Diploma Programme
Programme du diplôme
Programa del Diploma

International Baccalaureate
Baccalauréat International
Bachillerato Internacional

Markscheme

November 2018

Environmental systems and societies

Standard level

Paper 1

9 pages

International Baccalaureate
Baccalauréat International
Bachillerato Internacional

1. *Possible ecosystems include:*
deciduous forest/maple forest/beech forest/temperate forest;
coniferous forest/boreal forest/taiga forest/spruce forest/pine forest;
lake;
river/stream;
meadow / beaver meadow;
marsh / beaver marsh;
pond / beaver pond;
wetlands;   **[1 max]**

Do not accept forest/wood as too general.
Do not accept biomes eg "taiga/tundra biome" or only "taiga".

2. coniferous/spruce/pine forests are found on soils underlain by sand and gravel / deciduous forest
are found in areas with less/little sand and gravel;
coniferous/spruce/pine forests are found at lower elevation/altitudes / deciduous
maple/beech forest are found at higher elevations/altitudes;
coniferous/spruce/pine forests are found in areas with less surface water/fewer lakes /
deciduous maple/beech forest are found in areas with more surface water/lakes;   **[2 max]**

3. (a) *Award **[1]** for 4 named species correctly identified as being in the same food chain and **[1]***
for arrows going in the correct direction.
For example:
spruce/maple tree → woodland jumping mouse → red fox → Algonquin wolf
spruce/maple → snowshoe hare → red fox → Algonquin wolf
spruce/maple → fairy moth → grey jay → northern saw whet owl;   **[2 max]**

Do not accept just "trees/vegetation".
Do not credit arrows if more than one set of arrows given eg illustrating waste/respiration.

(b) hunting/trapping/fishing removes species from the food chain / hunting of
beavers/moose reduces food availability to predators such as wolves/bears;
logging (forest management) removes species from food chain;
trampling (from tourist)/development of tourism facilities could reduce food
source/first trophic level;
introduced species, *eg* cats/dogs, add additional predators or prey;
removal of dams may lead to loss of pond species *eg* bullhead
lily/dragonfly/bullfrogs/pearl dace reducing food source for other species;
protection of wolves increases wolf numbers, thereby increasing predation on
beaver/moose/hare etc. reducing herbivore numbers;   **[2 max]**

Note: *For credit the human activity must be explicitly linked to effect on the food web.*
Do not credit if activity is only linked to habitat loss.
Do not accept "deforestation/agriculture or only "pollution".
Accept other reasonable responses.

4. (a) *Award [1 max] for changes in ONE nutrient:*
amount of carbon in sediments is 5 % higher in ponds/after construction of the dam /
carbon is 20% in pond and 15% in stream;
concentration of phosphate is higher by 1.1 mg kg^{-1} in ponds/after construction of the dam /
phosphate concentration is about 1.15mg kg^{-1} in the pond compared to about 0.05mg kg^{-1}
in both streams;
concentration of nitrate is higher by 0.75 mg kg^{-1} in ponds / nitrate concentration in pond is
2 mg kg^{-1} compared to 1.25mg kg^{-1} upstream/site A / nitrate concentration in pond is 2 mg
kg^{-1} compared to 0.25mg kg^{-1} downstream/site C;

Award [1 max] for changes in oxygen:
concentration of dissolved oxygen is lower by 9 ppm in ponds / oxygen concentration in pond
is 3ppm compared to 12 ppm upstream/downstream/after construction of the dam;
                                                                                            [2 max]

*Note: Figures do not need to be exact for nitrates or phosphates but some quantification is
required.*
Do not accept phosphate levels are negligible.

(b) dams reduce stream velocity/water flow creating ponds/marshes/additional habitat diversity /
beaver ponds create new habitats for different aquatic plants (which increases plant diversity);
dam could reduce (diversity of) river fish species / cause loss of brook trout species;
dams lead to loss of trees/terrestrial vegetation from flooding (reducing species diversity);
as flooded trees die more nesting sites are provided for birds (increasing species diversity);
when flooded trees die it decreases habitat availability for some organisms reducing species
diversity;
low levels of oxygen in the resultant pond could reduce fish diversity/aquatic species
diversity;
succession in meadow after dams collapse results in greater habitat diversity / when dams
collapse, beaver meadows create habitats which differ from the surrounding forest;   **[3 max]**

Accept other reasonable responses.
Do not accept only "trees die / speciation".

5. *Biotic [1 max]:*
increase in small bushes followed by trees / reforestation / plant diversity increases;
increase in (mammal) species more adapted to forests;
increase in animal diversity / increase in predation due to greater animal diversity;

Abiotic [1 max]:
reduction in soil moisture (as water is taken up by trees);
reduction in soil nitrogen / reduction in soil nutrients;
reduction in light penetration;
reduced temperature ranges due to greater shade in day;
increased humidity due to transpiration by trees/water channel/creation of river;   **[2 max]**

Do not accept only "change in vegetation/creation of new vegetation area".
Do not accept "increase in water turbidity" as meadow is not a water body.

6. use appropriate method/sampling device for identified abiotic factor *eg* use of thermometer to measure soil or air temperature / pH probe to measure pH value of soil / light sensor to measure light intensity / soil test kits to measure concentration of nutrients/nitrates/phosphates / hygrometer to measure humidity / use of soil moisture sensor/tensiometer / soil texture using different mesh size sieves;
use systematic sampling/interrupted belt transect/ take readings at regular intervals along transect;
repeat readings to obtain averages/increase reliability /take multiple readings to obtain average/increase reliability; **[3 max]**

7. (a) Award **[1]** for working/calculation and **[1]** for correct answer.
Working/calculation [1]
$500–19 = 481$, then $\frac{481}{500} \times 100$;

$(500–19)/500 \times 100$;
500 -- 100% then 19 ---- 3.8% followed by 100 - 3.8;
500 -- 100% then 19 ---- 3.8% followed by 481 ---- 96.2%;
500-19 = 481 then 500 -- 100% followed by 481 ---- 96.2%;
19/500 = 0.038 then 1-0.038 = 0.962;

Answer [1]
= 96 /96.2; **[2 max]**

(b) less demand for beaver pelts/fur / people no longer want to wear fur / change in fashion tastes / fur no longer considered beautiful;
changing attitudes towards hunting;
alternative materials available, *eg* synthetics developed;
glut in market (oversupply) from other areas reducing unit price / large number of beavers in 2015 resulted in cheaper pelts; **[1 max]**

Do not accept "almost extinct in 1900" since the two comparative dates are 1940 and 2015.
Do not accept "beavers are considered by IUCN as least concern".
Do not accept only "there has been an increase in numbers".

8. recognition of rights of First Nations to keep cultural traditions alive / part of cultural heritage of First Nations / food source for indigenous people;
population of beaver are high / populations are able to recover easily;
beavers are categorised as "Least Concern" on IUCN Red List;
hunting only occurs at a very small scale;
value of pelts is so low that trapping will be motivated by cultural influences rather than economic factors;
reduces damage to property/flooding caused by beavers/beavers cause economic damage;
provides income from hunting licences; **[1 max]**

Do not accept only "beavers cause damage / trapped by indigenous people / increases tourism / caught only during hunting season".

9.   (a)   beavers increase diversity of habitats with their dams which increases biodiversity;
opportunities for ecotourism as people can see the beavers;
beavers once lived in this area so this is ecosystem restoration;
additional food source for other species, *eg* wolves;
possible economic benefits if trapped for pelts;
increased genetic diversity of beaver population / can breed with other beavers and
increase beaver population;
to restore wetland habitat;   **[1 max]**

   Do not accept "beavers build dams that regulate water flow".

   (b)   increased damage to property (through gnawing wood);
flooding when beaver dams collapse / beaver dams can cause flooding;
increased conflicts between landowners and beavers;
upset/unbalance the food webs / outcompete other species / competition with other species;
impact on existing habitats / create short-term changes;
people are not used to them so will not know how to manage them;
poaching is a risk in a region with a high density of human population;
genetics of introduced population may be very different from that of original stock;
may not adapt well to new location and die;
may have no natural predator to limit population;   **[1 max]**

   Do not accept "beavers are an invasive/alien species".

10. (a)   beavers remain in lodges in winter so they are unavailable as a food source / harder for
            wolves to catch them / easier to spot beavers in summer when they are out of their lodges;
            other species (*eg* moose) are easier to catch in winter;
            other prey of wolves like snowshoe hare or foxes may be harder to catch in summer;
            young are out in summer and are more vulnerable/easily caught;
            density of population higher in summer following breeding;   **[1 max]**

            Do not accept only "beavers breed in the summer" or "beavers remain in lodges in winter".

      (b)   remote wilderness areas so hard for scientists to spot them easily / densely wooded so not
            easily visible from the air;
            large territorial range ($35\,km^2$)/highly mobile so hard to locate;
            wolves are nocturnal/hunt at night/sleep during the day and therefore difficult to spot;
            look very similar to coyotes so hard to identify accurately;
            lack of long-term records to use as baseline data;
            camouflaged so hard to see especially in winter;
            seasonal fluctuations in numbers;   **[2 max]**

            Do not accept "wolves are dangerous/predators/migrate".
            *Do not accept "wolves are mobile so use of quadrat method is not effective" or "use of
            capture, mark, release, recapture method is not suitable (as it may harm the wolves)".*
            Do not accept only "wolves look similar to coyotes / have large territorial range".

      (c)   if the range overlaps with areas outside of Algonquin Provincial Park, *ie* not protected, the
            wolf is at risk of being hunted / may be mistaken as coyotes in the buffer zone and killed by
            accident;
            genetic isolation may occur as there may be no mixing with wolf populations from outside of
            Algonquin Provincial Park;
            restricted gene pool can lead to less resistance to diseases;
            high population density increases risk of diseases spreading;
            wolves may end up competing for territory/food with each other leading to higher
            mortality/limiting population growth / increase in intraspecific competition;
            concentrated population is more prone to high losses during event of wildfires/natural
            disasters;   **[3 max]**

11.   *Ways in which Algonquin **IS** a model of sustainable management [4 marks max]:*
multiple nature reserve zones that protect different ecosystems/landscapes and species for future generations (environmental sustainability);
Algonquin Provincial Park is a large area (7630 km^2) allowing for greater biodiversity (environmental sustainability);
high level of biodiversity makes the area more resilient to change;
(low-impact) recreational uses are allowed accounting for the recreational needs of humans (social sustainability);
indigenous people are still allowed to trap in the park so First Nation rights have been respected (social sustainability);
trapping of beavers is allowed but only on a very small scale / only with ethical traps / hunting of beavers is controlled;
managing beaver population limits damage/flooding of other habitats;
hunting of wolves is prohibited;
park generates an income (economic sustainability) which can be reinvested in managing the park / used for further conservation measures;
no humans are allowed to live in the park to ensure that conflicts are avoided/minimised;
visitor centres are provided in a small part of the park reducing impact elsewhere;
visitor centres contribute to educating people about the park/conservation;
single access point to the park so visitor numbers can be controlled;
campsites are kept simple in wilderness areas so will not have a big impact on most wild areas;
one million visitors a year but still has very high rates of diversity suggesting they are doing a good job of managing it sustainably;
buffer zone around the park protects coyotes and wolves if they stray beyond the boundary;

*Ways in which Algonquin **IS NOT** a model of sustainable management [4 marks max]:*
trapping of beavers is still permitted and many people believe that animals should not be harmed (biorights);
boundary of park does not correspond with territorial ranges of wolves so once wolves step outside the buffer zone they may still be hunted or trapped by accident;
nature reserve is only 7 % of the area so potentially damaging economic activity is still allowed in 78 % of the park;
logging results in habitat destruction (hence conflicts with protection);
natural reserves are fragmented meaning populations might be isolated genetically;
major routeway (route 60) passes through the park so vehicles could hit and kill animals as they cross / roads fragment habitat / roads create a barrier for wildlife movement;
poaching is difficult to control as surrounding roads (Highways 17 and 11) increase access to more remote areas of park;
one million visitors a year is likely to have a big impact as it may be hard to enforce good behaviours, *eg* not littering, in remote parts of the park / recreational activities may still disrupt wildlife;
development zone is connected to a wilderness zone, so wilderness zone is likely to have heavy use;
development zone is located within wolf pack territory;

Conclusion/Appraisal *[1]*
For example:
Despite the number of protected areas within the park, the large number of visitors is likely to have an overall detrimental effect on its habitats and associated wildlife and therefore this park is not an ideal model of sustainable development;

Algonquin Provincial Park provides an excellent model of sustainable management by balancing the recreational/social/cultural needs of people (including the First Nation) whilst preserving the biodiversity of the area;

A valid conclusion should be credited if it is explicit, balanced (addresses both sides of the argument) and supported by evidence. Do not credit the conclusion if only one side of the argument has been considered within the overall response.

Award 5 max if there is no conclusion/opinion. **[6 max]**
Accept other reasonable responses supported by information in the resource booklet.
Do not accept 'protected designation prevents industrial/agricultural/urban development of area'.