INTERNATIONAL BACCALAUREATE
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MARKSCHEME

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ENVIRONMENTAL SYSTEMS

Standard Level

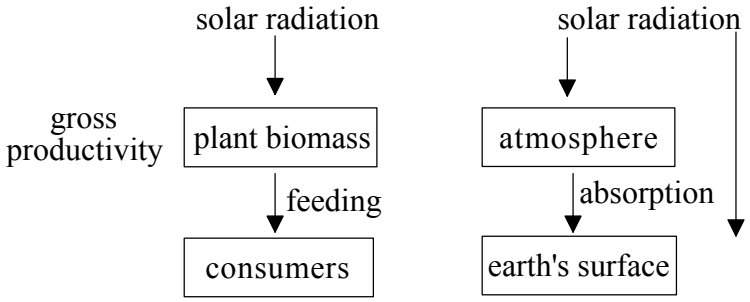
Paper 2

10 pages

SECTION A

1. (a) Flow diagram. *(Use discretion – a number of variations may be produced which are equally valid.)*

At least 3 correct flows in correct direction ***[1]***; at least 2 storages identified ***[1]***; overall clarity of diagram ***[1]*** ***[3]***



(b) *Any two of:*
reflection by clouds ***[1]*** / absorption by gases ***[1]*** / back scattering by dust ***[1]*** / reflection by earth's surface ***[1]*** / reflection by vegetation ***[1]*** ***[2]***

(c) *Any two of:*
70° latitude more reflective due to presence of ice / snow / bare rock ***[1]***; radiation travels through more atmosphere at 70° latitude ***[1]***; radiation spread over larger area at 70° ***[1]***; lower angle of incidence ***[1]*** ***[2]***
Allow from point of view of 10° North, i.e. more vegetation, so absorption is high, sun's rays more direct, etc.

(d) $\frac{80}{5\times10^{6}} \times 100 = 1.6\times10^{-3}\,\%$ or 0.0016% ***[1]***

$\frac{9}{3\times10^{6}} \times 100 = 0.3\times10^{3}\,\%$ or 0.0003% ***[1]***

correct working ***[1]*** *(deduct **[1]** if % sign not given)* ***[3]***

(e) *Any two of:*
at 70° latitude – temperature is limiting ***[1]*** / less plant cover ***[1]*** / water may be frozen and limiting ***[1]*** / soil infertility ***[1]*** / single layer of vegetation ***[1]*** / less photosynthesis ***[1]*** ***[2]***
Accept at 10° North, more plant cover, multiple layers of vegetation etc.

(f) *Any two of:*
a state of balance ***[1]***; in which processes are continuing ***[1]***; but inputs equal outputs ***[1]***; creating no net change ***[1]***; appropriate graph ***[1]***; negative feedback ***[1]*** ***[2]***

(g) inputs = 9 kJ m^{-2} yr^{-1}
outputs to consumers = 2 kJ m^{-2} yr^{-1}

outputs (other losses) = 9 – 2 = 7 kJ m^{-2} yr^{-1} ***[1]*** *(units needed)* ***[1]***

(h) *Allow **[1]** for each definition.*

- Renewable – trees are self-maintaining natural capital ***[1]*** / using solar radiation ***[1]***;
- Natural capital – the trees in the forest are natural capital since they are a useful resource that can provide timber for harvesting ***[1]***;
- Natural income – the amount of new timber provided over a given time is the natural income from this capital ***[1]***;
- Sustainable yield – provided only this income is harvested without causing long term damage to the system, this is sustainable yield ***[1]***

Accept any reasonable answers. ***[4]***

(i) *Any of:*
prevention of soil erosion ***[1]***; climate stability ***[1]***; other plant or animal materials ***[1]***; aesthetic values ***[1]***; water catchment ***[1]***;
Accept any other reasonable answer. ***[1]***

SECTION B

2. (a) Lost from atmospheric storage by fixation by photosynthesis ***[1]***;
Photosynthesis by green plants / phytoplankton / producers / autotrophs ***[1]***;
Takes carbon dioxide, water, chlorophyll and light energy to make organic compounds / glucose and releases oxygen ***[1]***;
Light energy is transformed to chemical energy ***[1]***;
Release by respiration ***[1]***;
By animals / heterotrophs / zooplankton / decomposers ***[1]***; producers also respire ***[1]***;
Breakdown / oxidation of organic matter using oxygen to produce energy, carbon dioxide and water ***[1]***;
Release by combustion – fast oxidation of organic matter ***[1]***;
Release by diffusion of carbon dioxide from the water to the atmosphere ***[1]*** / dissolves in atmosphere (rain) ***[1]***
(Award marks for reasonable points e.g. examples of the above.) ***[8 max]***

(b) More C in atmosphere as carbon dioxide ***[1]*** / less C in sink as organic molecules ***[1]***;
Due to: increased burning of fossil fuels ***[1]*** /
increased use of cars ***[1]*** / increased industrialisation ***[1]***;
deforestation ***[1]***;
increased water temperature – gases less soluble ***[1]***
(Accept any reasonable activity) ***[4 max]***

(c) Effects: global warming ***[1]***;
Sea temperatures rise – plankton killed ***[1]***;
Ice caps melting ***[1]*** / habitats destroyed ***[1]***;
possible rise in sea levels due to thermal expansion ***[1]*** / low lying lands flooded ***[1]*** /
organisms displaced ***[1]*** / ecosystems destroyed ***[1]***;
weather patterns changed ***[1]*** / crop growth patterns altered ***[1]***;
(*Award marks for any reasonable answers that relate changes to the biosphere.)* ***[5 max]***

Expression of ideas ***max [3 marks]***

Total [20 marks]

3. (a) *Allow up to **[5]** for listing the possible limits and up to **[2]** for more detailed consideration of the limits. Accept any reasonable answers, e.g.:* physical and biological limits – space to live ***[1]*** / space to grow food ***[1]*** / enough absorption of waste / carbon dioxide ***[1]***/ space for recreation ***[1]***/ finite use of resources ***[1]*** / competition for finite resources ***[1]*** / soil degradation and erosion ***[1]*** / atmospheric pollution ***[1]***/ land availability for crop growth ***[1]***; social limits – aggression between nations over finite land resources ***[1]*** / political policies limiting population growth ***[1]*** / overcrowding so reducing quality of life ***[1]*** ***[7 max]***

(b) Developing country has higher mortality rate amongst young ***[1]***; less availability of fresh, clean water / balanced diet ***[1]***; more children die before age of five years than in developed country ***[1]***; less medical care ***[1]*** subsistence farming relies more on human inputs for labour ***[1]***/ have more children to work the land ***[1]*** / pay less wages ***[1]*** / custom / religion ***[1]*** / desire for child to carry family name ***[1]*** / desire for male / female offspring ***[1]*** children to care for parents in their old age ***[1]*** ***[4 max]***

(c) *Named example **[1]**; description **[3[**; evaluation **[2]***
e.g: People's Republic of China ***[1]***; description – emphasis on family planning education ***[1]***; emphasis on one child policy ***[1]***; compulsory abortions ***[1]***; tax penalties if more than one child per family ***[1]***;

evaluation *e.g.* negative – morality of this is abhorrent to many ***[1]***; interferes with human rights ***[1]***; international objections ***[1]***; leads to female infanticide as males are preferred ***[1]***; ineffective in remote rural areas ***[1]*** but has slowed population growth ***[1]*** *e.g.* positive – prevents overcrowding ***[1]***; jobs for all ***[1]***; social services can cope ***[1]***
Any reasonable point is acceptable.
[6 max]

Expression of ideas ***max [3 marks]***

Total [20 marks]

4. (a) Most heat energy reaches earth's surface at the equator ***[1]***; redistribution is from equator towards poles ***[1]***; by Hadley cell and other two cells ***[1]***; convection cells driven by solar radiation ***[1]***; hot air rises as lower density, cools at altitude and falls again ***[1]***; hot air spreads northwards and southwards to low pressure areas ***[1]*** moved by low altitude prevailing winds (easterlies and westerlies) ***[1]***; Coriolis force ***[1]***;
water evaporates from oceans and atmosphere absorbs latent heat ***[1]***;
released through condensation ***[1]***
Allow up to ***[2]*** *for diagram of Hadley cell.* ***[7 max]***

(b) Oceans heated by solar radiation ***[1]***; currents move warm water from equator to poles ***[1]***; cold water from poles to equator ***[1]***;
convection cells cycle water in oceans ***[1]***; upwellings bring cold water towards surface ***[1]***; example of ocean current ***[1]***;
water has a higher heat capacity than land – gains and loses heat more slowly ***[1]***; transfers heat of land to oceans and vice versa ***[1]***; *e.g.* Gulf Stream moderates maritime climate of northern Europe ***[1]*** ***[4 max]***

(c) Named ecosystem and brief description / *e.g.:* mangrove swamp at Hoi Ha Wan Bay, Hong Kong ***[1]***
First law of thermodynamics – conservation of energy/ energy cannot be created or destroyed ***[1]***
Second law – 'in any isolated system, entropy tends to increase spontaneously' ***[1]*** *(owtte)*
Application of laws to named ecosystem ***[2]*** /
e.g.: the ecosystem depends on solar radiation – converted to chemical energy by photosynthesis by producers (mangrove bushes, algae) and moved along food chains as herbivores (limpets) and carnivores (dog whelks) feed ***[1]***;
life processes increase order and decrease entropy ***[1]*** / in death of organisms, entropy increases as usable energy is lost and is dissipated as heat ***[1]*** ***[6 max]***

Expression of ideas ***max [3 marks]***

Total [20 marks]