

ST June 2009 PART A
SHORT-ANSWER QUESTIONS

INSTRUCTIONS

ANSWER THE QUESTIONS IN PART A IN YOUR *ANSWER BOOKLET*.

1. Organisms living in the same ecosystem interact; some of these interactions are called “trophic relationships.”

In your *Answer Booklet*:

- Match the following living organisms with their trophic level:

– nut-

– mushroom

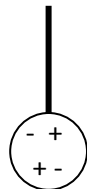
– squirrel

– fox

- Using arrows, connect the living organisms to form a food chain.

2. Two charged spheres, A and B, are suspended from a wire.

Sphere A



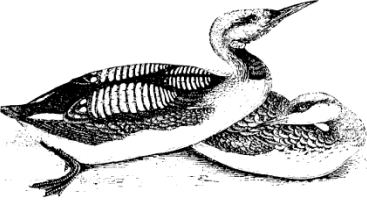
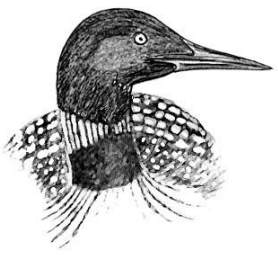
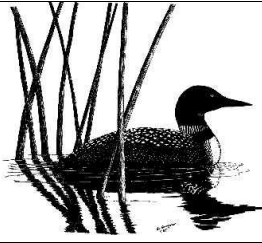

Sphere B



In your *Answer Booklet*, indicate:

- the polarity of the spheres
- the behaviour of the spheres when they are suspended next to each other

3. Blood samples were taken from four loons in northern Quebec and analysed for their mercury(Hg) content. When the concentration of mercury exceeds 5 ppm, loons have problems breeding.

Loon	Mass of mercury in sample	Mass of blood sample
 A	3.0 mg	100 g
 B	0.0003 g	100 g
 C	0.020 g	1.0 kg
 D	0.2 mg	10 kg

Use the above table to arrange the samples in increasing order of concentration and determine which loons could experience reproductive problems.

4. Plants use **photosynthesis** to combine carbon dioxide (CO_2) and water (H_2O) in the presence of sun light to produce sugar ($\text{C}_6\text{H}_{12}\text{O}_6$) and life giving oxygen gas (O_2).

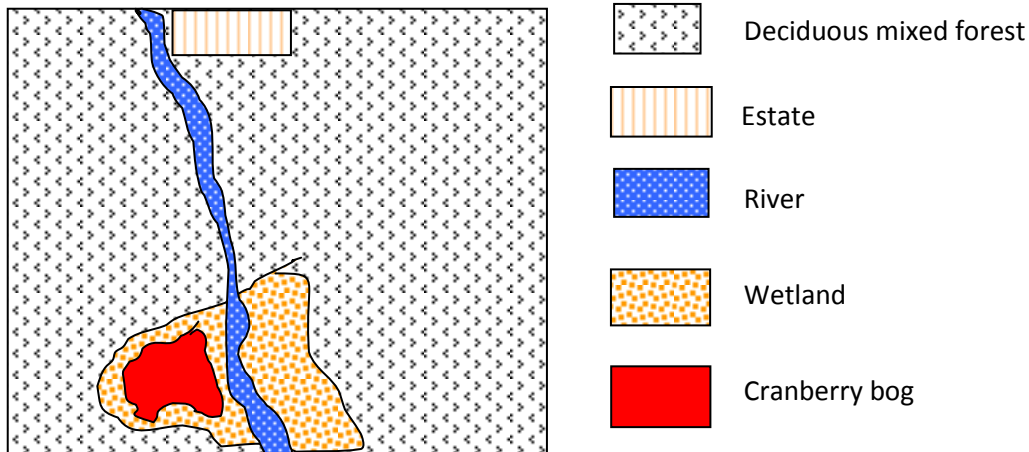
a) Write the **balanced** equation for **respiration in your answer booklet**.

b) If 60g of sugar are burned in the presence of 64g of oxygen gas there is 36g of water produced and an unknown amount of Carbon dioxide. What is the mass of Carbon dioxide produced?

PART B FORMING AN OPINION

Agriculture and the Environment

A local consortium of business people in a small town, in response to the economic downturn, has decided to purchase a section of land 1.6 km by 1.6 km containing 640 acres (2.6 km²). The section consists of 615 acres of deciduous bush (a mix of ash, birch, beech, cherry, sugar maple and walnut, (about 20 trees per acre), 6 acres of river bed, 10 acres of wetlands including a cranberry bog of about 5 acres, and a 3 acre estate with a house and barns. The owner presently taps the larger sugar maples to make maple syrup which is sold to residents of a nearby town. Some of the fallen trees are used for heating the estate home. The consortium's proposal is to harvest the lumber, burn the shrubbery, and go into the beef feedlot farming business with the meat to be sold to a local supermarket chain for a modest profit. The farm will employ people from the community to look after the cattle and run a large slaughter house to be situated on the location of the present buildings.



The municipal council has been approached to approve the proposal. It is presently aware of the following details:

- The river is the source of the water used by a downstream town.
- A local furniture-building company makes extensive use of selected lumber from the forest.
- The wetland includes the only cranberry bog in the area and is used in the cultivation and harvesting of cranberries.

You are asked to read the background information and write a report in the space provided giving your opinion on how the council should vote.

You must:

1. state whether you are for or against this proposal; provide arguments based on at least three factors outlined in the background information provided and provide scientific information to support your recommendation;
2. discuss the impact of the proposal on the carbon cycle, on greenhouse gases, on global warming, on the economy and on the environment.

Background Information

Factor 1 The Carbon Cycle

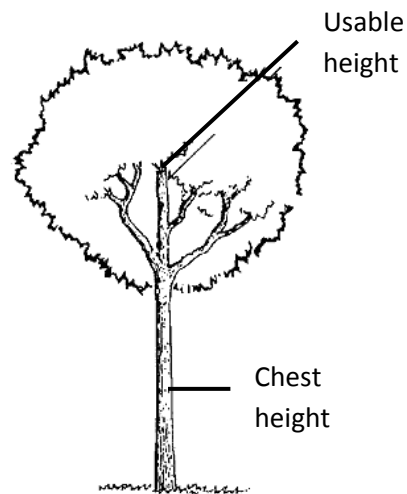
The **carbon cycle** is the sequence by which carbon is exchanged among the [biosphere](#), [pedosphere](#) (soil), [geosphere](#), [hydrosphere](#), and [atmosphere](#) of the Earth. It consists of four major reservoirs for carbon dioxide:

- The plants including forests. Plants use carbon dioxide as they grow during photosynthesis. During burning carbon dioxide is released back into the atmosphere.
- The terrestrial biosphere, which is usually defined to include fresh water systems and non-living organic material, such as soil carbon.
- The [oceans](#), including [dissolved inorganic carbon](#) and living and non-living marine biota.
- The [sediments](#) including [fossil fuels](#).

Factor 2 Market Value of Forests

Different kinds of trees in the forest have different values. The price for one board foot of different kinds of lumber is summarized below. One board foot is the volume of a one foot length of a board one foot wide and one [inch](#) thick. A medium-sized tree with a diameter of 12 inches at chest height and a usable height of 24 feet contains about 50 board feet of lumber.

Kind of Lumber	Price/Bd.-Ft.
Ash	\$3.40
Basswood	\$3.40
Beech	\$2.75
Cedar	\$2.75
Cherry	\$6.60
Mahogany	\$6.10
Maple	\$5.10
Oak	\$3.60
Pine	\$150
Poplar	\$2.55
Teak	\$16.50
Walnut	\$5.50



Factor 3 Water Pollution and Livestock

Today, most cattle, hogs and poultry are raised under intensive conditions resembling manufacturing processes. Their manure is spread or sprayed onto fields and pastures as raw, untreated liquefied slurry. This creates an enormous threat of pollution to both surface and ground water--the source of drinking water for most Canadians.

Manure is spread when the land is not growing a crop, either spring or fall. Fall application means manure will be more likely to be picked up by spring runoff. Manure spreading is primarily a waste disposal process, and only secondarily a fertilizer.

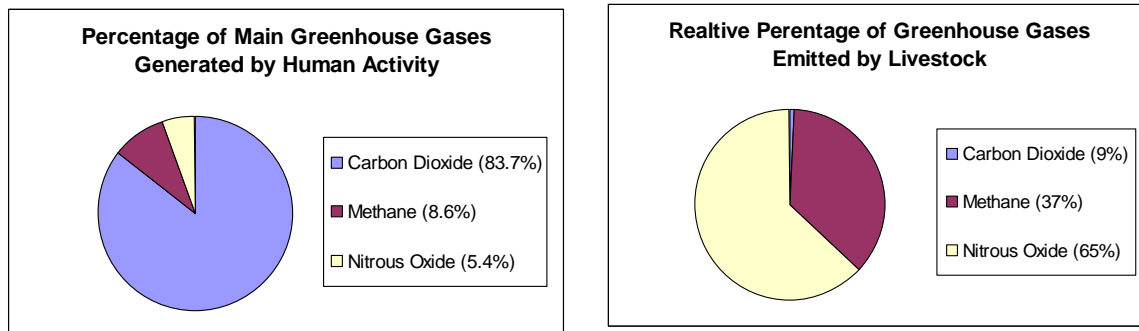
Drinking water is water that is of sufficiently high quality so that it can be consumed or used without risk of immediate or long term harm. Such water is commonly called **potable water**. In Quebec, the daily requirement for water is 3.7 L per day for human males older than 18, and 2.7 L for human females older than 18 including water contained in food, beverages, and drinking water. Additional clean water is required for washing clothes, bathing and gardening

Factor 4 Methane Production

Methane occurs naturally when organic matter decomposes. Man-made processes produce methane in several ways:

- from extracting and burning coal,
- from natural gas operations,
- from large herds of livestock (i.e. digestive gases),
- from bacteria in rice paddies,
- from decomposition in landfills.

Livestock are a major emitter of greenhouse gases. Livestock are responsible for 18% of green-house gas emissions as measured in carbon dioxide equivalent. This includes 9% of carbon dioxide (CO₂), 37% of methane (CH₄), and 65% of nitrous oxide (N₂O) emissions. Methane has 23 times the global warming potential of carbon dioxide and nitrous oxide has 296 times the warming potential of CO₂.



Arguably the best way to reduce global warming is to reduce or eliminate the consumption of animal products and focus on food grains and vegetable proteins (wheat, rice, and beans). The University of Chicago compared the global warming impact of meat eaters with that of vegetarians and found that the American diet –including the processing steps – results in an average annual production of an extra 1.5 tons of CO₂ equivalent compared to non-meat eaters.

Factor 5 Wetlands and Cranberry Production

Wetlands are considered the most [biologically diverse](#) of all [ecosystems](#). Plant life found in wetlands includes [water lilies](#), [cattails](#), [sedges](#), [tamarack](#), [black spruce](#), and many others. Animal life includes many different [amphibians](#), [reptiles](#), [birds](#), and [furbearers](#). Wetlands help purify water, recycle nitrogen and phosphorous, and maintain a balanced carbon cycle.

Wetlands play a role in the cultivation of cranberries. Cranberries are a fruit crop that is grown in wet, marshy areas called bogs.

They grow best where there is a cool growing season and no extreme cold. The marshy bogs have peat at the bottom.

Peat is a layer that is formed when dead plants fall to the bottom of the water and sit

there year after year. The cranberry 'beds' have a combination of sand and this peat at the bottom.

Cranberry farmers aim to harvest about 160 barrels of cranberries per acre at a price of \$67/barrel.

Cranberries are full of antioxidants, which protects cells from damage by unstable molecules called free radicals. The National Institutes of Health is funding research on the cranberry's effects on heart disease, yeast infections and other conditions, and other researchers are investigating its potential against cancer, stroke and viral infections.



Factor 6 Beef Farming

There is an increasing market for beef.

Between 1970 and the present, annual meat consumption in developing countries has tripled from 11 kg to 33 kg compared to developed countries (from 65 kg to 80 kg).

Annual meat production is projected to more than double by 2050.



Finished steers such as the one shown have a market value of about \$800. The market value depends on many factors including the carcass weight, the dressing percentage, and the quality of the meat (e.g. rib fat and ribeye area). The steer shown had a carcass mass of about 450 kg.

The profit from beef feedlot farming depends on the initial cost of the livestock, the cost of the corn and other feed materials, and the final price the farmer receives for the finished animal. These factors are all variable; the demand and hence price of beef can change as can the availability and price of corn.

PART C
LONG ANSWER QUESTIONS

INSTRUCTIONS

ANSWER QUESTIONS 6 TO 8 IN PART C IN YOUR *ANSWER BOOKLET*; SHOW ALL YOUR WORK.

6. Analysis of Soil Types

A farmer needs to decide which vegetable to plant in their field. A soil test determined that the soil is made up of 25% of sand, 25 % of silt and 50 % of clay. The pH of the soil was 6.5. The soil has a low amount of nitrogen.

Asparagus

Asparagus grows in most any soil as long as it has good internal drainage. Asparagus roots do not like waterlogged soils that will lead to root rot. It prefers a soil pH of 6.5-7.5, and will not do well if the pH is less than 6.0. The type of fertilizer asparagus prefer is 10% nitrogen, 20% phosphorus and 10% potassium.

Tomatoes

Tomatoes can be grown on many different soil types. tomatoes grow best in a soil with a pH of 6.2 to 6.8. The type of fertilizer needed for tomatoes is 5% nitrogen, 20% phosphorus, 20% potassium. Excess nitrogen fertilizer can result in plants with extremely vigorous tomatoes vine growth but little fruit production.

Task: Which vegetable should be planted in the field? Why?

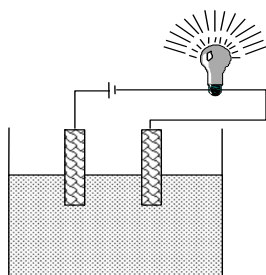
Justify your answer using scientific arguments.

7. Electrical Conductivity

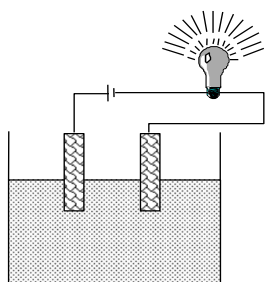
The following diagram shows 3 solutions being tested for electric conductivity with a conductivity meter.

Explain **why** and **how** the light bulb lights up for each sample being tested. You must refer to

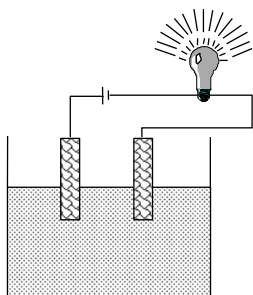
- The nature of the solution.
- Ionic dissociation.
- The nature of the materials used in the conductivity meter.
- The components or construction of the conductivity meter.



NaOH_(aq)



KCl_(aq)



HCl_(aq)

8. Electrical Charges

While making detectors in the shop, a technician realizes that the dust sticks to the pieces of acrylic he cuts out. You mention that this is because of electrostatic action, but he does not believe you.

Referring to the Rutherford-Bohr atomic model, explain electrostatic action, that is, a displacement of electrical charges.