

States Of Matter

- 1 In which 1.0-gram sample are the particles arranged in a crystal structure?
- (1) $\text{CaCl}_2(\text{s})$ (3) $\text{CH}_3\text{OH}(\ell)$
 (2) $\text{C}_2\text{H}_6(\text{g})$ (4) $\text{CaI}_2(\text{aq})$
- 2 One mole of liquid water and one mole of solid water have different
- (1) masses (3) empirical formulas
 (2) properties (4) gram-formula masses
- 3 Which sample of matter has a crystal structure?
- (1) $\text{Hg}(\ell)$ (3) $\text{NaCl}(\text{s})$
 (2) $\text{H}_2\text{O}(\ell)$ (4) $\text{CH}_4(\text{g})$
- 4 At 1 atm, equal masses of $\text{H}_2\text{O}(\text{s})$, $\text{H}_2\text{O}(\ell)$, and $\text{H}_2\text{O}(\text{g})$ have
- (1) the same density
 (2) the same distance between molecules
 (3) different volumes
 (4) different percent compositions

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

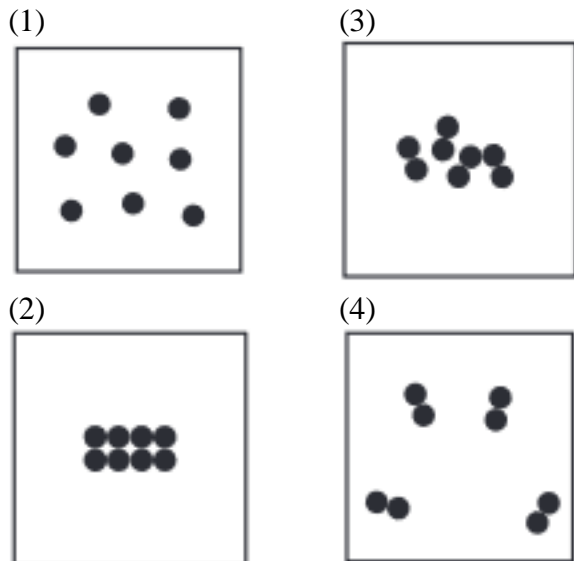
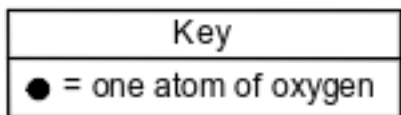
Selected Physical Properties of Iodine-127 Samples at 1 atm

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

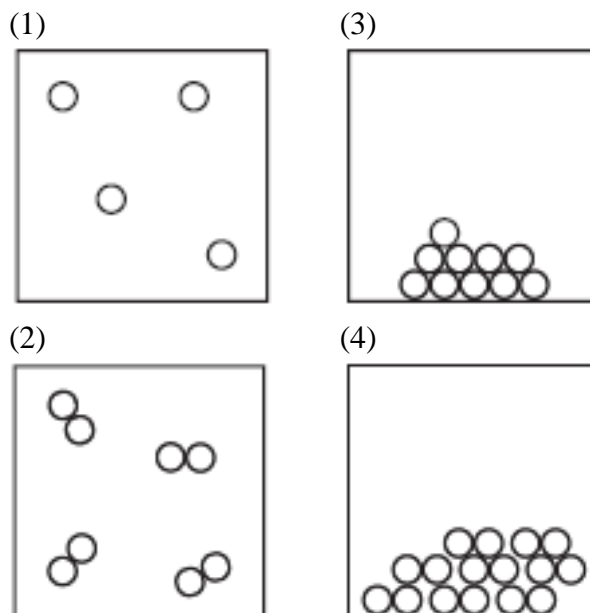
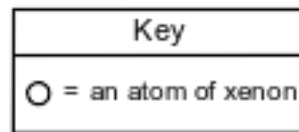
These two samples are two different

- (1) mixtures (3) phases of matter
 (2) substances (4) isotopes of iodine
- 6 A sample of $\text{CO}_2(\text{s})$ and a sample of $\text{CO}_2(\text{g})$ differ in their
- (1) chemical compositions (3) molecular structures
 (2) empirical formulas (4) physical properties
- 7 Which sample of matter sublimes at room temperature and standard pressure?
- (1) $\text{Br}_2(\ell)$ (3) $\text{CO}_2(\text{s})$
 (2) $\text{Cl}_2(\text{g})$ (4) $\text{SO}_2(\text{aq})$
- 8 Which sample of CO_2 has a definite shape and a definite volume?
- (1) $\text{CO}_2(\text{aq})$ (3) $\text{CO}_2(\ell)$
 (2) $\text{CO}_2(\text{g})$ (4) $\text{CO}_2(\text{s})$

9 Which particle diagram represents a sample of oxygen gas at STP?



10 Which particle model diagram represents xenon at STP?



Base your answers to questions 11 on the information below and on your knowledge of chemistry.

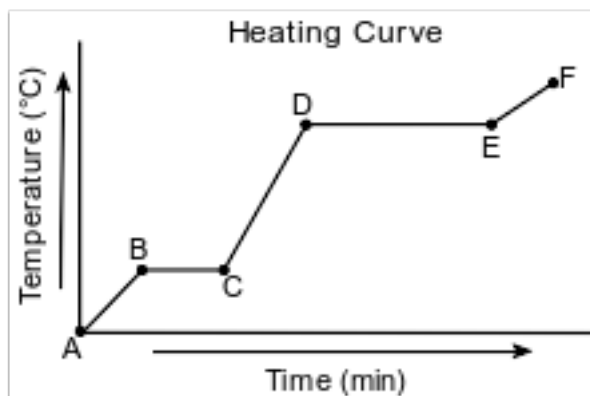
A metal worker uses a cutting torch that operates by reacting acetylene gas, $C_2H_2(g)$, with oxygen gas, $O_2(g)$, as shown in the unbalanced equation below.



11 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 12 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.



- 12 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 13 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 ₂ O 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	

13 Identify the phase of Ea at 310. K.

Base your answers to questions 14 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

14 Identify the phase of the chlorine at STP.

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

A technician recorded data for two properties of Period 3 elements. The data are shown in the table below.

Two Properties of Period 3 Elements

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Ionic Radius (pm)	95	66	51	41	212	184	181	—
Reaction with Cold Water	reacts vigorously	reacts very slowly	no observable reaction	no observable reaction	no observable reaction	no observable reaction	reacts slowly	no observable reaction

15 State the phase of chlorine at 281 K and 101.3 kPa.

Answer Keys

1 1

2 2

3 3

4 3

5 3

6 4

7 3

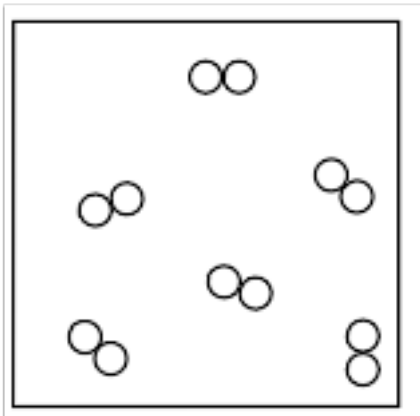
8 4

9 4

10 1

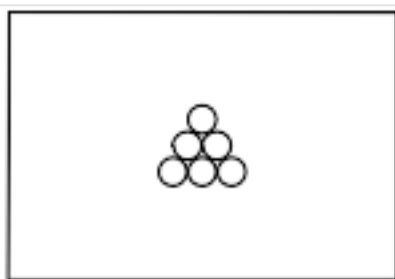
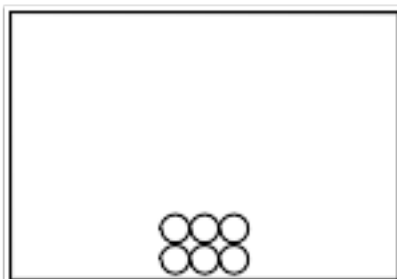
11 Allow 1 credit for a diagram with at least six diatomic molecules drawn to represent the gas phase of

- the sample.
- Example of a 1-credit response:



12 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:



13 Allow 1 credit for liquid or (*ℓ*).

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

- gas
- (g)

15 Allow 1 credit for gas or (g).