

Changes in matter

1. Does each of the following phenomena describe a physical change, a chemical change or a nuclear transformation? Explain your answers.
- Litmus paper turns red in a vinegar solution.
 - A rail on a railway track expands on a hot day.
 - Skin tans when exposed to ultraviolet rays from the sun.
 - The sun shines because its mass decreases by 6.3×10^{14} kg every second.
 - An egg cooks in a frying pan.
 - Salt scattered on roads deices them.

Chemical changes: *The phenomena in a), c) and e) are chemical changes because the nature and properties of the matter are altered and new molecules are formed.*

Physical changes: *The phenomena in b) and f) are physical changes because the nature and properties of the matter are not altered. It is still composed of the same molecules.*

Nuclear transformations: *The phenomenon in d) is a nuclear transformation because atomic nuclei unite to form new elements.*

[___ /6]

2. Identify the chemical changes in the following list, and for each change, write at least one sign that justifies your choice.
- A candle burns, making the wax melt.
 - Frost forms on a car windshield in winter.
 - Vinegar makes milk curdle.
 - Iron turns red when heated.
 - Wild strawberries ripen at the end of June.
 - Sugar crystals form in syrup that is too thick.
 - Baking powder makes a cake rise.



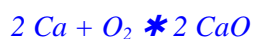
Chemical change	Sign
a)	<i>Emission of heat, light or a gas</i>
c)	<i>Formation of a precipitate</i>
e)	<i>Change in colour</i>
g)	<i>Release of a gas</i>

[___ /4]

3. Write the chemical equation for each of the following reactions. Make sure your equations are consistent with the law of conservation of mass.

a) Production of lime:

Calcium (Ca) reacts with molecular oxygen (O₂) to form calcium oxide.



b) Production of alumina:

Aluminum (Al) reacts with molecular oxygen (O₂) to form aluminum oxide.



c) Production of magnetite:

Iron (Fe) reacts with molecular oxygen (O₂) to form iron oxide.



[___ /6]

4. Jonathan really likes to ask his students riddles in the form of lab demonstrations. The following are two examples:

A. In a porcelain crucible, he heats 10 g of a reddish metallic powder for three minutes at high heat, stirring all the while. The powder turns black. The mass of the hot powder is 10.2 g. After half an hour, the cooled powder is still black, and its mass is still 10.2 g.

B. In a porcelain crucible, he heats 10 g of a blue salt for three minutes at high heat, stirring all the while. The salt turns white. The mass of the hot salt is 8.4 g. After half an hour, the cooled salt turns blue again, and its mass is now 10.0 g.

a) In which of the two demonstrations does a chemical change occur? Explain your answer.

A chemical change occurs in demonstration A because the colour of the powder changes and its mass increases. Another substance has therefore combined with the powder.

b) What type of chemical change does this reaction illustrate?

The reaction is an example of combustion (or oxidation).

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5. Complete and balance the following equations for neutralization reactions.

- a) $\text{HCl} + \underline{\text{KOH}} * \text{KCl} + \text{H}_2\text{O}$
b) $\text{HNO}_3 + \text{NaOH} * \underline{\text{NaNO}_3} + \underline{\text{H}_2\text{O}}$
c) $\underline{2 \text{HBr}} + \text{Mg}(\text{OH})_2 * \text{MgBr}_2 + \underline{2 \text{H}_2\text{O}}$

[___ /3]

6. Which part of the triangle of fire are firefighters tackling in each of the following situations? Explain your answers.

- a) Firefighters at an airport pour foam onto a pool of flammable liquid spilled by an airplane in distress.

The firefighters are smothering the oxidizing agent because the foam will block any contact with oxygen in the air.

- b) Firefighters spray water onto the roofs and sides of two houses next to a blaze.

The firefighters are preventing fuel from reaching its ignition temperature because water will prevent structures surrounding the fire from reaching this point.

- c) During a forest fire, firefighters begin clear-cutting a threatened area. They cut a 50-m-wide stretch of forest a few kilometres ahead of the fire.

The firefighters are removing the fuel. When the fire reaches the clear-cut area, there will be no more fuel—trees, in this case—to burn.

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7. Fires are often caused by a pan of oil left unsupervised on a stove element. Which type of combustion occurs in this situation? Explain your answer.

In this situation, spontaneous combustion occurs because the heat from the stove element brings the oil to its ignition temperature, and it then spontaneously bursts into flames.

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8. Gases are more soluble in cold water than in warm water. The abundant fishing grounds of the North Atlantic, especially the banks of Newfoundland, illustrate this phenomenon. One of the risks of climate change is that such cold ocean waters will warm up, causing a drop in phytoplankton activity. Phytoplankton are microorganisms living on the surface of ocean waters, at a depth of no more than 15 m. They act like plants and are unquestionably the most important of all producers—more important than all the forests on Earth combined. The balance of gases around the world depends on them, making them vital to the survival of most living species.



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- a) Name the chemical reaction that occurs in phytoplankton and write a balanced equation for it.

The chemical reaction that occurs in phytoplankton is photosynthesis.

The balanced chemical equation for photosynthesis is:



- b) Explain how a loss of phytoplankton productivity can affect other living species on Earth.

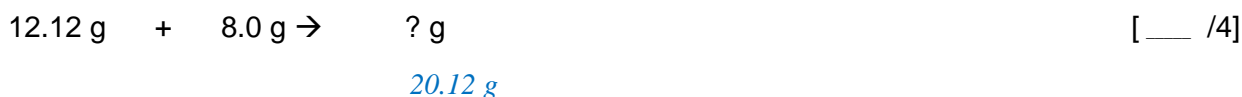
Phytoplankton produce the energy and oxygen needed for cellular respiration in organisms at the bottom of the food chain. A drop in these populations leads to a food shortage for all species and, consequently, to a drop in the number of individuals that survive.

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9. Using the law of conservation of mass, answer the following questions.

- a) Assuming that magnesium and oxygen will react completely with one another, predict the mass of magnesium oxide that will be produced.

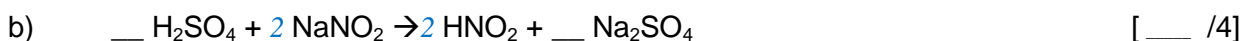
Magnesium + Oxygen → Magnesium Oxide



- b) Predict the mass of oxygen that will be left after the reaction of 48.6 grams of magnesium with 50.0 grams of oxygen, if 80.6 grams of magnesium oxide is produced.

Magnesium + Oxygen ---→ Magnesium Oxide

10. Balance the following equations.



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