Answers to
END-OF-CHAPTER QUESTIONS

# CHAPTER 1: Portable Electronics: The Periodic Table in the Palm of Your Hand

**Emphasizing Essentials**

 **1. Answer:**

**a.** Compound (2 molecules of one compound made up of two different elements).

**b.** Mixture (2 atoms of one element plus 2 atoms of another).

**c.** Mixture (3 different substances, two elements and one compound).

**d.** Element (4 atoms of the same element).

**2. Answer:**

**a.** element (4 molecules of one diatomic element)

**b.** Compound (2 molecules of one compound made up of two different elements).

**c.** Mixture (2 atoms of one element plus 2 atoms of another).

**d.** Compound (4 molecules of one compound made up of two different elements).

**3. Answer:** Exact answer will vary depending on viewing size of text. An approximate measurement for the period could be 0.25 mm. Converting this to nanometers: or 250,000 nm.

**4. Answer:**

Converting 10.0 nanometers to millimeters:

**5. Answer:**

**a.** 1.5 × 103 m

**b.** 9.58 × 10–11 m

**c.** 7.5 × 10–6 m

**6.** **Answer:** , , .

**7. Answer:**

**a.** Group 1 and Group 17

**b.** 1A: lithium, sodium, potassium, rubidium, cesium, francium

7A: fluorine, chlorine, bromine, iodine, astatine

**c.** 1A: All but hydrogen (a nonmetal) are reactive metals.

 7A: All but astatine (a metalloid) are reactive nonmetals.

8. **Answer:**

**a.**



**b.** iron, Fe; magnesium, Mg; aluminum, Al; sodium, Na; potassium, K; silver, Ag.

**c.**



**d**. sulfur, S; oxygen, O, carbon, C, chlorine, Cl, fluorine, F (and others).

**9. Answer:**

**a.** compound **b.** compound **c.** mixture

**d.** element **e.** mixture **f**. element

**10.** **Answer:**

**a.** heterogenous mixture **b.** heterogenous mixture **c.** heterogenous mixture
**d.** homogenous mixture **e.** heterogenous mixture

**11.** **Answer:**

Grey spheres: electrons

Black spheres: protons

White spheres: neutrons

**12.** **Answer:** There are several allotropes of sulfur. The most stable and common allotrope consists of 8 atoms in a ring. Other common allotropes include rings of 5, 6, 7, 10 and larger number of atoms. Most allotropes are yellow solids, although they can be found in liquid or gaseous forms at appropriate temperatures. Most of these allotropes are created by heating sulfur of the 8-membered ring form.

**13. Answer:**

An aluminum atom with mass number 27 has 13 protons, 14 neutrons, and 13 electrons.

**14. Answer:**

A copper atom with a mass number 64 has 29 protons, 35 neutrons, and 29 electrons.

**15. Answer:**

Electrical conductivity is the transport of electrons from one location to another. Thermal conductivity is the transfer of heat from one location to another. Their difference is in what is being transferred.

**16.** **Answer:**

**17.** **Answer:**

**a.** 1 carbon atom (nonmetal), 2 oxygen atoms (nonmetals)

**b.** 2 hydrogen atoms (nonmetals), 1 sulfur atom (nonmetal)

**c.** 1 nitrogen atom (nonmetal), 2 oxygen atoms (nonmetals)

**d.** 1 silicon atom (metalloid), 2 oxygen atoms (nonmetals)

**Concentrating on Concepts**

**18. Answer:**

A variety of answers are possible. An example of an illustration of 9N purity is the time span of 1 second compared to 31.7 years. A similar example with 12 N purity is 1 second compared to 31,700 years. A volume-related example of 9N purity would be like taking 1 liter of water out of 400 Olympic-sized swimming pools full of water!

**19. Answer:**

**20**. **Answer:** Answers will vary, depending on year selected. As of 2019, the latest technology node is 5 nm, which features a gate length of around 10 nm (https://en.wikichip.org/wiki/5\_nm\_lithography\_process).

This is equivalent to .

**21. Answer:**

The periodic table allowed gaps for unknown elements. The elements were placed into gaps based on their atomic weight and number of protons.

**22. Answer:**

Thttp://www.australianminesatlas.gov.au/education/fact\_sheets/aluminium.html

**23. Answer:**

 Regular glass is also amorphous & is composed primarily of silicon and oxygen atoms with additives of sodium and calcium oxides. A comprehensive website that quantitatively compares the physical and optical properties of typical soda-lime glass, Gorilla glass, and quartz is found at: <http://abrisatechnologies.com/specs/AT%20Specialty%20Glass%20Technical%20Capabilities%20Brochure.pdf>

**24. Answer:**

**25. Answer:**

**26. Answer:**

**27. Answer:**
 They are found in ores, minerals, and compounds.

**28. Answer:**

A transparent material allows light to travel through it without refracting. Having a transparent screen keeps the light produced from distorting when you look at it. Additives can give solids like glass a different color or other properties like strength. Heat treatment can also add durability.

**29. Answer:**Gold prospectors can use panning to separate gold flakes from other solids. This involves taking the mixture and agitating it in water. This separates out the gold because it stays in the bottom of the pan and other substances float in the water and can be poured out.

**30. Answer:**

**31. Answer:**

**32. Answer:**

**33. Answer:**

**Exploring Extensions**

**34.** **Answer:**

**35. Answer:**
The colors of many gemstones come from impurities in the crystal structure. For example, the purple color of amethyst comes from Fe3+ ions in a SiO2 crystal, and the red color of rubies comes from Cr3+ in an Al2O3 crystal.

**36. Answer:**

Impurities break up the crystal structure of crystalline solids and, since properties of materials are in part dependent on structure, this will change the material properties. Throughout this chapter, we have seen impurities that change properties such as color, transparency, melting point, and electrical conductivity.

**37**. **Answer:** A thin layer of material is sandwiched between two pieces of glass. When an electrical current is passed through the glass, the material will line up according to the direction of the current, similar the liquid crystal display (LCD) of common calculators.

**38. Answer:**

Devices can be physically pulled apart to reveal the components containing the metals. Plastic parts such as circuit boards are either dissolved in solvent or burned to isolate the metallic components. These metals themselves may be either melted or dissolved in acids and then filtered and reconstituted to generate purer forms of the metal for other uses. A recent report describes the use of fungi to extract precious metals from electronic waste, a potentially more environmentally friendly way of recycling.

**39. Answer:** Apple has removed mercury and arsenic from screens and lead from solder in their electronics.

**40. Answer:**

The two largest destinations for electronic waste in the world are in New Dehli, India, and Guiyu, China. Studies have shown air, water, and soil pollution from electronics recycling around Guiyu leading to poisoning from heavy metals such as lead and organic pollutants such as dioxins. To prevent these situations, new methods of recycling need to be developed with greater safety awareness for workers, tighter controls on emissions from recycling centers, and redesign of the electronic devices to reduce toxic components.

**41. Answer:** Old electronic devices could be disassembled and either parts could be reused as is or could be mechanically or chemically separated into raw materials to be used for manufacturing new devices.

**42. Answer:**



The H2 and SiCl4 gases are recycled through reaction to generate chlorosilanes that are used to purify the Si in earlier steps. However, CO is released, which is further oxidized to CO2, a greenhouse gas.

**43. Answer:**

Answers will vary as there are many ways to strengthen glass. This may include heating the glass or adding different elements into the structure.

**44. Answer:**

There were 46.89 million iPhones sold in 2018. 25% of this is 11.72 million. An iPhone 8 has a mass of 202 grams. 24% of the mass of an iPhone is Al, so one phone has 48.48 grams. This multiplied by 11.72 million iPhones is kg. Copper is 6% of the mass of an iPhone, which is 12.12 grams per iPhone. This multiplied by 11.72 million iPhones is kg. Cobalt is 5% of the mass of an iPhone, which is 10.1 grams per iPhone. This multiplied by 11.72 million iPhones is kg. Each iPhone contains 300 mg of silver, multiplied by 11.72 million is 3516 kg of silver. Each iPhone contains 30 mg of gold, multiplied by 11.72 million is 351.6 kg. At current pricing, this yields:

Al: $1,949,376, Cu: $862,224, Co: $4,062,740, Ag: $1,913,196, Au: $16,598,779=$25,386,315.

**45. Answer:**
4

**46. Answer:**
Some considerations include toxicity of materials used in the device, availability of raw materials, amount of energy required by the device, and number of uses for the device and disposable components (such as batteries).

**47. Answer:**

**48. Answer:**