Section One: Multiple-choice **30% (30 marks)**

Question	Answer
1	b
2	c
3	b
4	a
5	b
6	d
7	d
8	b
9	a
10	c
11	c
12	d
13	a
14	c
15	d
16	b
17	d
18	b
19	b
20	d
21	c
22	d
23	d
24	a
25	b

Section Two: Short Answer

Question 26 **20 marks**

(a) what do the arrows represent? Flow of energy (1)
(b) Identify the producers (1)

(b) Identify **two (2)** organisms in the food web that are both second and third order consumers. (2 marks)

Description	Marks
Dragonfly	1
Damselfly	1
TOTAL	**2**

(c) Explain the purpose of constructing a food web of a community. (2 marks)

Description	Marks
Describe the feeding relationships and energy flow in a community.	1
Show species interactions and community structure.	1
TOTAL	**2**

(d) Identify the **two (2)** most important abiotic factors of this food web and explain why they are crucial to its survival. (4 marks)

Description	Marks
Sun/light Provides energy to primary producers, which are the foundation of the food web.	1 – 2
Water Provides habitat for most of the organisms and required for cellular	1 – 2

A new highway is constructed near the habitat in which the organisms of the food web live. Toxins from the construction and use of this new highway enter the water body following winter rains. As a result, both the dragonfly and damselfly populations are significantly reduced.

(e) Describe the effect of reduced dragonfly and damselfly numbers on the food web. (4 marks)

Increased number of tadpoles developing into frogs.
Greater competition for food between kookaburra, bee-eater, lizard and frog.
Adult frogs may reduce in number.
Daphnia population may increase.
Increase in tadpoles and *Daphnia* may reduce normal algae levels.
Rainbow bee-eater will have reduced food source.
Swamp Harrier may lose bee-eater as prey.
Increase in backswimmer beatles

Any other acceptable response.

Question 27

Wetlands are an important refuge for many organisms, both aquatic and terrestrial. Urbanisation and agricultural development has had a negative impact on wetland ecosystems throughout Australia.

(a) Explain how wetland ecosystems have been changed as a result of;

(i) Urbanisation. (2 marks)

Description	Marks
***Four (4)** points from below for a total of **four (4)** marks.*	
Wetlands filled in completely and built over.	1
Removal of fringing (riparian) vegetation.	1
Planting non-native species around wetlands – lawn etc.	1
Addition of excess nutrients from fertilisers.	1
Used as sinks for stormwater drains and road run-off.	1
Sediments disturbed during housing development, releasing toxins.	1
TOTAL	**2**

(ii) Agricultural development and practices. (2 marks)

Description	Marks
***Four (4)** points from below for a total of **four (4)** marks.*	
Use of fertiliser and pesticides on crops – wash into adjacent wetlands.	1
Livestock farming near wetlands – excrement pollutes the water.	1
Extensive horticulture around wetlands. Nutrient input.	1
Change in (ground) water levels due to removal of deep-rooted plants.	1
Dryland salinity resulting from rising groundwater.	1
Wetlands filled in and altered for housing developments.	1
Addition of non-native aquatic species, disrupting food web (yabbies etc).	1
TOTAL	**2**

(b) Define ‘eutrophication’. (2 marks)

Description	Marks
Excessive nutrient enrichment	**1**
of water bodies (fresh and marine).	**1**
TOTAL	**2**

(c) Describe the effect of eutrophication on the ongoing health of a wetland in the absence of any environmental management plan. (4 marks)

Description	Marks
Excessive growth of algae/cyanobacteria forming blooms.	**1**
Some algal blooms produce toxins.	**1**
Algal blooms dominate other plant life and reduce light penetration.	**1**
Decomposition of dead algae depletes oxygen content of water.	**1**
Less/not enough oxygen for aquatic fauna to respire.	**1**
Death of aquatic fauna (fish etc) and reduction of diversity.	**1**
TOTAL	**4**

(d) Suggest **four (4)** management strategies for the prevention or rehabilitation of degraded wetland ecosystems. (2 marks)

Description	Marks
Four (4) *points from below for a total of* ***four (4)*** *marks.*	
Replanting riparian vegetation – sink for nutrients.	1
Changes to stormwater drainage.	1
Reduce source of input of nutrients and toxins.	1
Biofiltration.	1
Nutrient swales.	1
Treatment of water with restorative chemicals – bind with nutrients.	1
Artificial oxygenation of water.	1
TOTAL	**2**

Question 28 **20 marks**

The Honey possum (*Tarsipes rostratus*) is a tiny marsupial that inhabits the Banksia woodlands of southwest Western Australia. The Honey possum is nocturnal and feeds on the nectar and pollen from several species of *Banksia* and *Grevillea*, along with some low growing eucalypts. They are able to travel up to 500 metres during a single evening. Honey possums move quickly between plants during feeding sessions to reduce time spent on the ground.

(a) Explain the ecological benefits of the Honey possum's feeding habits. (3 marks)

Description	Marks
Pollination of native species.	1
Ensures continual recruitment (germination) of new plants.	1
Helps maintain diversity of floral communities.	1
TOTAL	**3**

(b) Describe the relationship that exists between the Honey possum and the floral species from which they feed. (2 marks)

Description	Marks
Mutualism	1
Honey possum receives nutrition while plants get pollinated.	1
TOTAL	**2**

(c) Explain how nocturnal behaviour can increase the possum's chance of survival. (1 mark)

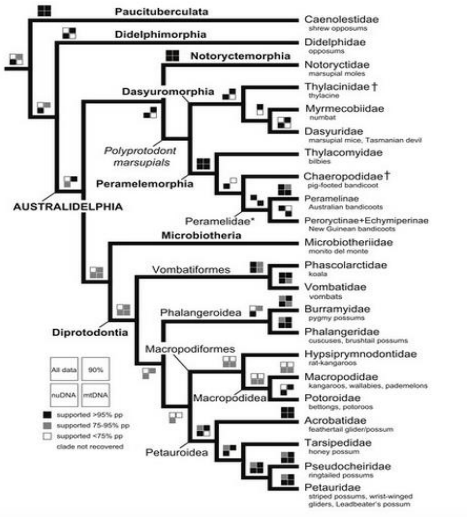
Description	Marks
Avoid predation from larger animals active during the day (e.g. eagles).	1
TOTAL	**1**

(d) Describe and explain **three (3)** major threats to the Honey possum's population and distribution.

(6 marks)

Description	Marks
***Three (3)** threats with explanation from points below.*	
Dieback Kills *Banksia* species that are a food source for HP's.	1 – 2
Habitat fragmentation Reducing size of available habitat therefore reducing available resources. Can also affect gene pool.	1 – 2
Removal of habitat Limiting distribution and range of available habitat. Reduces carrying capacity.	1 – 2
Feral pests – cats, foxes. Introduced feral animals hunt small marsupials at night, therefore increasing risk of predation.	1 – 2
TOTAL	**6**

The Honey possum is classified as the sole species of the family Tarsipedidae. Its relationship to other marsupials is shown in the diagram below.



(e) Explain what a phylogenetic tree is used to represent

(f) Outline 3 assumptions made when a scientist constructs a phylogenetic tree (3)

- The more closely related the more characteristics they will share
- Some characteristics that are shared by a group will not be present in more distantly related groups.
- Many ways an organism can be related, simplest possible way most likely, features shared because they have evolved from common ancestor, feature evolved once.

(g) Identify the Honey possum's most distant relative, including the family and order. (2 marks)

Description	Marks
Shrew opossum	1
Order – Paucituberculata; Family - Caenolestidae	1
TOTAL	**2**

Question 29 **20 marks**

Abalone is a marine mollusc that is highly prized by both commercial and recreational fishers. In the past five years, the abundance of Roe's abalone (*Haliotis roei*) has severely declined in the West Coast Zone (Busselton Jetty to Greenough River mouth). Researchers have found that this decline coincided with an unusually warm Leeuwin current that affected the recruitment of larval abalone.

(a) Define 'population'. (2 marks)

Description	Marks
A group of individuals from the same species,	1
living in the same area at the same time.	1
TOTAL	**2**

(b) describe and explain two management strategies put in place by appropriate government agencies to protect the West Coast Zone abalone populations from further decline. (4 marks)

Description	Marks
• License required for abalone capture. License restricts person to restricted area. • To prevent decrease in population size	1 1
• Restricted season (and limited time for 'fishing'). • Chance for fish to grow and reproduce	1 1
• Bag limit (15 per person). • To reduce impact on population size	1 1
• Size limit (must be 'adult' size, reproductive age). • Ability to replenish fish stocks	1 1
Any two strategies and a reason TOTAL	**4**

(c) Describe how Fisheries' scientists sample to measure the population abundance of abalone in a given area. (4 marks)

Description	Marks
Randomly selected quadrats placed in water on the substrate (1x1 or 2x2) in a given study area.	1
Quadrats are best for sedentary/slow moving organisms – abalone can be counted without being disturbed.	1
Researchers must dive or snorkel to reach where some organisms are located.	1
Relative abundance of whole study site can be calculated from data	1

(d) Calculate the average density of an abalone population from the data presented in the table below. (2 marks)

Table 1: Number of abalone found in sample sites taken from a coastal marine area 200m^2.

Sample	Number per 2m^2	Sample site observations
1	3	Sandy bottom.
2	7	Shallow reef.
3	23	Reef shelf.
4	11	Half reef, half sand.
5	9	Shallow reef.
6	5	Sandy bottom.
7	17	Reef shelf.
8	14	Reef shelf.
9	2	Half shallow reef, half sand.
10	21	Reef shelf.

Description	Marks
Correct use of formula and correct calculations; $\frac{112}{(10 \times 2)}$	1
Correct answer; 5.6 individuals per m^2	1
TOTAL	**2**

(e) Complete the table below regarding the **three (3)** different patterns of population distribution. Include an example for each pattern and explain why the organism is distributed in this manner. (6 marks)

Description	Marks
Clumped Small, tight groups of organisms throughout their habitat. Fish – swim in schools for protection.	1 – 2
Uniform Evenly spaced position of organisms throughout the habitat. Tree plantations – easy to log and drive machinery, or Penguins – huddle in uniform manner to keep warm.	1 – 2
Random Non-uniform and no method to distribution. Native trees in forest – tree grows were the seed falls or is carried, or Solitary animals (E.g. Wedge-tailed eagle) – move constantly to obtain food and resources.	1 – 2
TOTAL	**6**

Question 30 **20 marks**

(a) Define 'dichotomous key'. (2 marks)

Description	Marks
Method of identifying an organism using a system where each new category is divided into two, contrasting choices.	1
With each sequential division, the descriptions become more specific.	1
TOTAL	**2**

Description	Marks
*Any **four (4)** effects from the following;*	
Increased number of tadpoles developing into frogs. Greater competition for food between kookaburra, bee-eater, lizard and frog. Adult frogs may reduce in number. *Daphnia* population may increase. Increase in tadpoles and *Daphnia* may reduce normal algae levels. Rainbow bee-eater will have reduced food source. Swamp Harrier may lose bee-eater as prey. *Any other acceptable response.*	1 – 4
TOTAL	**4**

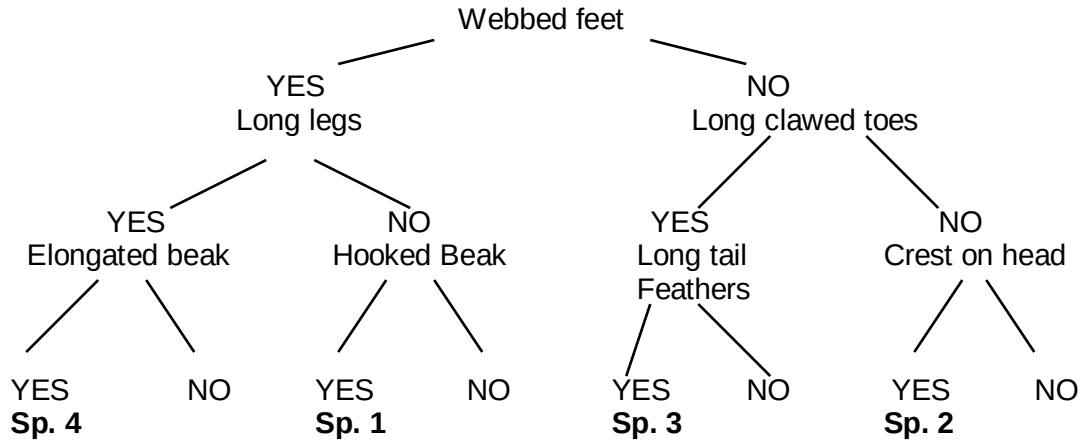
(b) Explain how the classification of organisms can assist environmental scientists in the development of appropriate conservation strategies. (3 marks)

Description	Marks
Identification of rare or endangered species (or undescribed species) in an ecosystem under threat.	1
Determine the species richness in a given area under investigation.	1
Establish the biodiversity of an ecosystem earmarked for protection.	1
TOTAL	**3**

(c) Construct a simple dichotomous key, using yes and no questions, for the water bird species in the images below. (6 marks)

Description	Marks
Selection of at least **four (4**) appropriate features.	1 – 2
Presenting features in a two-question, yes, no format.	1 – 3
Final choice for each organism.	1
TOTAL	**6**

Example;

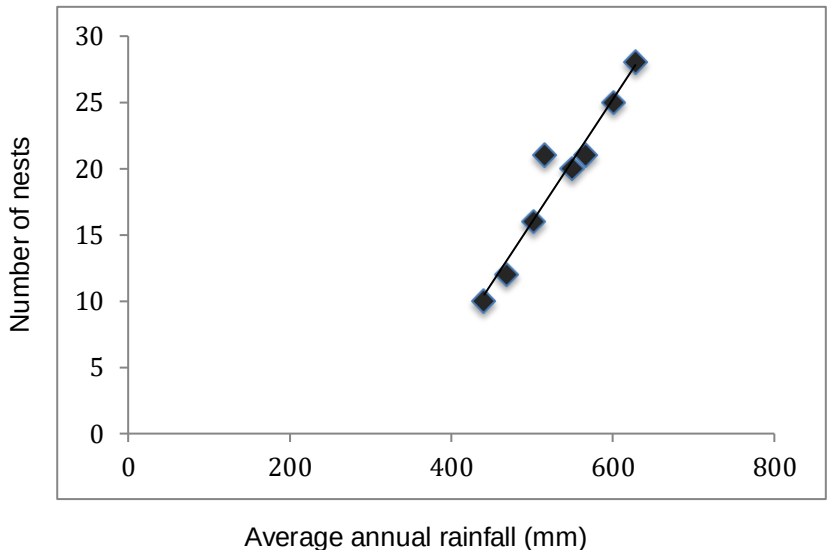


(d) Construct a graph to show the relationship between the number of swan nests and average, annual rainfall. (5 marks)

Description	Marks
Scatter graph/correlation with line of best fit	1
Axes correct	1
Axes labelled with appropriate units	1
Plotted correctly	1
Appropriate title	1
TOTAL	**5**

Example;

Title: The relationship between average annual rainfall and swan nest number over an eight-year period (2005 – 2012).



(e) Describe the relationship revealed in the graph. (2 marks)

Description	Marks
Positive correlation.	1
Greater rainfall, more nests.	1
TOTAL	**2**

(f) Explain **two (2)** limitations in the collection of data for this investigation. (2 marks)

Description	Marks
Two (2) *points from below.*	
Use of annual average rainfall instead of looking at winter rainfall data.	1
Only counting nests. No consideration for number of breeding females or migration to other wetlands.	1
No repetition at other similar wetlands.	1
TOTAL	**2**

Section Three: Extended answer **20% (40 marks)**

This section contains **four (4)** questions. You must answer **two (2)** questions; **one (1)** from Part A and **one (1)** from Part B.

Part A

Q31

(Discuss how scientists classify ecosystems based on their biotic and abiotic factors.
(10 marks)

Description	Marks
Ecosystems fall into two categories – terrestrial and aquatic.	
Terrestrial ecosystems are classified into six major ecosystems – tropical rainforests, savannah, grasslands, tundra, deserts, temperate forests.	1
In terrestrial ecosystems, vegetation (biotic) is the basis for classification because it is the most visible and dominant aspect.	1
Landscape and ecological relationships amongst species inhabiting the ecosystems are also considered.	1
Vegetation classifications involve vegetation growth forms and structure. Classification is based on percentage (%) of ground covered/shaded by tallest layer of vegetation (canopy cover) and the form of the tallest layer such as tree, mallee, grass and/or shrubs.	1
Ecological characteristics (abiotic) include landform, biogeography and climate and soil and influence the distribution of vegetation.	1
Terrestrial ecosystems are named after their dominant species. E.g. Jarrah forest or Banksia woodland.	1
Aquatic ecosystems are classified as either freshwater or marine.	1
Marine ecosystems are either oceanic or seas.	1
Freshwater ecosystems are based on movement of water (abiotic) Rivers with moving water are 'lotic'. Lakes and wetlands are still water and are termed 'lentic'.	1
Abiotic factors are important in classifying aquatic ecosystems. Light penetration and water depth influence primary production. Other biotic factors are determined by the type and abundance of producers.	1
TOTAL	**10**

(b) Compare and contrast the process of primary and secondary succession. (10 marks)

Description	Marks
Primary succession is the first stage of colonising a bare site containing no organisms, caused by a catastrophic event (fire, volcanic eruption and earthquakes etc).	1
Begins with pioneering plants colonising the area. The species depends on the abiotic factors of the habitat. Termed 'r-selected species'.	1
Colonising species have special characteristics to make them successful such as rapid reproduction, effective seed dispersal and rapid growth.	1
R-selected species move in to colonise unused areas but are outcompeted once other species become established.	1
Once the ecosystem's producers have become established, other organisms are able to colonise the area – small herbivores first. Then the community gradually expands as organisms migrate from other areas.	1
Secondary succession is the re-colonisation of a plant community that has been disturbed, regaining equilibrium. Disturbances include fire, clear-fell logging and land clearing for farming.	1
The organisms that recolonise the area may be different to those in the original community.	1
Plants that depend on intense light, such as weeds and grasses, invade the new open area. Seeds from trees and shrubs blow in from adjacent communities and become established, proving more shade.	1
As the larger vegetation grows, weeds are outcompeted. The vegetation becomes more complex. This allows the original fauna, such as birds and small marsupials, to re-establish themselves.	1
Over time, leaf litter builds up, providing habitat and resources for decomposers. The complexity of the food web increases with increasing diversity of organisms.	1
TOTAL	**10**

Part B

Q 33

(a) Describe the role of keystone species in a community. Explain how the concept of 'keystone species' has influenced the development of conservation strategies. (10 marks)

Description	Marks
A keystone species has a large influence over organisms in lower trophic levels, relative to its small population.	1
Keystone species have been shown to prevent organisms in these lower levels from monopolising food resources and space.	1
This allows the co-existence of several species with similar resource requirements.	1
The presence of a keystone species allows for a greater degree of biodiversity in a restricted area.	1
If the keystone species is removed or declines in number, the community may become unstable, as the normal influence of the keystone species is lost. This may reduce diversity in the community.	1
The importance of these species has led ecologists to develop conservation strategies based on a single keystone species.	1
Used to maintain diversity in areas under threat by creating a habitat that enables endangered species to thrive.	1
Used to maintain community structure in community re-establishment.	1
Support populations of species that require costly or time-consuming conservation efforts.	1
Some ecologists argue that the definition of a keystone species is not refined enough to become the foundation for conservation efforts. It has been suggested that focusing on one species only could be detrimental to other species considered less important to diversity.	1
TOTAL	**10**

"A healthy soil environment provides the foundation for maintaining the biodiversity of terrestrial ecosystems".

QS 34

Justify this statement using your knowledge and understanding of ecosystem dynamics.
(10 marks)

Description	Marks
The type of soil present in an ecosystem can determine the species that grow there.	1
Roots in the soil take up nutrients that are essential to the growth of plants. Nitrogen, carbon, phosphorus and potassium.	1
Nitrogen cycle is dependent upon soil ecosystems. Atmospheric nitrogen is 'fixed' by bacteria in the soil as ammonia molecules.	1
Some nitrogen-fixing bacteria have symbiotic relationships with the roots of native plants. Bacteria live within nodules on the roots and transport nitrogen directly to the plant.	1
Soil bacteria can also convert nitrogen compounds (ammonia) into nitrates and nitrites that are absorbed by the plant's roots.	1
Soil invertebrates break down dead organic matter into smaller pieces. These are called detritivores (E.g. earthworms etc).	1
Decomposers include bacteria and fungi. These feed on the detritus and release the nutrients stored within.	1
Organic matter in the soil, humus, stores nutrients as well as increasing the water holding capacity of the soil.	1
Organic matter in the soil increases aeration and oxygen content. This provides soil organisms with oxygen for metabolic reactions.	1
Soils without humus have limited capacity to store water or nutrients. They are more susceptible to damage if exposed to environmental changes.	1
TOTAL	**10**