



2018 MANITOBA ENVIROTHON FIELD TEST

Churchill Taiga Trek

STOP 1

NATIVE PLANTS AND FORESTRY (2 pts)

Canada has played a leadership role in collaborating with other countries to develop a framework of criteria and indicators for monitoring and reporting on progress in sustainable forest management. Define CRITERIA and INDICATORS in this context.

1) Criteria (1.0 pt)

2) Indicators (1.0 pt)

Answer:

1) *Criteria: a set of basic social, economic and environmental values (0.5 pt) that Canadians want to sustain or conserve in forests (0.5 pt)*

2) *Indicators: objective scientific measures related to each criterion (0.5 pt) that are tracked over time and used to assess change (0.5 pt)*

Reference:

1)-2) *Sustainable Forest Management in Canada, p 2*

STOP 2

NATIVE PLANTS AND FORESTRY (2 pts)

We know that climate change could impact the health of Manitoba's forests. Briefly describe two (2) ways that climate change could increase the impacts of forest pests in Manitoba. (2 pts)

Answer:

Any 2 of the following: (2 pts - 1 pt each)

Warmer temperatures can increase rate of reproduction of pests like, spruce budworm, jack pine budworm, and forest tent caterpillar. Climate change may reduce late spring frosts which control forest pests and limit outbreaks protecting forests from mass defoliation. Warmer temperatures allow insects to grow more rapidly. Larvae would grow faster, eat more, and reach maturity sooner. There would be less opportunity for predators to prey on vulnerable larval stages.

Reference:

Climate Change Connection, p 2



STOP 3

NATIVE PLANTS AND FORESTRY (2 pts)

Compare and contrast DEFORESTATION and AFFORESTATION. (2 pts)

Answer:

Answer must cover the following key points:

Deforestation: The permanent clearing of forest (0.5 pt) to make way for a new non-forest land use, such as agriculture or commercial development (0.5 pt)

Afforestation: Creation of a new forest through planting or seeding (0.5 pt) on land which was not forest before (0.5 pt)

Reference:

State of Canada's Forests, 2017, p 26

STOP 4

NATIVE PLANTS AND FORESTRY (10 pts)

This question requires BOTH features AND materials found at the stop or in the back of the test binder.

1) Using the equipment provided, measure the trees marked F-A and F-B at this stop. Record the information below. (8 pts - 2 pts each)

Tree F-A: Diameter _____ cm

Height _____ m

Tree F-B: Diameter _____ cm

Height _____ m

2) Trees in the Arctic often exhibit unique growth characteristics. Briefly describe two (2) characteristics and explain the cause of each. (2 pts - 0.5 pt each)



<u>Characteristic</u>	<u>Cause</u>

Answer:

1) F-A: Diameter TBD (2 pts)

F-A: Height TBD (2 pts)

F-B: Diameter TBD (2 pts)

F-B: Height TBD (2 pts)

Partial marks: TBD

2) KRUMMHOLTZ:

Tree SKIRT (0.5 pt), caused by extreme cold weather and better growth due to protection under snow and low out of strongest winds (0.5 pt)

FLAG or BANNER trees - asymmetrical branching, facing away from the prevailing winds (0.5 pt), caused by wind blown ice crystals (0.5 pt)

Reference:

1) Forestry Equipment Techniques, p 2-3; Provincial Training

2) Provincial Training; Brandson Book, p 178, 184

STOP 5

NATIVE PLANTS AND FORESTRY (2 pts)

Multiple Choice: Which of the choices is correct? Circle the best response.

1) How many Manitobans work directly or indirectly in the province's forest industry in jobs from harvesting, hauling and paper and lumber production, to furniture, window, door and paper products manufacturing? (0.5 pt)

- a) 1 in 25
- b) 1 in 50
- c) 1 in 75



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- d) 1 in 100
- e) 1 in 200

2) In Canada, the main forest industries are: (0.5 pt)

- a) forestry and logging
- b) pulp and paper manufacturing
- c) wood product manufacturing
- d) all of the above

3) In Canada, where are the most (over 50%) forest industry jobs located? (0.5 pt)

- a) Manitoba
- b) British Columbia
- c) Ontario and Quebec
- d) Atlantic Canada
- e) Saskatchewan

4) Indicate whether the statement is true (T) or false (F) by circling the correct answer. (0.5 pt)

T F The forest sector is one of the largest employers of indigenous people in Canada.

Answer:

- 1) a (0.5 pt)
- 2) d (0.5 pt)
- 3) c (0.5 pt)
- 4) T (0.5 pt)

Reference:

- 1) *Forestry Document, p 4*
- 2) *State of Canada's Forests, p 51,52,61,66*
- 3) *State of Canada's Forests, p 50*
- 4) *State of Canada's Forests, p 48*

STOP 6

NATIVE PLANTS AND FORESTRY (2 pts)

1) The tree line has previously been as much as _____ km further north than it is today.
Circle the best response. (0.5 pt)



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- a) 20
- b) 120
- c) 220
- d) 320

2) Indicate whether the statement is true (T) or false (F) by circling the correct answer. (0.5 pt)

T F Human disturbance and animal overgrazing are the only factors affecting the growth of arctic vegetation.

3) Name two (2) of the three coniferous tree species that make up the tree line in the Hudson Bay region (1 pt)

Answer:

- 1) *d (0.5 pt)*
- 2) *F (0.5 pt)*
- 3) *Any 2 of the following: Black spruce, White Spruce, tamarack (1.0 pt - 0.5 pt each)*

Reference:

- 1) *Brandson, p 178*
- 2) *Brandson, p 176*
- 3) *Brandson, p 184*

STOP 7

NATIVE PLANTS AND FORESTRY (2 pts)

Churchill is in the Hudson Bay Lowlands ecotone (transition zone) between the northern boreal forest and southern arctic tundra. It has long hours of summer sunlight but only a very short growing season.

List four (4) adaptations to this short season found in northern plants. (2 pts)

Answer:

Any 4 of the following: Perennial lifestyle, Bud readiness, low height and growth form, flower adaptations, seed adaptations, vegetative reproduction (2 pts - 0.5 pt each)

Reference:

Brandson, pages 181-183



STOP 8

NATIVE PLANTS AND FORESTRY (10 pts)

This question requires BOTH features AND materials provided at the stop or in the back of the test binder.

1) The tree cookies provided at the stop are from a tree that was harvested at the Twin Lakes area near Churchill in the winter of 2017.

a) Using the samples and equipment provided, determine the age of this tree cookie F-E when it was harvested. (2 pts)

b) Look at the annual rings in the tree cookie. How would you describe the tree's growth rate during the period 2006-2017? Circle the best response. (1 pt)

- i) slower than average
- ii) average
- iii) fast than average
- iv) cannot tell

c) Look at the graph labelled F-F. Describe two (2) factors which could explain your answer in b). (2 pts)

Multiple Choice: Which of the choices is correct? Circle the best response.

2) Dendrochronology refers to: (0.5 pt)

- a) the time of year that leaves form on trees
- b) the study of plant evolution
- c) the analysis of tree growth ring patterns in science
- d) the difference in plant growth from one area to another

3) Dendrochronological timelines can be used by researchers to: (0.5 pt)

- a) calculate the age of buildings or structures
- b) calculate the age of archeological sites
- c) study the effects of climatic factors on tree growth
- d) all of the above

4) The oldest trees recorded by researchers in Churchill are estimated to be _____ years old. (0.5 pt)



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- a) 150
- b) 200
- c) 300
- d) 350

5) Indicate whether the statement is true (T) or false (F) by circling the correct answer. (0.5 pt)

T F Tree ring width can be affected by both biotic and abiotic factors.

6) Using the Field Guide to the Native Trees of Manitoba, identify the specimens labeled F-G and F-H. State the full common or scientific name. (2.0 pts - 1.0 pt each)

F-G _____

F-H _____

7) Tamarack is a unique species in that it loses its needles annually. In scientific terms, it is considered both _____ and _____. (1 pt - 0.5 pt each)

Answer:

1a) 57 years +/- 3 years (2 pts)

Partial marks: +/- 5 years (1 pt)

1b) iii (1 pt)

1c) Churchill precip \ temp chart shows significant increase in precip and temp during that time period. (2 pts)

2) c (0.5 pt)

3) d (0.5 pt)

4) d (0.5 pt)

5) T (0.5 pt)

6) F-G: TBD (1 pt)

F-H: TBD (1 pt)

7) deciduous (0.5 pt), coniferous (0.5 pt)

Reference:

1)-2): Regional and Provincial Training, Youtube video

3)-5): Principles of Dendrochronology

6) Brandson, p 184

7) Brandson, p 185, Field Guide to Native Trees of Manitoba, p 30



STOP 9

NATIVE PLANTS AND FORESTRY (2 pts)

1) **Fill in the blanks:** Complete the sentences with the most appropriate words. (1.5 pts - 0.5 pt each)

_____ are successful inhabitants of stressful habitats that experience cold and/or extreme dry conditions. They often occupy niches where nothing else will grow. They are a composite partnership of a(n) _____ and a(n) _____.

2) How many species of these organisms have scientists identified in Wapusk National Park? Circle the best response. (0.5 pt)

- a) 30
- b) 130
- c) 230
- d) 330

Answer:

- 1) Lichen, fungus, algae (1.5 pts - 0.5 pt each)
- 2) b (0.5 pt)

Reference:

Brandson, p 191

STOP 10

NATIVE PLANTS AND FORESTRY (10 pts)

This question requires materials provided at the stop or in the back of the test binder.

Look at the map labelled F-I to answer the following questions.

Multiple Choice: Which of the choices is correct? Circle the best response. (10 pts - 1 pt each)

1) Approximately how many years ago was this map drawn?

- a) 100
- b) 200
- c) 300
- d) 500



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2) How many rivers are shown on this map?

- a) 10
- b) 12
- c) 15
- d) 17

3) What is the only settlement on this map called?

- a) The Norther Most Coper Mind
- b) Prince Wales Fort
- c) Barren Ground
- d) Much Wood

4) What is the name of the longest river?

- a) Kasodes
- b) Tothekiadese
- c) Thallodese
- d) Thewwlasidese

5) In the summer, how many days does it take the indeyons to travel from Prince Wales Fort to the wood whear they risort?

- a) 12
- b) 13
- c) 17
- d) 19

6) How many wooded areas are shown on this map using a tree symbol?

- a) 1
- b) 2
- c) 3
- d) 4

7) What kind of animal was identified on this map?

- a) caribou
- b) whale
- c) dear
- d) bear



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8) How long was the journey in the winter for the indeyons to travel to ye fort to traid from their risort?

- a) 15
- b) 17
- c) 20
- d) 25

9) What river is the shortest?

- a) Battedese
- b) Rasidase
- c) Pokethocoko
- d) Shawtheuedese

10) What area is located on the left side of the winter trackway?

- a) indeyons risort
- b) dear planty
- c) barren ground
- d) much wood

Answer:

- 1) c (1 pt)
- 2) d (1 pt)
- 3) b (1 pt)
- 4) b (1 pt)
- 5) c (1 pt)
- 6) b (1 pt)
- 7) c (1 pt)
- 8) d (1 pt)
- 9) b (1 pt)
- 10) d (1 pt)

Reference:

- 1)-10) Ability to read and interpret maps

STOP 11

NATIVE PLANTS AND FORESTRY (2 pts)

Indigenous peoples have inhabited and cared for the land in Manitoba for millenia. Their knowledge of the land is an important resource today.



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- 1) What does Pimachiowin Aki mean in English? (0.5 pt)
- 2) When a fire occurs in a forested rocky area, the area is opened to plants that don't grow well in forest.
 - a) What fruit can usually be harvested after a fire? (0.5 pt)
 - b) How many years must pass after a fire before the fruit should be harvested? (0.5 pt)
- 3) *Anishinaabe ishkote* is the Anishinaabe term for controlled fire. In what season is it practiced? (0.5 pt)

Answer:

- 1) *The Land That Gives Life (0.5)*
- 2a) *Blueberry (0.5)*
- 2b) *3-10 years (0.5)*
- 3) *Spring (0.5)*

Reference:

- 1) *Pimachiowin Aki, p iii*
- 2a)-2b) *Pimachiowin Aki, p 28*
- 3) *Pimachiowin Aki, p 31*

STOP 12

NATIVE PLANTS AND FORESTRY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Look at the photo labeled F-D.

- 1) What is being harvested? (1 pt)
- 2) List two (2) ways the harvested resource has been used by indigenous peoples. (1 pt)

Answer:

- 1) *birch bark (1 pt)*
Partial marks: bark (0.5 pt)
- 2) *Any 2 of the following: making baskets, horns for calling moose, covering wigwams, building canoes (1 pt - 0.5 pt each)*

Reference:

- 1) *Pimachiowin Aki, p 32*
- 2) *Pimachiowin Aki, p 31*



STOP 13

NATIVE PLANTS AND FORESTRY (2 pts)

Pre-Harvest Surveys are performed before any forested area in Manitoba is harvested. Why are Pre-Harvest Surveys performed? (2 pts)

Answer:

Identifies resource values (0.5 pt) in an attempt to mitigate impacts (0.5 pt) of forest management activities on sensitive sites, waterways, wetlands, wildlife and their habitat 0.5 pt), and to conserve biodiversity (0.5 pt)

Reference:

Pre-harvest Survey Guidelines, p 1

STOP 14

NATIVE PLANTS AND FORESTRY (2 pts)

Fill in the blank: Complete the sentences with the most appropriate word from the word bank below. (2 pts - 0.5 pt each)

Word Bank

afforestation	deforestation
All Annual Cut	monitoring
Allowable Tree Cut	permanent sampling
Annual Allowable Cut	reforestation
Annual Cut Trees	revegetation
clearcutting	segregation

1) The permanent clearing of forests to make way for a new non-forest land use is called _____ .

2) The removal of all the trees from an area sufficiently large enough so that the “forest influence” is absent from the majority of the harvested area is referred to as _____ .

3) The creation of a new forest through planting or seeding on land that wasn't forest before is called _____ .



4) The amount of timber that can be cut from Manitoba's forests over a one year period to provide a sustained yield is identified as the _____.

Answer:

- 1) *deforestation (0.5 pt)*
- 2) *clearcutting (0.5 pt)*
- 3) *afforestation (0.5 pt)*
- 4) *Annual Allowable Cut (0.5 pt)*

Reference:

- 1) *State of Canadas Forests 2017 page 30*
- 2) *Clearcutting in Manitoba, page 7*
- 3) *State of Canadas Forests 2017 page 30*
- 4) *Clearcutting in Manitoba, page 15*

STOP 15

NATIVE PLANTS AND FORESTRY (2 pts)

- 1) Emerald ash borer has been found in Winnipeg. What are the two (2) best defense options to limit the spread of this pest in the city and in the rest of Manitoba? (1 pt)
- 2) List two (2) symptoms of emerald ash borer attack in an ash tree? (1 pt)

Answer:

- 1) *Prevention measures (could say public education, or don't move firewood) (0.5 pt) and early detection (0.5 pt)*
- 2) *Any 2 of the following: Thinning and dieback of crown, vertical bark cracks, woodpecker or squirrel damage, epicormic shoots, D-shaped exit holes, S-shaped larval galleries under the bark (1 pt - 0.5 pt each)*

Reference:

- 1) *Emerald Ash Borer, p 1*
- 2) *Emerald Ash Borer, p 5*

STOP 1

SOILS AND LAND USE (2 pts)

CEC is one of the important properties of soil which affects soil fertility.

- 1) What does the acronym CEC stand for? (0.5 pt)



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2) **True/False:** Indicate whether the statements below are true (T) or false (F) by circling the correct answer. (1 pt - 0.5 pt each)

- T F As CEC levels decrease, more frequent and smaller applications of fertilizer are desirable.
- T F In many highly weathered, naturally acid soils, there is an inverse relationship between CEC and pH.

3) What is one (1) way you can increase CEC in the soil? (0.5 pt)

Answer:

- 1) Cation-Exchange Capacity (0.5 pt)
2a) T (0.5 pt)
2b) F (0.5 pt)
3) 1 of the following: increase organic matter, increase clay (0.5 pt)

Reference:

1)-3) From the Surface Down, p 14

STOP 2

SOILS AND LAND USE (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

A sampling core with the following dimensions was used to take sample S-J:

height: 1 cm
radius: 0.5 cm

1) Using the scale provided, determine the bulk density of sample S-J. Recall that the volume of a cylinder is $\pi(r^2)h$. Show all your work. (1.5 pts)

Note: The container holding the soil sample, and the identical empty container have the same mass.

2) Considering its bulk density, is sample S-J a compacted soil? (0.5 pt)

Answer:

- 1) TBD (1.5 pts) (1 pt for correct answer in g/cm^3 , 0.5 pt for volume of 0.785 cm^3 , work must be shown)
2) no if BD less than $1.80 / \text{cm}^3$ (0.5 pt)

Reference:

1) Soil Management Guide, p 47



2) *Soil Management Guide*, p 48

STOP 3

SOILS AND LAND USE (2 pts)

Churchill is home to many historical landmarks, such as the York Factory Depot building. Riverbank erosion is posing a serious threat to the future of the Depot.

- 1) List two (2) recommendations that are practical for the area that may help reduce this erosion. (1 pt)
- 2) Describe how climate change could exacerbate riverbank erosion in this area. (1 pt)

Answer:

1) *maintaining a protective cover on the soil (0.5 pt), creating a barrier to the erosive agent (0.5 pt)*

Other answers may be acceptable but have to take into account Churchill limitations (ex plant growth)

2) *1 of the following: increase permafrost instability/melting (0.5 pt) leading to increased erosion/riverbank slumping (0.5 pt) OR increased storm activity (0.5 pt) leading to increased wave action (0.5 pt)*

Reference:

- 1) *Soil Quality Resource Concerns: Soil Erosion*
- 2) *Churchill Hudson Bay, p 81*

STOP 4

SOILS AND LAND USE (2 pts)

1) Regardless of location, food production requires adequate heat/sunlight, water and soil nutrients.

a) Define MACRONUTRIENT. (0.5 pt)

b) List two (2) macronutrients. (1 pt)

2) In southern Manitoba livestock manure is used as a source of nutrients. Due to its limited availability in the Churchill region, what is commonly used as a replacement? (0.5 pt)

Answer:

1a) *nutrients needed by plants in large amounts (0.5 pt)*



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- 1b) Any 2 of the following: nitrogen, phosphorus, potassium and sulfur (1 pt - 0.5 pt each)
2) seaweed (0.5 pt)

Reference:

- 1) *Soils and Land Use Document*, p 28
2) *Churchill Hudson Bay book*, p 205

STOP 5

SOILS AND LAND USE (10 pts)

This question requires BOTH features AND materials found at the stop or in the back of the test binder.

- 1) Look at the photograph labelled S-A. What is the most likely mode of deposition responsible for the presence of the geologic materials shown in Photograph S-A? (1 pt)
- 2) What type of bedrock is the most likely origin of the soil at stop 5 and shown in Photograph S-B? (1 pt)
- 3) Describe how two (2) soil forming factors are responsible for providing the organic component of the soil at Stop 5. (2 pts)
- 4) Describe how two (2) soil forming factors are responsible for providing the mineral component of the soil at Stop 5. (2 pts)
- 5) Describe what the broken rock in Photograph S-B and Turbic Cryosols have in common. Be specific. (1 pt)
- 6) Two (2) of the following statements about landscape and soils around Churchill are false. Write their letters and explain why they are false. (2 pts - 1 pt each)
 - A: A soil from Brandon has been around longer than a soil from the plains around Churchill.
 - B: There aren't enough vegetation and soil organisms to form a topsoil at Stop 5 as shown in Photograph S_B.
 - C: Short summers and cool annual temperatures prevent soil development near Churchill.
 - D: Agriculture and forestry are not available land uses around Churchill because of harsh climate, inadequate drainage, limited water holding capacity, low nutrients, and sometimes salinity.
 - E: The land around Churchill is rising up out of the ocean over time.
- 7) Lichens are plentiful at stop 5 as shown in Photograph S-C. One (1) of the following statements about lichens is false. Write its letter and explain why it is false. (1 pt)



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- A: Lichens cover rocks to protect them from weathering and erosion.
- B: Lichens break down rocks chemically by producing different types of acids.
- C: Lichens contribute directly to soil organic matter.

Answer:

- 1) morainal or glacial (size of the boulders is the key indicator) (1pt)
- 2) limestone or sedimentary (1pt)
- 3) Any 2 of the following pairs: (2 pts: 0.5 for each factor and 0.5 pt for each explanation)
 - TIME - needed to create more and more dead plant and animal material for organic matter
 - ORGANISMS - they grow to add organic material to the soil by their life and death
 - CLIMATE - plants and microbe productivity depends on temperatures and moisture - a cool climate slows the addition of organic matter to the soil
 - TOPOGRAPHY/RELIEF - will affect availability of moisture which affects the amount of vegetation produced that would add to organic matter
- 4) Any 2 of the following pairs: (2 pts: 0.5 for each factor and 0.5 pt for each explanation)
 - PARENT MATERIAL - modes of deposition provide mineral soil particles to start soil building
 - TIME - needed to create more mineral soil from weathering rocks
 - ORGANISMS - lichens and plants can break down rock into the mineral component
 - CLIMATE - Freezing and thawing, heating and cooling, wetting and drying aids in the weathering of rocks to produce more mineral soil
- 5) expansion of water when freezing to move things apart or around (1 pt)
Partial marks: 0.5 pt for just frost action or ice
- 6) B - even though small, they contribute organic matter to the development of a thin layer of soil OR there are abundant plants in low lying areas where they can produce a topsoil (1 pt: 0.5 pt for correct choice; 0.5 pt for correct explanation)
C - soil development is still happening - it is just slower from being cold and shorter summers (1 pt: 0.5 pt for correct choice; 0.5 pt for correct explanation)
- 7) A - Lichens actually accelerate the breakdown of stone by physical and chemical weathering (1 pt: 0.5 pt for correct choice + 0.5 pt for any correct explanation)

Reference:

- 1) Soils and Land Use, p. 25-26
- 2) Soils and Land Use, p. 9; Hudson Plains Ecozone, p.1
- 3)-4) Soils and Land Use, p 5, 9-13, 27
- 5) Soils and Land Use, p. 27; Climate Change in the North, p. 27; Canadian System of Soil Classification
- 6) Soils and Land Use, p 10-11; Hudson Plains Ecozone, p 287,289
- 7) Role of Lichens in Weathering



STOP 6

SOILS AND LAND USE (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Look at the diagrams of soil profiles labeled S-I.

- 1) Diagram i) represents a soil profile on top of a hill in a cultivated field.
 - a) Which profile (ii or iii) represents a soil profile that would likely be found at the bottom of the hill? (0.5 pt)
 - b) Explain why that profile would be found at the bottom of a hill. (0.5 pt)
- 2) In Diagram ii), what caused the Apb horizon? (Hint: what do the suffixes mean?) (1 pt)

Answer:

1a) ii) (0.5 pt)

1b) The A horizon is thicker at the bottom of the hill due to erosion from the top of the hill (0.5 pt)

2) The soil is cultivated, giving the plowed suffix (p) (0.5 pt); and the erosion from the top of the hill accumulating in the depression likely led to the buried horizon suffix (b) (0.5 pt).

Reference:

1)-2) Soils & Land Use document, p 6-7, 9-10

STOP 7

SOILS AND LAND USE (2 pts)

- 1) Review the following data about a 0-6" Newdale Clay loam sample.

	<u>Soil Moisture Content</u>
Saturation	42 %
Field Capacity	29 %
Permanent Wilting Point	12 %

What is the available water content of the above soil? (1 pt)

- 2) Define SATURATION with regard to soil moisture. (0.5 pt)



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3) Which of the following statements is false? Circle the best response. (0.5 pt)

- a) Soil water is more readily available as moisture content approaches field capacity.
- b) Soil moisture information is useful for determining the risk of groundwater contamination.
- c) Saturation conditions may induce nitrification.
- d) When soil is air dried, only hygroscopic water remains.

Answer:

- 1) 17% (1 pt - 0.5 pt for correct answer, 0.5 pt for correct unit)
- 2) moisture content at which all soil pores are completely water filled (0.5 pt)
- 3) c (0.5 pt)

Reference:

- 1)-3) Soil Management Guide, p 42-43

STOP 8

SOILS AND LAND USE (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) What is the geological feature seen in Figure S-D? (0.5 pt)
- 2) How is this feature created? (1.5 pt)

Answer:

- 1) pot hole or kettle (0.5 pt)
- 2) A rock is caught in a depression of a larger rock (0.5 pt) and water spins that rock on its axis (0.5 pt) wearing down a hole over thousands of years (0.5 pt)

Reference:

- 1)-2) Churchill Hudson Bay p 67

STOP 9

SOILS AND LAND USE (10 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) To which soil order do peat soils belong if there is no permafrost within 3 meters of the surface? (1 pt)



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2) To which soil order do peat soils belong if there is permafrost less than one meter from surface? (1 pt)

3) What is the Great Group of the following Organic Soil as described below? (2 pts)

<u>Depth</u>	<u>Description</u>	<u>Symbol</u>
0-40 cm	Organic material poorly decomposed, readily identifiable mosses	Of
40-120 cm	Organic material strongly decomposed, very stable	Oh
120-160 cm	Organic material moderately decomposed, somewhat recognizable for plant species	Om

4) What is the term for the layer of soil which thaws and freezes? (1 pt)

5) Thermokarst is a common type of landscape in the north.

a) Describe a thermokarst landscape, including its features. (1.5 pts)

b) What causes a thermokarst landscape? (0.5 pt)

6) Look at the photos labelled S-E and S-F. Identify the feature of northern peatlands in each. (2 pts - 1 pt each)

S-E _____

S-F _____

7) Which of the following is found in the highest proportion of organic soils? Circle the best response. (0.5 pt)

- a) air
- b) water
- c) plant based organic material

8. Which of the following is the most nutrient rich? Circle the best response. (0.5 pt)

- a) bog
- b) fen
- c) palsa



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Answer:

- 1) Soil Order- Organic (1 pt)
- 2) Soil Order- Cryosolic (1 pt)
- 3) Great Group- Humisol (2 pts)
- 4) Active Layer (1 pt)
- 5a) Thermokarst landscape is very uneven (0.5 pt), with hummocks, palsas, and ponds of water (0.5 pt for each feature to a maximum of 1 pt)
- 5b) caused by the melting of permafrost. (0.5 pt)
- 6) S-E: Polygonal peat plateau or ice wedge plateau (1 pt)
S-F: Cryoturbation or frost churning (1 pt)
- 7) b (0.5 pt)
- 8) b (0.5 pt)

Reference:

- 1) Northern Soils, p 5
- 2) Northern Soils, pp 5-6
- 3) Northern Soils, p 5
- 4)-5) Northern Soils, p 2
- 6) Northern Soils, pp 4, 8
- 7) Northern Soils, p 2
- 8) Northern Soils, p 3

STOP 10

SOILS AND LAND USE (2 pts)

1) Define ISOSTATIC REBOUND. (1 pt)

Multiple Choice: Which of the choices is correct? Circle the best response. (1 pt - 0.5 pt each)

2) Isostatic rebound is:

- a) increasing over time
- b) decreasing over time
- c) no change in rate
- d) no longer occurring

3) The rate of rebound is calculated using:

- a) radiocarbon dating of shells
- b) radiocarbon dating of polar bears
- c) comparing the heights of rings used to attach ships to the bedrock
- d) both a) and c)



Answer:

- 1) *melting of ice sheets lessening the weight on the earth's crust (0.5 pt) which leads to land rising (0.5 pt)*
- 2) *b (0.5 pt)*
- 3) *d (0.5 pt)*

Reference:

- 1)-3) *Churchill Hudson Bay, p 124*

STOP 11

SOILS AND LAND USE (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

1) A sandy soil has a bulk density (BD) of 1.2 g/cm^3 . Assuming the soil is dry and particle density (PD) is 2.65 g/cm^3 , calculate:

- a) % porosity, where $\% \text{ porosity} = \{1 - (\text{BD}/\text{PD})\} \times 100$ (0.5 pt)
- b) the depth of infiltration for 25 mm of precipitation, where $\text{depth of infiltration} = \text{depth of water} / (\% \text{ porosity}/100)$ (0.5 pt)

2) Based on the above equations, how would you expect the depth of infiltration to change in a clay soil? Explain why. (1 pt)

Answer:

- 1a) *55% (0.5 pt) requires correct answer and unit for full marks*
- 1b) *4.5 cm (0.5 pt) requires correct answer and unit for full marks*
- 2) *depth of infiltration will decrease (0.5 pt) because bulk density increases, therefore porosity increases which is in the denominator of the equation (0.5 pt)*

Reference:

- 1)-2) *Soil Management Guide, p 48*

STOP 12

SOILS AND LAND USE (2 pts)

1) What are the three (3) primary modes of pesticide degradation that occur in soil? (1.5 pts)

2) What material found in soil has a high cation-adsorption capacity, as well as an influence on the persistence, degradation, bioavailability, and leachability of pesticides in soils? (0.5 pt)



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Answer:

- 1) biological (0.5 pt), chemical (0.5 pt), photochemical (0.5 pt)
- 2) organic matter (0.5 pt)

Reference:

- 1) Soil Quality Information Sheet: Pesticides
- 2) Soil Management Guide, p 151

STOP 13

SOILS AND LAND USE (10 pts)

This question requires materials provided at the stop or in the back of the test binder.

The 2017 calendar published by the Manitoba Soil Science Society recognized a significant or unique soil type in each province and territory of Canada. Use the calendar and your soils knowledge to answer the following questions.

- 1) What noteworthy anniversary prompted the Society to adopt the theme of the 2017 soils calendar? (0.5 pt)
- 2) Podzols are found in a number of provinces.
 - a) Name two (2) provinces in which a Podzol is identified as a significant or unique soil type. (0.5 pt)
 - b) To what level of classification does the name Podzol refer? Circle the best response. (0.5 pt)
 - i) Order
 - ii) Great Group
 - iii) Sub-Great Group
 - c) Which of the following is a crop commonly grown on several of these Podzolic soils? Circle the best response. (0.5 pt)
 - i) wheat
 - ii) canola
 - iii) potato
 - iv) asparagus
 - d) Name the Podzolic soil that shares a name with a provincial capital city. (0.5 pt)
- 3) Newfoundland and Labrador is Canada's youngest province.



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- a) What is the Order of the soil reported to be prevalent there? (0.5 pt)
- b) Describe how this soil type could be affected by climate change? (1 pt)
- 4) What was the soil forming process common to both the Champagne soil of the Yukon and Red River Valley soils of Manitoba? (1 pt)
- 5) The soil types for British Columbia and Manitoba recognized in the poster were formed under different conditions.
- a) Briefly differentiate between the natural vegetation of the British Columbia soil, as described on the poster, and the natural vegetation of the Manitoba soil. (0.5 pt)
- b) What land use do you anticipate is most prevalent today on these two soils? (1 pt)
- c) Have these two soils been officially designated as provincial soils? (0.5 pt)
- 6) Which two (2) soils (name and province) can be expected to exhibit an eluviated A horizon, i.e. an Ae horizon? (1 pt)
- 7) What property is chiefly responsible for Order classification of the Sainte-Rosalie in Quebec? (1 pt)
- 8) Congratulations, you have been named Canada's pedologist laureate! Equipped with the best spade and hand-auger technology, which of the thirteen soils described on the poster do you choose to dig? Why? (1 pt)

Answer:

- 1) *Canada's 150th birthday (150 years since Confederation, the creation of the country) (0.5 pt)*
- 2a) *Any 2 of the following: Newfoundland, Prince Edward Island, New Brunswick and Nova Scotia (0.5 pt)*
- Partial marks: none*
- 2b) *i (0.5 pt)*
- 2c) *iii (0.5 pt)*
- 2d) *Charlottetown (0.5 pt)*
- 3a) *Cryosolic (0.5 pt)*
- 3b) *The length of time during the year that the topsoil is frozen could shorten and the permafrost in the subsoil could melt. (1 pt)*
- 4) *Both soils formed from lacustrine materials, meaning that they were laid down during the presence of lakes created by glacial melt-water (Glacial Lake Champagne and Glacial Lake Agassiz, respectively). (1 pt)*
- 5a) *The B.C. soil developed under forest while the Manitoba soil developed under grassland. (0.5 pt)*
- 5b) *Being located at high elevation, the land use on the B.C. soil likely remains forest (0.5 pt). The Manitoba soil is predominantly farmed, i.e. land use is agriculture. (0.5 pt)*



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5c) yes (0.5 pt)

6) Breton in Alberta and Guelph in Ontario because they are Luvisols which, by definition, should each exhibit an Ae horizon, unless it has been made undetectable due to tillage (1 pt)

7) Classified a Gleysol, the Sainte-Rosalie exhibits very poor drainage. (1 pt)

8) Any creative answer welcomed! (0.5 pt for soil, 0.5 pt for reason)

Reference:

1) Ability to read and interpret information

2a) Ability to read and interpret information

2b) Soils and Land Use document, p 40

2c)-2d) Ability to read and interpret information

3a) Ability to read and interpret information

3b) Soils and Land Use document

4) Soils and Land Use document, p 25; Soil Management Guide, p 8

5) Ability to read and interpret information

6) Soils and Land Use document, p 6; Soil Management Guide, p 18

7) Soils and Land Use document, p 39

8) n/a

STOP 14

SOILS AND LAND USE (2 pts)

List two (2) advantages and two (2) disadvantages to using a zero till system. (2 pts)

Advantages:

Disadvantages:

Answer:

ADVANTAGES: any 2 of the following: increased OM, moisture conservation, less erosion, improved aggregation, less compaction, less fossil fuel use, less labour requirement. Other answers may be acceptable. (1 pt - 0.5 pt each)

DISADVANTAGES: any 2 of the following: increased herbicide use, increase disease pressure, high residue conditions can interfere with seeding operations, cooler soil temperatures can delay emergence, too much moisture can drown seedlings. Other answers may be acceptable. (1 pt - 0.5 pt each)

Reference:

Soil Management Guide, p 98, 99, 108



STOP 15

SOILS AND LAND USE (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Look at the photo labeled S-H.

- 1) What is the soil feature pictured in S-H? (*Hint: It's not snow!*) (0.5 pt)
- 2) What two (2) conditions are required for the feature in S-H to be present? (1 pt)
- 3) On a soil map for this location, the following code is used:

BWO/xcxt

Which position (1st, 2nd, 3rd, or 4th) in the denominator indicates the degree of the feature shown in S-H? (0.5 pt)

Answer:

- 1) *salinization (0.5 pt)*
- 2) *presence of soluble salts in subsoil, groundwater, or both (0.5 pt); high water tables (0.5 pt)*
- 3) *4th (0.5 pt)*

Reference:

- 1) *MB soil management guide: Soil Salinity; Soil Quality Info sheet - Salinization*
- 2) *MB soil management guide, p65*
- 3) *MB soil management guide, p 69*

STOP 1

THEME (10 pts)

- 1) Climate change is projected to have a number of negative impacts on Arctic wildlife. List four (4) issues that may impact key traditional, subsistence, and economic species. (2 pts)
- 2) Caribou are a key traditional and subsistence species for Aboriginal peoples.
 - a) Briefly describe two (2) reasons why caribou play such an important traditional role. (2 pts)
 - b) List two (2) changes in their environment which will be problematic for caribou. (1 pt)



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c) For each of the environmental changes listed in 2b), explain why the change may be problematic. (2 pts)

3) Seals rely on sea ice for their survival and breeding. What two (2) environmental changes related to climate will affect the survival and recruitment of ringed seal pups? (1 pt)

4) Polar bears may decline in the face of environmental changes related to climate, related to decreases in food availability and ice conditions. Why may this be economically damaging to northern communities? (1 pt)

5) Amphibians can be particularly sensitive to environmental changes related to climate, such as altered hydroperiods and seasons, increased incidence of severe storms, changes in precipitation, and warmer conditions. One local species, the wood frog, has already experienced some consequences due to changing weather conditions. Briefly describe how one (1) change in weather conditions is affecting wood frogs. (1 pt)

Answer:

1) Any 4 of the following: changes in mortality rates, reduced reproductive capacity, increased competition for resources due to northward expansion of southern species, emergence of new zoonotic diseases, access to food under deeper snow pack, etc. (2 pts - 0.5 pt each)

2a) Brief description of traditional role of caribou in any 2 of the following: local nutrition, economics, culture, and spirituality (2 pt - 1 pt each)

2b) Any 2 of the following: increased temperature, wetter seasons, deeper snow pack, UV radiation increases (1 pt - 0.5 pts each)

2c) Any 2 of the corresponding answers (2 pts - 1 pt each)

INCREASED TEMPERATURE: changes composition of flora communities resulting in the loss of nutritionally important plant species

WETTER SEASONS: changes composition of flora communities resulting in the loss of nutritionally important plant species

DEEPER SNOW PACK: reduces availability of food,

INCREASED UV: reduces nutritional content of forage

3) Decreased snow depth, earlier ice break-up (1 pt - 0.5 each)

4) Any 1 of the following: Reduced tourism; reduced sport hunts (and therefore additional income from guiding and outfitting) (1 pt)

5) Any 1 of the following: Warmer temperatures leading to breeding earlier and the production of fewer eggs; More rain and snow over winter leading to the production of more eggs (1 pt)

Reference:

1) *Climate Change in the North, p. 53-55*

2a)-2c) *Climate Change in the North, p. 53*

3) *Climate Change in the North, p. 54*

4) *Climate Change in the North, p. 54-55*

5) *Climate Change in the North, p. 58*



STOP 2

THEME (2 pts)

Name two (2) existing adaptations of northern infrastructure that reduce impacts of ground disturbance, and briefly explain how each can be adapted further to respond to climate change. (2 pts – 0.5 pt each)

<u>Existing Adaptation</u>	<u>Further Adaptation</u>

Answer:

Any 2 of the following pairs (0.5 pt each infrastructure, 0.5 pt each further adaptation):
The use of pile foundations - may need to be deeper to account for climate change and loss of permafrost
Insulation of the ground surface - which may require thicker gravel pads
Clearance of snow to promote colder winter ground temperatures - may need to be used more often
Artificial cooling to ensure foundation soils remain frozen - increase use

Reference:

Climate Change in the North, p. 47

STOP 3

THEME (10 pts)

This question requires materials provided at the stop or in the back of the test binder.

1) Refer to the graph labelled T-A. This graph provides information about Arctic sea ice based on satellite measurements.



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- a) What information about Arctic sea ice is conveyed by the graph? (2 pts)
 - b) Describe any trend(s) you see in the graph. (1 pt)
 - c) Roughly how many square kilometers of Arctic sea ice were there in September 1979? (0.5 pt)
 - d) Roughly how many square kilometers of Arctic sea ice were there in September 2017? (0.5 pt)
- 2) Briefly describe four (4) observed and/or potential impacts of the trend(s) shown in the graph? (4 pts)
- 3) Describe a feedback mechanism involved in Arctic sea ice changes shown in the graph labelled T-A. (2 pts)

Answer:

1a) Average monthly (0.5 pt) arctic sea ice extent (0.5 pt) for September (0.5 pt) from 1979-2017 (0.5 pt)

1b) A decline in average September arctic sea ice extent between 1979 and 2017 (1 pt)

1c) between 7 million and 8 million square kilometers in 1979 (0.5 pt)

1d) between 4 million and 5 million square kilometers in 2017 (0.5 pt)

2) Any 4 of the following: less albedo (i.e. reflection of solar energy) leading to arctic warming; a longer shipping season; more mining activity; more oil and gas extraction; more tourist activity; more commercial fishing; more mobile sea ice leading to shipping hazards; more coastal erosion; more evaporation from ice-free ocean; more precipitation; more extreme weather; increased occurrence of algal blooms; altered ranges for arctic species; changing diets among marine mammals; declines in some or all polar bear populations; difficulty for people hunting or travelling to hunting grounds (4 pts - 1 pt each)

3) A warming feedback mechanism exists between the decline in sea ice and a warming atmosphere due a decline in reflectivity or albedo as ice melts (0.5 pt). As reflective surfaces like sea ice are replaced by darker surfaces such as open water (0.5 pt), less solar energy is radiated back to space and the region warms further (0.5 pt), leading to still more melting (0.5 pt).

Reference:

1) Ability to interpret graph

2) Climate Change in the North, p. 24, 40, 48, 54, 69, 73, 76

3) Climate Change in the North, p. 43, 76



STOP 4

THEME (2 pts)

This question requires features found at the stop.

- 1) What ecozone is Churchill situated in? (0.5 pt)
- 2) Look at the landscape around you. Identify one (1) landform typical of Churchill's ecozone. (0.5 pt)
- 3) **True/False:** Indicate whether each statement is true (T) or false (F) by circling the correct answer. (1 pt - 0.5 pt each)
 - T F Over the past 50 years, there has been an overall trend of increasing snow precipitation in the Arctic.
 - T F Some Arctic lakes have dried up due to increased evaporation and increased duration of ice cover.

Answer:

- 1) Taiga Shield (0.5 pt)
- 2) Any 1 of the following: rolling terrain with uplands, wetlands, many lakes (0.5 pt)
- 3) T, F (1 pt - 0.5 pt each)

Reference:

- 1)-2) *Climate Change in the North, p. 14*
- 3) *Climate Change in the North, p. 34*

STOP 5

THEME (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) The diagram labelled T-D shows the Arctic water cycle. Use the diagram to answer the following questions.
 - a) What component of the water cycle exerts a major control on climate due to its capacity to absorb large amounts of solar energy? (0.5 pt)
 - b) What provides the energy that drives the Earth's climate? (0.5 pts)
- 2) Much of the land in the diagram labelled T-D is coloured white.



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- a) Briefly explain the effect of light coloured snow and ice on the climate system. (0.5 pt)
- b) Briefly explain how this effect might be affected by climate change. (0.5 pt)

Answer:

1a) ocean (0.5 pt)

1b) the Sun (0.5 pt)

2a) Light-coloured surfaces reflect solar energy back into space, reducing warming on Earth. (0.5 pt)

2b) Climate change may melt snow and ice, replacing light coloured surface with darker surfaces such as open water or land, leading to increased warming and more melting. (0.5 pt)

Reference:

1) Climate Change in the North, p. 11

2) Climate Change in the North, p. 43

STOP 6

THEME (2 pts)

- 1) Which of the following statements is correct? Circle the best response. (0.5 pt)
 - a) Warmer temperatures may allow invading species to survive and reproduce, causing an increase of native biota and serious impairment of traditional hunting and fishing practices.
 - b) Warmer temperatures may allow invading species to survive and reproduce, causing the extinction of native biota and serious impairment of traditional hunting and fishing practices.
 - c) Warmer temperatures may allow native species to survive and reproduce, causing an increase of invasive species and serious impairment of traditional hunting and fishing practices.
 - d) Warmer temperatures may allow native species to survive and reproduce, causing the extinction of invasive species and serious impairment of traditional hunting and fishing practices.
- 2) The spruce bark beetle is a naturally occurring forest pest that has lead to widespread mortality of white spruce in the southwestern Yukon. Identify one (1) way each of the following factors contributes to the infestation of this forest pest. (1.5 pts – 0.5 pt each)
 - a) warmer winters
 - b) warmer summers
 - c) drier summers



Answer:

- 1) *b (0.5 pt)*
- 2a) *increase in winter survival of the beetles (0.5 pt)*
- 2b) *warm temperatures enable spruce bark beetles to complete life cycle in 1 year (0.5 pt)*
- 2c) *drought stress reduces the ability of white spruce to resist insect attack (0.5 pt)*

Reference:

- 1) *Climate Change in the North, p. 36*
- 2) *Climate Change in the North, p. 51*

STOP 7

THEME (2 pts)

- 1) Rapid changes in climate can be particularly problematic for terrestrial birds. Increasing temperatures can directly affect birds by forcing them to use more energy for thermoregulation. List two (2) other reasons why increasing temperatures may be problematic for birds. (1 pt)
- 2) Gray Jays, as seen around the Churchill region, are a species that is particularly vulnerable to the impacts of climatic warming. Recent research, like that carried out around the Churchill Northern Studies Centre, has found two interconnected issues that may pose a serious threat to the long term survival of Gray Jays as a result of a changing climate. What are these two (2) issues? (1 pt)

Answer:

- 1) *Any 2 of the following: disrupt their maintenance (e.g., basal activity and condition), reproduction, timing of breeding, timing of migration, reduce survival, reduce fitness, etc. (1 pt - 0.5 pts each)*
- 2) *Gray jays rely on hoarding perishable food items which requires consistently cold temperatures. (0.5 pt) Gray jays also have reduced reproductive performance after warmer winters. (0.5 pt)*

Reference:

- 1) *Climate Change in the North, p. 59*
- 2) *Climate Change in the North, p. 60, 61*

STOP 8

THEME (2 pts)

List four (4) impacts of melting permafrost. (2 pts)



Answer:

Any 4 of the following (2 pts - 0.5 pts each): increased surface water, so larger ponds and lakes; release of methane and carbon dioxide to atmosphere; increased depth of active layer; ground instability; landslides; damage to infrastructure, such as tilting of buildings or breaking up of roads; drunken forest effect due to trees falling over in unstable soils ; increased coastal erosion; increased and enhanced greenhouse gas emissions from cryosolic and organic soils; increased microbial activity in organic soils which further increases breakdown of plant material to greenhouse gases; drying of organic soils; increased fire susceptibility of organic soils and forests; decrease in the amount of continuous permafrost (from year to year); decreased habitat for northern arctic species; decreased ease of travel for hunting due to unstable surface conditions

Reference:

Climate Change in the North, p. 29, 30, 31

STOP 9

THEME (2 pts)

- 1) Briefly explain Permafrost Carbon Feedback. (1 pt)
- 2) What is the active layer in permafrost? (0.5 pt)
- 3) Circle the word inside the parentheses which completes the sentence correctly.

Permafrost Carbon Feedback (**increases / decreases**) the thickness of the active layer. (0.5 pt)

Answer:

- 1) *Permafrost Carbon Feedback is the release of greenhouse gases and enhancement of global warming through the increased thawing of the surface permafrost. (1 pt)*
Partial marks: 0.5 pt - missing "enhancement of global warming" or "release of greenhouse gases"
- 2) *the top layer of the permafrost where the freeze-thaw cycle occurs. (0.5 pt)*
- 3) *Increases (0.5 pt)*

Reference:

1)-3) Climate Change in the North, p. 31 & 32

STOP 10

THEME (2 pts)

- 1) The cryosphere is an important part of Arctic ecosystems.



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a) Define CRYOSPHERE. (0.5 pt)

b) Give an example of a component of the cryosphere. (0.5 pt)

2) An increase in temperatures associated with climate change affects ablation in Northern Canada.

a) Define ABLATION. (0.5 pt)

b) Give an example of one way a change in ablation may affect the water cycle in Northern Canada. (1 pt)

Answer:

1a) Places where water is in its solid form, frozen into ice or snow (0.5 pt)

1b) Any 1 of the following: ice sheets, glaciers, ice caps, sea ice, snow, permafrost (0.5 pt).

2a) The removal of snow and ice by melting or evaporation, typically from a glacier or iceberg (0.5 pt).

2b) Any 1 of the following: increase in ablation rates changes the magnitude and timing of river flow and drainage patterns, contributes to rising sea levels, affects ocean circulation and weather patterns, increase in wetland presence in the North. (0.5 pt)

Reference:

1a)-1b) *Climate Change in the North*, p. 82

2a) *Climate Change in the North*, p. 82

2b) *Climate Change in the North*, p. 15, 16, 25

STOP 11

THEME (2 pts)

True/False: Indicate whether the following statements are true (T) or false (F) by circling the correct answer. (2 pts - 0.5 pts each)

T F Most of the peatlands in North America are located in the short grass prairie region.

T F Northern peatlands have been building carbon approximately 9000 years.

T F Cryosolic peatland soils contain approximately twice the amount of nitrogen compared to the atmosphere.

T F The layer of soil where thawing occurs is known as the cryoturbation layer.

Answer:

F, T, F, F (2 pts - 0.5 pts each)



Reference:

Climate Change in the North, p. 30-31

STOP 12

THEME (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

1) Look at the diagram labelled T-F.

- a) Name the phenomenon illustrated in the diagram. (0.5 pt)
- b) Briefly explain the phenomenon. (1.0 pt)

2) Give one (1) example of a human activity that influences the phenomenon you described in question 1. (0.5 pt)

Answer:

1a) greenhouse effect (0.5 pt)

1b) heat-trapping gases in the atmosphere keep the earth's surface warm by absorbing and releasing solar energy (1 pt)

2) Any 1 of the following: burning fossil fuels, releasing chemicals into the atmosphere, reducing the amount of forest cover, rapid expansion of development and industry (0.5 pt)

Reference:

1) Climate Change in the North, p. 11, 12

2) Climate Change in the North, p. 65

STOP 13

THEME (2 pts)

Briefly describe two (2) impacts on northern communities caused by early break up of ice roads and traditional routes. (2 pts)

Answer:

Any 2 of the following: Reduces the economic value of remote communities and industries; Reduces access to traditional hunting and fishing areas; Increases the difficulty of resupplying northern communities and industrial sites; Requires greater flexibility in scheduling of extraction and exploration for oil and gas and mining companies; Creates dangerous travel conditions for freight haulers and/or residents of northern communities (2 pts - 1 pt each)



Reference:

Climate Change in the North, p. 36, 48, 49

STOP 14

THEME (10 pts)

This question requires BOTH features AND materials found at the stop or in the back of the test binder.

From this stop, you can see an old weather monitoring station.

- 1) Explain the difference between weather and climate. (2 pts)
- 2) Our understanding of the climate system is improved through observations, theoretical studies, and modelling.
 - a) Briefly explain how climate models are constructed and why they are useful. (2 pts)
 - b) Name two (2) aspects of climate change that could be studied using climate modeling. (1 pt)
- 3) Using the climate maps labelled T-B and T-C, answer the following questions.
 - a) What projected climate information do these maps illustrate? (1 pt)
 - b) What conclusion can you draw about northern regions of Canada compared to the southern regions? (1 pt)
 - c) Compare the two maps. What is the difference in trends between the two months? (1 pt)
- 4) Climate models are never entirely accurate. One factor that influences the accuracy of a model is the quality of the observed data used to create the model. Provide two (2) possible reasons that models may not accurately represent the real world. (2 pts)

Answer:

- 1) *Weather is the minute-by-minute variable condition of the atmosphere on a local scale. (1 pt); Climate is a conceptual description of an area's average weather conditions and the extent to which those conditions vary over long time intervals. (1 pt)*
- 2a) *Observations, experiments, theory and collected climate data are used to construct computer models (1 pt); Models represent the climate system and make help us predictions about its future behaviour. (1 pt)*
- 2b) *Any 2 of the following: Temperature, precipitation, sea ice, disease, species range, storms, floods, drought, gas emissions (1 pt)*



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- 3a) Projected change in mean temperature relative to mean temperatures between 1976 to 2005 (1 pt)
3b) Increased warming in northern regions compared to southern regions (1 pt)
3c) December is expected to warm much more than the month of June (1 pt)
4) Any 2 of the following: There are temporal gaps in the raw weather station data; there are large geographic distances between weather stations; there are mountains present; there are large contrasts in microclimate inside of a 10km by 10km region (2 pts - 1 pt each)

Reference:

- 1) *Climate Change in the North*, p. 19
2a) *Climate Change in the North*, p. 44
2b) *Climate Change in the North*, p. 24, 26, 34, 60, 62, 67, 77
3a)-3b) *Climate Change in the North*, p. 78
3c) *Climate Change in the North*, p. 79
4) *Climate Change in the North*, p. 78

STOP 15

THEME (2 pts)

- 1) A climate-literate person _____. Circle the best response. (0.5 pt)
- a) understands the essential principles of Earth's climate system
 - b) knows how to assess scientifically credible information about climate
 - c) communicates about climate and climate change in a meaningful way
 - d) makes informed and responsible decisions with regard to actions that may affect climate
 - e) all of the above
- 2) The physical impacts of climate change on the environment may also affect the mental health well-being of northern residents whose ways of life are connected to the local environment. List three (3) forms of social disruption that may occur as a result of climate change. (1.5 pts)

Answer:

- 1) e (0.5 pt)
2) *Disruption of traditional hunting cycles and patterns (0.5 pt), reduced ability of elders to predict weather and provide information to others in the community (0.5 pt), concern over losses of cemeteries and homes due to coastal erosion (0.5 pt)*

Reference:

- 1) *Climate Change in the North*, p. 74
2) *Climate Change in the North*, p. 72



STOP 1

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Examine Diagram A-F of the hydrological cycle. Note that three of the cycle's process labels have been erased and replaced by letters A, B, and C.

1) Beside each of the letters below, write the name of the process represented by that letter in the diagram. (1.5 pt - 0.5 pt each)

A _____

B _____

C _____

2) Which of these three processes would be affected most in a region of permafrost? (0.5 pt)

Answer:

1) A - Precipitation (0.5 pt), B - groundwater flow (0.5 pt), C - transpiration (0.5 pt)

2) Groundwater Flow (0.5 pt)

Reference:

Aquatic Ecology, p 5

STOP 2

WATER AND AQUATIC ECOLOGY (10 pts)

1) The Hudson Bay receives three main sources of freshwater, including precipitation, melting sea ice and inflows from a number of rivers. During the summer months, what source contributes the highest volume of freshwater in the bay? (0.5 pt)

2) Hudson Bay is a huge inland sea.

True/False: Indicate whether the following statements are true (T) or false (F) by circling the correct answer. (2 pts - 0.5 pt each)

T F Hudson Bay has 100% ice cover during the winter months.

T F Maximum ice coverage occurs in mid-April to early May.

T F Sea ice has concentrated levels of salt.



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T F Ice formation in the bay begins in the southern part and freezes northward.

3) As freshwater flows into Hudson Bay, it mixes with salt water from the sea. This mixing goes on throughout the year.

a) As this water stratifies, where would you expect to find the layer of freshwater? (1 pt)

b) How often does turnover of the deep water occur? Circle the best response. (0.5 pt)

- i) 1 – 2 years
- ii) 4 – 14 years
- iii) 7 – 35 years
- iv) 60 + years

c) When a river flows into the ocean, fresh water mixes with salt water and creates a unique, shallow ecosystem containing brackish water. What is this ecosystem called? (0.5 pt)

4) The Hudson Bay Lowlands are home to a number of peatlands. Briefly describe two (2) differences between fens and bogs? (2 pts)

5) Around Hudson Bay, warm, moist air from the land can move over the colder sea water of the Bay. Briefly describe one (1) atmospheric process you would expect to occur when this happens. (1 pt)

6) Two people are boiling water for dinner, one person is located in Churchill (at sea level) while one person is located in Colorado (5,280 feet above sea level). Whose water will have a lower boiling point? (1 pt)

7) The cold climate in northern Canada slows down many processes in the hydrologic cycle. For example, in the Northwest Territories and Nunavut, water bodies remain ice-covered for six to ten months of the year.

a) Does evaporation from water bodies increase or decrease when they are ice-covered? (0.5 pt)

b) Give one (1) reason for for this increase/decrease. (1 pt)

Answer:

1) Melting sea ice (0.5 pt)

2) F, T, F, F (2 pts – 0.5 pt each)

3a) Fresh water will remain above the salt water in a shallow layer. (1 pt)

3b) ii (0.5 pt)

3c) estuary (0.5 pt); no points for "delta"



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4) Any 2 of the following: Fens have higher nutrient levels than bogs; Fens are more productive than bogs; Bogs are strongly acidic, while fens may be acidic or alkaline; Bogs are peat-covered wetlands, while fens are dominated by sedges. (2 pts - 1 pt each)

5) Moisture from the warm land air would condense when it reaches the colder air over the sea and form a fog (1 pt).

Partial marks: Water fog or sea fog (0.5 pt)

6) The person located in Colorado (1 pt)

7a) decrease (0.5 pt)

7b) The liquid water is trapped under the ice and therefore cannot evaporate into the air. Some water may enter the atmosphere directly through the ice through the process of sublimation, but it will be much less than during the open-water season. (1 pt).

Reference:

1) Churchill Hudson Bay – A Guide to Natural and Cultural Heritage, p 152

2) Churchill Hudson Bay – A Guide to Natural and Cultural Heritage, p 152 – 155

3) Churchill Hudson Bay – A Guide to Natural and Cultural Heritage, p 152 – 153

4) Churchill Hudson Bay, p 175-176; Aquatic Ecology, p 23-24

5) Churchill Hudson Bay, p 139; Aquatic Ecology, p 3

6) Aquatic Ecology, p 3

7) Aquatic Ecology, p 13, hydrologic cycle document

STOP 3

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Not far from you is the Churchill River Estuary. It is the transition zone between the freshwater ecosystem of the Churchill River and the marine ecosystem of Hudson Bay. At high tide salt water enters the river and sits below the less-dense fresh water. Offshore, seawater is vertically stratified with a fresh water plume from the River extending several kilometers into the Bay. Stratification due to density can influence mixing and the distribution of nutrients. Also, aquatic biota may be restricted in their habitats due salinity tolerance.

Determine the salinity of the 2 water samples in the graduated cylinders labeled A-L and A-M using the following instructions.

Directions:

Measure the temperature, to the nearest whole degree, of the water in cylinders A-L and A-M using the thermometers provided. Record in the table below.

Measure the specific gravity each sample (A-L and A-M) by reading the scale inside the stem of the hydrometer floating in each cylinder. Record in the table below.



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Note: Take your readings where the surface of the water touches the scale. Document A-N shows a diagram of the scale on the hydrometer to help you read it. It starts at 1.000 at the top of the stem and is labeled every 0.005 with tics every 0.001.

Use Table A-O to convert your temperature and specific gravity measurements into salinity in parts per thousand (ppt). Look for your specific gravity reading in the column labeled 'Observed Reading'. Follow across to the column with the temperature that you measured and get the salinity value.

<u>Parameter</u>	<u>Sample A-L</u>	<u>Sample A-M</u>
Temperature	°C	°C
Specific gravity	(0.5 pt)	(0.5 pt)
Salinity	ppt (0.5 pt)	ppt (0.5 pt)

Answer:

1) TBD at time of test. (2 pts - 0.5 pt for each correct specific gravity reading; 0.5 pt for each correct conversion to salinity; no points for temperature)

Reference:

1) Video training; Provincial training

STOP 4

WATER AND AQUATIC ECOLOGY (2 pts)

In 2009, Canadians used an average of 274 liters of water per day. Listed below are broad categories of household water use.

Matching: Match the water use categories with the percentages of total household water use that they account for by drawing a line between appropriate pairs. (2 pts - 0.5 pt each)



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<u>Water use categories</u>	<u>Percent of total water use</u>
laundry	35%
kitchen/cleaning	30%
showers and bathing	20%
flushing toilets	15%

Answer:

laundry - 20 % (0.5 pt)

kitchen/cleaning - 15 % (0.5 pt)

showers and bathing - 35% (0.5 pt)

flushing toilets - 30 % (0.5 pt)

Reference:

Aquatic Ecology Document, p 60

STOP 5

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Hydroelectric power generation is the single greatest source of electricity in Manitoba and Canada. It is generally referred to as an "instream" use of water because the water is not removed from the river where it is used. Churchill River water is used by Manitoba Hydro for electricity generation, but this water is permanently removed from the Churchill. Since 1977, Manitoba Hydro has redirected, on average, 60% of the flow of the Churchill River into the Nelson River where it is used to help power the generating stations on the Nelson. Information sheet A-G shows how this is done.

1) Briefly describe one (1) advantage for human usage arising from the diversion of Churchill River water into the Nelson. (1 pt)

2) Briefly describe one (1) ecological concern arising from removal of so much of the flow from the lower Churchill River, downstream from the diversion site at Southern Indian Lake. (1 pt)

Answer:

1) Any 1 of the following, or similar reasons: Financial savings from not building generating plants on the Churchill; More efficient use of the existing power plants on the Nelson River:



Shorter distances to transmit electrical power to southern populations; Cost savings from not needing to build new roads to access potential generating sites along the Churchill. (1 pt)
2) *Any 1 of the following, or similar reasons: Reduced flows can impact fish populations and/or migrations in the lower river; Lower flows may result in less food and/or nutrients reaching the Churchill estuary for use by Beluga whales and other wildlife; Increased production of methyl mercury in flooded Southern Indian Lake and subsequent contamination of fish populations; Lower flows reaching the estuary may result in colder water temperatures and lower productivity during the summer months. (1 pt)*

Reference:

1)-2) *Aquatic Ecology, p 51-52.*

STOP 6

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) Identify the aquatic invasive species in the photo labeled A-J. (1 pt)
- 2) List two (2) characteristics that contribute to the success of this species. (1 pt)

Answer:

- 1) *Rusty crayfish (1 pt)*
- 2) *Any 2 of the following: Few natural enemies, high reproductive rates, high survival/ tolerance, good dispersal, aggressive competitors (1 pt - 0.5 pt each)*

Reference:

- 1) *Aquatic Invasive Species p 14*
- 2) *Aquatic Invasive Species p 1-2*

STOP 7

WATER AND AQUATIC ECOLOGY (2 pts)

Scientists at the International Institute for Sustainable Development have been conducting nutrient-bioenergy research in the Netley-Libau Marsh, located where the Red River enters Lake Winnipeg. Part of this research has investigated the feasibility of regularly harvesting the leaf and stem portions of cattails from this large marsh.

- 1) What term do scientists use for the algal problem currently plaguing Lake Winnipeg during mid to late summer? (0.5 pt)
- 2) Which nutrient is primarily responsible for causing this condition? (0.5 pt)



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3) Briefly explain how harvesting cattails from the Netley-Libau Marsh might help to reduce the amount of this nutrient that reaches Lake Winnipeg. (1 pt)

Answer:

- 1) eutrophication or algal bloom (0.5 pt)
- 2) Phosphorus or phosphate (0.5 pt)
- 3) Cattails accumulate phosphorus during the growing season. When the cattails die back and decompose, this phosphorus is released back to the water and sediments. Removal of cattail vegetation prior to decomposition would also remove phosphorus and prevent it from moving into the lake. (1 pt)

Reference:

- 1) Lake Ecology p 35
- 2) general knowledge; Lake Ecology p 18
- 3) ability to reason and interpret information

STOP 8

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Examine the maps on sheet A-H. Note that the upper map on this sheet is a portion of a 1:50,000 scale topographic map of a region in the Boreal Shield where there are many small lakes. The lower map shows the bathymetric contours of one of these lakes located near the centre of the upper map. The numbers on the contour lines on both maps are in meters.

- 1) What is the contour interval of the upper map in meters? (0.5 pt)
- 2) What is the contour interval of the lower (bathymetric) map in meters? (0.5 pt)
- 3) What is the maximum depth of the lake shown in the lower map? (0.5 pt)
- 4) What is the total change in elevation from the deepest place at the bottom of the lake to the highest ridge forming the lake's drainage basin boundary in meters? (0.5 pt)

Answer:

- 1) 10 meters (0.5 pt)
- 2) 4 meters (0.5 pt)
- 3) 34 (32-36 accepted) meters (0.5 pt); no partial marks
- 4) 86 (80-92 accepted) meters (0.5 pt); no partial marks

Reference:

Mapping fact sheet, pages 1, 4.



STOP 9

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires BOTH features AND materials found at the stop or in the back of the test binder.

Note the wetland terrain at this stop. Often called "peatland", it is typical of a large part of the Hudson Bay Lowlands. Document A-I, shows this site last fall before freeze-up.

Wetlands form an important habitat group that has been subdivided into five habitat types.

- 1) Which of these five habitat type best describes the wetland adjacent to this stop? (0.5 pt)
- 2) What kind of moss characterizes this wetland type? (0.5 pt)
- 3) **True/False:** *Indicate whether each statement is true (T) or false (F) by circling the correct answer. (1 pt - 0.5 pt each)*
 - T F Wetlands of this type are characterized by a high water table.
 - T F Wetlands of this type are relatively nutrient rich.

Answer:

- 1) bogs (0.5 pt)
- 2) sphagnum (0.5 pt)
- 3) T, F (1 pt - 0.5 pt each)

Reference:

- 1)-3) *Aquatic Ecology, page 23*

STOP 10

WATER AND AQUATIC ECOLOGY (2 pts)

The lower Churchill River has been important to Churchillians as an historic travel route, as their potable water source, as a place of recreation and for subsistence harvesting. While Churchill relies on surface water as a source for drinking water, a number of other areas in Manitoba rely on groundwater. List four (4) major contaminants that could impact a town's groundwater supply. (2 pts)

Answer:

Any 4 of the following: Landfills, leaking gasoline storage tanks, leaking septic tanks, accidental spills, infiltration from farm land treated with pesticides and fertilizer, road salt, petroleum



products leaking from underground storage tanks, overabundance of naturally occurring iron, sulphides, manganese, and substances such as arsenic. (2 pts – 0.5 pt each)

Reference:

Aquatic Ecology, p 72 – 76

STOP 11

WATER AND AQUATIC ECOLOGY (10 pts)

This question requires materials provided at the stop or in the back of the test binder.

1) Follow the directions below to determine the amount of nitrate in a sample representing water from a Hudson Bay Lowland pond shortly after a runoff event.

Directions:

Remove your sunglasses. Put on safety goggles and gloves.

Use the sample water labeled A-E. Follow the instruction on the laminated card labeled Nitrate (reverse side of colour chart) to do the test.

Continue with questions 2-4 while waiting for the test to complete.

Use the colour chart on the laminated card to determine the amount of nitrate in the pond water. If the colour you obtain is between colours on the chart, report your result halfway between the numbers on the chart.

- a) Concentration of nitrate in the pond water is _____ ppm. (2.5 pts)
- b) Write in words what the abbreviation 'ppm' stands for. (0.5 pt)
- 2) Why is it important to measure nitrate in a water quality monitoring program? (1 pt)
- 3) Nitrogen movement from the air and through the aquatic and terrestrial ecosystems is complex. Use Diagram A-P of the Nitrogen Cycle to help you answer the following questions.

Multiple Choice: *Which of the choices is correct? Circle the best response. (4 pts- 1 pt each)*

- a) In an aquatic ecosystem, which organism can use nitrogen (N₂) directly from the air?
- i) Phytoplankton
 - ii) Cyanobacteria
 - iii) Decomposers
 - iv) All of the above.



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- b) Which is a possible source of usable nitrogen for a Hudson Bay Lowland pond?
- i) Runoff from snow melt
 - ii) Goose Poop
 - iii) Melting Permafrost
 - iv) All of the above
- c) What is the name of the process that converts dead material into a usable form of nitrogen?
- i) Decomposition
 - ii) Denitrification
 - iii) Nitrification
 - iv) Relaxation
- d) How do fish get their nitrogen?
- i) By water passing over their gills
 - ii) By eating plankton
 - iii) By stirring up the sediment
 - iv) By going to McDonald's

4) In a recently published paper, researchers from the Churchill Northern Studies Centre studied nutrient cycling in ponds on the Hudson Bay Lowlands. They determined that the ponds had low nutrient levels and little algal biomass in the shallow water.

True/False: Indicate whether each statement is true (T) or False (F) by circling the correct answer. (2 pts - 0.5 pt each)

- T F The trophic state of these ponds is called eutrophic.
T F Look around you. The most likely source of nitrogen for the ponds is organic matter in the peat.
T F Nitrogen can be stored in sediments of ponds.
T F Geese droppings can contribute nitrogen to ponds in the Churchill area.

Answer:

1a) 20 ppm (2.5 pts)

Partial marks: 5-19 ppm (1 pt)

1b) parts per million (0.5 pt)

2) Any 1 of the following : NO_3 is a nutrient essential for plant growth/life; NO_3 taken up by plankton and aquatic plants in order to grow; high levels of NO_3 might cause algal blooms or excessive plant growth/eutrophication. (1 pt)

3a) ii (1 pt)

3b) iv (1 pt)



- 3c) i (1 pt)
- 3d) ii (1 pt)
- 4) F, T, T, T (2 pts - 0.5 pt each)

Reference:

- 1a) Training at Provincials; livestream training videos
- 1b) Water Quality document, p 10
- 2) Water Quality document, p 10-11
- 3a) Applying information in diagram; Water and Nutrient Cycles, p 4; Productivity of Freshwater Ecosystems, p 3
- 3b) Applying information in diagram; Water and Nutrient Cycles, p 4
- 3c) Water and Nutrient Cycles, p 4; Lake Ecology, p 33
- 3d) Lake Ecology, p 22-23
- 4) Lake Ecology, p 34, Livestream training 2018

STOP 12

WATER AND AQUATIC ECOLOGY (2 pts)

List two (2) of the three main structural forms of aquatic macrophytes and name one species which is an example of each form. (2 pts - 0.5 pt each)

<u>Form of macrophyte</u>	<u>Example</u>

Answer:

Any 2 of the following pairs: (2 pts - 0.5 pt each form and 0.5 pt each example)
 EMERGENT - any 1 of: cattails, bulrushes, rush, reed grass, arrowhead, giant bur-reed
 FLOATING - any 1 of: water smartweed, yellow water lily, star and lesser duckweed, common bladderwort, floating-leaf pondweed
 SUBMERGED - any 1 of: Canada waterweed, white waterbuttercup, mares tail, coontail, pondweed (richardson, flatstem, small-leaf, large-sheath, sago), narrow-leaves water-plantain

Reference:

Identifying Aquatic Plants



STOP 13

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) Use the Key to Manitoba Sport Fish to identify the species of fish A-A. (1 pt)
- 2) Based on the characteristics listed in the key, what is the difference between a lake trout and an arctic char? (1 pt)

Answer:

- 1) TBD (1 pt)
- 2) some variant of: lake trout have a deeply forked tail, while arctic char have a square or tightly notched tail (1 pt)

Reference:

- 1)-2) Key to Manitoba's Sport Fish

STOP 14

WATER AND AQUATIC ECOLOGY (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) Using the identification key provided, identify the invertebrate labeled A-K. Give the common name. (1 pt)
- 2) Many macroinvertebrates can be classified as benthic organisms. Name the two (2) key roles benthic organisms play within a food web. (1 pt)

Answer:

- 1) TBD (1 pt)
- 2) Consumers, decomposers (1 pt - 0.5 pt each)

Reference:

- 1) Identification Guide to Freshwater Macroinvertebrates
- 2) Understanding Lake Ecology, pg .31



STOP 15

WATER AND AQUATIC ECOLOGY (10 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) Algae are primary producers in marine and freshwater aquatic ecosystems, producing oxygen and carbohydrates through photosynthesis. List the two (2) ingredients that the algae use (in the presence of sunlight) to create these products. (1 pt)

- 2) Take a look at Diagram A-B, which illustrates the local food web in rivers and streams around Churchill.
 - a) Name the two (2) groups of organisms that feed on phytoplankton (1 pt).

 - b) What type of organism feeds on the two organisms you named in 2a? (0.5 pt).

- 3) Primary productivity varies between ecosystems, depending on a number of factors.
 - a) Is primary productivity in the ecosystem around Churchill lower or higher than ecosystems in more southern areas of Canada? (0.5 pt)

 - b) Give one (1) reason for this difference (1 pt).

- 4) Researchers often analyze stable isotopes of carbon and nitrogen in organisms in a food web to determine their trophic status. The rule is, the higher the nitrogen value, the higher that organism is in the food web. For example, a lake trout will have a higher nitrogen value than a zooplankton. Keeping this information in mind, look at Figure A-C. Using the shapes as organism names, list the organisms from lowest to highest trophic level. (2 pts)

- 5) Sea ice in Hudson Bay plays a critical role in supporting the entire marine food web. In the space below, draw a marine food chain that is representative of the organisms you might see in Hudson Bay. Start with sea-ice microalgae at the base of the food chain, and show organisms at four (4) additional trophic levels. Make sure you end your food chain with a top predator organism. (2.5 pts).

- 6) The aquatic ecosystem around Churchill includes both marine and freshwater areas. If a fish is ANADROMOUS, where does it live? (1 pt)

- 7) What type of aquatic organism would the piece of equipment labeled A-D be used to sample? (0.5 pt)

Answer:

- 1) Carbon dioxide and water (1 pt - 0.5 pt each)



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- 2a) benthic invertebrates, herbivorous zooplankton (1 pt - 0.5 pt each).
- 2b) planktivorous fish (0.5 pt).
- 3a) lower (0.5 pt)
- 3b) Any 1 of the following: less light in the north, less warmth/heat in the north (1 pt).
- 4) triangle, square, diamond, circle (2 pts – 0.5 pt each)
- 5) some variation of: microalgae, zooplankton, fish, seal, polar bear (or similar, at marker's discretion) (2.5 pt - 0.5 pt each).
- 6) Anadromous fish spend part of the year in fresh water bodies, and part of the year in the ocean (1 pt)
- 7) Any 1 of the following: plankton, phytoplankton, zooplankton (0.5 pt)

Reference:

- 1) Lake ecology, p 24
- 2) ability to follow instructions and read an infographic
- 3) Churchill Hudson Bay book, p 156-158, general knowledge of northern climates
- 4) ability to follow instructions and interpret a graph
- 5) Churchill Hudson Bay book, p 169-170
- 6) Churchill Hudson Bay book, p 324
- 7) Aquatic Sampling Techniques, p 5

STOP 1

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

You are Detective G. Rizzly and you have come across the scene of a violent attack on the northern landscape. Using your best CSI skills, look at the "clues" you can see within the crime scene, identify who was involved, and how they fit into the local "criminal" ecosystem. (2 pts)

- 1) What trophic level does each of these animals belong to in this scenerio? (1 pt - 0.5 pt each)

W-K _____

W-L _____

- 2) Draw a complete food chain connecting W-K and W-L to their surrounding ecosystem, and including at least two (2) other organisms. (1 pt)

Answer:

- 1) W-K: Primary Consumer (0.5 pt), W-L: Secondary Consumer (0.5 pt)
- 2) Any food chain that correctly relates the two identified animals in their appropriate order along the chain and includes 2 additional organisms in their appropriate order in the same chain. (1 pt)



Reference:

1)-2) *Mammals of Manitoba; Wildlife Training; Wildlife Document, pg. 35-37*

STOP 2

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) Using A Guide to Age Determination in White-tailed Deer provided at the stop, determine the age of the deer jaw labelled W-M. (1 pt)
- 2) Briefly explain why land managers gather the ages of deer that have been harvested each season. (1 pt)

Answer:

- 1) TBD (1pt)
- 2) *By gathering the data land managers can make informed decisions about deer management. (1 pt)*

Reference:

Texas Park and Wildlife Guide to Age Determination of White Tailed Deer

STOP 3

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

- 1) Identify the type of trap labeled W-J. (0.5 pt)
- 2) What fur bearing mammal may not be trapped by any leg-hold trap or snare device in the province of Manitoba? (0.5 pt)
- 3) Manitoba is divided into a number of trapping areas.
 - a) What trapping area does Churchill fall under? (0.5 pt)
 - b) What fur bearing mammal is unique to and may only be trapped in this trapping area? (0.5 pt)

Answer:

- 1) *Leg Hold Power Snare (0.5 pt)*
- 2) *Black Bear (0.5 pt)*
- 3a) *6A Barren Lands (RTL District) (0.5 pt)*



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3b) Arctic Fox (0.5 pt)

Reference:

1)-2) Manitoba Trapping Guide 2017, pg 22

3a) Manitoba Trapping Guide 2017, pg 4

3b) Manitoba Trapping Guide 2017, pg 5

STOP 4

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

1) Animals have different strategies to manage their heat budgets.

a) What is the key difference between an ectotherm and endotherm? (0.5 pt)

b) What is the key difference between an poikilotherm and homeotherm? (0.5 pt)

2) Many species of marine invertebrates and fish are homeothermic endotherms. How is this possible? (1 pt)

Answer:

1a) *Ecotherms gain heat from their environment but endotherms use metabolic (self produced) heat (0.5 pt).*

1b) *The internal temperature of poikilotherms vary widely, but homeotherms temperature remain relatively stable (0.5 pt).*

2) *These species gain their heat from their environment but the temperature of their environment remains relatively stable and so their body remains relatively stable, and therefore they are homeotherms (1 pt).*

Reference:

Wildlife Document, p 26 - 27

STOP 5

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

1) If a polar bear has been surprised at close range or shows signs of being agitated or threatened, what do you do? Circle the correct response(s). (1 pt)

a) Make yourself look big.

b) Back away quickly.

c) Be prepared to defend yourself

d) Use an air horn or a deterrent, if available



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2) What do you do if a polar bear charges you? (0.5 pt)

3) When is the most active polar bear season? (0.5 pt)

Answer:

1) *c, d (1 pt - 0.5 pt each)*

2) *Stand your ground and be prepared to fight. (0.5 pt)*

3) *Mid-summer to freeze-up (0.5 pt)*

Reference:

Safety in Polar Bear Country PDF

STOP 6

WILDLIFE AND WILDLIFE MANAGEMENT (10 pts)

1) Churchill is the home of many varieties of sea life. The beluga, *Delphinapterus leucas*, is one species that returns to this region yearly with its young.

- a) Describe two (2) adaptations this species has for living in the cold. (2 pts)
- b) What is the meaning of the beluga's scientific name, *Delphinapterus leucas*? (1 pt)
- c) What feature of this whale is the reason it has been given such a distinctive name? (1 pt)
- d) Give two (2) examples of how belugas were used historically. (2 pts)

2) Collared lemmings are another important species found in the Churchill region. Give one (1) example of their historic use in the region. (1 pt)

3) Cape Churchill caribou are an important ungulate species found within this area.

- a) Where are their calving grounds? (1 pt)
- b) Give two (2) reasons this group of caribou use this particular area for calving. (2 pts)

Answer:

1a) *A brief description of any 2 of the following: blubber, thick skin, hold its breath for long periods of time, skin colour, lack of dorsal fin, head shape, etc. (2 pts - 1 pt each)*

1b) *"the white dolphin without a wing" (1 pt)*

1c) *it is missing a dorsal fin (or it has a dorsal ridge instead of dorsal fin) (1 pt)*

1d) *Any 2 of the following: Food for humans (meat and muktuk), dog food/food for dog teams, oil for lanterns (2 pts - 1 pt each)*



- 2) Skin for bag for amulets (by the Inuit) (1 pt)
- 3a) Northeastern section of Wapusk National Park (1 pt)
- 3b) Good visibility from predators, good foraging areas (2 pts - 1 pt each)

Reference:

Churchill Hudson Bay: A guide to natural and cultural heritage (Lorraine Brandson), p 208-211, 253, 285

STOP 7

WILDLIFE AND WILDLIFE MANAGEMENT (10 pts)

This question requires BOTH features AND materials found at the stop or in the back of the test binder.

Walk around the stop. Search out and identify the wildlife and wildlife signs that are present. (10 pts - 1 pt each)

W-N _____

W-O _____

W-P _____

W-Q _____

W-R _____

W-S _____

W-T _____

W-U _____

W-V _____

W-W _____

Answer:

W-N: TBD

W-O: TBD

W-P: TBD

W-Q: TBD

W-R: TBD

W-S: TBD



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W-T: TBD
W-U: TBD
W-V: TBD
W-W: TBD

Reference:

Birds of Manitoba; Mammals of Manitoba; Wildlife Training

STOP 8

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

- 1) Describe the key differences between chionophores and chioneuphores. (1 pt)
- 2) Name the two (2) main kinds of anatomic adaptations of chionophiles. (1 pt)

Answer:

- 1) *Chionophores dislike snow, and venture out infrequently in the winter time (0.5 pt). Chioneuphores do not actively avoid snow, and carry on as normal during the winter time (0.5 pt).*
- 2) *Floaters (0.5 pt) and pelage changes (0.5 pt)*

Reference:

Wildlife in Winter Document, p 5-6

STOP 9

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

- 1) **True/False:** *Indicate whether each question is true (T) or false (F) by circling the correct answer. (1 pt - 0.5 pt each)*

- T F Female moose and caribou are the only female cervids with antlers.
T F Both moose and caribou typically live in herds

- 2) Both caribou and moose are well adapted to their habitats. Choose one (1) of these species. State the habitat where it lives, and briefly describe one (1) adaptation to that habitat. (1 pt)

Answer:

- 1) *F, F (1 pt - 0.5 pts each)*



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KEY

2) *CARIBOU* live in the arctic tundra and subarctic boreal forest. Adaptations include: have a white belly, neck, and area above their hooves, range in colour based on habitat, and migrating annually (0.5 pt for habitat and 0.5 pt any one of the adaptations). OR
MOOSE live in forested regions. Adaptations include: good swimmers, thick brown fur, long nose, long legs. (0.5 pt for habitat and 0.5 pt any one of the adaptations).

Reference:

Wildlife Document, p 25-26

STOP 10

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

With climate change, many species of wildlife that otherwise would not overlap are now sharing space. In the case of Polar Bears and Grizzly Bears, they are also interbreeding.

- 1) Briefly explain why hybrid grizzly-polar bears with more grizzly ancestry (3/4 grizzly and 1/4 polar) may affect the future of polar bears. (1 pt)
- 2) Will these hybrid bears be designated as a new species of bear? Briefly explain why or why not. (1 pt)

Answer:

- 1) *The dominance of grizzly DNA is a concern because polar bears' unique genetic traits allow them to live on sea ice and survive on a high fat diet of seals, and they might ultimately lose out to the dominant population of grizzlies. (1 pt)*
- 2) *No (0.5 pt); It would take somewhere in the order of hundreds of thousands of years for a new species to arise OR Hybrids can still mate with polars and grizzlies and produce fertile offspring. (0.5 pt)*

Reference:

Grizzly-Polar bear hybrids spotted in the Canadian Arctic

STOP 11

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

This question requires BOTH features AND materials provided at the stop or in the back of the test binder.

- 1) Identify the two (2) ducks in the pond labelled W-H and W-I using the field guide provided at the stop. (1 pt - 0.5 pt each)



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KEY

W-H _____

W-I _____

2) I am a 10-year-old girl from Churchill, MB. My dad has taken me and my 12-year-old cousin out hunting for ducks. We are all able to provide the correct documentation in order to legally hunt in the province of MB, but my 12-year-old cousin has decided NOT to purchase a regular migratory game bird permit and license, nor a wildlife habitat conservation stamp, in order to save on money. Between the three of us what is the number of ducks that we can legally harvest in regards to our daily limits and our possession limits in this designated area? (1 pt - 0.5 pt each)

Daily Limit _____

Possession Limit _____

Answer:

- 1) W-H Wigeon: (0.5 pt); W-I: Green Winged Teal (0.5 pt)
- 2) Daily Limit: 8 (0.5 pt); Possession Limit: 24 (0.5 pt)

Reference:

- 1) Ability to use a field guide and ability to interpret information
- 2) Manitoba Hunting Guide 2017, pg 9, 56

STOP 12

WILDLIFE AND WILDLIFE MANAGEMENT (10 pts)

This question requires BOTH features AND materials found at the stop or in the back of the test binder.

Your team is estimating the size of a closed population of southern red-backed voles. Individuals are being caught using Sherman live-traps, and released. During the first night of trapping, 20 individuals were trapped, marked and released. The data from the first two survey nights was recorded on the data sheet labelled W-Y.

Last night was the final night of trapping (Survey #3). The traps are found in the area marked by small metal flags. Plastic mice represent individual voles in the population. Voles that have been 'marked' are represented by mice marked by a large dot.

1) Look at the data sheet labelled W-Y to determine the total number of voles and the number of marked voles caught on 23 May and 24 May. Check the traps to see how many individuals were caught last night, and how many of them are marked. Record the data for all three survey nights in the chart below. (2 pts)



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Survey	Total number of voles caught	Number of marked voles caught
Survey #1 (23 May)		
Survey #2 (24 May)		
Survey #3 (25 May)		

2) Using the Peterson method, calculate the total population size (N) for each trial ($N=(MC)/R$) (3 pts - 1 pt each)

Survey #1

Survey #2

Survey #3

3) Calculate the average (mean) population of voles. (2 pts)

4) The survey is only catching a small number of individuals. Write the adjusted formula that corrects for the small sample size. (2 pts)

5) Mark recapture is only one of many methods used to estimate population size. List two (2) other field methods that can be used to estimate population size. (1 pt)

Answer:

1) Total number of voles: Survey #1: 15, Survey #2: 15 (0.5 pt for first #1 and #2); Survey #3: 15 (0.5 pt)

Marked voles: Survey #1: 5, Survey #2: 2 (0.5 pt for first #1 and #2); Survey #3: 6 (0.5 pt)

2) Calculated using the following formula: $N=(MC)/R$, where M = number of marked individuals, C = number of individuals captured in resampling, R = number of marked individuals recaptured in resampling

Survey #1 - 5 marked, $N=(20 \times 15)/5 = 60$ (1 pt)

Survey #2 - 2 marked, $N=(20 \times 15)/2 = 150$ (1 pt)

Survey #3 - 6 marked, $N=(20 \times 15)/6 = 50$ (1 pt)

3) (Sum of 3 estimated populations from question 2)/3 = $(60+150+50)/3 = 86.7$ (1 pt); rounded to whole number (as they are animals), 87 (1 pt)

4) Total (estimated) population size (N_c) corrected: $N_c = ((M+1) \times (C+1))/(R+1)$ (2 pts)

5) Any 2 of the following: complete census, quadrat sampling, transects (1 pt - 0.5 pt each)



Reference:

Wildlife Document, p 50-53

STOP 13

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

1) Using the Key to Invertebrates labelled W-X, identify the specimens labeled W-F and W-G to the most specific group possible. (1 pt - 0.5 pt each)

W-F _____

W-G _____

2) Give an example of another animal from the same phylum for each W-F and W-G. (1 pt - 0.5 pts each)

W-F _____

W-G _____

Answer:

1) W-F: Mollusca (0.5 pt)

W-G: Insect (0.5 pt)

2) W-F: Any 1 of the following: clams, snails, slugs, squid, and octopus, etc. (0.5 pt)

W-G: Any 1 of the following: crustaceans (lobsters and crabs), spiders, scorpions, and centipedes, etc. (0.5 pt)

Reference:

Wildlife Document, p 8-9

STOP 14

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Look at the skull labelled W-E.

1) Calculate the dental formula for Skull W-E. (1 pt)

2) Using the dental formula sheets and the skull plates provided, identify what species the skull belongs to based on the dental formula. (1 pt)



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Answer:

- 1) I 3/3, C 1/1. P 2/2, M 1/1 (0.5 pt) = 28 (0.5 pt)
- 2) Lynx (1 pt)

Reference:

- 1) Wildlife Document, p 16-21
- 2) Ability to use field guides; Wildlife Training

STOP 15

WILDLIFE AND WILDLIFE MANAGEMENT (2 pts)

This question requires materials provided at the stop or in the back of the test binder.

Identify the organs indicated by the pins flagged W-A, W-B, W-C and W-D . (2 pts - 0.5 pt each)

W-A _____

W-B _____

W-C _____

W-D _____

Answer:

- W-A Heart TBD (0.5 pt)
W-B Liver TBD (0.5 pt)
W-C Gizzard TBD (0.5 pt)
W-D Intestine TBD (0.5 pt)

Reference:

Wildlife Document, pg 15.