

Markscheme

May 2023

Environmental systems and societies

Standard level

Paper 1

© International Baccalaureate Organization 2023

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2023

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2023

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

Subject details: Environmental systems and societies SLP1

Markscheme

Mark allocation

Candidates are required to answer:

- **ALL** questions
- The maximum total = **[35]**.

1. Environmental systems and societies uses marking points and markbands to determine the achievement of candidates

When using marking points:

- i. A markscheme often has more marking points than the total allows. This is intentional
- ii. Each marking point has a separate line and the end is shown by means of a semi-colon (;)
- iii. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded**
- iv. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

When using markbands (Only for Section B, part (c) questions):

- i. Read the response and determine which band the response fits into
- ii. Then re-read the response to determine where the response fits within the band
- iii. Annotate the response to indicate your reasoning behind the awarding of the mark
Do not use ticks at this point
- iv. Decide on a mark for the response
- v. At the end of the response place the required number of ticks to enable RM Assessor to input the correct number of marks for the response.

2. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
3. Words in brackets () in the markscheme are not necessary to gain the mark.
4. Words that are underlined are essential for the mark.
5. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).

6. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
7. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.
8. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

1. (a)

- a. greater availability/access to health care / more advanced health care available / greater income to afford health care;
- b. more access to healthier diet / greater income to afford better nutrition;
- c. greater access to clean potable water / better sanitation;
- d. less air pollution due to factories being relocated to outside the city;

[1 max]

Do not accept only 'government policy to reduce air pollution / better air quality than the rest of China'.

Do not accept 'increase in migration / relocation of people from Beijing'.

Do not accept only 'better quality of life / better education'.

(b) 1966 / 1969 / 1997 / 2017;

[1]

Note: only mark the first answer if more than one year is given.

(c)

- a. over time fewer children/reduction in birth rate due to increased use/access to family planning/contraception/sex education/cultural acceptance of using contraception;
- b. women delay having children due to access to education/employment/developing their career and therefore having less time to have children/choosing to have smaller families;
- c. over time fewer children/reduction in birth rate due to migration from rural areas to cities where children are not required to work in agriculture to support parents / reduction in births because of increasing cost of bringing up children;
- d. fewer children/births due to improvements in welfare system/pensions reducing reliance on children to support parents;
- e. reduction in infant/child mortality due to improved nutrition/access to healthcare/immunizations results in lower fertility as parents know children will survive;
- f. government policy/legislation that encourages fewer children/reduction in birth rate (e.g. implementation of one-child policy (until 2015));
- g. reduction in birth rate due to a larger proportion of people past child-bearing age/rise in median age/aging society;

[2 max]

Do not accept 'decrease in fertility rate/decrease in crude birth rate without explanation'.

Do not accept only 'decrease in birth rates because women are more educated'.

Do not accept only 'less need for child labour'.

Do not accept only 'reduction in infant mortality'.

Do not accept only 'people are less focused on having children'.

Do not accept 'people are migrating to other areas'.

Do not accept reference to 'decrease in population size/restricting overpopulation' rather than reduction in children/birthrates/under 30 age groups

2. (a) workings [1 max]
e.g. $(117.020-71.195)/(2019-2008)$ or $(117.020-71.195)/11$ or $45.825/11$;

final answer [1 max]
= $4.166/4.17/4.2$ (kWh bn);

[2]

Note: Allow [1] max if correct average is given with no correct working shown.
Allow ECF if selection of one value in the workings shown is incorrect e.g. the incorrect number of years is used (such as, 12 instead of 11 resulting in $3.819/3.82/3.8$ (KWh bn)).
If no workings are given, ECF cannot be applied.
Do not accept incorrect rounding of the answer.

- (b)
- switch to a *named* alternative source of energy to generate electricity e.g. gas/oil/renewables/hydroelectric/wind/solar;
 - moved coal powered industry to areas outside Beijing;
 - government banning/implementing quotas/having education campaigns to reduce use of coal (for heating/cooking);
 - cap on cars could reduce the manufacture/production of cars in Beijing which reduces coal use;

[1 max]

Note: Do not award mark for 'reduction in coal use'.
Do not accept only 'switch to an alternative energy source.'
Do not accept 'use of coal is reduced due to cap on number of new cars/limiting car ownership'.
Do not accept 'government regulation of coal mining'.

3. (a)
- greatest amount of combustion of fossil fuels/fires for heating;
 - during colder/winter months people walk/cycle less and instead use cars more that uses fossil fuels (petrol/diesel);
 - high level of construction work in December, because it's drier;
 - lowest amount of rainfall in December, which would wash out $PM_{2.5}$ from atmosphere;
 - temperature inversion/high pressure system may develop which hold the pollutants/ $PM_{2.5}$ in the city during the winter/cold months;
 - in December factories are working overtime to mass produce goods for the western world for Christmas, therefore air pollution via fossil fuel emissions is high;
 - engines are less efficient in cold weather, releasing more $PM_{2.5}$;

[1 max]

Do not accept only 'in colder months heat is required to stay warm', link needs to be made with using fires/fossil fuels.
Do not accept 'use of electric heaters to stay warm'.
Do not accept only '...increase in use of cars' without link to increase use of fossil fuels.

- (b)
- a. ozone formation/reaction depends on sunlight/UV light;
 - b. day length/sunlight hours greater in June–July/summer months / vice versa;
 - c. higher temperatures (in summer months) increase (the rate of reaction and therefore) formation of ozone;
 - d. in the summer months there may be an increase in tourism/travel leading to greater use of transport that generates NO_x/volatile organic compounds (VOCs)/precursors of tropospheric ozone; **[1 max]**

Do not accept 'there is higher use of air conditioning in the summer months that releases NO_x/VOCs/precursors of tropospheric ozone'.

- (c)
- a. consistency across nations;
 - b. not subject to national political bias / local geographical conditions may influence baseline levels;
 - c. can be based on international/established scientific data / avoids problem of lack of scientific knowledge within a country;
 - d. internationally agreed protocols/methods for obtaining data; **[1 max]**

Do not accept 'encourages countries to work together'.

Do not accept 'WHO know what levels of PM_{2.5} are harmful'.

Do not accept 'WHO is responsible for safe levels of PM_{2.5} and ozone'.

- 4.
- a. acid deposition is likely to have decreased due to reduction in NO₂/SO₂ which contribute to the formation of acid deposition;
 - b. reduction in coal combustion that contributes NO₂/SO₂/precursors of acid deposition;
 - c. cap on number of new cars in Beijing/reduction in use of buses/increase in use of cyclists (in 2017) /increase in use of subways therefore reduction in NO₂/SO₂/precursors of acid deposition;
 - d. use of catalytic converters/scrubbers that remove NO₂/SO₂/precursors of acid deposition;
 - e. moving industry to outside Beijing would lower SO₂/NO₂ levels in the city / moving industry to outside Beijing would transfer SO₂/NO₂ levels elsewhere;
 - f. NO₂/SO₂ is absorbed by green spaces/tree planting so less nitric acid/sulphuric acid is formed; **[3 max]**

Note: For credit an explicit link must be made to 'NO₂/SO₂/precursors of acid rain' for each marking point.

5. (a)
- a. reduction in use of bikes/taxis;
 - b. increase in use of subway;
 - c. increase in use followed by stabilization of cars;
 - d. increase till 2008 and subsequent slight decrease/fairly steady bus use / overall little/no change in bus use; **[1 max]**

- (b)
- a. increase in (%) use of subway due to lower cost/subway system improvements because of economical investment/governmental environmental agenda/aim to reduce pollution;
 - b. initial decline in (%) bike use due to improved subway/public transport/decline in price of subway tickets/greater ownership/use of private vehicles / reduction in bike use due to higher per capita GDP, so people can afford alternative methods of transport / reduction in bike use due to urban expansion/roads becoming less safe to ride on / reduction in bike use due to poor air quality;
 - c. (percentage) car use initially increased due to economic growth/greater income/increase in population/cultural value/status symbol of car ownership;
 - d. (percentage) car use since about 2010 shows a steady change/decline due to cap on number of new vehicles allowed in Beijing/improvements in public transport/greater environmental awareness;
 - e. since about 2015 gradual increase in use of bikes due to government drive to encourage bike use (e.g. subsidies to buy bikes)/due to greater environmental awareness to reduce use of private vehicles;
 - f. decrease in use of taxis as public transport has improved / decrease in taxi use due to increase in price of using taxis; **[2 max]**

*Do not accept 'bike use has decreased due to climate change'.
Accept other reasonable responses*

- 6.
- a. plants absorb air pollutants / plants act as carbon sinks / plants produce oxygen;
 - b. plants/green areas provide habitat for wildlife/biodiversity/honey bees/wildlife corridors;
 - c. plants absorb/intercept rainfall and reduce risk of flash floods / plants intercept run-off and acts as filters removing pollutants/particulates which in turn can help to improve water quality of nearby rivers/lakes / plant roots hold soil and reduce soil erosion / plants can act as a wind break and reduce wind erosion of the soil;
 - d. provides thermoregulation for houses / reduces heat island effect / reduces air temperature by providing shade;
 - e. plants can absorb noise / reduce noise pollution; **[2 max]**

*Do not accept only 'improves air quality'.
Do not accept only 'increases biodiversity'
Do not accept only 'allows species to breed'.
Do not accept only 'prevents floods/soil erosion'.
Do not accept responses that are focused on social/cultural/aesthetic/economic aspects.
Note: Accept other reasonable response linked to an environmental benefit.*

7. (a)

- a. water conservation awareness campaigns to change behaviour and reduce use/waste / change in individual behaviour e.g. having shorter/less showers;
- b. use of more efficient water-saving appliances/devices (e.g. washing machines/dishwashers/showerheads and taps with water restrictors/low flow toilets);
- c. increased use of grey water e.g. for watering gardens / use in flushing toilets;
- d. improvements in infrastructure reducing water leakage/losses;
- e. installation of household water meters (user pays concept) / water tariff rates that increase as use increases / increase in water prices;
- f. water restrictions (e.g. ban on using hose pipes/washing cars/watering lawns) / use water quotas;

[1 max]

Do not accept only 'increase in water monitoring'.

Do not accept 'collect rainwater' as focus is on reduction in water usage per person.

Do not accept only 'people are informed there is a limited supply of water'.

Do not accept only 'legislation/education' without link to how it changes water use.

Do not accept 'reduce agricultural use'.

Note: *Accept other reasonable responses.*

(b)

Cons: [2] max

- a. people relocated from the area to be flooded / loss of communities/villages / loss of livelihoods in the area;
- b. loss of habitat to area that was flooded / loss of habitat to construction of the canal/pipeline that carries the water from the reservoir to Beijing / destruction of habitat caused by building of road to the construction site;
- c. reduction in flow into the Yangtze river affecting wildlife/fish populations/human settlements / loss of water for the Shanghai area;
- d. dam blocks fish migration;
- e. dam disrupts/reduces flow of sediments downstream;
- f. (weight of water in dam) can trigger seismic movement/earthquakes;
- g. increase in insect vectors/water-borne diseases (e.g. bilharzia/malaria);
- h. rotting vegetation in dam can release greenhouse gases (methane and carbon dioxide) / it is energy intensive to build and equipment used release greenhouse gases/CO₂;
- i. potential loss of water from canals/dams due to evaporation / potential loss of water from canals due to long distance of transfer to Beijing (1200km);
- j. it is expensive to construct / pipelines will require continual maintenance which is expensive;
- k. over-dependency on a single source could be an issue e.g. drought in the Shanghai region;

Pros [2] max

- l. production of hydroelectric power / generates electricity sustainably;
- m. provides flood control;
- n. provides water supply for Beijing residents / improves availability of safe water / decreases water scarcity;
- o. water available for irrigation;
- p. water available for industry;
- q. avoids use of groundwater/polluted surface water;

[3 max]

Note: Award [2] max if only pros or only cons given

Conclusion [1 max] needs to be balanced considering both sides of the argument for credit and makes a clear value judgement e.g.: While the benefits to Beijing in terms of addressing water scarcity would be enormous, the environmental impacts (e.g. of loss of habitats) and social impacts (e.g. loss of villages and communities) of increasing the dam size would outweigh the benefits.

Conclusion is not mandatory and 3 marks can be achieved through consideration of both cons and pros.

8. (a) 2014

[1]

Note: Only mark the first answer if more than one year is given.

(b) (i)

- a. data is easier to collect/measure;
- b. data is more objective/directly measures pollutants / identifies amount of pollutant;
- c. identifies the pollutants;
- d. can help to identify source of pollution;

[1 max]

Do not accept only 'identifies the source/cause of pollution'.

Do not accept 'the data is more easily recognizable / more accurate / more reliable'.

(b) (ii)

- a. directly measures impact on habitat/community / awareness of the health and biodiversity of the river;
 - b. shows effects/synergy of combined pollutants;
 - c. cheaper than chemical analysis / no expensive equipment is required;
 - d. linear index scale is easily understood by non-scientist;
- [1 max]**

Do not accept 'provides information of water quality over time/historic pollution'.

Do not accept 'measures environmental impact / measures impact on water / is quicker / more efficient'.

Do not accept only 'provides qualitative information'.

9.

- a. running out of space for landfill / expansion of landfills destroys valuable land/reduces availability of land for other uses;
 - b. landfill leachates/leakages can pollute soils/rivers/groundwater resources/contaminate the surrounding ecosystems;
 - c. landfill gases can cause explosions / landfills release methane/carbon dioxide that contributes to global warming;
 - d. to reduce vermin associated with landfills;
 - e. to reduce littering associated with landfills;
 - f. to reduce odour associated with landfills;
 - g. incineration of waste can be used to generate electricity;
- [2 max]**

Do not accept 'transporting waste to landfill using vehicles produces air pollution/noise/traffic congestion'.

10. (a)

- a. zoo can provide specialised/safe conditions required for individual species;
- b. it increases population of critically endangered species, which could be released into the wild/increasing genetic diversity / it produces populations for reintroduction of species / by breeding species prevents them from going extinct;
- c. it raises awareness through education programmes;
- d. it can gather revenue to fund conservation;
- e. it supports (flagship) species that raise wider concern/support for conservation; **[1 max]**

*Do not accept only 'zoos prevent species from becoming extinct'.
Do not accept only 'helps to restore critically endangered species'.*

(b)

- a. it supports/conserves whole ecosystems/food webs;
- b. it keeps species in their natural environment / it creates habitat for wildlife;
- c. it is very cheap / simple to establish/manage / makes effective use of green waste;
- d. it is more ethically acceptable as it does not require keeping animals in captivity; **[1 max]**

Do not accept 'does not require much space'.

11.

Pros for model of good environmental management [4 max]

- a. limiting population of the city would limit generation of air pollution/water pollution/waste generated/ecological footprint;
- b. limiting factories in the city would limit PM_{2.5}/PM₁₀/PM/precursors of ozone/NO₂/SO₂/precursors of acid rain/GHGs;
- c. the Beijing Clean Air Action Plan is limiting the number of private vehicles/has reduced use of coal which emit air pollutants (such as PMs/GHGs);
- d. increasing green areas/dead hedges provides habitats for urban wildlife/wildlife corridors;
- e. increasing green areas provides carbon sinks/helps absorb air pollutants;
- f. creation of green areas/parks can help improve mental/physical well-being / provide areas for recreation;
- g. through these environmental management strategies Beijing has potential to reach net zero carbon emissions by 2050 which would reduce its contribution to global warming/climate change;
- h. policies/investment into prevention of air pollution has resulted in a reduction in pollution between 1998 and 2017 of PM/NO₂/SO₂;
- i. in recent years there has been an increase in the use of less polluting forms of transport such as bikes/subways and trains;
- j. the council has stricter standards/legislation/greater enforcement which limits water pollution;
- k. the South–North Water Project ensures that Beijing has a reliable/safe supply of water;
- l. South–North Water Project provides renewable hydroelectric power/flood control / use of hydroelectric power will reduce use of fossil fuels;
- m. waste management strategy includes reduction of waste generation at source / use of waste to energy incinerators to generate electricity will reduce use of fossil fuels;
- n. Beijing zoo has an active breeding program that has produced offspring of critically endangered species (e.g. Northern white cheeked gibbon, Guizhou snub-nosed monkey)/flagship species (e.g. Giant Panda);

Cons for model of good environmental management [4 max]

- o. aging population increasing burden on health care/younger generation;
- p. reduction in working population reducing economic growth;
- q. despite cap on population in city, electricity demand continues to increase / electricity demand continues to increase which uses fossil fuels and releases GHGs;
- r. ozone/PM_{2.5} continue to be above the WHO limits;
- s. use of private cars continues to be high (about 30% of all transport modes) which generate air pollutants / a lower proportion of people use bikes than in the past opting to use alternative modes of transport that create more air pollution;
- t. a large proportion of rivers in Beijing (40%) are still highly polluted;
- u. the South–North Water Project has diverted water away from other areas adversely affecting wildlife/communities downstream / construction of South–North Water Project has resulted in loss of wildlife habitats / extending the dam/constructing pipelines damages the soil and can lead to soil erosion;
- v. dam scheme interferes with fish migratory routes / may cause seismic movement;
- w. incineration of waste creates air pollutants such as dioxins;
- x. focus on popular flagship species (e.g. Giant Panda) may detract from funding/supporting other species with higher ecological value;
- y. due to the interconnected nature of systems on earth, relocating factories to outside Beijing can still have an adverse effect on the planet (e.g. carbon dioxide emissions causing climate change);

[6 max]**Note:** Award [5 max] for both pros and cons.

Conclusion [1 max]

For example: Although air pollution has decreased since 1999, PM2.5 levels are above WHO safe limits throughout the year and therefore Beijing cannot yet be considered a good model of environmental management;

Although expanding the Danjiangkou dam provides more clean/renewable electricity for Beijing, it causes more loss of habitat for local species and demand of energy keeps rising; hence Beijing cannot be considered a model of good environmental management;

Despite relatively high levels of PM2.5 recorded in 2015 and poor water quality in 2018, Beijing is moving in the right direction with implementation of the Beijing Clean Air Action Plan, stricter water quality standards and greening the city and hence Beijing can be considered a good model of environmental management;

A valid conclusion should be credited if it is explicit, balanced (addresses both sides of the argument) supported by evidence and makes a clear value judgement.

Do not credit the conclusion if only one side of the argument has been considered within the overall response.

Accept other reasonable responses supported by the information in the resource booklet..
