Neap

Trial Examination 2022

VCE Environmental Science Units 3&4

Written Examination

Suggested Solutions

SECTION A – MULTIPLE-CHOICE QUESTIONS

1	A	**B**	C	D	16	A	B	**C**	D
2	A	B	C	**D**	17	A	**B**	C	D
3	**A**	B	C	D	18	**A**	B	C	D
4	A	B	**C**	D	19	A	**B**	C	D
5	**A**	B	C	D	20	A	B	**C**	D
6	A	B	**C**	D	21	A	B	**C**	D
7	A	B	C	**D**	22	A	B	**C**	D
8	A	**B**	C	D	23	A	B	C	**D**
9	A	**B**	C	D	24	A	B	C	**D**
10	A	B	C	**D**	25	A	**B**	C	D
11	A	**B**	C	D	26	A	B	C	**D**
12	**A**	B	C	D	27	**A**	B	C	D
13	A	**B**	C	D	28	A	**B**	C	D
14	A	B	**C**	D	29	**A**	B	C	D
15	**A**	B	C	D	30	A	B	**C**	D

Question 1 B

B is correct. Species diversity refers to the number of different species on Earth and the number of individuals within each species.

A is incorrect. Species richness only refers to the number of different species in an area.

C is incorrect. Ecosystem diversity refers to the number of different habitats and ecosystems on Earth.

D is incorrect. Biodiversity refers to the amount of different living organisms across all biomes, including the genetic variations of organisms and variety of ecosystems on Earth.

Question 2 D

D is correct. Climate change, genetic drift and natural selection all affect species diversity.

A, **B** and **C** are incorrect. These factors all affect species diversity by changing ecosystems or altering genetic diversity.

Question 3 A

A is correct. Inbreeding can affect small populations that are isolated from other populations of the same species. Limited options for gene flow can lead to inbreeding, which increases the chances of offspring being homozygous. This can reduce genetic diversity.

B and **C** are incorrect. Although mutations and natural selection can impact genetic diversity, they do not necessarily threaten genetic diversity.

D is incorrect. Genetic drift occurs when alleles are eliminated from a population due to a chance event. There is no information in the question that suggests this occurred.

Question 4 C

C is correct. Provisioning services provide elements that keep individuals in an ecosystem healthy. Option **C** describes the provision of shade to the ecosystem.

A and **B** are incorrect. These options describe regulating services.

D is incorrect. This option describes a cultural service.

Question 5 A

A is correct. The *Environment Protection and Biodiversity Conservation Act 1999* (Australia) is a Commonwealth/federal legislation act that protects threatened species in Australia from harm.

B is incorrect. The *Flora and Fauna Guarantee Act* (Vic) is a piece of state government legislation that protects species from harm in Victoria only.

C is incorrect. The Convention on International Trade in Endangered Species (CITES) treaty is an international treaty designed to protect species from poaching and international trade.

D is incorrect. The Gippsland Lakes Ramsar Site Management Plan is a local government protection plan.

Question 6 C

C is correct. The mark-recapture technique is most appropriate for sampling a bird species.

A is incorrect. Transect sampling is most appropriate for sampling ecosystem zonation.

B is incorrect. Quadrat sampling is most appropriate for sampling the composition of plant communities or mostly stationary animals in an ecosystem.

D is incorrect. The collection method is not a known sampling technique for field studies in Environmental Science.

Question 7 D

D is correct. The independent variable is the factor that, when changed, affects the dependent variable. As the hypothesis is stating that the number of off-lead dogs will affect the number of Australian fairy terns, option **D** is the correct response.

A is incorrect. The number of Australian fairy terns is the dependent variable in this field study.

B is incorrect. The number of other bird species in the area may be an extraneous variable in this field study.

C is incorrect. The time of day could be a controlled variable in this field study.

Question 8 B

B is correct. The El Niño–Southern Oscillation cycle can last for three to eight years. This climatic pattern can lead to drought in Australia that may impact the survival of some species, thus altering biodiversity.

A is incorrect. The El Niño–Southern Oscillation does not keep biodiversity stable in Australia.

C is incorrect. The El Niño–Southern Oscillation does not keep biodiversity stable in Australia, and the resulting climatic changes are experienced in Australia and in Central and South America.

D is incorrect. The El Niño–Southern Oscillation does not alter volcanic activity in Australia.

Question 9 B

B is correct. The bioaccumulation of dichlorodiphenyltrichloroethane (DDT) can show in the reproductive tissue of Australian peregrine falcons, leading to thin eggshells and a low chick survival rate.

A is incorrect. The ingestion of DDT by the falcon is not likely and, if this did occur, the DDT would not collect in the reproductive tissues.

C is incorrect. The falcon is not able to excrete DDT.

D is incorrect. Mature feathers are not living tissue and would not absorb DDT.

Question 10 D

D is correct. Translocation is a technique to conserve threatened or endangered species. It involves reintroducing the endangered species back into an area where they had previously become extinct.

A is incorrect. This option describes wildlife corridors.

B is incorrect. This option describes gene banks.

C is incorrect. This option describes captive breeding programs.

Question 11 B

B is not a correct statement and is therefore the required response. The precautionary principle states that all precautions must be taken to protect the environment, even if data is lacking. As this project does not have sufficient data to say that no harm will come to the whale and dolphin species, the precautionary principle would indicate that the project should not go ahead.

A is a correct statement. It is not possible to maintain ecological integrity while seismic blasting is occurring.

C is a correct statement. Intragenerational equity was likely considered as the project may provide a way to supply gas to the population of this generation.

D is a correct statement. It is likely that the biosphere will be negatively impacted by this project, as animals will be affected by the seismic blasts.

Question 12 A

To find the percentage decrease, subtract the final value from the starting value, divide that answer by the starting value and multiply the resultant value by 100.

$$40 - 2 = 38$$

$$\frac{38}{40} = 0.95$$

$$0.95 \times 100 = 95\%$$

Question 13 B

Statements I and II are the only correct statements. Statement III incorrectly suggests that the ecological integrity of the site decreased. Between 2015 and 2017, the ecological integrity of the site increased as the number of boneseed plants decreased.

Question 14 C

C is correct. The mouse plague is affecting crops, which provide food to the Australian population.

A is incorrect. The information in the question does not refer to the mice affecting water supplies.

B is incorrect. The information in the question does not refer to the mice affecting any forms of energy production.

D is incorrect. The mouse plague will not affect human population numbers.

Question 15 A

A is correct. Out of all the Earth's spheres, the bromadiolone will least affect the atmosphere.

B is incorrect. Bromadiolone will impact wildlife and plants species (biosphere).

C is incorrect. Bromadiolone will leach into waterways (hydrosphere) from farm runoff.

D is incorrect. Bromadiolone will impact the soil (lithosphere) if applied to crop land.

Question 16 C

C is correct. Carbon dioxide is a greenhouse gas and heavily released during volcanic eruptions.

A is incorrect. Methane is not significant in volcanic activity.

B and **D** are incorrect. Sulphur dioxide and hydrogen sulphide are not considered to be greenhouse gases.

Question 17 B

To find the energy efficiency, divide the energy out by the energy in and multiply the result by 100. For the solar panels, the energy in and energy efficiency are known values, and the energy out is unknown. Let energy out = x.

Using inverse operations:

$$\frac{x}{5} \times 100 = 20\%$$

$$\frac{x}{5} = 0.2$$

$$\left(\frac{x}{5}\right) \times 5 = (0.2) \times 5$$

$$x = 1$$

Therefore, the output to the home is 1 kW.

Question 18 A

A is correct and **B** and **C** are incorrect. There is no correlation between solar activity and global temperature in the graph.

D is incorrect. The graph shows an upward trend in global temperature.

Question 19 B

B is correct. Fluctuations in solar activity do not affect volcanic activity. Solar activity and volcanic activity are independent environmental changes.

A, **C** and **D** are incorrect. Solar activity affects wind, the water cycle and cloud cover.

Question 20 C

C is correct. Volcanic activity is a natural event that increases levels of carbon dioxide (CO_2) in the atmosphere, thus increasing greenhouse gases and impacting the natural greenhouse effect.

A and **B** are incorrect. Water vapour is the gas that contributes the most to the natural greenhouse effect, not CO_2 or methane.

D is incorrect. Industrial agriculture is a human activity that contributes to the enhanced greenhouse effect, not the natural greenhouse effect.

Question 21 C

C is correct. The industrial meat industry in the US produces methane, which is the greenhouse gas with the greatest global warming potential.

A, **B** and **D** are incorrect. These options describe human activities that produce CO_2, which has a lower global warming potential than methane.

Question 22 C

C is correct. Ice core sampling is the method that can produce the most accurate historical record of global atmospheric CO_2 data.

A is incorrect. Although tree-ring samples can sometimes measure CO_2 levels, they cannot provide data as far back as 800 000 years.

B is incorrect. Ocean temperature changes show changes in atmospheric temperature, not CO_2 levels.

D is incorrect. Sedimentary rock samples show historical data of the biosphere via fossils, not CO_2 levels.

Question 23 D

D is correct. Volcanic eruptions release a significant amount of CO_2 into the atmosphere and have caused fluctuations in CO_2 levels throughout history.

A is incorrect. The burning of fossil fuels only began in the 1800s.

B is incorrect. Although melting glaciers can alter atmospheric CO_2 levels, this is not the main reason for the fluctuation.

C is incorrect. A mass extinction would not cause huge fluctuations in atmospheric CO_2 levels.

Question 24 D

D is correct. Promoting land-based activities will not build resilience against the severity of tropical cyclones. Land-based tourism would still be affected by tropical cyclones.

A is incorrect. Enhancing the technology responsible for warning the public of an incoming cyclone would mean that the public can prepare their homes for an incoming cyclone to prevent damage or move to a safe area earlier.

B is incorrect. Enhancing coastal infrastructure will lessen the erosion of land.

C is incorrect. Researching alternate, higher altitude sites for subsidence farms could mean that people would no longer lose food sources when low-lying land is damaged by tropical cyclones.

Question 25 B

B is correct. Hydro-electric power plants need to disrupt the natural flow of a river in order to create electricity, whereas tidal-power plants make use of the rise and fall of the ocean and do not disrupt the natural flow of the tides.

A is incorrect. This statement is describing an advantage of hydropower, rather than a disadvantage.

C and **D** are incorrect. These options are false statements.

Question 26 D

D is correct. Revegetating the land is the only biological rehabilitation strategy shown as an option.

A, **B** and **C** are incorrect. These responses all refer to mechanical mine rehabilitation strategies.

Question 27 A

A is correct. The user pays principle is based on the idea that the person, people or organisation that is utilising a natural resource should be incurring the full cost of the resource. In this case, a rise in coal prices reflects the fact that there is more reliance on coal burning for electricity while the hydro-electric dams are making less electricity.

B is incorrect. The precautionary principle refers to the idea that new projects should not be undertaken if data is not available to guarantee environmental health, which is not relevant in this question.

C is incorrect. The fluctuation in coal prices is not due to regulatory frameworks, which are usually initiated by the government.

D is incorrect. An environmental impact assessment should, theoretically, already exist before the opening of the coal mines.

Question 28 B

B is correct. The albedo effect occurs due to light surfaces reflecting more solar energy than dark surfaces, which absorb the energy. This experiment is comparing the effects of light being shined on different-coloured surfaces.

A is incorrect. An experiment testing the enhanced greenhouse effect would compare greenhouse gases with oxygen.

C and **D** are incorrect. There is no carbon or water present in this experiment.

Question 29 A

A is correct. All three boxes should have the lights positioned at the same distance from each box to ensure a fair experiment. This variable should be controlled in each trial.

B is incorrect. The colour of the box is the independent variable.

C is incorrect. The temperature is the dependent variable.

D is incorrect. The location of the laboratory in the school would, theoretically, not affect the results.

Question 30 C

C is correct. Systematic errors occur due to inaccuracy in the measuring equipment used, such as the thermometers, and will be consistent each time the measurement is taken.

A is incorrect. Personal errors are mistakes such as observer errors or miscalculations.

B is incorrect. Random errors include errors made when reading the measuring equipment, not the equipment itself.

D is incorrect. Temperature errors are not a legitimate type of experiment error in the scientific method.

SECTION B

Question 1 (15 marks)

a. The three reintroduced sites are protected by humans using a fence and have been deliberately altered to keep out foxes and cats. 1 mark

As this is not the 'wild', the eastern barred bandicoot still has no wild populations. 1 mark

b. *For example:*

Inbreeding is another threat this species faces. 1 mark

This threat can affect small populations that are isolated from other populations of the same species, such as the eastern barred bandicoot populations. 1 mark

Limited options for gene flow can lead to inbreeding, which increases the chances of offspring being homozygous. This can reduce genetic diversity, thus threatening survival. 1 mark

Note: Accept other relevant threats. Acceptable responses could include competition from introduced, non-predatory species; changes in habitat due to climate change; or the inability to cope with disease due to a small population.

c. *For example:*

The *Environment Protection and Biodiversity Conservation Act 1999* (Australia) is national legislation, while the *Flora and Fauna Guarantee Act* (Vic) is state legislation.

Both acts protect threatened or rare species from harm as a means of conservation.

The *Environment Protection and Biodiversity Conservation Act 1999* (Australia) could be considered as being more beneficial as the species has a greater geographic range of protection.

3 marks

1 mark for stating a difference between the Acts.
1 mark for stating a similarity between the Acts.
1 mark for making a statement about which legislation is more beneficial to the survival of the species with appropriate justification.

d. *For example:*

Another conservation technique that could be used is a gene bank for eastern barred bandicoot DNA.

If genetic diversity is low, the stored genes and DNA of the threatened species could be infused into the population to conserve genetic diversity.

3 marks

1 mark for identifying an appropriate technique.
1 mark for explaining the chosen technique.
I mark for noting how the chosen technique conserves genetic diversity.
Note: Accept other relevant conservation techniques. Acceptable responses could include baiting, capturing and culling predators in natural areas or building wildlife corridors for close populations.

e. **i.** *Any one of:*

- anthropocentric values
- ecocentric values

1 mark

ii. *Sample response (anthropocentric values):*

These reserves are based on anthropocentric values because the school students are benefitting by learning and tourists are gaining enjoyment from visiting the reserve.

Sample response (ecocentric values):

These reserves are based on ecocentric values because their purpose is to protect biodiversity.

1 mark

Note: Both justifications are acceptable, but the response must be relevant to the value system chosen in ***Question 1e.i.***

iii. **Anthropocentric:** Anthropocentric values are those that emphasise the importance of humans and use the environment primarily to benefit humans. 1 mark

Ecocentric: Ecocentric values are those that emphasise the importance of the environment/ecosphere and of humans equally. 1 mark

Question 2 (10 marks)

a.

Species recorded at site B	n_i	$n_i - 1$	$n_i(n_i - 1)$
brolga	0	**0 – 1 = –1**	**0 × –1 = 0**
orange bellied parrot	0	**0 – 1 = –1**	**0 × –1 = 0**
red-necked avocet	6	**6 – 1 = 5**	**6 × 5 = 30**
chestnut teal	25	**25 – 1 = 24**	**25 × 24 = 600**
silver gull	30	**30 – 1 = 29**	**30 × 29 = 870**
straw-necked ibis	12	**12 – 1 = 11**	**12 × 11 = 132**
black-faced cuckoo-shrike	15	**15 – 1 = 14**	**15 × 14 = 210**
N =	**88**		$\sum\left[n_i(n_i-1)\right] = 1842$ Σ
N(N – 1)	**88 × 87 = 7656**		

Therefore $D = 1 - \dfrac{\sum\left[n_i(n_i-1)\right]}{N(N-1)}$

$D = 1 - \dfrac{\mathbf{1842}}{\mathbf{7656}}$

$D = 1 - \mathbf{0.241}$

$D = \mathbf{0.759}$

The Simpson's Index (D) for site B is **0.759**.

3 marks

Award 3 marks for providing the correct calculations, correct table entries and correct final answer.
Award 2 marks for providing the correct table entries and significant progress in the calculation (including minor errors resulting in an incorrect final answer).
Award 1 mark for providing some correct table entries and calculations.
Note: Award a maximum of 2 marks if the final answer is incorrectly rounded to 0.760 or 0.800.

b. Site A has a higher species diversity. 1 mark

Site A has a D value of 0.767 and Site B has a D value of 0.759.A higher D value equates to a higher species diversity; therefore, site A, which has a higher D value, has a higher species diversity. 1 mark

*Note: If incorrect rounding is used in **part a.**, the D value at site B should be 0.760 or 0.800 and the data quoted for the second mark should reflect the calculated value.*
*Note: Consequential on answer to **Question 2a.***

c. **i.** *For example:*

Birdwatchers may count the same bird twice. 1 mark

This could lead to inaccurate data. 1 mark

Note: Accept other appropriate limitations, including amateur/hobbyist birdwatchers misidentifying bird species.

ii. mark-recapture 1 mark

d. *For example:*

Birds supply a provisioning service. Birds can pollinate crops, which provide food for humans.

2 marks

1 mark for identifying a relevant ecosystem service.
1 mark for an appropriate explanation.
Note: Acceptable responses could include cultural services via the recreation activity of birdwatching and regulating services via the cycling of carbon.

Question 3 (7 marks)

a. *For example:*

This court ruling does not meet the principle of intergenerational equity. Intergenerational equity considers the impact that a project has on future generations. As part of this, environmental, social, and economic impacts must be considered.

This court ruling allows the logging of old growth forests for timber resources in Australia. This project will be severely harmful to the animal species in the area. It will potentially drive the Leadbeater's possum to extinction, meaning that future generations may not have the ability to view the animals in their natural habitat or benefit from the ecosystem services provided by the forest.

Once the old growth trees have been logged, they must be transported and milled for use in construction. This requires fossil fuels. The use of fossil fuels does not meet the principle of intergenerational equity as combustion leads to the enhanced greenhouse effect and subsequent global warming.

3 marks

1 mark for stating whether the project does or does not meet intergenerational equity.
1 mark for discussing why this project does or does not meet intergenerational equity.
1 mark for showing a clear understanding of the principles in a cohesive response.

b. *Environment Protection and Biodiversity Conservation Act 1999* (Australia) 1 mark

Note: Exact terminology must be used (that is, 'Environment Protection and Biodiversity Conservation Act 1999').

c. The precautionary principle states that all care must be taken to ensure that no irreversible damage occurs to biological resources or living species when planning environmental projects.

As the project allows logging to resume in the forest, which is a significant habitat for the Leadbeater's possum and other threatened species, it is likely that it will cause harm.

This court ruling does not meet the precautionary principle as it states that the project should not proceed if it threatens to harm the environment.

3 marks

1 mark for defining the precautionary principle.
1 mark for describing how logging can damage the environment.
1 mark for linking the environmental damage to the precautionary principle.

Question 4 (10 marks)

a. Using hydro-electric power would mean that the natural river flow is altered. This can have a negative impact on wildlife, such as fish species, and natural forest land.

2 marks
1 mark for noting the environmental change.
1 mark for commenting on how the change could have a negative impact on the environment.

b. The gravitational potential energy (GPE) of water is stored in the dam. 1 mark

GPE is converted into kinetic energy when the water is released. 1 mark

Kinetic energy is converted to mechanical energy by a turbine. 1 mark

Mechanical energy is converted to electrical energy by a generator. 1 mark

c. Electricity that is being sold to other countries must travel further than electricity that is being used in Costa Rica. 1 mark

Heat loss would occur during the transfer process used to send the electricity to neighbouring countries. 1 mark

This means that distribution is more efficient within Costa Rica than sending it to neighbouring countries. 1 mark

d. *Any one of:*

- biogas
- solar power

1 mark

Question 5 (8 marks)

a. Both bleaching alert peaks happen around the January to March period on the graph. 1 mark

This coincides with the Australian summer, which is the hottest part of the year. 1 mark

b. Both instances of bleaching warnings occur at the same time as the average sea temperature reaching above 30°C. 1 mark

Therefore, it can be concluded that a sea temperature of above 30°C triggers a coral bleaching event. 1 mark

c. *For example, any one of the following anthropocentric impacts:*

- Loss of colour in the coral on the reef can lead to the loss of tourism income.
- Loss of reef species can reduce the appeal of dive sites.
- Loss of fish species from reduced prey options can lead to impacts on the fishing industry.

1 mark

For example, any one of the following environmental impacts:

- Coral species reject *Zooxanthellae*, their symbiotic algae, resulting in the loss of their food source and bright colours.
- loss of fish species that prey on coral
- loss of habitat for various small fish, mollusc and crustacean species

1 mark

d. The average monthly sea surface temperature fluctuates due to naturally occurring fluctuations in solar activity. 1 mark

The differences in solar output during summer and winter lead to differences in sea temperature. 1 mark

Question 6 (16 marks)

a. *For example:*

A mechanical process that may be implemented is the demolition of infrastructure. This involves knocking down and removing all trace of buildings and vehicles that were used during the operation of the mine.

2 marks

1 mark for identifying an acceptable mechanical rehabilitation method.
1 mark for describing what the named method involves.
Note: Accept other mechanical rehabilitation methods. Acceptable responses could include replacing rock and soil to cover the crater or pit; or dredging mud or polluted water from storage dams.

b. *For example:*

The mining of coal for electricity means coal must be combusted. Increased atmospheric CO_2 from combustion can lead to an increased uptake of CO_2 into oceans. This would lead to ocean acidification.

3 marks

1 mark for identifying an acceptable impact.
1 mark for explaining how the named impact would enter the carbon cycle.
1 mark for noting the impact of this change.
Note: Accept other relevant responses. Acceptable responses could include increased CO_2 leading to greater trapping of heat energy in the atmosphere, which would lead to increased global temperatures.

c. **i.** *For example:*

Employees of the current mine may be for the excavation and opening of a new mine. They may hold this opinion as they will likely get to keep their jobs.

2 marks

1 mark for naming an appropriate, relevant stakeholder that is in favour of the project.
1 mark for providing an appropriate reason for their opinion.

ii. Environmental groups may be against the excavation and opening of a new mine. They may hold this opinion if they are concerned about climate change caused by CO_2 emission from the mine.

2 marks

1 mark for naming an appropriate, relevant stakeholder that is against the project.
1 mark for providing an appropriate reason for their opinion.

d. *For example:*

A harmful impact on the biosphere would be the removal of vegetation, which must be removed or knocked down when the new mine is excavated.

This would lead to loss of habitat for animal species in the area.

2 marks

1 mark for identifying an acceptable impact.
1 mark for describing how the named impact would affect the biosphere.
Note: Accept other relevant impacts. Acceptable responses include release of toxins into watercourses and ground water; permanent disruption of rock layers and soil integrity leading to unproductive land post mine rehabilitation for regrowth of native flora; additional anthropogenic climate change leading to global warming and flow on impacts on the biosphere.

e. *For example:*

While neither project allows for the improvement of Australia's sustainable development, the project that should be approved is the new coal mine.

As the existing mine was already contributing to global CO_2 emissions, the new mine will not contribute additional emissions to the atmosphere.

Both projects will need infrastructure to be set up, which will require machines that burn fossil fuels and the removal of trees at the site. The projects will both contribute to CO_2 levels during setup.

The new, large-scale cattle farm would lead to a huge production of methane, a greenhouse gas with a greater global warming potential than carbon dioxide. The CO_2 emissions from the farm would also be large, as production of feed and fermentation of waste releases carbon dioxide.

From a social aspect, the new coal mine will mean that employees who already work for the company will be able to keep their roles, although open pit mines contribute to many health issues for surrounding populations. From an animal welfare perspective, the new cattle farm will mean that thousands more animals will be killed per year as part of the meat industry; the general condition of cattle farms is an ethical issue as well.

5 marks

1 mark for stating which project should be approved.
1 mark for discussing the global warming potential of both projects.
1 mark for discussing the environmental impacts of both projects.
1 mark for discussing the social ethics of both projects.
1 mark for showing a clear understanding of the principles in a cohesive response.
Note: Responses may recommend either project be approved. Accept responses that recommend rejecting both projects if appropriate justification is given.

Question 7 (10 marks)

a. The graph shows that, regardless of the predicted outcome, the temperature will increase over the next 80 years. 1 mark

It shows that the surface temperature change could potentially increase by a maximum of approximately 4.2°C and a minimum of approximately 1°C. 1 mark

b. $4.2 - (-0.5) = 4.7°C$ 1 mark

Note: Accept values that vary by ±0.1°C.

c. The enhanced greenhouse effect occurs because of increased greenhouse gases in the atmosphere absorbing infrared radiation that has been re-emitted from the Earth's surface. 1 mark

Global temperatures rise as a result. 1 mark

The predictions in the graph are affected by the amount of greenhouse gases that may or may not actually be released into the atmosphere between now and 2100. 1 mark

d. *For example:*

One impact that increased global temperatures will have on the environment is thermal expansion. Ocean water molecules will expand, causing sea levels to rise.

2 marks

1 mark for identifying an acceptable impact.
1 mark for outlining the named impact.
Note: Accept other relevant impacts. Acceptable responses could include coral bleaching as a result of rising ocean temperatures and changes in biodiversity from organisms not adapting.

e. *For example:*

An adaptation action that could be used is upgrading the design of coastal infrastructure, including upgrading housing and building sea walls or other protective structures. This would benefit areas that are expected to be impacted by rising sea levels.

2 marks

*1 mark for identifying a relevant action that could be taken by the Australian government to combat the impact identified in **part d.***
*1 mark for a description of how the named action would combat the impact identified in **part d.***
*Note: Accept other relevant adaptation actions that combat the impact identified in **Question 7d.** For example, if the impact identified in **part d.** is coral bleaching, an appropriate adaptation action would be to change the location of dive and snorkel tour operators.*

Question 8 (14 marks)

a. **Independent:** temperature 1 mark

Dependent: average mass of honey 1 mark

b. *For example:*

It is predicted that, as temperatures increase above 24°C (the September average), the average mass of honey produced will decrease. This is because the bees' optimal activity level is likely to coincide with the climate in which they are found.

2 marks

1 mark for outlining a relationship between the independent and dependent variable.
1 mark for providing an appropriate explanation of the hypothesis.
Note: Accept other relevant hypotheses that appropriately reflect the scenario.

c. *For example, any one of the following safety precautions:*

- Wear protective equipment to avoid bee stings.
- Wear sun protection when working outdoors.
- Be careful with heating equipment when subjecting the hives to different temperatures.

1 mark

For example, any one of the following ethical considerations:

- Do not harm the bees.
- Be careful not to change the structure of the natural hive.
- Do not harm other animals in the area.

1 mark

Note: Accept other relevant safety precautions and ethical considerations.

d. Validity refers to how closely an experimental conclusion can be related to real life. 1 mark

There are many extraneous variables that could not be controlled in this experiment (for example, flower species and predators). 1 mark

Therefore, the validity of the experiment is low. 1 mark

e. *For example:*

At temperatures 4°C below or above the bees' regular climate, bee activity slows (as shown by the rate of honey production).

This can be seen in the graph as, at 20°C and 28°C (± 4°C from the average climate), the bees produce at least 30 grams less honey per month than their potential maximum.

2 marks

1 mark for linking the change from the temperature of the bees' regular climate due to climate change to a reduction in bee activity (reduced production of honey).
1 mark for using appropriate data to support the response.
Note: Accept other relevant conclusions. Responses must refer to the data in the graph.

f. *For example:*

The experiment is designed to test whether the activity of bees will be affected by the predicted rise in global temperatures over the coming 100 years. According to the results of the experiment, a variation of 4°C will cause bee activity to slow. Less bee activity means less pollination of some important crops, which may lead to a reduction in some food sources globally.

3 marks

1 mark for identifying the relationship to climate change.
1 mark for referring to the results of the experiment.
1 mark for identifying the implication for food/crop production.

