UNIT 2 STUDY GUIDE/PRACTICE TEST Name KEY

Energy: Particle Motion

TOPIC 2.1: HEAT AND TEMPERATURE

- Temperature is a **measure** of average Kinetic energy.

1. Which property is a measure of the average kinetic energy of the particles in a sample of matter?

   A) mass B) density C) pressure D) temperature

2. Which sample of water contains particles having the highest ~~average kinetic energy~~ temp?

   A) 25 mL of water at 95°C B) 45 mL of water at 75°C
   C) 75 mL of water at 75°C D) 95 mL of water at 25°C

3. Which sample of ethanol has particles with the highest ~~average kinetic energy~~ temp?

   A) 10.0 mL of ethanol at 25°C B) 10.0 mL of ethanol at 55°C
   C) 100.0 mL of ethanol at 35°C D) 100.0 mL of ethanol at 45°C

4. Which temperature is equal to 120. K?

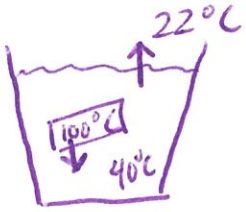
   A) −153°C B) −120.°C C) +293°C D) +393°C

   $K = °C + 273$
   $120 = °C + 273$
   $-273 \quad -273$

- Heat is a form of **energy** that flows from HIGH to LOW temperature.

5. In a laboratory where the air temperature is 22°C, a steel cylinder at 100.°C is submerged in a sample of water at 40.°C. In this system, heat flows from

   A) both the air and the water to the cylinder
   B) both the cylinder and the air to the water
   C) the air to the water and from the water to the cylinder
   D) the cylinder to the water and from the water to the air



6. Object A at 40°C and object *B* at 80°C are placed in contact with each other. Which statement describes the heat flow between the objects?

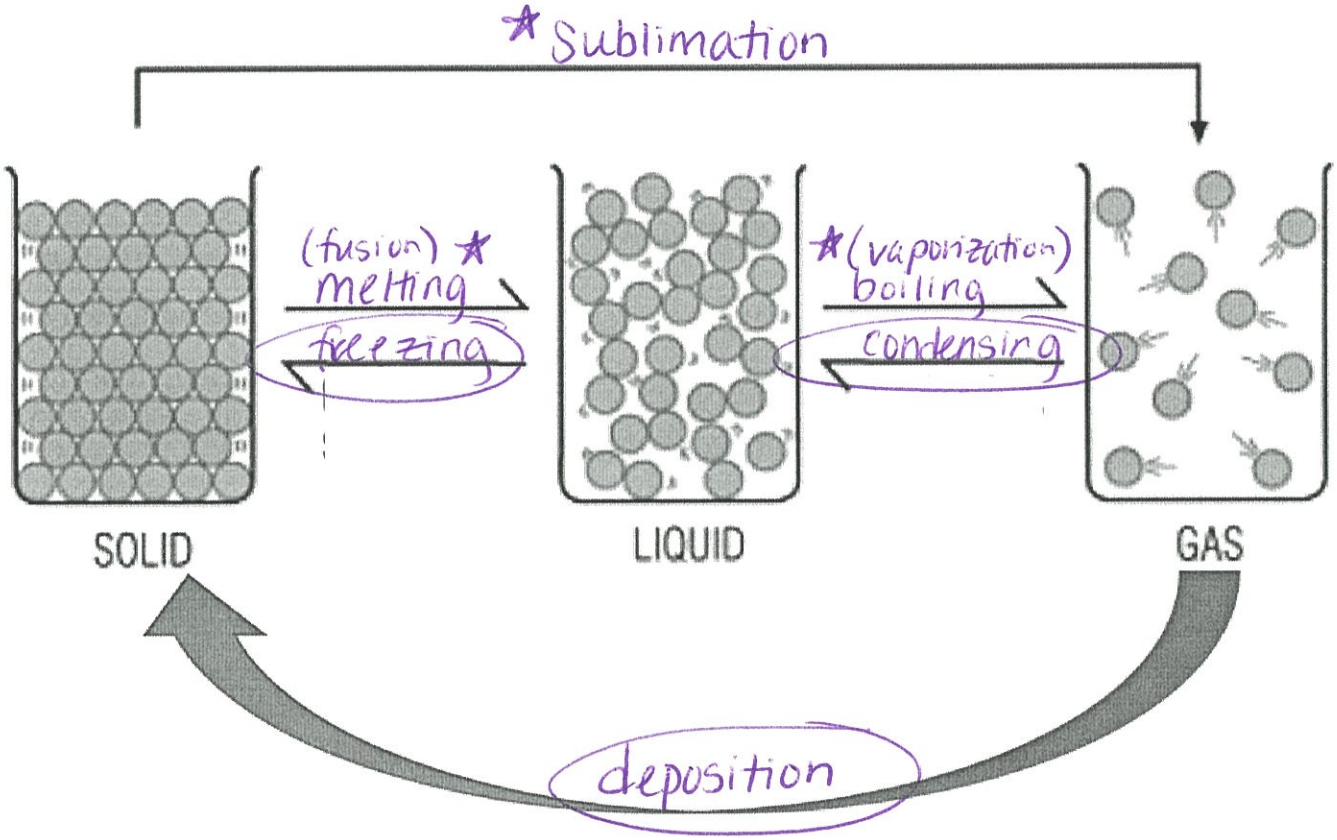
   A) Heat flows from object *A* to object *B*.
   B) Heat flows from object *B* to object *A*.
   C) Heat flows in both directions between the objects.
   D) No heat flow occurs between the objects.

7. What occurs when a 35-gram aluminum cube at 100°C is placed in 90. grams of water at 25°C in an insulated cup?

   A) Heat is transferred from the aluminum to the water, and the temperature of the water decreases.
   B) Heat is transferred from the aluminum to the water, and the temperature of the water increases.
   C) Heat is transferred from the water to the aluminum, and the temperature of the water decreases.
   D) Heat is transferred from the water to the aluminum, and the temperature of the water increases.

TOPIC 2.2: PHASE CHANGES

- Label the diagram below with the appropriate names of the six **phase changes.**
- Put a star next to the phase changes that are **endothermic** (HEAT ENTERS THE SYSTEM)
- Circle the names of the phase changes that are **exothermic** (HEAT EXITS THE SYSTEM)



1. Which process is exothermic?

   A) boiling of water
   B) melting of copper
   C) condensation of ethanol vapor
   D) sublimation of iodine

2. Which physical changes are endothermic?

   A) melting and freezing
   B) melting and evaporating
   C) condensation and sublimation
   D) condensation and deposition

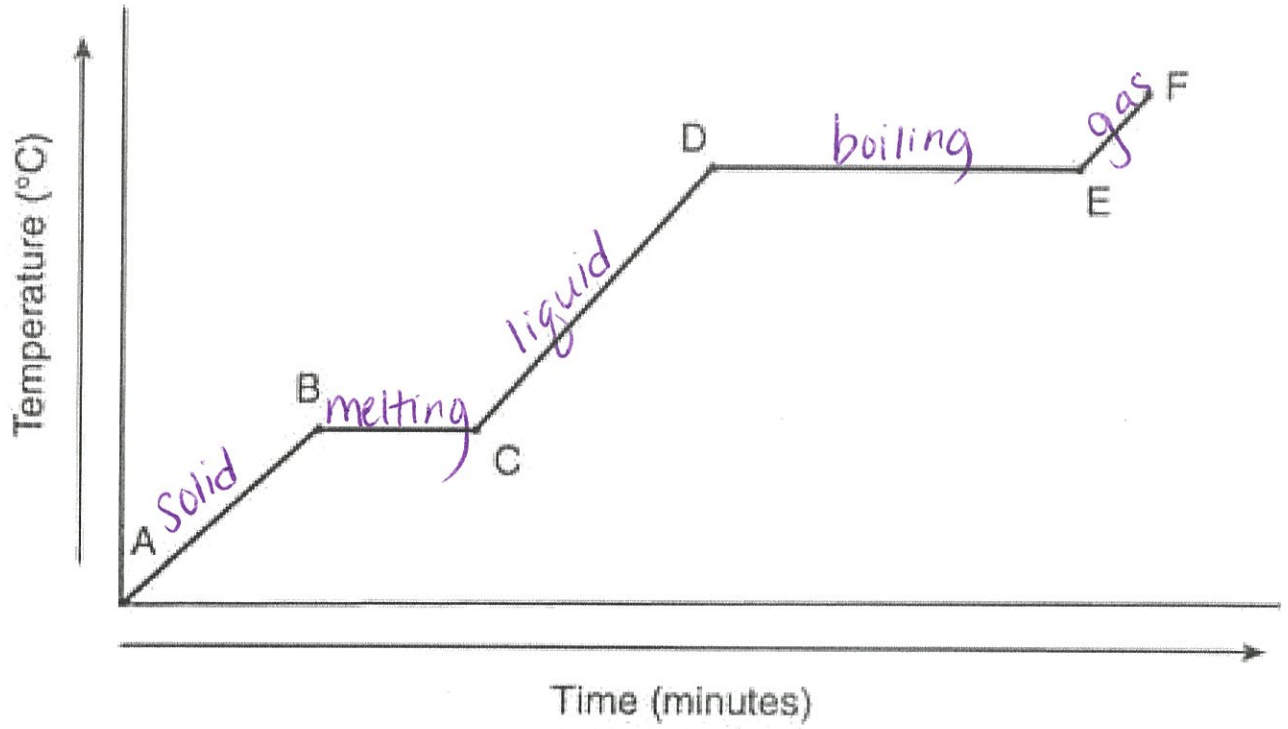
3. Which equation represents sublimation?

   A) $I_2(s) \rightarrow I_2(g)$ B) $I_2(s) \rightarrow I_2(\ell)$ C) $I_2(\ell) \rightarrow I_2(g)$ D) $I_2(\ell) \rightarrow I_2(s)$

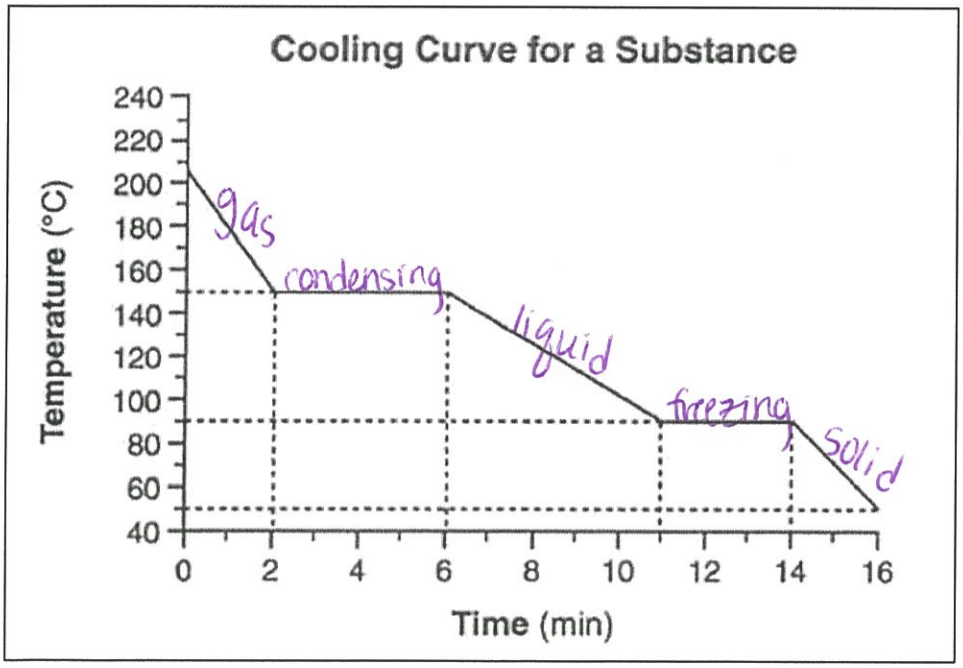
4. The freezing point of bromine is Table S → MP of bromine is 266K, convert to °C

   A) 539°C B) −539°C C) 7°C D) −7°C

TOPIC 2.3: HEATING AND COOLING CURVES

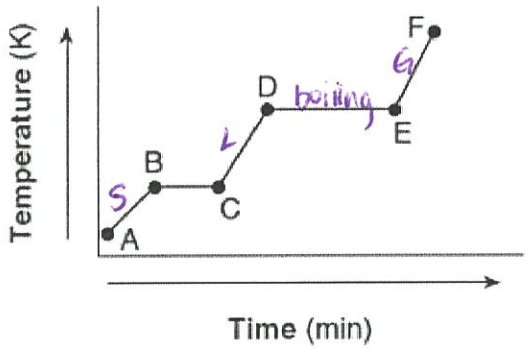


- Label the heating curve using the following terms: **solid, liquid, gas, melting, boiling.**
- Which line segments does KINETIC ENERGY increase? AB, CD, EF
- Which line segments does POTENTIAL ENERGY increase? BC, DE
- Which line segments does KINETIC ENERGY stay the same? BC, DE
- Which line segments does POTENTIAL ENERGY stay the same? AB, CD, EF



- Label each segment of the cooling curve with the correct phases and phase changes involved. Also label where **KE** is decreasing and where **PE** is decreasing.
- What is the boiling point of this substance? 150°C
- What is the freezing point? 90°C

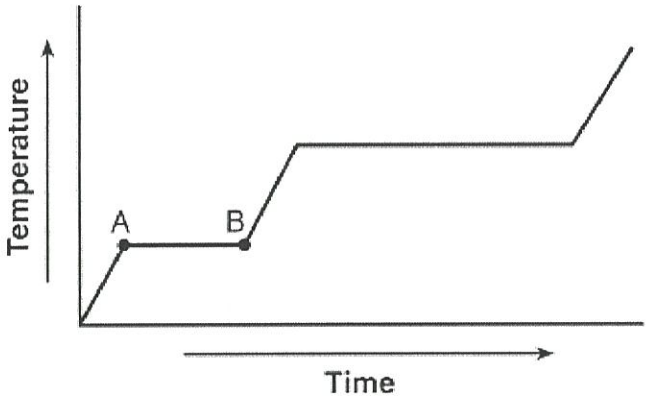
1. The heating curve below represents a sample of a substance starting as a solid below its melting point and being heated over a period of time.



Which statement describes the energy of the particles in this sample during interval *DE*?

A) Both potential energy and average kinetic energy increase.
B) Both potential energy and average kinetic energy decrease.
C) Potential energy increases and average kinetic energy remains the same.
D) Potential energy remains the same and average kinetic energy increases.

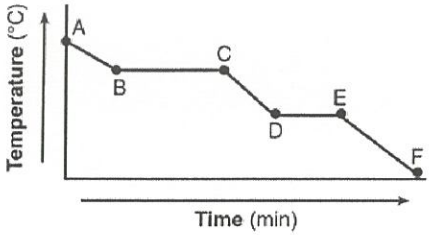
2. The graph below represents the relationship between time and temperature as heat is added at a constant rate to a sample of a substance.



During interval *AB* which energy change occurs for the particles in this sample?

A) The potential energy of the particles increases.
B) The potential energy of the particles decreases.
C) The average kinetic energy of the particles increases.
D) The average kinetic energy of the particles decreases.

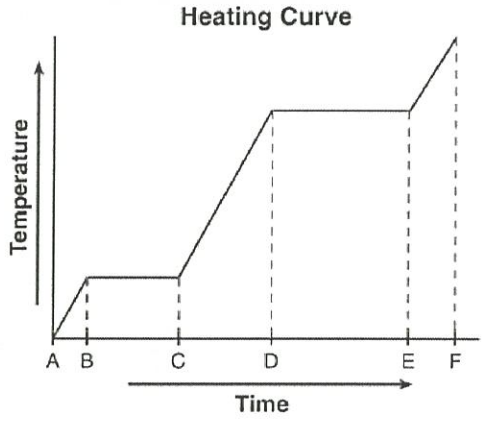
3. Given the cooling curve of a substance:



During which intervals is potential energy decreasing and average kinetic energy remaining constant?

A) *AB* and *BC* B) *AB* and *CD* C) *DE* and *BC* D) *DE* and *EF*

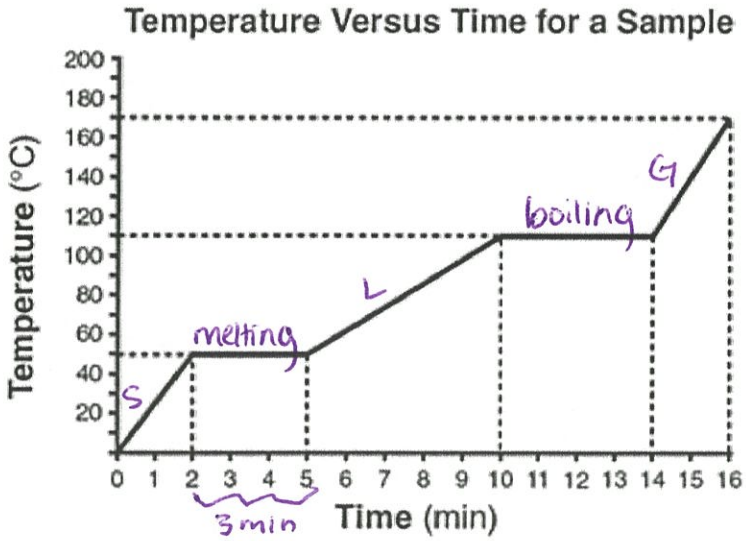
4. Given the diagram representing a heating curve for a substance:



During which time interval is the average kinetic energy of the particles of the substance constant while the potential energy of the particles increases?

A) *AC* B) *BC* C) *CD* D) *DF*

5. Starting as a solid, a sample of a substance is heated at a constant rate. The graph below shows the changes in temperature of this sample.



What is the melting point of the sample and the total time required to completely melt the sample after it has reached its melting point?

A) 50°C and 3 min B) 50°C and 5 min
C) 110°C and 4 min D) 110°C and 14 min

TOPIC 2.4: CALCULATING HEAT INVOLVED IN TEMPERATURE CHANGE

$$q = mC\Delta T$$

- What does each variable stand for?
  - q : heat
  - m: mass
  - C: specific heat
  - ΔT: change in temp.
- Where can you find the **specific heat capacity (C)** of **water**? Table B
- What is the specific heat capacity of water? 4.18 J/gK

TOPIC 2.5: HEAT OF FUSION AND HEAT OF VAPORIZATION

$$q = mH_f$$

$$q = mH_v$$

- What does each variable stand for?
  - q : heat
  - m: mass
  - H_f: heat of fusion
  - H_v: heat of vaporization
- Where can you find the **heat of fusion** and **heat of vaporization** of water? Table B
- What is the **heat of fusion** of water? 334 J/g
- What is the **heat of vaporization** of water? 2260 J/g
- Why does it take more energy to vaporize water than to melt it? to go from l → g, you have to completely overcome particle attractions which requires a lot of energy

LAB SKILLS – PERCENT ERROR

Write EQUATION (from Table T)

$$\%\text{ error} = \frac{mv - av}{av} \times 100$$

1. A student found the boiling point of a liquid to be 80.4°C. If the liquid's actual boiling point is 80.6°C, the experimental percent error is equal to

   (mv → 80.4, av → 80.6)

   A) $\frac{80.6 - 80.4}{80.6} \times 100$
   B) $\frac{80.6 - 80.4}{80.4} \times 100$
   C) $\frac{80.5 - 80.4}{80.5} \times 100$
   D) $\frac{80.5 - 80.4}{80.4} \times 100$

2. If the observed value for a density is 0.80 g/ml and the accepted value is 0.70 g/ml, what is the percent error?

   A) 0.17%
   B) 0.14%
   C) 17.%
   D) 14.%

   $\frac{0.8 - 0.7}{0.7} \times 100$

3. A student in a laboratory determined the boiling point of a substance to be 71.8°C. The accepted value for the boiling point of this substance is 70.2°C. What is the percent error of the student's measurement?

   A) 1.60%
   B) 2.28%
   C) 2.23%
   D) 160.%

   $\frac{71.8 - 70.2}{70.2} \times 100$

SHOW WORK HERE

1. What is the total amount of heat absorbed by 100.0 grams of water when the temperature of the water is increased from 30.0°C to 45.0°C?

A) 418 J
B) 6270 J
C) 12 500 J
D) 18 800 J

(1) $q = mC\Delta T$

$q = (100)(4.18)(15)$

$q = 6270\ J$

2. The temperature of a sample of water changes from 10°C to 20°C when the sample absorbs 418 joules of heat. What is the mass of the sample?

A) 1 g
B) 10 g
C) 100 g
D) 1000 g

(2) $q = mC\Delta T$

$418 = m(4.18)(10)$

$\frac{418}{41.8} = m\frac{41.8}{41.8} \Rightarrow m = 10$

3. How much energy is required to vaporize 10.00 grams of water at its boiling point?

A) 2.26 kJ
B) 3.34 kJ
C) 4.2 kJ
D) 22.6 kJ

(3) $q = mH_v$

$q = (10)(2260)$

$q = 22600\ J \times \left(\frac{1\ kJ}{10^3\ J}\right)$

$q = 22.6\ kJ$

4. What is the total number of joules released when a 5.00-gram sample of water changes from liquid to solid at 0°C?

A) 334 J
B) 1670 J
C) 2260 J
D) 11 300 J

(4) $q = mH_f$

$q = (5)(334)$

$q = 1670\ J$

5. What is the total amount of heat required to completely melt 347 grams of ice at its melting point?

A) 334 J
B) 1,450 J
C) 116,000 J
D) 784,000 J

(5) $q = mH_f$

$q = (347)(334)$

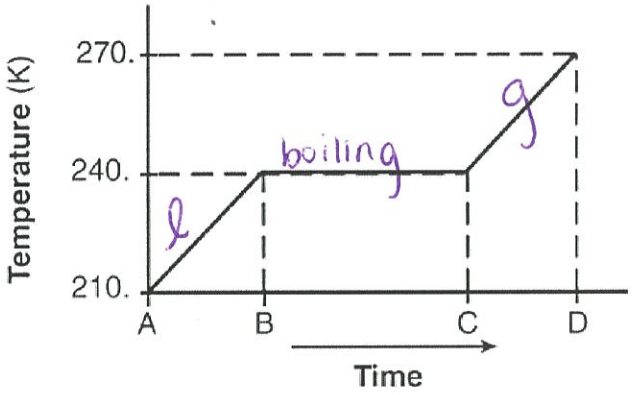
$q = 115898$

$q = 116{,}000\ J$

Base your answers to questions 6 and 7 on the information below

A 5.00-gram sample of liquid ammonia is originally at 210. K. The diagram of the partial heating curve below represents the vaporization of the sample of ammonia at standard pressure due to the addition of heat. The heat is *not* added at a constant rate.

Partial Heating Curve for Ammonia



Some physical constants for ammonia are shown in the data table below.

Some Physical Constants for Ammonia

C →	specific heat capacity of $NH_3(\ell)$	4.71 J/g•K
H_f →	heat of fusion	332 J/g
H_v →	heat of vaporization	1370 J/g

6. Determine the total amount of heat required to vaporize this 5.00-gram sample of ammonia at its boiling point.

$q = m H_v$

$q = (5)(1370)$

$q = 6850\ J$

7. Calculate the total heat absorbed by the 5.00-gram sample of ammonia during time interval AB. Your response must include *both* a correct numerical setup and the calculated result.

$q = mc\Delta T$

$\Delta T = 240 - 210$

$= 30$

$q = (5)(4.71)(30)$

$q = 706.5\ J$