

MARKSCHEME

NOVEMBER 2000

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

SECTION A

1. (a) (i) solar energy/the sun [1]
- (ii) evaporation [1]
- (b) (i) $\frac{300}{400} \times 100 = 75\%$ [1]
- need correct answer for the mark, not necessarily working.*
- (ii) $\frac{336}{400} \times 100 = 84\%$ [1]
- (c) (i) $100 - 64$ or $336 - 300 = 36 \times 10^{15}$ kg
- Award [1] for correct answer (36) and [1] for units (10^{15} kg). [2]
- (ii) Burning fossil fuels releases more carbon dioxide/greenhouse gases [1]; ... which increases global temperatures [1]; ... which melts ice [1]; increased temp. → increased evaporation → increased cloud cover [1]. **max [3]**
- (d) Vegetation/plants/animals/organisms/biomass/soil water [1];
Appropriate mechanisms for transfer [2]/
e.g. organisms – water enters by absorption through roots or digestive system [1];
water leaves by transpiration or excretion (sweating, urination) [1]. **max [3]**

- (e) (i) Condensation/precipitation/run off/groundwater flow would increase (because of extra water in atmosphere) [1]

Or: run off / groundwater flow would decrease (because of extra evaporation from warmer surfaces) [1]

- (ii) (*accept any two of*)

- increase in evaporation / condensation leads to increased cloud cover [1]; leads to increased reflection of solar radiation / higher albedo [1];
- increase in precipitation leads to more snow [1]; leads to increased reflection of radiation [1];
- decrease in the rate of evaporation decreases amount of water vapour entering the atmosphere [1]; water vapour is a greenhouse gas (so reducing it will reduce the greenhouse effect) [1] and/or reducing atmospheric water vapour will reduce cloud cover [1]; and hence increase radiation loss to space [1].

(*One change in flow [3 max], two changes in flow [4 max]*) [4]

- (iii) (*Response must follow on from (e) (ii)*)

For increases in flow given above; feedback is negative [1]

For decreases in flow given above; feedback is positive [1] [1]

(*If part (ii) is not answered or answer does not mention a direction of change in flow and its consequences, no credit can be given here.*)

- (f) Transformation = condensation and evaporation [1];
Transfer = precipitation and run off/groundwater flow [1]. [2]

Total [20] marks

SECTION B

General Essay Markscheme

Each essay is marked out of 20 of which 3 are for expression and development of ideas (EDI).

- | | |
|---|---|
| 0 | No expression of relevant ideas. |
| 1 | Expression and development of relevant ideas is limited. |
| 2 | Ideas are relevant, satisfactorily expressed and reasonably well developed. |
| 3 | Ideas are relevant, very well expressed and well developed. |

2. A number of appropriate calculations could have been selected providing they show the change **relative** to world population.

e.g. per capita area for both years (0.2 ha in 1960, 0.1 in 1997) [1]; ... per capita production for both years (270 kg in 1960, 322 kg in 1997) [1]; ... or percentage change in area and production (increase in area 0.8, increase in production 130 %) [1]; ... compared to percentage change in population [1]; ... to show relative decrease in area [1]; ... and relative increase in production [1].

World population has changed by 2.81×10^9 , area has changed by 5×10^6 ha and grain production by 1061×10^9 kg [1];

Candidates need to manipulate the figures to gain full marks.

Award up to [2] for accuracy of arithmetic and use of units

max [6]

- (b) (i) Grain production per unit area has increased.

[1]

- (ii) Since carrying capacity is the maximum number that can be **sustainably** supported [1]; strategies will only genuinely increase carrying capacity if they involve **sustainable** exploitation [1].

Candidates should give at least one example of increasing yield that is sustainable, and at least one that is not, to satisfy the question.

[2]

Strategies might include use of fertilisers; irrigation; mechanised farming; genetic engineering; selective breeding; rotation of leguminous crops *etc.*

(Award [1] for each valid example of a strategy that would increase yield and [1] for establishing whether or not it does so sustainably ... for up to a maximum of four examples).

Candidates that select only sustainable, or only unsustainable strategies can only be given credit for up to three examples.

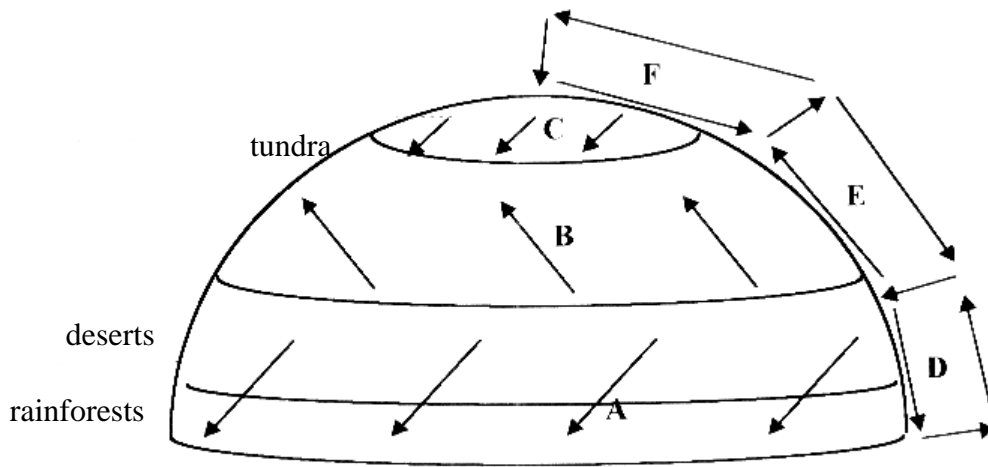
(If candidate states in (b) (i) that grain production per unit area decreases, use error carried forward to award marks correspondingly).

max [8]

Expression of ideas [3]

Total [20] marks

3. (a)



- | | |
|---------------------------------|------------------------------|
| A – Easterlies or trades | D – Hadley cell |
| B – Westerlies | E – Mid-latitude cell |
| C – Polar easterlies | F – Polar cell |

Clear labelled diagram [1];

With correct identification of low altitude prevailing winds: easterlies [1]/westerlies [1];

Polar easterlies [1]; convection cells: Hadley cell [1]/ other cells [1];

Biomes of rainforest [1]; deserts [1]; and tundra [1].

max [6]

(b) Air at the tropics gains energy through insolation [1]; and re-radiation from Earth [1]; rises to high altitude due to low density/convection [1]; spreads polewards by convection cells/towards low pressure/Coriolis force [1].

max [3]

Insolation at equator causes evaporation of water from oceans [1]; which absorbs (latent) heat from oceans [1]; water vapour carried in air movements away from equator [1]; latent heat subsequently released through condensation [1].

max [2]

- (c) (i) Hadley cell gives rise to heavy precipitation in lower latitudes which ensures water is not a limiting factor for productivity [1];
It also contributes significantly to poleward distribution of heat which increases the range of favourable conditions for productivity [1];
It generates the winds giving rise to ocean currents which, in turn, increase the range of favourable conditions for marine productivity [1]; however, the downward movement of warm dry air at 30° latitude limits water availability and thus productivity [1].

max [3]

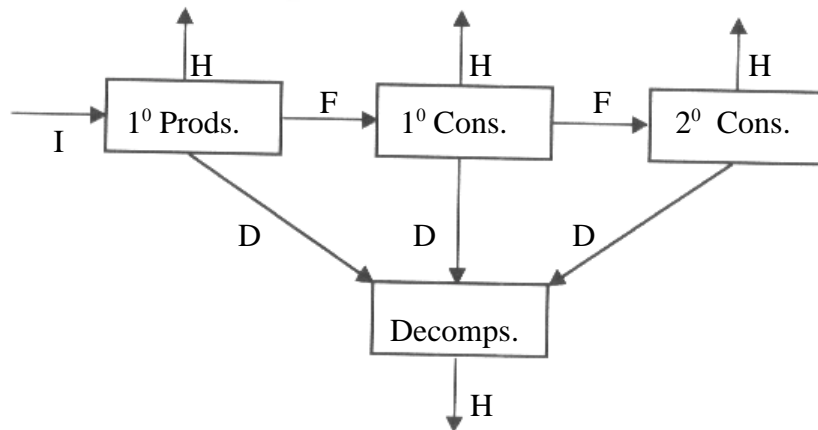
- (ii) By increasing primary productivity this supports more extensive food webs and thus greater biodiversity [1];
By giving rise to the different climatic conditions of *e.g.* rainforests and deserts, this promotes divergent evolution and greater biodiversity [1];
By increasing the physical range of life-supporting conditions on the planet this increases the diversity of terrestrial habits that can be colonised and thus biodiversity [1].

[3]

Expression of ideas [3]

Total [20] marks

4. (a)



I – Insolation / sunlight / sun / light
H – Heat loss / respiration / respiration loss

F – Feeding
D – Death & decomposition

Clearly labelled diagram [1];
 Including all flows of heat loss [1];
 Feeding [1]; death/decomposition [1]; insolation [1];
 With valid and named producers and consumers [1].

max [5]

(b) 1st Law – All solar energy entering the system is converted to chemical energy [1]/ and eventually heat energy [1]; so no energy is created or destroyed [1].

max [2]

2nd Law – Energy transformations occurring along the food chain involve a net decrease in chemical energy / 10 % rule stated [1]/ And a net increase in heat energy [1]; which has a higher entropy than chemical energy [1]; so there is a net increase in entropy as a result of these energy transformations [1].

max [3]

(c) Negative feedback occurs when a change in a system reverses or inhibits further change in the same direction.
 or other words to that effect.

[1]

Internal factor e.g. inc. pop. density leads to more aggression / competition [1]; dec. mating success/dec. pop. density [1]; so change led to reversal of change [1].
OR e.g. low food *per capita* leads to dec. fertility [1]; dec. pop. density/higher food *per capita* [1]; so change led to reversal of change [1].
OR other valid examples.

max [3]

External factor e.g. inc. pop. density leads to inc. mineral consumption [1]; minerals become limiting so dec. pop. density [1]; so change led to reversal of change [1];
OR e.g. inc. pop. density leads to inc. parasitism [1]; inc. mortality so dec. pop. density [1] so change led to reversal of change [1].
OR other valid examples.

(Biotic / abiotic or density dependent / independent factors are acceptable. In some cases, especially if abiotic / density independent factors are selected, negative feedback is not directly relevant, so discussion to this effect should gain the mark.)
 Allow [2 max] if named species not given.

max [3]

Expression of ideas [3]
 Total [20] marks