

7.E: Solids, Liquids, and Phase Changes (Exercises)

Properties of Liquids

1. What is the difference between evaporation and boiling?
2. What is the difference between a gas and vapor?
3. Define *normal boiling point* in terms of vapor pressure.
4. Is the boiling point higher or lower at higher environmental pressures? Explain your answer.
5. Referring to Fig. 10.4.3, if the pressure is 400 torr, which liquid boils at the lowest temperature?
6. Referring to Fig. 10.4.3, if the pressure is 100 torr, which liquid boils at the lowest temperature?
7. Referring to Fig. 10.4.3, estimate the boiling point of ethanol at 200 torr.
8. Referring to Fig. 10.4.3, at approximately what pressure is the boiling point of water 40°C?
9. Explain how surface tension works.
10. From what you know of intermolecular forces, which substance do you think might have a higher surface tension—ethyl alcohol or mercury? Why?
11. Under what conditions would a liquid demonstrate a capillary rise?
12. Under what conditions would a liquid demonstrate a capillary depression?

Answers

1. Evaporation occurs when a liquid becomes a gas at temperatures below that liquid's boiling point, whereas boiling is the conversion of a liquid to a gas at the liquid's boiling point.
- 2.
3. the temperature at which the vapor pressure of a liquid is 760 torr
- 4.
5. diethyl ether
- 6.
7. 48°C
- 8.
9. Surface tension is an imbalance of attractive forces between liquid molecules at the surface of a liquid.
- 10.
11. Adhesion must be greater than cohesion.

Solids

1. What is the difference between a crystalline solid and an amorphous solid?
2. What two properties do solids have in common? What two properties of solids can vary?
3. Explain how the bonding in an ionic solid explains some of the properties of these solids.
4. Explain how the bonding in a molecular solid explains some of the properties of these solids.
5. Explain how the bonding in a covalent network solid explains some of the properties of these solids.
6. Explain how the bonding in a metallic solid explains some of the properties of these solids.
7. Which type(s) of solid has/have high melting points?
8. Which type(s) of solid conduct(s) electricity in their solid state? In their liquid state?
9. Which type of solid(s) is/are considered relatively soft?
10. Which type of solid(s) is/are considered very hard?
11. Predict the type of solid exhibited by each substance.
 - a. Hg
 - b. PH₃
 - c. CaF₂
12. Predict the type of solid exhibited by each substance.

- a. $(\text{CH}_2)_n$ (polyethylene, a form of plastic)
 - b. PCl_3
 - c. NH_4Cl
13. Predict the type of solid exhibited by each substance.
- a. SO_3
 - b. Br_2
 - c. Na_2SO_3
14. Predict the type of solid exhibited by each substance.
- a. BN (boron nitride, a diamond-like compound)
 - b. B_2O_3
 - c. NaBF_4
15. Predict the type of solid exhibited by each substance.
- a. H_2S
 - b. Si
 - c. CsF
16. Predict the type of solid exhibited by each substance.
- a. Co
 - b. CO
 - c. CaCO_3

Answers

- 1. At the atomic level, a crystalline solid has a regular arrangement of atoms, whereas an amorphous solid has a random arrangement of atoms.
- 2.
- 3. The oppositely charged ions are very strongly held together, so ionic crystals have high melting points. Ionic crystals are also brittle because any distortion of the crystal moves same-charged ions closer to each other, so they repel.
- 4.
- 5. The covalent network solid is essentially one molecule, making it very hard and giving it a very high melting point.
- 6.
- 7. ionic solids, covalent network solids
- 8.
- 9. molecular solids
- 10.
- 11.
 - a. metallic
 - b. molecular solid
 - c. ionic crystal
- 12.
- 13.
 - a. molecular solid
 - b. molecular solid
 - c. ionic crystal
- 14.
- 15.
 - a. molecular solid
 - b. molecular solid
 - c. ionic crystal

7.4 Temperature

1. Perform the following conversions.

255°F to degrees Celsius

−255°F to degrees Celsius

50.0°C to degrees Fahrenheit

−50.0°C to degrees Fahrenheit

2. Perform the following conversions.

1,065°C to degrees Fahrenheit

−222°C to degrees Fahrenheit

400.0°F to degrees Celsius

200.0°F to degrees Celsius

3. Perform the following conversions.

100.0°C to kelvins

−100.0°C to kelvins

100 K to degrees Celsius

300 K to degrees Celsius

4. Perform the following conversions.

1,000.0 K to degrees Celsius

50.0 K to degrees Celsius

37.0°C to kelvins

−37.0°C to kelvins

Convert 0 K to degrees Celsius. What is the significance of the temperature in degrees Celsius?

Convert 0 K to degrees Fahrenheit. What is the significance of the temperature in degrees Fahrenheit?

5. The hottest temperature ever recorded on the surface of the earth was 136°F in Libya in 1922. What is the temperature in degrees Celsius and in kelvins?

6. The coldest temperature ever recorded on the surface of the earth was −128.6°F in Vostok, Antarctica, in 1983. What is the temperature in

degrees Celsius and in kelvins?

Answers

1. 124°C

2. −159°C

3. 122°F

4. −58°F

5.

6. 1. 373 K

2. 173 K

3. −173°C

4. 27°C

7.

8. −273°C. This is the lowest possible temperature in

degrees

Celsius.

9.

10. 57.8°C; 331 K

11.

7.5 - 7.6 Energy and Heat Capacities.

Note: you will need to consult a table of heat capacities, [such as the one included here](#), in order to solve many of these problems.

0. A pot of water is set on a hot burner of a stove. What is the direction of heat flow?
 1. Some uncooked macaroni is added to a pot of boiling water. What is the direction of heat flow?
 2. How much energy in joules is required to heat 150. g of H₂O from 0.0°C to 100.0°C?
 3. How much energy in joules is required to heat 125 g of Fe from 25.0°C to 150.0°C?
 4. If 250 cal of heat were added to 43.8 g of Al at 22.5°C, what is the final temperature of the aluminum?
 5. If 195 cal of heat were added to 33.2 g of Hg at 56.2°C, what is the final temperature of the mercury?
 6. A sample of copper absorbs 607 J of energy, and its temperature rises from 37.8°C to 41.7°C. What is the mass of the copper?
 7. A large, nugget of gold absorbs 410. J of heat. If its temperature rises from 22.0°C to 29.7°C, what is the mass of the gold nugget?
 8. If 1.00 g of each substance in [this Table](#) were to absorb 100 cal of heat, which substance would experience the largest temperature change?
 9. If 1.00 g of each substance in [this Table](#) were to absorb 100 cal of heat, which substance would experience the smallest temperature change?
 10. Determine the heat capacity of a substance if 23.6 g of the substance gives off 199 cal of heat when its temperature changes from 37.9°C to 20.9°C.
 11. What is the heat capacity of gold if a 250 g sample needs 133 cal of energy to increase its temperature from 23.0°C to 40.1°C?
- *Note: For the next two questions, you will need a table of heat of fusion (melting) or vaporization, [which you can find here](#).
12. What quantity of heat is required to melt 2.00 kg of iron at its melting point (1809 K)? For iron, $\Delta H_{\text{fus}} = 13.80 \text{ kJ/mol}$.
13. What mass of water would need to evaporate from your skin in order to dissipate $1.70 \times 10^5 \text{ J}$ of heat from the surface of your body?



Answers

1. Heat flows into the pot of water.
2. 62700 J
3. 7020 J
4. 49.1 °C
5. 231.7 °C
6. 404 g
- 7.
8. Lead and Gold would have the highest temperature change
- 9.
- 10.
- 11.
12. 494 kJ
13. 75.2 g

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