ENVIRONMENTAL SCIENCE AND SOCIETY (ESS315114)

GENERAL COMMENTS

The written examination was well received by candidates and teachers. Most candidates felt the examination paper was accessible and allow ample scope for them to demonstrate their knowledge. Teachers appreciated the varying range of complexity in questions from those that assessed basic understanding through to questions that required greater analysis of interrelated concepts, as is the nature of Environmental Science.

In most cases, candidates provided very good answers. Where candidates performed poorly it was mostly due to inadequate detail in their responses. Candidates are advised to carefully read the questions, seek out exactly what is being asked of them and make connections to the course content they have covered during the year. This should provide scope for all candidates to attempt all questions.

Candidates are again reminded that the Information Sheet be used as a reference to assist them in constructing their responses. Responses that are written word-for-word from the sheet reveal little understanding of the required knowledge, and often yield little if any credit. Candidates should use the information and apply it to the question. It is also advisable for future candidates to equip themselves with an approved English dictionary, this can prove to be an invaluable asset if terms used in the question challenge their understanding of what is being asked.

WRITTEN EXAMINATION

The following section specifically comments on candidates’ performance. Marking examiners have offered suggested answers to each question, followed by specific comment on aspects such as how the question was assessed, where candidates gained or lost marks, where they had difficulty in interpreting the question, or where candidates failed to comprehend what was required to successfully answer the question. The suggested answers are by no means prescriptive. Candidates providing different but valid answers were rewarded accordingly as noted by the examiners.

SUGGESTED ANSWERS AND COMMENTS

PART 1 – CRITERION 2

QUESTION 1

a) The amount of nutrients in the grey water. Other acceptable answers included type of water: grey or rainwater.

b) The yield or mass of the apricots produced.

c) The greater the concentration of nutrients supplied to an apricot tree as grey water irrigation, the higher the yield of apricots.

d) The 6 trees were the control. The yield of the trees treated with grey water would be compared to the control to see if there was an increase in yield.

e) The two nutrients that are likely to be present in the grey water are nitrate ions and phosphate ions.
COMMENTS

a) Some answers were too brief and just stated water which gained no marks.

b) Many candidates wrote the growth of apricot trees which received a maximum of ½ marks.

c) Several candidates only scored half marks on this part of the question because their answer stated that trees watered with grey water would produce a higher yield of apricots because of the nutrients in the water but there was no correlation between increasing concentrations of nutrients and apricot yield.

d) This part of the question was generally well answered but there were still quite a few answers that showed a lack of understanding about an experiment needing a control and how the results from the control allows the independent variable to be measured against it.

e) This part of the question was poorly answered. Answers confused phosphorus and phosphates. Faeces and organic matter were often quoted as a nutrient. Outlining the technique to detect nitrates and phosphates were too generalist, use a probe or take a water sample frequently being stated with very little or no detail of the process. ½ mark was awarded per nutrient.

f) Whilst many candidates noted that pathogens or bacteria could be present several confused the terms abiotic and biotic resulting in candidates naming pH and other abiotic factors which gained them no marks.

QUESTION 2

a) A number of combinations of methods were acceptable. These included:

- Scientists could carry out a transect survey from the shore to the island and the drop off to deeper water which would be like a cross-section. Multiple transects should be placed randomly over the area and at different times of the year.

- The number of individuals of each species encountered across this transect could be counted and recorded as a census or sampling could occur with evenly placed quadrats.

- If sampling is used an estimation of the total number could be calculated by multiplying out the sample area figures over the whole area or similar habitat.

- Sampling could also be collected by underwater photography, use of sonar to estimate size of shoals of fish, satellite imagery for large species, plankton nets, trawling and using numbers from fishing catch.

b) i) Baseline data or baseline study

   ii) To identify any changes due to natural cycles (storms, floods etc.) or human induced (oil spills, sewage, pollution etc.)

COMMENTS

a) There were numerous answers possible for this question and those candidates who attempted the question tended to score at least ½ marks but to gain full marks answers needed to outline how the area would be sampled and not just note the technique. Better answers recognised that benthic and pelagic organisms needed to be sampled, that the island was submerged at high tide therefore studies should include transects across the island at low tide and that techniques needed to take account of the different depths of water within the area being studied.
b) i) Candidates that stated that the term used was control were awarded ½ marks.

ii) Most students stated that baseline data allowed for trends to be observed as well as changes to an ecosystem over time.

QUESTION 3

a) Aerial photos could be taken when the gorse is in bloom so the yellow colour would show up. The area could be measured on a grid, marked on a map of the farmland and compared to the area of productive arable land.

b) On ground surveys where the size of any particular gorse patch could be measured by a surveyor or using quadrats etc. Individual patches could be compared to the aerial photos using position data.

c) The method was capture, tag, release, recapture. Photo monitoring using motion sensor cameras was another possibility.

d) A wide range of methods were given, many of which were not acceptable. Good answers included that the contents of a cat’s stomach (trapped or shot) or the scats of cats (faeces) could be examined to see if there were bandicoot remains. Other acceptable answers included:

- Use of cameras to study potential predator-prey relationship between the cat and bandicoot.
- Studying bandicoot carcasses to look for evidence of cats e.g. teeth marks on bone.
- Sampling numbers of cat and bandicoot numbers over time, graphing the results and looking at predator-prey cycles.

COMMENTS

This question was not particularly well answered especially part (c) and (d).

a) Several earned ½ a mark from stating the use of drones, aerial photographs etc. but gained 1 mark if they stated that the gorse would show up more if it was in bloom. Part of the outline needed to state that the data collected would need to be mapped and analysed to calculate the percentage covered in gorse in order to estimate the productive farmland in Tasmania. Quite a few answers either misread the question or did not understand remote sensing techniques and outlined using field surveys and which gained them no marks.

b) Answers to this question were often vague and stated that a ground survey could be conducted with no outline of the type of survey (1/2 mark) and no mention of comparing the ground survey data to the aerial photograph information. Both were needed for two marks.

c) Answers that did not note that an animal had to be captured, tagged and recaptured were awarded ½ a mark. Credit was given to other possible answers which included counting the number of bandicoots per gorse bush and multiplying this data by the number of bushes.

d) Generally answers to this part of the question were inadequate and very few gained full marks partly because two reasonable methods were not stated. Many methods given lacked scientific design and allowed for uncontrolled variables to affect potential results. 1 mark was awarded per acceptable method.
QUESTION 4

a) The penguin is leaving the colony because the current weight is less than the weight three days ago.

b) Acceptable number of times ranged between 11-13

c) Reasons for a decrease in weight near the end of October. These included:
   • Penguin is a female and she laid an egg
   • Decrease in krill availability
   • Penguin regurgitating food for the chick
   • Less body fat needed as the season changes to spring and it is warmer
   • Increase in the number of competitors for the food source

d) Method 1 - Advantage
   • Gives an accurate number of fish and krill that the penguin caught (although some may have been digested already)

Method 1 - Disadvantage
   • Ethical considerations for depriving the penguin and chick of food as well as harm to the penguin.
   • Amount of manpower needed for one data set.

Method 2 - Advantage
   • Can link each penguin to the weight data and feeding episode.
   • Provides a larger data set and long term data.
   • Less traumatic once the implant is in place.

Method 2 - Disadvantage
   • May be inconvenient/slower having to go through the weighbridge and reduce feeding time.
   • Does not identify whether the weight gain is due to eating fish or krill.

COMMENTS

This question improved many candidates overall score for this part of the exam. Most were able to answer (a), (b) and (c) without many problems.

a) Only ½ mark was awarded if the answer just stated the penguin was leaving the colony. A reason was needed for 1 mark. Many answers did calculate the amount by which the penguins weight had decreased although this was not needed.

b) 1 mark was awarded for answers that ranged between 11-13 times that the penguin returned from feeding. Candidates need to read the graph carefully because errors occurred when the axes were misread, years instead of days for example.

c) This was well answered with most candidates scoring 1 mark.

d) Many candidates gained ½ marks in this section of the question because their responses were too brief and did not fully develop their answer. For example, stating that the data collected using Method 1 is more accurate compared with Method 2 would only receive 1/2 marks. A better answer explained that this is because in Method 1 you could count the regurgitated krill whereas in Method 2 it was an estimate based on the penguin’s weight which could also include other organisms ingested.
PART 2 – CRITERION 5

QUESTION 5

(a)

(b) Phytoplankton

(c) Tertiary consumer or trophic level 4

COMMENTS
Generally well done. Candidates lost marks for not including organisms in the food web or placing them on the incorrect trophic level or missing arrows (relationship).

QUESTION 6

(a) Explain formula (1): \( r \) equals the rate of population change. ‘b’ is the number of births and would increase as more red deer survive and reproduce (1). ‘d’ is the death rate and without humans hunting this will decrease and will cause an increase in the population (1). ‘i’ is immigration or movement of red deer into some new areas. There may be a small initial increase in ‘i’ due to the overall increase in numbers and dispersal of red deer; ‘e’ is emigration or movement out, and there will be very little movement as there are few places for red deer to move. Great Britain is an island so immigration and emigration basically non-existent (1).

(b) i.
ii) Initially with humans and Lynx hunting the Red Deer it would have existed in low numbers that fluctuated seasonally with food availability (1). Without human or Lynx predators the population increased exponentially (1). With the Lynx re-introduced the population levelled at a higher carrying capacity determined by the lynx predator only (1).

(c) Ongoing culling by humans shooting Red Deer is costly and time consuming and usually results in large population fluctuations (1). Re-introducing the Lynx regains the natural system and reinstates the predator-prey relationship and regulates Red Deer populations at natural levels with no human intervention (1).

COMMENTS

Question generally poorly answered.

a) Despite being in the information booklet, many candidates did not state what the formula stood for, or made up their own formula.

b) Graphs varied widely but were generally poor

c) Many candidates engaged in discussions on the ethics of culling rather than focussing on why re-introducing the Lynx is preferable.

QUESTION 7

(a) They are omnivorous consuming both plants and animals.

(b) Far more energy is derived from the cereal crops than from eating the sheep and goats.

(c) The agricultural systems are far more productive and produce far more crops than the food plants available in the forest ecosystem (1). 10% concept, that is 90% of energy lost between trophic levels hence more primary producers in agricultural system allows for a greater population of humans (1).

(d) The sun or sunlight

(e) | Species Interaction                  | Relationship |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Large predators and humans</td>
<td>Predation</td>
</tr>
<tr>
<td>Wolves or humans eating sheep</td>
<td>Competition (1) or Predation (1)</td>
</tr>
<tr>
<td>Sheepdogs and humans</td>
<td>Mutualism (1)</td>
</tr>
<tr>
<td>Wolves and sheep</td>
<td>Predations (1)</td>
</tr>
</tbody>
</table>

COMMENTS

Generally well answered although many candidates lost marks by not being able to identify the correct relationships in part (e).
QUESTION 8
(a) Photosynthesis.
(b) Many possible answers including carbohydrates, glucose, fats, protein, amino acids, DNA.
(c) Respiration.
(d) Carbon dioxide.

COMMENTS
A straightforward question and generally well answered by most candidates.

QUESTION 9
(a) Anaspides tasmaniae
(b) Allanaspides helonomus and Allanspides hickmani
(c) While Anaspides spinulæ and Paranaspides lacustris both live in lakes, they cannot occupy the same niche. A niche is defined as an organism’s role in a particular habitat. Two species cannot occupy the same niche otherwise one will outcompete the other. They live in difference geographic locations (1), one in Great Lake at 1000m and one in Lake St Clair at 700m. They feed in difference locations (1) on different food resources (1) within the water body. One feeds at the lake bottom on detritus while the other feeds on submerged water plants.

COMMENTS
Generally well answered.

PART 3 – CRITERION 6

QUESTION 10
(a) The greatest number of species of native grasses in the cemetery compared with elsewhere (1). A high level of genetic diversity amongst the species of grasses (1).
(b) Many reasons accepted provided they were specific to the cemetery. Examples include:
   • The area is fenced off therefore not exposed to grazers.
   • There is a large number of different niches/microhabitats in the area (around graves, near stone walls etc.).
   • People visiting the cemetery would bring in seeds on their shoes.
   • Increased nutrients due to decomposing bodies.

COMMENTS
For part (b) many candidates listed multiple options but with very little detail (e.g. more nutrients) and therefore only ½ mark were awarded. The question asked candidates to ‘State a reason’ implying only one reason, credit was only given to the first option where candidates listed multiple options.
QUESTION 11

(a) Many reasons were accepted and needed to be well explained for the full 2 marks. For example: Low genetic diversity in plant species due to small area (1) therefore species more susceptible to environmental change so more likely to go extinct (1).

Other answers accepted included explanations on: edge effects; habitat fragmentation; surrounded by urban/agricultural land therefore increase in pollution etc.

(b) To allow interbreeding/movement of species between areas (1) therefore increasing genetic diversity / increasing population sizes / stabilising population numbers (1).

COMMENTS

Common answer for (a) was that the areas are small, therefore plants will outcompete each other and die or will be over consumed by animals in the park and therefore die; no marks awarded. Only ½ mark awarded in part (b) if student just stated that it would create a connection between the park without explaining the impact of this connection.

QUESTION 12

(a) Two changes were required: 1 mark for identifying and 1 mark for explaining each change.

Examples of changes include:

- Alpine regions in Tasmania would have been covered in glaciers and these would have melted after ice age, therefore changing the landscape
- Disappearance of animal species with change in environment as slow to adapt animals went extinct.
- Changes to vegetation as the climate warmed, therefore different species present due to in changes in productivity.
- Increase in sea levels, closing off the land bridge to mainland Australia.

(b) Absence of fire would allow the re-establishment of trees, shrubs and slower growing species (1) which would change the area from grasslands to woodlands or sclerophyll forest (1).

COMMENTS

Part (a) responses were generally poor as many students misinterpreted the question by including changes that have occurred since European settlement.

QUESTION 13

(a) Two introduced species were required. State introduced species (½) and identify how they are a threat to native mammals (½). Example answer: rabbits out compete native mammals for food resources and foxes predate upon small native mammals

(b) Response must refer to one of the introduced species stated in (a). Example answer: Rabbits are generalist species which can survive in a range of different habitats and varying conditions. They are also able to rapidly reproduce therefore increasing their population numbers quickly, There are limited environmental controls on their population (e.g. disease or predators).

(c) Biological control
COMMENTS

Most candidates provided good responses for this question. Students lost marks in (a) by not linking the introduced species stated with how they threaten native mammals. In (b) candidates needed to provide a full explanation to gain full marks. Several students only provided short responses with limited depth and were only granted part marks for (b).

QUESTION 14

(a) There is not enough food (½) due to fewer plants in flower (½) OR reduced food for birds due to limited flowers (¼) means that birds increase predation of insects (¼).

(b) Candidates must list two reasons. There are several possible responses including:
   • A greater food supply due to increase in flowering plants.
   • There is an increase in insects that can be consumed.
   • Increase in reproduction therefore increasing the bird population.
   • Birds that migrated the previous winter returning to the area.

(c) Plants may reduce in numbers in the future due to a decrease in pollination (reduction in reproduction) OR nothing may happen to plant numbers as a decrease in birds could see an increase in insects which also act as pollinators.

(d) Migration to warmer climates.

COMMENTS

(a) Several students referred to colder temperatures in winter being the cause. This is correct but these responses needed more detail linking temperature to a decrease in food availability.

(b) Generally well answered.

(c) There were several common responses that were factually incorrect, these included: an increase in plant numbers due to a decrease in ‘predators’ (birds are not predators of plants), and plants would die without pollination (individual plants would not die, they are simply not able to reproduce).

(d) Many answers were accepted as students were required to suggest survival strategies. Credit was given for hibernation, food storage and changing diets.

QUESTION 15

(a) pH 7.53 (no credit was given for responses that stated ‘Tank 2’ or only ‘2’).

(b) An increase in CO2 would cause the formation of carbonic acid when dissolved in the tank water, decreasing the pH (1). This is to represent the process of increased atmospheric CO2 causing ocean acidification (1).

(c) To represent the impact of increased global temperatures due to increased greenhouse gases. (only ½ mark awarded if students stated that it was to test the impact of increased temperature on CO2 solubility or impact on shell thickness)
(d) Several possible responses with one mark being given for each of the following:

- Increase in CO2 in atmosphere would increase ocean acidification.
- This study was looking at impact of ocean acidification on aquarium species of prawns.
- Relevant to commercial harvesting if experiment undertaken on commercial species.
- Commercial prawns are an important protein source for global populations.
- Would allow commercial prawn fishermen to predict the impact of increased ocean acidification on prawn harvest in the future.

**COMMENTS**

This question was answered poorly with many candidates overlooking ocean acidification as the concept being assessed. Answers were more focused on experimental design rather than human impact on environment. Also a number of candidates thought that a decrease in prawn exoskeletons would be a good thing for the commercial fishing industry as it would increase the amount of prawn meat.

**QUESTION 16**

3 marks were allocated for each change (climatic and other major change). 1 mark was given for identifying each change and 2 marks were given for outlining the evidence that would be seen in the future for this change.

Possible climatic changes include:

- An increase in temperature (evidence – melting ice caps, sea level rise, increase frequency of extreme weather events).
- An Increase in atmospheric CO2 concentrations (evidence – temperature increase, melting ice caps etc).

Other major changes include:

- An increase in plastic pollution (evidence – present in sediment layers, decline of global marine ecosystems).
- Deforestation or wide spread habitat destruction (evidence – fossil records showing decrease in biodiversity or comparison of records of land use into the future).

**COMMENTS**

Responses for this question were generally poor. Many candidates misread or misinterpreted the question and identified two changes but then explain why the change is occurring rather than talking about evidence that would be present thousands of years into the future.
PART 4 - CRITERION 7

QUESTION 17

(a) Possible water usage (½) and potential environmental problem (1 ½) in each stage of the river. Students needed to list a different possible water use for each stage in order to gain full marks.

<table>
<thead>
<tr>
<th>River stage</th>
<th>Possible water usage</th>
<th>Potential Environmental problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headwaters in pristine bushland</td>
<td>Drinking Water</td>
<td>- Habitat destruction from construction of dams.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Shortage of H₂O downstream.</td>
</tr>
<tr>
<td>Cleared land upstream</td>
<td>Irrigation</td>
<td>- Salination from a higher water table.</td>
</tr>
<tr>
<td>Flatland Downstream</td>
<td>Industrial Use</td>
<td>- Pollution due to chemical spills/runoff.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Eutrophication from thermal pollution.</td>
</tr>
<tr>
<td>Deep water near the river mouth</td>
<td>Port Infrastructure</td>
<td>- Loss of habitat results in less biodiversity.</td>
</tr>
</tbody>
</table>

(b) Ecosystem Services

COMMENTS

Both questions (a) and (b) were well answered.

QUESTION 18

(a) Population: The greater the population, the greater the environmental impact (1). Countries with a higher population such as USA have a bigger impact than countries of a similar size with smaller populations such as Canada (1).

Personal Wealth: The richer the country/individual, the more they consume (1). Australian citizens are generally well off and have a greater impact on environment due to more cars, eating out at restaurants and buying more goods (1). Environment is often harmed in order to make a profit (1).

Technology: More technological countries like Australia use more goods that require more resources, energy, and water (1). The manufacturing, transport and use of these technologies or products results in a bigger impact (1).

(b) Ecological footprint is more accurate as it takes into account more variables and a larger aspect of an individual’s life (1). Examples of these variables are number of people per household, their diet, pet ownership, type of heating, energy sources, waste production, transport etc (1). Population size, wealth and technology give an overall average for a nation, however it is not as useful for an individual citizen (1). An ecological footprint can give the individual a better idea of their own impact and solutions on how they can minimise this (1).
COMMENTS

(a) Generally well answered although there were several common errors including; candidates not mentioning a specific example when explaining the reason why it had an impact. A positive impact was accepted as an answer for the technology component where candidates discussed how technology can support the environment such as renewable technology.

b) Many candidates simply quoted what the definition for a footprint was without going into detail of how it is a good measure.

QUESTION 19

(a) Yes - they can be considered a commons as all groups, to at least some extent, describe the forests as belonging to all citizens (1) OR No – the forests are partially managed and privately owned by companies such as Forestry Tasmania which means it is not freely available to all people (1).

A common is a resource which is potentially renewable and has free and unmanaged access to all people (1). The Deep Green conservationists and Green Politicians views indicate it should be a common whilst the Tasmanian Government and Forestry Tasmania views show it is not a common (1).

(b) A tragedy of the commons is when a potentially renewable resource that is freely accessible to the public is degraded or depleted in some way through individual or groups over utilising the resource in self-interest. In this case, it would be a tragedy of the commons if the forest was cut down or the quality of the land decreased (1).

Yes – if the forests are not managed properly and are degraded (eg the soil quality or decreased amount of biodiversity) then this would be a tragedy of the commons (1). No – Whilst the forests are a public resource and belong to everyone they are the responsibility of the government to manage. Therefore they should not become a tragedy as access to the resource is restricted (1).

COMMENTS

a) Definition of a commons was available to candidates on the information sheet so this question should have been straightforward. Some common errors were that candidates missed the differences between viewpoint and values of the groups and that the question was about ‘commons’, not the “tragedy of the commons”.

b) Well answered with most candidates demonstrating a clear understanding of the concept.

QUESTION 20

Pesticide A - Primary pollutant/highly toxic/non-specific/broad spectrum pesticide were all accepted for ½ a mark. The pesticide kills species other than the target species and must be toxic to a wide range of organisms (1).

Pesticide B – Biomagnification (½). Species higher up the food chain concentrate the toxin because it is not biodegradable and so as the total biomass decreases up the food chain, the poison concentration increases to a point where it is toxic (1).

Pesticide C – Pesticide resistance/pest resurgence (½). Some of the target species have a genetic resistance that enables them to survive the poison. They are able to breed and pass on this resistance to their offspring eg, Natural Selection (1).
Pesticide D – Synergy/Secondary Pollutant (½). The pesticide chemicals combining with other chemicals and altering to become more toxic and affecting more species.

**COMMENTS**

Generally well answered with most candidates gaining full marks for pesticide A, C and D. Some common errors with pesticide B were that it was called Bioaccumulation.

**QUESTION 21**

The presence of fish farms results in increased nutrients within the water from excess fish food and fish waste (1). The increase in nutrients can lead to an algal bloom and/or a direct increase in bacteria (1). The algal bloom prevents light from reaching the aquatic plants lower in the water column, these plants can also run out of nutrients; the combined effect causes them to die (1). Bacteria which undertake aerobic respiration will breed and feed on the extra biomass from dead plants and algae (1). The bacteria will take out significant amounts of oxygen from the water (increasing biological oxygen demand) and the lack of oxygen will result in fish and other species with higher oxygen demands to die (1).

Global warming results in an increased water temperature due to the increased atmospheric temperature (1). The warmer temperature causes both less oxygen to be soluble in the water and increases the rate of plant/algae biomass accumulation and bacteria growth and decomposition (1).

**COMMENTS**

Candidates who read the question carefully were able to typically score high marks by going through the process of eutrophication (given 4 marks maximum) and link it to global warming (2 marks maximum). Many candidates misunderstood the question and discussed how eutrophication leads to global warming.

**PART 5 – CRITERION 8**

**QUESTION 22**

(a) Environment Protection and Biodiversity Conservation Act (EPBC Act)

(b) Whole ecosystems need to be protected because of the many complex connections and interactions within them (1). Each species needs its habitat and niche to be protected, so that it has all the requirements necessary for its survival in the wild (including food species, sources of nutrients, nest sites and many more) (1). One species is not more ‘valuable’ than others, and could not survive in the wild if the whole ecosystem it depends on was destroyed (1).

Candidates were also given credit for other suggestions, including 1 mark for any of these:

- Each species depends on other species in the ecosystem, including the predators, competitors and parasites which prevent their populations increasing too fast and exceeding their carrying capacity, which would result in over-use or damage to the resources they and other species depend on to survive.
- A threatened species is not really protected if the whole ecosystem it needs for survival is not protected. A species in captivity does not have the opportunity to learn and use the full range of behaviours that it would have in the wild.
- Each species helps to maintain the integrity of the whole ecosystem, and the ecosystem’s full range of functions and ecosystem services, so protecting just one species is of limited value.
• Every species has value (interspecific equity), so it is not ethical to focus on the survival of individual species.

• Humans tend to respond to the needs of ‘cute’ species (especially mammals and birds), and other ecologically important but ‘not cute’ species may not receive sufficient protection unless the whole ecosystem is protected.

• Biodiversity is very important and must be protected, not just individual species.

• Biodiverse ecosystems are more resilient when faced with changes such as global warming, which makes it very important to protect biodiversity, not just single species.

(c) Promoting the ‘Easter bilby’ allows the public to gain education/knowledge/understanding about the bilby and the threats it faces (1). This may motivate members of the public to take action to help conserve the bilby, either by donating money or volunteering their time to help (1). For example, people might control their domestic cats and dogs better, to prevent bilby predation (1).

Many other good suggestions were given full credit, including 1 mark for any of these:

• People might volunteer to help organisations which are working to protect the bilby, for example, planting native species as part of habitat regeneration projects.

• Greater awareness might lead people to drive slower at night, reducing bilby roadkill deaths.

• Greater bilby recognition might prevent misidentification and reduce shooting deaths.

• People might realise they have bilbies on their land and actively protect their habitat.

• People might contribute to bilby research projects, or join in as citizen scientists.

• People might give more care/assistance if they find a sick or injured bilby, for example, taking it to a wildlife centre or vet.

• People might report bilby sightings to assist identification of areas where bilbies are found.

• People might be motivated to lobby/put pressure on governments (local/state/federal) to do more to protect bilbies, whether through legislation, habitat protection, restriction of developments in bilby habitat, creation of reserves or providing interpretive signage.

COMMENTS

(a) Most candidates answered this well. ‘EPBC Act’ was given full marks. Others gave incorrect responses or skipped the question. The important point to note was that Australian/Federal legislation was required, not State/Territory legislation. The Threatened Species Acts are State laws, not Federal, so they were not given credit.

(b) Most candidates gave good responses to this question. Many candidates assume that a ‘species’ would be an animal – it could be any kind of organism. A number of candidates thought that ‘specie’ was a real word and incorrectly used this to refer to a single species.

(c) No credit was given for repeating the idea of ‘awareness’ in answers.

A very common error in (b) and (c) was to rewrite the question before beginning an answer – a waste of candidates’ time and the space provided for writing their answers.
QUESTION 23

(a) Ramsar Convention on Wetlands of International Importance (1).

(b) Federal (1)

(c) Federal or State (1 for either of these)

(d) A wide range of answers was possible; for example, any of the following (1 mark for any sensible suggestion):

- Control/eradicate feral cats or other introduced species.
- Enforce ‘no guns’/’no shooting’ policies.
- Enforce ‘no taking of plants or animals’ rules.
- Enforce ‘dogs on leads’ or, ‘no dogs’ rules.
- Prohibit quad bike/motorbike/trail bike/all vehicle access to protected wetlands.
- Prosecute individuals who break rules in protected wetlands.
- Control invasive/introduced plant species/weeds.
- Rehabilitate damaged areas.
- Monitor/study the wetland species and habitats (eg bird counts)
- Restrict public access to breeding/nesting areas, especially in the breeding season.
- Create walkways, viewing areas/bird observation hides, and restrict public access into the protected wetland areas.
- Manage drainage from adjacent roads (eg by building culverts)
- Provide signage to inform the public about the wetland species, their habitat and the threats they face and the rules/regulations of the protected area.
- Produce an Environmental Impact Assessment (EIA) for any proposed Visitor Centre, carpark or other works in or adjacent to the protected wetland.
- Develop a Management Plan for the protected wetland reserve.

COMMENTS

(a) ‘Ramsar Convention’, or even ‘Ramsar’ gained the full mark. (A few candidates wrote ‘RAMSAR’ in capitals, which is incorrect; the convention is named after the city of Ramsar, in Iran. This did not affect the marking).

(b) This is because it is an international agreement, to which Australia (the whole country) is a signatory.

(c) The Federal (Australian) Government is responsible for upholding any international agreement to which Australia is a signatory. However, State Governments are responsible for actually running the National Parks.

(d) Although there were many possible answers to this question, some unconvincing responses were not given credit. No marks were given for saying ‘EIA’ in the absence of any reason/proposed development. ‘Ban access’ only gained a ½ mark as access to protected areas is usually managed, not banned outright. It is important to note that the Parks and Wildlife Service does NOT ‘create National Parks’ or ‘make laws/legislation’. That is the role of governments. The Parks and Wildlife Service must manage the National Parks and other reserves, uphold legislation and inform the public – but not ‘make the laws’.
QUESTION 24

(a) ZPG would be fair to future generations, because it would stop the human population on Earth increasing to such an extent that there were no longer enough resources (such as fish in the oceans, recreational opportunities, good soil for farming) left for them. Also, it is not fair to future generations if an ever-increasing human population leaves people in the future to deal with huge pollution problems which they did not create, including climate change.

(b) Within any one generation, ZPG would make it easier to achieve Intrigenerational Equity, because there would not be more and more people competing to gain access to the resources for life. Without ZPG, if the human population continues to increase, it will become difficult or impossible for all the people in any generation to gain enough resources for a healthy life.

(c) ZPG would make it easier to achieve Ecobgical Integrity in the future. If the human population continues to increase, more ecosystems will be destroyed or become fragmented, due to the need for more and more resources, including farmland to feed the people and space for housing and roads. It would be very difficult for ecosystems to function, maintain biodiversity and deliver ecosystem services under the pressures of a continually expanding human population.

COMMENTS

(a) One mark for showing clear understanding that ‘Intergenerational Equity’ is all about fairness towards future generations. The second mark was for giving at least one example. The best answers gave specific examples of resources such as intact land/soils, clean air and water, experiences of nature/wilderness, food from farms or wild places like the oceans, forest resources, fibres for clothing. One-word examples could not gain more than a ½ mark.

The question required that the candidates ‘Discuss ZPG’ in relation to each Sustainability Principle, so ZPG had to be included in the explanation to gain full credit.

(b) One mark for showing clear understanding that ‘Intragenerational Equity’ is all about fairness towards all the people in any one generation. The second mark was for explaining how ZPG would make it easier to achieve this. Some very good answers acknowledged that Intrigenerational Equity is about fair distribution of resources for all, not just about the population size, and that the rich and powerful generally gain far more of the planet’s resources than the poor are able to access.

(c) One mark for showing understanding that ‘Ecological Integrity’ refers to ecosystems being intact, functional and capable of providing ecosystem services including the maintenance of biodiversity. The best answers showed clear understanding of the ecosystem services provided by functioning ecosystems, such as the storm surge protection provided by wetlands during extreme weather events, the provision of clean air and water, food, fuel, fibres, building materials and recreation, as well as biodiversity. The second mark was for explaining how ZPG would make this easier to achieve. The best answers showed clear understanding of how human demand leads to over-exploitation of resources, land clearing and habitat loss.

Overall, many candidates experienced considerable difficulty in addressing Question 24. Many candidates did not understand the phrase, ‘Advocates of Zero Population Growth urged couples to have on average only 2.3 children’, and seemed to think this was a ‘law’ and that families would be forced to restrict their family size. Many candidates were outraged by this suggestion and then failed to focus on the requirements of the question. Many answers discussed Inter- and Intrigenerational equity in relation to the ‘unfairness’ if future generations were ‘not allowed’ to have large families. These candidates overlooked the fact that the ‘Ethical Considerations’ asked for in the question were Principles of Sustainability, not ethical considerations in relation to personal decisions about family size.
QUESTION 25

(a) An Environmental Impact Assessment (EIA) must be carried out.

(b) Neighbours (½) might be concerned about increased traffic in the area, impacts to the aesthetic values of the area and increased noise and litter from the tourists visiting the new ecotourism venture (1½).

Members of the aboriginal community (½) might be concerned about loss or damage to cultural heritage, inappropriate access by the general community if the caves are a sacred site, and damage to the environment and ecosystem of the cave and the surrounding land (1½).

Candidates were also given credit for other suggestions, including the full 2 marks for any of these:

• Cavers (concerned about loss of access, numbers of tourists in the caves, cost of admission to the caves, damage to the caves)

• Neighbouring farmers (concerned about tourist cars making it difficult to move cattle or other livestock on the roads as well as general detriment to the peace and quiet of the area)

• Other tourism operators in the area (concerned about the competition/loss of revenue)

• Clients/visitors (wanting a good, safe and interesting experience and enough for children to do)

• Scientists (concerned about impacts to the cave community, which they may have been studying for many years)

• State government (responsible for protecting threatened species but keen to boost tourism and revenue)

• Local government (concerned that water and sewerage infrastructure must be sufficient, and responsible for organising rubbish collection and disposal, which will add to demand on their services)

(c) The accommodation proposal - tourists staying at the accommodation will use a lot of water, and sewage will be produced. If it is a remote area, it may not be possible to connect to mains sewerage and water. Drainage from septic tanks and long drop toilets might contaminate underground cave systems, so expert advice will be needed about this. Rainwater tanks and water saving shower heads would help with efficient water use and composting toilets might be a good choice.

Candidates were also given credit for other suggestions, including the full 2 marks for any of these:

• Rubbish and litter (solutions: bins/animal-proof bins; recycling; composting)

• Noise (‘curfew’ times when guests must turn loud music down or off)

• Habitat destruction when clearing sites for building (choose already-cleared sites where building has occurred previously/carry out a vegetation/species survey and avoid building on sites which have special ecological significance)

• Damage to cave systems below the accommodation, from noise/vibration during construction or from seepage of waste water or sewage effluent (carry out a geological survey and site the accommodation away from the cave system, over solid rock if possible)

• It was not essential to combine water and sewage issues as in the example provided above – either could be used as single issues + solutions.

The cave development - candidates gave a range of excellent suggestions. Suggested impacts included (1 mark for any of these):
The cave development would probably result in damage to the cave structure from creating paths, walkways, attaching handrails, building steps and installing lighting.

There could also be erosion of the cave floor, if there were no walkways in some areas.

Geological structures (stalactites, stalagmites) could be damaged during construction.

People may touch geological structures, contaminating them with oils from their skin.

The sensitive cave ecosystem (perhaps including cave spiders, cave crickets) would be disturbed.

Lighting would impact cave species which are adapted to total darkness.

Species including microbes will be introduced to the cave by visitor movements (for example, on shoes) and may have negative impacts on cave ecosystems.

Since the proposal is for ‘self-guided adventure tourism’, unsupervised visitors may behave irresponsibly. This could result in fragile cave structures being damaged/broken, littering, people accessing areas off the paths, or shining bright lights directly on cave species.

Suggested solutions included (1 mark for any of these):

- Exercise all possible care during construction work and supervise construction workers very carefully to minimise impacts to the physical structures of the cave.

- Have walkways to prevent erosion of the cave floor.

- Have some areas which are ‘off-limits’ and which retain their natural state.

- Have rules which are clearly explained to visitors such as, ‘no touching cave organisms’, ‘no shining lights directly onto cave organisms’.

- Give a briefing presentation before visitors enter the cave, explaining why it is important not to touch the cave structures and how to minimise all impacts.

- Have low-intensity lights or red lights which do not disturb cave species.

- Have lights which turn off automatically after visitors pass by, instead of polluting the cave with lights left on all the time.

- Have footwear washing stations at the entrance to the cave.

- Have guided, supervised tours instead of self-guided tours.

COMMENTS

Question 25 was answered well by most candidates and many gained close to full marks.

(a) ‘EIA’ received the full mark. A ½ mark was given for other reasonable suggestions which would be components of the EIA. No marks were given for unrealistic suggestions such as, ‘No impact on organisms/ecosystems’ or ‘No threatened species must be present’.

(b) Some candidates named two stakeholders but only gave one set of shared concerns – this approach generally failed to gain full marks. Some candidates failed to recognise the convention that ‘stakeholders’ are people who are affected/impacted/concerned by a development. Although people (e.g., members of conservation groups, aboriginal people and others) may speak on behalf of other species or ecosystems, no credit was given for naming non-human species, wildlife or ecosystems as ‘stakeholders’ in themselves.
(c)  I mark for each significant impact and 1 mark for the suggested, specific, solution. Many candidates lost marks because they overlooked the need to suggest solutions. Vague statements like, ‘Ensure there is minimal impact’ gained no marks.

Some candidates lost marks for identifying human safety issues rather than ‘environmental impacts’ as required by the question.

Note on bats: Tasmanian bats, in general, roost in hollow trees, not in caves, so there was very little chance that bats would be found in the caves or impacted by this proposed cave development. Candidates were not expected to know this, and suggestions about bat impacts were accepted.

‘Translocation’ of species in one form or another was a suggested conservation strategy offered by a number of candidates. The marker viewed this with scepticism, especially in relation to bats. In general, translocation is more likely a ‘last resort’ strategy for highly endangered organisms (e.g. Tasmanian devils to Maria Island) rather than a routine mitigation response to development.

QUESTION 26

(a) Polluter pays principle/precautionary approach would be taken by the mining company. This is because they need to comply with permit conditions in order to avoid fines, preventable clean-up costs or loss/damage to their ‘social licence’ and reputation in the community.

(b) The State Government must ensure that the mining company abides by all relevant legislation and complies with their permit conditions. The Environment Protection Authority (EPA) may conduct environmental monitoring and require the mine to carry out monitoring. If the mine breaches laws or permit conditions, the government may fine or prosecute the company.

COMMENTS

Many candidates left this question blank or struggled to answer it. Many candidates made good use of Page 25 of the ‘Information Sheet’ to come up with usable strategies. Good marks were obtained by candidates who attempted the question, since a wide range of suggested ‘Sustainability Strategies’ was given credit if they gave a reasonable response to the question.

Examples included:

(a) Mining company:

• Full-cost pricing, as the mining company should price its products taking into account the full costs of all environmental protection measures, site clean-up and rehabilitation after mining ends.

• Efficient resource use, for example, ‘closed loop’ processes, cleaning up and reusing waste water on-site, using renewable energy to reduce carbon footprint and using renewable resources on the mine site; recycling site waste wherever possible.

Specific ‘actions’ could also be given as ‘strategies’, for example:

• Prevent/clean up run-off of contaminated water to nearby waterways (retention ponds/dams/bunds/artificial wetlands)

• Staged revegetation of the mine site

• Limit work hours to prevent truck movements after dark e.g. to prevent Tasmania devil roadkill

• Use light-coloured road surfaces, to improve wildlife visibility and reduce roadkill
• Minimise road building by using pre-existing roads
• Study/survey and protect biodiversity around the mine site
• Educate mine workers about biodiversity and threats to wildlife, to support compliance with the mining company’s environment protection strategies and increase knowledge, ‘buy-in’ and pride about the company’s environment protection achievements
• Follow all aspects of the Environmental Management Plan (EMP) carefully
• Gain approvals for all works on the site (follow EIA process)
• Manage noise, dust, pollution impacts—e.g. by wetting down dusty roads, covering conveyors and trucks, planting trees and other vegetation
• Research the site geology and aquifers carefully and do everything possible to prevent contamination of groundwater
• Build and maintain social licence through stakeholder consultation and aboriginal community engagement
• Fund conservation programs as ‘offsets’ to environment impacts e.g. Tasmanian Devil research
• Manage waste rock/overburden to reduce aesthetic impact. Recover minerals from waste rock wherever possible (efficiency of resource use)
• Minimise use of toxic materials in ore processing

(b) Tasmanian State Government: Other than monitoring/ensuring compliance/fines, other reasonable suggestions included:

• Site inspections
• Shutting down the operation in the event of major incidents/non-compliance
• Suspending the mine’s licence/permit if the operation does not comply with standards
• Requiring a significant bond to be paid before works start and not returning the bond to the company unless/until all required site clean-up, rehabilitation, revegetation has occurred at the end of the mining operation
• Limiting the size of the mine/the amount of resource that can be extracted
• Requiring any of the mine sustainability strategies suggested above, as part of the mine’s conditions.

QUESTION 27

(a) An Emissions Trading Scheme (ETS) involves putting a limit, or ‘cap’ on the total amount of carbon which can be emitted (1) but a carbon tax does not do this directly. A carbon tax creates a disincentive (1) to emitting carbon, since the more carbon emissions are associated with them, the more expensive products become (1). As a result, customers may choose cheaper products, which saves them money and also reduces carbon emissions. With an ETS, polluters buy permits (1) to produce carbon pollution. If a company has low emissions, it can sell its permits to companies who emit more (1). In this way, an ETS creates an incentive to emit less carbon (½) (due to the opportunity to sell permits to big polluters) as well as a disincentive to emit carbon pollution (½) which requires buying more permits to pollute.
(b) It is easier to weigh coal or measure the volume of petroleum before it is burned than to capture the CO2 gas emitted and weigh it (1). The amount of CO2 emitted when fossil fuels are combusted can be calculated since the carbon content of the fuel is known.

**COMMENTS**

(a) Although many candidates left this blank, it was well answered by many of those who attempted it. It was a very specific question, requiring detailed knowledge, but the most successful candidates demonstrated good understanding of the topic. Some candidates wrote about ‘carbon offsets’ which are a third approach to reducing carbon pollution. No credit was given for offset programs. Nor was credit given to other ‘Green Economics’ approaches such as subsidies or tax breaks for renewable energy technologies. Credit was also given to answers which included any of the following alternative points:

- Both a carbon tax and an ETS are intended to reduce carbon emissions and hence reduce global warming.
- Both are ‘economic signals’, which stimulate investment in clean technologies and the uptake of renewable energy.
- Both approaches stop the impacts of carbon pollution being externalities for business, and shift the burden for carbon pollution control onto the polluters.
- With an ETS, the market determines the price for permits.
- With an ETS, the level of the overall ‘cap’ on carbon pollution can be lowered by governments as time goes by, gradually reducing the maximum permitted level of overall carbon pollution.

(b) Credit was also given to answers which stated that CO2 is not the only greenhouse gas/pollutant released when fossil fuels are combusted, and a price on carbon can involve carbon equivalents (e.g. nitrous oxide) that also contribute to global warming.