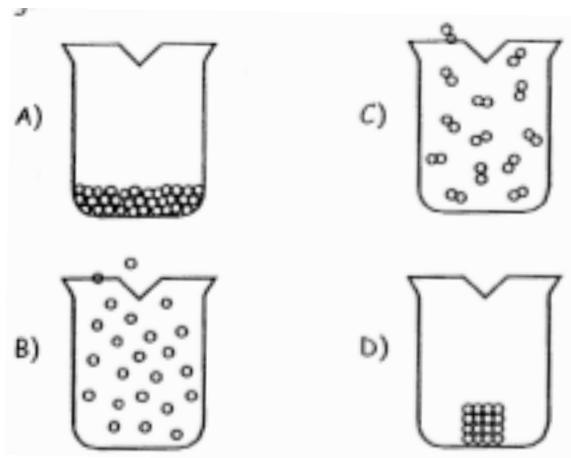


Name _____
 Topic 5 Review - Physical Behavior of Matter

_____ 1. Which particle *best* represents a diatomic gas?



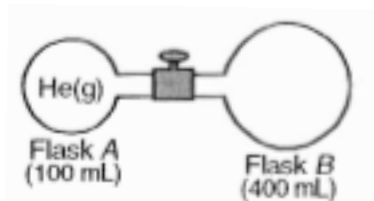
_____ 2. A 1-gram sample of which substance in a 1-liter sealed container will occupy the container completely and uniformly?

- | | |
|------------------------------------|------------------------------------|
| 1) Hg _(l) | 2) H ₂ O _(l) |
| 3) H ₂ O _(g) | 4) Ag _(s) |

_____ 3. Under the same conditions of temperature and pressure, a liquid differs from a gas because the particles of a liquid

- 1) take the shape of the container they occupy
- 2) have stronger forces of attraction between them
- 3) are in constant straight-line motion
- 4) have no regular arrangement

_____ 4. The diagram below shows two flasks connected by a stopcock. Flask A contains helium gas. Flask B contains a vacuum.



What final volume will the gas occupy after the stopcock is opened?

- | | |
|----------|----------|
| 1) 500mL | 2) 400mL |
| 3) 100mL | 4) 300mL |

_____ 5. Which sample contains particles arranged in a regular geometric pattern?

- | | |
|-----------------------|------------------------|
| 1) CO _{2(l)} | 2) CO _{2(aq)} |
| 3) CO _{2(g)} | 4) CO _{2(s)} |

_____ 6. At what point do a liquid and a solid exist at equilibrium?

- 1) vaporization point
- 2) boiling point
- 3) sublimation point
- 4) melting point

_____ 7. What term represents the change of a substance from the solid phase to the liquid phase?

- 1) evaporation
- 2) vaporization
- 3) condensation
- 4) fusion

_____ 8. A gas is *most* likely to change to the liquid phase when the pressure on the gas

- 1) increases and its temperature decreases
- 2) decreases and its temperature decreases
- 3) increases and its temperature increases
- 4) decreases and its temperature increases

_____ 9. A mixture of ice and water is in equilibrium at standard pressure. The temperature of the mixture must be

- | | |
|----------|----------|
| 1) 212°C | 2) 273°C |
| 3) 0°C | 4) 100°C |

_____ 10. What conditions of pressure and temperature exist when ice melts at its normal melting point?

- 1) 1 atm and 0°C
- 2) 760 atm and 273K
- 3) 760 atom and 0°C
- 4) 1 atm and 0K

_____ 11. At 1 atmosphere, which substance will sublime when heated?

- | | |
|------------------------------------|------------------------|
| 1) CH _{4(g)} | 2) HCl _(aq) |
| 3) H ₂ O _(l) | 4) CO _{2(s)} |

_____ 12. The boiling point of water at standard pressure is

- | | |
|----------|----------|
| 1) 373 K | 2) 100 K |
| 3) 273 K | 4) 0 K |

13. What process occurs when dry ice, $\text{CO}_{2(g)}$, is changed into $\text{CO}_{2(s)}$?

- 1) deposition
- 2) condensation
- 3) fusion
- 4) vaporization

14. As the temperature of liquid water decreases, its vapor pressure

- 1) increases
- 2) decreases
- 3) remain the same

15. What is the first phase change that is *most* likely to occur as the pressure on nitrogen gas is increased and its temperature is decreased?

- 1) evaporation
- 2) solidification
- 3) condensation
- 4) crystallization

16. According to Table H in your Chemistry Reference Table, what is the vapor pressure of water at 105°C ?

- 1) 68kPa
- 2) 105kPa
- 3) 120kPa
- 4) 110kPa

17. Which liquid has the *highest* vapor pressure at standard temperature?

- 1) ethanoic acid
- 2) propanone
- 3) ethanol
- 4) water

18. Which change results in a release of energy?

- 1) the melting of $\text{H}_2\text{O}_{(s)}$
- 2) the condensation of $\text{H}_2\text{O}_{(g)}$
- 3) The boiling of $\text{H}_2\text{O}_{(l)}$
- 4) the evaporation of $\text{H}_2\text{O}_{(l)}$

19. Which phase change is endothermic?

- 1) gas to solid
- 2) liquid to gas
- 3) liquid to solid
- 4) gas to liquid

20. The graph below represents the relationship between the temperature and time for a substance that was heated uniformly starting at t_0 . The substance was in the solid phase at t_0 .



During what time interval does the heat absorbed by the substance represent the heat of fusion of the substance?

- 1) t_3 to t_4
- 2) t_2 to t_3
- 3) t_1 to t_2
- 4) t_0 to t_1

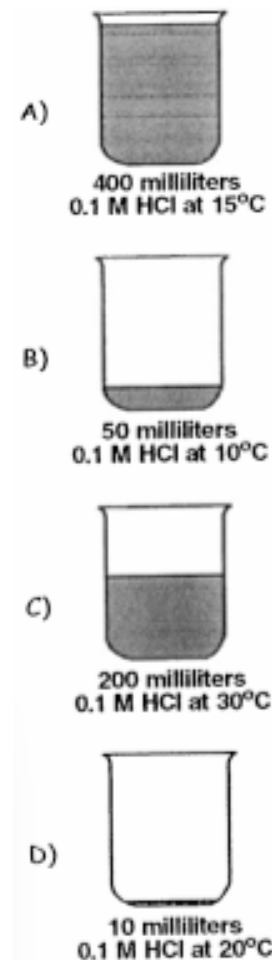
21. The temperature of a substance is a measure of its particles'

- 1) average potential energy
- 2) entropy
- 3) enthalpy
- 4) average kinetic energy

22. What Kelvin temperature is equal to -33°C ?

- 1) 33 K
- 2) -33 K
- 3) 240 K
- 4) 306 K

23. In which beaker would the particles have the *highest* average kinetic energy?



23. Human body temperature is 37°C . What temperature does this correspond to on the Kelvin scale?

- 1) -236 K
- 2) 98.6 K
- 3) 310 K
- 4) 236 K

24. Two pure water samples held in separate containers at 1 atmosphere of pressure must have molecules possessing the same average kinetic energy if the samples have the same

- 1) temperature
- 2) mass
- 3) density
- 4) volume

25. At 1 atmosphere of pressure, the fixed temperature points on a Celsius thermometer are located on the basis of

- 1) the ice/water equilibrium temperature, only
- 2) both the ice/water and the water/steam equilibrium temperatures
- 3) neither the ice/water nor the water/steam equilibrium temperatures
- 4) the water/steam equilibrium temperature, only

26. Equal volumes of all gases at the same temperature and pressure contain an equal number of

- 1) protons
- 2) atoms
- 3) molecules
- 4) electrons

27. The volume of a given mass of an ideal gas at constant pressure is

- 1) inversely proportional to the Kelvin temperature
- 2) directly proportional to the Celsius temperature
- 3) directly proportional to the Kelvin temperature
- 4) inversely proportional to the Celsius temperature

28. The diagrams below represent four 500-mL flasks. each flask contains the gas represented by its symbol. All gas samples are at STP.



Each flask contains the same number of

- 1) atoms, only
- 2) molecules, only
- 3) atoms and molecules
- 4) atoms, but a different number of molecules

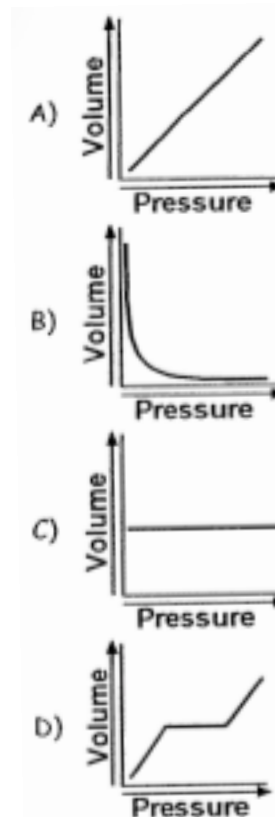
29. As the pressure of a gas 101.3 kPa is changed to 50.65 kPa at constant temperature, the volume of the gas

- 1) remains the same
- 2) decreases
- 3) increases

30. The volume of a 1.00-mole sample of an ideal gas will decrease when the

- 1) pressure decreases and the temperature increases
- 2) pressure increases and the temperature decreases
- 3) pressure increases and the temperature increases
- 4) pressure decreases and the temperature decreases

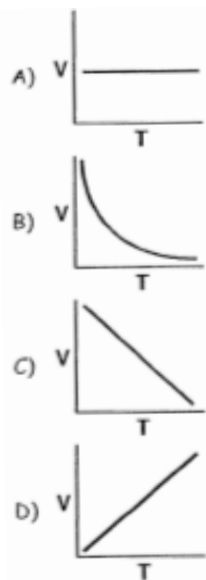
31. Which graph *best* shows the change in the volume of one mole of nitrogen gas as pressure increases and temperature remains constant?



32. According to the kinetic molecular theory, the particles of an ideal gas

- 1) have no potential energy
- 2) have strong intermolecular forces
- 3) are arranged in a regular, repeated geometric pattern
- 4) are separated by great distances, compared to their size

33. At constant pressure, which graph shows the correct relationship between the volume of a gas (V) and its absolute temperature (T)?



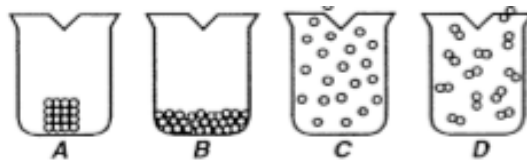
34. Which gas under high pressure and low temperature has a behavior *closest* to that of an ideal gas?

- 1) $O_2(g)$
- 2) $CO_2(g)$
- 3) $H_2(g)$
- 4) $NH_3(g)$

35. Which temperature change would cause a sample of an ideal gas to double in volume while the pressure is held constant?

- 1) from 400. K to 200. K
- 2) from 200. K to 400. K
- 3) from 400. °C to 200. °C
- 4) from 200. °C to 400. °C

36. The particle diagrams below represent elements at STP.



Which particle diagram best represents a monoatomic gas?

- 1) A
- 2) B
- 3) C
- 4) D

37. The table below shows the temperature, pressure and volume of 5 samples.

| Sample | Element | Temp (K) | Pressure (atm) | Volume (L) |
|--------|---------|----------|----------------|------------|
| A | He | 273 | 1 | 22.4 |
| B | O_2 | 273 | 1 | 22.4 |
| C | Ne | 273 | 2 | 22.4 |
| D | N_2 | 546 | 2 | 44.8 |
| E | Ar | 546 | 2 | 44.8 |

Which sample contains the same number of molecules as sample A?

- 1) E
- 2) B
- 3) C
- 4) D

Constructed Response Questions

38. When a chemical cold pack is activated, a chemical reaction occurs that causes the pack to feel cold.

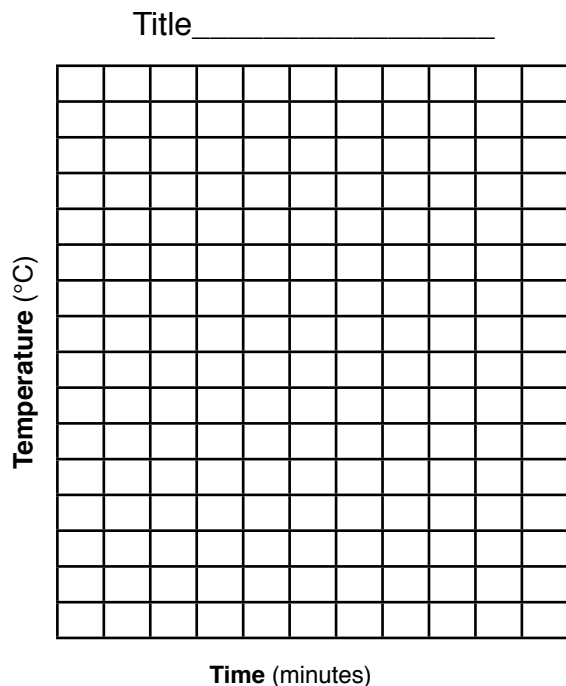
a. Is the reaction that takes place inside a chemical cold pack exothermic or endothermic?

b. Describe the transfer of energy between a cold pack and the air around it.

Questions 39 and 40 refer to the following:

A student performed a laboratory investigation to determine the melting point of solid p-Dichlorobenzene (moth crystals). The student filled a test tube with solid p-Dichlorobenzene then gently heated the test tube in a beaker of boiling water. As the student heated the p-Dichlorobenzene, temperature readings were taken every half minute. The following data were collected:

| Time (minutes) | Temperature (°C) |
|----------------|------------------|
| 0.0 | 20.0 |
| 0.5 | 35.0 |
| 1.0 | 50.0 |
| 1.5 | 53.0 |
| 2.0 | 53.0 |
| 2.5 | 53.0 |
| 3.0 | 53.5 |
| 3.5 | 55.0 |
| 4.0 | 60.0 |
| 4.5 | 70.0 |



39. a. Construct a line graph on the grid according to the following directions:

1. Mark an appropriate scale on the axis labeled "Temperature °C".
2. Mark an appropriate scale on the axis labeled "Time(minutes)".
3. Plot the data from the data table. Surround each point with a small circle and connect the points.

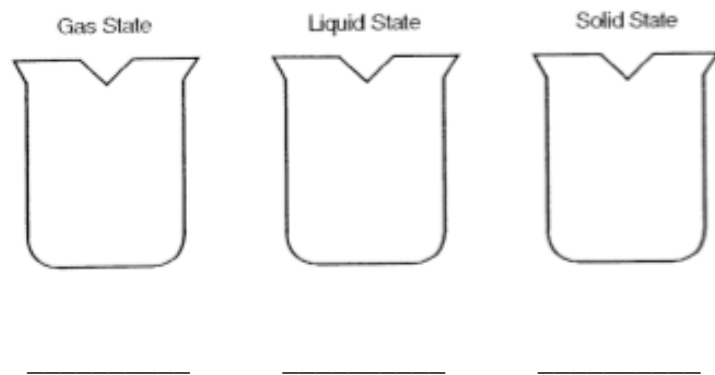
b. Write an appropriate title on the graph.


c. From the data table and the graph, determine the melting point of p-Dichlorobenzene.

40. Explain the plateau in temperature between 1.5 and 3.0 minutes in terms of kinetic *and* potential energy.

Questions 41 through 43 refer to the following:

The halogen family (Group 17) contains elements that exist in the gas, liquid and solid states at room temperature at standard pressure.



41. a. Using  to represent one molecule of a halogen, draw a particle diagram to represent a halogen in the gas, liquid, and solid states in the containers above. [Each diagram should contain at least 6 halogen molecules.]
- b. On the line below each container, identify (by name and/or symbol) a halogen which exists in the corresponding phase at room temperature and standard pressure.
42. Describe the different between a halogen in the gas, liquid and solid state in terms of particle arrangement.
43. Explain, in terms of intermolecular forces of attraction, why different halogens under the same conditions of temperature and pressure can exist in three different phases.

44. Jacques Charles (1746-1823) was a french physicist and a hot air balloonist. He is credited with stating the relationship between the temperature and volume of a gas.

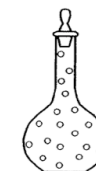
- a. The air inside a hot air balloon is heated by a giant gas burner. What effect does increasing the temperature have on the volume of the gas inside the balloon?
- b. As a hot air balloon rises to higher altitudes, atmospheric pressure against the balloon decreases. What effect does the decrease in pressure have on the volume of the gas inside the balloon?

45. The particle diagram below represents a sample of a gas sealed in a 1.0 liter flask. The sample was heated gently and the gas pressure was measured over a range of temperatures as reported in the data table.

- a. State the relationship between the temperature and pressure of the gas when the volume remains constant.
- b. Explain the increase in pressure of the sample at higher temperatures in terms of kinetic energy and collisions of the gas particles.

| Temperature (K) | Pressure (kPa) |
|-----------------|----------------|
| 300 | 101.3 |
| 310 | 104.7 |
| 320 | 108.1 |
| 330 | 111.4 |

- c. Calculate the gas pressure at 340 K. [Write the correct formula. Show ALL work. Indicate the answer with the appropriate unit.]



46. Ammonia (NH_3) is commonly used in the manufacture of nitric acid, synthetic fibers, and fertilizers. It is marketed as $\text{NH}_3(\text{l})$ in steel containers or as $\text{NH}_3(\text{aq})$ in bottles or drums.

a. What is the difference in composition between a sample labeled $\text{NH}_3(\text{l})$ and a sample labeled $\text{NH}_3(\text{aq})$.

b. In the boxes below, draw a particle diagram to support your answer to part a.



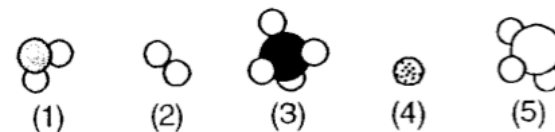
$\text{NH}_3(\text{l})$



$\text{NH}_3(\text{aq})$

47. The diagram below represents a gaseous mixture of the substances labeled 1 through 5.

a. Which of the five substances represent compounds? [Explain why.]



b. Which of the five substances are elements? [Explain why.]

c. Does the diagram represent a homogeneous or heterogeneous mixture? [Give one reason to justify your answer.]

