofluorocarbons (CFCs) is a photo-initiated, catalytic process with rates enhanced by certain ice surfaces. In southern hemisphere winter, a vortex of winds isolates the polar stratosphere and reduces the temperature below -78°C , allowing ice clouds of water, nitric acid, and sulfuric acid mixtures to form. Heterogeneous reactions on these ice crystals quickly form chlorine gas, regenerating the precursor to the catalytic ozone destroyer much faster than gas phase reactions. By the end of winter, chlorine gas concentrations have risen to a substantial level, yet it remains inactive without sunlight. Once southern hemisphere spring arrives, photolysis releases chlorine radicals that rapidly destroy ozone in the isolated vortex. The overall ozone depletion can reach 50% across the total column of air and 90% at certain

altitudes. Late spring brings a breakdown of the vortex, loss of the ice clouds, and less ozone depletion.