

Matter and Energy Review

58. Which of the following cannot be decomposed by chemical means?

- (1) sodium
- (2) ethanol
- (3) sucrose
- (4) water

59. A compound differs from an element in that a compound

- (1) is homogeneous
- (2) has a definite composition
- (3) has a definite melting point
- (4) can be decomposed by a chemical reaction

60. A compound differs from a mixture in that a compound always has a

- (1) homogeneous composition
- (2) maximum of two elements
- (3) minimum of three elements
- (4) heterogeneous composition

61. Most elements are

- (1) metals
- (2) nonmetals
- (3) gases
- (4) made in a laboratory

Key

65

62. A pure substance that is composed only of identical atoms is classified as

- (1) a compound
- (2) an element
- (3) a heterogeneous mixture
- (4) a homogeneous mixture

63. Which is characteristic of all mixtures?

- (1) They are homogeneous.
- (2) They are heterogeneous.
- (3) Their compositions are in a definite ratio.
- (4) Their compositions may vary.

64. A heterogeneous material may be

- (1) an element
- (2) a compound
- (3) a pure substance
- (4) a mixture

65. Which of these materials is a mixture?

- (1) water H_2O
- (2) air *heterogeneous* $\rightarrow N_2 O_2 CO_2 H_2O$
- (3) methane CH_4
- (4) magnesium Mg

66. Each particle contained in hydrogen gas is made up of two identical hydrogen atoms chemically joined together. Hydrogen gas is

- (1) a compound
- (2) an element
- (3) a homogeneous mixture
- (4) a heterogeneous mixture

ONE OF
THE 7
DIATOMIC
ELEMENTS

67. Which of the following materials is a pure substance?

- (1) air
- (2) water
- (3) fire
- (4) earth

68. Which statement is an identifying characteristic of a mixture?

- (1) A mixture can consist of a single element.
- (2) A mixture can be separated by physical means. *3 techniques*
- (3) A mixture must have a definite composition by weight.
- (4) A mixture must be homogeneous.

67



69. Which substance can be decomposed by a chemical change? (Compound)

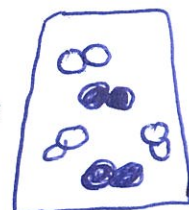
- (1) ammonia NH_3 (3) magnesium Mg
(2) aluminum Al (4) manganese Mn

Answer the following questions using complete sentences.

70. A sample of a material is passed through a filter paper. A white deposit remains on the paper, and a clear liquid passes through. The clear liquid is then evaporated, leaving a white residue. What can you determine about the nature of the sample? separated by filtration then Evaporation
it was heterogeneous initially

71. A substance is found to contain only calcium and sulfur. How would you determine whether the substance is a compound or a mixture?

72. Using  to represent a hydrogen molecule and  to represent an oxygen molecule, draw a picture of a mixture of hydrogen and oxygen gases.



73. What are some of the differences between a mixture of iron and oxygen and a compound composed of iron and oxygen?

Compound \rightarrow Fixed ratio

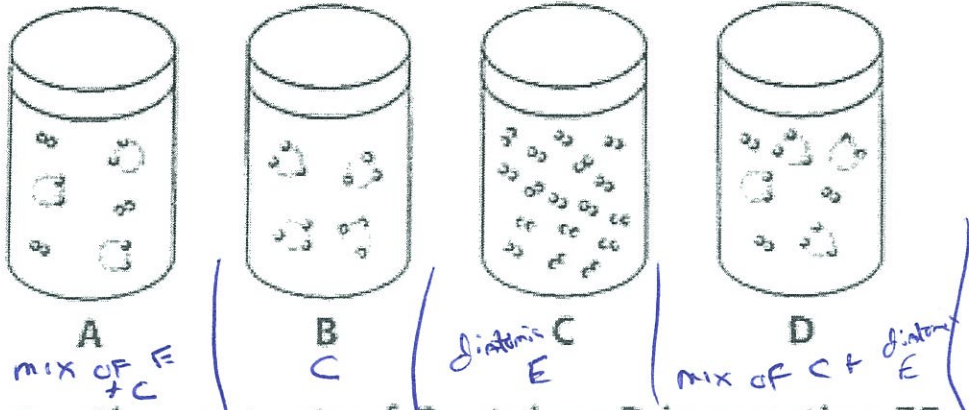
Mixture \rightarrow Varies in composition

\rightarrow Sulfur is yellow as an element and will most likely retain that yellow color in a mixture but will not as a compound

68

74. Is a pepperoni pizza homogeneous or heterogeneous? Explain your answer. *visibly distinct parts*

75. Examine the contents of the four containers shown below. Use complete sentences to identify each as containing only elements, only compounds or a mixture of these. Explain each of your answers.



76. Are the contents of Container D in question 75 homogeneous or heterogeneous? Explain your answer. *Homogenous → appear mixed in a uniform way*

77. A chemist receives two samples. Analysis of one sample shows it to be 88.88% oxygen by mass and 11.12% hydrogen. Analysis of the other sample shows it to be 94.12% oxygen and 5.88% hydrogen. Are these samples of the same material? Explain your answer.

NO they are two different compounds

1. Which substance has a definite shape and a definite volume at STP?

- (1) $\text{NaCl}(aq)$ (3) $\text{CCl}_4(l)$
 (2) $\text{Cl}_2(g)$ (4) $\text{AlCl}_3(s)$

2. At STP, which element has a definite shape and volume?

- (1) Ag (2) Hg (3) Ne (4) Xe
liquid *gas*

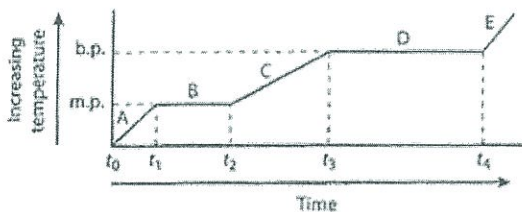
3. Which sample is most likely to take the shape of and occupy the total volume of its container?

- (1) $\text{CO}_2(g)$
 (2) $\text{CO}_2(l)$
 (3) $\text{CO}_2(aq)$
 (4) $\text{CO}_2(s)$

4. As a substance changes from a liquid to a gas, the average distance between molecules

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

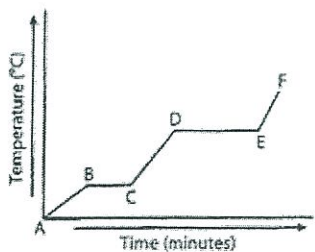
10. A solid substance initially at a temperature below its melting point is heated at a constant rate. The heating curve for the substance is shown in the graph below.



Which portions of the graph represent times when heat is absorbed and potential energy increases while kinetic energy remains constant?

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

11. A solid substance initially at a temperature below its melting point is heated at a constant rate. The heating curve for the substance is shown in the graph below.



Which segment of the graph represents a time when both the solid and liquid phases are present?

- (1) AB (2) BC (3) DE (4) EF

5. Which substance takes the shape of and fills the volume of any container into which it is placed?

- (1) $\text{H}_2\text{O}(l)$ (3) $\text{I}_2(s)$
 (2) $\text{CO}_2(g)$ (4) $\text{Hg}(l)$

6. Which sample of matter sublimates at room temperature and standard pressure?

- (1) $\text{Br}_2(l)$ (3) $\text{CO}_2(s)$
 (2) $\text{Cl}_2(g)$ (4) $\text{SO}_2(aq)$

7. Which phase change represents sublimation?

- (1) $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(s)$ (3) $\text{I}_2(s) \rightarrow \text{I}_2(g)$
 (2) $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(g)$ (4) $\text{I}_2(s) \rightarrow \text{I}_2(l)$

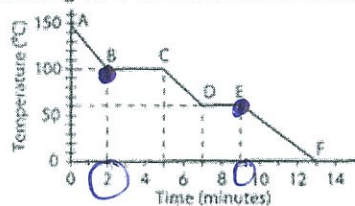
8. Which phase change represents sublimation?

- (1) $\text{NH}_3(l) \rightarrow \text{NH}_3(g)$ (3) $\text{KI}(s) \rightarrow \text{KI}(l)$
 (2) $\text{CO}_2(s) \rightarrow \text{CO}_2(g)$ (4) $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(s)$

9. At 1 atm, equal masses of $\text{H}_2\text{O}(s)$, $\text{H}_2\text{O}(l)$, and $\text{H}_2\text{O}(g)$ have

- (1) different volumes
 (2) the same density NO
 (3) different percent compositions NO
 (4) the same molecular spacing NO

12. A gaseous substance initially at a temperature above its boiling point is cooled at a constant rate. The cooling curve for the substance is shown below.



How much time passes between the first appearance of the liquid phase of the substance and the presence of the substance completely in its solid phase?

- (1) 5 minutes (3) 7 minutes
 (2) 2 minutes (4) 4 minutes

13. The heat of fusion is defined as the energy required (at constant temperature) to change a

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

14. During which process is potential energy decreasing and average kinetic energy remaining the same?

- (1) A liquid is converted to a solid at its freezing point.
 (2) A solid is converted to a liquid at its melting point.
 (3) A gas is cooled from a temperature of 120°C to 115°C .
 (4) A liquid is heated from 38°C to 58°C .

15. Which physical change is endothermic?

- (1) $\text{CO}_2(l) \rightarrow \text{CO}_2(s)$ (3) $\text{CO}_2(g) \rightarrow \text{CO}_2(s)$
 (2) $\text{CO}_2(g) \rightarrow \text{CO}_2(l)$ (4) $\text{CO}_2(s) \rightarrow \text{CO}_2(g)$

16. Which phase change is exothermic?

- (1) $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(l)$ (3) $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(g)$
 (2) $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(s)$ (4) $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(g)$

9-2 = 7 min

← Absorbs heat from surroundings

→ Releases heat to the surroundings

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

- (1) mass (3) pressure
(2) temperature (4) density

18. Which unit is used to express the amount of energy absorbed or released during a chemical reaction?

- (1) degree Temp (3) gram mass
(2) torr pressure (4) joule

19. Which list includes three forms of energy?

- (1) chemical, mechanical, electromagnetic
(2) chemical, mechanical, temperature
(3) thermal, pressure, electromagnetic
(4) thermal, pressure, temperature

20. The minimum number of fixed reference points required to establish the Celsius temperature scale for a thermometer is

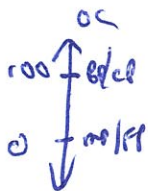
- (1) 1 (2) 2 (3) 3 (4) 4

21. What are the fixed reference points on the Celsius thermometer?

- (1) 32 and 100 (3) 32 and 212
(2) 0 and 212 (4) 0 and 100

22. The difference between the boiling point and the freezing point of pure water at standard pressure is

- (1) 32 K (2) 273 K (3) 100 K (4) 373 K



23. What is the freezing point of water on the Kelvin scale at standard pressure?

- (1) 0 K (2) 32 K (3) 100 K (4) 273 K

24. Which sample of copper has atoms with the lowest average kinetic energy?

- (1) 40. g at 15°C (3) 20. g at 35°C
(2) 30. g at 25°C (4) 10. g at 45°C

25. Energy is added to a substance. Compared to the Celsius temperature of the substance, the Kelvin temperature

- (1) will always be 273 greater
(2) will always be 273 lower
(3) will have the same reading at 0
(4) will have the same reading at 273

26. What Kelvin temperature is equal to -73°C?

- (1) 100 K (2) 173 K (3) 200 K (4) 346 K

27. Which temperature is equal to 20 K?

- (1) -253°C (2) -293°C (3) 253°C (4) 293°C

28. Compared to a 26-gram sample of Cu(s) at STP, the atoms of a 52-gram sample of Fe(s) have

- (1) a higher average kinetic energy
(2) a lower average kinetic energy
(3) the same average kinetic energy
(4) twice as much average kinetic energy

29. Which temperature change indicates an increase in the average kinetic energy of the molecules in a sample?

- (1) 305 K to 0°C
(2) 355 K to 25°C
(3) 15°C to 298 K
(4) 37°C to 273 K

$K = C + 273$
Lowest Temp.

SAME Temp MEANS SAME KE

Heating

30. When 25.0 grams of water are cooled from 20.0°C to 10.0°C, the number of joules of heat energy released is

- (1) 42 (3) 840
(2) 105 (4) 1050

31. How many joules of heat energy are released when 50.0 g of water are cooled from 70.0°C to 60.0°C?

- (1) 41.8 J (3) 209 J
(2) 2.09×10^3 J (4) 4.18×10^3 J

32. What is the total number of joules of heat energy absorbed when the temperature of 200.0 g of water is raised from 10.0°C to 40.0°C?

- (1) 126 J (3) 2.51×10^4 J
(2) 840. J (4) 3.36×10^4 J

33. How many kilojoules of heat energy are absorbed when 100.0 g of water are heated from 20.0°C to 30.0°C?

- (1) 4.18 kJ (3) 418 kJ
(2) 41.8 kJ (4) 0.418 kJ

34. What is the amount of heat energy released when 50.0 grams of water is cooled from 20.0°C to 10.0°C?

- (1) 5.00×10^2 J (3) 2.09×10^3 J
(2) 1.67×10^5 J (4) 1.13×10^6 J

35. A 100.-gram sample of H₂O(l) at 22.0°C absorbs 8360 joules of heat. What will be the final temperature of the water?

- (1) 25.7°C (3) 18.3°C
(2) 42.0°C (4) 20.0°C

36. When 20.0 g of a substance are completely melted at its melting point, 3444 J are absorbed. What is the heat of fusion of this substance?

- (1) 41 J/g (3) 16,400 J/g
(2) 172 J/g (4) 68,900 J/g

37. The total amount of heat required to completely vaporize a 100.-gram sample of water at its normal boiling point is

- (1) 2.26×10 J (3) 2.26×10^3 J
(2) 2.26×10^2 J (4) 2.26×10^5 J

$q = m c \Delta T$

1) Find ΔT
2) then find q

Find H_f
 $q = m H_f$

$q = m H_v$

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For each of the following problems, be sure to show your work, use the proper units, and express your answer to the correct number of significant figures.

$$m = \frac{q}{c\Delta T}$$

$$m = 5.98g$$

$$q = mc\Delta T$$

$$q = 4080J$$

$$T_f = 31.2^\circ C$$

$$T_i = 45.2^\circ C$$

38. A sample of water is heated from 10.0°C to 15.0°C by the addition of 125 J of heat. What is the mass of the water?

39. What is the total number of joules absorbed by 65.0 g of water when the temperature of the water is raised from 25.0°C to 40.0°C?

40. If 100.0 J are added to 20.0 g of water at 30.0°C, what will be the final temperature of the water?

41. The temperature of 50.0 g of water was raised to 50.0°C by the addition of 1.0 kJ of heat energy. What was the initial temperature of the water?

42. What would be the temperature change if 3.0 g of water absorbed 15 J of heat?

$$\Delta T = .84^\circ C$$

43. What is the total number of kilojoules of heat needed to change 150. g of ice to water at 0°C?

$$q = mH_f$$

$$q = 50.1 kJ$$

44. What is the total number of kilojoules required to completely boil 100.0 g of water at 100.0°C and 1 atmosphere?

$$q = mH_v$$

$$q = 226 kJ$$

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

$$q = mH_v$$

$$q = 2260 J = 2.260 kJ$$

46. At 1 atmosphere of pressure, 25.0 g of a compound at its normal boiling point are converted to a gas by the addition of 34,400 J. What is the heat of vaporization for this compound in J/g?

$$H_v = \frac{1376 J}{g}$$

↑
Don't
Forget
UNIT

67. By using a paper filter, which of the following can be separated?

- (1) two immiscible liquids
- (2) two heterogeneous solids
- (3) a solid in a liquid
- (4) two miscible liquids

68. Equal amounts of ethanol and water are mixed at room temperature and at 101.3 kPa. Which process is used to separate ethanol from the mixture?

- (1) reduction
- (2) distillation
- (3) filtration
- (4) ionization

69. Crude oil is separated into its components by

- (1) fractional distillation
- (2) filtration
- (3) paper chromatography
- (4) column chromatography

70. The principle that allows paper chromatography to separate mixtures depends on the different components having

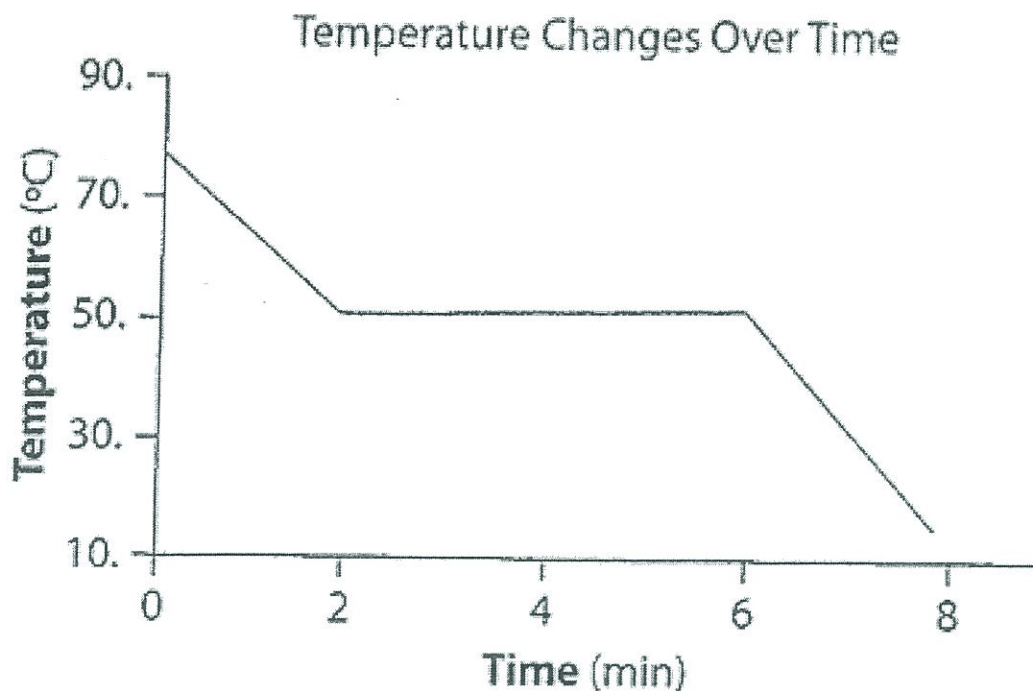
- (1) different boiling points
- (2) different attractions to the paper
- (3) different densities
- (4) similar solubility in water

71. A mixture consists of sand and an aqueous salt solution. Which procedure can be used to separate the sand, salt, and water from each other?

- (1) Filter out the sand, then evaporate the water.
- (2) Filter out the salt, then evaporate the water.
- (3) Evaporate the water, then filter out the salt.
- (4) Evaporate the water, then filter out the sand.

Use the following information and graph to answer questions 28 through 30.

The graph below shows a compound being cooled at a constant rate starting in the liquid phase at 75°C and ending at 15°C.



- 28 What is the freezing point of the compound in degrees Celsius? 50°C
- 29 State what is happening to the average kinetic energy of the particles of the sample between minutes 2 and 6. $\text{IT IS CONSTANT BECAUSE TEMP IS CONSTANT}$
- 30 If a total of 780 joules of energy is lost by 25.0 grams of this substance between 2 and 6 minutes, determine the heat of fusion (H_f) of this substance.

$$q = m H_f$$
$$H_f = \frac{q}{m} = \frac{780 \text{ J}}{25.0 \text{ g}} = \boxed{\frac{31 \text{ J}}{g}}$$

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Practice Questions

for the New York Regents Exam

Directions

Review the Test-Taking Strategies section of this book. Then answer the following questions. Read each question carefully and answer with a correct choice or response.

Part A

- Which set of properties does a substance such as $\text{CO}_2(g)$ have?
 - definite shape and definite volume
 - definite shape but no definite volume
 - no definite shape but definite volume
 - no definite shape and no definite volume
- A liquid is poured from a volumetric flask into a beaker. Which of the following is true?
 - It retains its original volume and shape.
 - It retains its original volume, but its shape changes.
 - It retains its original shape, but its volume changes.
 - Both the volume and shape change.
- The heat required to change 1 gram of a solid at its normal melting point to a liquid at the same temperature is called the heat of
 - vaporization
 - fusion
 - reaction
 - formation
- Which statement best describes the molecules of H_2O in the solid phase?
 - They move slowly in straight lines.
 - They move rapidly in straight lines.
 - They are arranged in a regular geometric pattern.
 - They are arranged in a random pattern.
- As the temperature of a substance rises, the average kinetic energy of the particles making up the substance
 - increases
 - decreases
 - remains the same
- When a substance melts, it undergoes a process known as
 - condensation
 - fusion
 - sublimation
 - vaporization
- Which sample of CO_2 has a definite shape and a definite volume?
 - $\text{CO}_2(aq)$
 - $\text{CO}_2(l)$
 - $\text{CO}_2(s)$
 - $\text{CO}_2(g)$

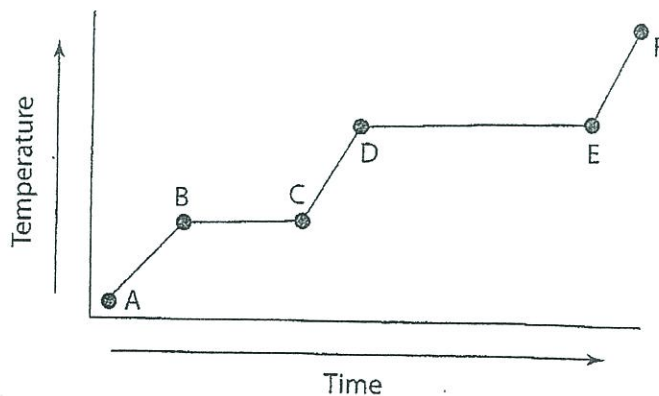
Temp and KE directly related

- Which of the following is a unit of heat energy?
 - torr
 - degree
 - gram
 - joule
- Which energy transfer occurs when ice cubes are placed in water that has a temperature of 45°C ?
 - Chemical energy is transferred from the ice to the water.
 - Chemical energy is transferred from the water to the ice.
 - Thermal energy is transferred from the ice to the water.
 - Thermal energy is transferred from the water to the ice.

thermal = Heat

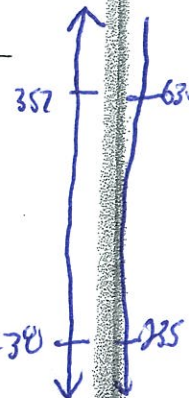
Part B-1

- The graph below represents the uniform heating of a substance, starting below its melting point, when the substance is solid. Which line segments represent an increase in average kinetic energy?



- AB and BC
- AB and CD
- BC and DE
- DE and EF

- A liquid's freezing point is -38°C and its boiling point is 357°C . How many Kelvins are there between the boiling point and the freezing point of the liquid?
 - 319
 - 395
 - 592
 - 668



TOPIC 4 Physical Behavior of Matter

12 A mixture of sand and table salt can be separated by filtration because the substances in the mixture differ in

- (1) boiling point (3) solubility in water
 (2) density at STP (4) freezing point

13 Which Celsius temperature is equivalent to 323 K?

- (1) 50°C (3) 273°C
 (2) 212°C (4) 596°C

14 When steam condenses to water, the surrounding temperature

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

g → l is Exo

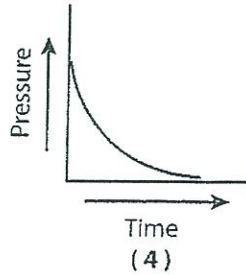
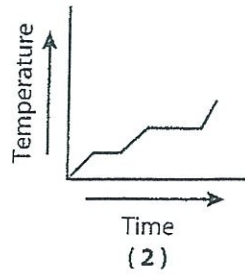
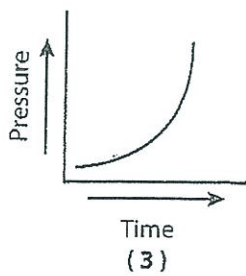
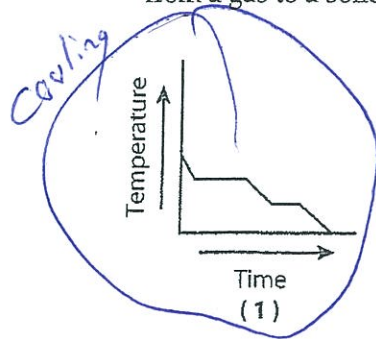
15 Which grouping of the three phases of bromine is listed in order from left to right for increasing distance between bromine molecules?

- (1) gas, liquid, solid
 (2) liquid, solid, gas
 (3) solid, gas, liquid
 (4) solid, liquid, gas

16 A sealed, rigid 1.0-liter cylinder contains He gas at STP. An identical sealed cylinder contains Ne gas at STP. These two cylinders contain the same number of

- (1) atoms (3) ions
 (2) electrons (4) protons

17 Which graph best represents a change of phase from a gas to a solid?



Parts B-2 and C

Base your answers to questions 18 through 20 on the following information.

A student heats a 15.0 gram metallic sphere of unknown composition to a temperature of 98°C. The sphere is transferred to a calorimeter containing 100. mL of water at a temperature of 25.0°C. The student observes that the resulting temperature of both the water and the object is 27.1°C after the object is submerged.

18 Describe, in terms of the object and the water, the flow of heat energy that took place during the experiment. *From metal to water*

19 Calculate the amount of heat energy gained by the water in the calorimeter. $q = (100. g)(4.18)(27.1 - 25.0) = 878 J$

20 Using the quantity of heat calculated in the previous question, determine the specific heat of the object. $-878 = (15.0)(c)(27.1 - 98)$
 $c = 0.826 J/g \cdot ^\circ C$

Base your answers to questions 21 through 23 on the information below.

A student prepared two mixtures, each in a labeled beaker. Enough water at 20.°C was used to make 100 milliliters of each mixture.

Information about Two Mixtures at 20.°C

	Mixture 1	Mixture 2
Composition	NaCl in H ₂ O	Fe filings in H ₂ O
Student Observations	<ul style="list-style-type: none"> colorless liquid no visible solid on bottom of beaker 	<ul style="list-style-type: none"> colorless liquid black solid on bottom of beaker
Other Data	<ul style="list-style-type: none"> mass of NaCl(s) dissolved = 2.9 g 	<ul style="list-style-type: none"> mass of Fe(s) = 15.9 g density of Fe(s) = 7.87 g/cm³

21 Classify each mixture using the term "homogeneous" or the term "heterogeneous".

22 Remembering that density is equal to the mass of an object divided by its volume, determine the volume of the Fe filings used to produce mixture 2. $V = 2.02 cm^3 = 2.02 mL$

23 Describe a procedure to physically remove the water from mixture 1.

Evaporate the water leaving only SALT