

Chemistry Benchmark #2

1. Which is true about chemical bonding in the formation of sodium chloride?

- A. An electron is lost by the sodium atom.
- B. An electron is lost by the chlorine atom.
- C. Electrons are shared between sodium and chlorine atoms.
- D. Electrons are dispersed in both sodium and chlorine atoms.

2. How do covalent bonds form between atoms?

- A. Metal ions share electrons.
- B. Atoms of nonmetals share electrons.
- C. Electrons are transferred from nonmetals to metals.
- D. Electrons are transferred from metals to nonmetals.

3. A chemist makes the following observations about an unidentified element, X.

Element X Reacted With	Reaction?	Compound Formed
lithium	no	
calcium	no	
oxygen	yes	X_2O
chlorine	yes	XCl

From which group of the periodic table of the elements can the chemist infer the element comes?

- A. I
- B. II
- C. VI
- D. VII

4. Which compound contains covalent bonding?

- A. K_2S
- B. N_2O
- C. ZnI_2
- D. $AlCl_3$

5. The diagram represents bonding between two atoms of chlorine.

What is represented in this diagram?

- A. ionic bonding between two atoms of chlorine
- B. metallic bonding between two atoms of chlorine
- C. covalent bonding between two atoms of chlorine
- D. a combination of ionic and covalent bonding between two atoms of chlorine

6. Which element would form an ionic bond with sodium?

- A. aluminum
- B. fluorine
- C. iron
- D. lead

7. Carbon atoms can form single, double, or triple bonds with other carbon atoms. Which is a correct comparison of bond energies between carbon atoms?

- A. single > double > triple
- B. single > double < triple
- C. single < double < triple
- D. single < double > triple

8. Which compound has the strongest intermolecular forces present?

- A. H_2O
- B. H_2S
- C. H_2Se
- D. H_2Te

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9. Element X has the physical properties shown in the table.

Element	Description	Melting Point (mp) °C	Tensile Strength	Electrical Conductivity
X	Soft, malleable, solid	961	High	High

Which is most likely element X?

- A. carbon
- B. neon
- C. silver
- D. sulfur

10. Which molecular geometry is present in a molecule of methane, CH₄?

- A. bent
- B. tetrahedral
- C. trigonal planar
- D. trigonal pyramidal

11. How are polar covalent bonds different than nonpolar covalent bonds?

- A. Polar bonds form between metals; nonpolar bonds form between nonmetals.
- B. Polar bonds form between nonmetals; nonpolar bonds form between metals.
- C. Electrons are shared equally in polar bonds; electrons are not shared equally in nonpolar bonds.
- D. Electrons are shared equally in nonpolar bonds; electrons are not shared equally in polar bonds.

12. The melting points of several substances with different types of bonding are shown.

Melting Points of Substances

Substance	Melting Point (°C)
1	-210
2	100
3	420
4	801

Which substance is most likely a compound with nonpolar bonds?

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

13. 30. There are 145.6 L of O₂ gas at STP. How many moles of O₂ are present?

- A. 3.3 moles
- B. 4.6 moles
- C. 6.5 moles
- D. 9.1 moles

14. How many moles are in 325 grams of sulfuric acid (H₂SO₄)?

- A. 3.02×10^{-1} moles
- B. 3.31 moles
- C. 1.62×10^1 moles
- D. 3.19×10^4 moles

15. What is the mass of a 12.2 mole sample of Al(OH)₃?

- A. 1.56×10^{-1} grams
- B. 6.39 grams
- C. 952 grams
- D. 1610 grams

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16. How many formula units are in 5.0 moles of NaCl?

- A. 8.3×10^{-24} formula units
- B. 2.9×10^{24} formula units
- C. 1.2×10^{23} formula units
- D. 3.0×10^{24} formula units

17. Which represents an empirical formula?

- A. N_2O_2
- B. P_4O_{10}
- C. H_2SO_4
- D. $\text{C}_6\text{H}_{12}\text{O}_6$

18. Which represents the percent composition by mass of potassium in potassium chromate (K_2CrO_4)?

- A. 26.77%
- B. 32.96%
- C. 40.27%
- D. 59.73%

19. What is the molecular formula of a compound with an empirical formula of $\text{C}_2\text{H}_4\text{Cl}$ if the molecular weight is 127.0 g/mol?

- A. $\text{C}_2\text{H}_4\text{Cl}$
- B. $\text{C}_4\text{H}_8\text{Cl}_2$
- C. $\text{C}_6\text{H}_{12}\text{Cl}_3$
- D. $\text{C}_8\text{H}_{16}\text{Cl}_4$

20. A compound is found to contain 69.58% Ba, 6.090% C, and 24.32% O. Which is the empirical formula of the compound?

- A. BaCO
- B. BaCO_2
- C. BaCO_3
- D. $\text{Ba}_{11}\text{CO}_4$

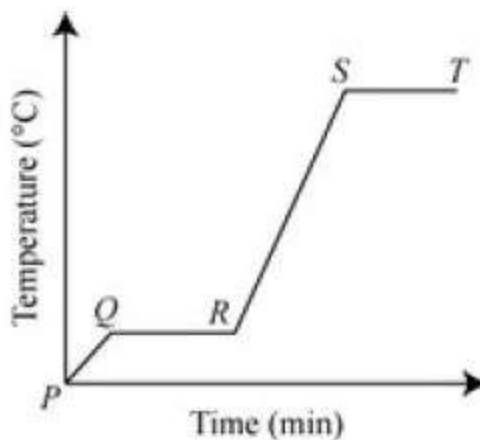
21. Which process involves a decrease in kinetic energy?

- A. deposition

22. The temperature of 50 mL of water changes from 20°C to 25°C . Which is true?

- A. The average kinetic energy of the water increases.
- B. The average kinetic energy of the water decreases.
- C. The concentration of the water molecules increases.
- D. The concentration of the water molecules decreases.

23. Ben studied the physical properties of water in the chemistry laboratory. He first weighed 100 g of ice and put it in a beaker. He applied heat and observed the changes that occurred in the ice over time. The graph shows the heating curve of the results.



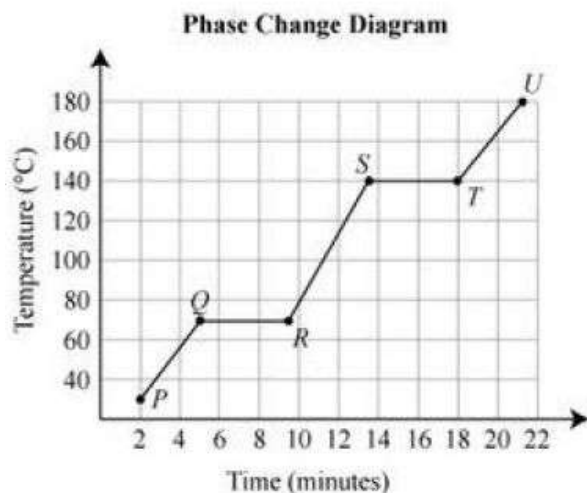
Which represents the phase marked S–T on the curve?

- A. solid ice
- B. ice water
- C. liquid water
- D. boiling water

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- B. melting
- C. sublimation
- D. vaporization

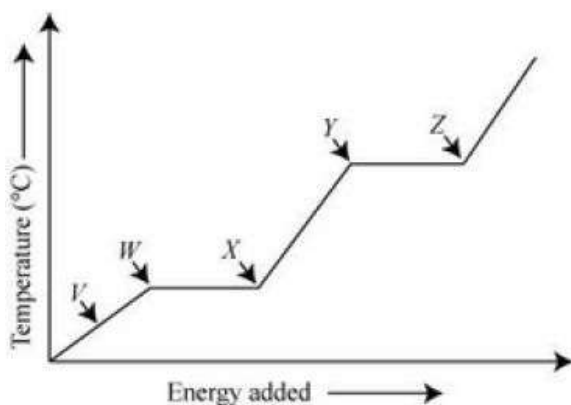
24. A heating curve for a pure substance is shown:



Which is the melting point for this substance?

- A. 30°C
- B. 70°C
- C. 140°C
- D. 180°C

25. The state of a substance is converted from solid to liquid to gas by adding energy to increase its temperature as shown in the graph.



During which section of the graph is the substance changing from liquid to gas?

- A. from V to W

26. A phase diagram is shown.

In which state of matter would substance X be in?

- A. gas
- B. liquid
- C. plasma
- D. solid

27. The phase diagram for a pure substance is shown below.

If the temperature is increased from point 1 to point 2, the substance will undergo which physical transition?

- A. freezing
- B. melting

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- B. from W to X
- C. from X to Y
- D. from Y to Z

28. How much energy is needed to bring 200. grams of water from 25.0°C to 90.0°C?

- A. 20.9 kJ
- B. 26.7 kJ
- C. 54.3 kJ
- D. 75.2 kJ

29. Which is the amount of heat needed to increase the temperature of 250 grams of water from 22°C to 67°C?

- A. 1.1×10^4 J
- B. 2.3×10^4 J
- C. 4.7×10^4 J
- D. 7.0×10^4 J

30. The table shows the specific heat of some common metals.

A 10 gram sample of each metal is heated to a temperature of 25°C. If the initial temperature of each sample was 20°C, which sample absorbed the greatest amount of energy in making the temperature change?

- A. aluminum
- B. copper
- C. lead
- D. nickel

31. How many grams of ice will melt at 0°C if 275 J of heat energy is absorbed?

- A. 0.823 g
- B. 1.21 g

- C. sublimation
- D. vaporization

32. When 35.0 g of water are converted to steam, energy is absorbed. Which correctly represents the amount of energy absorbed?

- A. 70.7 J
- B. 146 J
- C. 11,700 J
- D. 79,100 J

33. 15.0 g of an unidentified metal changes temperature from 21.5°C to 37.2°C when absorbing 123.2 J of heat. Which type of metal is this?

- A. aluminum
- B. lead
- C. titanium
- D. zinc

34. Which conditions of P and T are most ideal for a gas?

- A. low P, high T
- B. high P, low T
- C. high P, high T
- D. low P, low T

35. A vessel with an internal volume of 10.0 L contains 2.80 atm of nitrogen gas, 4.03 atm of hydrogen gas, and 7.99 atm of argon gas. At 25°C, what is the pressure (in atm) inside the vessel?

- A. 2.80 atm
- B. 7.99 atm
- C. 10.00 atm
- D. 14.82 atm

36. A sample of helium gas occupies 2.65 L at 1.20 atm. What pressure would this sample of gas exert in a 1.50-L container at the same temperature?

- A. 3.31 atm
- B. 1.20 atm

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- C. 14.8 g
- D. 21.9 g

37. A sample of helium gas occupies 12.4 L at 23°C and 0.956 atm. What volume will it occupy at 40°C and 0.956 atm?

- A. 7.13 L
- B. 11.7 L
- C. 21.6 L
- D. 13.1 L

38. A balloon has a volume of 1.20 L at 24.0°C. The balloon is heated to 48.0°C. Calculate the new volume of the balloon.

- A. 2.40 L
- B. 1.70 L
- C. 1.30 L
- D. 2.10 L
- E. 1.20 L

39. If the temperature of an ideal gas is raised from 100K to 200K, while the pressure remains constant, the volume

- A. remains the same
- B. doubles
- C. goes to 1/2 the original volume
- D. increases by a factor of 100

40. An oxygen sample has a volume of 4.50 L at 27°C and 1.053 atm. How many moles of oxygen does it contain?

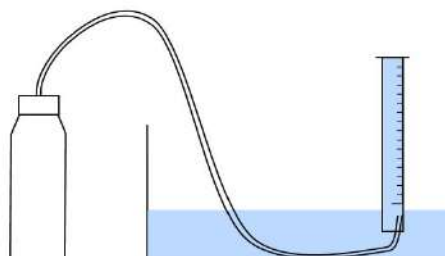
- A. 0.0963 mol
- B. 0.0193 mol
- C. 0.193 mol
- D. 3.85 mol

41. Mercury vapor contains Hg atoms. What is the volume of 200. g of mercury vapor at 822 K and 0.500 atm?

- A. 82.2 L
- B. 67.2 L
- C. 329 L

- C. 2.12 atm
- D. 0.679 atm

42. Zinc metal is added to hydrochloric acid to generate hydrogen gas and is collected over pure water, a liquid whose vapor pressure at 20.0°C is 18 torr, as shown below.



The volume of the mixture is 1.7 L, and its total pressure is 615 torr. If the graduated cylinder contains nothing but water vapor and hydrogen gas, what pressure of hydrogen was collected?

- A. 18 torr
- B. 597 torr
- C. 615 torr
- D. 633 torr

43. These two containers of gas contain 0.5 moles of gas each (not necessarily drawn to scale):

0.5 mol He	0.5 mol Xe
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Both gases have a temperature of 93.8 K and have a pressure of 132 kPa.

Which statement is true concerning the gas samples?

- A. The helium box has the same number of molecules and the same mass as the xenon box.
- B. The helium box has the same number of molecules and a different mass as the xenon box.
- C. The helium box has a different number of molecules and the same mass as the xenon box.
- D. The helium box has a different number of

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D. 135 L

molecules and a different mass as the xenon box.

44. A sealed container has 1 mole of helium and 2 moles of nitrogen at 30°C. When the total pressure of the mixture is 60 kPa, what is the partial pressure of the nitrogen?

- A. 10 kPa
- B. 20 kPa
- C. 40 kPa
- D. 60 kPa

45. The volume of a sample of gas is 650. mL at STP. What volume will the sample occupy at 0.0°C and 127 kPa?

- A. 568 mL
- B. 476 mL
- C. 650. mL
- D. 520. mL

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Answer Key

Question	Answer	Standard
1	A	NCES.9_12.SC.CH.1.2.1
2	B	NCES.9_12.SC.CH.1.2.1
3	A	NCES.9_12.SC.CH.1.2.1
4	B	NCES.9_12.SC.CH.1.2.2
5	C	NCES.9_12.SC.CH.1.2.2
6	B	NCES.9_12.SC.CH.1.2.2
7	C	NCES.9_12.SC.CH.1.2.3
8	A	NCES.9_12.SC.CH.1.2.3
9	C	NCES.9_12.SC.CH.1.2.5
10	B	NCES.9_12.SC.CH.1.2.5
11	D	NCES.9_12.SC.CH.1.2.5
12	A	NCES.9_12.SC.CH.1.2.5
13	C	NCES.9_12.SC.CH.2.2.4
14	B	NCES.9_12.SC.CH.2.2.4
15	C	NCES.9_12.SC.CH.2.2.4
16	D	NCES.9_12.SC.CH.2.2.4
17	C	NCES.9_12.SC.CH.2.2.5
18	C	NCES.9_12.SC.CH.2.2.5
19	B	NCES.9_12.SC.CH.2.2.5
20	C	NCES.9_12.SC.CH.2.2.5
21	A	NCES.9_12.SC.CH.2.1.1
22	A	NCES.9_12.SC.CH.2.1.1

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23	D	NCES.9_12.SC.CH.2.1.2
24	B	NCES.9_12.SC.CH.2.1.2
25	D	NCES.9_12.SC.CH.2.1.2
26	B	NCES.9_12.SC.CH.2.1.3
27	C	NCES.9_12.SC.CH.2.1.3
28	C	NCES.9_12.SC.CH.2.1.4
29	C	NCES.9_12.SC.CH.2.1.4
30	A	NCES.9_12.SC.CH.2.1.4
31	A	NCES.9_12.SC.CH.2.1.4
32	D	NCES.9_12.SC.CH.2.1.4
33	C	NCES.9_12.SC.CH.2.1.4
34	A	NCES.9_12.SC.CH.2.1.5
35	D	NCES.9_12.SC.CH.2.1.5
36	C	NCES.9_12.SC.CH.2.1.5
37	D	NCES.9_12.SC.CH.2.1.5
38	C	NCES.9_12.SC.CH.2.1.5
39	B	NCES.9_12.SC.CH.2.1.5
40	C	NCES.9_12.SC.CH.2.1.5
41	D	NCES.9_12.SC.CH.2.1.5
42	B	NCES.9_12.SC.CH.2.1.5
43	B	NCES.9_12.SC.CH.2.1.5
44	C	NCES.9_12.SC.CH.2.1.5
45	D	NCES.9_12.SC.CH.2.1.5