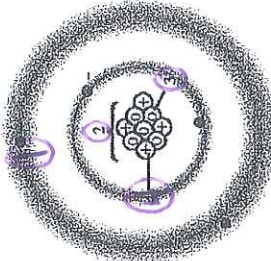


Sample Questions for Content Domain I

This section has some sample questions for you to try. After you have answered all the questions, check your answers in the "Answers to the Content Domain I Sample Questions" section that follows. That section will give you the correct answer to each question and will explain why the other answer choices are incorrect.

- 1 The following diagram shows a model of a beryllium atom.

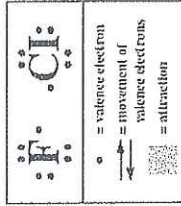
Beryllium



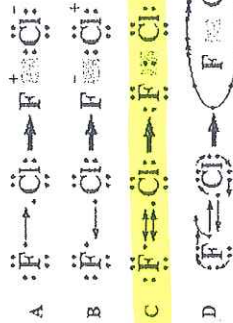
Which of the marked particles represents a proton?

- A 1
B 2
C 3
D 4

- 2 Use the key to answer the question.



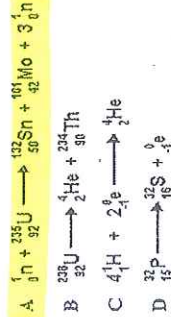
Whenever ionic or covalent bonds form there is a movement of electrons. Which of the following reaction pictures best shows what happens when a covalent bond forms between fluorine and chlorine?



- 3 Which type of radiation, from an external source, will penetrate deepest into the human body?

- A alpha
B gamma
C ultraviolet
D x-ray

- 4 Which of the following equations represents a nuclear fission reaction?



(N) $\rightarrow 1 < 2$

- 5 Gold-191 is a radioactive isotope that has a half-life of 12.4 hours. If a lab starts with a 13.2-milligram sample of gold-191, how much will remain after 37.2 hours?

- A 6.60 mg
B 4.40 mg
C 1.65 mg
D 0.825 mg

$\frac{37.2}{12.4} = 3$

$13.2 / 0.6 / 3 = 1.05$

- 6 Which of the following is the LEAST likely reason for the popularity of fission as a way of producing electricity?

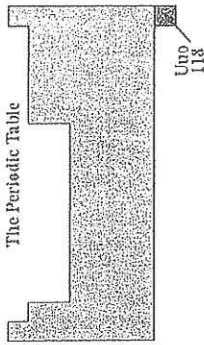
- A Spent uranium fuel is easier to dispose of than ashes from burned coal.
B Nuclear energy is sometimes less expensive than other energy sources.
C Uranium provides more energy than an equal amount of petroleum.
D Nuclear fission produces less air pollution than burning fossil fuels.

- 7 The valence shell of a neutral atom loses two electrons. Which of the following ions might result?

- A O^{2-}
B K^+
C N^{3-}
D Mg^{2+}

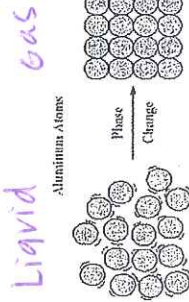
LOSES 2 e⁻
to become +2 charge

The Periodic Table



- 8 In the future, nuclear scientists may actually discover a new element named ununocium (Uuo). Its position is shown in the periodic table above. Which of the following properties might be expected for the element?

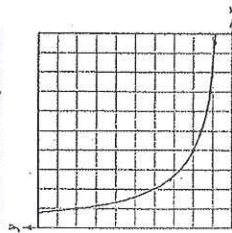
- A metalloïd solid
B metallic liquid
C nonmetallic gas
D metallic solid



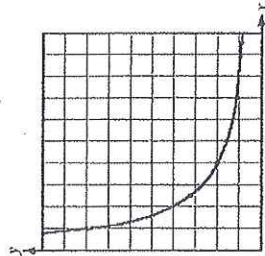
9 The above diagram shows the motion of some aluminum atoms before and after a phase change. What phase change has occurred?

- A condensation
- B freezing**
- C vaporization
- D melting

Results of Gas Experiment



Results of Gas Experiment



10 A student experiments with nitrogen gas, changing one variable at a time: temperature, pressure, or volume. Unfortunately, the student forgot to label the axes. Which of the following pairs of labels are possible for the graph shown above?

- A x-axis | Pressure** **y-axis | Volume**
- B x-axis | Temperature y-axis | Volume
- C x-axis | No. of gas molecules y-axis | Volume
- D x-axis | Temperature y-axis | Pressure

Sample Questions for Content Domain II

This section has some sample questions for you to try. After you have answered all the questions, check your answers in the "Answers to the Content Domain II Sample Questions" section that follows. That section will give you the correct answer to each question and will explain why the other answer choices are incorrect.

1 The chart shown was taken from a student's laboratory notebook.

Density of Copper	
Mass of copper sample (g)	8.539
Volume of water in graduated cylinder before sample added (mL)	3.74
Volume of water in graduated cylinder after sample added (mL)	4.69

What is the density of the copper sample?

- A $0.987 \frac{\text{g}}{\text{mL}}$
 - B $1.82 \frac{\text{g}}{\text{mL}}$
 - C $2.28 \frac{\text{g}}{\text{mL}}$
 - D $8.99 \frac{\text{g}}{\text{mL}}$**
- Handwritten notes:*
 $\pm 0.9 - 3.14 = 0.95$
 $D = \frac{m}{V}$
 $= \frac{8.54}{0.95}$

2 What is the formula of the compound containing Ca^{2+} and F^- ?

- A CaF
 - B Ca_2F
 - C CaF_2**
 - D CaF_3
- Handwritten notes:*
 $\text{Ca}^{2+} + \text{F}^- \rightarrow \text{CaF}_2$

3 What is the name of the compound represented by the formula NO_2 ?

- A nitrogen dioxide**
- B dinitrogen monoxide
- C nitrogen oxide
- D mononitrogen dioxide

4 This table above shows the reaction of sodium chloride (NaCl) with silver nitrate (AgNO_3) and the masses of the compounds involved in the reaction.

Reaction	NaCl + $\text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$
Mass before reaction (g)	11.69 33.98 0.00 0.00
Mass after reaction (g)	0.00 0.00 x 17.00

How many grams of AgCl, x, are produced by the reaction?

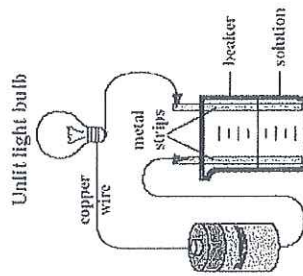
- A 16.98
 - B 28.67**
 - C 45.67
 - D 62.67
- Handwritten notes:*
 Lot Co of Mass
 $11.69 + 33.98 = 45.67$
 $45.67 - 17 = x \quad x = 28.67$

5 Which of the following is a balanced equation for the synthesis of ammonia (NH₃)?

- A $N_2 + 3H_2 \xrightarrow{\text{heat/pressure}} 2NH_3$
 B $N_2 + H_2 \xrightarrow{\text{heat/pressure}} NH_3$
 C $N_2 + H_2 \xrightarrow{\text{heat/pressure}} 2NH_3$
 D $2N_2 + 3H_2 \xrightarrow{\text{heat/pressure}} 2NH_3$

Solution Number	Name	Formula of Solute	Concentration (%)
1	Ammonia	NH ₃	5.0
2	Glucose	C ₆ H ₁₂ O ₆	20.0
3	Calcium chloride	CaCl ₂	25.0
4	Hydrochloric acid	HCl	0.25

Weak
NON
Strong
strong

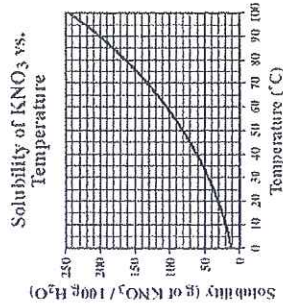


6 Some students did the experiments above to see what kind of solution conducts electricity and makes the light bulb glow. Which of the four solutions will MOST likely cause the light bulb to remain unlit?

- A 1
 B 2
 C 3
 D 4

7 A chemist is trying to dissolve a large crystal of magnesium sulfate (MgSO₄) in water by stirring the solution, but the crystal dissolves very slowly. What can the chemist do to speed up the process?

- A lower the temperature of the water
 B discontinue stirring the solution
 C pour off some of the MgSO₄ solution
 D break the crystal into smaller pieces



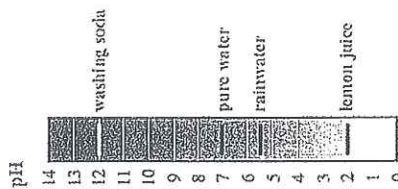
8 A chemist dissolved 120.00 grams of potassium nitrate (KNO₃) in 200 grams of boiling water. The solution was allowed to cool. According to the above solubility curve, at what temperature should the KNO₃ begin to precipitate?

- A 18°C
 B 39°C
 C 65°C
 D 88°C

9 Which of the following substances, when dissolved in water, will turn red litmus paper blue?

- A KOH
 B NaCl
 C H₂O
 D H₂SO₄

Base
[ends in OH]
typically



10 The strip chart above shows the pH of some common substances. Which substance is basic?

- A lemon juice
 B rainwater
 C pure water
 D washing soda

Sample Questions for Content Domain III

This section has some sample questions for you to try. After you have answered all of the questions, check your answers in the "Answers to the Content Domain III Sample Questions" section that follows. That section will give you the correct answer to each question and will explain why the other answer choices are incorrect.

- 1 Which energy transformation takes place when a match is struck against the side of a matchbox and bursts into flames?
- A electrical energy → light energy
 - B heat energy → kinetic energy
 - C chemical energy → heat energy**
 - D potential energy → electrical energy

- 2 Conduction can BEST be described as the transfer of heat energy by

- A waves traveling through empty space
- B fluids traveling through other fluids
- C gases expanding within a fluid medium
- D atoms colliding with their neighbors**

- 3 A 0.0150 kg cylinder of zinc cooled from 100.0°C to 20.0°C. The metal lost 466 J of heat energy. What is the specific heat capacity of the zinc?

- A 311 $\frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$
- B 388 $\frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$**
- C 559 $\frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$
- D 1550 $\frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$

solve for

$$Q = mc\Delta T$$

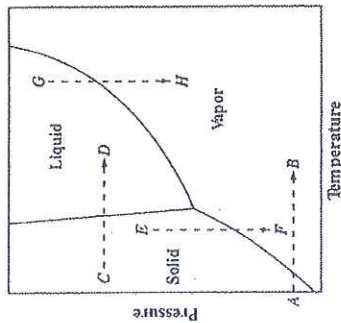
$$Q = 466 \text{ J}$$

$$m = 0.015 \text{ kg}$$

$$\Delta T = 100 - 20 = -80^\circ$$

$$\frac{Q}{m\Delta T} = c \quad \frac{466}{0.015 \times 80^\circ}$$

- 4 Use the following phase diagram for water to answer the question.



Some ice crystals are released from the space shuttle into the near vacuum of space. Solar radiation causes a phase change. Which path indicated in the diagram BEST illustrates what happens to the ice crystals?

- A AB
- B CD
- C EF
- D GH

solid → gas

- 5 The following advertisement shows some data about a new car.



What is the magnitude of the average acceleration of the car?

- A 1.2 m/s²
- B 2.0 m/s²
- C 3.6 m/s²**
- D 8.0 m/s²

$$a = \frac{v_f - v_i}{t}$$

$$a = \frac{27 \text{ m} / 7.5 \text{ s} = 3.6$$

- 6 On the Moon, gravity causes a rock hammer to fall more slowly to the ground than on Earth. Which lunar factor causes the slower rate of fall?

- A smaller radius
- B slower rotation
- C lower density
- D lesser mass**

- 7 A stone is carried up Mount Everest, elevation 8850 meters. The weight of the stone decreases while the mass of the stone remains constant. The BEST explanation for this difference is that the mass is unaffected by outside forces, while the weight is influenced by the
- A weaker gravitational force
 - B lower density of air
 - C weaker magnetic field
 - D lower air temperature

- 8 A lever is used to lift a box, as shown in the diagram below.



What is the mechanical advantage of the lever?

- A 4
- B 5
- C 10
- D 25

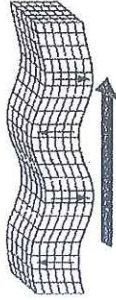
$$\frac{Res. F}{Eff. F} = MA$$

$$\frac{1000N}{200N} = 5$$

Sample Questions for Content Domain IV

This section has some sample questions for you to try. After you have answered all the questions, check your answers in the “Answers to the Content Domain IV Sample Questions” section that follows. That section will give you the correct answer to each question and will explain why the other answer choices are incorrect.

- 1 The following diagram shows a type of earthquake wave called an s-wave.

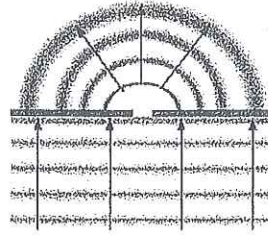


Besides the wave, what else is moving to the right?

- A rocks in the wave
 - B the wavelength
 - C energy of the wave
 - D electromagnetic waves
- 2 A system of filters gradually turns a beam of orange light ($f = 5.0 \times 10^{14}$ Hz) into green light ($f = 6.0 \times 10^{14}$ Hz). Which of the following experiences an increase during the color change?
- A wavelength of the wave
 - B speed of the wave
 - C average number of photons
 - D average energy of the photons

- 3 Sound waves and ultraviolet light waves both share the property of being able to
- A move through space
 - B travel at $300,000 \frac{m}{s}$
 - C carry energy
 - D propagate through rock

- 4 The following diagram shows what happens to some water waves.



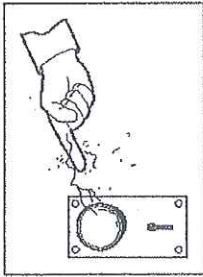
What process are the waves undergoing?

- A refraction
- B diffraction
- C reflection
- D interference

- 5 A truck is blowing its horn as it approaches a bystander at an intersection. According to the Doppler Effect, the bystander will notice that the sound

A decreases in frequency
 B increases in wavelength
 C increases in pitch
 D decreases in speed

- 6 Use the diagram to answer the question.



A person received an electrical shock when reaching for the metal door knob. The shock was caused by the

A high number of electrons on the door knob
 B discharge of an imbalance of electrons
 C highly conductive surface of the door knob
 D low resistance of the person's skin

- 7 What is the resistance of an electrical device that allows a current of 10 amperes with 120 volts?

A 12 Ω
 B 110 Ω
 C 130 Ω
 D 1200 Ω

$$V = IR$$

$$R = \frac{V}{I} = \frac{120V}{10A} = 12\Omega$$

- 8 When a loop of wire is turned at a right angle to Earth's magnetic field, the wire and magnetic field will create a weak

A electric transformer
 B electromagnet
 C electric motor
 D electric generator