

Sample Diploma Problems

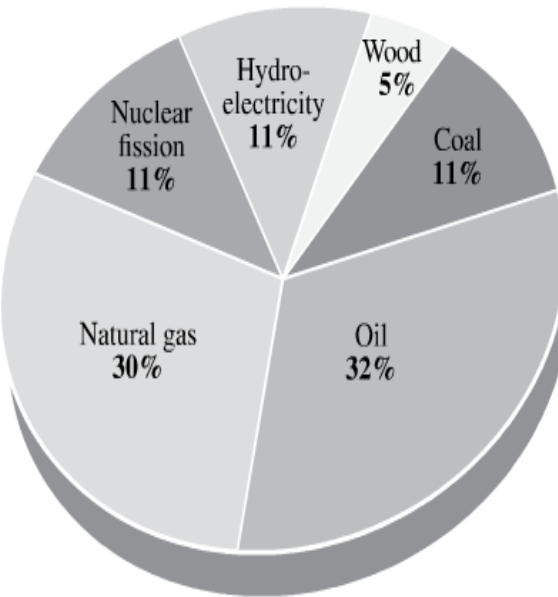
3. Sustainable development encourages the increased use of energy sources that are *i* and for the energy efficiency of technologies to be *ii* .

The statement above is completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	renewable	increased
B.	renewable	decreased
C.	non-renewable	increased
D.	non-renewable	decreased

The electricity generated, by energy source, for a particular country is represented in the pie chart below.

Electricity Generated by Energy Source



4. Of the types of energy shown above, the **total** percentage representing renewable resources is

- A. 11%
- B. 16%**
- C. 41%
- D. 57%

Sample Diploma Problem

- 23.** One disadvantage of using tides to generate electrical energy is
- A.** flooding of agricultural land
 - B.** thermal pollution of air and water
 - C.** the relatively high cost of construction
 - D.** the use of hazardous materials, such as arsenic and cadmium

Use the following information to answer question 7.

Disadvantages of a Particular Energy-producing Technology

- Produces particulate matter
- Contributes to climate change
- Contributes to acid deposition
- Relies on a non-renewable resource

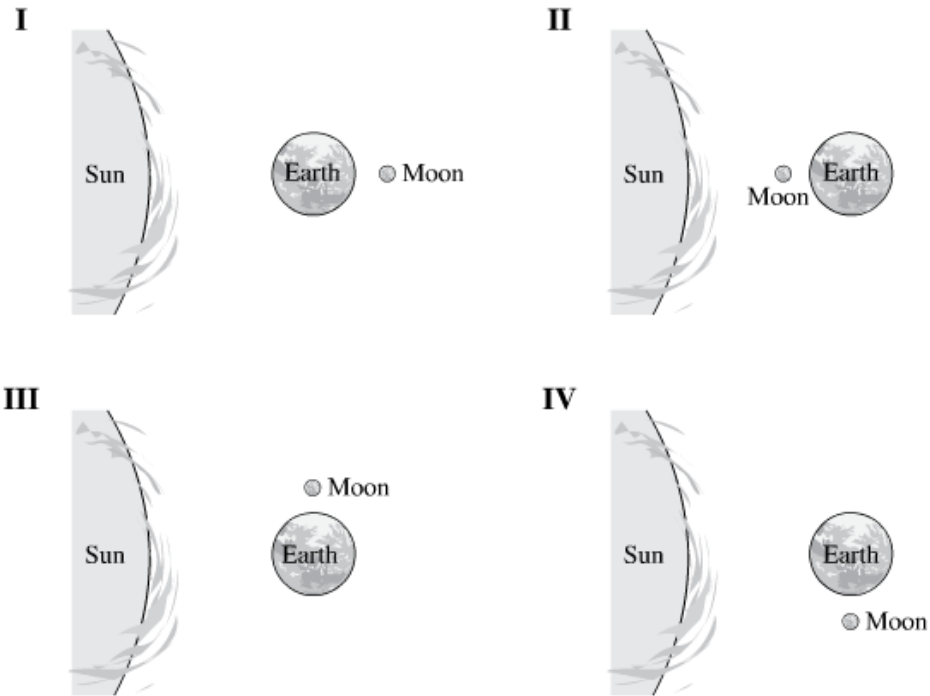
7. The technology described above is **most likely** a

- A.** coal-fired power plant
- B.** nuclear fission reactor
- C.** hydroelectric dam
- D.** wind turbine

Use the following information to answer question 22.

Tides are caused by the relative positions of Earth, the Sun, and the Moon.

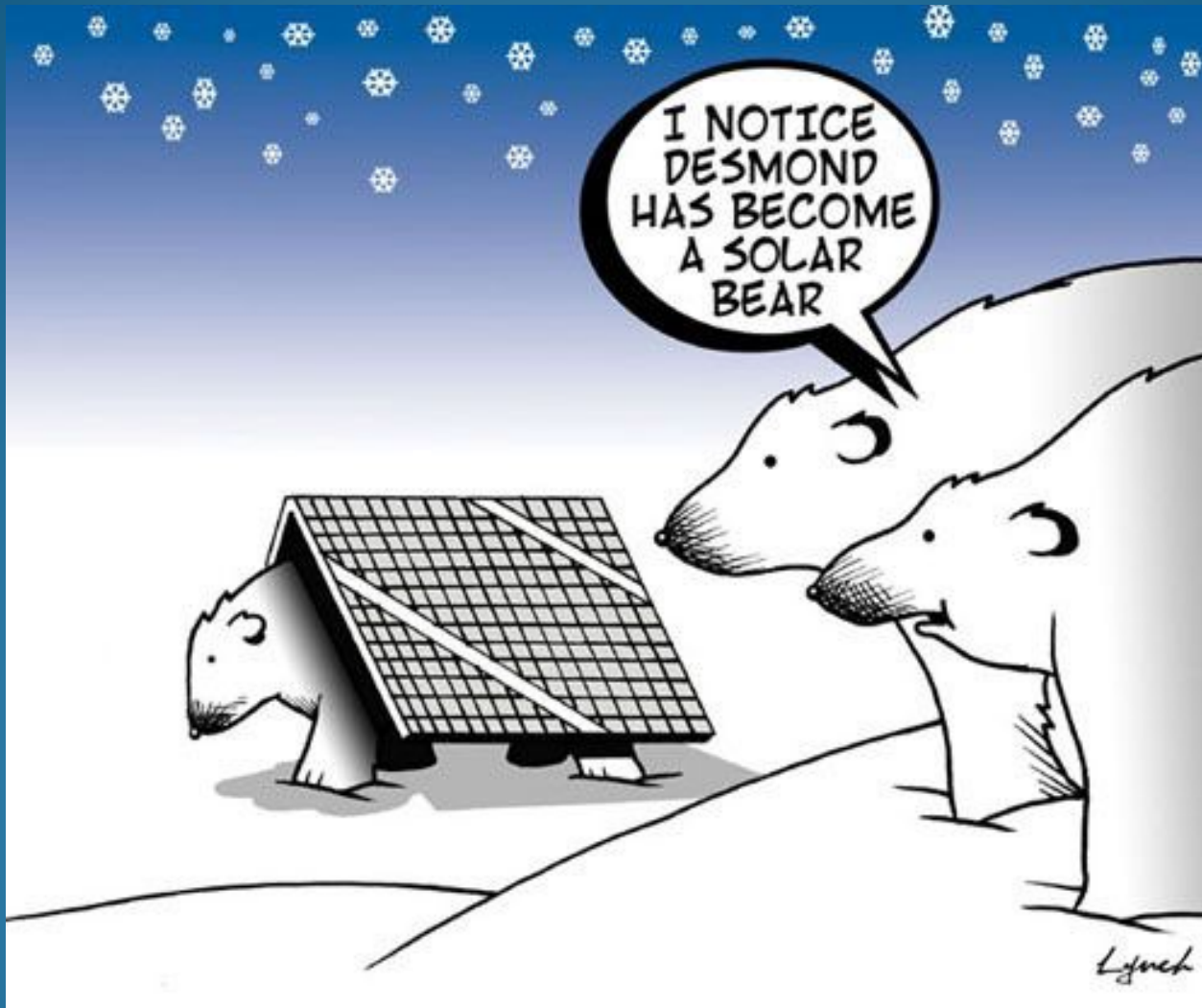
Relative Positions of Earth, the Sun, and the Moon



22. Which two relative positions of Earth, the Sun, and the Moon result in the greatest tidal variation?

- A. I and II
- B. I and IV
- C. II and III
- D. III and IV

Solar Energy



Curriculum

- describe the environmental impact of developing and using various energy sources; solar power, wind power, biomass, hydroelectricity
- contrast the proportion of solar energy that creates wind and drives the water cycle with the small proportion captured by photosynthesis as chemical potential energy
- describe the functioning of renewable energy technologies and assess their advantages and disadvantages, including active and passive solar-heating technologies, wind turbines, hydroelectric power, biomass energy, geothermal energy, hydrogen fuel cells

1) Passive Energy

- Passive solar design uses many features to maximize solar energy:
 - South facing windows to absorb energy.
 - Concrete floors to absorb radiation and transfer to other sections using conduction.
 - Convection currents created due to temperature differences.
 - Energy efficient building materials.
 - Roof overhang to prevent overheating in summer.

Passive Solar Energy



Passive Solar Energy

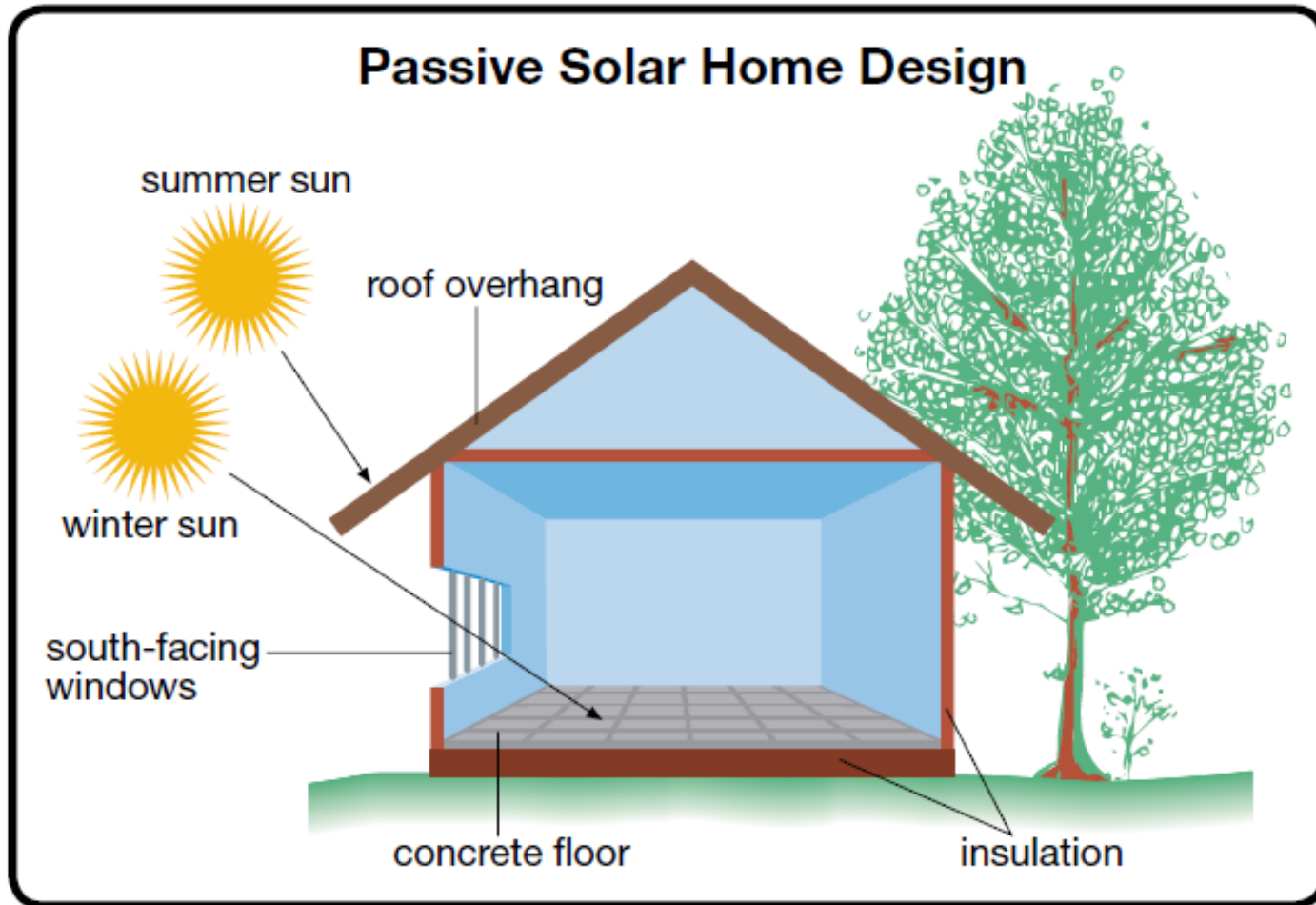
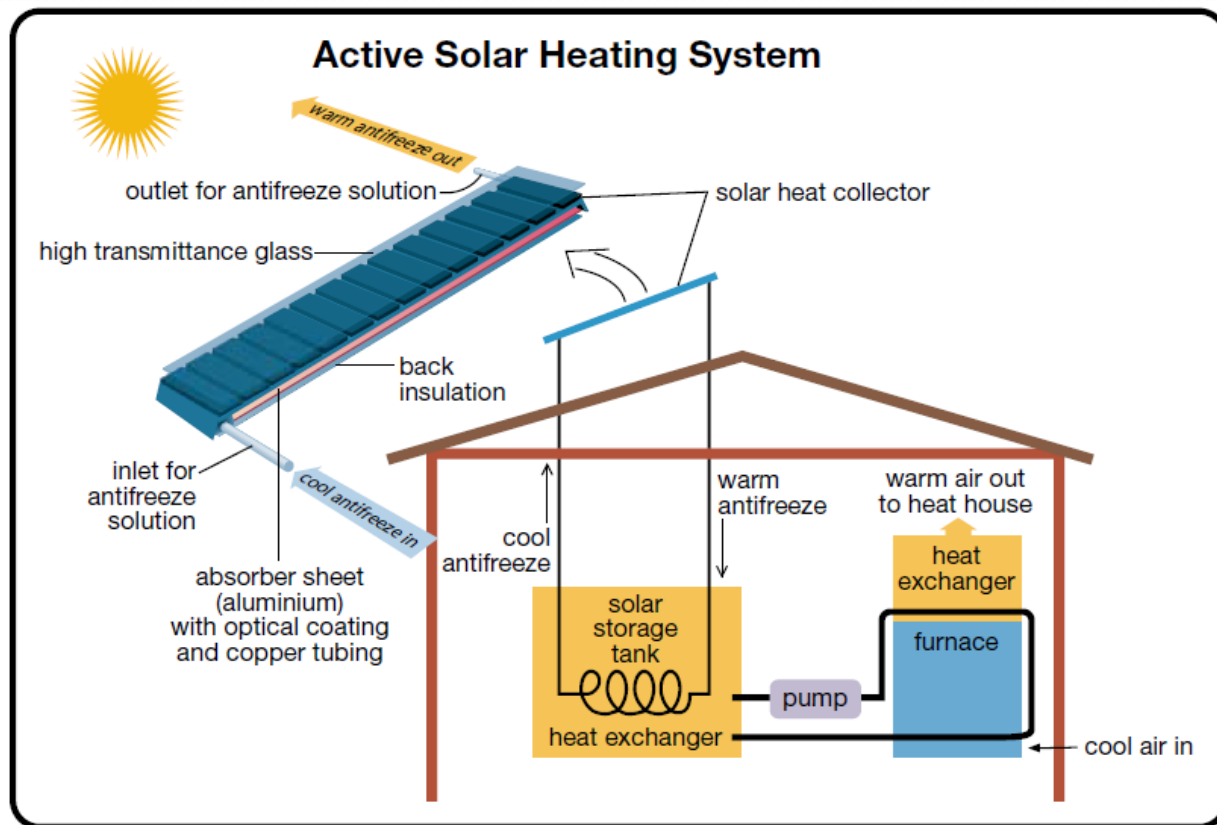


Figure D2.8

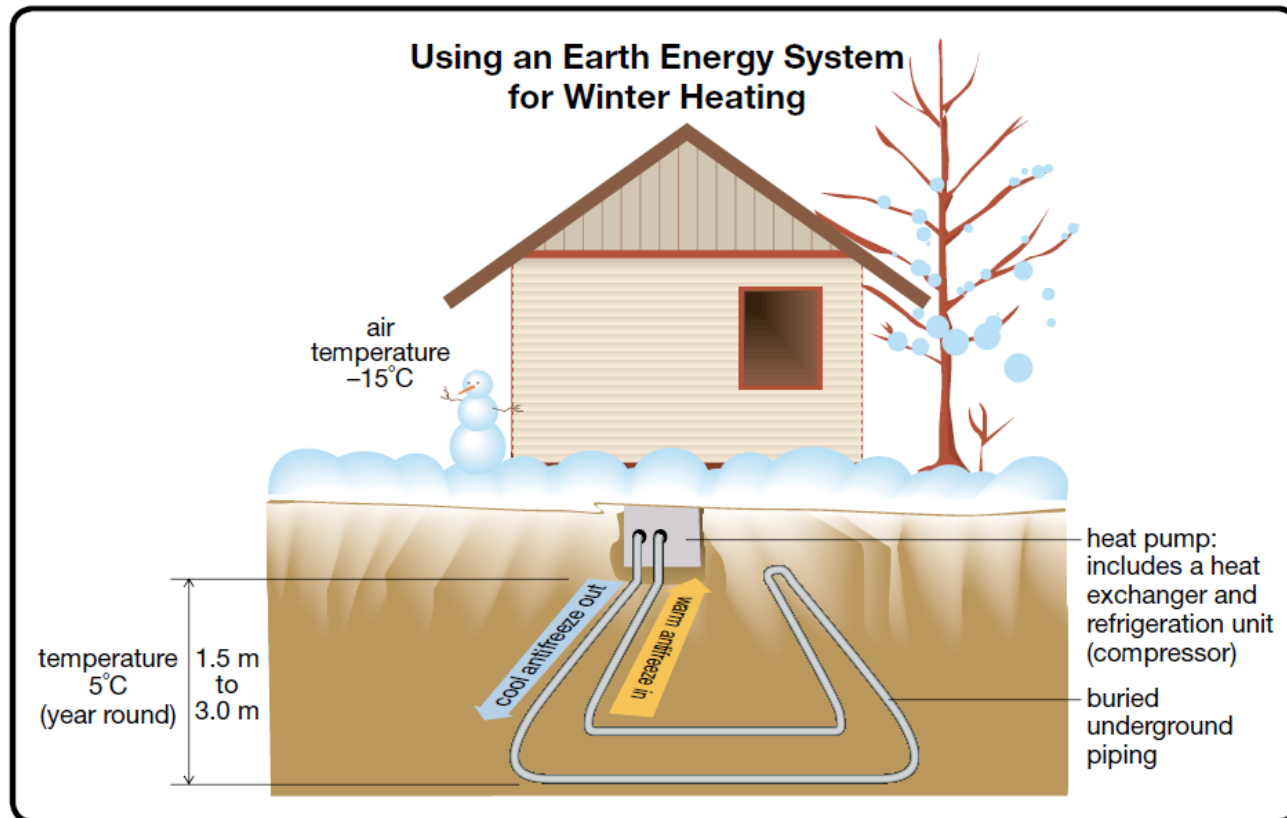
Solar Heat Collector

- This absorbs energy from the sun and pumps it through a heat exchanger



Earth Energy Systems

- Earth Energy System absorbs the Earth's thermal energy year around



4) Photovoltaic cells

- Converts EMR into electric energy.
- Photon absorbed--- electrons ejected (brighter source = more electrons).
- Disadvantages:
 - Electric current is weak = used in small devices or hook many together to create a large current.
 - Only work in the light (not at night).
 - Produce only DC current
 - Expensive to produce.

Photovoltaic Cells

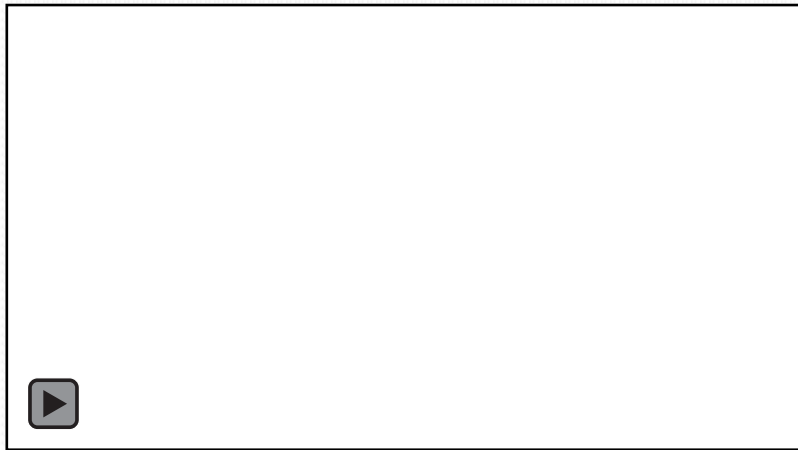
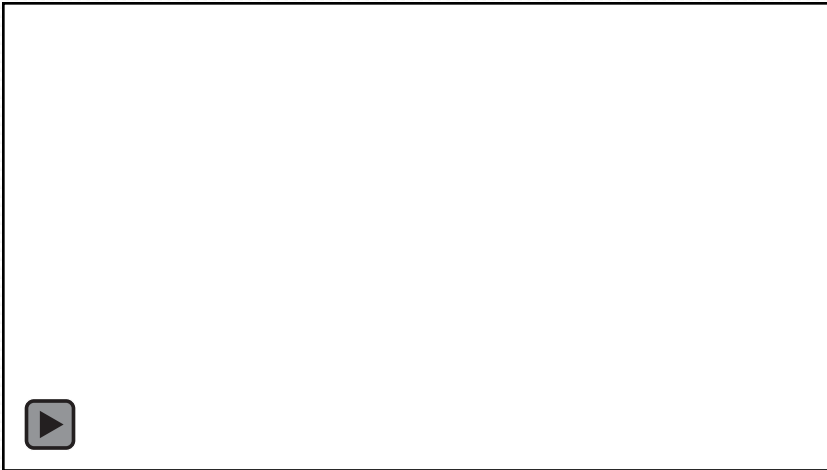
- Photovoltaic cells are solar panels that convert EMR light energy into electrical energy



New Ideas (4 min)



Tesla solar roof (2 min)



Advantages and Disadvantages

Clean energy
Quiet
Environmental impacts minor

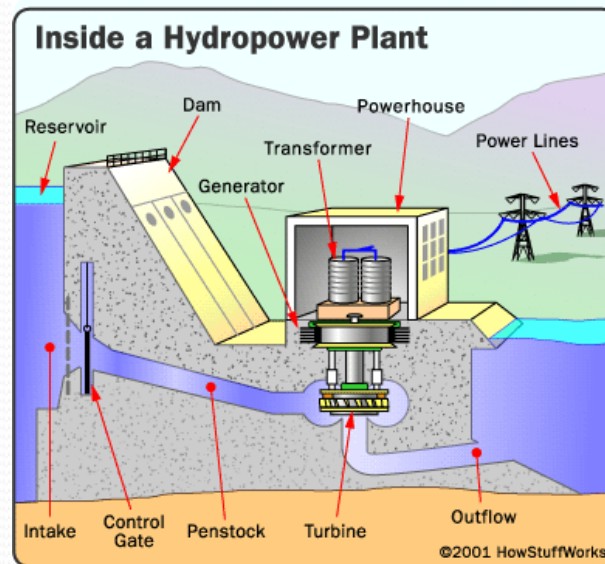
Expensive
Energy production dependant on sun

5) Hydroelectric Power

- Moving water possess' kinetic energy; hydroelectricity generates 19% of worlds electricity = renewable resource.
- 95% of Quebec's energy comes from water.
- Original source of energy is the sun → water heated by sun evaporates → carried by air currents → forms precipitation and falls at higher altitude. Creates potential energy.

Hydroelectric Power

- Does hydroelectric power use the sun's energy?
 - **hydroelectric energy is the result of heat energy from the sun and the gravitational forces from the earth**
- Hydroelectricity powers 19% of the world and 5% of Alberta's power



b) Hydroelectric Power

- Provide 5% of Energy in Alberta.
- Power must be assessed based on economic, environmental and social concerns:
 - Renewable, emission free and 80% efficient, low per kWh cost.
 - Land loss due to reservoir filling (impedes movement of nutrients = ↓ fertility).
 - Leaching of metals into water = ↓ quality.
 - Loss of current cities/archeology sites.
 - Interactions with aquatic ecosystem/species.

Advantages and Disadvantages

Clean (used H₂O)
Doesn't pollute the air
renewable

Fishing populations can be
affected
Affect water quality

a) Hydroelectric Dams

- Convert gravitational potential energy into electricity.
- Store water in reservoir → higher the reservoir level = more kinetic energy created.
- Force of water pushes against turbine blades → blades turn and generator convert kinetic energy into electrical energy. Transformers increase voltage.

Wind Energy



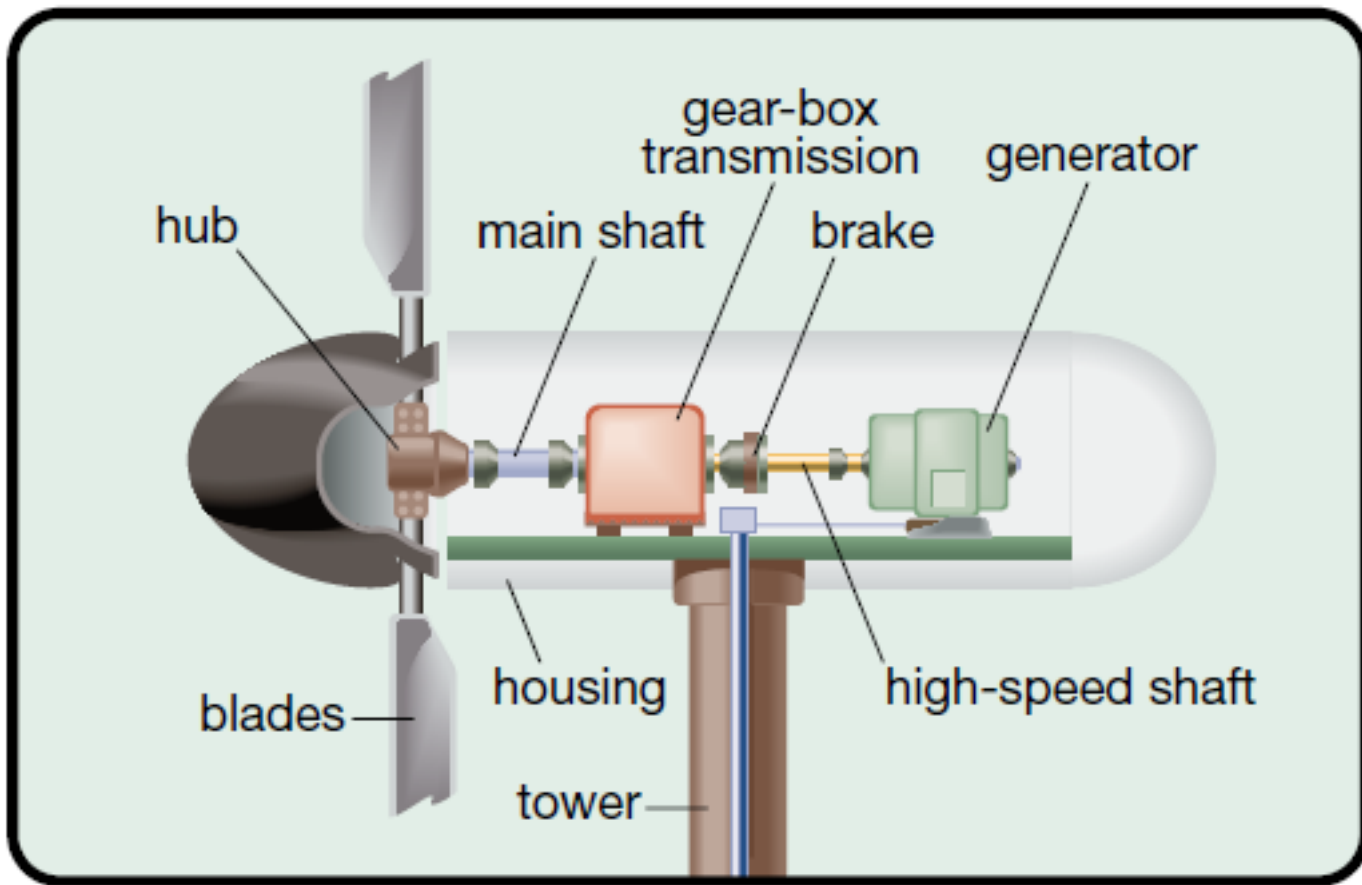
- Does wind energy come from the sun?
 - Yes! The **sun's** radiation warms different parts of the earth, oceans, and other bodies of water, at different rates. ... The result of this air exchange **is wind**
- More **the 50%** of the sun's energy is used to power the water and wind cycles and **less than 1%** goes into photosynthesis of plants
- Differences in temperature due to differences in solar heating create wind
- In some places the wind can be so strong that it can drive powerful turbines

6) Wind Energy

- Wind travelling through a smaller opening (tunnel) generates lots of kinetic energy.
 - SW corner of AB is well suited for this.
- Solar energy converted to thermal energy = kinetic energy in air increases → kinetic energy of turbine → electrical energy of generator.
- Convection currents create Westerly's that flow across Alberta.
 - Pincher Creek, Fort Macleod, Lethbridge are prime spots for wind power due to wind patterns.

EMR (Light) \rightarrow heat \rightarrow Ek \rightarrow electricity

Wind Energy



a) Wind energy limitations

- Fastest growing form of electricity generation in Canada; sun provides energy source (renewable).
- Versatile (used for cities and homes).
- Limitations:
 - Limited usage due to required conditions.
 - Variable energy source.
 - Inefficient conversion (30%) to electricity.
 - Land loss for wind farms.

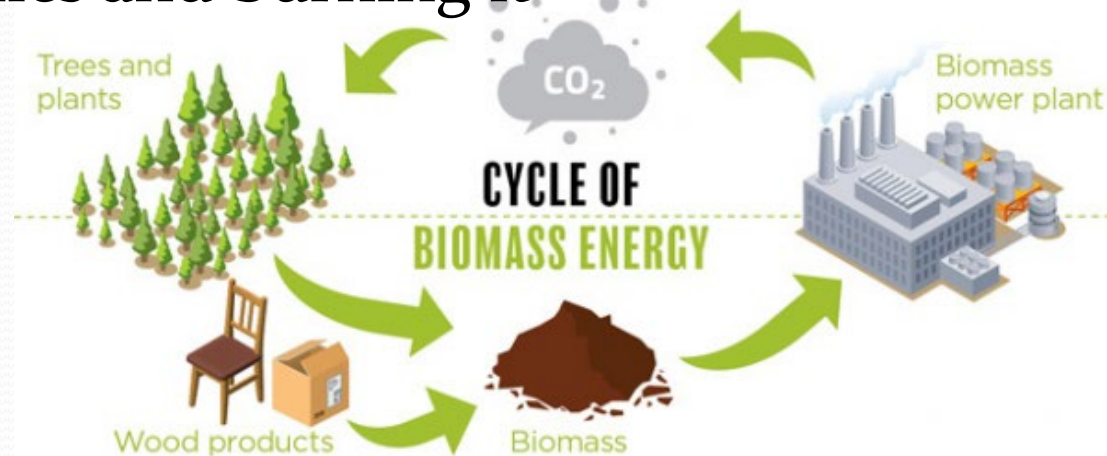
Advantages and Disadvantages

Zero emissions
Can increase
production
capacity as your
needs grow

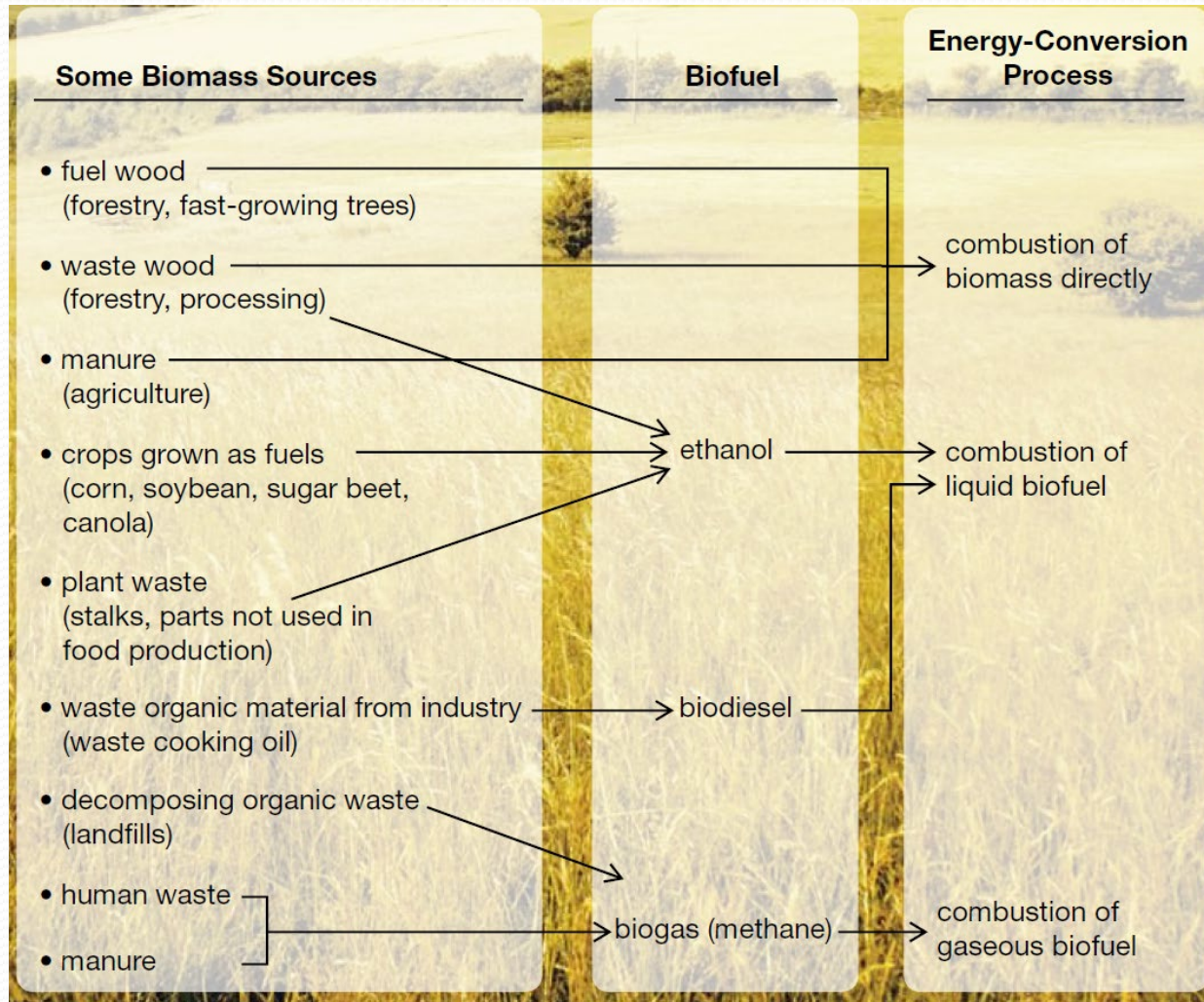
High initial investment
Wind must be between
25 – 100 kph for power
generation
Turbines must be nearby
existing transmission
lines

Biomass

- Biomass is using plant matter or agricultural waste as a source of fuel
- This involves burning wood waste from timber plants and using the energy from burning the waste
- It can be collecting methane gas from composing organics and burning it



Biofuel



Ethanol in Gasoline

- Produced using yeast to ferment sugars in plants = alcohol!
- Ethanol blends with gasoline up to 10%; newer vehicles can use up to 85% blend.
- Renewable source (crops regrown).
- Benefits and concerns:
 - New crops absorb CO₂; create alternate energy source.
 - Land taken from crop growing for food; fertilizers used can harm environment.
 - Inefficient creation of fuel (low energy molecules created, high concentrations of ethanol = toxic).

Ethanol in Gasoline

- Where do we get ethanol (alcohol) from?
 - Fermented from corn, wheat, potatoes ect
- Does this energy come from the sun?
 - Yes! Need sun to grow crops
- Is it renewable?
 - Yes, because you can replant the crops
- Ethanol is currently blended with gasoline

Biodiesel

- Using cooking oil waste to make fuel for vehicles



Advantages and Disadvantages

Renewable (grow crops)
Less carbon emissions when
burned

Food shortages
Needs lots of labour
Impacts to environment to cultivate
crops
Affects biodiversity

Hydrogen fuel

- Hydrogen fuel cell functions as an electrochemical cell does; reactants supply circuit with constant energy.
- Hydrogen enters at an electrode, oxygen enters at the opposite → hydrogen reacts and provides electrons (electricity) and ions that complete flow of charge.
- Flameless combustion reaction.
- Usage limited by high cost of catalysts/Hydrogen availability; very efficient and produce only water vapor as byproduct.

Hydrogen Fuel Cells

- A fuel cell is a battery that can be refilled
- Hydrogen fuel cells use hydrogen and oxygen as a fuel source and turn it into water and energy

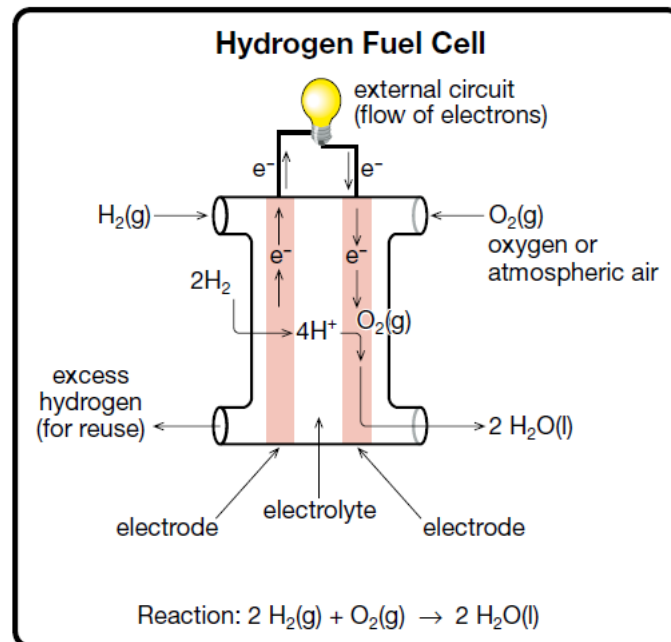
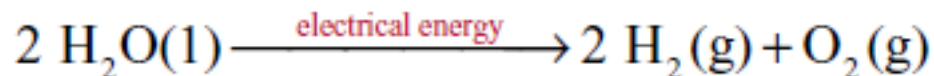


Figure D2.22

Seems Too Good to be True

- Why don't we just use hydrogen fuel cells then?
- How can we get hydrogen?

Decomposition of Water



- Where do we get the energy to break down water from?
- How can we make fuel cells a possibility?

Sample Diploma Problems

Use the following information to answer numerical-response question 2.

Some Environmental Goals

- 1 Promotion of biodiversity
- 2 Reduction of greenhouse gases
- 3 Promotion of sustainable development
- 4 Preservation of Earth's natural resources
- 5 Reduction of the quantity of fossil fuels used
- 6 Development of non-combustion technologies

Numerical Response

2. If ethanol, which is produced by fermenting plant matter from crops, is blended with gasoline it will help meet the goals above that are numbered _____, _____, _____, and _____.

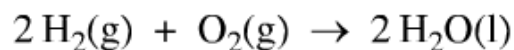
2 **3** **4** **5**

(Record all **four digits** of your answer **in any order** in the response boxes at the bottom of the screen.)

Use the following information to answer question 5.

One company is developing a type of hydrogen fuel cell that they hope will replace conventional internal-combustion engines. This fuel cell runs on hydrogen gas that is produced by splitting water with electricity from a photovoltaic cell. Oxygen from the air reacts with this hydrogen and produces water, a non-polluting waste product that can be used to cool the engine.

Equation for the Reaction that Occurs in a Hydrogen Fuel Cell



5. If the hydrogen fuel cell described above became widely used to power vehicles it is likely that carbon emissions would *i* and reliance on oil would *ii* .

The statement above is completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	increase	increase
B.	increase	decrease
C.	decrease	increase
D.	decrease	decrease

Use the following information to answer question 8.

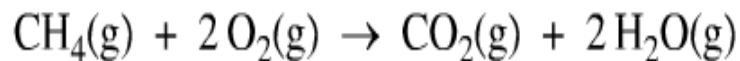
Some Energy Sources

- I** Wind
- II** Hydro
- III** Uranium
- IV** Gasoline
- V** Natural gas

8. Which energy sources numbered above produce negative byproducts when used to generate electricity?
- A.** I, II, and III
 - B.** I, II, and IV
 - C.** II, IV, and V
 - D.** III, IV, and V

Use the following information to answer questions 10 and 11.

Methane gas is collected from the decaying biological material in a sludge tank and is burned to produce heat and electricity for a waste-water treatment plant. The combustion of the collected methane gas is represented by the equation below.



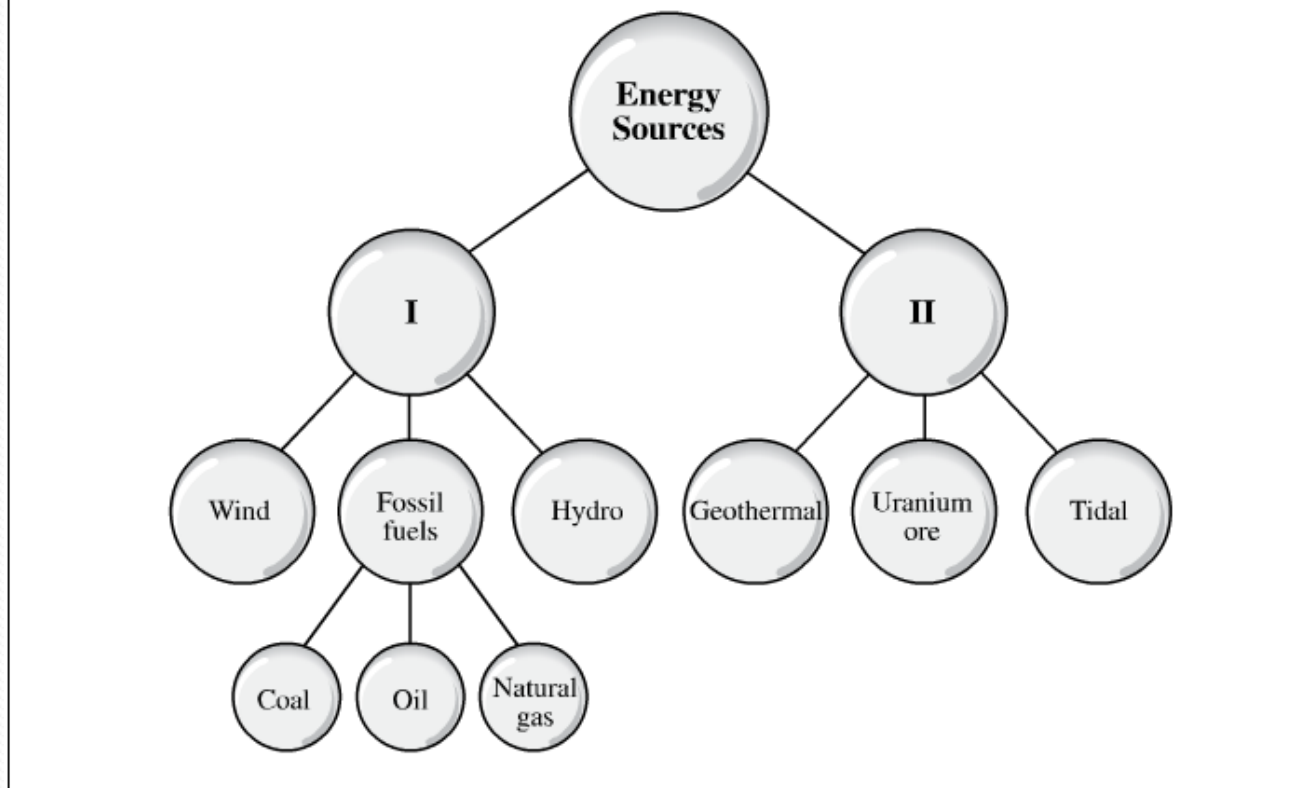
10. The source of the energy used by the waste-water treatment plant is best classified as a type of
- A. renewable biomass
 - B. renewable fossil fuel
 - C. non-renewable biomass
 - D. non-renewable fossil fuel

12. Which of the following rows identifies the approximate proportion of solar energy that creates wind and drives the water cycle and the approximate proportion of solar energy stored by plants through photosynthesis?

Row	Approximate Proportion of Solar Energy that Creates Wind and Drives the Water Cycle	Approximate Proportion of Solar Energy Stored by Plants
A.	50%	50%
B.	50%	< 1%
C.	< 1%	50%
D.	< 1%	< 1%

Use the following information to answer question 13.

A student drew a concept map to help her study various energy sources used to produce electricity. Her concept map is shown below.

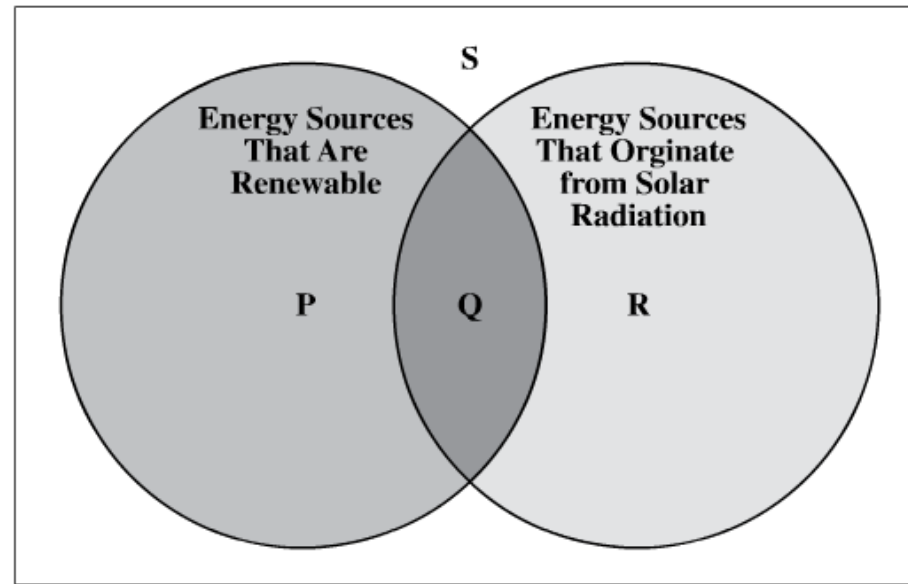


13. Which of the following rows identifies the missing terms in the concept map shown above?

Row	I	II
A.	Renewable	Non-renewable
B.	Solar in origin	Non-solar in origin
C.	Non-renewable	Renewable
D.	Non-solar in origin	Solar in origin

Use the following information to answer questions 14 and 15.

A Venn diagram uses two or more circles to represent different groups of objects. Overlapping areas of circles show the common objects that belong to both groups. Objects that do not belong in groups are placed in the area outside the circles. The Venn diagram below shows the relationships among some different energy sources.



14. Which of the following rows shows where tidal energy should be placed in the diagram and where biomass energy should be placed in the diagram?

Row	Region Where Tidal Energy Should Be Placed	Region Where Biomass Energy Should Be Placed
A.	P	Q
B.	P	R
C.	Q	Q
D.	Q	R

Use the following information to answer question 16.

Some Technologies that Produce Electricity

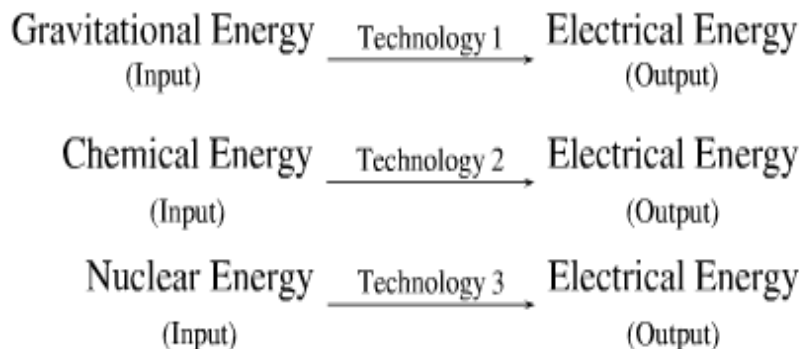
- 1** Wind turbine
- 2** Hydroelectric dam
- 3** Nuclear-fission reactor
- 4** Fossil fuel power plant
- 5** Tidal generating station
- 6** Geothermal power plant
- 7** Biomass-burning generator

16. Which two technologies numbered above include the conversion of chemical potential energy into thermal energy?

- A.** 1 and 6
- B.** 2 and 5
- C.** 3 and 6
- D.** 4 and 7

Use the following information to answer numerical-response question 3.

Three Electrical Energy Generating Technologies



Numerical Response

3. Match the technology numbered in the flowchart above with the type of technology that it represents below. (Use each number only once.)

Hydroelectric dam 1 (Record in the **first** box)

Geothermal power station 3 (Record in the **second** box)

Fuel cell 2 (Record in the **third** box)

(Record your answer in the response boxes at the bottom of the screen.)