

# Geography 12

## June 2002 Provincial Examination

### ANSWER KEY / SCORING GUIDE

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- Topics:**
1. The Nature of Geography
  2. Systems of the Earth
  3. Resources of the Earth

#### Part A: Multiple Choice

Q	K	C	S	T	PLO	Q	K	C	S	T	PLO
1.	D	U	1	1	1B1	21.	C	K	1	2	2A1
2.	C	U	1	2	2C1b	22.	D	U	1	2	2A3
3.	C	U	1	2	2C1a	23.	A	K	1	2	2A3
4.	B	U	1	1	1A1	24.	C	U	1	1	1B2
5.	A	U	1	2	2C1b	25.	C	U	1	2	2B1
6.	A	U	1	2	2C3	26.	A	U	1	2	2A5
7.	C	U	1	2	2C1d	27.	B	U	1	2	2A3
8.	D	U	1	2	2C1d	28.	A	U	1	2	2A3
9.	C	U	1	2	2D1	29.	D	U	1	2	2A3
10.	D	K	1	2	2D3a	30.	C	U	1	2	2A5, 2A3
11.	A	K	1	2	2D3b	31.	A	U	1	2	2B2
12.	D	U	1	2	2D3b	32.	A	K	1	2	2B3
13.	C	U	1	2	2D3e	33.	C	U	1	2	2B3
14.	B	U	1	2	2D3e	34.	A	U	1	1	1B4, 2B4
15.	A	U	1	2	2D3d	35.	C	U	1	1	1C1
16.	A	U	1	2	2D3d	36.	B	U	1	1	1C1
17.	D	K	1	3	3A4a	37.	D	U	1	1	1C1
18.	C	K	1	3	3A1	38.	C	U	1	1	1C1, 2D3e
19.	B	K	1	1	1A2	39.	B	U	1	2	2D3e
20.	B	U	1	2	2A1	40.	A	U	1	3	3A4

**Multiple Choice = 40 marks**

## Part B: Written Response

<b>Q</b>	<b>B</b>	<b>C</b>	<b>S</b>	<b>T</b>	<b>PLO</b>
1.	1	H	6	3	3B2
2.	2	U	4	2	2D3, 1C2
3.	3	H	4	2	2C3
4.	4	U	4	1	3A2, 3C1
5.	5	U	3	1	1C2, 2B3
6.	6	H	4	3	3A3
7.	7	U	3	3	3C1, 3A3
8.	8	U	3	2	2B5
9.	9	H	6	1	1B2
10.	10	H	3	1	1A3
11.	11	H	10	3	3C4, 3A4a, 3B2, 3C1

**Written Response = 50 marks**

Multiple Choice = 40 (40 questions)

Written Response = 50 (11 questions)

**EXAMINATION TOTAL = 90 marks**

### **LEGEND:**

**Q** = Question Number

**C** = Cognitive Level

**T** = Topic

**K** = Keyed Response

**S** = Score

**PLO** = Prescribed Learning Outcome

**B** = Score Box Number

**PART B: WRITTEN RESPONSE**

**Value: 50 marks**

**Suggested Time: 80 minutes**

**INSTRUCTIONS:** Answer each question in the space provided. You may not need all of the space provided. Answers should be written in **ink**. **Comprehensive answers are required for full marks.**

**REFERENCE  
DATA BOOKLET**

**Use Photograph 3 and the Topographic Map to answer question 1.**

1. Using the data provided, **explain** the possible effects of human activity on the natural environment of Kapuskasing. Answer in **paragraph** form. **(6 marks)**

**Response:**

<p><b>Effect of Human Activity on the Natural Environment</b></p>	<ul style="list-style-type: none"><li>• Pulp mills may contribute to water contamination, particularly by dioxins and furans released as by-products of the paper process.</li><li>• Mills could emit air pollution and a foul odour. Tall chimneys are the solution of choice.</li><li>• The industry has a voracious appetite for wood; whole forests may have been turned into paper for export.</li><li>• Logging industry and saw mills may result in the cutting down of forests, increasing soil erosion.</li><li>• Possible rupture of gas pipelines.</li><li>• Leaching of industrial effluents from the lumber yards and cement plants.</li><li>• Leachates from the dumps, the sewage pond and the auto wreckers may occur and seep into the groundwater.</li><li>• Urban and domestic run-off (oil, gas, detergents, phosphates, airport) may occur.</li><li>• Reduced infiltration rates due to urban and industrial development (asphalt) may result.</li><li>• Use of chemical fertilizers and pesticides from the experimental farm and golf course may contaminate water sources — eutrophication.</li><li>• Extraction of gravel may increase mass wastage and the siltation of streams.</li><li>• The infrastructure required for the generation of power can block the migration of fish.</li><li>• Global warming may alter ecosystem.</li></ul>
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**Effect of  
Human Activity on the  
Natural Environment  
(Continued)**

- Airport could disrupt bird migration routes.
- Highway is a threat to wildlife attempting to cross.
- Water pollution has downstream effects also (riparian zones).
- Disruption of water cycle when forests are logged— fewer trees transpire water vapour in the atmosphere.
- Bears become dependent upon dump sights and there could be an increase in wildlife/human confrontations.
- Human activity adversely affects the heritage and culture of Aboriginals.
- Thermal pollution in river from pulp mill effluent discharge.
- If chlorine is used in the filtration process, there could be impacts on aquatic life.
- Railway trains could derail.
- Acid rain.
- Flooding due to deforestation.
- Oil/gas from boats in river.
- Logging causes siltation of streams.
- Airport: noise pollution and de-icing agents are detrimental.
- Pollution has long-reaching effects on the food chain.
- Camping could cause forest fires (habitat destruction).
- Chemical leaks from tanks.

Select one of the following features to answer question 2.  
Indicate your selection with a ✓.

Sea Stack

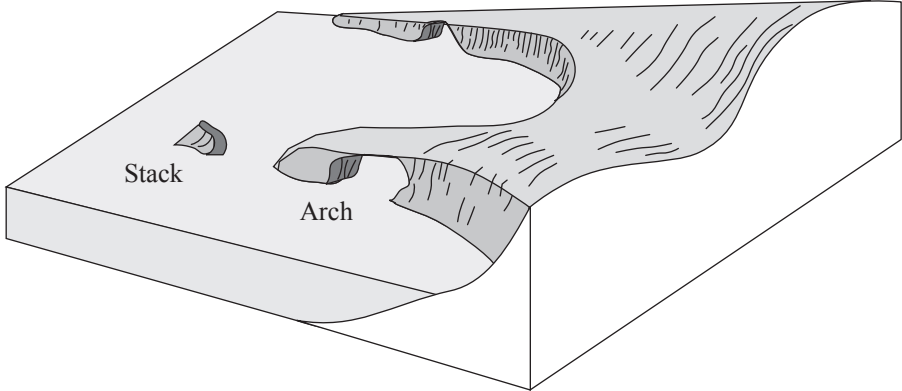
Oxbow Lake

2. **Sketch** and clearly **label** a diagram(s) of the feature you selected.

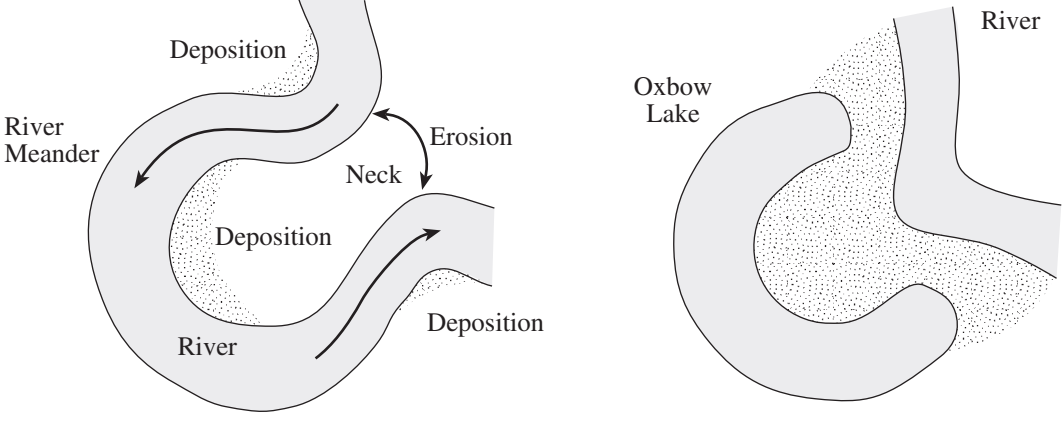
**Explain** how the feature is formed.

**(4 marks)**

**Response:**

<b>SEA STACK</b>	
	
<ul style="list-style-type: none"><li>• A cave turns into an arch and finally a stack.</li><li>• Caves may develop on the side of a headland as a result of wave refraction.</li><li>• The erosive power (corrasion, attrition, chemical weathering and hydraulic action) of waves gives rise to a natural arch as the back walls of adjacent headland caves are removed over time.</li><li>• When the arch collapses (due to weakening over time and gravity), the end of the headland remains as a pillar of rock called a sea stack.</li></ul>	
<p><b>Note to Markers:</b></p> <p><b>This question is to be marked holistically. The explanation may be shown in the diagram.</b></p>	

**Response:**

<b>OXBOW LAKE</b>	
	
<ul style="list-style-type: none"><li>• As the river wears away (erodes through hydraulic action and corrasion) at the outside bend of a meander, the neck of the meander gets continually narrower.</li><li>• Eventually, the river breaks through the neck.</li><li>• Bars of sediment from the inner curves (the slip-off slope or point bar deposits) dam up water in the old cut-off meander, creating an oxbow lake.</li></ul>	
<p><b>Note to Markers:</b></p> <p><b>This question is to be marked holistically. The explanation may be shown in the diagram.</b></p>	

3. a) **Describe** two benefits associated with volcanic activity.

**(2 marks)**

**Response:**

<p><b>Volcanic areas provide opportunities for</b></p>	<ul style="list-style-type: none"><li>• expressing spiritual values.</li><li>• geothermal power and heating.</li><li>• attaining valuable minerals (gold).</li><li>• rocks (pumice and obsidian).</li><li>• inexpensive land for residential areas.</li><li>• agriculture with soils rich in minerals.</li><li>• large tourist attractions because of their scenic beauty and hot springs.</li><li>• the collection of materials for building (cinder, lava rock).</li><li>• the creation of new land (Hawaii and Iceland).</li><li>• scientific research in the area of volcanic predictions.</li><li>• health (spas in Japan).</li><li>• job opportunities—economic gain.</li><li>• education.</li><li>• recreation.</li><li>• release of pressure in small amounts diminishes chance of larger eruptions.</li></ul>
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b) Besides loss of life, **outline** two problems associated with volcanic activity. (2 marks)

**Response:**

<b>Problems</b>	<ul style="list-style-type: none"><li>• Lahars, tsunamis, mudflows, forest fires and pyroclastic flows could occur.</li><li>• Acidity of water increases.</li><li>• Siltation of rivers—diversion of rivers.</li><li>• Loss of wildlife habitat could occur.</li><li>• Human habitation and scenic beauty could all be destroyed.</li><li>• Loss of valuable monuments/native grounds.</li><li>• Loss of “a sense of place”.</li><li>• There is a threat to humans from the possibility of nuée ardentes (hot, poisonous gas clouds).</li><li>• Human injury could occur (respiratory problems).</li><li>• Volcanic ash may destroy agricultural areas or flight paths.</li><li>• Earthquakes destroy infrastructure.</li><li>• Lava flows could destroy buildings.</li><li>• Destruction of gas/power/water lines.</li><li>• Cost of repairs and/or evacuations.</li><li>• Loss of jobs/income.</li><li>• Looting and vandalism.</li><li>• Decrease in property values in close proximity.</li><li>• Loss of tourist dollars.</li><li>• Disruption of transportation and communication corridors.</li><li>• Climate could be altered (acid rain, global warming).</li></ul>
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Select one of the following activities to answer question 4.  
Indicate your selection with a ✓.

Mining       Urban Development

4. a) **Explain** two ways the activity you have selected may threaten fish stocks.      **(2 marks)**

**Response:**

<b>Mining</b>	<ul style="list-style-type: none"><li>• loss of trees for road development may occur<ul style="list-style-type: none"><li>– increase surface run-off and soil erosion causing siltation of rivers and destruction of spawning grounds</li><li>– spawning grounds and site development</li></ul></li><li>• pollution of mine site may occur<ul style="list-style-type: none"><li>– thermal waste water</li><li>– chemicals leach from settling ponds, accidental discharges</li><li>– chemicals (dioxins, cyanides, furans) released into the water</li></ul></li><li>• water contamination from mining (heating the water, sewage from the mines)</li><li>• acidification of streams and lakes</li><li>• acid rock drainage may occur</li><li>• mining of gravel used for blacktop and cement destroys spawning grounds</li><li>• tailing pond collapse and ensuing poisoning</li><li>• spawning habitat destruction, kills the fish</li></ul>
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## Urban Development

- industrial and domestic waste increases water pollution and heats the water
- development on drained wetlands could destroy fish feeding grounds
- shoreline development may destroy spawning grounds
- urban run-off may pollute waterways
- small spawning creeks may be filled in by urban, agricultural or industrial development
- loss of trees may cause siltation of streams
- increased population results in increased number of sports fishers (overfishing)
- channelized streams destroy spawning areas
- decreased infiltration of H<sub>2</sub>O due to paved areas
- invasive species choke out native species (kills the local fish)
- “landscaping” of streams in urban development areas (fertilizers)

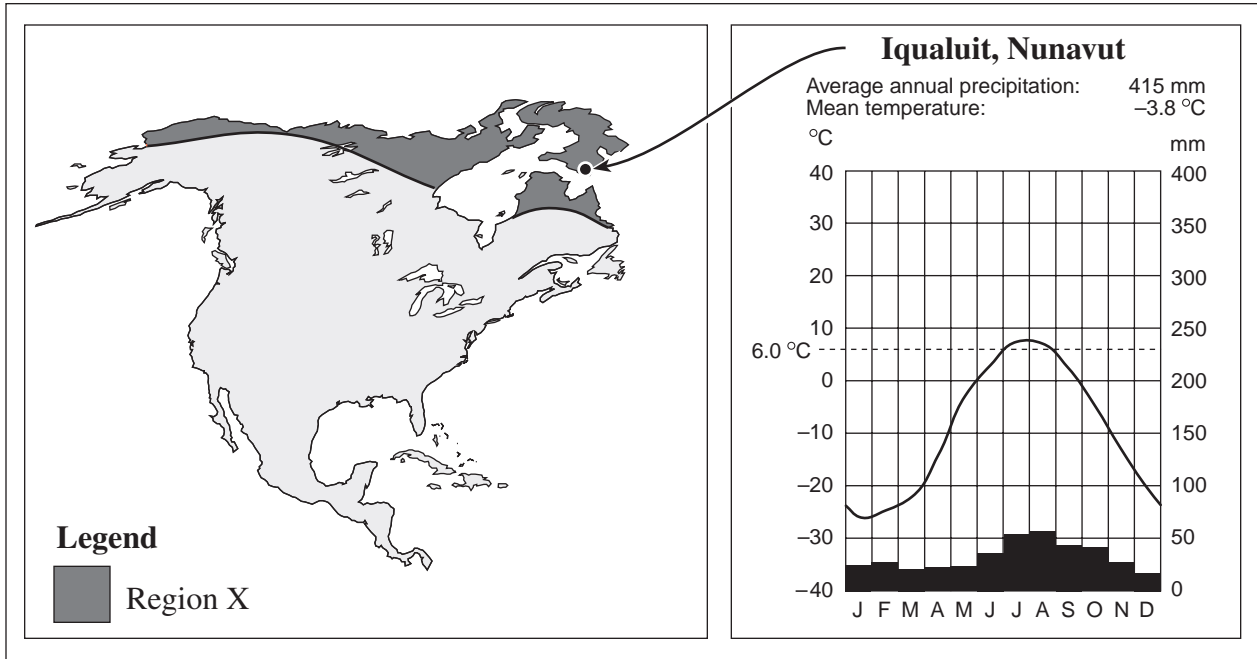
b) **Outline** two different ways to promote the sustainability of Canada's fish stocks.

**(2 marks)**

**Response:**

<b>Sustainability</b>	<ul style="list-style-type: none"><li>• habitat preservation (beach, forest and shore protection)</li><li>• protection of spawning grounds via legislation</li><li>• appropriate harvesting strategies (selective logging, horse logging, helicopter logging and reforestation)</li><li>• tertiary treatment of sewage</li><li>• strict legislation and laws regarding mining and industry waste water (settling ponds, lime settling ponds)</li><li>• guidelines for the use of manure and agricultural chemicals near streams and rivers</li><li>• fines for ocean dumping</li><li>• double-hulled ocean tankers</li><li>• government closures and moratoriums</li><li>• setting smaller quotas and limits on catch</li><li>• single species licences, issue few licences</li><li>• heavy fines and jail time for illegal harvesting</li><li>• enforceable international agreements</li><li>• enhancement programs, fish farming, create spawning channels, fish ladders around dams</li><li>• limit shoreline development and draining of wetlands</li><li>• encourage catch and release programs</li><li>• educate people regarding better water practices (fishing, sustainability, pollution control, mining practices)</li><li>• promote streamkeepers' and shorekeepers' programs in communities adjacent to stream beds</li><li>• restrict aquaculture and the use of antibiotics in fish farms</li><li>• ban the release of non-native fish species (Atlantic salmon into Pacific waters)</li><li>• fight global warming</li><li>• yellow fish signs on drains</li><li>• use alternate food supplies</li></ul>
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Use the following information to answer question 5.



5. a) **Identify** the natural vegetation associated with region X represented by the data above. **(1 mark)**

**Response:**

<b>Vegetation</b>	<ul style="list-style-type: none"> <li>• tundra</li> <li>• dwarf shrubs and trees</li> <li>• lichens</li> <li>• mosses</li> <li>• microtherm</li> <li>• muskeg</li> <li>• grasses</li> <li>• cryosolic</li> </ul> <p><b>NOTE: No marks given for “xerophytes”.</b></p>
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b) **Explain** two ways the vegetation has adapted to the climatic conditions of region X.

**(2 marks)**

**Response:**

<b>Adaptations</b>	<ul style="list-style-type: none"><li>• low growing to protect from cold wind</li><li>• short germination period reduces growth</li><li>• shallow roots due to permafrost</li><li>• plants grow in hollows and behind rocks to protect from the cold</li><li>• sedge grasses lie dormant during the ten months when temperatures are below 6°C</li><li>• thick bark reduces transpiration</li><li>• small leaves</li><li>• hygrophytic plants are able to withstand wet, swampy, cold conditions</li><li>• dark green leaves absorb the sun's rays, raising the temperature of the plant and promoting rapid photosynthesis during the short, intensive growing season</li><li>• spacing to reduce competition</li><li>• live in snow for wind protection</li><li>• bright colours to attract pollination</li><li>• symbiotic relationship</li></ul>
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Select one of the following renewable energy sources to answer question 6.  
Indicate your selection with a ✓.

Biomass       Solar

6. a) Besides the fact that is renewable, **identify** two advantages associated with your energy selection. **(2 marks)**

**Response:**

<b>Biomass Advantages</b>	<ul style="list-style-type: none"><li>• extensive region of forests</li><li>• inexpensive and convenient</li><li>• the second largest renewable energy resource, after hydro</li><li>• the use of biomass instead of imported fossil fuel provides stimulus for the local economy</li><li>• it is more environmentally friendly than fossil fuels</li><li>• biomass contains very little sulphur, heavy metals or fuel bound nitrogen</li><li>• low technology required</li><li>• biomass contributes little net carbon</li><li>• burned biomass is replaced by growth of new biomass</li><li>• use of biomass waste reduces disposal costs; biomass ash can be returned to agricultural soil</li><li>• waste disposal (human/animal)</li><li>• developing rural economy</li><li>• methane from landfills</li><li>• challenge monopolies of fossil fuel industry</li></ul>
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**Solar Advantages**

- pollution free (no need for fossil fuels—reduces global warming and acid rain)
- unlimited supply especially in tropical and high sunshine regions
- passive solar energy is suitable for sunny low latitude nations that cannot afford fossil fuels
- suitable for isolated communities
- direct solar energy is suitable for heating buildings and hot water
- photovoltaic power stations are small and can be put into production quickly (easy to enlarge as demand increases)
- photovoltaic cells suitable for lighthouses, ocean buoys, railway signs
- inexpensive to run once constructed
- “sun” energy (photosynthesis, life giving qualities—crops, plant growth)
- creation of high tech industry with solar panels
- no monopolies to develop—accessible
- once installed, energy is cheap for the consumer

b) **Outline** two disadvantages of your energy selection.

**(2 marks)**

**Response:**

<b>Biomass Disadvantages</b>	<ul style="list-style-type: none"><li>• requires reforestation</li><li>• resource may become depleted</li><li>• not economical to transport biomass fuels over long distances</li><li>• power plants are located near the source of the biomass which results in the need for transmission lines</li><li>• the removal of biomass (trees) results in soil erosion, flooding, etc.</li><li>• the burning of garbage is not as good for the environment as recycling</li><li>• increases the amount of CO<sub>2</sub></li><li>• climate dependent (suitability of location for forests)</li><li>• methane—not user friendly</li><li>• unattractive to consumer (smell)</li><li>• loss of potential medical cures</li><li>• loss of habitat for animals</li><li>• could challenge fossil fuels/industry and job loss</li></ul>
<b>Solar Disadvantages</b>	<ul style="list-style-type: none"><li>• initial start up costs are high (costly to construct solar panels)</li><li>• greatest source is not where the demand is, a great deal of potential power is lost in transmission</li><li>• solar ponds, sun-tracking mirrors and power towers require a great deal of space (disruption of habitat when building large panel fields)</li><li>• unreliable during winter (cloud coverage, shorter days, lower sun angle) when energy demands are greatest</li><li>• requires storage facilities</li><li>• low voltage power source</li><li>• technology not fully developed</li><li>• loss of jobs in fossil fuel industry if solar industry development is great enough</li></ul>



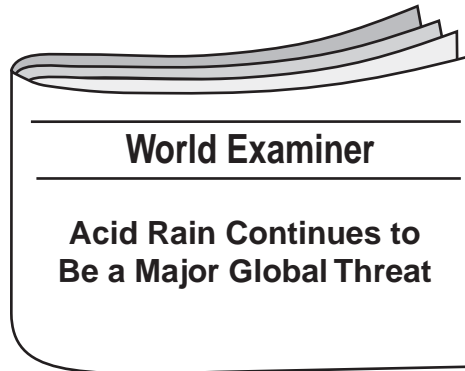
7. **Outline** three reasons why endangered species should be protected.

**(3 marks)**

**Response:**

<p><b>Reasons Endangered Species Should be Protected</b></p>	<ul style="list-style-type: none"><li>• 40% of all prescriptions are derived from natural compounds.</li><li>• Only 5% of known plant species have been screened for medicinal properties — we lose 100 species daily (the Pacific Yew — a former trash tree — is one of the most promising treatments for breast cancer).</li><li>• Humans depend on 20 species of plants for 90% of world food (related plants contain disease resistant material and could provide the means to develop new crops — genetic material from a wild corn species was used to stop a live fungus).</li><li>• When species become endangered, it is an indicator that the health of vital ecosystems are beginning to unravel.</li><li>• Losing one plant species can trigger the loss of up to 30 other insect, plant and higher animal species.</li><li>• Pollution is killing the coral reefs which serve as habitat for hundreds of species of fish.</li><li>• Commercial fish species have begun to decline, causing a threat to the multi-million dollar tourism industry.</li><li>• There is cultural value associated with endangered species (poetry, literature, films).</li><li>• Endangered species are food sources (tuna). Extinction could impact the food chain.</li><li>• Income from selling exotic species (legal and illegal).</li><li>• Plant and animal species and their ecosystems form the basis of a multi-billion dollar, job-intensive tourism industry.</li><li>• Each year people participate in wildlife-related recreation including observing, feeding and photographing wildlife.</li><li>• Our national heritage of biological diversity is an invaluable and irreplaceable resource.</li><li>• Ecotourism can thrive on providing opportunities to view endangered species (whale watching).</li><li>• To prevent extinction (endangered species are unable to protect themselves).</li><li>• To maintain nutrient cycles.</li><li>• To maintain sustainability and evolution reproduction.</li><li>• For education.</li><li>• For research.</li><li>• For future generations.</li><li>• For ethical, moral, aesthetic reasons.</li></ul>
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Use the following headline to answer question 8.



8. a) **Identify** one major source of acid rain.

**(1 mark)**

**Response:**

<b>Sources of Acid Rain</b>	<ul style="list-style-type: none"><li>• sulfur dioxide and nitrogen oxides</li><li>• combustion of fossil fuels in industry, power production and transportation produces sulfur dioxide</li><li>• nitrogen oxides from spreading of agricultural fertilizers</li><li>• factory, buses, power, industry, power plant, steel factory, cars, Europe, S.E. Asia, China, volcanic activity, hydro-carbons, combustion engines, fertilizer</li></ul>
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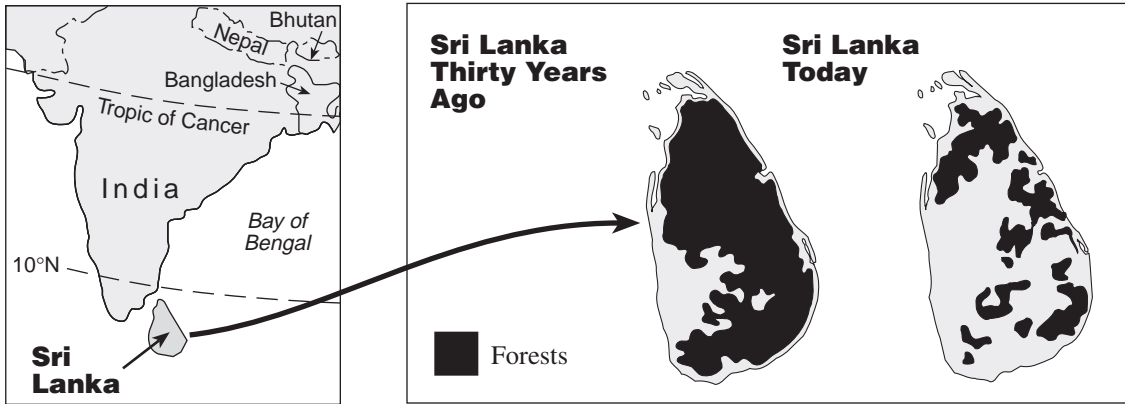
b) **Outline** one impact that acid rain has on each of the following:

**(2 marks)**

**Response:**

<b>Forest Ecosystems</b>	<ul style="list-style-type: none"><li>• acidification of soils reduces plant growth and causes crown die-back</li><li>• deterioration of natural forest growth, trees die (sugar maple trees), not good for roots</li><li>• plant is more susceptible to disease (heavy metals are dissolved by acids and taken up by the trees)</li><li>• stunts growth of trees</li><li>• damage to fine root hairs limits the uptake of water</li><li>• depletes nutrients</li><li>• kills bacteria</li></ul>
<b>Aquatic Ecosystems</b>	<ul style="list-style-type: none"><li>• alters pH balance of lake threatening phytoplankton survival (lowers pH, lakes die)</li><li>• fish habitat becomes too acidic for spawning to be a success</li><li>• affects the immune system of fish (heavy metals are dissolved by acids and taken up by fish)</li><li>• disrupts the food chain</li><li>• acid shock in spring melt waters (acids have accumulated during winter snows and are released in spring melt during the vulnerable time in the life cycle of fish and amphibians)</li></ul>

Use the following maps to answer question 9.



Based on a map in the "Energy and Industry" section by Paul Warburton from *Longman Coordinated Geography*, Edited by Simon Ross. © 1990, Pearson Education Limited.

9. a) **Suggest** two possible reasons for the loss of Sri Lanka's forests.

**(2 marks)**

**Response:**

<p><b>Sri Lanka is losing its forests to</b></p>	<ul style="list-style-type: none"> <li>• fuelwood collection</li> <li>• make room for             <ul style="list-style-type: none"> <li>– agricultural activities (ranching, cash crops)</li> <li>– urban development</li> <li>– road development</li> <li>– mining</li> <li>– dams</li> <li>– industrial activities (global warming)</li> <li>– recreation and resort development</li> <li>– logging for valuable hardwoods and pulpwoods (export quality)</li> <li>– population growth</li> </ul> </li> <li>• generate             <ul style="list-style-type: none"> <li>– tax revenue</li> <li>– jobs</li> <li>– trade</li> </ul> </li> <li>• tropical storms (cyclones)</li> <li>• ineffective legislation protecting forests</li> <li>• demand for product from the developed world</li> <li>• new technology in forest industry which has permitted faster harvest</li> <li>• forest fires</li> <li>• civil war</li> <li>• disease in the timber</li> <li>• acid rain</li> </ul>
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b) **Assess** the impact that deforestation may have on the following:

**(4 marks)**

**Response:**

<b>Atmosphere</b>	<ul style="list-style-type: none"><li>• reduces air quality (trees take in carbon dioxide and give off oxygen)</li><li>• climate change since trees regulate climate by influencing wind, temperature and rainfall</li><li>• global warming</li><li>• decrease in transpiration (drought increases)</li><li>• reduction in groundwater levels</li></ul>
<b>Hydrosphere</b>	<ul style="list-style-type: none"><li>• increased siltation (in streams and rivers affects aquatic habitats)</li><li>• increased run-off (flooding, loss of soil fertility, mass wasting)</li><li>• loss of humus and nutrients in water (diminished fertility)</li><li>• reduced transpiration and rainfall</li><li>• decreased infiltration</li><li>• increased soil erosion (sheet and gully)</li><li>• increased mass wasting</li></ul>

Use the following cartoon to answer question 10.



©1995 Sidney Harris.  
From *Teachers' Guide (Academic) — Perspectives: Canadian Geography* edited by Wayne Andrew and Graham Draper. Irwin Publishing Ltd., 325 Humber College Blvd., Toronto, Ontario, M9W 7C3. ©2000. Page 159.

10. Discuss three concerns associated with the disposal of toxic waste.

(3 marks)

Response:

<p><b>Concerns Associated with the Disposal of Toxic Waste</b></p>	<ul style="list-style-type: none"> <li>• contamination of soil</li> <li>• contamination of surface and groundwater</li> <li>• toxins may enter the food chain (bioaccumulation)</li> <li>• impacts on people's health both short-term and long-term (may cause cancer, birth deformities or other health problems)</li> <li>• impacts on animal and marine life</li> <li>• life expectancy of toxic material (long lasting)</li> <li>• spills or leaks during transportation</li> <li>• lack of international agreement for disposal</li> <li>• developing nations are dumping grounds for toxic waste (different environmental standards)</li> <li>• toxins are produced but solutions are not being developed as fast</li> <li>• the mixing of different toxic wastes can be dangerous</li> <li>• lax regulations regarding waste disposal</li> <li>• NIMBY – no group wants to take responsibility for disposal</li> </ul>
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<b>Concerns Associated with the Disposal of Toxic Waste (Continued)</b>	<ul style="list-style-type: none"><li>• responsibility (Who's is it?)</li><li>• developed countries produce it and developing countries become the dumping grounds (economic motives)</li><li>• cost of clean up</li><li>• property values decrease</li><li>• bioterrorism</li><li>• beauty of areas affected</li><li>• difficult to monitor</li><li>• apathy</li><li>• tourism affected</li><li>• spoils land for future uses</li></ul>
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11. Using your understanding of geography and the data provided:

- **describe** the physical factors which influence the environment of the Great Plains;
- **outline** the human activities which have threatened the water supply of the Great Plains;
- **explain** why it is difficult to implement resource management solutions in this region.

Answer in **multi-paragraph** form.

**(10 marks)**

**Response:**

<b>Physical Factors</b>	
<b>Location</b>	<ul style="list-style-type: none"> <li>• Canadian Prairies and the American Great Plains</li> <li>• found in mid-latitudes in the interior of the continent</li> <li>• important agricultural area</li> <li>• breadbasket of North America</li> <li>• topographically flat terrain formed as a result of continental glaciation</li> <li>• subsidence of land (from collapsed aquifer —mined subterranean cavern)</li> </ul>
<b>Climate</b>	<ul style="list-style-type: none"> <li>• continental effect creates extremes in climate (hot summers and cold winters)</li> <li>• short growing season</li> <li>• winter precipitation mainly in the form of snow</li> <li>• spring thaw provides moisture for germinating seeds</li> <li>• area receives 250 – 500 mm of precipitation a year</li> <li>• summer convectional precipitation</li> <li>• influence of the development of tornadoes</li> </ul>
<b>Vegetation</b>	<ul style="list-style-type: none"> <li>• temperate grasslands</li> <li>• composed of short and tall grasslands</li> <li>• short grass area called steppe</li> <li>• few original tall grassland areas</li> <li>• indicates suitability for growing cereal crops (grains)</li> </ul>



<b>Soil</b>	<ul style="list-style-type: none"> <li>• chernozem are found in some of the grassland areas</li> <li>• some of the most fertile soils in the world</li> <li>• black soil with extremely thick humus layer</li> <li>• humus accumulates due to slow decomposition of the annual buildup of grass</li> <li>• deep, fertile, well-drained soils rich in humus</li> <li>• because evaporation exceeds precipitation, soils experience relatively low levels of leaching (capillary action is a dominant soil forming process)</li> </ul>
<b>Groundwater</b>	<ul style="list-style-type: none"> <li>• water falls on the earth and enters the soil through percolation and infiltration</li> <li>• this water moves down to the aquifer (porous rock) and travels underground long distances</li> <li>• under the force of gravity groundwater comes to the surface (artesian)</li> </ul>
<b>Rock Type</b>	<ul style="list-style-type: none"> <li>• minerals contain chemicals which may dissolve and contaminate groundwater (suitable for animals)</li> <li>• rock acts as a filter for groundwater</li> <li>• sedimentary rock (porous sandstone)</li> <li>• cap rock conduit</li> </ul>

<b>Human Activities Which Threaten the Water Supply of the Great Plains</b>	
<b>General Description</b>	<ul style="list-style-type: none"> <li>• significant number of major cities (domestic run-off)</li> <li>• farming and livestock are the two main economic activities in the area</li> <li>• the natural vegetation has been replaced with farm crops</li> <li>• it is known as the breadbasket region</li> </ul>
<b>Agricultural Practices</b>	<ul style="list-style-type: none"> <li>• mining of groundwater over a long period of time has depleted this 1000 year old resource</li> <li>• the harvesting of crops has removed soil nutrients</li> <li>• nutrients must be added and farmers rely on chemical fertilizers to revitalize soil</li> <li>• phosphoric components and nitrates which have been added to the soil have entered groundwater</li> <li>• the eutrophication of ponds and lakes has occurred</li> <li>• use of artificial pesticides containing DDT, which leach into the groundwater and bioaccumulate in the food chain</li> <li>• organochlorines such as DDT create health problems</li> <li>• gully erosion and sheet erosion are most common in the Great Plains</li> <li>• pursuit of agriculture in a semi-arid region</li> </ul>

<p><b>Soil Erosion (Water and Wind)</b></p>	<ul style="list-style-type: none"> <li>• overcultivation</li> <li>• salinization of soil due to over irrigation</li> <li>• Ogalla Aquifer has become depleted because it has been overmined and is no longer a reliable water source for all who depend on it (population growth, crop irrigation, livestock raising)</li> </ul>
<p><b>Groundwater</b></p>	<ul style="list-style-type: none"> <li>• groundwater is a major source of water for this region</li> <li>• when the amount of groundwater that is pumped exceeds recharge rates, groundwater overdraft occurs which will then impact the human activity in this region</li> <li>• agriculture <ul style="list-style-type: none"> <li>– agricultural pesticides and fertilizers cause contamination from nitrate and organic chemicals</li> <li>– manure from livestock, dairy and poultry operations increases levels of nitrates, phosphates and fecal bacteria</li> </ul> </li> <li>• urban and industrial groundwater contamination <ul style="list-style-type: none"> <li>– infiltration of de-icing chemicals from roadways</li> <li>– oil and gas production leaks</li> <li>– chemical wastes (leachates) from landfills</li> <li>– leaking underground storage tanks</li> <li>– dumps and landfills create leachates</li> <li>– run-off from septic tanks and drain fields</li> <li>– oil and gas exploration activities</li> <li>– effluent from sewage treatment plants</li> <li>– mining activities (acid rock drainage)</li> </ul> </li> <li>• because end users do not pay for the real value of water, it is potentially misused/wasted</li> <li>• water subsidies can promote mismanagement of the resource</li> <li>• discovery of natural gas in the 1920s and 1930s has accelerated the depletion of the aquifer (water is now pumped out by mechanized pumps)</li> <li>• subsidence of land (from collapsed aquifer —mined subterranean cavern)</li> </ul>

## Why It Is Difficult to Implement Resource Management Strategies

- the origin and movement of groundwater is difficult to determine
- removing contaminants and restoring groundwater quality is time consuming and expensive
- groundwater lies beneath soil, out of sight and largely out of mind
- multi-government jurisdictions have difficulty regulating
- the strong lobbying power of the agricultural community
- there would be arguments over groundwater ownership
- there is government subsidization for water use in the agricultural industry
- the widespread availability of natural gas to fuel the pumps that bring the groundwater to the surface means that crop irrigation is affordable
- dry land farming techniques require four times the amount of land to produce the same amount of produce as an irrigated parcel of land
- climate change (global warming)
- development over recharge areas limits recharge rate
- who is responsible for the aquifer multi-state usage
- water is a common resource (rights to its use are geographically determined)
- water subsidies mean that end users do not pay the real value for the resource

**END OF KEY**