

Answers to Unit 3 Review Questions

1. Type: nonrenewable

Example for renewable energy source: Students' answers could include sunlight; moving water such as river flow, tides, and waves; geothermal sources, and biomass. Note that wind is already given as an example on the graphic organizer provided in the question.

Example for nonrenewable energy source: Students' answers could include nuclear sources such as uranium, and fossil fuels such as coal or natural gas.

3. Students' answers will likely be similar to the example sentences given below.

a) Example 1: According to the law of electric charge, negative charges and positive charges attract each other.

Example 2: The law of electric charge states that opposite charges like negative charges and positive charges attract each other. It also states that a negative charge repels all other negative charges and a positive charge repels all other positive charges.

b) Example 1: Ohm's law states that the voltage (electrical potential difference) between two points in a circuit equals the current times the resistance between those two points.

Example 2: Ohm's law explains the relationship between voltage, current, and resistance.

c) Example 1: Current can flow through a load in a closed circuit.

Example 2: When a switch is closed in a circuit, the circuit is called a closed circuit. Current can then flow through the circuit and the load in the circuit transforms electrical energy into another form of energy.

d) Example 1: A smart meter is an electrical energy meter that measures how energy use changes in a building over the day. An EnerGuide label gives details about how much electrical energy an appliance uses in a year of normal use.

Example 2: A smart meter and an EnerGuide label are tools that help people use electrical energy more sustainably.

4. a) Students should identify the light bulbs as the loads, the battery as the source, and the open switch as the switch. Direction of current flow is from the negative terminal through the circuit to the positive terminal. [Note to teacher: The direction of flow of electrons is considered the direction of the flow of current. At this level, positive current is not used.]

b) Students may correctly identify the circuit as a parallel circuit or an open circuit, or both.

6. a) Mechanical energy is the sum of kinetic energy and potential energy.

b) A geothermal generating station uses thermal energy from molten rock, which comes close to the surface where Earth's crust is thin, to heat liquid water and convert it to steam. The steam turns turbines to generate electrical energy.
7. It is technically incorrect to refer to a generator system as a generator because a generator is actually one of three parts of the generator system. The generator transforms the kinetic energy of the spinning shaft of the generator system into electrical energy.
8. a) In nuclear fusion reactions, new atoms are made as smaller atoms collide and fuse. In nuclear fission reactions, new atoms are made by splitting larger atoms.

b) nuclear fission
9. The law of electric charge states that opposite charges attract each other and like charges repel each other. This law applies to all individual charges. Every negative charge attracts every positive charge. In the same way, every negative charge repels every other negative charge, and every positive charge repels every other positive charge.
10. The analogy of a worker can be used to explain how chemical energy does work to create an electrical potential difference if the worker represents chemical energy released in chemical reactions. The analogy explains how charges are separated and gain electrical potential energy as a cell becomes charged. A worker carries electrons up a ladder and places them at the negative terminal. The worker leaves positively charged ions on the bottom at the positive terminal. The first electron is easy to carry up the ladder because only one pair of charges is being separated. The attraction is not very strong. After a few charges have been separated, all of the positive charges of the positively charged ions at the positive terminal are attracting the negative charge of the electron that the worker is carrying. As well, the negative charges of the electrons at the negative terminal are repelling the negative charge of the electron that the worker is carrying. So it takes more energy to carry each additional electron up the ladder. The worker (chemical energy) has done a lot of work to separate the charges. This energy is now stored in the electrical potential energy of the separated charges.
11. The AA and AAA "batteries" that people use in daily life are actually cells. A battery is a connection of two or more cells. Instead, a single cell is found inside AA and AAA "batteries."
12. The load shuts off when a switch is opened in a series circuit because once the switch is open there is no longer a closed path along which the current can flow. In order for current to flow in a circuit, it is necessary for the circuit to form a closed loop.
13. When the toque is removed from the person's head, two different materials rub together. Before they rubbed together, the material of the toque and the hair were electrically neutral. When they rubbed together, electrons were transferred from one material to the

other. As a result, the materials became electrically charged. One material lost electrons and became positively charged. The other material gained electrons and became negatively charged. The positive and negative charges attract each other and the hair sticks to the toque.

14. Students' answers could include the following:

Example 1: The voltage between two points in any circuit is the same as the value of the current and resistance multiplied together.

Example 2: The electrical potential difference between two parts of a circuit is equal to the current times the resistance between them.

Accept any answer that reflects a clear understanding of Ohm's law (in a student's own words): the electrical potential difference between two points in a circuit is equal to the current times the resistance between those two points.

15. a) A short circuit forms when a load is missing from a closed circuit. Without a load the resistance is too low. This can make the current dangerously high.

b) A short circuit might be dangerous if the current gets so high that the conductor gets very hot, possibly starting a fire. Thus, short circuits can become fire hazards if they occur within a building's wiring.

16. Answers should give one similarity and one difference. A series circuit is the same as a parallel circuit in that current flows through them both when they are closed. However, a series circuit has just one pathway through which current can flow, while current can flow along more than one pathway in a parallel circuit. A series circuit thus has no branches, while a parallel circuit does. As a result, any switch or burnt out load will open a series circuit, while this will not happen in a parallel circuit. Further, current is the same throughout a series circuit, while it is reduced in each branch of a parallel circuit. At a branch point in a parallel circuit, the current splits so that the sum of the currents in the branches is the same as the current in the single conductor before the branches. Another difference between the two types of circuits is that series circuits are typically not used in home wiring, while parallel circuits are.

17. When current encounters two branches of a parallel circuit it is reduced in each branch. At a branch point the current splits so that the sum of the currents in the branches is the same as the current in the single conductor before the branches.

18. The danger of running too many appliances on the same parallel circuit in a building is that when all the loads on the circuit are running, a large amount of current passes through the conductor near the source. Large amounts of current flowing through a wire produce a lot of heat, which can become a fire safety hazard.

19. The radio could have a phantom load that uses electrical energy when it is plugged in but not running. For example, it might have a light that shines to indicate it is plugged in,

a clock, or if it has a remote control, it may be in standby mode to receive the signal from the remote to turn on.

20. Hydroelectric dams use a renewable energy source.

21. Students' answers could include any of the examples below.

WAC Bennett Dam: Located on the Peace River, this large hydroelectric dam provides most of B.C.'s electrical energy.

The Klemtu Small-scale Hydro and Solar Project: Refers to a small-scale hydro generating station on Baron Lake and photovoltaic cells on the roof of the Kitasoo Community School.

Race Rocks Tidal Energy Project: Located southwest of Victoria in the Race Rocks Ecological Reserve, this is the first operating tidal current turbine in Canada.

Williams Lake Biomass Plant: This is the largest biomass generating station in North America. It burns wood waste from the forestry industry to generate electrical energy.

Bear Mountain Wind Park: Sitting on a ridge looking over Dawson Creek, Bear Mountain Wind Park is the first wind park to provide electrical energy commercially in B.C.

SunMine Solar Energy Project: B.C.'s largest solar project is located just outside of Kimberley, with over 4000 photovoltaic cells mounted on 96 solar trackers.

22. a) Students' answers could include reference to the slogan being relevant to how many kilowatts an appliance is rated for. Each kilowatt could count because each extra kilowatt of the power rating would increase how much electrical energy an appliance uses over a given period of time. This would mean that the consumer uses and pays for more electrical energy. It could also refer to kilowatt-hours because to a person as a consumer because each kilowatt-hour of electrical energy they consume costs money or reflects a choice they make to use either nonrenewable or renewable energy sources.

b) Students' answers could include reference to the slogan being relevant to the environment because every kilowatt-hour generated can have a negative effect on the environment, or it may have few or no harmful effects.

23. Answers should include an understanding of resource management (humans changing the natural environment in some way to enhance or alter a natural resource) and the idea of a holistic approach, studying the entire ecosystem that the resource is a part of.

24. a) The procedure provided should identify the independent variable as distance between buildings and the turbine and the dependent variable as the amount of electrical energy generated. It should explain how it would keep other variables constant. Additionally, an explanation should be provided as to how both distance from buildings and amount of electrical energy generated would be measured. A materials list and safety guidelines should also be given, as per the question.

b) The results might suggest the best placement of wind turbines in urban centres to generate the greatest amount of electrical energy. Conversely, the results might suggest that wind turbines should not be placed near urban centres, but should be placed in open areas.

c) Students' answers could include local wind patterns, speed, and constancy in a given location or pattern of wind flow around the building which might vary due to local wind patterns, building shape, or proximity to other buildings. Students might also want to investigate factors such as public opinion of wind turbines in urban spaces or safety of setting up wind turbines in such areas.

27. The simplest circuit would be a closed series circuit with a lamp, motor, and closed switch. Students might also draw a closed parallel circuit as long as the motor and lamp are placed in series.

28. All sketches must be closed parallel circuits to be correct. Bulb A must be connected in parallel to bulbs B and C. Bulbs B and C must be connected in parallel to bulb A but in series with each other. The switch must be in series with the source so that all current is interrupted when the switch is opened. Answers should explain that bulbs B and C remain on if A burns out because the burnt out bulb does not impede the flow of current to B and C because that branch of the circuit still remains closed. However, if B burns out, A will remain on because current will still flow through that branch of the circuit, while C will go out because it is in series with B and current will no longer reach it through the burnt out load/open circuit.

29. When the solid metal ball receives a negative charge, electrons are transferred to the ball. Almost all metals are conductors, which means that electrons travel through them easily. Because electrons repel each other, they will distribute themselves as far apart as possible. Therefore, they will spread out on the surface of the ball. The electrons will not leave the metal ball because rubber is an insulator and charges cannot travel through it.

30. If a positively charged balloon attracts Object A, the object must be negatively charged or electrically neutral. If a positively charged balloon repels Object B, the object must be positively charged. There are therefore two possibilities:

1. A is negatively charged and B is positively charged.

2. A is neutral and B is positively charged.

To determine the charge of Object A: If you charged another object with a negative charge and held it near Object A, it would repel Object A if the object had a negative charge but attract it if it had a neutral charge.

32. The current will be 0 A because the burnt out bulb will open the series circuit and no current will flow through it.

34. A possible cause of the fire is that if all the appliances that were plugged into the extension cord were running at the same time, a large amount of current would have

passed through the conductor near the outlet. If the extension cord was not designed to carry large currents, this could have produced a lot of heat, which may have started the fire.

35. A power rating is a rate at which electrical energy is used. To find out how much electrical energy an appliance uses, this rate must be multiplied by how long the appliance is running. In a typical home, a washing machine runs for much less time than a television. As a result, a washing machine might use less electrical energy over the course of a year than a television.

36. a) Students' answers could include a discussion of how society could balance its desire or need for electrical energy with a consideration of the effects of electrical energy generation on environmental and human health. Although this question is about hydroelectric dams specifically and the mercury they release, students should recognize that the balance here is between the need to generate electrical energy and the need to reduce harm that results from that generation. Another point that could be considered is if the harm to the environment caused by energy generation changes over time. For instance, with regards to hydroelectric dams, over a period of 10 to 30 years, decomposition rates slow and mercury in the environment decreases. Answers could consider if this should effect the how we value the damage caused by the mercury.

b) Students' answers should refer to their personal sense of fairness with regards to loss compensation. Accept any reasonable answers that clearly explain students' points of view.

c) Students' answers should define a sustainable energy system as a sustainable way of perceiving, producing, and using energy, including electrical energy. The system has the following characteristics:

the extraction, production, and use of energy have limited impact on environmental and human health

there is less reliance on decreasing nonrenewable sources

it ensures the availability of renewable and reliable energy sources for current and future generations

it provides access to affordable energy for Earth's entire population

In light of these characteristics, whether or not hydroelectric dams can be part of a sustainable energy system depends in the most part upon what students consider a limited impact on environmental and human health. Answers should explain whether students believe hydroelectric dams to have a limited impact, or not. Further, hydroelectric dams may or may not meet the characteristic of providing access to affordable energy for Earth's entire population. Answers could discuss students' opinions on this point as well. Most students will agree that dams do result in less reliance on decreasing nonrenewable sources and can ensure the availability of renewable and reliable energy sources for current and future generations.

40. Students' answers could include the suggestions below for a) through d).

a) Benefits of installing photovoltaic cells: sunlight is a renewable resource, sunlight reaches the cells directly from the Sun and does not have to be transported like some other fuels, once the cells are installed they might not have to be replaced for a long time, could reduce reliance on nonrenewable energy sources, there are long term financial savings once the system has paid for itself, using the cells to generate electrical energy has little if any impact on the environment.

b) Problems related to installing photovoltaic cells: the cells may be expensive, you would need to be trained in how to install them or pay someone who does, the cells may need to be cleaned and maintained regularly, broken or old cells might need to be replaced.

c) Other factors to take into account: where they could be purchased, if there is a warranty, if the government provides a rebate for the purchase, how easy they are to install and maintain, what other energy sources could be used.

d) If provinces offer subsidies that help homeowners pay for renewable energy technology they install in their homes or buy back excess electrical energy produced by the consumer, this provides a powerful financial incentive to install photovoltaic cells, if the incentive is large enough. However, the technology would still not be free, so homeowners must still have some additional reason for installing the cells. Students should also explain how their own decision would be influenced.

41. Students' answers could include the idea that countries that are better off have an ethical responsibility to help the less fortunate, or that countries should first achieve a sustainable energy system in their own backyard before worrying about other nations, or many opinions in between.

42. The school is moving toward a sustainable energy system because it is meeting or helping to meet several characteristics of such a system. By using renewable resources such as sunlight, wind, and human-generated kinetic energy it is relying less on decreasing nonrenewable energy sources. In this way the school is also helping to ensure that the extraction, production, and use of energy have limited impact on environmental and human health. It can also be argued that its commitment to using these renewable energy sources and the involvement of students is helping to ensure the availability of renewable and reliable energy sources for current and future generations.

Answers should refer to the four principles outlined on p. 261. For example: The school is also moving toward several characteristics of First Peoples Ecosystem Based Management. They are showing respect and responsibility by making decisions that respect the natural world and the well-being of all who call it home as they practise responsible use of resources. By involving students and teachers, the school supports intergenerational knowledge and shares knowledge and decision making skills between generations. The school also displays balance and interconnectedness through its involvement of future generations.