Physical Behavior Of Matter

1 Which sample of matter represents a mixture?
(1) aqueous ammonia (3) liquid mercury
(2) gaseous ethane (4) solid iodine

2 Which sample of matter is classified as a substance?
(1) air (3) milk
(2) ammonia (4) seawater

3 In which 1.0-gram sample are the particles arranged in a crystal structure?
(1) $CaCl_2(s)$ (3) $CH_3OH(\ell)$
(2) $C_2H_6(g)$ (4) $CaI_2(aq)$

4 One mole of liquid water and one mole of solid water have different
(1) masses (3) empirical formulas
(2) properties (4) gram-formula masses

5 Which sample of matter has a crystal structure?
(1) $Hg(\ell)$ (3) NaCl(s)
(2) $H_2O(\ell)$ (4) $CH_4(g)$

6 At 1 atm, equal masses of $H_2O(s)$, $H_2O(\ell)$, and $H_2O(g)$ have
(1) the same density
(2) the same distance between molecules
(3) different volumes
(4) different percent compositions

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7 Some physical properties of two samples of iodine-127 at two different temperatures are shown in the table below.

Selected Physical Properties of Iodine-127 Samples at 1 atm

Sample	Sample Temperature (K)	Description	Density (g/cm^3)
1	298	dark-gray crystals	4.933
2	525	dark-purple gas	0.006

These two samples are two different
(1) mixtures (3) phases of matter
(2) substances (4) isotopes of iodine

8 A sample of $CO_2(s)$ and a sample of $CO_2(g)$ differ in their
(1) chemical compositions (3) molecular structures
(2) empirical formulas (4) physical properties

9 Which sample of matter sublimes at room temperature and standard pressure?
(1) $Br_2(\ell)$ (3) $CO_2(s)$
(2) $Cl_2(g)$ (4) $SO_2(aq)$

10 Which sample of CO_2 has a definite shape and a definite volume?

(1) $CO_2(aq)$ (3) $CO_2(\ell)$

(2) $CO_2(g)$ (4) $CO_2(s)$

Base your answers to questions 11 on the information below.

Nitrogen gas and oxygen gas make up about 99% of Earth's atmosphere. Other atmospheric gases include argon, carbon dioxide, methane, ozone, hydrogen, etc.

The amount of carbon dioxide in the atmosphere can vary. Data for the concentration of $CO_2(g)$ from 1960 to 2000 are shown in the table below.

Atmospheric Concentration of $CO_2(g)$

Year	Concentration (ppm)
1960	316.9
1980	338.7
2000	369.4

11 Explain why the atmosphere is classified as a mixture.

Base your answers to questions 12 on the information below and on your knowledge of chemistry.

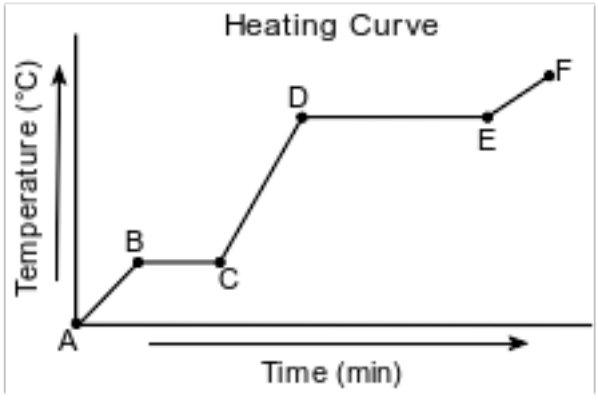
A metal worker uses a cutting torch that operates by reacting acetylene gas, $C_2H_2(g)$, with oxygen gas, $O_2(g)$, as shown in the unbalanced equation below.

$C_2H_2(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g) + \text{heat}$

12 In your answer booklet, use the key to draw a particle model diagram to represent the phase of the $O_2(g)$. Your response must include at least six molecules.

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

Starting as a solid, a sample of a molecular substance is heated, until the entire sample of the substance is a gas. The graph below represents the relationship between the temperature of the sample and the elapsed time.



13 Using the key below, draw a particle diagram to represent the sample during interval AB. Your response must include at least six molecules.

Key
◯ = a molecule of the substance

Base your answers to questions 14 on the information below and on your knowledge of chemistry.

In the late 1800s, Dmitri Mendeleev developed a periodic table of the elements known at that time. Based on the pattern in his periodic table, he was able to predict properties of some elements that had not yet been discovered. Information about two of these elements is shown in the table below.

Some Element Properties Predicted by Mendeleev

Predicted Elements	Property	Predicted Value	Actual Value
eka-aluminum (Ea)	density at STP	5.9 g/cm^3	5.91 g/cm^3
	melting point	low	30.°C
	oxide formula	Ea_2O_3	
	approximate molar mass	68 g/mol	
eka-silicon (Es)	density at STP	5.5 g/cm^3	5.3234 g/cm^3
	melting point	high	938°C
	oxide formula	EsO_2	
	approximate molar mass	72 g/mol	

14 Identify the phase of Ea at 310. K.

Base your answers to questions 15 on the information below and on your knowledge of chemistry.

The table below contains selected information about chlorine and two compounds containing chlorine. One piece of information is missing for each of the substances in the table.

Chlorine and Two Compounds Containing Chlorine

Name	Formula	Molar Mass (g/mol)	Phase at STP
chlorine	Cl_2	71	?
calcium chloride	$CaCl_2$	?	solid
1,2-dichloroethene	?	97	liquid

15 Identify the phase of the chlorine at STP.

Answer Keys

1 1

2 2

3 1

4 2

5 3

6 3

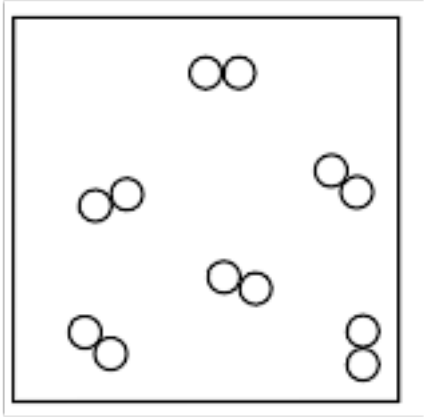
7 3

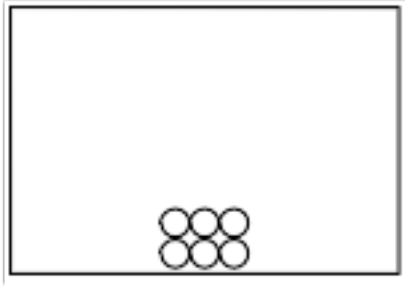
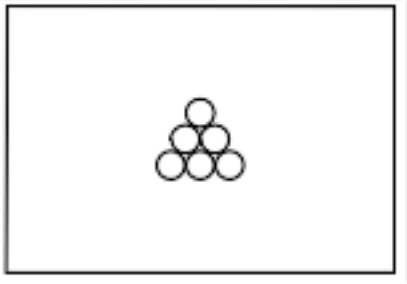
8 4

9 3

10 4

11 Allow 1 credit. Acceptable responses include, but are not limited to:
- The gases in a mixture can be separated by physical means.
- The gases in the atmosphere are separate elements or compounds that are not chemically combined with each other.
- The proportions of the gases in the atmosphere can vary.
- more than one substance

12 Allow 1 credit for a diagram with at least six diatomic molecules drawn to represent the gas phase of
- the sample.
- Example of a 1-credit response:
- 

13 Allow 1 credit for a diagram with at least six molecules drawn to represent the solid phase of
- the sample.
- Examples of 1-credit responses:
- 


14 Allow 1 credit for liquid or (ℓ).

15 Allow 1 credit. Acceptable responses include, but are not limited to:

- gas
- (g)