Unit VIII Answers

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1. The solid will keep its shape and volume. The liquid will keep its volume but change shape to match the container. The gas will change in both volume and shape to fill the entire container.

2. Surface tension is the result of attractive (vanderWaals) forces between molecules. At the surface there are no molecules above to attract so there is an inward force that pulls the molecules together and minimizes the surface area of the liquid.

3. Doubling the Kelvin temperature doubles the energy of the molecules.

4. The gas in boiling water is water – water vapor.

5. Melting point and freezing point – they are the same temperature.

6. In both processes high energy molecules leave the liquid and go into the gas phase, leaving behind cooler (lower energy) molecules.

7. Frost forming on a cold night.

8. In both liquids and solids the molecules are very close together – almost touching.

9. Put a liquid like water out on a surface and notice that after a period of time the water is "gone".

10. Put a liquid in a container and heat it until bubbles start forming throughout the liquid. The temperature when this happens is the boiling point.

11. No, turning up the "heat" will only make the water boil faster, the temperature will not increase.

12. When the high energy water vapor makes contact with the cool coils energy is transferred from the water vapor to the cool coils. As the water vapor looses energy the vanderWaals forces are able to bring the water molecules closer together, forming a liquid.

13. The water will give some of its energy to the surroundings allowing the vanderWaals forces to have a greater attractive effect. When the temperature reaches 0° C the vanderWaals forces will be able to overcome the kinetic energy to cause the molecules to lock into relatively fixed positions – the water freezes. When all of the water is solid the temperature will go lower than 0°C and the molecules that are still vibrating will vibrate more slowly.

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1. Sodium chloride has strong ionic forces – attractions between oppositely charged particles- between small ions.

2. Dipole-dipole forces are forces that exist between the positive and negative regions of polar molecules.

3. Hydrogen bonding, a special kind of dipole-dipole force that is between hydrogen of one polar molecule and the electronegative element of another polar molecule, is the most significant attractive force between water molecules. It is unusually strong providing for things like high melting and boiling points, higher surface tension, and higher enthalpy of vaporization and fusion.

4. Because of the shape of the water molecule the ice crystal has an open structure (empty space between groups of 6 molecules) that causes the same amount of water to have a greater volume when it is ice.

5. These elements have a high electronegativity causing very polar bonds with hydrogen.

6. London dispersion forces result from temporary dipoles formed in electron orbitals. The more electrons an atom has the more likely that it is able to rearrange the position of the electrons to form a temporary dipole.

7. Substances with stronger intermolecular forces are more likely to be a solid at room temperature because more kinetic energy is required to overcome these attractive forces.

8. a) CF_4 b) CH_2F_2 has a higher boiling point because polar molecules have more attractive forces requiring greater kinetic energy (temperature) to pull the molecules apart.

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1. The amount of energy required to melt one mole of a substance at its melting point.

2. The amount of energy required to vaporize (change to a gas) one mole of a liquid at its boiling point.

3. The entropy of vaporization is much larger. The randomness difference between gases and liquids is much greater than between liquids and solids.

4. ΔG is positive, so $\Delta H > T\Delta S$

5. The liquid and gas states are at equilibrium at 77K.

6. a) boiling point decrease as pressure decreases. b) the melting point is affected very little by pressure differences.

7. 266 K 8. 332 K 9. 233 K

Pg 405

1. There are three types of contents. Above the liquid will be a gas or vapor phase will have water molecules with larger energy, very far apart and small vanderWaals forces. The liquid phase extending to the bottom of the glass will have molecules of moderate energy, held close together by the vanderWaals forces, able to slide past each other so that it takes the shape of the glass. The solid floating at or near the top of the liquid will have low energy, the molecules will only be vibrating around fixed positions being held by vanderWaals forces and maintaining the original shape.

2. The temperature where the solid and liquid phases are in equilibrium.

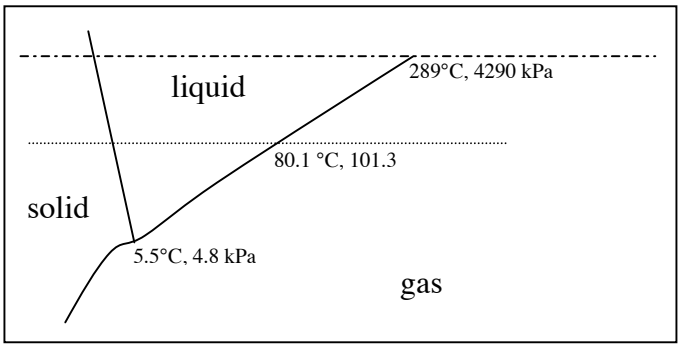
3. The temperature where the vapor pressure of the liquid is equal to the atmospheric pressure.

4. A substance that is at a temperature greater than its critical temperature and pressure.

5. The solid carbon dioxide turns to gaseous carbon dioxide, it sublimes.

6. The volume decreases until just before 0.61 kPa of pressure when deposition takes place and ice forms. At very high pressures the ice will melt to form a liquid.

7. a)



b) liquid c) vapor d) changes from solid to liquid e) changes from liquid to gas

8. The ether takes energy from your hand and evaporates. Because it took energy from your hand, your skin is cooler.

9. The alcohol evaporates easily at human body temperature. When it evaporates the high energy molecules leave the surface, the lower energy (lower temperature) molecules remain behind. The remaining molecules take energy from the skin. The process repeats to reduce the temperature of the skin.

10. a) water boils at about 65°C. b) 0.0°C

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1. solid, liquid or gas

5. The forces are London forces. A combination of gravitational forces and temporary or induced dipoles.

6. Dipole-dipole forces are more general – any attraction between polar molecules. Hydrogen bonds are a specific form of dipole-dipole forces where at least one of the atoms in the polar molecule is hydrogen.

8. The boiling point is the temperature where the vapor pressure is equal to the atmospheric pressure.

9. The triple point of a substance is where (temperature and pressure) all three phases; solid, liquid and gas; are at equilibrium.

10. Solid particles are held close together and vibrate around fixed positions. Liquid particles are held close together but have enough energy to move past each other. Gas particles are very far apart and move with very little to no attractive influences from other particles.

11. Surface tension is the force that acts on the surface of a liquid and tends to minimize the area of the surface. Because of surface tension liquids tend to form a shape with the lowest possible surface area which is a sphere.

12. The water does not wet the Teflon surface because the water molecules are not attracted to Teflon. The water forms spherical drops because of surface tension to reduce the surface area.

13. For a pure substance the melting point and freezing point are the same temperature.

14. Up to 100 °C the water is gaining random kinetic energy and some of the water at the surface will have enough energy to evaporate. At 100 °C the water will boil, changing phase to a gas until all of the water liquid is gone. From 100 °C to 155 °C the water gas will continue to gain more random kinetic energy.

15. Your example 16. Your example

17. Ionic substances experience attraction because of unlike electrical charges. In polar substances there is an uneven charge distribution causing an attraction that is not as strong as in the ionic substances because the charge differences are less.

18. In dipole-dipole force3s the positive portion of one molecule attracts the negative portion of a different molecule.

19. The difference in electronegativity of hydrogen and the bent shape of the water molecule cause water to be a polar substance.

20. The melting point of calcium chloride is considerably higher because the charges on the calcium ion are larger than those on the sodium ion.

21. Yes, but compared with ionic forces London dispersion forces are almost not noticible.

24. Water and hydrogen peroxide form hydrogen bonds with each other.

25. Because of the bent shape of the water molecule and the hydrogen bonding the 6 sided crystal structure of ice has an open space that causes the volume of the ice to be greater than the volume of the liquid water.

26. Rubidium chloride has very strong ionic forces while hydrogen chloride has only week dipole-dipole forces.

27. Carbon tetrabromide has many more electrons in the molecule so the London dispersion forces between the molecules are stonger.

44. It is possible for particles to sublime if particles at the surface gain enough kinetic energy to escape the attractive forces. This is the case for moth balls (naphthalene) and ice for two examples.

45. The vapor pressure increases until the critical pressure is reached.

46. a) point A b) point C c) point D d) Point B

47. The lines in the phase diagram show the temperatures at which two phases are in equilibrium. solid-liquid, liquid-gas or solid-gas.

83. a) states b) liquids c) gases d) equilibrium
e) vapor pressure f) melting point g) boiling point