Examiners' Report
IM Environmental Science

Special September Session 2020

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A. STATISTICAL INFORMATION

The total number of candidates who registered to sit for Environmental Science was **430**, which is **61** candidates more than in 2019.

Table 1 shows the distribution of grades for the Main 2020 session of the examination.

GRADE	A	B	C	D	E	F	ABS	TOTAL
No. of Candidates	17	37	108	95	63	21	89	430
% OF TOTAL	4.0	8.6	25.1	22.1	14.7	4.9	20.7	100.0

Table 1: Distribution of grades for Environmental Science 2020 Special September Session

B. GENERAL REMARKS

General Remarks on the Written Examination

As in previous years, examiners noted that some candidates found it really hard to express themselves in good English or to use scientific terms in the right context. Candidates also showed that they did not possess a clear understanding of basic scientific concepts (including very basic knowledge of chemistry) underlying natural environmental phenomena or the impact of anthropogenic interventions on the environment. In most of the cases they relied on common sense knowledge opening themselves up to a host of misconceptions and confusing arguments. This is indicated from the quality of responses given in section A, but also in the answers given by those opting to tackle such environmental chemistry questions in section B.

Some responses reflected an inability to understand what was expected by the question. Consequently, answers to questions in Section B were extremely lengthy and included many repetitions and irrelevant information. Other accounts took the form of an uninterrupted long paragraph, even in cases where the question was divided in sub-questions. On the other hand, other responses were either too short or completely out of point.

There were also some cases of illegible or partly legible (often small and crammed) handwriting, accompanied by very poor presentation of work and inaccurate unlabelled diagrams. This makes it harder for the examiner to decipher and understand any written explanations.

C. COMMENTS ON PAPER

Section A

Question 1

In part (a), a few candidates wrote inorganic instead of organic. Another common mistake was using the term natural instead of physical or biological. In part (b), candidates were asked whether different processes increased or decreased soil erosion. The two questions about the processes of gullying and multicropping were consistently answered incorrectly. Another frequent error was that instead of giving the reason why the process brings about soil erosion or conservation, candidates chose to explain the process itself. Quite a number of candidates confused gullying with water-logged soil.

Question 2

In their answer to part (a), a high percentage of candidates could not give one way of how inorganic nitrogen enters living organisms. In part (b), a great majority of answers gave respiration as a process of how carbon enters living organisms. In part (c) very few candidates gave examples of how the nitrogen cycle is negatively impacted by humans. Impacts like water pollution, eutrophication and algal blooms were rarely mentioned. Conversely, in part (d), the answers showed a good understanding of how the carbon cycle is negatively impacted by humans.

Question 3

In part (a) of the question, candidates had to state whether each of the statements listed was true or false. The statements which were repeatedly answered incorrectly indicate a lack of awareness that the highest concentration of freshwater is found in the icecaps and glaciers. Also the answers revealed that the meaning of the lithosphere and asthenosphere are not well known. In part (b), the reasons provided for why the statements were false were mostly correct.

Question 4

With a mean mark of 5.7 (out of a maximum of 12), it is clear that a good number of candidates struggled in their explanations of the statements related to atmospheric pollution. In part (a), many candidates referred only to the excessive presence of carbon dioxide as the main culprit of acid rain, failing to refer to the other oxides of sulfur and nitrogen (also generated during fossil fuel combustion). Very few candidates expressed the interactions between the gaseous oxides and water (producing carbonic, nitric and sulfuric acids - all contained in acid rain) in the form of word / symbolic chemical equations. In part (b), the majority of candidates referred correctly to the specific damage caused by acid rain on the biotic components of an ecosystem, while only a few mentioned the impact on the abiotic factors. In part (c), candidates focused mainly on the toxicity of carbon monoxide without explaining that it binds with haemoglobin preventing oxygen uptake. Answers to part (d), have once again confirmed the long-standing misconception that enhanced greenhouse effect and ozone depletion are related or different facets of the same problem. Consequently in part (e), a significant number of candidates confused ozone-depleting substances (ODSs) with greenhouse gases (GHGs). In part (f), most candidates cited nitrous oxide (N_2O) as the only product of chemical reactions between nitrogen and oxygen gases. Very few candidates referred to the other oxides of nitrogen, namely nitric oxide (NO) and nitrogen dioxide (NO_2) which are the main gases synthesized at high temperature from the elements and which contribute to acid rain and photochemical smog.

Question 5

Candidates did pretty well in this question which had a mean score of 3.1 (out of a maximum of 5 marks), with more than one fifth (22.3% of total) gaining full marks. The two most frequent mistakes were: (i) the use of the term 'desalination' to refer to the advanced (or tertiary) treatment of wastewater; and (ii) the application of 'salinization' for removal of salt from water by a number of techniques including distillation and reverse osmosis.

Question 6

This turned out to be one of the most challenging questions in Section A with candidates obtaining a low average mark of 3.9 (out of a maximum of 10). In part (a), many candidates considered aluminium as being a cheap and reusable material, but the majority failed to refer to its chemical inertness making it corrosion

resistant. Very few candidates cited that recycling aluminium consumes a considerably lower amount of energy and is hence substantially less polluting than extracting it from the ore bauxite. Only a minority of candidates referred correctly, in their answer to part (b), to the negative impact on aquatic life originating from the wastewater produced during the paper recycling process. In part (c), candidates generally outlined the problem of separating / sorting plastic waste according to the different properties, but few highlighted the fact that the products from mixed plastic waste would have inferior properties and limited uses. In part (d), most candidates failed to distinguish between the concepts of 'reusing' and 'recycling', with the latter involving some processing, being more energy-intensive and polluting. In fact, the reasons given were more related to the preservation and re-utilization of glass objects rather than to the sustainability of the re-manufacturing process of glass. Most of the candidates had no problems getting the two marks assigned for part (e) citing the benefits of conservation of the raw material as a finite natural resource. However, there were other valid responses including reference to higher energy consumption and increased pollution during extraction compared to the recycling option.

Question 7

Most candidates fared well in this question with part (a) being answered correctly by the majority. Candidates erroneously mentioned fungal spores as an organism. Spores are the reproductive structures that a fungus utilizes (fungi are not animals). Candidates also mentioned the Australian bush as a producer where in reality, it is a form of biome pertaining to Australia. For part (c), candidates mentioned an ecological service which is not a symbiotic relationship. Some candidates failed to realise that the bandicoot was attaining nourishment from the fungus and from such action, their spores could be dispersed. For part (d) some candidates utilized the terms allo- and autogenic succession. It is to be noted that these terms explain how succession can be done and not necessarily a type.

Question 8

Most responses given indicated that candidates lacked the sufficient knowledge to produce pyramids of numbers and pyramids of biomass. Most confused biomass with energy and therefore depicted and explained pyramids of energy rather than biomass. Question (b) was answered correctly as most candidates related logging to a negative chain reaction in the assigned food chain.

Question 9

Most candidates fared well in this question. However, most candidates mentioned disease, war and poverty as contributors to the decline in population numbers. It is to be reminded that these factors all contribute to the increase in mortality rate and it is mortality rate the overarching factor that influences population dynamics. Some also mentioned tourism which is not a contributing factor to the increase/decrease of population numbers as the move is indefinitely temporary. For part (b), many candidates failed to realise that the values given to them were in thousands and therefore attained an inaccurate answer. In part (c), a number of candidates wrote the formula but no answer was supplied.

Section B

Question 1

Part (a) of the question dealt with the rock cycle. The diagrams presented nearly always give the three types of rock, however magma was frequently omitted and the arrows showing the processes, which transform one rock type to another, were often incorrect. While the majority of responses given by the candidates attempting this question indicated that they are aware that the three types of rock are transformed into one another, the details of how these transformations occur were not always given. For example, processes like sedimentation in the formation of sedimentary rock, volcanism in the formation of igneous rock and plate tectonics in the formation of metamorphic rock were rarely stated and explained. In answers to part (b), the majority of candidates gave good examples of how extraction of mineral and non-mineral resources can impact the environment in a negative way. Some answers mentioned the examples without explaining how the environment is impacted.

Question 2

Most candidates correctly outlined the general structure and layers of the atmosphere in part (a) as well as how the temperature varies within the different layers. However, the reasons for the increase in temperature within the stratosphere and thermosphere were generally not known. Part (b) asked for an explanation of the greenhouse effect as a natural phenomenon. Although, the majority of candidates knew what the greenhouse effect is, a good number did not make the connection that the phenomenon is a natural one and that it is important for the maintenance of life on Earth. Most candidates answered this question by explaining the effect of greenhouse gases arising from pollution. Parts (c) and (d) were in general very poorly answered. In part (c) regarding the Earth's overall radiation budget, very few candidates mentioned and explained albedo and also the fact that the energy received by the Earth is equal to the energy emitted. In part (d) very few candidates showed knowledge of the global climate circulation. In the answers given there was barely any mention of convection currents, and how the excess heat from the equator is being circulated towards the poles.

Question 3

This was the least chosen question in this section and was attempted by only 23.5% of the total number of candidates. A good one third (33.8%) of the candidates attempting this question performed well, each scoring between 15 and 20 marks. Generally speaking, candidates fared well in parts (a), (b) and (c), but then failed miserably in the remaining parts (d) and (e) which concerned measures to mitigate photochemical smog and the impact of temperature inversion on this type of atmospheric pollution. Many candidates mentioned a number of valid control techniques, but others only suggested ineffective or irrelevant options such as wearing of masks, the use of particulate filters, and the use of low-sulfur fuels (which are more suitable to address industrial smog rather than this type of smog). Performance in part (e) was rather bad, showing that most of the candidates had no idea about the occurrence of 'temperature inversion' and its impact on air pollution. A few responses stated that it was a sudden drastic rise in temperature, which had some effect on global warming.

Question 4

This was the second most chosen question in this section and was attempted by 39.6% of the total number of candidates. More than one fifth of the candidates secured a mark between 15 and 19.5. In part (a), many responses presented did not refer to the chemical composition of 'fossil fuels' (which mainly consist of hydrocarbons) and failed to include proper examples. Instead, they generally focused on the impact of pollution created from fossil fuel combustion. One common misconception was that 'biofuels' are equivalent to all forms of renewable sources of energy, citing wind, solar and hydroelectric power as typical examples. Many responses to part (b) consisted of a clear explanation of the principles involved in the process of 'reverse osmosis', sometimes illustrated with simple but appropriate diagrams. However, these contrasted with other poor responses, which included wrong descriptions of other unrelated techniques such as distillation, osmosis or purification of salt. The majority of candidates appeared to be familiar with the concept of 'water harvesting', though others confused the term with the use of irrigation for agricultural purposes. Candidates generally correctly explained the term 'eutrophication' in part (c), though some missed to indicate common / potential sources of such water pollution. In the same question, a considerable number of respondents confused the term 'biodegradation' with 'environmental degradation', illustrating their accounts with issues such as deforestation, overexploitation of resources and human activities affecting biodiversity and ecosystems. In part (d), most responses included a correct explanation of the basic function of a 'catalytic converter' but failed to refer to the role of the metallic catalysts in the device. Some responses revealed a number of misconceptions (such as the processing of oxides of sulfur (SO_x) by the converter). In contrast, most responses showed lack of awareness that the 'electrostatic precipitator' was another filtration system to reduce particulate matter pollution. Some responses indicated that it might be some electric device that increases the chances of water precipitation! Responses to part (e) were mostly acceptable though some of them barely referred to specific examples to support their statements.

Question 5

This was the most opted for question with 43% of the candidates attempting it. Most fared well in this question as they provided clear growth curves and properly explained the factors that contribute to the population dynamics in LEDCs. This being said, some common mistakes included: (i) candidates presented population pyramids instead of growth curves. Some candidates represented sigmoidal curves with an actual S shape alluding to a period of population regression. (ii) In predator-prey relationships, many candidates discussed the pattern, but never disclosed why predators must peak <u>after</u> the prey. Also, answers presented did not supplement the fact that prey numbers must always be higher than predators for the cycle to be sustainable.

Question 6

This question was attempted by 26% of the candidates. Though most exhibited good understanding of what was being asked, many supplied brief explanations and did not sustain their arguments with brief explanations. In part (a), many failed to mention that biomes are geographical areas influenced by climates and characterized by specific vegetation. This led them to an incorrect and/or inaccurate discussion about climate conditions and vegetation types in part (b). Many referred to weather which does not contribute to the general aspects of biomes. Part (c) was mostly answered correctly, however, some replies wrongly referred to biodiversity as a synonym for the term habitat. The answers for part (d) demonstrated that

candidates still have misconceptions of adaptations pertaining to both biomes (i.e. Tundra and Deserts). Most candidates gave far more examples for Desert rather than Tundra. For Deserts, most candidates mentioned that camels store water in their humps, which is not the case. Cacti's spines were associated more with deterring herbivory rather than a reduction in surface area to minimize water loss. Many candidates seemed unaware that vegetation is present in Tundra as many candidates only mentioned faunal adaptations and no floral adaptation.

D. CONCLUDING COMMENTS

Candidates must keep in mind that marks are awarded on the quality rather than quantity of written material. Some candidates preferred to write all they knew about the topic rather than directly address the point/s raised by the examiner.

Section B questions were sometimes attempted without any necessary planning, resulting in long and winding explanations full of disjointed ideas. It is important that candidates allocate sufficient time for the planning of an answer so that concepts and arguments are presented in a logical way.

It must again be emphasized that although Section B questions are usually longer than those in Section A, they need not be answered by extensive accounts. Examiners again suggest that the answers to section B questions are to be split in a number of paragraphs according to the points being made. Key terms may be underlined and descriptions may be illustrated with simple appropriately labelled diagrams.

Chairperson
Examination Panel 2020