



Victorian Certificate of Education 2012

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

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ENVIRONMENTAL SCIENCE

Written examination 1

Wednesday 13 June 2012

Reading time: 2.45 pm to 3.00 pm (15 minutes)

Writing time: 3.00 pm to 4.30 pm (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	5	5	70
			Total 90

- 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 white out liquid/tape.

Materials supplied

- Question and answer book of 22 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **student number** 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, **and** sign your name in the space provided to verify this.
- 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.

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.

Question 1

Which one of the following is a non-fossil fuel energy source?

- A. oil
- B. coal
- C. natural gas
- D. geothermal

Question 2

A cold pack found in many first-aid kits consists of two chemicals separated by a divider. When the divider is removed, these chemicals react to produce a cold surface which can be placed on an injury.

The two chemicals combining is an example of

- A. a reversible reaction.
- B. a combustion reaction.
- C. an exothermic reaction.
- D. an endothermic reaction.

Use the following information to answer Questions 3–5.

An electricity-generating power station in the Latrobe Valley of Victoria is powered by coal. The coal is burned in a boiler to produce steam, which drives a turbine to turn a generator. The steps involved in the process and the percentage efficiency of each step are shown in Figure 1.

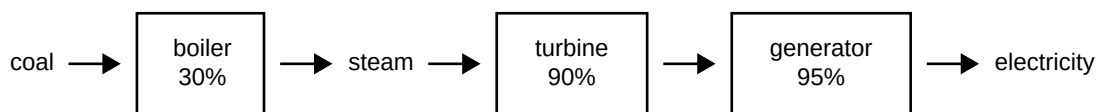


Figure 1

Question 3

The operation of the generator is an example of the conversion of

- A. kinetic to potential energy.
- B. kinetic to electrical energy.
- C. electrical to potential energy.
- D. chemical to electrical energy.

Question 4

The overall percentage energy efficiency of the conversion of coal to electrical energy in the power station is approximately

- A. 26%
- B. 35%
- C. 98%
- D. 215%

Question 5

Environmentalists suggest that the power station be converted to burn natural gas.

The most likely reason for this is that natural gas

- A. is renewable, whereas coal is not.
- B. is more readily available and easier to extract than coal.
- C. produces less carbon dioxide per unit of energy produced than coal.
- D. is not a fossil fuel, but coal is a fossil fuel.

Use the following information to answer Questions 6–8.

Figure 2 shows Earth's atmosphere. P, Q and R are possible paths that different types of radiation can take. A dotted line implies partial absorption occurring.

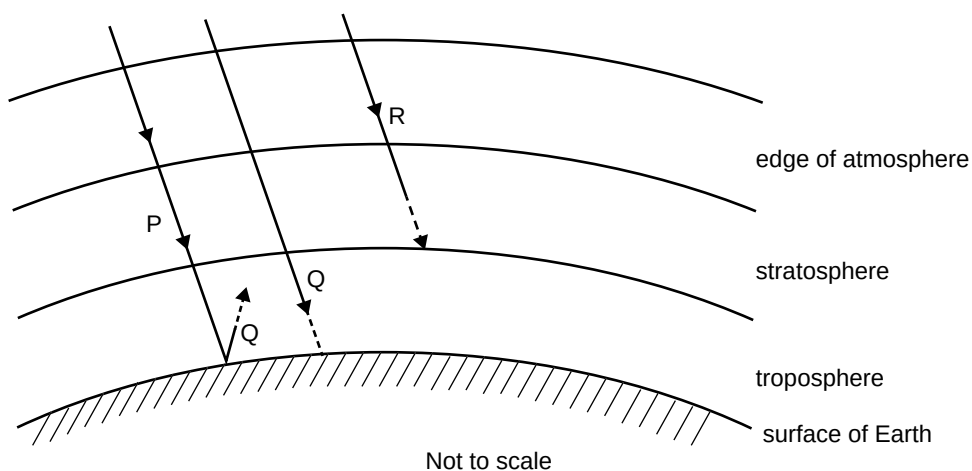


Figure 2

Question 6

Which type of radiation is path P most likely to be?

- A. X-ray
- B. visible
- C. infrared
- D. ultraviolet

Question 7

Which type of radiation are the paths marked Q most likely to be?

- A. X-ray
- B. infrared
- C. ultraviolet
- D. greenhouse

Question 8

Which of the following statements best describes the mechanism that maintains Earth's surface at a temperature at which humans can live?

- A. absorption of ultraviolet radiation at Earth's surface
- B. balance between solar radiation and cooling by the oceans
- C. absorption of incoming ultraviolet radiation by the ozone layer
- D. equilibrium between incoming solar radiation and reradiated infrared radiation

Use the following information to answer Questions 9 and 10.

The Environmental Protection Authority is attempting to reduce the impact of fossil fuel used in cars by making improvements in the refining of petrol and diesel fuels to remove impurities. Benzene is a carcinogenic chemical found in motor fuels.

A monitoring station measures the average annual benzene concentration at a particular location over a ten-year period. The average annual concentrations are shown in Figure 3.

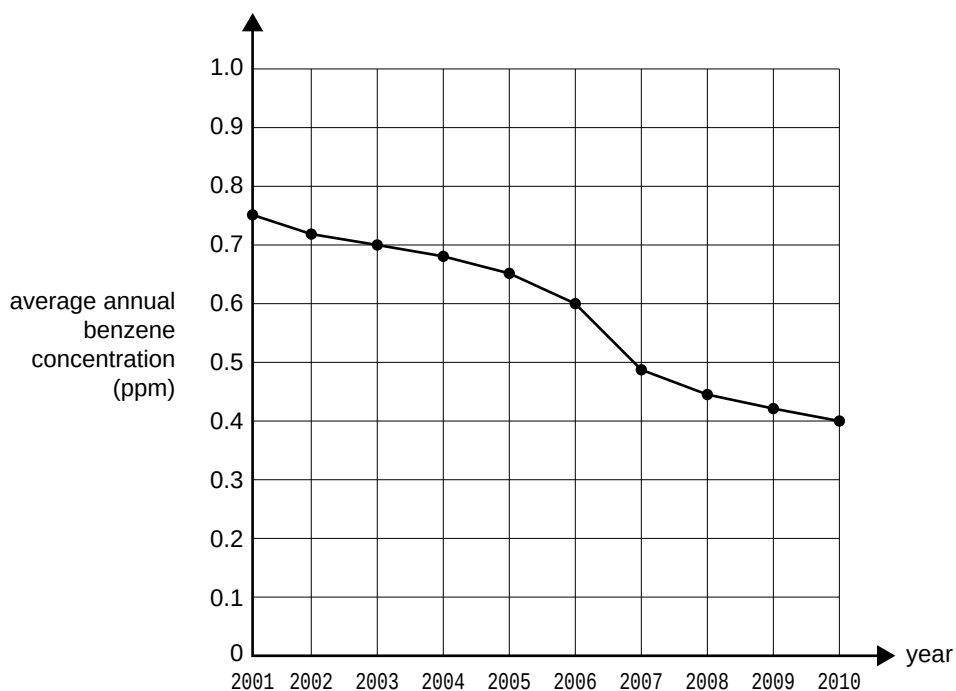


Figure 3

Question 9

Which of the following is the best estimate of the percentage decrease in benzene concentration in the period from 2006 to 2010?

- A. 0.20%
- B. 33%
- C. 50%
- D. 66%

Question 10

In which period was the rate of decrease in benzene concentration the greatest?

- A. 2001–2002
- B. 2003–2004
- C. 2006–2007
- D. 2009–2010

Question 11

Which of the following changes to the conservation category of a threatened species would indicate a decreased risk of extinction?

- A. vulnerable to critical
- B. endangered to critical
- C. vulnerable to endangered
- D. endangered to vulnerable

Question 12

The Major Mitchell Cockatoo is endemic to Australia.

This means that it

- A. exists only in Australia.
- B. is at risk of extinction in Australia.
- C. relies on other Australian species to exist.
- D. has been introduced into Australia from elsewhere.

NO WRITING ALLOWED IN THIS AREA

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SECTION A – continued
TURN OVER

Use the following information to answer Questions 13–20.

A scientist, Phil, is studying a number of possum species in three related but separate locations: A, B and C.

Phil randomly selects a number of sample sites in each location. The total area of the sample sites in each of A, B and C is 1.0 square kilometre.

The total number of each species counted in the sample sites for each location is shown below.

Species	Numbers in sample sites in Location A	Numbers in sample sites in Location B	Numbers in sample sites in Location C
Common Brushtail Possum	62	20	52
Common Ringtail Possum	30	20	25
Eastern Pygmy Possum	10	16	35
Feathertail Possum	0	14	6
Leadbeater's Possum	0	15	4
Sugar Glider	0	12	6
Yellow-bellied Glider	50	14	8

Question 13

Location A has a total area of 10 square kilometres.

Which of the following is the best estimate of the number of Common Brushtail Possums in Location A?

- A. 6.2
- B. 62
- C. 124
- D. 620

Question 14

With respect to species richness, which of the following statements is true?

- A. Location A has the least species richness.
- B. Location B has the least species richness.
- C. Location C has the least species richness.
- D. There is insufficient information in order to decide.

Question 15

Species diversity combines both species richness and relative abundance.

With respect to species diversity, which of the following statements is true?

- A. Location A has the greatest species diversity.
- B. Location B has the greatest species diversity.
- C. Location C has the greatest species diversity.
- D. There is insufficient information in order to decide.

Question 16

Three years later, Phil samples Location A again. He now finds eight Eastern Pygmy Possums in the sample sites of Location A. He concludes that the probability of extinction of the Eastern Pygmy Possum has increased.

Which of the following statements is correct?

- A. There is now less chance of genetic swamping.
- B. Phil has probably miscounted, since this decrease in the number of Eastern Pygmy Possums is unlikely.
- C. The difference is likely to be within normal statistical variation.
- D. The number of Eastern Pygmy Possums has decreased, so Phil's conclusion is correct.

Question 17

Phil plans to relocate a number of Eastern Pygmy Possums from Location C to Location A.

The most likely reason for this would be to

- A. avoid genetic swamping.
- B. achieve demographic variation.
- C. reduce inbreeding in Location A.
- D. increase the species richness in Location A.

Question 18

A national park ranger proposes to build a wildlife corridor between Locations A and C. Phil expresses concern that this may have an adverse effect on the Eastern Pygmy Possum.

Which of the following effects on the Eastern Pygmy Possum is Phil likely to be concerned about?

- A. inbreeding
- B. genetic drift
- C. genetic swamping
- D. demographic variation

Question 19

The probability of extinction of the Eastern Pygmy Possum in Location B is 0.4 and in Location C is 0.3.

Which of the following best gives the probability of extinction in both areas?

- A. 0.7
- B. 0.4
- C. 0.3
- D. 0.12

Question 20

A zoo decides to begin a captive breeding program for the Eastern Pygmy Possum. It plans to take 12 possums from Location C, the area with the most Eastern Pygmy Possums.

Another scientist argues that it would be better to take four Eastern Pygmy Possums from each location for the captive breeding program instead of 12 from Location C.

The most likely reason for the scientist's argument would be

- A. to avoid genetic drift.
- B. less reduction in numbers in Location C.
- C. to make a more interesting display for zoo visitors.
- D. to increase genetic diversity in the captive group in the zoo.

END OF SECTION A
TURN OVER

SECTION B**Instructions for Section B**

Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1

Name one fossil and one non-fossil fuel energy source you have studied.

Fossil _____

Non-fossil _____

- a.** For your nominated **fossil** fuel energy source, state a geographic location from which it is extracted. Describe its accessibility, availability and the approximate length of time it will remain a viable source at this location.

3 marks

- b.** Describe the process of converting your nominated **fossil** fuel energy source to usable energy. Explain how it is used to provide domestic and industrial energy. In your answer include reference to the method of distribution to end users.

4 marks

SECTION B – Question 1 – continued

NO WRITING ALLOWED IN THIS AREA

- c. Describe **two** environmental impacts of the extraction, production and/or distribution (not the end use) of your nominated **fossil** fuel energy source.

3 marks

- d. Describe two advantages and two unrelated disadvantages when your nominated **non-fossil** fuel energy source is used as an energy source for domestic and industrial purposes.

Advantage 1

Advantage 2

Disadvantage 1

Disadvantage 2

4 marks

- e.** Name a geographic location, such as a town, city or region.
Describe the energy needs of this location.

Outline how your nominated energy sources could be used to meet the needs of this location. Describe how these needs would be met in an adequate and sustainable way.

5 marks

Question 2

- a. Explain the difference between the natural greenhouse effect and the enhanced greenhouse effect. In your answer include the role of the major atmospheric gases that contribute to the natural and enhanced greenhouse effects.

3 marks

- b. Name a fossil fuel energy source. You may use the same fossil fuel energy source as in **Question 1** or a different one.

Explain the mechanism by which this energy source contributes to the enhanced greenhouse effect.

3 marks

- c. Describe one step or strategy taken to reduce the enhanced greenhouse effect. Explain how this step or strategy helps to reduce the enhanced greenhouse effect.

3 marks

- d. Describe one land use change and explain how this change can increase or reduce the enhanced greenhouse effect.

3 marks

Question 3

Name one threatened animal species that you have studied this year.

- a. Describe a specific population of this species.

In your answer include

- the specific geographic location of the population
- a description of the habitat
- the size of the population at this location.

4 marks

- b. Explain how the size of this population relates to the total numbers of the species. Comment on the importance of this population to the survival of the species as a whole.

3 marks

- c. State the conservation category of the species as a whole, giving a reason for this status.

2 marks

- d. Describe a specific threat to the population described in **part a.**, including how this threat has affected the numbers of the population over time.

3 marks

- e. Outline a management strategy that addresses this threat.

3 marks

- f.** Evaluate the success of this management strategy in addressing the specific threat described in **part d**. Include evidence and numerical data to support your evaluation.

3 marks

- g.** Outline one way in which the management of this specific population could be improved.

2 marks

Question 4

Researchers are studying the African Bush Elephant in an attempt to develop an action plan to increase the overall numbers of this threatened species. One threat is poaching, as the tusk of the African Bush Elephant is highly valued and traded both inside and outside Africa.

- a.** Name a convention that protects against the trading of elephant tusks outside Africa.

1 mark

Use the following information to answer Questions 4b.–d.

Two small populations of African Bush Elephants, Population 1 and Population 2, exist in two habitats that have become isolated from each other.

The following table shows the number of adult males and females in each population.

	Population 1	Population 2
Number of adult males	10	2
Number of adult females	36	50

- b.** Researchers consider that Population 2 is more at risk of extinction than Population 1. Explain why researchers may have come to this conclusion.

2 marks

NO WRITING ALLOWED IN THIS AREA

- c. The researchers suggest restoring a wildlife corridor to connect the two habitats. Give two reasons why this may benefit the elephant populations.

1. _____

2. _____

3 marks

- d. One method used to determine the reproductive capability of a population is the ratio of males to females in the population. A higher ratio indicates higher reproductive capacity. Using this method, calculate which population has higher reproductive capacity. Show your working.

Population with higher reproductive capacity

1 mark

Question 5

A township is planning to increase its water supply by building a small dam. Three sites are considered: A, B and C. The region is famous for its variety of frog species. The town's residents wish to minimise the impact of the dam on the frog species and on biodiversity in general. They employ a scientist, Pat, to assess the frog species diversity of each site.

Species diversity combines both species richness and relative abundance. Pat uses an index, D, she has previously developed to assess species diversity. A higher index means greater species diversity.

Pat's index is defined as

$$D = 1 - \left[\frac{\text{sum of the differences of each species' numbers from the mean for the site (absolute/positive)}}{\text{total number of individuals}} \right]$$

Pat gathers the following data.

Species	Number at Site A	Number at Site B	Number at Site C
Common Froglet	20	16	40
Eastern Banjo Frog	14	10	8
Giant Burrowing Frog	0	0	8
Green and Golden Bell Frog	12	15	15
Leaf Green Tree Frog	0	0	6
Lesueur's Tree Frog	16	10	0
Southern Barred Frog	5	13	8
Southern Brown Tree Frog	10	10	7
Spotted Marsh Frog	10	14	0
Striped Marsh Frog	13	12	8

Pat's calculations for the indices for Sites A and B

Species	Number at Site A	Difference from mean	Number at Site B	Difference from mean
Common Froglet	20	10	16	6
Eastern Banjo Frog	14	4	10	0
Giant Burrowing Frog	0	10	0	10
Green and Golden Bell Frog	12	2	15	5
Leaf Green Tree Frog	0	10	0	10
Lesueur's Tree Frog	16	6	10	0
Southern Barred Frog	5	5	13	3
Southern Brown Tree Frog	10	0	10	0
Spotted Marsh Frog	10	0	14	4
Striped Marsh Frog	13	3	12	2

Total number of individuals	100	100
Mean	10	10
Sum of differences	50	40

$$\begin{aligned} \text{Index } D_A &= 1 - 50/100 \\ &= 1 - 0.50 \\ &= 0.50 \end{aligned}$$

$$\begin{aligned} \text{Index } D_B &= 1 - 40/100 \\ &= 1 - 0.40 \\ &= 0.60 \end{aligned}$$

- a. Calculate Pat's index for Site C.

Species	Number at Site C	Difference from mean
Common Froglet	40	
Eastern Banjo Frog	8	
Giant Burrowing Frog	8	
Green and Golden Bell Frog	15	
Leaf Green Tree Frog	6	
Lesueur's Tree Frog	0	
Southern Barred Frog	8	
Southern Brown Tree Frog	7	
Spotted Marsh Frog	0	
Striped Marsh Frog	8	

	Site C
Total number of individuals	
Mean	
Sum of differences	
Index D = $1 - \frac{\text{sum of differences}}{\text{total number}}$	

Index D_C for site C

3 marks

- b. From your data, indicate which site has the greatest species diversity. Justify your answer.

Site _____

3 marks

- c. Another scientist, Bill, claims that since all the sites have the same total number of individuals and the same number of species, the species diversity is the same for all sites. Pat argues that her calculated index indicates that species diversity is not the same for all sites.

Who is correct? Explain your answer.

4 marks

- d. A third scientist, Dale, concludes from studying the data that there seems to be a case for preserving Site C rather than Site A or Site B.

Based on the data, give a reason why Site C might be more worthy of preservation. Your reason must not be related to species diversity.

2 marks