



**Victorian Certificate of Education
2006**

ENVIRONMENTAL SCIENCE

**Trial Written Examination 1
June 2006**

ANSWERS & COMMENTS

SECTION A – Multiple-choice answers

Question 1

A school purchased an 1800 watt solar voltaic cell system to power a computer laboratory but noticed, even under idea conditions, that it never produced more than 1200 joules per second. The reason for this is because:

- A. the system hasn't been wired properly
- B. solar electricity is unreliable
- C. changing energy from one form to another results in some energy being degraded
- D. light energy striking the solar cells will depend on the solar output of the sun at any given moment

Question 2

The variation in DNA between individuals within a population is best described as:

- A. the mutation rate
- B. species diversity
- C. phenotypic variation within a population
- D. genetic diversity

Question 3

Biogas collected at the Western Treatment Plant is sold to a power generation company that burns the gas to drive a steam turbine which powers an electric generator. The electricity is then sold back to the treatment plant to power large mixing machines that aerate the raw sewerage:

- The power station is 65% efficient
- The power distribution lines are 95% efficient
- The mixing machines are 60% efficient

The best estimate of the over all efficiency of this system is:

- A. 40%**
- B. 20%
- C. 60%
- D. 75%

Question 4

Maintaining biodiversity is important because:

- A. it reduces the evolutionary rate in animals and plants
- B. it reduces the impact from the “hole” in the Ozone layer
- C. is a major sink for carbon and hence is critical in reducing the impact of the enhanced greenhouse effect
- D. it makes ecosystems more robust and resilient to change**

Question 5

Water flowing into a hydroelectric power station from a reservoir situated above it could best be described as:

- A. potential energy being converted into kinetic energy**
- B. chemical energy being converted into electrical energy
- C. a non-fossil, non-renewable form of energy
- D. a form of energy production that has no impact on the environment

Question 6

The Southern Broodfrog, *Pseudophryne semimarmorata*, is currently not listed under the **Victorian Fauna and Flora Guarantee Act 1988** (FFG Act). Many field biologists in Victoria believe this species has been in decline for some time and there are currently attempts to get this species listed. The main purpose of listing a species is to:

- A. let people know about the them
- B. provide some regulatory frameworks for their protection**
- C. make it illegal to hunt and kill them
- D. collect as many specimens for captive breeding as possible before they go extinct

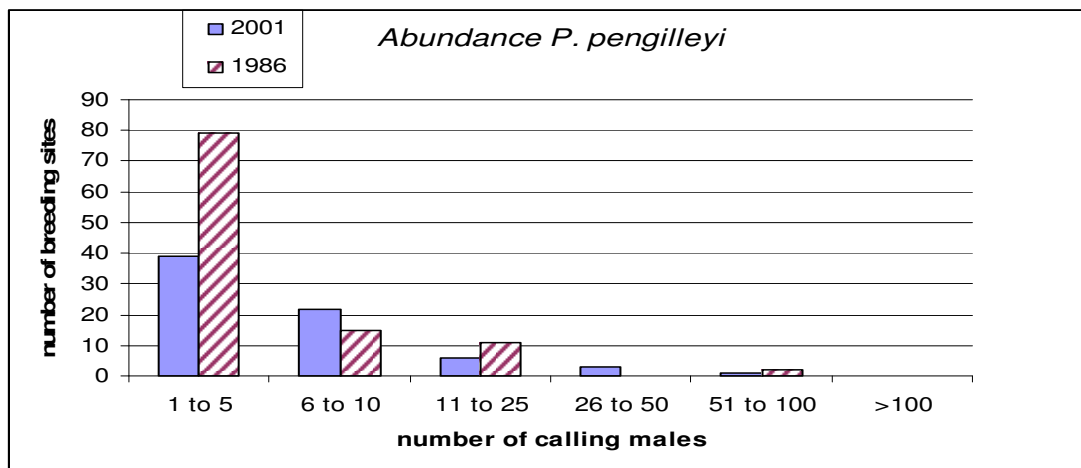
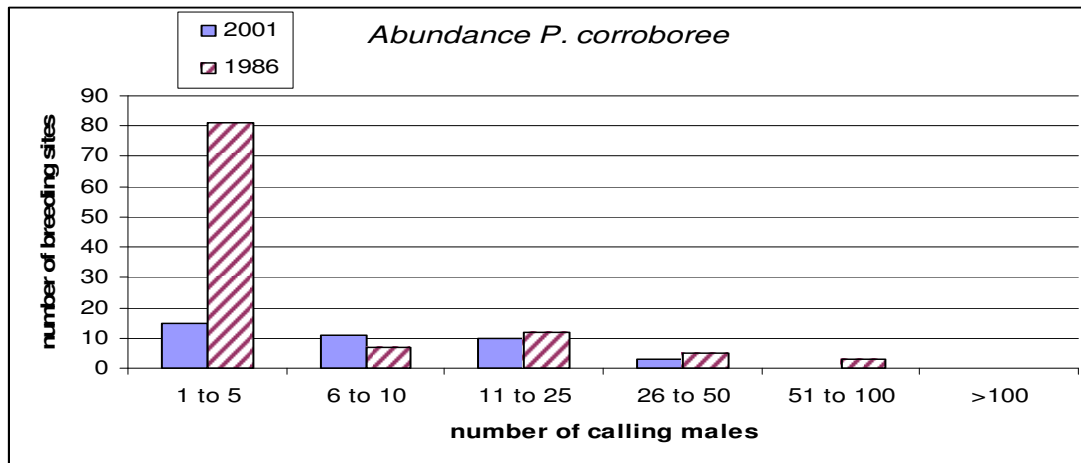
Question 7

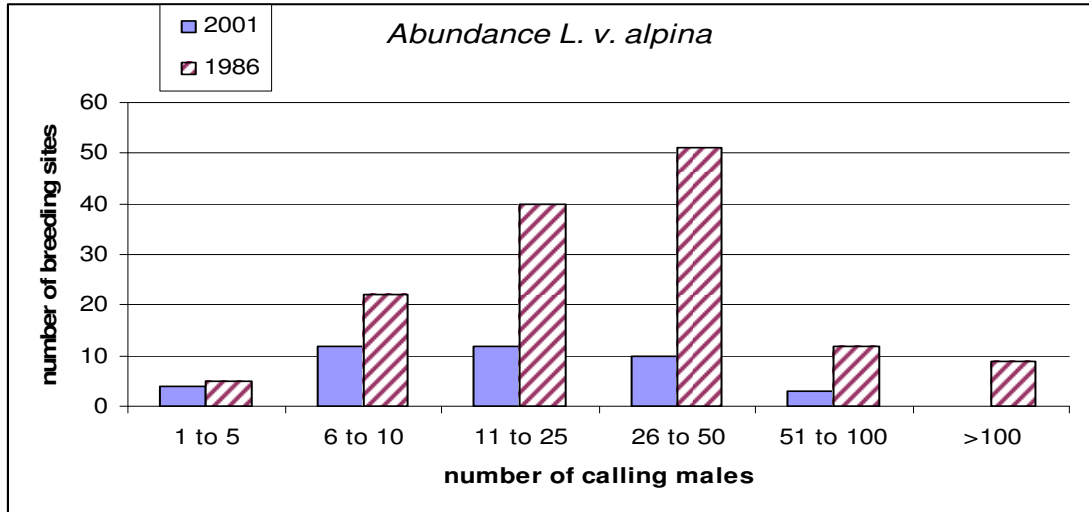
Which of the following is a non-renewable; non-fossil fuel?

- A. geothermal power
- B. nuclear power stations
- C. coal
- D. uranium

Question 8

Pseudophryne corroboree and *P. pengilleyi* are two closely related species of frog endemic to the Snowy Mountain region. *Litoria verreauxi alpine* is another non-related species that is also found in this area. All three species have suffered large declines in distribution and abundance and one is now listed as endangered under the **Environment Protection and Biodiversity Conservation Act 1999** (EPBC Act) while the other two are considered vulnerable.





Based on the information above the most likely species to be listed as endangered is:

- A. *P. corroboree*
- B. *P. pengilleyi*
- C. *Litoria verreauxi alpina*
- D. All of the above

Question 9

The process by which petrol in a car is ignited to produce energy is best known as:

- A. an endothermic reaction
- B. nuclear fission
- C. a participation reaction
- D. a combustion reaction

Question 10

Ecologists have devised several numerical methods for comparing the species diversity between two different samples or communities.

Jaccard's Index, the simplest of these comparisons, is calculated by dividing the number of species found in both of the two samples (*j*) by the number found in only one sample or the other (*r*) (total number of species) and then multiplying by 100. This gives a percentage of species similarity:

$$\text{Jaccard's Index} = 100(j/r)$$

Sample 1	Sample 2
Southern Brown Tree frog	Southern Brown Tree Frog
Common Froglet	Common Froglet
Spotted Marsh Frog	Spotted Marsh Frog
Pobblebonk Frog	Stripped Marsh Frog
Growling Grass Frog	

Jaccard's Index for sample 1 & 2 is approximately:

- A. 20% similarity
- B. 50% similarity**
- C. 70% similarity
- D. 90% similarity

Question 11

The process of burning coal to heat water to drive stream turbines is a chemical reaction that is best described as:

- A. poikilothermic
- B. homeothermic
- C. exothermic**
- D. endothermic

Question 12

Which of the following **would not** be considered a general threat to biodiversity?

- A. habitat fragmentation
- B. revegetation**
- C. inbreeding
- D. genetic swamping

Question 13

Which of the following is not considered a fossil fuel?

- A. brown coal
- B. oil
- C. natural gas
- D. biogas**

Question 14

The South Eastern Freeway Extension passes through a section of the Mullum Mullum Valley that contains a small population of the increasingly rare Southern Broodfrog, *Pseudophryne semimarmorata*. The impact of the tunnel on this population is unknown and no formal study has been undertaken. However local conservationists have urged the construction company to create a buffer zone of 25m around this site. This recommendation is an example of:

- A. a Population Viability Analysis
- B. the Precautionary Principle**
- C. an Environmental Impact Statement
- D. the Victorian Fauna and Flora Guarantee Act 1988 (FFG Act)

Question 15

The leaders of Tuvalu—a tiny island country in the Pacific Ocean midway between Hawaii and Australia—have conceded defeat in their battle with the rising sea, announcing that they will abandon their homeland. This rise in sea level has been blamed on the effects of the enhanced greenhouse effect which has caused the sea level to rise predominantly by the:

- A. thermal expansion of the sea water
- B. melting of the polar ice caps
- C. increased rainfall
- D. subsidence of the major landmasses

Question 16

The international convention which aims to halt the worldwide loss of wetlands and in doing so help protect many species, including migrating birds is best known as the:

- A. Convention on International Trade of Endangered Species (CITES)
- B. Victorian Fauna and Flora Guarantee Act 1988 (FFG Act)
- C. World Heritage Commission
- D. Ramsar Convention

Question 17

The enhanced greenhouse effect is primarily caused by:

- A. the “hole” in the Ozone layer
- B. increased strength of the sun’s radiation
- C. the use of fuel fossils as an energy source
- D. the removal of native vegetation

Question 18

A developer wishes to construct a series of wind turbines along the Victorian coastline in an area of Gippsland that could also contain some of the very rare Orange-bellied Parrots. Before getting approval for the construction of the wind farm the project operators would need to carry out:

- A. an Environmental Impact Assessment
- B. a capture and translocation program for any of the rare birds in the area
- C. a fund raising project within the local community
- D. a Population Viability Analysis on the Orange-bellied Parrot

Question 19

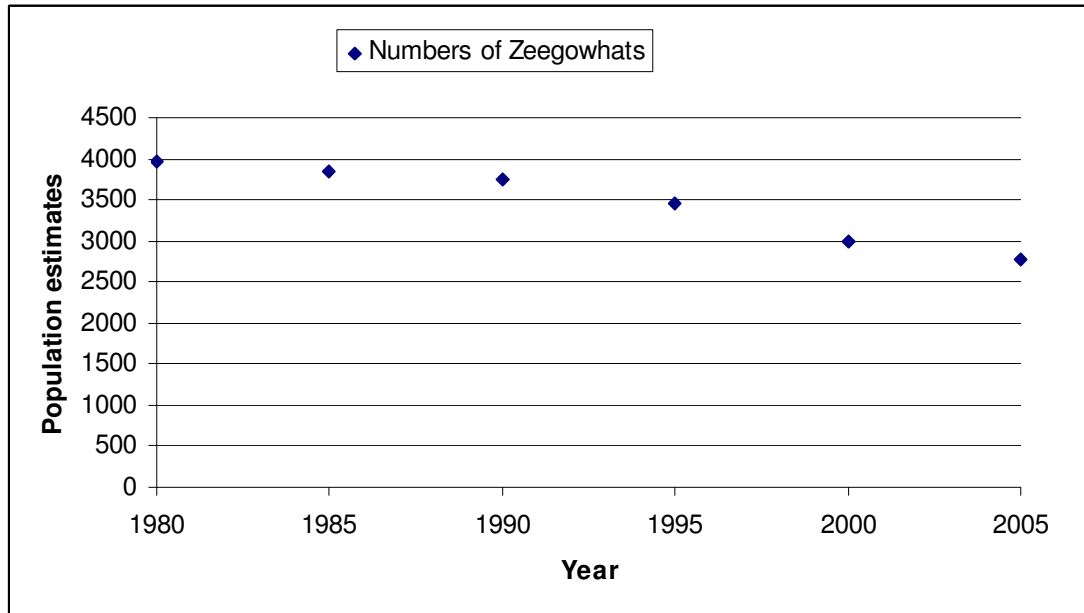
One of the main properties of a greenhouse gas is that it is:

- A. an anthropogenic gas
- B. transparent to visible wavelengths of light
- C. able to absorb UV radiation from the sun

D. occurs in the upper atmosphere

Question 20

The number of Zeegowhats occurring in central Victoria has been regularly surveyed since 1980 and in recent years field biologists have been concerned about the decline in numbers.



Based on the data above what has been the approximate percentage decline in the population of Zeegowhats between 1980 and 2000?

- A. 25%
- B. 50%
- C. 75%
- D. 5%

SECTION B – Short answers

Question 1

A large metropolitan college in Melbourne uses on average 10,000 kWh of electricity per month and as a consequence is responsible for the emission of around 160 tonnes of greenhouse gas.

a) Where would most of these greenhouse gases be released?

A Melbourne metropolitan College would draw most of its power from the power stations in the La Trobe Valley and it would be at these power stations that the greenhouse gases would be released.

b) What is the process taking place to generate most of this electricity?

The combustion of Brown Coal to drive steam turbines.

c) Is this form of energy considered renewable? Explain.

The rate of formation of brown coal, which takes millions of years, is far less than the current world demand for this resource and as a consequence coal can not be considered a renewable resource.

d) Victorians produce more tonnes of climate change pollution each year per person than the average American, making us one of the worst climate change polluters on the planet. Suggest two reasons why Victorians are such high greenhouse gas polluters.

1. *Most of the electricity used by Victorians comes from the burning of brown coal which is a much greater greenhouse polluter than most other forms of fossil fuels*

2. *Victoria has large reserves of brown coal which occur close to the surface making it cheaper to extract and use.*

Other answers could include inferences about lifestyle, climate etc, however students should be aware of the relatively abundant supply of brown coal in Victoria, how cheap it is to extract and the significance of this form of energy in relation to greenhouse gas production.

e) Describe the difference between the enhanced greenhouse effect and the natural greenhouse effect and its relationship to climate.

The main points here are that the greenhouse effect is a natural effect that moderates the climate, increases the overall warmth of the Earth by about 30°C and allows life to exist in its current forms. The enhanced greenhouse effect on the other hand is due to the anthropogenic increase in greenhouse gases in the atmosphere which further warms the planet and generates more extremes in climatic conditions.

f) Suggest **two** possible impacts of global warming and how the enhanced greenhouse effect may have caused these impacts.

So many to pick from however students should select examples where the cause is clearly known or at least the process is reasonably well understood. Significant amounts of media attention has recently focused on sea level rises due to the thermal expansion of water as the lower atmosphere warms as a consequence of the enhanced greenhouse effect.

The increased severity of storms due to increased levels of kinetic energy of the lower atmosphere has also generated significant amount of attention.

g) Describe a place in the world that is currently or may be affected by each impact listed in part **f**).

Tuvalu is a group of nine islands lying about half-way between Hawaii and Australia. The rise in sea level has significant implications for low lying atolls like Tuvalu including salinisation of drinking water, erosion of shore lines and increased high tide mark.

Hurricane Ivan was a recent Category 5 hurricane and may be only one of a number of super-storms under climate prediction models. Category 5 hurricanes have winds that blow continuously above 250 kilometres an hour. Ivan's gusts topped 320 kilometres an hour at times, making it the sixth most powerful hurricane on record for the Atlantic Basin. Hurricane Ivan, the incredibly powerful storm that killed at least 120 people in the Caribbean and southern United States.

Question 2

‘Far from being a blot on the landscape, wind farms are an asset, especially when you look at the alternatives.’ David Suzuki (*New Scientist*, 16 April 2005).

A critic has said Suzuki has missed the point that wind power will never contribute significantly to controlling atmospheric carbon dioxide, and that most people are not in favour of compromising their lifestyle to cut their demand on resources.

In a discussion of different renewable and non-renewable energy resources and their impacts on the environment, to what extent do you agree with Suzuki?

(5 marks)

Question 3

A botanist was investigating species diversity in dry eucalypt forest on the east coast of Tasmania. The forest consisted of two main *Eucalyptus* species with an understorey of *Acacia* species, *Banksia* sp, *Hakea* sp and some members of the Asteraceae family. The ground cover consisted mainly of epacrids and grasses. On two sides of a gully, A and B, he found the following differences:

		Area A	Area B
	Stratum of forest	Number of plants	Number of plants
Canopy	Species A	7	11
	Species B	3	2
	Species C	2	0
Understorey	Species D	15	0
	Species E	2	6
	Species F	3	0
Ground Cover	Species G	9	1
	Species H	5	7
	Species I	2	0

a) Which forest area has the greater plant species richness? Explain.

Species richness refers to the number of different species present regardless of abundance. Area A has 9 species present while Area B has 5 species present; hence Area A has the greatest species richness.

b) Which forest area is more likely to have the greater resistance to change if all other factors are kept the same? Explain.

Area A has got the highest species richness and highest abundance this is likely to give Area A much more resilience to change.

Species diversity is measured using a variety of statistical calculations. These indices are expressed as a number. One of these is Simpson's index (D) which is defined as $D = 1 - (p_1^2 + p_2^2 + p_3^2 + p_4^2 + \dots)$

where p_1 = number of individuals of species A at the site / total number of individuals at the site
 p_2 = number of individuals of species B at the site / total number of individuals at the site
 p_3 = number of individuals of species C at the site / total number of individuals at the site
etc.

A lower Simpson's index indicates a lower biodiversity.

- c) Calculate the Simpson's index for both sites by completing the table below. (4 marks)

Area A			
Species	Number	p value	p ² value
A	7	0.1458	0.0213
B	3	0.0625	0.0039
C	2	0.0417	0.0017
D	15	0.3125	0.0977
E	2	0.0417	0.0017
F	3	0.0625	0.0039
G	9	0.1875	0.0352
H	5	0.1042	0.0109
I	2	0.0417	0.0017
Total number	48		0.178

$$D = 1 - \text{Total } p^2 = \boxed{0.822}$$

Area B			
Species	Number	p value	p ² value
A	11	0.4074	0.1660
B	2	0.0741	0.0055
C	0	0	0
D	0	0	0
E	6	0.2222	0.0494
F	0	0	0
G	1	0.037	0.0014
H	7	0.2593	0.0672
I	0	0	0

Total number	27		0.2895
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$$D = 1 - \text{Total } p^2 = 0.7105$$

d) Explain what these results from part **c)** tell us about the species diversity of the two sites.

Using this index Area A has a higher Simpson's Index number indicating that this site has the higher species diversity.

Question 4

An isolated population of an endangered species of bird contains 100 birds. Two strategies are suggested for managing the population:

Translocation (the transfer of some birds to a new habitat) or;

Reintroduction (the removal of a small number of birds for a captive breeding program and reintroducing the captive birds and their offspring into the original population).

a) Describe **one** advantage and **one** disadvantage of each of these strategies.

(i) Translocation

Advantage: *Reduces the risk of this population being wiped out by stochastic events*

Disadvantage: *By translocating some birds the population is broken into two smaller populations which will both have a greater risk of inbreeding and therefore a loss of genetic diversity*

(ii) Reintroduction

Advantage: *Can be an effective strategy if one of the threatening processes operating on this system is that new birds are not being fledged.*

(1 mark)

Disadvantage: *Very expensive process and is open to all sorts of problems from genetic management and selective breeding to imprinting and learning life skills such as predator avoidance.*

b) State **one** other possible management option to protect the population.

Often the best strategies involve addressing the threatening process operating on the population. This may include predator removal; limiting competition from other species; improving habitat quality; providing supplemental feeding; increasing nest sites, etc.

Question 5

Australia's energy consumption per capita is boosted by large coal exports. These are also factored into Australia's carbon dioxide emissions which need to be at 108 per cent of 1990 levels over the period 2008-2012 for the agreed Kyoto Protocol target.

Although Australia has signed and ratified the United Nations Framework Convention on

Climate Change (UNFCCC), like the USA it has not done so for the Kyoto Protocol, which is intended to strengthen the UNFCCC by limiting carbon dioxide emissions for certain developed countries. Some countries are asked to reduce carbon dioxide emissions below 1990 levels, but Australia was allowed an increase.

Over 125 countries, including the European Union, Japan, Canada and more recently Russia have ratified the Protocol, the total emissions of ratifying countries now exceeds 55% and has allowed the treaty to have legal force.

a) What are the strengths and weaknesses of the Kyoto Protocol?

Strengths include the binding nature of agreements, the flexible limits placed on countries, the international nature of the agreement, the ability to trade carbon credits. Weaknesses include the failure of USA to ratify the agreement and the general issue of how to measure and ensure compliance.

b) Explain a strategy which could limit Australia's dependence on coal exports so that the Government might consider ratifying the Kyoto Protocol.

Australia is one of the world's major coal producers and is the world's largest exporter of coal. If Australia was held responsible for the Greenhouse gas emissions of its exports it would place greater pressure on the Government to develop alternative export strategies. One such strategy could be the increase in Uranium exports, however Australia might then be held responsible for the waste generated from the use of its Uranium.

c) Some countries are investing in Australian forest plantations as a way of reducing their carbon debt. Explain.

Forests as well as soils, oceans and the atmosphere store carbon, which moves among those different stores over time. Consequently, forests can act as sources or sinks at different times: Sources release more carbon than they absorb while sinks soak up more carbon than they emit. A young forest will act as a sink, soaking up Carbon. This sink can then be used to offset greenhouse emissions produced in other locations.

Question 6

a) Name **one** fossil energy source that you have studied this year and describe **two** of the adverse impacts associated with its use.

(3 marks)

b) Name **one** non-fossil energy source that you have studied this year and describe **two** of the adverse impacts associated with its use.

(3 marks)

c) Is this non-fossil energy source described in part **b)** a renewable form of energy? Explain.

(2 marks)

d) Evaluate the differences between the extraction and use of the fossil and non-fossil energy sources outline in part **a)** and **b)**.

(3 marks)

Question 7

a) Nominate a threatened species you have studied this year, and describe changes that have occurred to its distribution and population size over time.

(2 marks)

b) What conservation category is assigned to the threatened species you studied and by which conservation agency / legislation – IUCN, EA, DSE? Justify its ranking under this category.

(2 marks)

c) Describe **two** major threats to this species and suggest reasons why they are considered to be major threats to this species.

(3 marks)

d) Describe **two** mitigation strategies that have been used, or could be used, to protect this species.

(3 marks)

Question 8

The locally native, or indigenous, biodiversity of a place, together with landforms, is what gives every place its unique character. The majority of Australian species are unlike any other plants and animals. 84% of Australian terrestrial mammals, 85% of our flowering plants, 89% of our reptiles, 93% of our frogs and 85% of our in-shore temperate zone fish are uniquely Australian and do not occur naturally anywhere else in the world.

a) What term is applied to species that have their distribution restricted to particular area or region?

Endemic

b) Over 200 years of non-indigenous human settlement in the 8 800km² area of land that we call metropolitan Melbourne has reduced its indigenous biodiversity to scattered remnants.

Suggest **two** reasons why fragmentation of habitat can cause localised extinctions of species.

Two main reasons would be increased risk due to stochastic events and the other would be the deleterious effects of inbreeding and general lack of gene flow resulting in decreasing genetic diversity of the population

c) Suggest **three** reasons why the conservation of biodiversity is important to human survival and illustrate each reason with a specific example.

1. *Ecosystem services e.g., clean water, waste purification, etc*
2. *Utilitarian e.g., bioprospecting for new drugs*
3. *Social e.g., aesthetics, relaxation, spiritual etc*

END