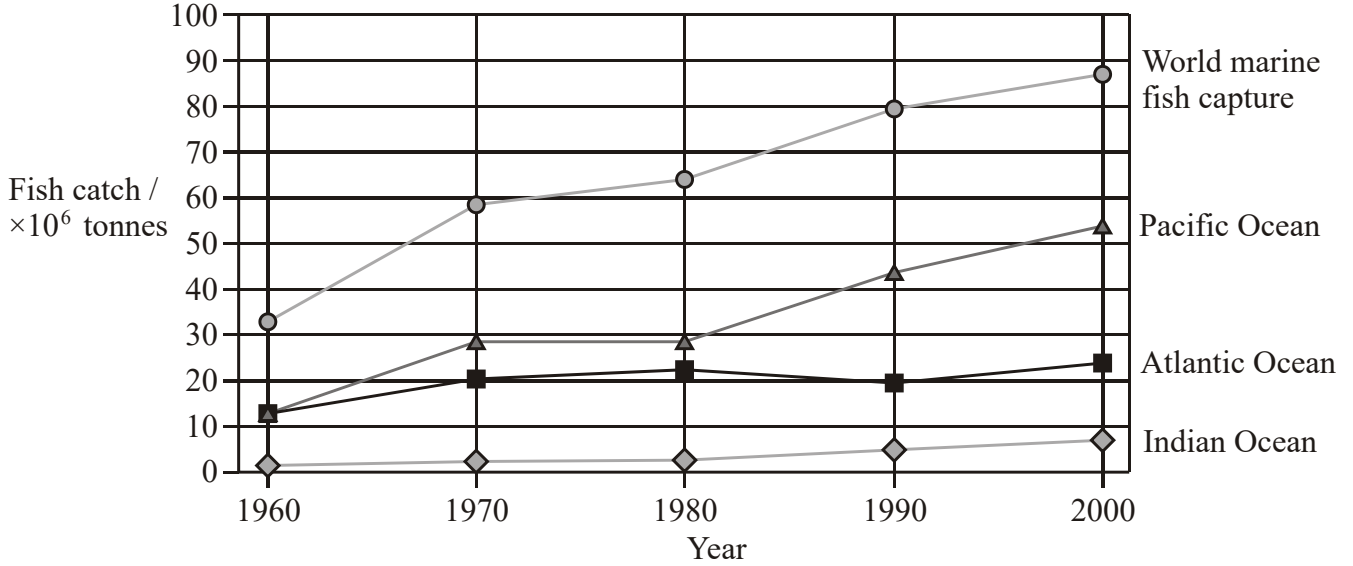


TOPIC 11 – ECOLOGY

Fish Catches (6 marks)

The Food and Agricultural Organization (FAO) gathered information to determine if marine ecosystems were being damaged by overfishing. The total fish captured in each of three oceans from the years 1960 to 2000 was compared to the overall world marine capture.



a. Calculate the percentage of the world catch that came from the Atlantic Ocean in 1990. (1 mark)

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b. Compare the data from the Pacific Ocean with that from the Atlantic Ocean. (3 marks)

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c. Suggest **one** reason in each case for the change in the quantity of fish captured in the Atlantic and Indian Oceans from 1980 to 1990. (2 marks)

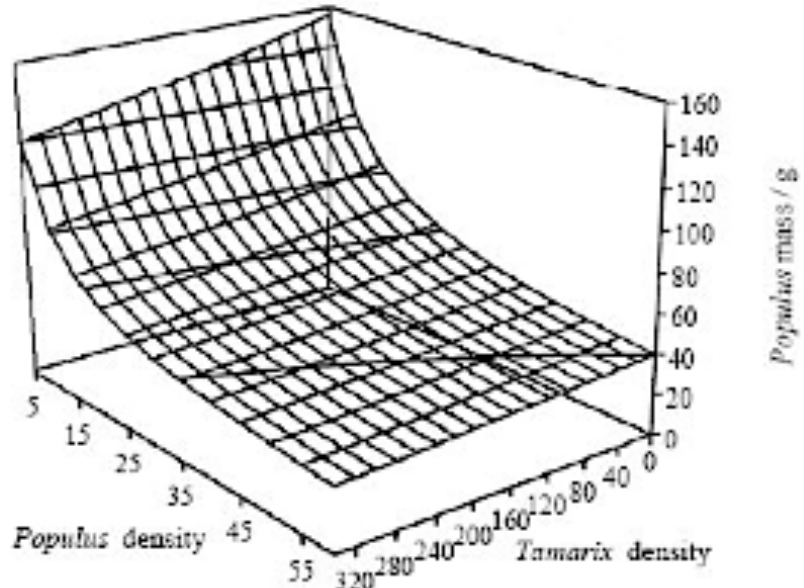
i. Atlantic Ocean:

ii. Indian Ocean:

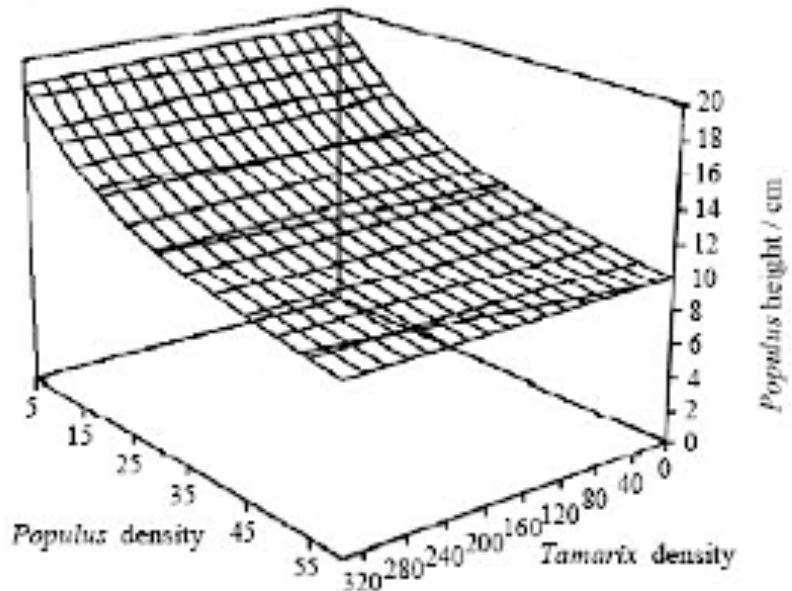
Seedling Competition (6 marks)

In the south-west of the USA, dams were built across rivers in the early 1900s to stop natural flooding. As a result, a non-native tree *Tamarix ramosissima* (salt cedar) gradually replaced the native *Populus deltoides* (cottonwood) as the dominant woody species. Flooding is being re-established to reverse the invasion of *Tamarix*. Studies were done to investigate the relative competitive abilities at the seedling stage using different densities of the two species. Seedlings were grown in pots at different densities and mixtures of the two species. A 3-D model was developed to show the effect of the densities of each species on *Populus* mass (graph A) and height (graph B). Densities represent the number of seedlings per 20-cm-diameter pot.

Graph A:
Effect of seedling densities
on *Populus* mass



Graph B:
Effect of seedling densities
on *Populus* height



a. Describe how *Tamarix* density affects *Populus* height. (1 mark)

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b. Considering the pots where *Populus* is growing without *Tamarix*, describe the change in mass **and** height of *Populus* with increased density of *Populus* seedlings. (3 marks)

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c. Suggest **two** factors that could have allowed *Tamarix* to dominate in non-flood conditions. (2 marks)

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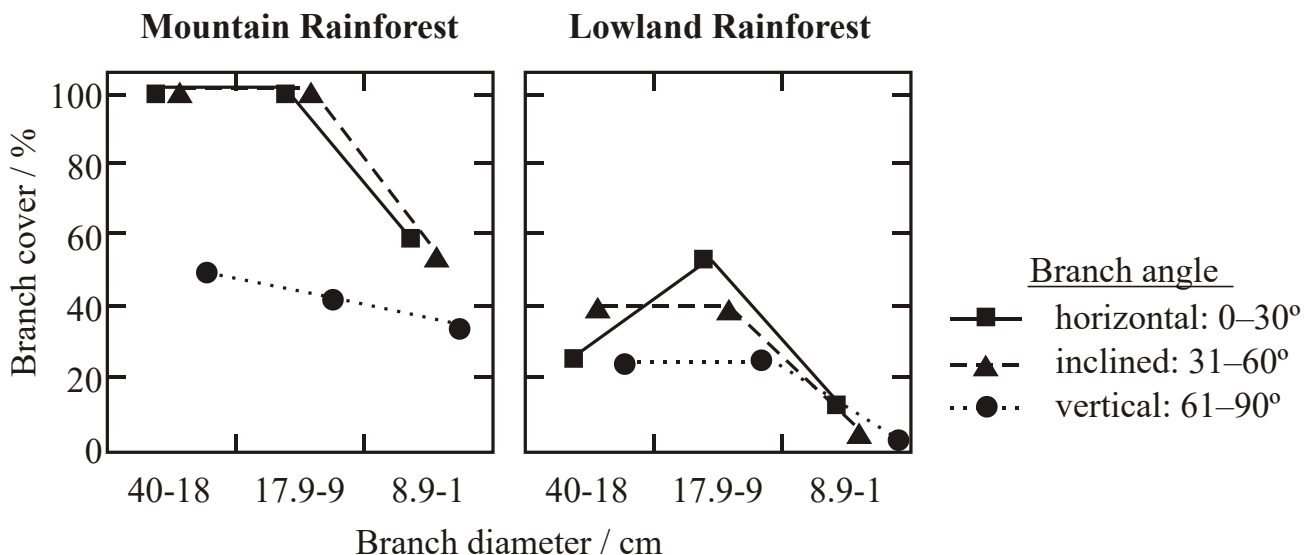
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Epiphyte Distribution (6 marks)

Plants called epiphytes grow above the ground on the surface of other plants such as trees. Epiphytes play an important role in rainforests because they can absorb vast amounts of precipitation water (rain and fog), retain minerals effectively and contribute enormous amounts of humus. An investigation was carried out in Ecuador to determine the distribution and abundance of epiphytes in lowland and mountain rainforests. Branch cover was measured for different branch diameters and different branch angles. (The larger the branch diameter, the closer it was to the trunk of the tree.) The results are shown below.



a. Outline the percentage of branch cover on horizontal branches of trees in mountain rainforests. (1 mark)

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b. Analyse how the branch angle affects the percentage of branch cover in mountain rainforests. (2 marks)

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c. Compare the percentage of branch cover between mountain rainforests and lowland rainforests for inclined branches. (2 marks)

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d. Suggest a reason for the overall difference in branch cover by epiphytes in mountain rainforests and lowland rainforests. (1 mark)

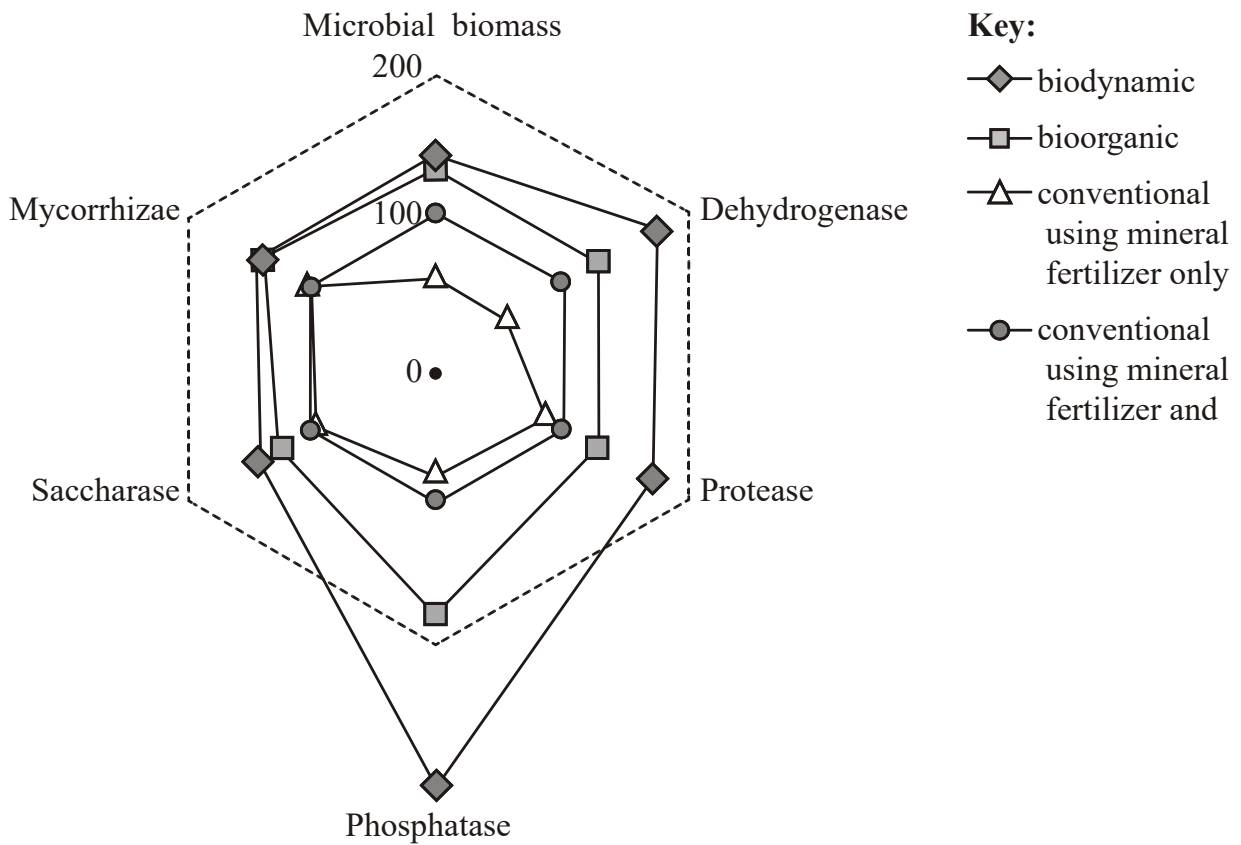
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Soil Ecology (6 marks)

Recently, a twenty-one year study was completed in Europe to determine the effectiveness of four different farming methods. Two organic methods, biodynamic and bioorganic, and two conventional methods, one using mineral fertilizer only and one using mineral fertilizer and manure, were all compared. The study considered how these four methods affected the physical, chemical, microbial and faunal (animal life) properties of the soil. In the following radial graph, microbial results are presented relative to the conventional method using mineral fertilizer and manure set at 100%.

Definitions: Mycorrhizae are associations between roots and fungi that can help roots absorb water and minerals from the soil better than roots without a fungus partner. Dehydrogenase, protease, phosphatase, and saccharase are enzymes in soil microorganisms which contribute to nutrient recycling.



a. Identify which enzyme appeared to be **most** affected by the different farming methods. (1 mark)

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b. Identify which enzyme appeared to be **least** affected by the different farming methods. (1 mark)

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c. List the farming methods from the lowest to the highest in their effect on microbial biomass. (2 marks)

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d. Evaluate the claim that organic farming methods are better for soil than conventional methods. (2 marks)

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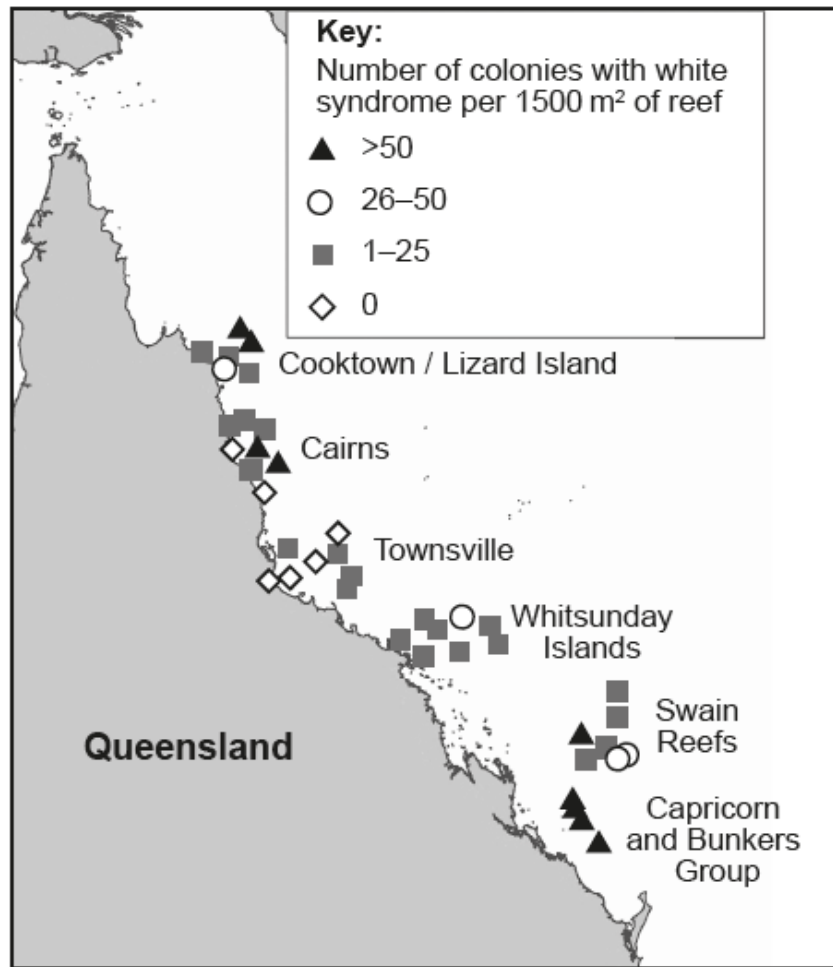
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Great Barrier Reef (13 marks)

The incidence of white syndrome, an infectious disease of coral, was investigated in a six-year study on Australia’s Great Barrier Reef. The map shows disease conditions on coral reefs at six study sites.



a. Identify the site with the highest incidence of diseased colonies. (1 mark)

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b. Deduce whether there is a trend in the incidence of white syndrome over the north-south range of latitude. (1 mark)

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Satellites were used to record sea surface temperatures. The temperatures each week above a reef were compared with mean temperatures for that week between 1985 and 2004. If the sea surface temperature was 1 °C or more above the mean, this was recorded as a weekly sea surface temperature anomaly (WSSTA). The number of WSSTAs was calculated for the twelve months preceding the date on which a reef was surveyed for white syndrome.

On each reef, the number of cases of white syndrome in a 1500 m² sample area was surveyed once per year. The table shows these cases in relation to numbers of WSSTAs and coral cover on the reef. Low coral cover was 0–24 % and high coral cover was 50–75 %.

Mean number of corals with white syndrome per 1500 m²			
WSSTAs per year	Coral cover / %		
	0–24	25–49	50–75
0	0.9	0.9	10.4
1 to 5	3.6	9.8	23.3
> 5	4.7	4.5	80.1

c. Describe the evidence that is provided by the data in the table for the harmful effects of rising sea temperatures on corals. (2 marks)

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d. The researchers concluded that there was a threshold coral cover percentage, below which infection rates tended to remain fairly low. Using the data in the table, identify this threshold level. (1 mark)

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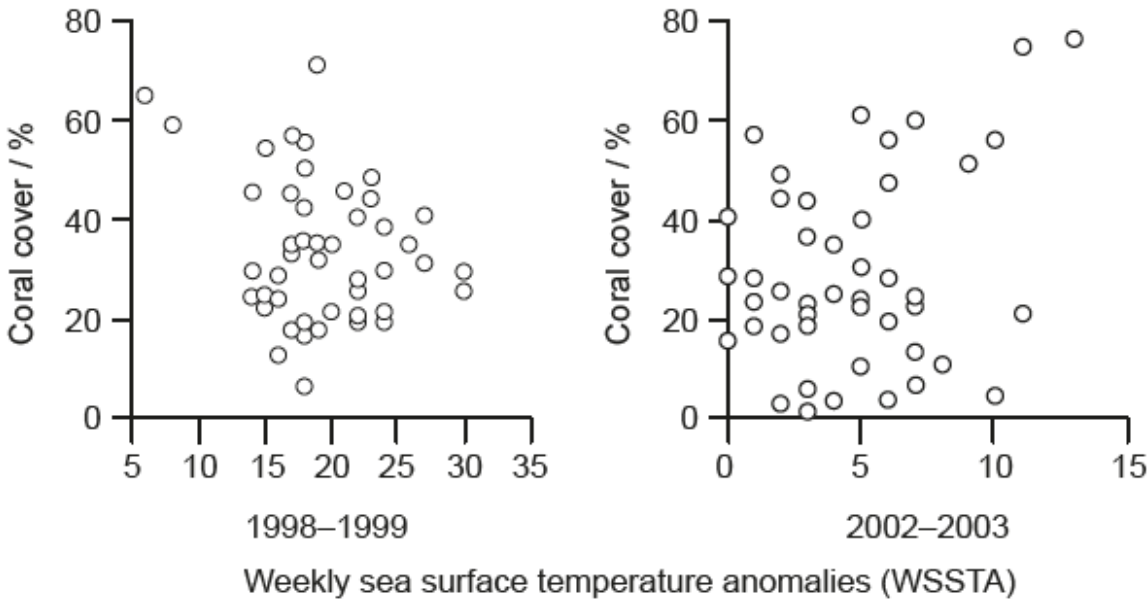
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e. Suggest a reason for a larger percentage of corals being infected with white syndrome on reefs with a higher cover of corals. (1 mark)

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The graphs show the relationship between the weekly sea surface temperature anomalies (WSSTA) and coral cover during two twelve-month periods (1998–99 and 2002–03), which were the warmest in the six-year study. Each dot represents one studied reef.



f. Compare and contrast the data for 1998–1999 and 2002–2003. (2 marks)

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g. Suggest a reason for the correlation between coral cover and WSSTA in 1998–1999. (1 mark)

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h. Some scientists predict that, if humans continue to produce carbon dioxide at the current rate, the pH of the oceans will become more acidic. Suggest possible effects on the coral reefs. (3 marks)

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i. This study was carried out over six years on the Australian Great Barrier Reef. State **one** advantage of field investigations compared with mesocosm experiments to study ecological processes. (1 mark)

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Answers

1a (1 mark)

25 (± 1) (%)

1b (3 marks)

- in 1960, the capture was the same in both oceans
- more fish caught in the Pacific Ocean than Atlantic Ocean after 1960
- % increase greater in Pacific Ocean than Atlantic Ocean
- in 2000, Pacific Ocean yield more than doubled Atlantic Ocean yield
- between 1980 and 1990 decrease in Atlantic Ocean capture and increase in Pacific Ocean
- from 1970 to 1980 no change in Pacific Ocean but increase in Atlantic Ocean yield

1c (2 marks)

- Atlantic Ocean*: quotas decreased / depleted stocks / consumer tastes / smaller fleet / yield decreased
- Indian Ocean*: better technology / quotas increased / consumer tastes / more stocks / bigger fleet / yield decreased

2a (1 mark)

Tamarix density has very small / no effect on *Populus* height at any density / high or low density

2b (3 marks)

- in mass and height there is an inverse relationship with density
- at low *Populus* density, the mass is high / maximum / about 155 g
- mass decreases from 160 g to 40 g
- at low *Populus* density, the height is maximum / high / 19 cm
- height decreases from 19 cm to 10 cm

Must include statements of **both** mass and density for full marks.

2c (2 marks)

- better underground / root growth to compete for water
- competition for minerals / nutrients
- greater resistance to drought / protection against dehydration / lower water needs
- resistance to higher salinity / changes in pH

3a (1 mark)

- thicker branches have more cover / branches near the tree have more cover
- thinner branches have less cover / no change until the branch is 17.9–1 cm

3b (2 marks)

- with higher angles there is usually less coverage
- there is less change between 0–30° and 31–60° than between 31–60° and 61–90°
- the coverage for horizontal and inclined branches almost the same
- the ends of branches show least coverage

3c (2 marks)

- the overall patterns are the same
- for branch diameters of 40–9 cm there is 100% coverage in the mountains compared to 40% in the lowland forest
- for thinner branches (8.9–1 cm) the percentage cover in forests is almost zero whereas mountain branches have 40% cover

3d (1 mark)

- mountain forests are often covered in mist or clouds so there is more moisture available
- more precipitation in mountain forests
- lowland forests are warmer and plants dry out more easily
- more animal activity / grazers in lowland forest

4a (1 mark)

phosphatase

4b (1 mark)

saccharase

4c (2 marks)

(lowest) conventional without manure → conventional with manure → bioorganic → biodynamic (highest)

Award [1 max] if only two are in the correct order.

4d (2 marks)

- both organic methods have the most positive effect on four / five factors
- biodynamic's effect on phosphatase activity is high
- but cannot be sure that organic methods are best since data for effect on physical / chemical / faunal is not given
- organic produce less pollution than conventional (by mineral fertilizers)

5a (1 mark)

Capricorn and Bunkers group

5b (1 mark)

there is no clear trend

5c (2 marks)

- effects (generally) increase with temperature anomalies/WSSTA
- effects increase for all different coral covers OR in the 25-49 cover there is an anomaly/is not an increasing trend
- harmful effect is higher in coral covers between 50-75 % / vice versa

5d (1 mark)

50 % / 25 % / 49 % OR 25-49 % (coral cover)

5e (1 mark)

- the closer the corals are (to each other) the easier the transmission
- other organisms in the community may act as vectors/carriers / OWTTE

5f (2 marks)

- Similarities:* similar range of cover in both periods OR weak correlation/no correlation in either
- Differences:* higher WSSTA range/more WSSTA in 1998-1999 than 2002-2003 OR positive (2002-2003) versus negative correlation (98-99) OR more coral reefs with very low % of coral cover (0-20 %) in 2002-2003

Must respond with one similarity and one difference for full marks.

5g (1 mark)

coral cover lower on reefs with higher temperature

5h (3 marks)

- corals would not be able to maintain their skeletons
- (if coral reefs are lost) habitat will be lost
- some organisms/coral can decline if the water becomes too acidified
- coral bleaching could occur/become worse OR coral could expel their mutualistic alga/zooxanthellae
- enzymes could be denatured

5i (1 mark)

real environmental conditions / larger scale investigations / more variables studied