

January 2008



Science 30

*Part B: Machine Scored
Grade 12 Diploma Examination*

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January 2008

Science 30

Part B: Machine Scored

Grade 12 Diploma Examination

Description

Time: 2 hours. This closed-book examination was developed to be completed in 2 h; however, you may take an additional 0.5 h to complete the examination.

Part B: Machine Scored consists of 40 multiple-choice and 12 numerical-response questions, of equal value, worth 65% of the total Science 30 Diploma Examination mark.

This examination contains sets of related questions. A set of questions may contain multiple-choice and/or numerical-response questions.

A science data booklet is provided for your reference.

Note: The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.

Instructions

- Turn to the last page of the examination booklet. Carefully fold and tear out the machine-scored answer sheet along the perforation.
- Use **only** an **HB** pencil for the answer sheet.
- Fill in the information on the back cover of the examination booklet and the answer sheet as directed by the presiding examiner.
- You are expected to provide your own calculator. You may use any scientific calculator or a graphing calculator approved by Alberta Education.
- You **must** have cleared your calculator of all information that is stored in the programmable or parametric memory.
- You may use a ruler and a protractor.
- Read each question carefully.
- Consider all numbers used in the examination to be the result of a measurement or an observation.
- When performing calculations, use the values of the constants provided in the data booklet.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do **not** fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Now turn this page and read the detailed instructions for answering machine-scored questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

- A. chemistry
- B. biology
- C. physics
- D. science

Answer Sheet

A B C

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box. Any boxes on the right that are not needed are to remain blank.**

Examples

Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _____.

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

$$\begin{aligned}\text{Average} &= (21.0 + 25.5 + 24.5)/3 \\ &= 23.666\dots \\ &= 23.7 \text{ (rounded to one decimal place)}\end{aligned}$$

Record 23.7 on the answer sheet →

2	3	.	7
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0
<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1
<input checked="" type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2
<input type="radio"/> 3	<input checked="" type="radio"/> 3	<input type="radio"/> 3	<input type="radio"/> 3
<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4
<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5
<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6
<input type="radio"/> 7	<input type="radio"/> 7	<input type="radio"/> 7	<input checked="" type="radio"/> 7
<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8
<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9

Correct-Order Question and Solution

Four Subjects	
1	Physics
2	Biology
3	Science
4	Chemistry

When the subjects above are arranged in alphabetical order, their order is _____, _____, _____, and _____.

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

Answer: 2413

Record 2413 on the answer sheet

2	4	1	3
•	•		
0	0	0	0
1	1	•	1
•	2	2	2
3	3	3	•
4	•	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Scientific Notation Question and Solution

The speed of light is $a.bc \times 10^d$ m/s. 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.)

Answer: $c = 3.00 \times 10^8$ m/s

Record 3008 on the answer sheet

3	0	0	8
•	•		
0	•	•	0
1	1	1	1
2	2	2	2
•	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	•
9	9	9	9

Medical science requires an understanding of body systems, genetics, and environmental chemistry.

1. An experiment demonstrated that rats experienced a decrease in white blood cell function after they were fed genetically modified potatoes. This decrease in the function of the rats' white blood cells likely affected the rats' ability to
 - A. fight disease
 - B. form blood clots
 - C. oxygenate blood
 - D. regulate the pH of body fluids

Use the following information to answer the next question.

Benefits and Risks Associated with Genetically Modified Plants

- I** Transfer of genetic material to pest organisms
- II** Decreased use of chemical insecticides
- III** Effect on non-target organisms
- IV** Increased crop yield

2. An ecological **benefit** and an economic **benefit** that are associated with genetically modified plants are numbered
 - A. I and III
 - B. I and IV
 - C. II and III
 - D. II and IV

Use the following information to answer the next question.

People who consume genetically modified organisms may experience allergic reactions, which can be triggered by the presence of foreign proteins in the genetically modified organisms.

3. The presence of foreign proteins in genetically modified organisms can cause an allergic reaction because the proteins function as *i* and cause an *ii* .

The statement above is completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	antigens	infection
B.	antigens	immune response
C.	antibodies	infection
D.	antibodies	immune response

Use the following information to answer the next question.

Steps in Preparing Bacteria to Produce Insulin

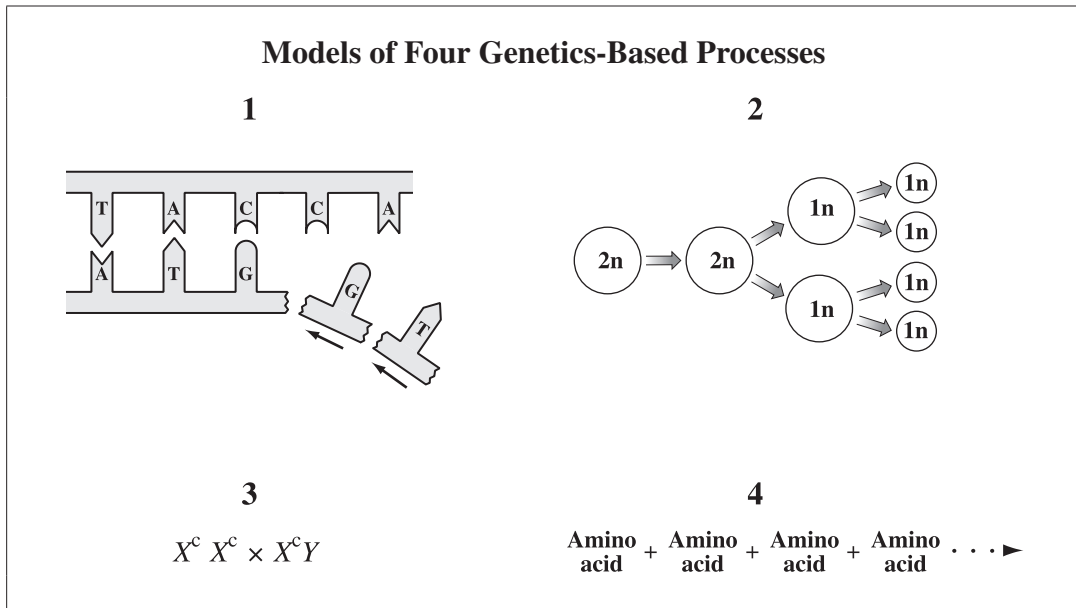
- 1 Bacteria containing the recombinant DNA is cultured and grown.
- 2 The insulin-producing gene is obtained from pigs.
- 3 DNA from bacteria is cut.
- 4 The insulin-producing gene is inserted into the bacterial DNA.

Numerical Response

1. The order in which the steps listed above should be performed in order for bacteria to produce insulin is _____, _____, _____, and _____.

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

Use the following diagrams to answer the next question.



Numerical Response

2. Match each of the models numbered above with its appropriate label given below.

Model: _____
Label: **Protein synthesis** **DNA replication** **Sex linkage** **Meiosis**

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

Use the following information to answer the next two questions.

Immunotherapy is an innovative practice of using the body's immune system to treat cancer.

Steps in Immunotherapy

- 1 Part of the tumour is removed from the patient.
- 2 Tumour-infiltrating white blood cells are isolated from the tumour.
- 3 The most aggressive tumour-infiltrating cells are identified.
- 4 Aggressive tumour-infiltrating cells are allowed to multiply in a tissue culture.
- 5 The patient's immune system is shut down.
- 6 Large numbers of tumour-infiltrating cells are returned to the patient.
- 7 Tumour-infiltrating cells attack tumour cells, reducing the size of the tumour.

4. Based on the information shown above, the most aggressive tumour-infiltrating cells behave most like
- A. killer T cells
 - B. helper T cells
 - C. memory T cells
 - D. suppressor T cells
5. *Tumour-infiltrating cells that are allowed to multiply in the lab undergo the process of i , which results in the production of cells that are ii .*

The statement above is completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	mitosis	haploid (1n)
B.	mitosis	diploid (2n)
C.	meiosis	haploid (1n)
D.	meiosis	diploid (2n)

6. Tumour-infiltrating cells are returned to the patient's circulatory system using a needle that is inserted into the patient's vein. A vein is used rather than an artery because a vein has
- A. thin walls and contains blood that is at a relatively low pressure
 - B. thin walls and contains blood that is at a relatively high pressure
 - C. thick walls and contains blood that is at a relatively low pressure
 - D. thick walls and contains blood that is at a relatively high pressure

Use the following information to answer the next question.

Some Parts of the Circulatory System

- 1 Aorta
- 2 Left atrium
- 3 Right ventricle
- 4 Capillaries in leg

Numerical Response

3. Tumour-infiltrating cells are injected into a **vein** in the arm. The order in which the tumour-infiltrating cells will move through the parts of the circulatory system listed above is _____, _____, _____, and _____.

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

Numerical Response

4. The pH of blood is normally 7.400. The hydronium ion concentration, $[\text{H}_3\text{O}^+(\text{aq})]$, in blood is $a.bc \times 10^{-8}$ mol/L. The values of **a**, **b**, and **c** are _____, _____, and _____.

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

Use the following information to answer the next question.

Oxygen Content of Blood

- 1** Oxygenated
- 2** Deoxygenated

Numerical Response

- 5.** For each of the blood vessels given below, use the number **1** to indicate that the blood in the blood vessel is oxygenated or a **2** to indicate that the blood in the blood vessel is deoxygenated.

**Oxygen Content
of Blood:**

Blood Vessel:	<u> </u>	<u> </u>	<u> </u>	<u> </u>
	Pulmonary artery	Aorta	Pulmonary vein	Vena cava

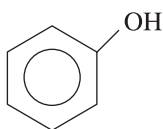
(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

- 7.** When a person is infected with a virus, the immune system components that first detect the presence of the virus are the
- A.** B cells
 - B.** antigens
 - C.** macrophages
 - D.** helper T cells
- 8.** Which of the following defence system components is **not** considered part of the body's first line of defence against infection by micro-organisms?
- A.** Tears
 - B.** Skin cells
 - C.** Stomach acid
 - D.** Helper T cells

Use the following information to answer the next question.

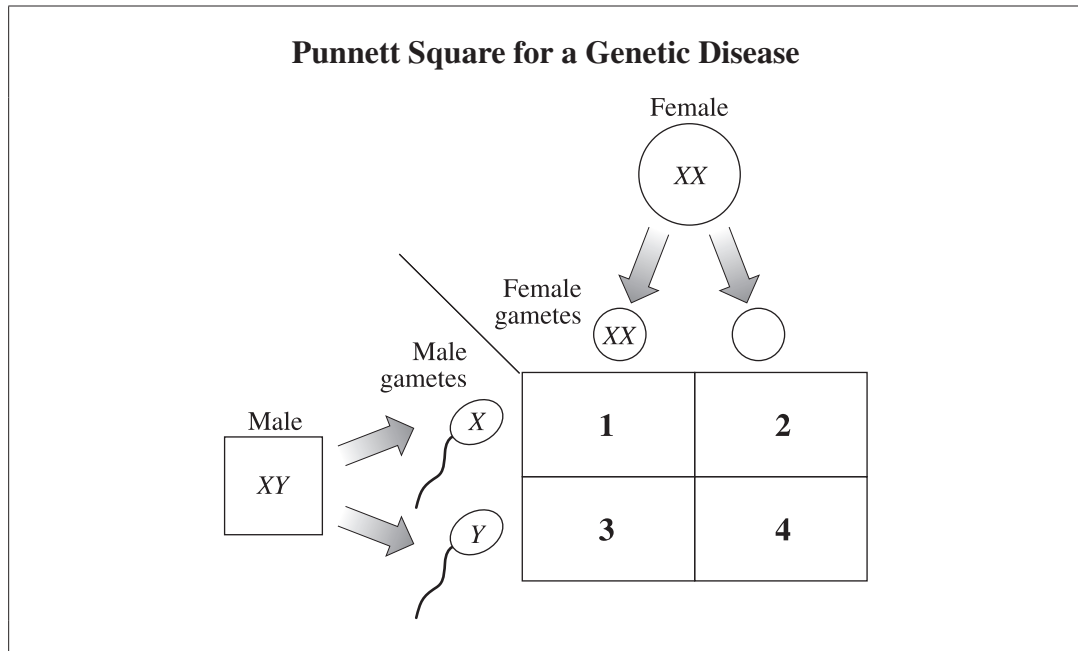
Phenol is a chemical that is involved in the manufacture of some pesticides.

Phenol



9. Because of its chemical structure, phenol is classified as
- A. an ester
 - B. an alkene
 - C. an alcohol
 - D. a carboxylic acid
-
10. A pesticide that comes in contact with a person's skin can be first absorbed into the person's bloodstream by
- A. a vein
 - B. a venule
 - C. a capillary
 - D. an arteriole

Use the following diagram to answer the next question.



Numerical Response

6. Match each of the numbered spaces in the Punnett square above to the genotype to which it corresponds, as given below.

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

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

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

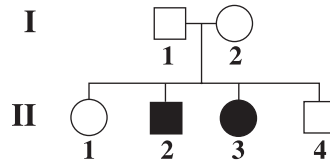
XXY _____ (Record in the **fourth** column)

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

Use the following information to answer the next question.

Cystic fibrosis is an autosomal recessive genetic disorder. People with the disorder produce abnormal amounts of sticky mucus in their lungs. Parents who are unaffected by cystic fibrosis can have children who are affected.

Pedigree Chart for Cystic Fibrosis



The alleles associated with cystic fibrosis are N and n .

11. Which of the following rows identifies the genotypes of individuals **I-1** and **I-2** and the phenotype of individual **II-2** shown in the pedigree chart above?

Row	I-1	I-2	II-2
A.	Nn	NN	Normal
B.	Nn	Nn	Cystic fibrosis
C.	NN	nn	Cystic fibrosis
D.	Nn	Nn	Normal

Environmental scientists are concerned with the causes and effects of various pollutants, along with social and political initiatives that may affect the environment.

Use the following information to answer the next question.

Chemical Analysis

Scientists can study environmental samples by placing small electrically charged drops of chemicals into a chemical analyzer. In the analyzer, the electrically charged drops are suspended between two fields—a **gravitational** field and an **electric** field.

Possible Orientations of Positively Charged Chemical Drops in a Chemical Analyzer

I

II

III

IV

12. The two diagrams shown above that depict situations in which a positively charged drop of chemical **could** remain suspended are
- A. I and II
 - B. I and III
 - C. II and IV
 - D. III and IV

Use the following information to answer the next two questions.

Some studies suggest that increased exposure to ultraviolet (UV) radiation is causing deformities in some amphibians.

13. The increase in the intensity of UV radiation reaching Earth's surface is caused by the release of *i* molecules that *ii* .

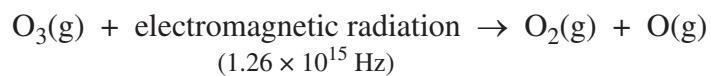
The statement above is completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	CO ₂	deplete the ozone layer
B.	CO ₂	trap thermal energy
C.	CFC	deplete the ozone layer
D.	CFC	trap thermal energy

14. UV radiation causes a change to the sequence of nitrogen bases in the DNA of amphibians that results in
- A. mitosis
 - B. meiosis
 - C. mutation
 - D. segregation

Use the following equation to answer the next two questions.

Chemical Reaction of Ozone



15. The form of electromagnetic radiation that brings about the change to the ozone molecule in the chemical reaction represented above is
- A. radio wave
 - B. gamma ray
 - C. infrared radiation
 - D. ultraviolet radiation

Numerical Response

7. Electromagnetic radiation with a frequency of 1.26×10^{15} Hz has a wavelength of $a.bc \times 10^{-d}$ m. 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 the next question.

Changes Due to Pollution

- I** Increased concentration of heavy metals in water
- II** Decreased thickness of the ozone layer
- III** Increased corrosion of buildings and automobiles
- IV** Increased numbers of plant species
- V** Increased soil pH

16. Which of the changes listed above are caused by acid deposition?
- A. I and III
 - B. I and IV
 - C. II and III
 - D. II and IV
-
17. The increase in the concentration of toxins as they move up the food chain is the result of
- A. biomagnification
 - B. natural selection
 - C. respiration
 - D. fusion
18. In an experiment to determine how the volume of sewage in a river affects algae growth, the manipulated, responding, and controlled variables are, respectively,
- A. algae growth, volume of sewage, and river water
 - B. algae growth, river water, and volume of sewage
 - C. volume of sewage, algae growth, and river water
 - D. river water, volume of sewage, and algae growth

Use the following information to answer the next question.

Some Gases Present in the Atmosphere

- I** H₂S(g)
- II** O₃(g)
- III** NO₂(g)
- IV** SO₂(g)

20. Which of the gases listed above contribute to acid deposition?

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

21. When CO₂(g) reacts with water in the atmosphere, H₂CO₃(aq) is produced. Rainwater can be tested for H₂CO₃(aq) with the pH indicator litmus and with a conductivity-testing device. Which of the following rows shows the results for these two tests if the rainwater contains H₂CO₃(aq)?

Row	Litmus	Conductivity
A.	Blue	Conductive
B.	Blue	Non-conductive
C.	Red	Non-conductive
D.	Red	Conductive

22. During a titration of $\text{HCl}(\text{aq})$ with $\text{NaOH}(\text{aq})$, the $\text{NaOH}(\text{aq})$ behaves as *i* , and the $\text{HCl}(\text{aq})$ behaves as *ii* .

The statement above is completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	an acid	a base
B.	an acid	an acid
C.	a base	an acid
D.	a base	a base

23. Which of the following procedures **best** ensures that the results obtained from a titration experiment are reliable?
- A. Drying the sample container between trials
 - B. Performing a minimum of three trials
 - C. Preparing new solutions for each trial
 - D. Using a variety of indicators

Use the following information to answer the next question.

Tap water in Calgary has a pH between 7.6 and 8.4, depending on the season.

24. If the indicators bromothymol blue and thymolphthalein are used to determine the pH range of the tap water in Calgary, their colours would be, respectively,
- A. blue and blue
 - B. yellow and blue
 - C. blue and colourless
 - D. yellow and colourless

Use the following table to answer the next two questions.

Policy, Country, Year Initiated	Effect
Toxic waste tax, Germany, 1991	Toxic waste production fell more than 15% in three years
Water pollution taxes, Netherlands, 1970	Main factor behind 72–99% drop in industrial discharges of heavy metals into regionally managed waters
Sulfur oxide tax, Sweden, 1991	One-third of a 40% emissions drop during 1989–95 attributed to tax
Ozone-depleting substance tax, United States, 1990	Smoothing and enforcing phase-outs of ozone-depleting substances
Carbon dioxide tax, Norway, 1991	Emissions appear to be 3–4% lower than they would be without the tax

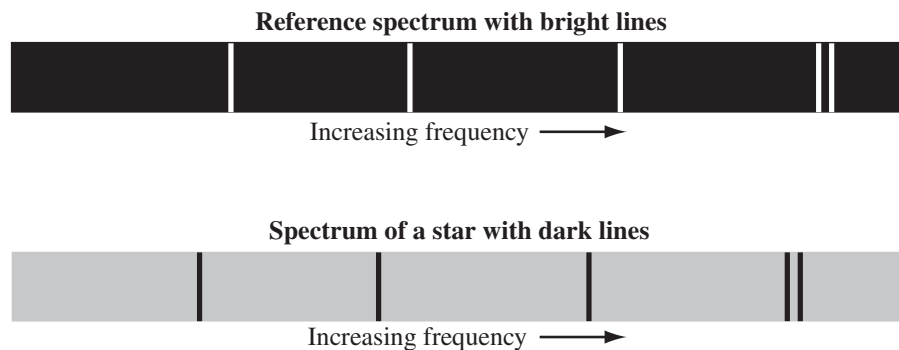
25. The taxes described in the table above represent government attempts to
- A. support the energy industry
 - B. increase fossil fuel consumption
 - C. tax renewable energy production
 - D. encourage sustainable development
26. A conclusion that can be drawn from the table is that
- A. taxes have no effect on environmental damage
 - B. technology cannot reduce environmental damage
 - C. the environmental benefits do not justify more taxes
 - D. increasing the cost to polluters reduces environmental damage

Scientists in a space station might analyze data from space and perform experiments on materials.

Use the following information to answer the next two questions.

Stars produce visible electromagnetic radiation with a characteristic pattern of frequencies of dark lines that have been removed from the spectrum. A reference spectrum may be produced by exciting the electrons of a particular gas.

Visible Electromagnetic Radiation from a Reference Spectrum and a Star



27. The reference spectrum shown above is an example of
- A. an emission spectrum
 - B. a diffraction spectrum
 - C. a continuous spectrum
 - D. an absorption spectrum
28. The star's spectrum shown above has *i* frequencies than the reference spectrum. The difference in the position of the frequencies suggests that the star is moving *ii* Earth.

The statements above are completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	higher	away from
B.	higher	toward
C.	lower	away from
D.	lower	toward

Use the following information to answer the next two questions.

Metallic Elements Matched with the Colours They Emit When Heated

Metallic Element	Colour of Light Produced
Copper	Blue-green
Barium	Yellow-green
Sodium	Yellow-orange
Strontium	Red

29. The metallic element listed above that emits the colour of light with the longest wavelength is
- A. copper
 - B. barium
 - C. sodium
 - D. strontium
30. An instrument that can be used to separate the wavelengths of light produced by the metals is
- A. an electroscope
 - B. a spectroscope
 - C. a polarimeter
 - D. a telescope
-
31. *The gravitational force between Earth and an orbiting object is dependent on the mass of i and the ii .*

The statement above is completed by the information in row

Row	<i>i</i>	<i>ii</i>
A.	Earth	speed of the object
B.	Earth	distance between the object and Earth
C.	both Earth and the object	speed of the object
D.	both Earth and the object	distance between the object and Earth

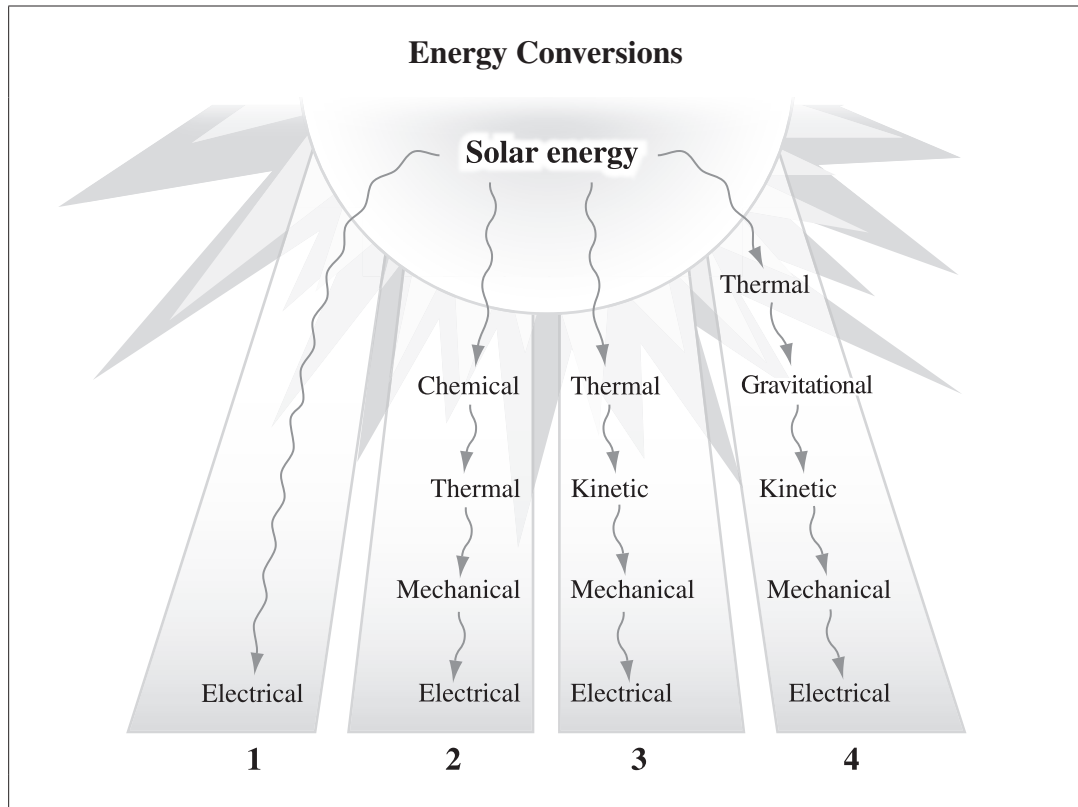
Various technologies are used to meet the energy demands of an increasingly energy-dependent society.

Use the following information to answer the next question.

Nuclear reactors such as the CANDU reactor use nuclear fission to produce energy.

- 32.** The change to matter in nuclear fission reactions involves
- A.** combining nuclei that have small masses to make a nucleus that has a large mass
 - B.** splitting a nucleus that has a large mass to make nuclei that have small masses
 - C.** emitting a helium atom from the nucleus of an element
 - D.** emitting an electron from the nucleus of an element

Use the following diagram to answer the next question.



Numerical Response

9. Match each of the sequences of energy conversions shown above with the corresponding technology listed below.

Coal-fired generator _____ (Record in the **first** column)

Photovoltaic cell _____ (Record in the **second** column)

Hydroelectric generator _____ (Record in the **third** column)

Wind turbine _____ (Record in the **fourth** column)

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

33. Tidal energy is the result of
- A. magnetic forces
 - B. electrical forces
 - C. gravitational forces
 - D. electromagnetic forces

Numerical Response

10. If 1.50 kg of uranium is converted into energy in a nuclear reactor, then the energy released by the reactor will be $a.bc \times 10^{17}$ J. The values of a , b , and c are _____, _____, and _____.

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

34. An electrical circuit is used to transmit energy from a power plant to consumers. A change to the voltage of the electricity in a circuit requires the use of a
- A. motor
 - B. resistor
 - C. generator
 - D. transformer

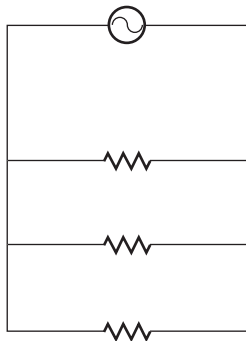
35. Generally, electrical power is transmitted from a generating station in the form of *i* at *ii* voltage so that the current may be *iii* .

The statement above is completed by the information in row

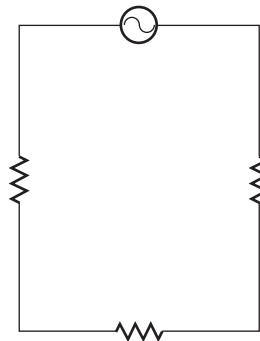
Row	<i>i</i>	<i>ii</i>	<i>iii</i>
A.	AC	high	decreased
B.	DC	high	increased
C.	AC	low	increased
D.	DC	low	decreased

36. A toaster, clock, and coffeemaker are wired in parallel. Which of the following diagrams illustrates this circuit?

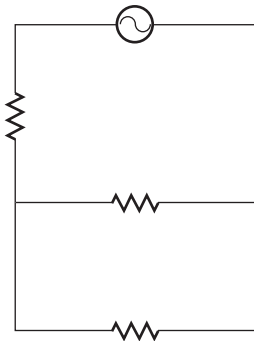
A.



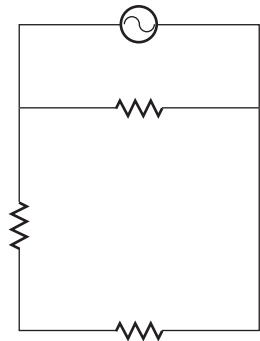
B.



C.



D.



Numerical Response

11. If 6.00×10^3 W of electrical power is required to operate a machine with a total resistance of 2.00Ω , then the current that flows within the machine is _____ A.

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

37. An electrostatic painting gun has a resistance of $1.0 \times 10^{10} \Omega$. If the voltage in this circuit is 120 000 V, then the current is
- A. 8.3×10^{-6} A
 - B. 1.2×10^{-5} A
 - C. 8.3×10^4 A
 - D. 1.2×10^{15} A

Use the following information to answer the next three questions.

Automobile Powered by Gasoline and Electricity

The hybrid automobile combines a gasoline combustion engine with an electric motor. During braking, a generator converts the energy from the moving automobile into electricity. The energy from the electricity is stored in batteries within the automobile. Electrical energy is then supplied to the automobile's electric motor to supplement the automobile's gasoline-powered motor.

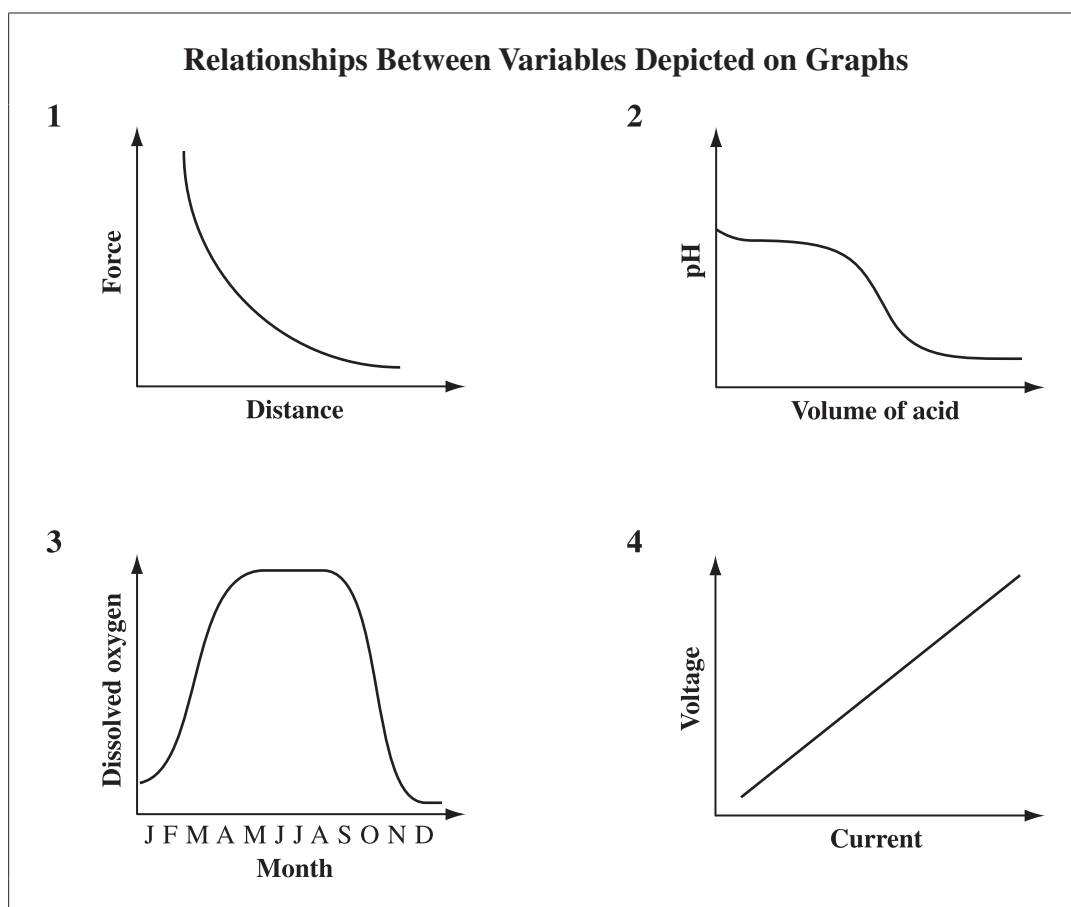
38. The electric motor in a hybrid automobile runs on a 144 V system and has a power output of 10 kW. The current used by the electric motor is
- A. 0.48 A
 - B. 0.69 A
 - C. 48 A
 - D. 69 A
39. The energy stored in the batteries of a hybrid automobile is in the form of
- A. electrical energy
 - B. chemical energy
 - C. thermal energy
 - D. kinetic energy

Use the following additional information to answer the next question.

Automotive engineers are experimenting with capacitors, which are objects that store electrical energy. A capacitor releases stored energy to the electric motor faster than a battery, enabling the automobile to have greater acceleration.

40. The length of time required for a capacitor to release 2.2×10^4 J of electrical energy to a 10 kW electric motor is
- A. 0.45 s
 - B. 2.2 s
 - C. 10 s
 - D. 22 s

Use the following graphs to answer the next question.



Numerical Response

12. Match each graph numbered above with its corresponding title given below.

- Depiction of Resistance (Ω) in a conductor _____ (Record in the **first** column)
- Buffering Capacity of Soil _____ (Record in the **second** column)
- Results of Sewage in a Lake _____ (Record in the **third** column)
- Depiction of Magnetic Field Strength _____ (Record in the **fourth** column)

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

*You have now completed the examination.
If you have time, you may wish to check your answers.*