

Topic 3.2 Assessment

Check Your Understanding Answers

Understanding Key Ideas

1. The nature of the chemical bonds in the reactants and products determine the amount of energy transformed in a chemical reaction.

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BC Science Connections 10 Teaching Notes Topic 3.2 How is energy transformed?

2. a) true b) true

c) false, Correction: Energy released in a chemical reaction is sometimes/often thermal energy.

d) false, Correction: If the reactants are lower in chemical potential energy than the products, energy is absorbed from the surroundings during the reaction. OR If the reactants are higher in chemical potential energy than the products, energy is released by the system during the reaction.

e) true

3. Your body does not burn in cellular respiration because the overall reaction takes place in small, controlled steps.

4. a) Energy transformation in fossil fuel combustion and fuel cells are similar because they both involve combustion reactions that release energy. Both can also be used to generate electrical energy or run a vehicle motor.

b) Fuel cells emit fewer pollutants than fossil fuel combustion. Fossil fuel combustion burns fossil fuels such as coal, oil, and gas, while fuel cells burn hydrogen.

5. a) A radioactive isotope is an isotope that has too many neutrons compared to protons. As a result, it has too much energy and is unstable.

b) The nuclei of some radioactive isotopes decay by emitting alpha particles (alpha decay) or beta particles (beta decay), along with gamma rays (gamma decay). This decay enables the radioactive isotopes to get rid of their extra energy. Radioactive isotopes also play a role in nuclear fission reactions in that the fission reactants and products are radioactive isotopes. They also play a role in fusion reactions. Although the final products are not radioactive isotopes, helium-5 is. (Tritium is also a radioactive isotope, but this is not mentioned in the Concept.) Diagrams could indicate the roles radioactive isotopes play in alpha, beta, or gamma decay, or nuclear fission or fusion.

6. a) Possible answers: a nuclear reaction, nuclear decay, beta decay

b) Possible answers: a beryllium nucleus/atom or a stable isotope, a beta particle or electron, and energy c) Possible answers: much more energy is transformed than in a nuclear reaction; atoms of an element are transformed into atoms of another element, while in a chemical reaction atoms stay the same; radiation is often given off, while it is not given off in a chemical reaction; radioactive isotopes lose energy to become more stable, while this does not occur in a chemical reaction.

Connecting Ideas

7. Cellular respiration and photosynthesis are reverse processes of each other. Photosynthesis uses carbon dioxide, water, and energy to produce oxygen and glucose, while in cellular respiration, glucose and oxygen react to produce carbon dioxide, water, and energy.

8. A chain reaction is necessary for fission to generate electrical energy because it causes many further reactions. Several neutrons are produced, along with energy and radioactive isotopes, in the initial reaction. Each neutron can split a neighbouring uranium-235 nucleus, and each of these produces three more neutrons and more energy and radioactive isotopes. This dramatically increases the amount of energy

transformed in a nuclear reactor, which controls the chain reaction and the energy released, which is transformed into electrical energy.

9. The process carried out in a photovoltaic cell is similar to what occurs in vision as follows: both use the transformation of light energy to carry out a useful task, both involve changes in the behaviour of electrons, both result in movement of some sort, both involve electrical energy

Making New Connections

10. a) Nuclear fission is used to generate electrical energy in Canada, but fusion is not because scientists have not yet succeeded in finding a way to control fusion to produce electrical energy on Earth.

b) Two benefits of using fusion to generate electrical energy include that fusion produces more energy per unit mass than fission, and it does not produce radioactive nuclear waste, because fusion does not produce radioactive isotopes.

c) Student answers should state their opinion as to whether fusion or fission will generate electrical energy by the end of the century and support that opinion with sound reasoning.

11. It is correct to state that we are all nuclear powered. Humans use chemical potential energy to carry out their body functions. This energy was transformed from solar energy through photosynthesis. Solar energy is generated in nuclear fusion reactions in the Sun. Hence, we are nuclear powered.