

557-410

APPLIED SCIENCE  
AND TECHNOLOGY

JUNE

WRITTEN EXAMINATION

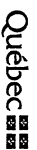
STUDENT BOOKLET

INSTRUCTIONS

1. Check the information in sections 1 and 2 of the machine-scored answer sheet.
2. Detach the *Answer Booklet* located in the middle of this *Student Booklet*.
3. Stick the self-adhesive label or fill in the required information on the cover page of the *Answer Booklet*.
4. Answer the questions in Part A on the answer sheet provided.
5. Write your answers to the questions in Parts B and C in the *Answer Booklet*, showing all your work.
6. You may use a scientific calculator without a graphic display, as well as a ruler.
7. Reference materials are not permitted, except for the sheet of formulas and quantities as well as Appendixes I and II included in this booklet.
8. Hand in *Student Booklet*, the *Answer Booklet* and the machine-scored answer sheet at the end of the examination.

Note: Each question is worth four marks.

TIME: 3 hours



**FORMULAS AND QUANTITIES**  
Applied Science and Technology

**FORMULAS**

$V = RI$      $V$  : potential difference  
           $R$  : resistance  
           $I$  : electric current intensity

$F_g = mg$      $F_g$  : gravitational force  
               $m$  : mass  
               $g$  : intensity of the gravitational field

$P = VI$      $P$  : electrical power  
           $V$  : potential difference  
           $I$  : electric current intensity

$v = \frac{d}{\Delta t}$      $v$  : average speed  
               $d$  : distance  
               $\Delta t$  : time difference

$E = P\Delta t$      $E$  : energy consumed  
           $P$  : electrical power  
           $\Delta t$  : time difference

$$\text{Energy efficiency} = \frac{\text{Amount of useful energy}}{\text{Amount of energy consumed}} \times 100$$

**QUANTITIES**

NAME	SYMBOL	VALUE
Intensity of the gravitational field on Earth	g	9.8 m/s <sup>2</sup> or 9.8 N/kg

**PART A**  
MULTIPLE CHOICE QUESTIONS

**INSTRUCTIONS**

This part of the examination consists of Questions 1 to 15.

Answer these 15 questions on the answer sheet provided. For each question, use an HB pencil to fill in the box under the letter that corresponds to your answer.

- Four characteristics of certain living things are listed below.
  - They are autotrophs.
  - They are heterotrophs.
  - They transform organic matter into inorganic matter.
  - They transform inorganic matter into organic matter.

Which of the above characteristics can be associated with **producers**?

- A) 1 and 3      B) 1 and 4      C) 2 and 3      D) 2 and 4

- The table below gives four characteristics of four different environments.

EVALUATION OF THE AMOUNT OF SUNLIGHT AND PRECIPITATION AS WELL AS TEMPERATURES IN DIFFERENT ENVIRONMENTS

Environment	Amount of Sunlight	Amount of Precipitation	Daytime Temperature	Night Time Temperature
1	High	High	Hot	Hot
2	Low	Low	Cold	Cold
3	Variable	Average	Variable	Variable
4	High	Very low	Hot	Cold

Which environment is most likely to have the **highest** primary productivity?

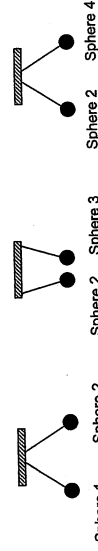
- A) Environment 1      B) Environment 2      C) Environment 3      D) Environment 4

- Which statement regarding a mineral ore is **TRUE**?

- A) All rocks in the lithosphere are ores.  
 B) A mineral ore is a rock not found in the Abitibi and North Shore regions.  
 C) A mineral ore is a rock rich in minerals that can be mined profitably.  
 D) A mineral ore contains only metal-bearing minerals.

- You are given four electrically charged spheres. You know that sphere 1 is negatively charged.

The following diagrams show what happens when these spheres are suspended in pairs close to each other.

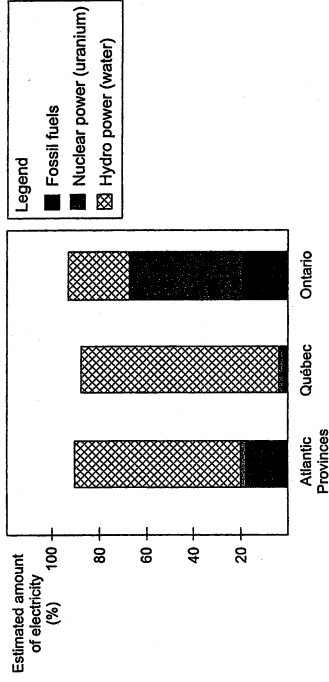


Which of the following diagrams correctly indicates the charge on spheres 3 and 4 and shows what will happen to them when they are suspended close to each other?

- A) Sphere 3 (-)      Sphere 4 (+)  
 B) Sphere 3 (+)      Sphere 4 (+)  
 C) Sphere 3 (+)      Sphere 4 (-)  
 D) Sphere 3 (-)      Sphere 4 (-)

- The following graph shows different sources of electricity in three major regions in Canada.

Graph 1 – Proportion of Electricity Produced From Different Sources in Three Major Regions in Canada



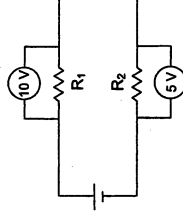
Adapted from: Statistics Canada (May 2011), *Report on Energy Supply and Demand in Canada — 2009 Preliminary*, Catalogue no. 57-203-X, pp. 110-111.

Given the information in this graph and your knowledge of energy resources, which conclusion is **TRUE**?

- A) Electricity production has little impact on the environment in these three regions, since they all mainly use hydro power.  
 B) Air pollution caused by electricity production is greater in Ontario than in Québec, since Ontario has more thermal power plants.  
 C) Greenhouse gas emissions related to electricity production are greater in Ontario than in the Atlantic Provinces, since Ontario has more nuclear power plants.  
 D) Electricity production has a major impact on the environment in the three regions, since they use no renewable energy.

- The electrical circuit in a device seems to be defective. A student was asked to check the value of resistor 1 ( $R_1$ ) in this circuit. The student took different measurements.

The following diagram shows the measurements taken by the student.



Given the measurements taken by the student and knowing that the current flowing through the circuit is 5 A, what is the value of resistor 1 ( $R_1$ ) in this electrical circuit?

- A) The value of resistor 1 is 0,5  $\Omega$ .  
 B) The value of resistor 1 is 2,0  $\Omega$ .  
 C) The value of resistor 1 is 3,0  $\Omega$ .  
 D) The value of resistor 1 is 50  $\Omega$ .

- A miniature boat race was held on a pond. The following table gives information about the distance covered by each boat at different moments during the race.

DISTANCE COVERED BY EACH MINIATURE BOAT IN RELATION TO TIME

Boat	Distance Covered (m)	Time (s)
1	9	5
2	6	4
3	12	9
4	16	10

Which boat had the highest average speed?

- A) Boat 1      B) Boat 2      C) Boat 3      D) Boat 4

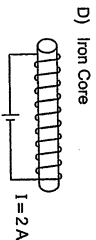
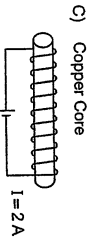
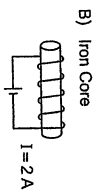
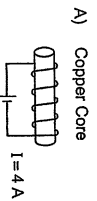
8. A technician examines different electrical devices to determine the one that is the most energy efficient.

While conducting a test, he notes that one of these devices consumes 720 000 J of energy and loses 230 000 J at the same time.

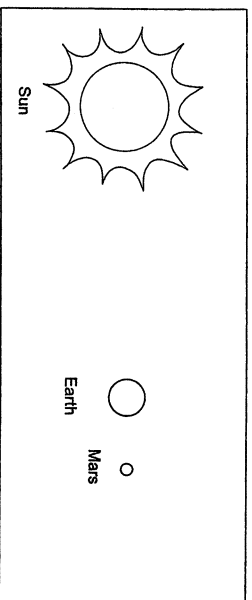
What is the energy efficiency of this device?

- A) 31.9%
- B) 46.9%
- C) 68.1%
- D) 75.8%

9. Which one of the following electromagnets will produce the strongest magnetic field?



10. The following diagram shows the position of the Earth and the planet Mars in relation to the Sun.



Note: The size of the Sun, the Earth and Mars, as well as the distances, are not to scale.

Two characteristics of the planet Mars are described in the following table.

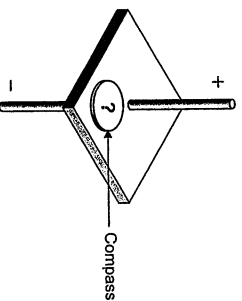
CHARACTERISTICS OF THE PLANET MARS COMPARED WITH THOSE OF THE EARTH

Topography: similar to that of the Earth (valleys, dunes, volcanoes, etc.)
Mass: one tenth of the mass of the Earth

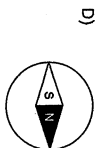
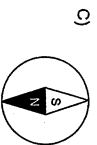
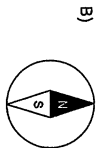
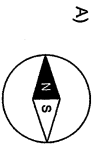
Which hypothesis is the most plausible when it comes to the weight of an object on Mars compared with its weight on Earth?

- A) The weight of an object on Mars is greater than it is on Earth, since Mars is farther away from the Sun. The gravitational force is therefore greater on Mars.
- B) The weight of an object on Mars is greater than it is on Earth because the radius of Mars is smaller than the radius of the Earth. The gravitational force is therefore greater on Mars.
- C) The weight of an object on Mars is less than it is on Earth, since Mars is smaller and has a smaller mass. The gravitational force is therefore lower on Mars.
- D) The weight of an object on Mars is the same as it is on Earth, since the topography of Mars is somewhat similar to that of the Earth. The gravitational force is therefore more or less the same on both planets.

11. The following diagram shows a straight current-bearing wire that runs through a surface on which a compass has been placed.



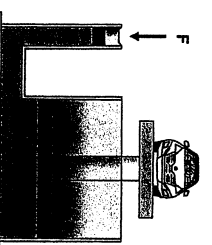
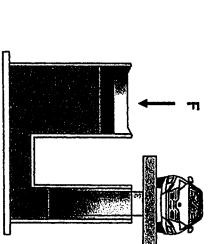
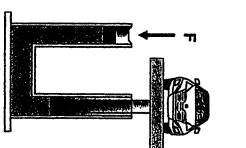
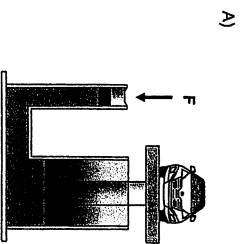
Which of the following compass needles is pointing in the direction of the magnetic field produced by the current flowing through the wire?



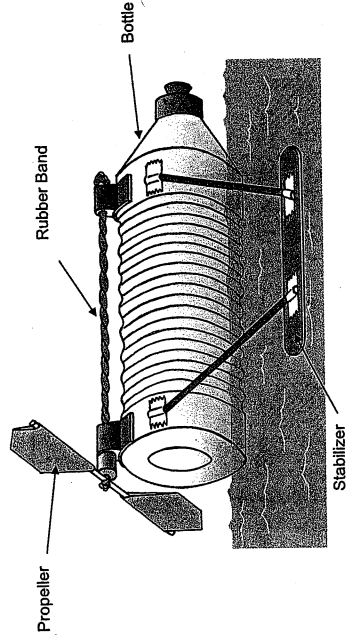
12. A hydraulic jack used to lift a car has two pistons filled with an incompressible fluid like water or oil.

Which of the following diagrams shows the jack that can transmit the greatest force to lift the car?

Note: The initial force (F) applied is the same in each diagram below.



13. One of your classmates designed the prototype rubber-band powered boat shown in the diagram below.



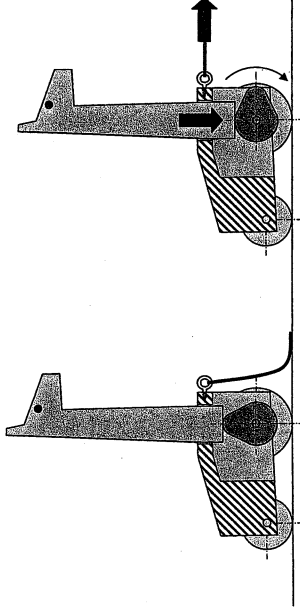
After testing it, your classmate thinks that the boat is not fast enough.

What should your classmate do to reduce the boat's friction?

- Use a bigger propeller.
- Use a smoother bottle.
- Use a bigger rubber band.
- Use wider stabilizers.

14. Your little brother likes to play with his wooden giraffe because when he moves it forward or backward, its head moves up and down. However, he does not understand why he cannot move the giraffe by pushing down on its head.

Below are diagrams of the wooden giraffe.



The following statements are related to the mechanism that controls the giraffe's neck.

- The mechanism that controls the giraffe's neck transforms rotational motion into translational motion.
- The mechanism that controls the giraffe's neck transforms translational motion into rotational motion.
- The mechanism that controls the giraffe's neck is a non-reversible motion transformation system.
- The mechanism that controls the giraffe's neck is a reversible motion transformation system.

Which statements are TRUE?

- 1 and 3
- 1 and 4
- 2 and 3
- 2 and 4

15. Technicians are working on a device that includes an electrical circuit that must be built with the best electrical conductor.

The following table gives the characteristics of four wires. One of these wires must be chosen to build this circuit.

CHARACTERISTICS OF FOUR ELECTRIC WIRES

Electric Wire	Characteristics	
	Type of Wire	Thickness of the Wire
1	nichrome	
2	copper	
3	nichrome	
4	copper	

Which one of these wires should the technicians use?

- Wire 1
- Wire 2
- Wire 3
- Wire 4

## PART B CONSTRUCTED-RESPONSE QUESTIONS

### INSTRUCTIONS

Answer questions 16 to 19 in your *Answer Booklet*, showing all your work.

16. This morning, Julie did the following:
- She turned on a 40-W lamp and left it on for 1 hour and 18 minutes.
  - For 54 minutes, she listened to a radio with a power of 5 W.
  - She took a shower.
  - She did her laundry in warm water.

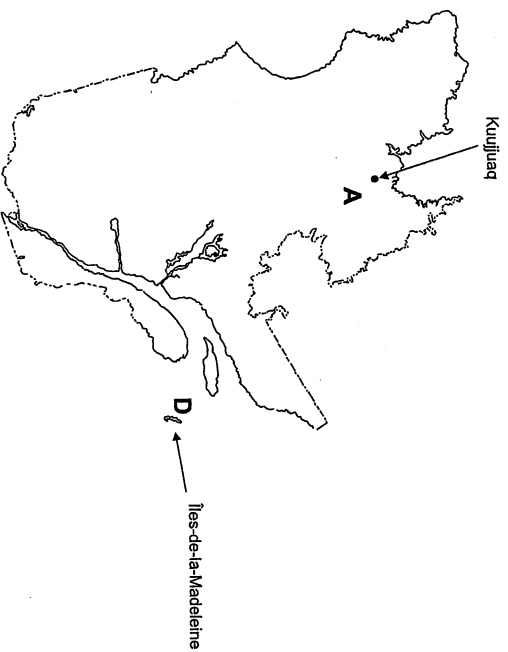
The following table indicates the amount of electrical energy consumed during certain activities.

ENERGY CONSUMED DURING DIFFERENT ACTIVITIES

Activity	Energy Consumed (W·h)
Bath	3600
Shower	2400
Warm water laundry	2590
Cold water laundry	240

Using this information, determine the total amount of electrical energy Julie used this morning.

17. The following map indicates the location of an anticyclone (A) and a depression (D) on July 30.



Using the information on the map shown above, in your *Answer Booklet*:

- Describe the weather conditions on the Îles-de-la-Madeleine and in Kuujuaq on July 30.
- Name the place (Îles-de-la-Madeleine or Kuujuaq) with the higher atmospheric pressure on July 30.

18. The population of certain animals, such as deer, often decreases when highways are built.

In your *Answer Booklet*:

- Indicate what type of disturbance this is.
- Indicate three reasons why deer populations decrease when highways are built.

19. In your *Answer Booklet*, complete the three views of the multiview orthogonal projection of the object illustrated below.

