

CHEMISTRY 11 – PROPERTIES OF MATTER WORKSHEET

- 1) Classify the following observations as *quantitative* or *qualitative* by placing a checkmark in the correct column.

Observation	Quantitative	Qualitative
The melting point of paradichlorobenzene is 53.5°C	✓	
Mercury (II) oxide is a deep red powder		✓
The density of scandium metal is 2.989 g/cm ³	✓	
Copper metal may be pulled into a wire (it is ductile)		✓
Silver metal forms a black layer of tarnish over time		✓
Zinc has a specific heat capacity of 388 J/(kg•K)	✓	
Oxygen gas supports combustion		✓
Changes to Br ₂ (l) at – 7.2°C	✓	
Attracts to a magnet		✓
Fractures into cubic crystals		✓

- 2) List the defining physical properties of each phase of matter: solids, liquids and gases.

Solids have a fixed shape and volume. The particles have very small spaces between each other and can therefore only vibrate. Each particle bounces around pushing the ones surrounding it outward. The particles have not spread far enough apart for any particles to fit through a gap between the particles surrounding it, so the structure remains intact.

Liquids have a fixed volume but their shape depends on the container that they are in. The particles have slightly larger spaces between them. The particles are travelling faster and striking each other harder. As a result they have spread apart to an extent where they can slip by one another.

Gases shape and volume depends on the container that they are in. The particles have the largest amount of space between them. The particles have been struck with enough force to escape their attractions to the other particles therefore they are now either too far apart or moving too fast for their attractions to affect their movement.

- 3) Colour is a physical property that MAY distinguish between two solids, two liquids or two gases. Suggest as many other physical properties as you can which might also distinguish between two:

(a) solids

density, melting temperature, lustre, malleability, ductility, electrical and heat conductivity, hardness, smell, taste

(b) liquids

density, boiling temperature, freezing temperature, diffusion rate, viscosity, electrical and heat conductivity, smell, taste

(c) gases

density, condensation temperature, diffusion rate, heat conductivity, smell, viscosity

4) State whether each phrase refers to a physical or chemical property.

(a) Glass is transparent physical

(b) Changes of state or form physical

(c) Relationships or interactions between matter and energy physical

(d) Adding lye to fat makes soap chemical

(e) Only evident through a chemical reaction or a lack thereof chemical

(f) Copper conducts electricity physical

(g) Dependent solely on the relationships between the material's own particles physical

(h) Relationships or interactions between different forms of matter chemical

(i) Fumes from ammonia and hydrochloric acid mix to produce a white smoke chemical

5) Composite materials (or just composites) consist of two or more constituent materials that adhere to each other but remain separate and distinct (for example, they could be layered on each other). Why do you think manufacturers sometimes use composite materials in their products?

Composite materials would be used to get a combination of properties not possible in a single material

6) Which of the following are intensive properties and which are extensive?

(a) Shape extensive

(b) Smell intensive

(c) Length extensive

(d) Colour intensive

(e) Electrical conductivity intensive

(f) Time required to dissolve a solid extensive

(g) Hardness intensive

(h) Temperature intensive

(i) Thermal expansion (the change in volume in response to a change in temperature) extensive

7) Classify each of the following as either a chemical change (primarily) or a physical change.

(a) the formation of fog

physical

(b) burning a cigarette

chemical

(c) crumpling a sheet of paper

physical

(d) the sprouting of a seed

chemical

(e) digesting food

chemical

(f) melting an ice cube

physical

(g) breaking a bottle

physical

(h) the rusting of iron

chemical

(i) mixing acid and base

chemical

(j) casting silver into a mold

physical

(k) milk going sour

chemical

(l) mixing yellow and blue paint to make green paint

physical

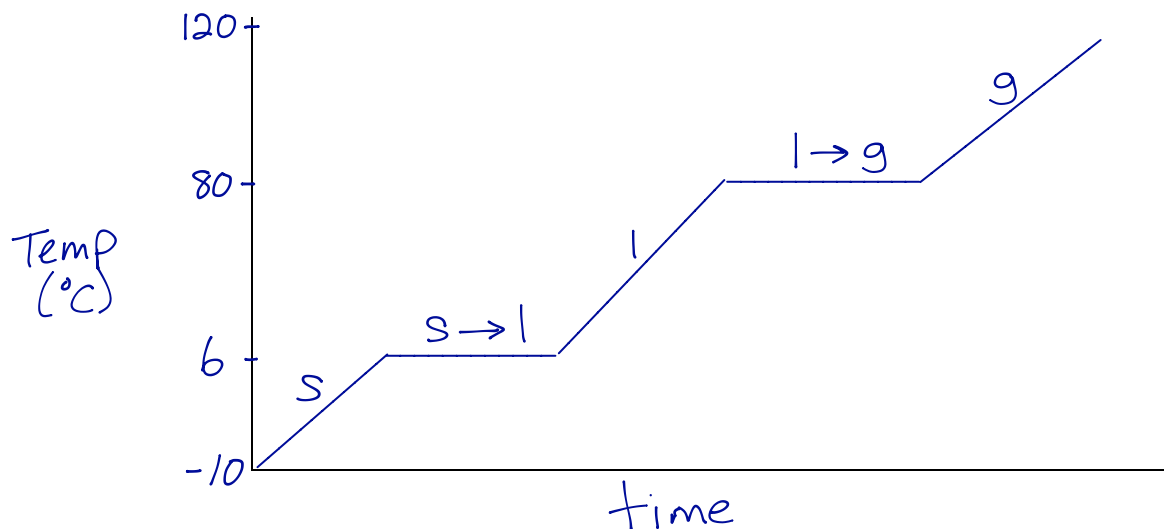
(m) mixing sand and water

physical

(n) separating an alcohol-water mixture into water and alcohol

physical

8) Benzene melts at 6°C and boils at 80°C . Plot a graph showing the temperature vs. time behaviour of benzene as its temperature is raised from -10°C to 120°C . Label the axes and indicate the phases present on each portion of the graph. No scale needs to be specified for the time axis.

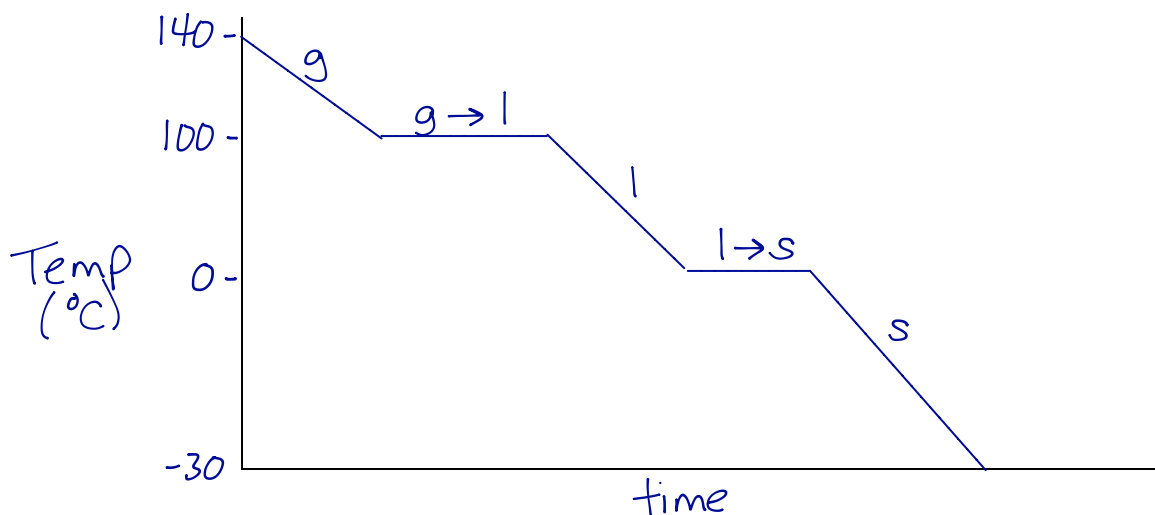


9) A sample of ice was melted by a steady supply of heat and after 20 minutes was completely melted. What was the approximate composition of the sample after

(a) 5 minutes? 25% liquid & 75% solid

(b) 15 minutes? 75% liquid & 25% solid

- 10) Water freezes at 0°C and boils at 100°C . Plot a graph showing the temperature vs. time behaviour of steam as its temperature is lowered from 140°C to -30°C . Label the axes and indicate the phases present on each portion of the graph. No scale needs to be specified for the time axis.



- 11) Which is greater, a substance's heat of fusion or its heat of vaporization? Explain in terms of relationships why this would be expected.

Heat of vaporization would be greater since the particles in the liquid state are not much farther apart than they are in the solid state whereas particles in the gas state are much farther apart than they are in the liquid state (there is a much greater increase in the amount of potential energy going from a liquid to a gas than going from a solid to a liquid).

- 12) Which is greater, a substance's heat of vaporization or its heat of combustion? Explain in terms of relationships why this would be expected.

Heat of combustion would be greater since the heat of combustion requires the rearrangement of atoms to form new molecules, whereas the heat of vaporization simply requires the rearrangement of the position of the molecules within the liquid (chemical changes generally involve much more energy than physical changes).

- 13) Complete the following flowchart showing the changes of state:

