1. Which substance has a definite shape and a definite volume at STP?
   1) NaCl(aq)  2) Cl₂(g)  3) CCl₄(ℓ)  4) AlCl₃(s)

2. Which two particle diagrams represent mixtures of diatomic elements?

   **Key**
   - ○ = atom of one element
   - • = atom of another element

   ![Diagram A](attachment:DiagramA.png)  ![Diagram B](attachment:DiagramB.png)  ![Diagram C](attachment:DiagramC.png)  ![Diagram D](attachment:DiagramD.png)

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

3. Given the diagrams X, Y, and Z below:

   ![Diagram X](attachment:DiagramX.png)  ![Diagram Y](attachment:DiagramY.png)  ![Diagram Z](attachment:DiagramZ.png)

   **Key**
   - Atom of element A = ○
   - Atom of element B = •

   Which diagram or diagrams represent a mixture of elements A and B?
   1) X, only  2) Z, only  3) X and Y  4) X and Z

4. Which of these contains only one substance?
   1) distilled water  2) sugar water  3) saltwater  4) rainwater

5. Which particle model diagram represents only one compound composed of elements X and Z?

   **Key**
   - □ = atom of element X
   - ○ = atom of element Z

   ![Diagram 1](attachment:Diagram1.png)  ![Diagram 2](attachment:Diagram2.png)  ![Diagram 3](attachment:Diagram3.png)  ![Diagram 4](attachment:Diagram4.png)

   1)  2)  3)  4)
6. Which particle diagram represents one pure substance, only?

1) 2) 3) 4)

7. When sample $X$ is passed through a filter paper a white residue, $Y$, remains on the paper and a clear liquid, $Z$, passes through. When liquid $Z$ is vaporized, another white residue remains. Sample $X$ is best classified as

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

8. Matter is classified as a

1) substance, only
2) substance or as a mixture of substances
3) homogenous mixture, only
4) homogenous mixture or as a heterogeneous mixture

9. Given the particle diagram representing four molecules of a substance:

Which particle diagram best represents this same substance after a physical change has taken place?

1) 2) 3) 4)

10. Which particle diagram represents a mixture of element $X$ and element $Z$, only?

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bullet$ = atom of $X$</td>
</tr>
<tr>
<td>$\circ$ = atom of $Z$</td>
</tr>
</tbody>
</table>

1) 2) 3) 4)
11. Which particle diagram represents a sample of one compound, only?

![Particle Diagrams]

1. 2. 3. 4.

12. Which particle diagram represents a mixture of an element and a compound?

![Particle Diagrams]

1. 2. 3. 4.

13. When a mixture of water, sand, and salt is filtered, what passes through the filter paper?

1) water, only  
2) water and sand, only  
3) water and salt, only  
4) water, sand, and salt

14. Which process represents a chemical change?

1) melting of ice  
2) corrosion of copper  
3) evaporation of water  
4) crystallization of sugar

15. Which diagram best represents a gas in a closed container?

1. 2. 3. 4.

16. 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

17. Which type of matter is composed of two or more elements that are chemically combined in a fixed proportion?

1) solution  
2) compound  
3) homogeneous mixture  
4) heterogeneous mixture
18. Particles are arranged in a crystal structure in a sample of
   1) \( \text{H}_2(\text{g}) \)          2) \( \text{Br}_2(\text{l}) \)          3) \( \text{Ar}(\text{g}) \)          4) \( \text{Ag}(\text{s}) \)

19. A sample is prepared by completely dissolving 10.0 grams of \( \text{NaCl} \) in 1.0 liter of \( \text{H}_2\text{O} \). Which classification best describes this sample?
   1) homogeneous compound
   3) heterogeneous compound
   2) homogeneous mixture
   4) heterogeneous mixture

20. Given the balanced particle-diagram equation:

   ![Particle Diagram](image)

   Which statement describes the type of change and the chemical properties of the product and reactants?
   1) The equation represents a physical change, with the product and reactants having different chemical properties.
   2) The equation represents a physical change, with the product and reactants having identical chemical properties.
   3) The equation represents a chemical change, with the product and reactants having different chemical properties.
   4) The equation represents a chemical change, with the product and reactants having identical chemical properties.

21. Given the simple representations for atoms of two elements:

   ![Element Representations](image)

   Which particle diagram represents molecules of only one compound in the gaseous phase?
   1) ionization
   2) combustion
   3) filtration
   4) sublimation

22. At room temperature, a mixture of sand and water can be separated by
   1) ionization
   2) combustion
   3) filtration
   4) sublimation

23. a Draw two different compounds, one in each box, using the representations for atoms of element \( X \) and element \( Z \) given below.

   Atom of element \( X = \) \( \bigcirc \)
   Atom of element \( Z = \) \( \bullet \)

   b Draw a mixture of these two compounds.
24. Base your answer to the following question on the information below.

The particle diagrams below represent the reaction between two nonmetals, $A_2$ and $Q_2$.

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>● = Atom of element $A$</td>
</tr>
<tr>
<td>○ = Atom of element $Q$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reactants</th>
<th>Product</th>
</tr>
</thead>
</table>

Compare the total mass of the reactants to the total mass of the product.

Base your answers to questions 25 and 26 on the particle diagrams below, which show atoms and/or molecules in three different samples of matter at STP.

<table>
<thead>
<tr>
<th>Key</th>
</tr>
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<tbody>
<tr>
<td>☐ = atom of $x$</td>
</tr>
<tr>
<td>● = atom of $y$</td>
</tr>
<tr>
<td>○ = atom of $z$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Sample 3</th>
</tr>
</thead>
</table>

25. Explain why (x)(x) does not represent a compound.

26. Which sample represents a pure substance?

27. The vapor pressure of ethanol at its normal boiling point is
   1) 80 kPa  
   2) 100 kPa  
   3) 101.3 kPa  
   4) 273 kPa

28. When the vapor pressure of a liquid is equal to the atmospheric pressure, the liquid will
   1) freeze  
   2) boil  
   3) melt  
   4) condense

29. What is the vapor pressure of water at 105°C?
   1) .60 kPa  
   2) 101.3 kPa  
   3) 120 kPa  
   4) 145 kPa

30. Which sample of water has the greatest vapor pressure?
   1) 100 ml at 20°C  
   2) 200 ml at 25°C  
   3) 20 ml at 30°C  
   4) 40 ml at 35°C
31. Base your answer to the following question on the diagrams below of four sealed flasks, each of which contains H₂O(ℓ) at the temperature shown.

![Flasks Diagram](image)

In which flask is the equilibrium vapor pressure of water the greatest?

1) 1  2) 2  3) 3  4) 4

32. Using your knowledge of chemistry and the information in Reference Table H, which statement concerning propanone and water at 50°C is true?

1) Propanone has a higher vapor pressure and stronger intermolecular forces than water.
2) **Propanone has a higher vapor pressure and weaker intermolecular forces than water.**
3) Propanone has a lower vapor pressure and stronger intermolecular forces than water.
4) Propanone has a lower vapor pressure and weaker intermolecular forces than water.

33. The chart below shows the change in vapor pressure of four pure liquids with increasing temperature. Which liquid has the *lowest* normal boiling point?

![Vapor Pressure Chart](image)

1) A  2) B  3) C  4) D

34. A beaker contains both alcohol and water. These liquids can be separated by distillation because the liquids have different

1) boiling points  2) densities  3) particle sizes  4) solubilities

35. Recovering the salt from a mixture of salt and water could best be accomplished by

1) evaporation  3) paper chromatography
2) filtration  4) density determination


1. 4
2. 2
3. 2
4. 1
5. 3
6. 1
7. 3
8. 2
9. 1
10. 4
11. 4
12. 4
13. 3
14. 2
15. 1
16. 4
17. 2
18. 4
19. 2
20. 3
21. 3
22. 3
23. \[ \begin{array}{c}
   \text{a} \\
   \text{b}
\end{array} \]
24. \textit{Examples:} — The total mass of reactants equals the total mass of product. — Mass of reactants equals mass of product. — Mass is conserved.
25. Acceptable responses:
   A compound must contain two or more different elements, only 1 kind of atom present.
26. Allow credit for 3.
27. 3
28. 2
29. 3
30. 4
31. 4
32. 2
33. 1
34. 1
35. 1