

Science 30

Released Items

2016 Released Diploma Examination Items



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Introduction

The questions presented in this booklet are from the August 2015 Science 30 Diploma Examination. The August 2015 Science 30 Diploma Examination was identical in content to the January 2014 Science 30 Diploma Examination. Teachers whose classes wrote the January 2014 Science 30 Diploma Examination can use instructional group reports to look at past performance of their students on particular items. This material, along with the program of studies and the [*Science 30 Information Bulletin*](#), can assist you with instructional programming.

These examination items are released by the Provincial Assessment Sector. They may be used by the classroom teacher as an examination, a quiz, or a review for students.

Additional Documents

The Provincial Assessment Sector supports the instruction of Science 30 in classrooms with the following documents available online.

- [School Reports and Instructional Group Reports](#)
available at <https://phoenix.edc.gov.ab.ca/login>
Detailed statistical information is provided on provincial, group, and individual student performance on the entire examination.
- [Science 30 Information Bulletin](#)
available at education.alberta.ca
Contains information about the diploma examinations for the upcoming school year, sample questions, assessment samples for classroom use with student exemplars, and scoring criteria.
- [Science 30 Previous Examinations](#)
Previous exams have been released for Science 30, including the January 2008, June 2008, January 2009, and August 2015 diploma examinations. Released materials are available in PDF and on Quest A+. <https://questaplus.alberta.ca>

Science 30 Diploma Examination August 2015— Blueprint Summary

Key: MC—Multiple Choice; NR—Numerical Response

| | Diff.* | Key | K | STS | Skill |
|-------|---------------|------------|----------|------------|--------------|
| MC 1 | 0.819 | A | A1.4k | | |
| MC 2 | 0.828 | B | | | A1.2s |
| MC 3 | 0.861 | D | | A3.2sts | A3.4s |
| MC 4 | 0.838 | D | A3.6k | | |
| MC 5 | 0.651 | D | A1.3k | | |
| MC 6 | 0.555 | D | A1.3k | | |
| MC 7 | 0.780 | B | A2.2k | | |
| MC 8 | 0.694 | A | A2.3k | | |
| MC 9 | 0.660 | D | A3.9k | A3.2sts | |
| MC 10 | 0.581 | C | A3.1k | | |
| MC 11 | 0.784 | B | A3.2k | | |
| MC 12 | 0.746 | D | A3.3k | | |
| MC 13 | 0.778 | C | A3.8k | | |
| MC 14 | 0.863 | D | | | B1.2s |
| MC 15 | 0.764 | B | | | B1.2s |
| MC 16 | 0.495 | B | B1.3k | | |
| MC 17 | 0.712 | C | B1.1k | | |
| MC 18 | 0.678 | C | B1.8k | | |
| MC 19 | 0.778 | C | | B2.1sts | B2.2s |
| MC 20 | 0.792 | B | B2.3k | | |
| MC 21 | 0.791 | A | | B2.1sts | B2.2s |
| MC 22 | 0.687 | C | B1.8k | | |
| MC 23 | 0.879 | C | C1.3k | | C1.2s |
| MC 24 | 0.663 | D | C1.3k | | |
| MC 25 | 0.848 | D | C1.3k | | |
| MC 26 | 0.657 | C | | | C1.3s |
| MC 27 | 0.782 | A | C1.8k | | |
| MC 28 | 0.647 | C | C1.9k | | C1.3s |
| MC 29 | 0.502 | D | C1.11k | C1.1sts | |

| | Diff.* | Key | K | STS | Skill |
|-------|---------------|--|----------|------------|--------------|
| MC 30 | 0.637 | D | C2.5k | | |
| MC 31 | 0.814 | C | C2.9k | C2.2sts | C2.3s |
| MC 32 | 0.802 | B | D1.3k | D1.1sts | |
| MC 33 | 0.804 | C | D1.1k | | |
| MC 34 | 0.548 | C | D1.3k | D1.1sts | |
| MC 35 | 0.517 | D | | | D2.3s |
| MC 36 | 0.698 | B | D2.4k | D1.1sts | |
| MC 37 | 0.691 | A | D2.13k | | |
| MC 38 | 0.773 | A | D2.5k | | |
| MC 39 | 0.666 | C | C2.1k | C2.1sts | |
| NR 1 | 0.773 | 110–130 | | | A1.2s |
| NR 2 | 0.645 | 158, 249, 367 | A2.3k | | |
| NR 3 | 0.481 | 3221 | A3.7k | | |
| NR 4 | 0.442 | 1871 | | | B1.3s |
| NR 5 | 0.638 | 3988 | | | B1.3s |
| NR 6 | 0.820 | 2134 | B2.3k | B2.1sts | |
| NR 7 | 0.670 | 3142 | B2.2k | B1.1sts | |
| NR 8 | 0.502 | 2251 | C1.4k | | C1.3s |
| NR 9 | 0.510 | 5528 | C1.7k | | C1.3s |
| NR 10 | 0.703 | 148, 259, 367 | C2.4k | C2.1sts | |
| NR 11 | 0.592 | 8729 | C2.6k | | |
| NR 12 | 0.645 | 158, 246, 347 | C2.11k | | |
| NR 13 | 0.716 | 1457, 1475, 4157, 4175, 1458, 4158, 1485, 4185, 1478, 1487, 4178, 4187 | D1.5k | D2.1sts | D2.3s |
| NR 14 | 0.352 | 726, 725, 638 | D2.1k | | D2.3s |
| NR 15 | 0.285 | 2345 (any order) | D2.4k | D2.1sts | |
| NR 16 | 0.266 | 107, 1.07, 106, 1.06 | D2.7k | | D2.3s |

*Difficulty—proportion of students answering the question correctly

Science 30 Diploma Examination August 2015— Released Items

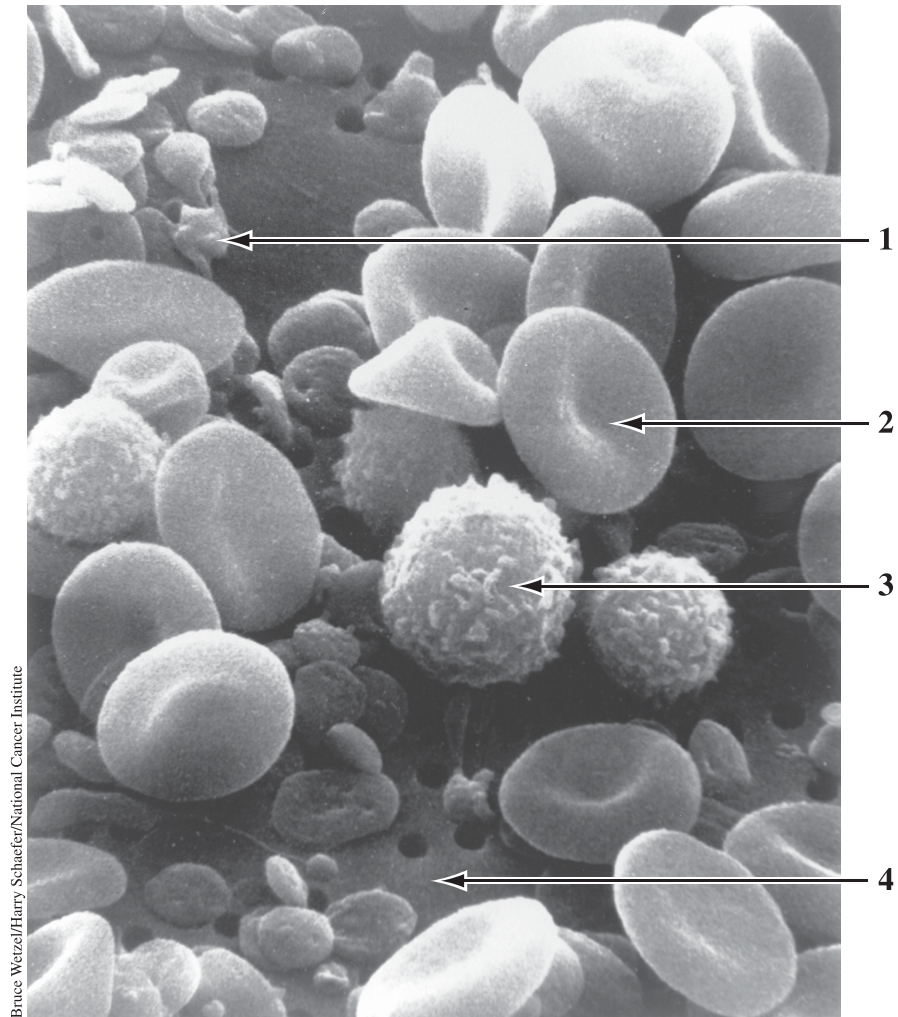
Use the following information to answer questions 1 to 4.

Thalassemia is an autosomal recessive disorder that affects red blood cells. Individuals with thalassemia are unable to produce normal hemoglobin.

- 1.** An individual affected by thalassemia has a reduced ability to
 - A.** transport oxygen
 - B.** produce enzymes
 - C.** fight off infections
 - D.** clot an open wound

Use the following additional information to answer question 2.

Scanning Electron Microscope (SEM) Image of Blood Components



2. The blood component in the image above that would be affected in a person with thalassemia is labelled

- A. 1
- B. 2
- C. 3
- D. 4

Use the following additional information to answer questions 3 and 4.

Individuals with a family history of thalassemia can receive genetic screening to determine whether they are carriers of the recessive allele. Some people are opposed to genetic screening because they feel that it could lead to a decision to terminate a pregnancy.

3. The perspective of the people opposed to genetic screening is
- A. technological
 - B. economic
 - C. scientific
 - D. ethical

Use the following additional information to answer question 4.

Thalassemia is caused by a mutation in a DNA sequence that results in a change in the nitrogen base sequence from AAG to TAG.

4. In individuals with thalassemia, the code for ***i*** is replaced with the code for ***ii***.

The statement above is completed by the information in row

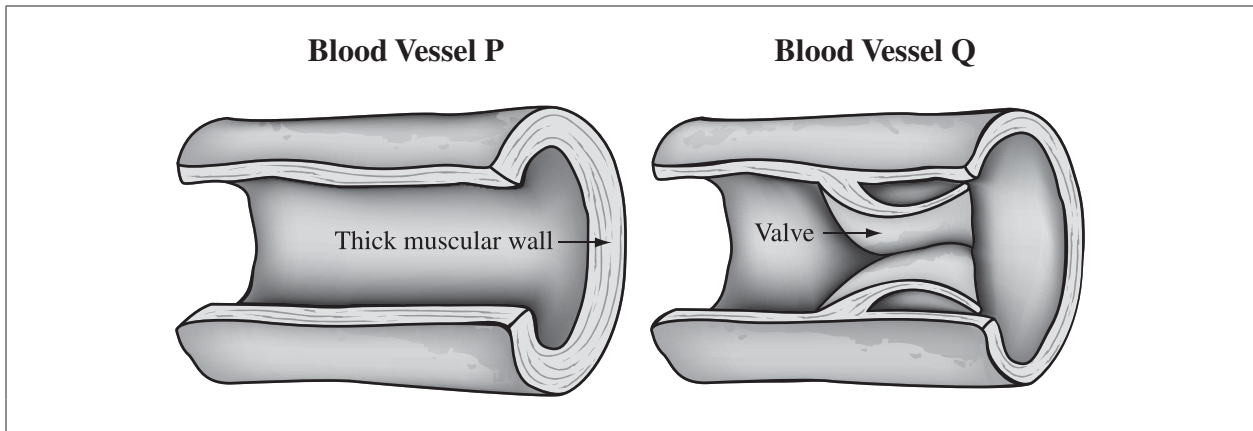
| Row | <i>i</i> | <i>ii</i> |
|-----|------------|-----------|
| A. | asparagine | tyrosine |
| B. | asparagine | STOP |
| C. | lysine | tyrosine |
| D. | lysine | STOP |

Numerical Response

1. The normal resting blood pressure of a healthy adult is _____ mmHg/80 mmHg.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Use the following information to answer question 5.



5. A blood vessel that transports blood from the body to the heart is *i* , which is represented in the diagram above by the blood vessel labelled *ii* .

The statement above is completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|-----------|-----------|
| A. | an artery | P |
| B. | an artery | Q |
| C. | a vein | P |
| D. | a vein | Q |

6. Gas and nutrient exchange takes place in *i* , where the blood pressure is *ii* than in arteries.

The statement above is completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|-------------|-----------|
| A. | venules | higher |
| B. | venules | lower |
| C. | capillaries | higher |
| D. | capillaries | lower |

Use the following information to answer question 7.

Some staphylococcal infections result from direct contact with infected wounds.

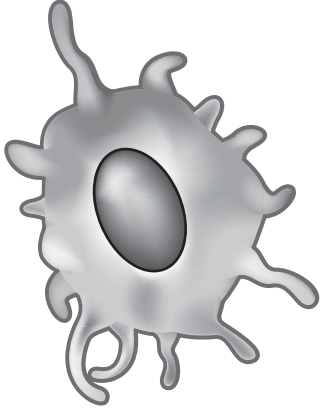


7. Which of the following cells is a **first line** of defence against staphylococcal bacteria?
- A. B cells
 - B. Skin cells
 - C. Killer T cells
 - D. Helper T cells
-

8. When a person receives a vaccine, *i* on the surface of the virus in the vaccine cause an immune response that results in the production of *ii* , which provide immunity against future exposure to the virus.

The statement above is completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|------------|------------------|
| A. | antigens | memory cells |
| B. | antigens | suppressor cells |
| C. | antibodies | memory cells |
| D. | antibodies | suppressor cells |

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

| Immune System Component | Diagram of Immune System Component | Role of Immune System Component |
|-------------------------|--|---|
| 1 Antibody | 4  | 7 Produce specific protein molecules when activated by helper T cells |
| 2 Macrophage | 5  | 8 Bind to and immobilize pathogens |
| 3 B cell | 6  | 9 Engulf pathogens and display antigens for identification |

Numerical Response

2. Using the numbers above, choose **one immune system component** from the table above and match it with the diagram of that component and with the role of that component. (There is more than one correct answer.)

Component _____ (Record in the **first** column)

Diagram _____ (Record in the **second** column)

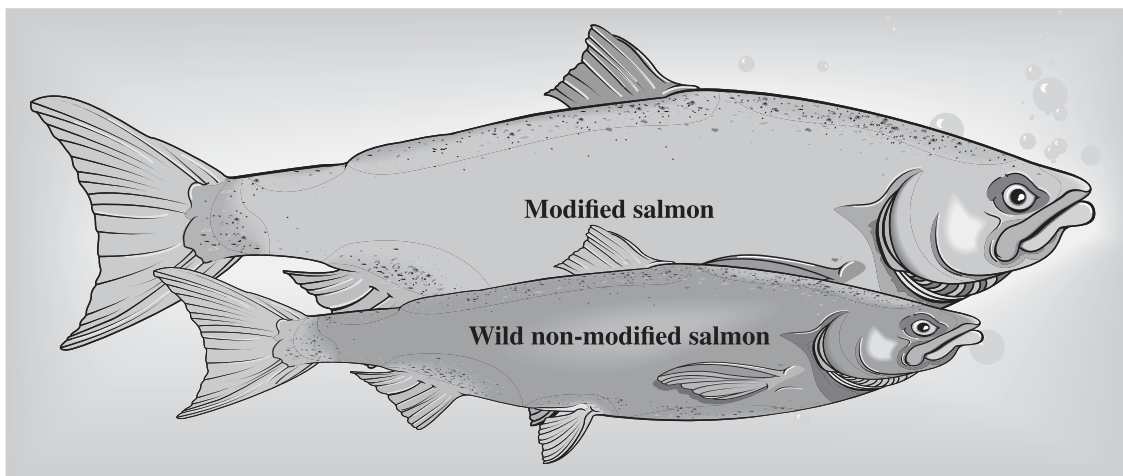
Role _____ (Record in the **third** column)

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 9.

One type of genetically modified salmon has additional growth hormone genes. The additional genes cause the salmon to reach maturity quickly and grow to nearly twice the size of non-modified salmon.

One-Year-Old Salmon



Statements About Genetically Modified Salmon

- I Farming genetically modified salmon could increase food supplies.
- II Genetically modified salmon could escape into the wild, disrupting wild salmon populations.
- III Some people believe genetically modified salmon could trigger allergies in humans who consume it.
- IV Farming genetically modified salmon could reduce the overfishing of endangered wild salmon species.

9. The statement that **best** supports the production of genetically modified salmon, from an environmentally conscious perspective, is
- A. Statement I
 - B. Statement II
 - C. Statement III
 - D. Statement IV

10. Which of the following rows identifies the chromosome number of body cells and the chromosome number of sex cells?

| Row | Body Cells | Sex Cells (Gametes) |
|-----|------------|---------------------|
| A. | $1n$ | $1n$ |
| B. | $1n$ | $2n$ |
| C. | $2n$ | $1n$ |
| D. | $2n$ | $2n$ |

Use the following information to answer questions 11 and 12.

Canavan disease is a degenerative condition in children that is characterized by a loss of brain function. A single gene mutation on chromosome 17 leads to Canavan disease. Two unaffected parents may have a son or a daughter with Canavan disease.

11. When an unaffected woman receives a genetic test for Canavan disease and is found to be a carrier, she has *i* of the affected allele and is said to be *ii* .

The statement above is completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|------------|--------------|
| A. | one copy | homozygous |
| B. | one copy | heterozygous |
| C. | two copies | homozygous |
| D. | two copies | heterozygous |

12. The pattern of inheritance for Canavan disease is **most likely**
- A. X-linked
 - B. Y-linked
 - C. dominant
 - D. recessive

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

Three Types of Proteins

- 1** Transport
- 2** Structural
- 3** Enzyme

Numerical Response

- 3.** Match the protein types numbered above with the descriptions below. (You may use a number more than once.)

Regulate chemical reactions _____ (Record in the **first** column)

Provide a framework for skin and internal organs _____ (Record in the **second** column)

Keratin that makes up hair and nails is an example _____ (Record in the **third** column)

Hemoglobin is an example _____ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 13.

The bulbs used in tanning beds produce ultraviolet (UV) radiation, which has enough energy to damage skin cells. Most of the damage done by UV radiation occurs when nucleic acid molecules in skin cells absorb the radiation.

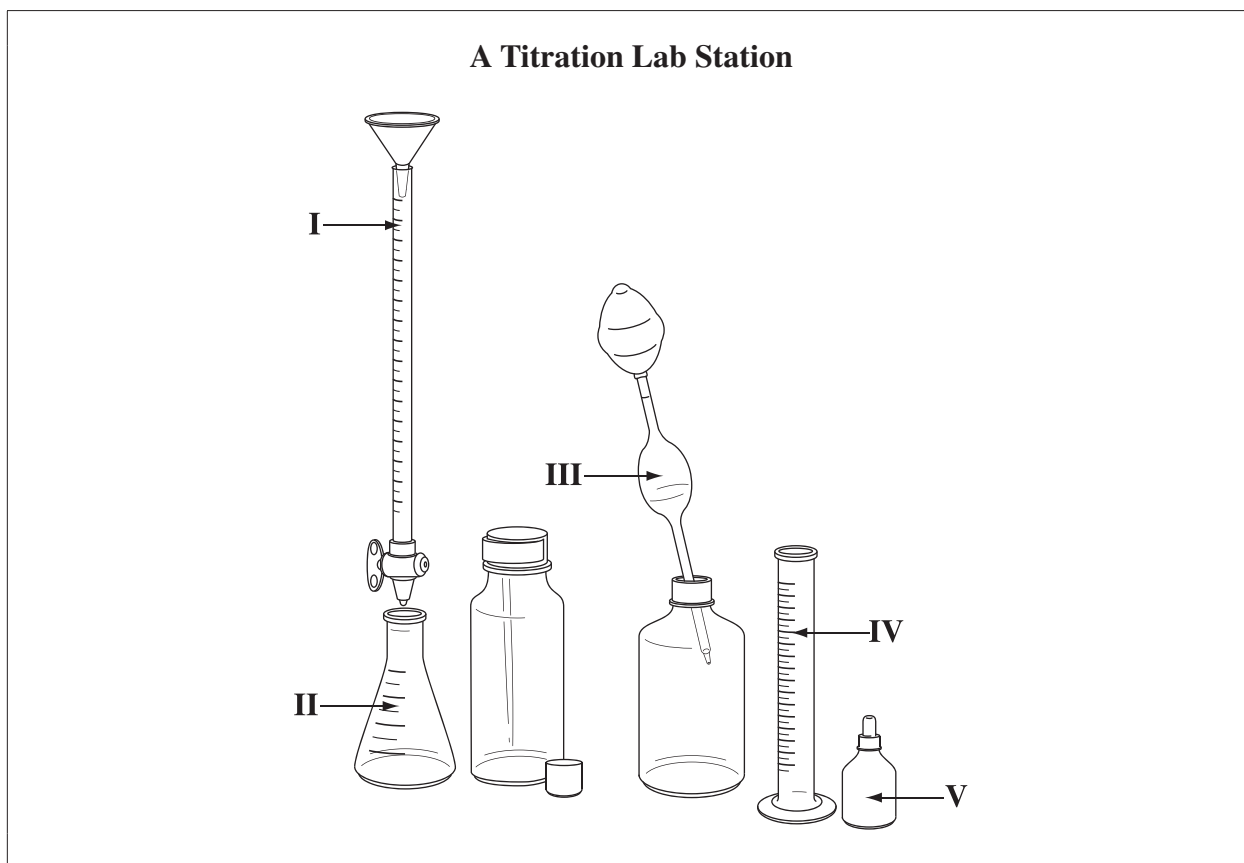
- 13.** The information above supports the hypothesis that UV radiation causes
- A.** an increase in blood pH
 - B.** a decrease in the ability of blood to carry oxygen
 - C.** an increase in the number of DNA mutations in a cell
 - D.** a decrease in the number of chromosomes present in a cell

Use the following information to answer question 14.

A sample of water collected upstream from a sewage treatment plant had a pH of 8.10.
A sample of water collected downstream from the same sewage treatment plant had a pH of 6.50.

- 14.** An indicator that could be used to distinguish between the two water samples is
- A. bromocresol green
 - B. phenolphthalein
 - C. methyl red
 - D. phenol red

Use the following information to answer question 15.



15. In order to ensure that a colour change occurs at the endpoint of a titration, an indicator should be placed into the equipment labelled
- A. I
 - B. II
 - C. III
 - D. IV

Numerical Response

4. If 15.6 mL of a 0.120 mol/L solution of hydrochloric acid, HCl(aq), was required to titrate a 10.0 mL sample of sodium hydroxide, NaOH(aq), then the concentration of the NaOH(aq) solution, expressed in scientific notation, is $a.bc \times 10^{-d}$ mol/L. The values of a , b , c , and d are $\frac{\quad}{a}$, $\frac{\quad}{b}$, $\frac{\quad}{c}$, and $\frac{\quad}{d}$.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Numerical Response

5. The hydronium ion concentration, $[H_3O^+(aq)]$, of a solution with a pH of 7.400, expressed in scientific notation, is $a.bc \times 10^{-d}$ mol/L. The values of a , b , c , and d are $\frac{\quad}{a}$, $\frac{\quad}{b}$, $\frac{\quad}{c}$, and $\frac{\quad}{d}$.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

16. A change in pH from 5.7 to 3.7 indicates *i* in the hydronium ion concentration $[H_3O^+(aq)]$, by a factor of *ii* .

The statement above is completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|-------------|-----------|
| A. | an increase | 2 |
| B. | an increase | 100 |
| C. | a decrease | 2 |
| D. | a decrease | 100 |

Use the following information to answer questions 17 and 18.

Some Chemical Reaction Equations

- 1 $2 C_8H_{18}(l) + 25 O_2(g) \rightarrow 16 CO_2(g) + 18 H_2O(g)$
- 2 $O_3(g) + Cl(g) \rightarrow O_2(g) + ClO(g)$
- 3 $H_2S(g) + H_2O(l) \rightarrow HS^-(aq) + H_3O^+(aq)$
- 4 $4 NO_2(g) + 2 H_2O(l) + O_2(g) \rightarrow 4 HNO_3(aq)$
- 5 $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$
- 6 $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$
- 7 $CH_3OH(l) + CH_3COOH(aq) \rightarrow CH_3OOCCH_3(aq) + H_2O(l)$

17. An example of a proton donor in the reactions shown above is
- A. $C_8H_{18}(l)$ in Reaction 1
 - B. $ClO(g)$ in Reaction 2
 - C. $H_2S(g)$ in Reaction 3
 - D. $H_2O(l)$ in Reaction 5
18. Which of the reactions numbered above can result in acid deposition?
- A. 2 and 6
 - B. 2 and 7
 - C. 4 and 6
 - D. 4 and 7

Use the following information to answer numerical-response question 6.

The Great Barrier Reef is the world's largest coral reef, stretching 2 000 km north to south along Australia's northeast coast. Evidence indicates that the Great Barrier Reef is facing significant environmental threats.

Environmental Threats to the Great Barrier Reef

- 1 Warmer global temperatures causing warmer ocean temperatures
- 2 Pesticides from agricultural operations washing into the surrounding ocean
- 3 Draining of coastal wetlands washing acidified water into the ocean
- 4 Heavy metals from industrial waste water being discharged into the ocean

Numerical Response

6. Match each threat to the Great Barrier Reef numbered above with its associated chemical listed below. (Use each number only once.)

DDT(aq) _____ (Record in the **first** column)

CO₂(g) _____ (Record in the **second** column)

H₂SO₄(aq) _____ (Record in the **third** column)

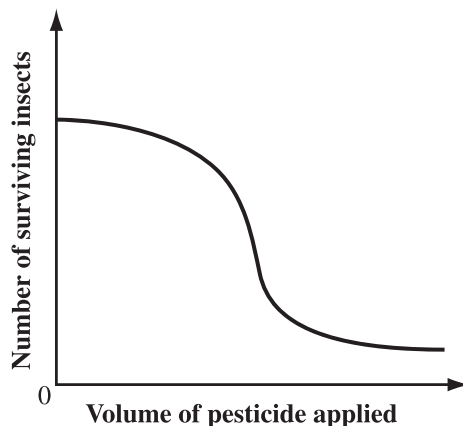
Pb²⁺(aq) _____ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 19.

A pesticide was used to control an insect population in some wheat fields. A study was conducted to examine the effect of the pesticide.

Relationship Between Pesticide Application and Insect Death



19. Which of the following rows identifies the variables in the pesticide study above?

| Row | Manipulated Variable | Responding Variable | Controlled Variable |
|-----|----------------------|---|---|
| A. | Type of pesticide | Number of insects alive after pesticide application | Volume of pesticide |
| B. | Type of pesticide | Volume of pesticide | Number of insects alive after pesticide application |
| C. | Volume of pesticide | Number of insects alive after pesticide application | Type of pesticide |
| D. | Volume of pesticide | Type of pesticide | Number of insects alive after pesticide application |

Use the following information to answer numerical-response question 7.

Some Organic Compounds and Their Applications

| Compound | Chemical Formula | Application |
|----------|------------------------------|--|
| 1 | $C_3H_7OH(l)$ | Disinfectant in hand sanitizer |
| 2 | $C_2Cl_3F_3(g)$ | Refrigerant |
| 3 | $CH_3CH_2CH_2COOCH_2CH_3(l)$ | Artificial flavouring for fruit juices |
| 4 | $CH_3COOH(aq)$ | Alternative to harmful household cleaning products |

Numerical Response

7. Match each compound numbered above to the chemical classification of that compound below. (Use each number only once.)

Compound: _____
Classification: Ester Alcohol Carboxylic acid Halogenated hydrocarbon

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

20. *There has been an increase in the intensity of UV rays reaching Earth because of the depletion of i in the upper atmosphere. This depletion has been attributed to the use of ii .*

The statements above are completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|------------|---------------------|------------------|
| A. | O ₃ (g) | DDT |
| B. | O ₃ (g) | CFCs |
| C. | CO ₂ (g) | DDT |
| D. | CO ₂ (g) | CFCs |

Use the following information to answer question 21.

The herbicide 2,4-dichlorophenoxyethanoic acid (2,4-D) is preferred by many farmers and homeowners over other pesticides because it kills broad-leaved plants, such as dandelions and clover, but has little effect on narrow-leaved plants such as wheat and lawn grass. A disadvantage of using 2,4-D is that the pests become resistant to the herbicide over time.

21. According to the information above, 2,4-D is a popular choice because of its
- A. high target specificity
 - B. ability to biomagnify quickly
 - C. tendency to cause mutations in crop pests
 - D. persistence in the area in which it is applied

Use the following information to answer question 22.

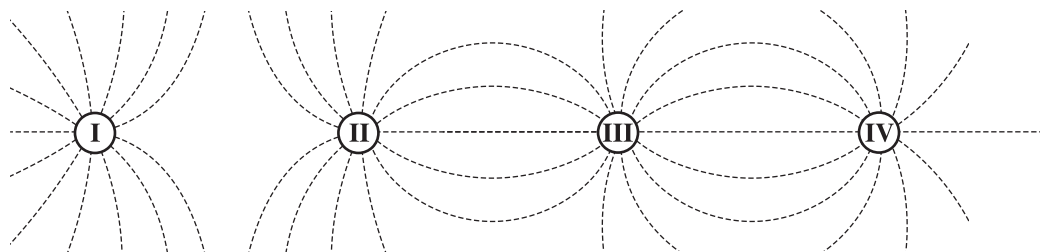
Some Environmental Problems

- I** Global warming
- II** Depletion of ozone
- III** Decreased pH of lakes
- IV** Leaching of heavy metals
- V** Decreased population of aquatic organisms

22. Which of the environmental problems listed above can be caused by acid deposition?
- A. I and III
 - B. II, III, and IV
 - C. III, IV, and V
 - D. IV and V only

Use the following information to answer question 23.

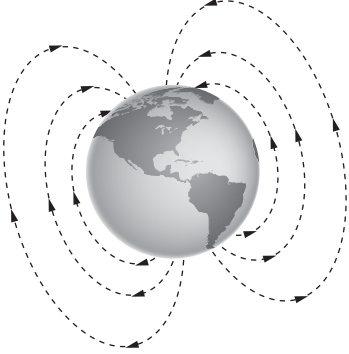
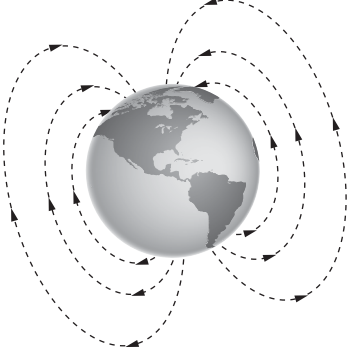
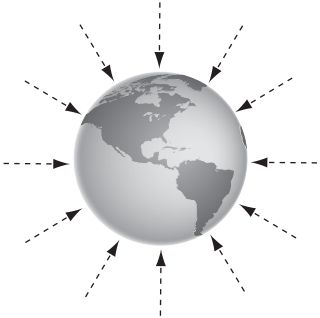
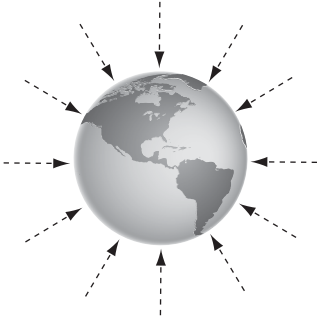
Field Lines Surrounding Charged Particles



23. Which of the following rows shows the **most likely** charge of the particles in the diagram above?

| Row | Charge of Particle I | Charge of Particle II | Charge of Particle III | Charge of Particle IV |
|-----|----------------------|-----------------------|------------------------|-----------------------|
| A. | Negative | Positive | Negative | Positive |
| B. | Positive | Negative | Positive | Positive |
| C. | Negative | Negative | Positive | Negative |
| D. | Positive | Positive | Positive | Positive |

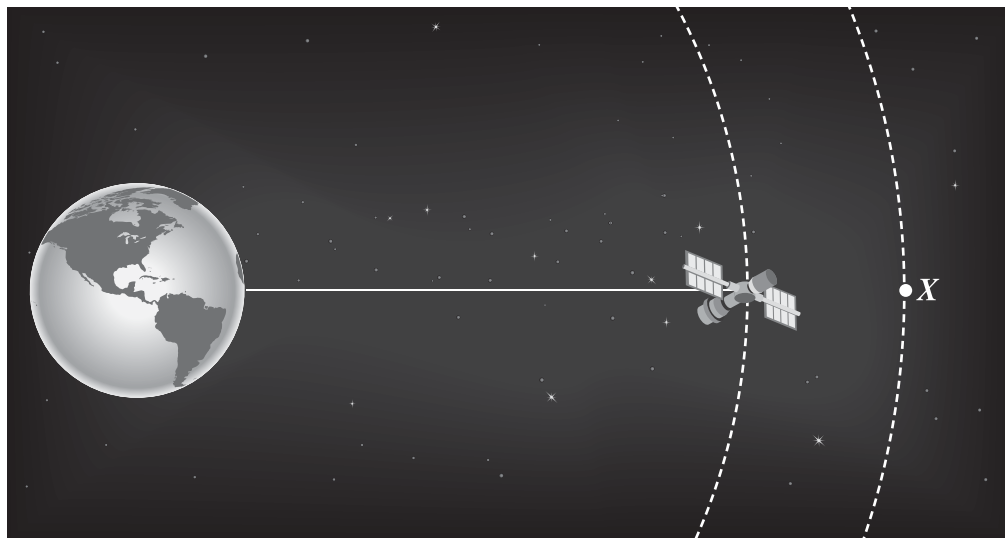
24. Which of the following rows depicts Earth's gravitational field and the equation used to determine the strength of the gravitational field?

| Row | Earth's Gravitational Field Diagram | Equation |
|-----|---|------------------------------|
| A. |  | $ \vec{E} = \frac{kq}{r^2}$ |
| B. |  | $g = \frac{Gm}{r^2}$ |
| C. |  | $ \vec{E} = \frac{kq}{r^2}$ |
| D. |  | $g = \frac{Gm}{r^2}$ |

Use the following information to answer question 25.

A Satellite in Orbit Around Earth

A satellite that has been orbiting Earth will soon be moved to a new orbit that goes through Point X, as shown below.



25. As the satellite is moved to Point X, Earth's gravitational field strength at the position of the satellite will
- A. increase, because the mass of Earth does not change
 - B. increase, because the distance between Earth and the satellite will be greater
 - C. decrease, because the mass of Earth does not change
 - D. decrease, because the distance between Earth and the satellite will be greater

Use the following information to answer numerical-response question 8.

A telecommunications satellite is in orbit 4.21×10^7 m from the centre of Earth.

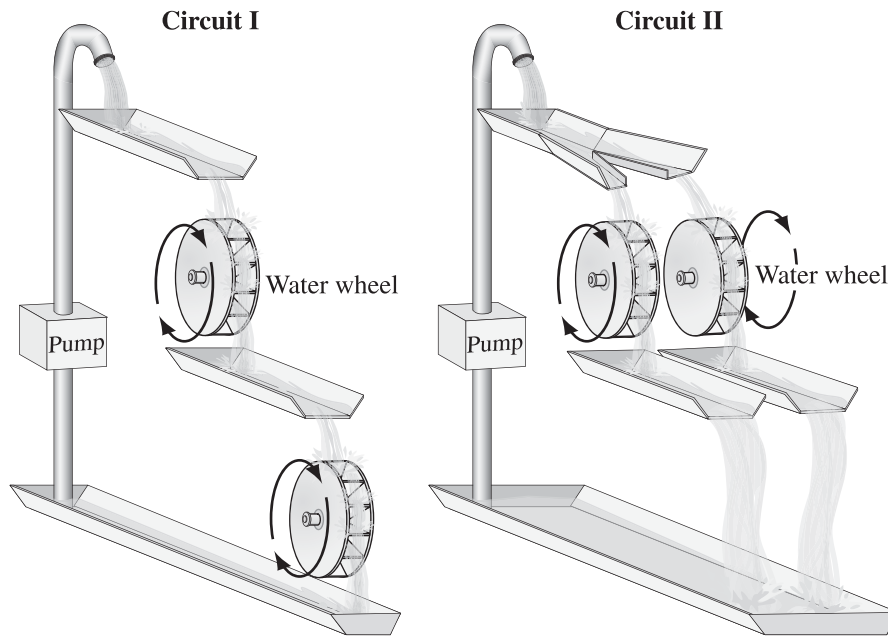
Numerical Response

8. Earth's gravitational field strength at the position of the satellite, expressed in scientific notation, is $a.bc \times 10^{-d}$ N/kg. The values of a , b , c , and d are _____, _____, _____, and _____.
- a b c d

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 26.

A student made an analogy between electric circuits and moving water. He drew two diagrams to represent two different types of circuits.



26. Circuit I shown in the diagram above represents a
- A. parallel circuit with a higher total resistance than Circuit II
 - B. parallel circuit with a lower total resistance than Circuit II
 - C. series circuit with a higher total resistance than Circuit II
 - D. series circuit with a lower total resistance than Circuit II

Use the following information to answer numerical-response question 9.

The Three Gorges Dam in China is the largest hydroelectric power station in the world. At full capacity the dam can produce 2.30×10^7 kW of power.

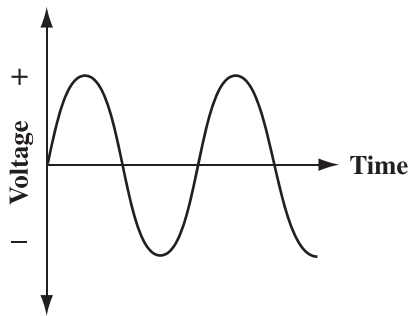
Numerical Response

9. If the dam runs at full capacity for 24.0 h, then the electrical energy produced, expressed in scientific notation, is $a.bc \times 10^d$ kW·h. The values of a , b , c , and d are $\underline{\quad}$, $\underline{\quad}$, $\underline{\quad}$, and $\underline{\quad}$.
- a b c d

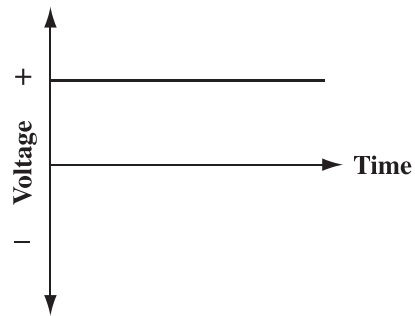
(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

27. Which of the following graphs **best** represents the relationship between voltage and time for an alternating current (AC)?

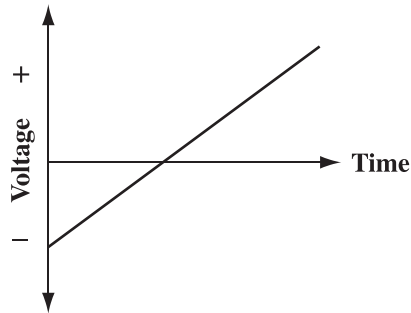
A.



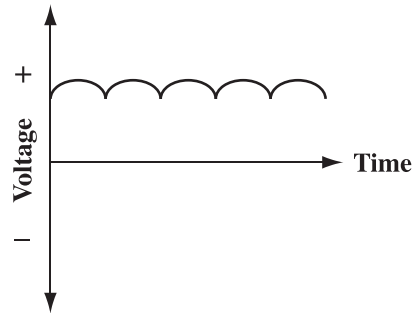
B.



C.



D.



28. If a Canadian traveller wishes to use the 220 V power source in her hotel room to power her 110 V hair dryer, she must use a *i* transformer. If the transformer has 50 turns on the primary coil, it would have *ii* turns on the secondary coil.

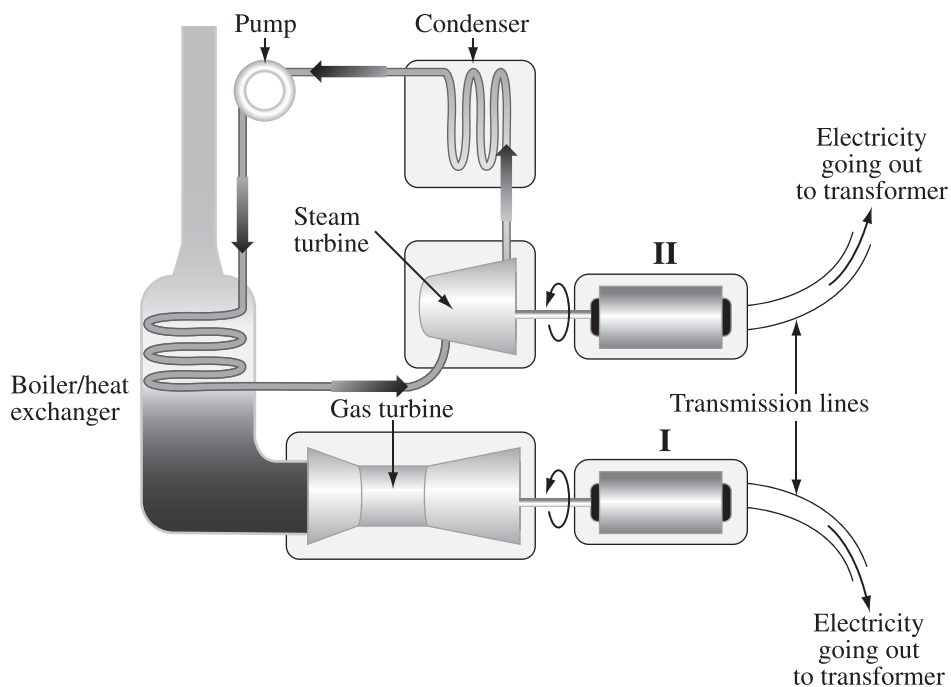
The statements above are completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|-----------|-----------|
| A. | step-up | 25 |
| B. | step-up | 100 |
| C. | step-down | 25 |
| D. | step-down | 100 |

Use the following information to answer question 29.

A combined-cycle gas turbine plant burns natural gas to produce electricity. To increase the efficiency of the plant, the excess heat produced during burning is used to create steam to turn a second turbine. The two turbines convert kinetic energy to electrical energy.

Combined-cycle Gas Turbine Plant

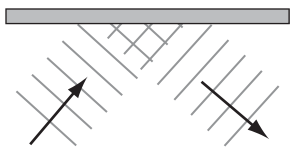
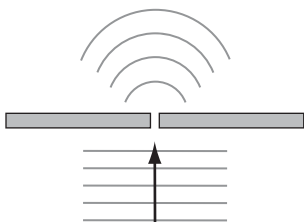



29. The parts of the diagram above labelled I and II represent electric *i* . The electricity that is produced by the combined-cycle plant would be in the form of *ii* with a relatively *iii* voltage for transmission to consumers in Alberta.

The statements above are completed by the information in row

| Row | <i>i</i> | <i>ii</i> | <i>iii</i> |
|-----|------------|--------------------------|------------|
| A. | motors | direct current (DC) | high |
| B. | motors | alternating current (AC) | low |
| C. | generators | direct current (DC) | low |
| D. | generators | alternating current (AC) | high |

Use the following information to answer numerical-response question 10.

| Property of Light | Diagram | Technology |
|-------------------|---|--------------------------------|
| 1 Reflection | 4  | 7 Filter for a camera lens |
| 2 Diffraction | 5  | 8 Curved mirror in a telescope |
| 3 Polarization | 6  | 9 Grating in a spectroscope |

Numerical Response

10. Using the numbers above, choose **one property of light** and match it with the diagram that represents that property of light and with a technology that relies on that property of light. (There is more than one correct answer.)

Property of light _____ (Record in the **first** column)

Diagram _____ (Record in the **second** column)

Technology _____ (Record in the **third** column)

(Record your answer in the numerical-response section on the answer sheet.)

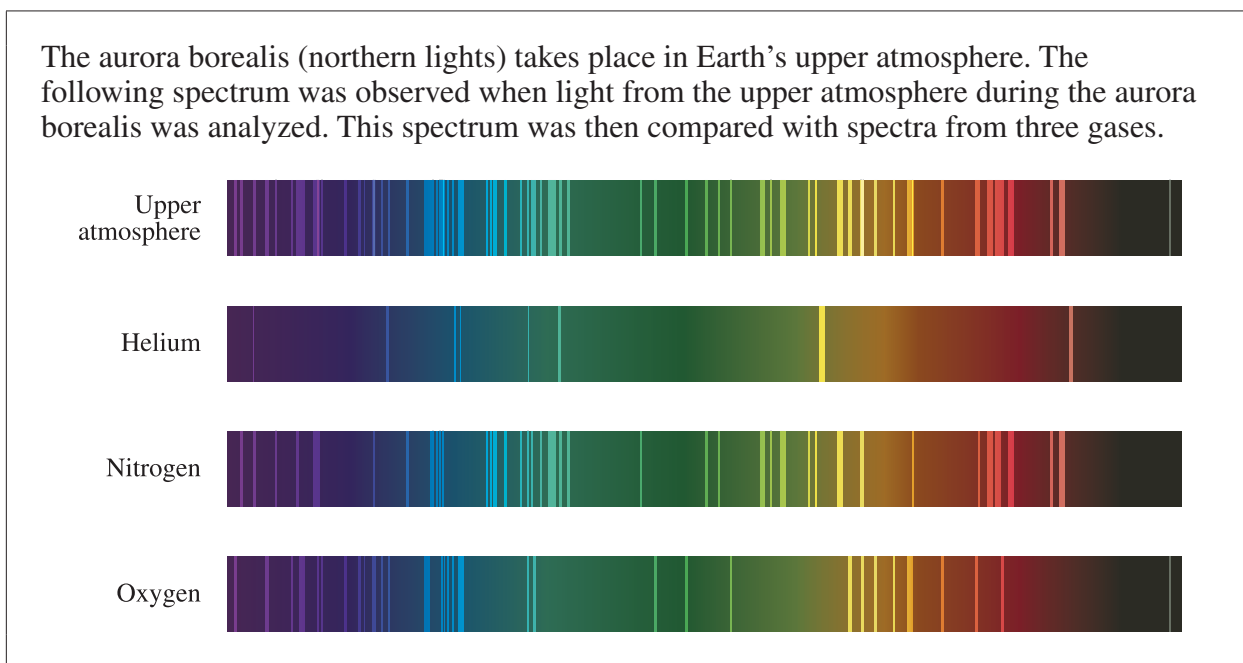
30. A difference between radio waves and visible light travelling through a vacuum is that
- A. visible light travels at a greater speed than radio waves
 - B. visible light has a longer wavelength than radio waves
 - C. radio waves travel at a greater speed than visible light
 - D. radio waves have longer wavelengths than visible light

Numerical Response

11. If an electromagnetic radiation (EMR) wave produced by the Sun has a wavelength of 3.44×10^{-2} m, the frequency of the wave, expressed in scientific notation, is $a.bc \times 10^d$ Hz. The values of a , b , c , and d are _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 31.



31. The spectra above indicate that the gases of the upper atmosphere are
- A. helium and nitrogen
 - B. helium and oxygen
 - C. nitrogen and oxygen
 - D. nitrogen only

Use the following information to answer numerical-response question 12.

| Type of Star | | Middle-life Stage | Final Stage | | |
|--------------|-------------------|-------------------|----------------|----------|--------------|
| 1 | Low-mass | 4 | Red supergiant | 6 | Neutron star |
| 2 | Intermediate-mass | 5 | Red giant | 7 | Black hole |
| 3 | High-mass | | | 8 | White dwarf |

Numerical Response

- 12.** Using the numbers above, choose **one type of star** and match it with its middle-life stage and its final stage. (There is more than one correct answer.)

Type of star _____ (Record in the **first** column)

Middle-life stage _____ (Record in the **second** column)

Final stage _____ (Record in the **third** column)

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 32.

The federal government set up a tax credit to help Canadians retrofit their homes to make them more energy efficient. For example, Canadian residents received funding to re-insulate their houses.

32. Increasing the insulation value of a house will reduce *i* energy lost while *ii* household heating costs.

The statement above is completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|------------|------------|
| A. | thermal | increasing |
| B. | thermal | decreasing |
| C. | electrical | increasing |
| D. | electrical | decreasing |

33. The energy consumed in modern societies comes mainly from coal, oil, and natural gas, which are *i* energy sources. The energy consumed in traditional Aboriginal societies comes mainly from wood, animal fat, and manure, which are forms of *ii* energy.

The statements above are completed by the information in row

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

34. An example of a **realistic** practice that promotes sustainable development is
- A. banning the use of fossil fuels
 - B. developing new low-efficiency energy sources
 - C. providing tax rebates on more fuel-efficient cars
 - D. prohibiting future development of energy sources

Use the following information to answer numerical-response question 13.

Advantages and Disadvantages of Various Energy Sources

| Advantages | | Disadvantages | |
|-------------------|--|----------------------|--|
| 1 | Technology already in place | 5 | Emissions add to global warming |
| 2 | Renewable fuel source | 6 | High cost to store waste products |
| 3 | No carbon dioxide emissions | 7 | Emissions lead to lung irritation |
| 4 | Fuel is easy to package, transport, and is readily available | 8 | Requires large areas of land for large-scale energy production |

Numerical Response

- 13.** Using the table above, identify **two** advantages and **two** disadvantages of using a coal-burning power plant to produce electricity in Alberta. (There is more than one correct answer.)

Advantages

Disadvantages

(Record in the
first column)

(Record in the
second column)

(Record in the
third column)

(Record in the
fourth column)

(Record your answer in the numerical-response section on the answer sheet.)

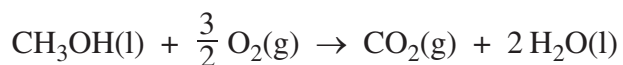
Use the following information to answer question 35.

A particular wind turbine converts 20.0% of the wind's kinetic energy into electrical energy.

- 35.** If 2.67 MW of electrical energy is produced by the wind turbine, the input energy is
- A.** 0.134 MW
 - B.** 0.534 MW
 - C.** 3.34 MW
 - D.** 13.4 MW

Use the following information to answer numerical-response question 14.

Methanol can be used in a fuel cell to generate electricity. The overall reaction that occurs in a methanol fuel cell is represented by the following equation.



Numerical Response

14. The energy released when 1.00 mol of methanol is reacted according to the equation above is _____ kJ.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Use the following information to answer numerical-response question 15.

Some Emissions or By-products

- 1 Noise pollution
- 2 Particulate matter
- 3 Thermal pollution
- 4 Sulfur dioxide, $\text{SO}_2(\text{g})$
- 5 Carbon dioxide, $\text{CO}_2(\text{g})$
- 6 Chlorofluorocarbons, CFCs

Numerical Response

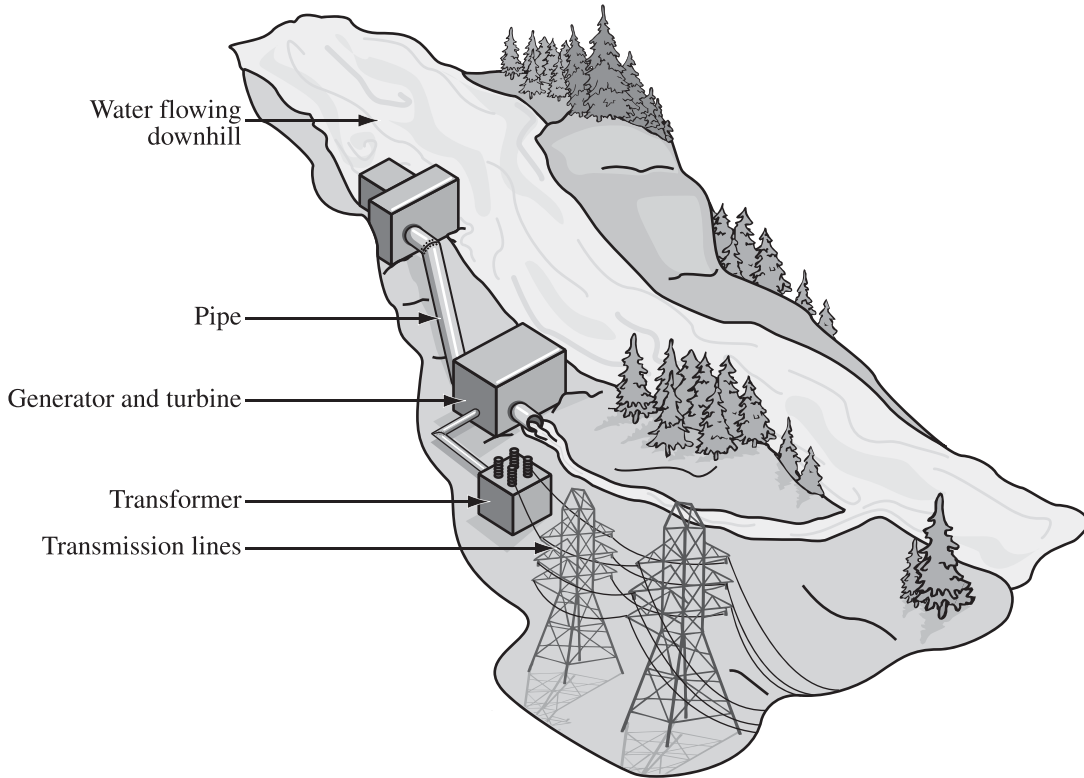
15. The emissions or by-products numbered above that are reduced or eliminated when wind power, rather than coal combustion, is used to generate electricity are _____, _____, _____, and _____.

(Record all **four digits** of your answer **in any order** in the numerical-response section on the answer sheet.)

Use the following information to answer question 36.

Run-of-river hydroelectric stations are built on rivers with a steady flow of water as an alternative to building a dam across the river and creating a reservoir behind the dam.

Run-of-River Hydroelectric Station

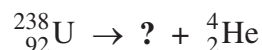


36. A **major** advantage of a run-of-river hydroelectric station compared with a hydroelectric dam is that the run-of-river station
- A. creates no greenhouse gases
 - B. causes less habitat destruction
 - C. uses a renewable energy source
 - D. does not originate from solar energy

37. Which of the following sequences **best** describes the energy conversions in a hydroelectric dam?
- A. Gravitational potential energy → kinetic energy → electrical energy
 - B. Gravitational potential energy → kinetic energy → thermal energy → electrical energy
 - C. Chemical potential energy → thermal energy → kinetic energy → electrical energy
 - D. Chemical potential energy → kinetic energy → gravitational potential energy → electrical energy

Use the following information to answer question 38.

A Natural Form of Decay for Uranium-238



38. The nuclear equation above represents *i* decay of uranium-238. The missing daughter isotope produced during this decay reaction is *ii* .

The statements above are completed by the information in row

| Row | <i>i</i> | <i>ii</i> |
|-----|----------|---------------|
| A. | alpha | thorium-234 |
| B. | alpha | plutonium-242 |
| C. | beta | thorium-234 |
| D. | beta | plutonium-242 |

Use the following information to answer numerical-response question 16 and question 39.

Natural gas is often found trapped in layers of shale that contain large amounts of radioactive potassium. As the potassium isotopes decay, they emit gamma radiation. When drilling to find natural gas reserves, geologists may look for high levels of gamma radiation from rock layers.

Gamma Decay of Potassium-40 and Associated Nuclide Masses

| | | | | |
|--|---|--------------|-----------|---|
| Potassium Isotope Decay | ${}_{19}^{40}\text{K} \rightarrow {}_{18}^{40}\text{Ar} + {}_{+1}^0\text{e} + {}_0^0\gamma$ | | | |
| Nuclide Mass ($\times 10^{-3}$ kg/mol) | 39.964 00 | 39.962 383 1 | 0.000 549 | 0 |

Numerical Response

16. As shown above, the change in mass that occurs during the radioactive decay of 1.00 mol of potassium-40, ${}_{19}^{40}\text{K}$, expressed in scientific notation, is $-a.bc \times 10^{-6}$ kg. The values of *a*, *b*, and *c* are , , and .
- a* *b* *c*

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

39. The instrument that a geologist uses to detect the gamma radiation in a shale layer would be most sensitive to electromagnetic radiation with a wavelength of
- A. 400 nm
 - B. 700 nm
 - C. 1.56×10^{-12} m
 - D. 2.31×10^{21} m