IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI



**ENVIRONMENTAL SYSTEMS**
**STANDARD LEVEL**
**PAPER 1**

Friday 14 November 2003 (afternoon)

45 minutes

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INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

**1.** Which of the following is an essential feature of a system in steady-state equilibrium?

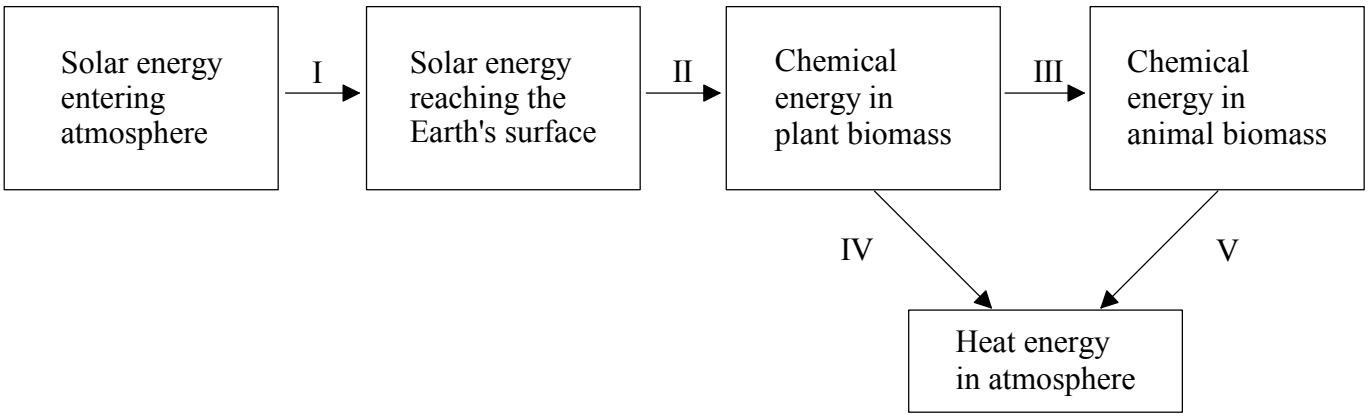
A. Positive feedback mechanisms

B. Negative feedback mechanisms

C. Balanced inputs and outputs

D. High diversity

*Questions 2 to 5 refer to the diagram below representing flows of energy through the biosphere.*




**2.** Which of the following correctly distinguishes flows I to V as transfer or transformation processes?

| | **Transfer** | **Transformation** |
|---|---|---|
| A. | II, IV, V | I, III |
| B. | I, III | II, IV, V |
| C. | I, IV, V | II, III |
| D. | I, II, III | IV, V |

**3.** Which units would be most appropriate for flow II and the "chemical energy in plant biomass"?

| | **Flow II** | **Chemical energy in plant biomass** |
|---|---|---|
| A. | $kJ\ m^{-2}\ yr^{-1}$ | $kJ\ m^{-2}$ |
| B. | $kJ\ m^{-2}$ | $kJ\ m^{-2}\ yr^{-1}$ |
| C. | $kg\ m^{-2}\ yr^{-1}$ | $kg\ m^{-2}$ |
| D. | $kJ\ m^{-2}\ yr^{-1}$ | $kg\ m^{-2}\ yr^{-1}$ |

**4.** Which of the following represents net primary productivity?

A. Flow III minus flow V

B. Flow II

C. Flow II minus flow IV

D. Flow III

**5.** Which of the following correctly shows the absorption or release of $CO_2$ in each of the flows II and V?

| | **Flow II** | **Flow V** |
|---|---|---|
| A. | Releases $CO_2$ | Absorbs $CO_2$ |
| B. | Absorbs $CO_2$ | Absorbs $CO_2$ |
| C. | Releases $CO_2$ | Releases $CO_2$ |
| D. | Absorbs $CO_2$ | Releases $CO_2$ |

**6.** Which of the following is an example of *mutualism*?

A. Vultures eating a dead antelope

B. An insect pollinating an orchid flower

C. A caterpillar eating leaves of a fig tree

D. A flea living on the skin of a rabbit

**7.** Which statement best describes the *niche* of a species in its habitat?

A. The biotic components it requires

B. The biotic and abiotic components it requires

C. The particular place where a species lives

D. The position of a species in the food web

**8.** Which statement(s) correctly describe the relative productivity of different biomes?

I. The productivity of biomes always decreases with increasing distance from the equator.
II. The productivity of biomes is directly proportional to the amount of solar energy they receive.
III. The productivity of biomes is related to the prevailing climatic conditions at their latitude.

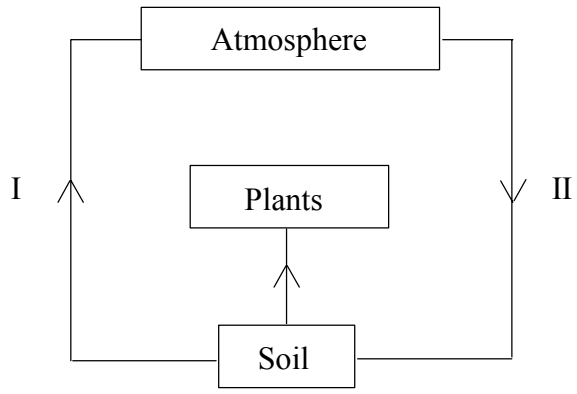
A. I, II and III

B. I and II only

C. II and III only

D. III only

**9.** The diagram below shows some of the storages and flows in the nitrogen cycle. Which processes can be represented by flows I and II?




| | I | II |
|---|---|---|
| A. | Respiration | Manufacture of fertilizers |
| B. | Denitrification by anaerobic bacteria | Fixation of nitrogen by lightning |
| C. | Fixation of nitrogen by lightning | Photosynthesis |
| D. | Nitrification by aerobic bacteria | Fixation of nitrogen by lightning |

**10.** What information would you need to estimate the gross productivity of a population of consumers over a period of time?

A. Biomass of food eaten only

B. Biomass of food eaten and biomass respired only

C. Biomass of food eaten and biomass of feces produced only

D. Biomass of food eaten, biomass of feces produced and biomass respired

**11.** Which of the following can generally be deduced from the shape of the survivorship curves for a given species?

A. Number of births per year

B. Maximum rate of population growth

C. Carrying capacity for a given population

D. Relative amount of parental care and investment per individual offspring

**12.** In which way do "S" and "J" population curves differ from one another?

A. Only S curves show exponential growth.

B. Only S curves show positive feedback.

C. Only S curves show a rapid decline after reaching their maximum value.

D. Only S curves show negative feedback as the population stabilises.

**13.** Which statement best explains why the net productivity of a climax community approaches zero as a result of succession?

A. Increased length of food chains have led to an increase in respiration.

B. Gross productivity has become very low.

C. The system is in decline because of its age.

D. Lower diversity has provided fewer feedback loops and decreased efficiency.

**14.** Which arrangement of atmospheric gases places them in order of their relative concentrations, from the highest concentration to the lowest?

| | **Highest** | ⟶ | **Lowest** |
|---|---|---|---|
| A. | Oxygen | Carbon dioxide | Nitrogen |
| B. | Nitrogen | Carbon dioxide | Oxygen |
| C. | Carbon dioxide | Oxygen | Nitrogen |
| D. | Nitrogen | Oxygen | Carbon dioxide |

**15.** Which combination in the table below best completes the missing words from the following passage?

A tropical cyclone gains energy through a … I … feedback mechanism. This involves the … II … of water which releases heat, causing air to rise, bringing in more heat in the form of water vapour from the ocean.

| | I | II |
|---|---|---|
| A. | negative | condensation |
| B. | positive | evaporation |
| C. | positive | condensation |
| D. | negative | evaporation |

**16.** Which is the most likely to occur as a result of a reduction of stratospheric ozone?

A. Increase in the amount of damage to plant life at the Earth's surface

B. Reduction of photochemical smog

C. Reduction in ultraviolet radiation reaching the Earth's surface

D. Increase in human respiratory problems

**17.** Which of the following possible impacts of global warming would be most likely to slow further increases in mean global temperatures?

A. Increased melting in the tundra leading to release of methane

B. Increased evaporation leading to greater snowfall in the polar regions

C. Climate change leading to reduction in gross primary productivity

D. Thermal expansion of the oceans leading to increase in aquatic habitats

**18.** Which of the following is **not** a result of acid deposition from burning of fossil fuels?

A. Leaching of calcium from soils

B. Death of coniferous trees in forests

C. Killing of fish due to high levels of aluminium in lakes

D. Thermal expansion of oceans

**19.** Which of the following is most likely to lead to an overall increase in the Earth's freshwater storages?

A. Removal of forests

B. Melting of polar ice caps

C. Increase in evaporation rates from the oceans causing increase in precipitation over the continents

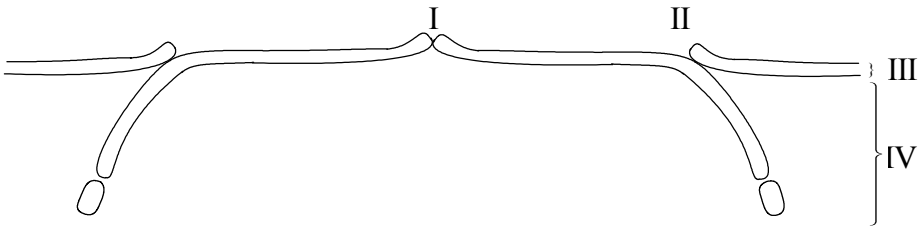
D. Discovery of new underground aquifers

**20.** Which combination in the table below best completes the missing words from the following passage?

The El Niño Southern Oscillation is associated with the disruption of … I … winds and … II … surface currents in the Pacific moving … III … South America.

| | I | II | III |
|---|---|---|---|
| A. | Easterly | Cold | Away from |
| B. | Westerly | Warm | Away from |
| C. | Easterly | Warm | Toward |
| D. | Westerly | Cold | Toward |

*Questions 21 and 22 refer to the diagram below representing a number of tectonic plates.*




**21.** Which is the best description of the components shown in the diagram?

A. Three plates and two destructive margins

B. Three plates and two constructive margins

C. Four plates, two destructive margins and one constructive margin

D. Four plates, two constructive margins and one destructive margin

**22.** Which of the following correctly identifies regions labelled I to IV?

| | I | II | III | IV |
|---|---|---|---|---|
| A. | Subduction zone | Mid-oceanic ridge | Mantle | Crust |
| B. | Mid-oceanic ridge | Subduction zone | Crust | Mantle |
| C. | Subduction zone | Mid-oceanic ridge | Mantle | Core |
| D. | Mid-oceanic ridge | Subduction zone | Crust | Core |

**23.** Which characteristics would be correctly associated with a sandy soil?

| | Air spaces | Drainage | Nutrient Content | Primary Productivity |
|---|---|---|---|---|
| A. | Large | Good | High | High |
| B. | Small | Good | High | High |
| C. | Small | Poor | Low | Low |
| D. | Large | Good | Low | Low |

**24.** Which is the best explanation of the advantage of contour-plowing?

A. Plowing across the contours improves the efficiency of harvesting techniques.

B. Plowing across the contours improves drainage of the soil.

C. Plowing parallel with the contours prevents erosion of the soil.

D. Plowing parallel with the contours improves drainage of the soil.

**25.** A population has a crude birth rate of 28 per thousand and a rate of increase of 1.4 %. What is the crude death rate per thousand?

A. 14

B. 26.6

C. 42

D. 29.4

**26.** Which of the following is characteristic of *r*-selected organisms?

A. They are typical of pioneer communities.

B. Usually a high proportion of the young survive to adulthood.

C. Sexual maturity is reached late in the lifespan.

D. They usually have a high degree of parental care of their young.

**27.** Which of the following does **not** represent an open system?

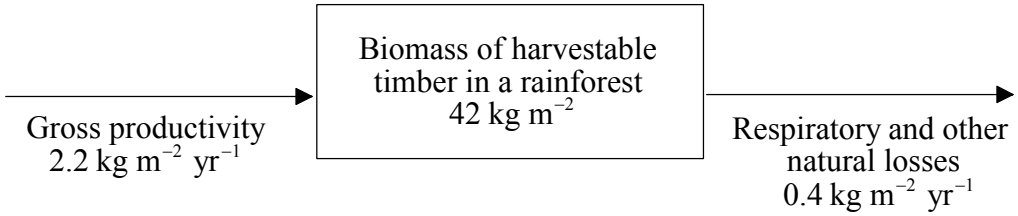
A. A lake inside a cave

B. The entire universe

C. A tropical island

D. A city

*Questions 28 and 29 refer to the flow diagram below.*




**28.** What is the maximum sustainable yield of timber from this forest?

A. 1.8 kg m$^{-2}$ yr$^{-1}$

B. 2.2 kg m$^{-2}$ yr$^{-1}$

C. 43.8 kg m$^{-2}$ yr$^{-1}$

D. 44.2 kg m$^{-2}$ yr$^{-1}$

**29.** Which of the following combinations of harvesting techniques would allow the exploitation of this resource to be fully sustainable?

I. Removal of the entire natural income of the forest

II. Removal of the entire natural capital of the forest

III. Use of petrol/gasoline-driven machinery for harvesting and transport

A. I and III only

B. III only

C. I only

D. I and II only

**30.** A country imports goods from another country. How will this be likely to affect the local carrying capacity of the importing country and the global carrying capacity for the whole Earth?

| | **Local carrying capacity** | **Global carrying capacity for the whole Earth** |
|---|---|---|
| A. | Increase | No effect |
| B. | Increase | Decrease |
| C. | No effect | Decrease |
| D. | No effect | No effect |