STUDENT NUMBER:-- -

STUDENT NAME: _____ CLASS: _____

ENVIRONMENT EDUCATION VICTORIA

Victorian Certificate of Education 2021

ENVIRONMENTAL SCIENCE

SOLUTIONS

Trial Written Examination

Reading time: 15 minutes
Writing time: 2 hours

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of Questions*	*Number of Questions to be answered*	*Number of Marks*
A	30	30	30
B	9	9	90
			Total 120

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied
- Question and answer book of 32 pages
- Answer sheet for multiple-choice questions

Instructions
- Write your **student number, name** and **class** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.----------

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room

Reviewed by: Dr Maddy Yewers [MSci, PhD - Ecology and Evolutionary Biology]

Please note this is a practice exam only and its degree of hardship and content is different to the end of year exam.
EEV takes no responsibility for your success in completing the actual VCE Environmental Science exam.

Section A - Multiple Choice Questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Total marks for this section: **30 marks**

Question 1

Which of the following is ***not*** an accepted criteria for a mass extinction event?

- **A.** The event must have occurred in a relatively short time frame
- **B.** The extinction involves multiple lifeforms and is widespread
- **C.** A significant part of life on Earth became extinct
- **D.** The cause of the mass extinction must be obvious

Question 2

Which of the following events resulted in the most species extinctions overall?

- **A.** Ordovician-Silurian
- **B.** Cretaceous-Tertiary
- **C.** End Permian
- **D.** End Triassic

Question 3

Which of the following best describes the distribution and variety of DNA and inherited traits amongst a population of organisms?

- **A.** Genetic abundance
- **B.** Species abundance
- **C.** Genetic diversity
- **D.** Species diversity

Use the following information to answer Questions 4 and 5.

The water hyacinth *(Eichhornia crassipes)* is a floating waterlily-type freshwater aquatic plant. This plant was introduced to Australia in the early 1900s as an ornamental plant for ponds and is now one of the world's worst weeds, causing environmental damage to lakes and rivers in QLD and NSW.

The water hyacinth has the ability to bio-magnify a high concentration of heavy metals (such as mercury and lead) in its leaf tissues without suffering damage to the actual plant. Some studies have suggested growing large numbers of water hyacinth in lakes that are contaminated by mercury will improve the condition of the water in the lakes.

Question 4

Which of the following ecosystem services is achieved by growing water hyacinth in mercury-contaminated lakes?

A. Nutrient cycling

B. Climate control

C. Soil formation

D. Water purification

Question 5

Which of the following explains how water hyacinth could harm the local lake environments?

A. Take nutrients and resources from native fish species

B. Change the genetic makeup of native fish species

C. Decrease the oxygen in the lake for local fish

D. Contribute to the overfishing problem by trapping local fish species

Question 6

The Sumatran Rhinoceros *(Dicerorhinus sumatrensis)* is the smallest of the rhinoceros species. Populations of this animal can be found in tropical rainforests on the Indonesian islands of Sumatra and Borneo. It is estimated that fewer than 80 individuals remain in highly fragmented populations on these islands. In the past 15 years, just two captive females have produced offspring.

According to the IUCN, which of the following is the most likely conservation category for the Sumatran Rhinoceros?

A. Extinct in the wild

B. Critically endangered

C. Endangered

D. Highly threatened

Question 7

Which of the following is true of genetic drift?

- **A.** It is a result of natural selection
- **B.** It only occurs in large populations
- **C.** It happens as a result of a large increase in population size
- **D.** It is a chance loss of an allele from a population

Question 8

Biodiversity changes may happen naturally, due to natural selection, brought on by the isolation of populations.

Which of the following describes a short-timescale, natural occurrence that may lead to population isolation?

- **A.** El Niño
- **B.** Bushfire
- **C.** New housing developments
- **D.** Tectonic movements

Use the following information to answer Questions 9-11.

Christmas Island is an Australian territory island, found approximately 350km south of the Indonesian islands of Java and Sumatra. Huge populations of red crabs inhabit burrows and rock crevasses in the tropical rainforest that covers much of the island. The crustaceans migrate from the rainforest to the shoreline for breeding once a year at the beginning of the wet season.

Although more than half of Christmas Island is dedicated as a national park, the island is still home to a population of around 2000 people. During the migration, the crabs must navigate roads, predatory birds and ants, and backyard pets to make it safely to the sea to spawn.

Source: https://parksaustralia.gov.au/christmas/discover/highlights/red-crab-migration/

As a measure in the protection and maintenance of the red crab population, 'crab bridges' (see image above) have been built over some roads to allow the crabs to cross without the danger of traffic. The 'crab bridges' are aided by roadside barriers to stop the crabs crossing the busy roads away from the bridge.

Question 9

The 'crab bridges' act as a strategy in the protection and maintenance of the biodiversity on Christmas Island.

Which of the following best describes 'crab bridges'?

A. Wildlife corridor

B. Translocation zone

C. Conservation bridge

D. Habitat regeneration zone

Question 10

The Christmas Island Tourism Association has used the bridges as part of their tourism marketing campaign to attract visitors to come to the island to view the migration.

Which of the following best describes this approach?

A. Ecocentric

B. Anthropocentric

C. Biocentric

D. Species-centric

Question 11

As part of a wildlife study, an environmental science student has suggested collecting data of the air temperature on the first day of the crab migration over a series of 5 years. She has also suggested comparing the values of air temperature to the number of crabs that successfully cross one particular bridge, to arrive at the sea, in that year. The purpose of her study is to try and determine if there is a correlation between air temperature and the number of crabs that successfully arrive at the sea in one particular area of the island.

Which of the following is ***not*** an appropriate ethical or safety guideline specific to this field investigation?

A. The environmental scientist must wear personal sun protection equipment when collecting data

B. The environmental scientist must take all measures possible to not disturb the natural movement of the crabs when collecting data

C. The environmental scientist must take all precautions in minimising the miscounting of crabs as they pass the end of the bridge

D. The environmental scientist must ensure all members of her data collection team display appropriate behaviour when in and around the water's edge

Use the following information to answer Questions 12 and 13.

Christmas Island is also home to the critically endangered Christmas Island flying fox. Roughly a quarter of Christmas Island Flying-fox habitat has been lost since the late 1880s due to mining and other developments on Christmas Island. Other threats include predation by feral cats, poisoning from environmental contaminants and physical disturbance and habitat change caused by Yellow Crazy Ants.

Question 12

To estimate the size of the flying fox population on Christmas Island, conservationists used the mark-recapture method. On the first night session of sampling they captured, marked and released 312 individuals. A week later they captured 625 flying foxes, of which 75 had been marked.

Which of the following is the best estimate of the size of the Christmas Island flying fox population?

A. 38

B. 150

C. 1300

D. 2600

Question 13

The Christmas Island flying fox is endemic to Christmas Island.

Which of the following best describes the term 'endemic' in this context?

A. Conservation management techniques being applied are vitally important to conserve the species

B. The population of flying foxes is at risk of extinction

C. The population of flying foxes are only found on Christmas Island

D. Christmas Island is a biodiversity hotspot

Question 14

Which one of the following is considered a fossil fuel?

A. Nuclear energy

B. Hydroelectricity

C. Geothermal energy

D. Natural gas

Question 15

Which of the following statements is the most correct regarding the Global Warming Potential of atmospheric gases?

A. It is a measurement of the gases absorption capability of infrared radiation

B. It is a measurement of the atmospheric lifetime of the gas

C. It is measured relative to 1 ton of CO_2 emissions

D. It is a measurement of climate change

Question 16

Iceland is one of very few countries that currently provides its citizens with electricity produced from 100% (or very close to 100%) renewable energy.

A leader in fighting climate change, Icelandic energy companies also undertake a process in which CO_2 is removed from the atmosphere, dissolved in H_2O and injected into basalt rock at around 500m below the surface.

Which of the following best describes this process?

A. The hydrogen cycle

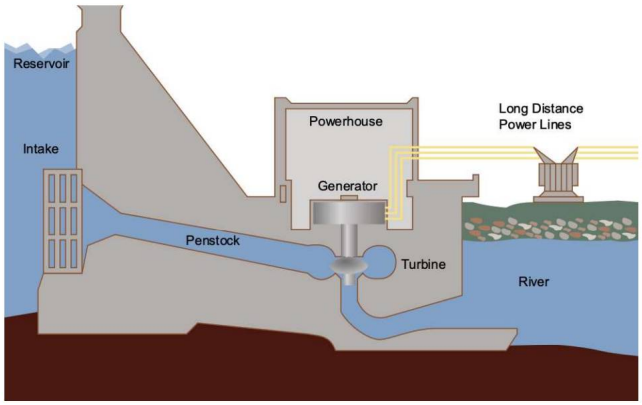
B. Carbon sequestration

C. Short term carbon storage

D. Acceleration of the carbon cycle

Use the following information to answer Questions 17 and 18.

The image below shows a hydroelectric power station



Source: Tennessee Valley Authority; SVG version by Tomia, CC BY-SA 3.0 http://creativecommons.Org/licenses/by-sa/3.0/ via Wikimedia Commons

Question 17

What type of energy does the water in the turbine represent?

A. Potential

B. Chemical

C. Kinetic

D. Electric

Question 18

The turbine is able to convert 1500 KJ of mechanical energy into 1000 KJ of electrical energy every second.

What is the percentage efficiency of the water turbine?

A. 5%

B. 25%

C. 67%

D. 150%

Question 19

The production of hydrogen powered cars is predicted to increase in the coming years as part of the Australian government's strategy to lower carbon emissions.

Which of the following is a major environmental advantage of hydrogen gas as a fuel source?

A. It can be easily extracted from the atmosphere

B. No CO_2 is emitted in the burning process

C. It is easier than petrol to store in a car

D. Bulk transportation is easier than bulk transportation of petrol

Question 20

The Ranger Uranium Mine is 230km east of Darwin. It is an open-cut uranium oxide (U3O8) mine, within Kakadu National Park, traditionally owned by the Bininj people.

The mine ceased functioning in January of this year and the rehabilitation process has begun.

Which of the following is ***not*** a description of a mechanical rehabilitation strategy for the Ranger Uranium Mine?

A. Replacing rock and soil to cover in the crater or pit

B. Replanting of plant species native to the site

C. Dredging mud from the water storage dams

D. Demolition of the buildings and infrastructure

Question 21

Which of the following activities contributes the most to carbon emissions globally?

A. Agriculture

B. Transport

C. Forestry

D. Energy supply

Question 22

The Paris Agreement is a legally binding international treaty on climate change. Its goal is to limit global temperature rise to 2 degrees Celsius.

Which of the following is true if this goal is to be met?

A. All nations need to stop burning fossil fuels by 2100

B. All nations need to stop burning fossil fuels by 2040

C. Fossil fuel burning is irrelevant, the Sun will cool and so will the Earth

D. It's already too late to meet this goal, as the burning fossil fuels should have stopped in the early 2000s

Question 23

Which of the following causes the greenhouse effect?

A. Greenhouse gases in the lower atmosphere absorbing incoming solar radiation

B. Greenhouse gases in the lower atmosphere absorbing incoming and re-radiated solar radiation from the Earth's surface

C. Too much heat in the atmosphere

D. Too much sunshine reaching Earth

Question 24

Which of these natural events affect Earth's climate?

- **A.** Thawing permafrost
- **B.** The path of the Earth around the sun
- **C.** Volcanic eruptions
- **D.** All of the above

Question 25

Which of these greenhouse gases is most abundant in the atmosphere?

- **A.** Carbon dioxide
- **B.** Methane
- **C.** Nitrous oxide
- **D.** Water vapour

Question 26

Most types of coral gain their bright colours due to a symbiotic relationship with photosynthetic marine algae called Zooxanthellae. The algae avoid predators by living inside the coral. The coral gain food as well as their bright colours from the algae. Coral bleaching is a problem that arises when the coral rejects the algae; as a result, they lose their food source as well as their bright colours.

What is the leading cause of this bleaching process?

- **A.** CO2 dissolved in ocean water
- **B.** Microplastic pollution
- **C.** Increased water temperature
- **D.** Sediment stirred up by extreme storms

Use the following information to answer Questions 27 and 28.

A local council is considering plans to develop a 245 hectare stretch of land in a coastal suburb in south-west Victoria. The land is currently dedicated as natural parkland; and is appreciated for its environmental and biodiversity values as well as it's Aboriginal cultural heritage.

A group of local residents have been especially vocal and active in their views on the importance of this area. Several threatened species are thought to use the creek and woodland area as habitat, but additional fieldwork is necessary to collect more data to confirm this.

The local council has proposed three options for the use of this land:

- **Option 1 -** Do not proceed with the development plan
- **Option 2 -** Create a neighbourhood estate, with medium density housing blocks, a school and small shopping center.
- **Option 3 -** Create a protected area within the land to be managed by Parks Victoria. This area will contain a creek zone and a population of the endangered Bellarine Yellow Gum *{Eucalyptus leucoxylon)* trees. Designate the remainder of the land as "rural zone", to be left as-is for the immediate future. This option incurs a significantly higher cost than Option 2.

Question 27

The local council has decided to accept Option 1.

Which of the following would be the most likely basis for their decision?

A. The precautionary principle

B. The user-pays principle

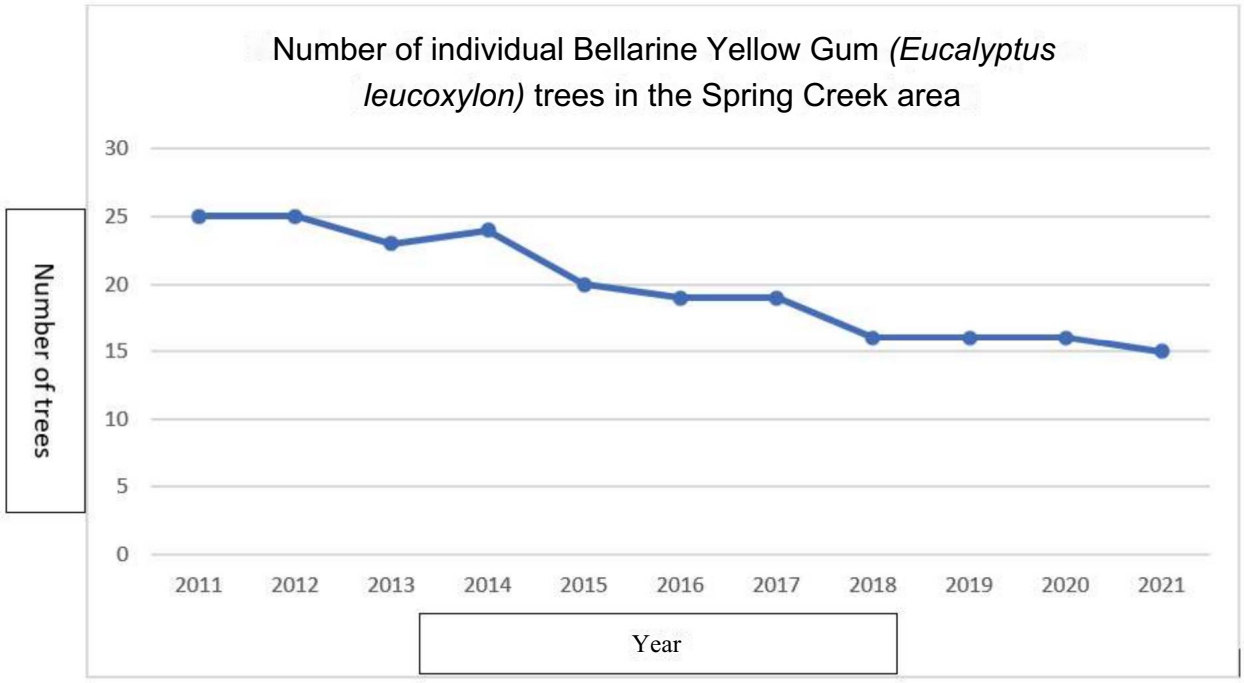
C. Intragenerational equity issues

D. Economic sustainability unease

Question 28

The Bellarine Yellow Gum *{Eucalyptus leucoxylori)* is one of many threatened species thought to be found in this area of Victoria.

Local council conservation scientists have been studying the population in this area for the past ten years. The figure below shows their data.



What was the percentage reduction in this population of trees from 2011 until 2021?

A. 10%

B. 15%

C. 40%

D. 60%

Use the following information to answer Questions 29 and 30.

An environmental scientist is studying the interactions of salt, ice and water as part of her study of climate change in Antarctica. Her aim is to test how salt affects the freezing point of water. She does this by following the method below.

1. Set up 5 beakers with 250ml of tap water (label beakers A to E).
2. Do not add salt to beaker A.
3. Add 3 grams of salt to beaker B.
4. Add 6 grams of salt to beaker C.
5. Add 9 grams of salt to beaker D.
6. Add 12 grams of salt to beaker E.
7. Place all beakers into a freezer. Reduce the temperature of the freezer by 1°C every minute and record the temperature when the water in the beaker freezes.

Her data is recorded below.

Beaker	**A**	**B**	**C**	**D**	**E**
Freezing point (°C)	0	-2	-4	-7	-8.5

Question 29

Which of the following is an appropriate conclusion based on the above data?

A. Salt has no effect on the freezing point of water

B. Salt increases the freezing point of water

C. Salt decreases the freezing point of water

D. Salt affects the freezing point of ice water but not tap water

Question 30

What was the independent variable for this experiment?

A. Grams of salt

B. Beaker number

C. Temperature of freezing point

D. Millilitres (ml) of tap water

END OF SECTION A

SECTION B - Short Answer Questions

Instructions for Section B

Answer **all** questions in the spaces provided. Write using **blue or black pen.**
Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
Total marks for this section: **90 marks**

Question 1(12 marks)

A group of scientists have been surveying two local regions of bushland, one of which is a high traffic area for sightseers and bushwalkers. Boneseed is a noxious introduced weed originally from South Africa. It is an evergreen woody shrub and can invade the understory of native forests and bushland. It competes with native plants, and dense infestations can be a significant fire hazard. It is spread by seed only and germination is promoted by fire, soil disturbance, weathering and ingestion of seeds by animals.

A survey was taken of some of the local plant species, and the results are shown in the tables below.

The index (D) can be calculated as follows.

Simpson's Index: $D = 1 - \frac{\Sigma[n_i(n_i-1)]}{N(N-1)}$

Note: 27 refers to the [6]sum of

W; means the total number of organisms of each individual species

N means the total number of organisms of all species

A higher index value indicates greater species diversity.

Species recorded at site A	***nt***	***ni-1***	***m (m -1)***
Prickly tea-tree	9	9-1=8	9 x 8 = 72
Rock correa	12	12- 1 = 11	12 x ll = 121
Myrtle wattle	8	8-1=7	7 x 8 = 56
Manna gum	7	7-1=6	7 x 6 = 42
Silver banksia	9	9-1=8	9 x 8 = 72
Boneseed	5	5-1=4	5 x 4 = 20
N	50		*S\n, (m - 1)]* = 383
N(N- 1)	2450		

Simpson's index: $D = 1 - \frac{\Sigma[n_i(n_i-1)]}{N(V-l)}$

$D = i - \frac{383}{2450} = o.844$

Simpson's Index (D) for site A is 0.844

a. Use the figures in the table below and the spaces provided to calculate Simpson's Index (D) for Site B.

3 marks

Species recorded at site B	***Hi***	***Hi- 1***	***ni(m -1)***
Prickly tea-tree	***6***	6-1=5	6x5 = 30
Rock correa	5	5-1=4	5 x 4 = 20
Myrtle wattle	5	5-1=4	5 x 4 = 20
Manna gum	2	2-1= 1	2x1=2
Silver banksia	3	3-1=2	3x2 = 6
Boneseed	15	15-1 =14	15 x 14 = 210
N	36		E[77,/H, - *1)}* = 288
N(N- 1)	36(36- 1) 1260		

Simpson's index:/) = 1 — $\frac{\Sigma[n_i(n_i-1)]}{N(N-1)}$

$D = 1 - \frac{288}{1260}$

$D = 0.771$

Simpson's Index (D) for site B is 0.771

b. Which site (A or B) has the higher species diversity? Explain and justify your answer using the Simpson's Index values.

2 marks

Site A has a higher species diversity **(1 mark)**

Site A has a Simpson's Index of 0.844 and Site B has a Simpson's Index of 0.771. Site A (0.844) is closer to 1, or a higher index indicates greater diversity.

Therefore, its species diversity is higher **(1 mark)**

c. Describe the sampling technique that would have been used to collect this plant data. 2 marks

Quadrat sampling **(1 mark)**

Quadrat is placed **RANDOMLY** in the study site and species found within the quadrat are counted or % coverage is estimated **(1 mark)**

d. Compare the species richness and the ecological integrity at each of the two sites. 2 marks

Both sites have 6 different species, therefore both Site A and Site B have the same species richness **(1 mark)**

Site B is likely to be the higher traffic area, due to its number of boneseed plants counted (15).

Therefore, it can be concluded that Site A, with only 5 introduced boneseed plants, has greater ecological integrity **(1 mark)**

e. Describe the impact that the boneseed can have on the native ecosystem, and suggest a management strategy that can be employed to control the spread of the species. 3 marks

Environmental weed competes with native plant species for nutrients, space and light **(1 mark)**

Can reduce biodiversity of native species in an area **(1 mark)**

Possible management strategy could include hand removal or chemical control to remove individual plants **(1 mark)**

NOTE - Various appropriate strategies would be accepted here

Question 2 (8 marks)

A species of ground dwelling orchid, *Pterostylis truncata* (Brittle Greenhood), is listed as endangered under the *Victorian Flora and Fauna Guarantee Act (1998).*

Once reported to be found in nine different locations, the Brittle Greenhood is now known only to survive in 3 locations, with remaining populations found on both private and public land.

The orchid is known to occur in habitats ranging from grasslands to woodlands, and in a variety of soils. The orchid's disappearance can be attributed to the impact of feral goats, road maintenance, European rabbits, competition from Boneseed, trampling by enthusiasts and weed invasion.

a. What is the benefit of the orchid being listed under the *Victorian Flora and Fauna Guarantee Act?* 1 mark

Species is legally protected for conservation in Victoria **(1 mark)**

b. It is possible that conservation techniques may not be successful, and the species numbers may continue to decrease in the coming years. If this were to be the case, state the new conservation category that the Brittle Greenhood could occupy. 1 mark

Accept either critically endangered or extinct in wild **(1 mark)**

c. What is a seed bank? Outline why a seedbank is vital in the conservation of the Brittle Greenhood. 2 marks

Seed banks are a types of gene bank. A place to store DNA of threatened species **(1 mark)**

Important for Brittle Greenhood as it can conserve the genetic diversity of this species if its population decreases further or becomes extinct in the wild **(1 mark)**

d. Describe the conservation management *and* monitoring techniques that could be employed to maintain and/or improve the numbers of the Brittle Greenhood. 4 marks

Any acceptable management AND monitoring techniques applicable to the Brittle Greenhood.

3 marks for both management AND monitoring described

1 mark for stating that ongoing monitoring must take place (not mentioned, NO full marks)

Management: identify areas where plant found, ensure areas are protected from people walking in area, fence off areas, eradicate feral pest animals from area, eradicate weed species that are in competition, ensure access for road maintenance limited or stopped altogether

Monitoring: survey areas after management actions taken place to check number so Brittle Greenhood increasing, monitor the feral and pest species to ensure they are not returning to area

Monitoring must he ongoing and throughout the year

Question 3(12 marks)

Current debate exists regarding the land that is currently occupied by a disused open-cut gold mine in northern Queensland.

The land surrounding the now-exhausted mine is bound by two mountain ranges. The major river that provides water to the mine and surrounding land has a catchment area of approximately 24,000km^2.

50km south of the mine is a 520km^2 national park which is home to a variety of animal and plant species, including 4 species of threatened marsupials. The park is used for bushwalking, mountain-bike riding and general outdoor recreation by thousands of people every year.

The land inclusive of the mine site and the national park holds cultural significance for multiple indigenous groups and the traditional owners still use areas for cultural ceremonies.

Debate surrounds two options for use of the gold-mine land:

- **Proposal A -** involves rehabilitating the mine and expanding the current National Park to include this land. This option is substantially cheaper.
- **Proposal B -** involves using the old mine site to build a renewable energy hub. This proposal would see infrastructure built to capture solar and wind energy for conversion to electricity. The same proposal also includes making use of the mining pits and much of the current infrastructure to create a hydro-energy storage facility for the creation of electricity. Currently all electricity provided to this area of Queensland has its entire electricity grid generated by coal-fired power plants.

a. Which of the two options (Proposal A or Proposal B) is more ecologically sustainable?

In your response, evaluate the proposal using each of the following sustainability principles:

- intergenerational equity
- intragenerational equity
- conservation of biodiversity
- ecological integrity. 6 marks

Choose and state EITHER Option A or Option B **(1 mark)**
Discussion of chosen proposal in regard to intergenerational equity **(1 mark)**
Discussion of chosen proposal in regard to intragenerational equity **(1 mark)**
Discussion of chosen proposal in regard to conservation of biodiversity **(1 mark)**
Discussion of chosen proposal in regard to ecological integrity **(1 mark)**
Students must write a clear response and use information from the stem **(1 mark)**

Example response:

Option A is more ecologically sustainable.

This proposal is able to meet principle of conservation of biodiversity and ecological integrity by taking care of expanding and restoring the natural environment that is protected within the national park boundaries. The native animal and plant species will have a greater range ofprotected area in which they can maintain habitats. This will mean that a greater area will be protected from hunting, collecting, future development and other disruptions to the ecological integrity of the area. As a result of this, biodiversity will be protected, managed and maintained; 4 threatened species of marsupials are found in the area, so it is important for the conservation of marsupial genetic diversity that these species are protected.

Intergenerational equity is considered in terms ofprotecting this land from development for future generations to enjoy. If the current generation uses the area of recreation and cultural benefit, then it is important that future generations can do so too. By expanding the national park area, we are considering this use, as well as paying respects to the first nation's people who hold cultural significance over the land.

Finally, proposal A considers Intragenerational equity by ensuring financial resources can be distributed to areas in which they are needed. Proposal A is substantially cheaper, therefore the money that may have been used in the construction of the energy hub can be usedfor construction of renewable energy sources elsewhere.

b. **i.** Name one stakeholder group that would hold an interest in **Proposal A.** Outline the role they may play in the decision making regarding the development of this land. 2 marks

Possible response of stakeholder group for **(1 mark):** Local indigenous groups/ traditional landowners

Possible response for role they play **(1 mark):** Consultation with this group and allowing them to provide assessment of cultural significance of the land as an argument FOR this proposal

NOTE - Various appropriate answers would be accepted here

ii. Name one stakeholder group that would hold an interest in **Proposal B.** Outline the role they may play in the decision making regarding the development of this land. 2 marks

Possible response of stakeholder group for **(1 mark):** Media outlets

Possible response for role they play **(1 mark):** Providing the public with an overview of the proposal.

Informing of both positive and negative outcomes of the project

NOTE - Various appropriate answers would be accepted here

c. Explain how the User Pays Principle could be applied to either proposal for development of the land. 2 marks

User Pays Principle refers to the fact that consumers pay the full cost for the goods and services provided by a project **(1 mark)**

Proposal A: People pay an entry free to use the national park which pays of costs of conservation and ranger wages **(1 mark)** OR

Proposal B: Cost of the renewable electricity reflected the costs involved in the development and maintenance of the facility **(1 mark)**

Question 4(12 marks)

A project is underway in the development and construction of the largest energy storage battery in the southern hemisphere.

The project is set to house a 450 MW/hour battery which will help provide electricity to Victoria's power grid during peak demand.

It is estimated that this project will cost the Victorian government $84 million.

The installation of the battery will allow Victoria to move towards a greater reliance on renewable energy sources.

a. Explain how this project will help contribute to Victoria's renewable energy targets. 2 marks

The battery will allow for large scale storage of energy **(1 mark)**

Energy can be harnessed during peak production times (for e.g. when the sun is shining or wind is blowing) and stored for sale during peak usage periods **(1 mark)**

b. Recently a fire broke out at the project site while engineers were testing features of the battery storage. The area contained a 13-ton lithium battery and the fire burned for at least 48 hours before fire crews were able to extinguish the flames.

State **ONE** negative impact this fire may have on any **TWO** of the Earth's spheres: hydrosphere, atmosphere, lithosphere or biosphere. 4 marks

i. Earth's sphere: Atmosphere **(1 mark)**

Negative impact:
Toxic smoke reducing air quality **(1 mark)**

NOTE - Various appropriate answers would be accepted here

ii. Earth's sphere: Biosphere **(1 mark)**

Negative Impact:
Toxic smoke affecting respiratory tract of native animals and livestock **(1 mark)**

NOTE - Various appropriate answers would be accepted here

Teacher note for this response: *If the negative impact correctly matches the given sphere, then 1 mark to be given for naming the sphere. If Negative impact is not correct for that sphere then mark for naming sphere not to be awarded*

c. Prior to the approval of this project, an external Environmental Consultant was required to undertake an Environmental Impact Assessment (EIA) of the project.

Describe the information that must be included in an EIA. 4 marks

Identification of significant environmental issues associated with the project **(1 mark)**

Assessment of the likely adverse impact of these issues **(1 mark)**

Decision/ recommendation whether the project should go ahead **(1 mark)**

Recommendations for monitoring procedures during and after completion of the project **(1 mark)**

d. During the planning stages for this project, it was suggested that the battery project should be located 150km west of its current site. It was argued that this location would allow for greater energy efficiency (as compared to its current site), as a large-scale wind farm is also found in the area.

Define the term energy efficiency and explain how locating the battery project close to a wind farm can improve energy efficiency. 2 marks

Energy efficiency refers to the amount of useful energy that is output in a system in comparison to the total energy that was input **(1 mark)**

Locating the battery close to the wind farm means that less energy is lost as heat during the transmission from the wind farm (site of electricity creation) to the battery (site of electricity storage) **(1 mark)**

Question 5 (8 marks)

Vanuatu is an island nation in the South Pacific Ocean. It is made of an archipelago of 83 islands and its main island, Efate, is home to approximately 70,000 people. Much of the population live in rural areas and do not have access to electricity. However, the population of the capital city, Port Vila, all have electricity provided to their homes. This electricity demand is met via both renewable and non-renewable sources.

Diesel (made from crude oil) is shipped into Port Vila and provides fuel for large scale generators on the island to generate 85% of the county's electricity demands.

a. Identify and outline **ONE** environmental disadvantage of using the diesel fuel generators for the island's electricity supply. 2 marks

Diesel is made from refined crude oil. Carbon dioxide is produced and released in the combustion process **(1 mark)**

CO2 is a major greenhouse gas and therefore contributes to the EGE and subsequent global warming **(1 mark)**

b. The Vanuatu Minister for Energy is currently working on two plans to increase the percentage of electricity generated from renewable sources from 16% to 25% by 2025.

Plan One - involves the building of five new wind turbines for placement on the southern tip of the island.

Plan Two - involves replacing the diesel fuel with biomass fuel created from coconut palm and nut debris.

Outline **ONE** disadvantage associated with each plan for increasing energy generated from renewable sources.

i. Plan One: More wind turbines: 2 marks

Disturbance of wildlife **(1 mark)**

Birds natural flight paths may lead them to fly though the blades, killing the bird **(1 mark)**

NOTE - Various appropriate answers would be accepted here

ii. Plan Two: Replacement of diesel with biomass fuel: 2 marks

Production release of methane during fermentation and processing **(1 mark)**

Methane is a major greenhouse gas and therefore contributes to the EGE and subsequent global warming **(1 mark)**

NOTE- Various appropriate answers would be accepted here

c. Each of the new wind turbines is capable of reliably providing 500 kW (kilowatt) of power.

Calculate the amount of MW (megawatt) this would provide to the island. Show your working. 2 marks

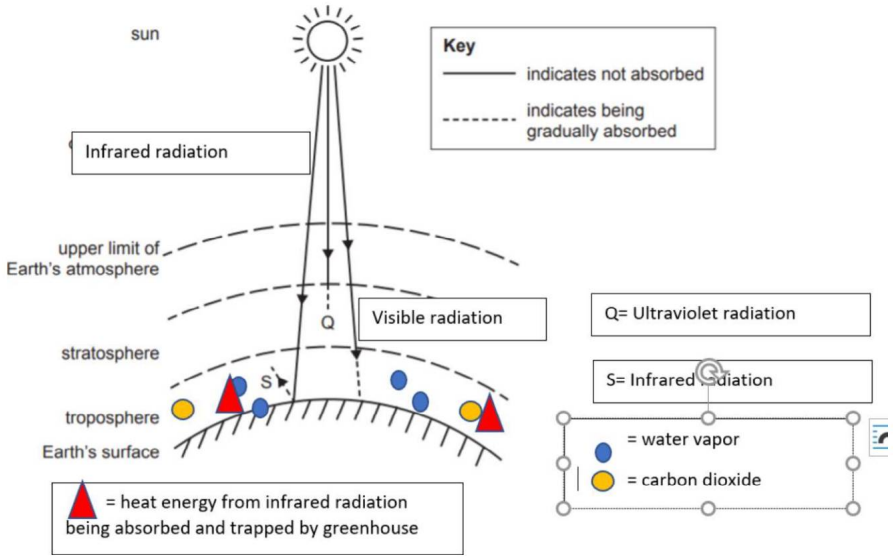
500 kW / 1000 = 0.5 megawatt

0.5x5= 2.5 megawatts **(1 mark for working. 1 mark for correct response with units)**

Question 6 (8 marks)

a. Annotate a basic diagram of the natural greenhouse effect. Label the different types of radiation involved.

3 marks



Students should show the three types of incoming radiation (infrared, ultraviolet and visible light) from the sun and what happens to these types of radiation as they enter the atmosphere and reach the surface of the Earth **(1 mark)**

Show visible radiation being absorbed by the Earth's surface and being **re-emitted** into the atmosphere as re-radiated infrared, which is then absorbed by the natural greenhouse gases (mainly water vapor and carbon dioxide) **(1 mark)**

Show that these gases in turn **absorb and trap** heat. **(1 mark)**

b. Compare and contrast the natural and enhanced greenhouse effects. 3 marks

Natural Greenhouse effect is caused by **natural** layer of greenhouse gases, Main contributing gasses- Water vapor, some CO2 and keeps temperature of the Earth habitable **(1 mark)**

EGE is caused by **enhanced,** of layer of **anthropogenic sources** of greenhouse gases, Main contributing gasses- CO2, Methane, Leads to increase in global temperatures> global warming > climate change (1 **mark)**

(1 mark) MUST be for student mentioning the names of greenhouse gases. Non mention of gasses, only 2 marks

c. Explain the mechanisms of the enhanced greenhouse effect in relation to the interaction of greenhouse gases and energy. 2 marks

Molecular structure of greenhouse gasses allows them to absorb infrared radiation that has been re-emitted from the Earth's surface **(1 mark)**

Greenhouse gases vibrate and release the energy, allowing for it to then be absorbed by another greenhouse gas molecule, subsequently trapping the energy in the atmosphere instead of allowing it to pass **(1 mark)**

Question 7 (8 marks)

a. In the 1920's, the Serbian scientist Milutin Milankovitch hypothesized that the position of the Earth relative to the sun influenced Earth's long-term climatic patterns and is, in turn, responsible for triggering the beginning and end of glaciation periods.

i. How does Earth's position relative to the Sun influences long term climatic patterns? 1 mark

Affects how much solar radiation reaches the Earth's atmosphere **(1 mark)**

ii. Outline the three Milankovitch cycles listed below. 3 marks

• Eccentricity:

Change in shape of orbit from slightly circular to elliptical **(1 mark)**

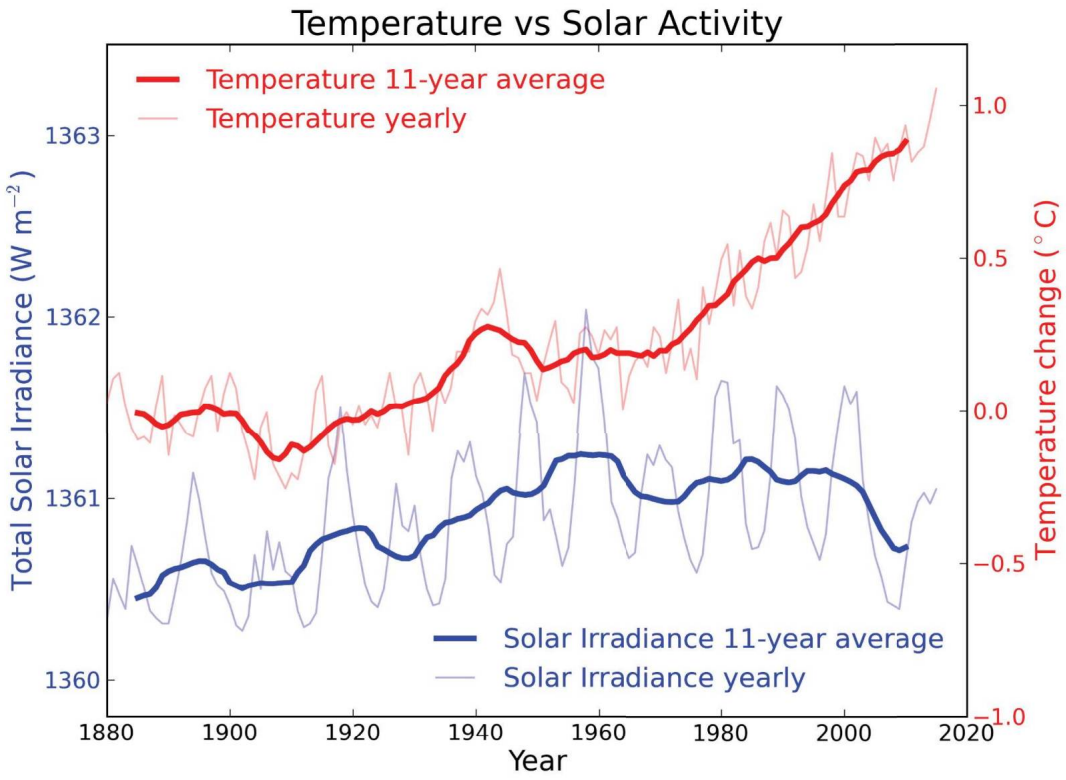
• Axial tilt:

Variation in tilt from 22.1 ° to 24.5° **(1 mark)**

• Precession:

Wobble of Earth on its axis as it rotates **(1 mark)**

The graph below shows the trend in global temperature compared to the amount of solar energy hitting the Earth.



Source: Skeptical science https://skepticalscience.com/solar-activity-sunspots-global-warming.htm

b. Describe the trends in temperature and solar activity that can be seen in the graph above. 2 marks

Temperature: increasing steadily with slight decreases at around 1900-1910 and 1940-1955

(1 mark temperature generally steady increase- must refer to data)

Solar activity: increases from 1885-approx 1960, generally constant to 2000, then decreases between 2000-2010.

(1 mark solar activity increasing then decreasing- must refer to data)

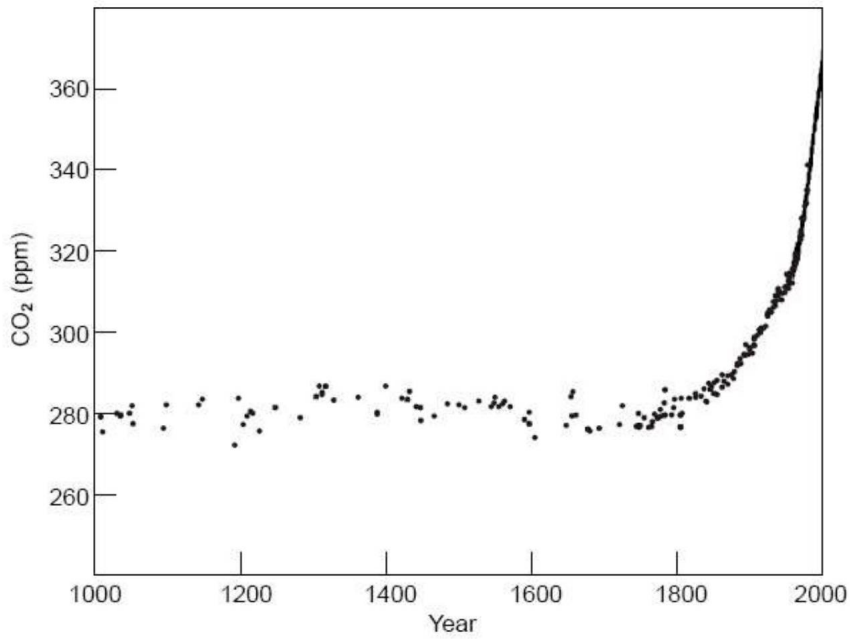
c. Using data from the graph above, explain the conclusions that can be drawn regarding the changes in solar activity and the Earth's temperature. 2 marks

Solar activity does not directly affect temperature **(1 mark)**

Solar activity and temperature generally both following similar trends between 1885 and 1960 but from 1960 to present temperature increasing, whereas solar activity is decreasing **(1 mark)**

Question 8(11 marks)

The following graph shows atmospheric carbon dioxide levels from the year 1000 to 2000.



Source: https://www.researchgate.net/figure/FiglAtmospheric-carbon-dioxide-over-the-last-1000-years_fig9_303684195

a. Calculate the percentage change in atmospheric carbon dioxide levels from the year 1000 to 2000.

Show your working. 2 marks

370-279 = 91 91/279 = 0.321 0.326x 100 = 32.6 % **(1 mark for calculation)**

Teacher note for this response: *Accept range 30.8 %- 32.6% if workings shown* **(1 mark correct answer)**

1 mark only for attempt at calculations but incorrect answer

b. The graph above includes data collected before the use of modem methods to record climate data.

i. Explain **ONE** method used by scientists to collect atmospheric carbon dioxide levels before the use of modern methods. 2 marks

Ice core sampling **(1 mark)**

Layers of ice contain small bubbles of air that contain sample of atmosphere when ice was formed. Can measure concentration of carbon dioxide in the air bubbles. **(1 mark)**

ii. State a modern method of collecting atmospheric carbon dioxide data. 1 mark

Atmospheric gas monitors/collection sites. **(1 mark)**

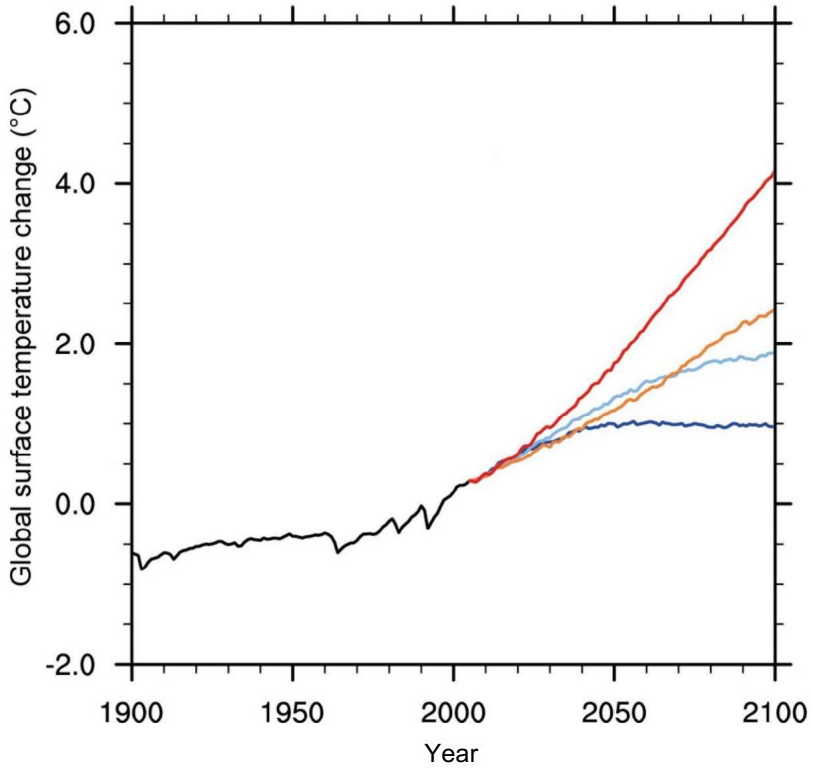
iii. Describe **ONE** impact of increased levels of atmospheric carbon dioxide on the carbon cycle. 2 marks

Teacher note for this response: *Any acceptable answer specific to Carbon Cycle can get marks:*

Example answer: Increased atmospheric CO2 can lead to increased uptake of CO2 into oceans **(1 mark)**

leading to oceanic acidification **(1 mark)**

The graph below shows four different predicted changes in global surface temperature to the year 2100.



Source: adapted from IPCC, 2013 and "future of climate change", https://climatechange.chicag0.g0v/climate-change-science/future-climate-change#Temperature

c. Explain why there are four different predicted outcomes for the changes in global temperatures. 2 marks

The exact amount of warming that will occur largely depends on actions made now to decrease the amount of carbon emissions **(1 mark)** as the actions will directly influence the amount of greenhouse gases released into the atmosphere which in turn will influence the amount of temperature change **(1 mark)**

Teacher note for this response: *1 mark for action dependent, 1 mark for link between action and em iss ions/temperature*

d. Explain the impact increased global temperatures will have on sea levels. 2 marks

Increased air temperature will lead to thermal expansion. Water molecules will increase in volume **(1 mark)**

This will result in sea levels rising **(1 mark)** **OR**

Increased air temperature will lead to glacial ice melting **(1 mark)**

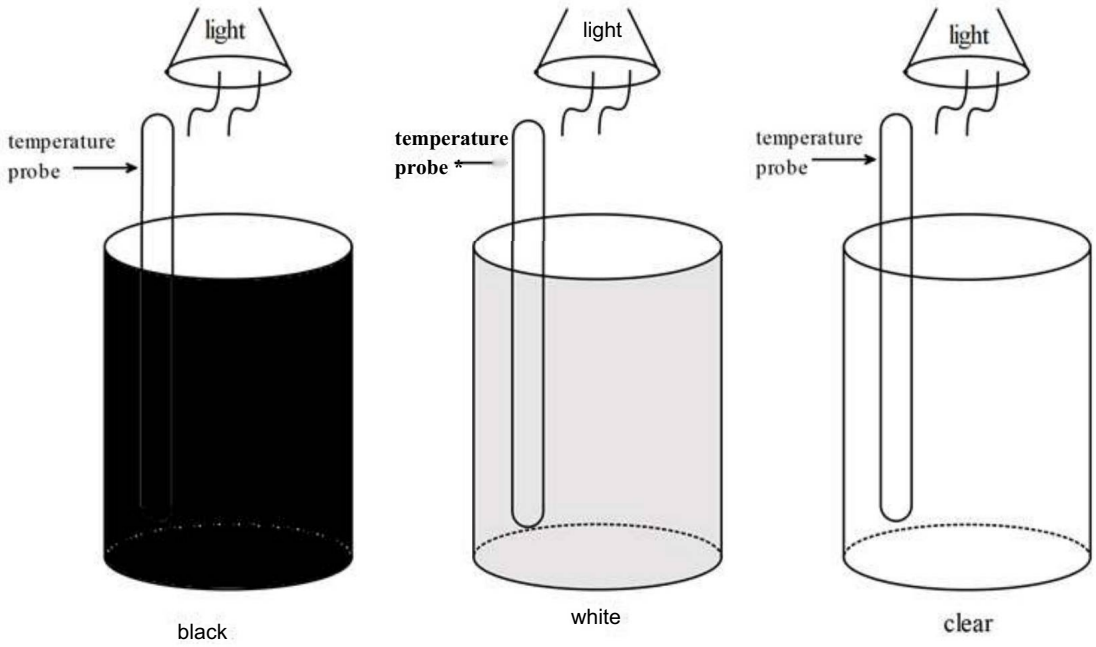
This can lead to a minor sea level rise **(1 mark)**

Question 9(11 marks)

Students set up an experiment to investigate the albedo effect and temperature.

They set up 3 containers, one white and one black and one clear. Each container had a temperature probe, and a light source was placed the same distance from the containers and all containers were exposed to the light for the same amount of time. The lights were switched on at the same time and the temperature was recorded every 2 minutes.

A diagram of the experimental set-up is shown below.



a. Write an appropriate hypothesis for this experiment. 2 marks

It is predicted that temperature in the black container will show a greater increase than the temperature in the white or clear containers **(1 mark)**

This is because the black material will absorb and hold the heat energy provided by the light source **(1 mark)**

b. Identify the container that would be considered the control group. Explain your answer. 2 marks

Clear **(1 mark)**

The clear container has no change in colour. The results will be used as a comparison to the black and white containers **(1 mark)**

c. Identify **ONE** independent and **ONE** dependent variable for this experiment. 2 marks

• Independent variable:

Colour of container (black, white or clear) **(1 mark)**

• Dependent variable:

Temperature (degrees Celsius) **(1 mark)**

d. Explain **ONE** way that the experiment could be improved to make the data more reliable. 2 marks

Repeating experiment multiple times **(1 mark)** under the same conditions **(1 mark)**

e. Using your knowledge of albedo and the albedo effect, explain the results you would expect from this experiment 3 marks

The black container will heat up more that the white container **(1 mark)**

Albedo is a measure of the reflectivity of a surface **(1 mark)**

Darker surfaces have a low albedo/absorb more energy or heat, lighter surfaces have high albedo/reflect more energy or heat **(1 mark)**

END OF QUESTION AND ANSWER BOOK

MULTIPLE CHOICE ANSWER SHEET

STUDENT NUMBER:-- -

Student Name: _____ Class:_____

Use a **PENCIL** for **ALL** entries.
For each question, shade the box which indicates your answer.
Marks will **NOT** be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer **- DO NOT** cross it out.

ONE ANSWER PER LINE	ONE ANSWER PER LINE	ONE ANSWER PER LINE
10 0 0 0	11 0 0 0 0	21 0 0 0 0
2 0 0 0 0	12 0 0 0 0	22 0 0 0 0
3 0 0 0 0	13 0 0 0 0	23 0 0 0 0
4 0 0 0 0	14 0 0 0 0	24 0 0 0 0
5 0 0 0 0	15 0 0 0 0	25 0 0 0 0
6 0 0 0 0	16 0 0 0 0	26 0 0 0 0
7 0 0 0 0	17 0 0 0 0	27 0 0 0 0
8 0 0 0 0	18 0 0 0 0	28 0 0 0 0
9 0 0 0 0	19 0 0 0 0	29 0 0 0 0
10 0 0 0 0	20 0 0 0 0	30 0 0 0 0