

4. Cogeneration is the process of using waste energy from one process to power a second process.
5. Sustainable: any process that supplies the needs of today's society without compromising the needs of future generations.
6. Fossil fuels are considered indirect solar energy sources because they were formed from the process of photosynthesis, which involves solar energy, in plants millions of years ago.
7. Photosynthesis converts solar energy to stored chemical energy directly. A windmill relies on solar energy to heat Earth's surface air first, creating convection currents of air, which then turn the turbines of a windmill.
8. Biomass is considered renewable because it can be replaced in a relatively short period of time.
9. The three factors are: an increasing population, an increasing demand for energy, and the reliance on non-renewable sources of energy.
10. An energy crisis happens when the reserves of available energy sources are depleted.
11. Two short-term solutions are to search for new reserves of fossil fuels and reduce the rate of consumption of existing fossil fuel reserves.
12. The most practical solution is to use our available non-renewable energy sources more efficiently, and to search for new, more sustainable energy sources.
13. Students' answers will vary, but should include some of the following.
Costs of developing thermal power stations:
 - Fossil fuels cannot be replaced.
 - Combustion results in thermal pollution in the air.
 - Combustion results in emissions of harmful gases.
 - Fossil fuels are needed for the production of other materials such as fertilizers and chemicals.
 - Reserves are dwindling, which leads to global uncertainties and political unrest.
 Benefits of developing thermal power stations:
 - Fossil fuels are accessible in many places in the world.
 - Fossil fuels can be transported in large quantities via tanker or pipeline.
 - Fossil fuels can be transformed into other forms of energy through a relatively simple process of combustion.
 - Fossil fuels store a great deal of chemical potential energy.
 - Fossil fuels are affordable as an energy supply.
14. Students' answers will vary but could include the following:
Advantages of a "user pay" tax:

- The cost will fall only on the users and not the rest of society.
- The tax will lead to increased conservation of energy.
- The tax will force users to become more efficient.

Disadvantages:

- The tax will increase the cost of energy.
- The tax would be difficult to administer and monitor.
- The tax does not solve the problem of an energy crisis.

Student Book pages 228

B3.0 Section Review

Knowledge

1. Heat is converted to mechanical energy in a heat engine.
2. Heat flows naturally from hot objects to cold objects. In the process of heat transfer, some energy is always lost to heat.
3. In a perpetual motion machine, no energy is lost to the surroundings during energy transfers in the device.
4. When you form a snowball, heat is flowing from your hands to the snow.
5. A thermo-electric converter has two strips of different metals joined at a junction. When the two strips are at different temperatures, heat flows from the warmer metal to the colder one. This flow of heat creates an electrical current that can be converted to mechanical energy in the motor.
6. Animals, wind, and moving water were used to operate pre-industrial simple machines.
7. Students' answers will vary but could include the following:
Benefits of non-renewable energy sources:
 - easily obtainable
 - found in almost all places in the world
 - transportable in large quantities relatively cheaply
 Costs of non-renewable energy sources:
 - harmful because of combustion products
 - wasteful of thermal energy
 - not sustainable
8. Southern Alberta has strong and steady winds due to the prevailing westerlies over the Rocky Mountains.

Applications

9. Students' answers will vary but may be similar to the following. A light bulb converts electrical

energy to light energy but most of the electrical energy is lost as heat. The heat and the light produced must equal the amount of input electricity.

10. Assuming that the floor does not absorb any of the energy from either ball, the steel ball will rise higher because it does not deform as much as the rubber ball when it hits the floor. But as the rubber ball deforms, its kinetic energy is converted to elastic potential energy, and during the deformation, energy is lost to heat. This is an application of the first law of thermodynamics.
11. This violates the first law of thermodynamics. You can never get more out of a system than you put in. Energy can never be created.
12. Hydro generation can be up to 75% efficient while thermal generation is only up to 15% efficient because in thermal generating stations, most of the energy from combustion is lost to heat. This is the waste energy. The useful energy is only the amount of electrical energy produced.
13. A 25% efficiency means that only one quarter of the total energy input is converted to useful energy output.
14. a) $\text{heat output} = \text{efficiency} \times \text{heat input}$
 $= (0.35)(1000 \text{ J})$
 $= 350 \text{ J}$
 $= 3.5 \times 10^2 \text{ J}$
b) The rest of the energy is wasted in the form of heat.
15. The energy crisis is the depletion of our energy sources.
16. The current solution is to try to find new reserves of non-renewable sources of energy, conserve energy, and try to become more efficient.
17. Students' answer will vary but could include the following:
 - a) Residential sector: better insulation of homes
 - b) Commercial sector: energy-efficient office equipment
 - c) Industrial sector: more efficient machines and cogeneration where possible
 - d) Transportation sector: more fuel-efficient vehicles or rail
18. Increasing energy conservation and energy efficiency means we use less non-renewable energy but we are still using them up.
19. A better solution to the energy crisis is to develop a new source of energy that is renewable.
20. Alberta power plants use non-renewable energy sources because there are large reserves of coal located near the thermal generating stations. They don't use wood because wood would have to be transported from great distances, depending on the location of the cutting areas.

Extensions

21. Because cold air falls, the cold air from the freezer compartment was used to cool food in lower compartments.
22. They are related because the greater the efficiency, the less energy is used so more is conserved.
23. It can be made more efficient by installing better insulation on the hot-water heater, lowering the temperature of the hot water, and installing more efficient burners or elements.
24. Electric car motors do not have as much power as internal combustion engines and electric batteries run down too quickly.
25. To an environmentalist the term "sustainable development" means developing energy sources other than fossil fuels that will ensure a safe environment and an energy supply for future generations. To an oil industry employee, the term "sustainable development" means discovering new reserves for future generations.

Student pages 232–237

Unit B Review

Vocabulary

1. acceleration: change in velocity during a specific time interval
cogeneration: using the waste energy from one process to power another process
efficiency: the ratio of the useful energy output to the total energy input
energy: the ability to do work
first law of thermodynamics: the total amount of energy, including heat, in a system and its surroundings always remains constant
force: a push or pull
heat: the transfer of thermal energy
kinetic energy: energy due to the motion of an object
law of conservation of energy: energy can never be created nor destroyed but can be converted from one form to another.
potential energy: energy due to the position of an object relative to another object (e.g., gravitational potential energy results from an object's position relative to Earth's surface)
second law of thermodynamics: heat flows naturally from hot to cold objects and in the process can be made to do work; during this process some energy is always lost as heat