

Year 1 Test: July 2020

Name:

Topics included: Biodiversity and Population, nutrient cycles, Energy and Ecosystems and Osmoregulation (Kidneys). You will have from 2-3.30pm on Friday 3rd July to complete the test.

PLEASE ADD YOUR ANSWER IN A DIFFERENT COLOURED TEXT

Q1. Ecologists investigated changes in grassland communities on large islands off the coast of Scotland between 1975 and 2010. On each island, they used data from a number of sites to determine the change in mean species richness and the change in mean index of diversity.

- (a) **Table 1** shows plant species recorded at one site, on one island, in 1975.

Species	Number of individuals
<i>Hydrocotyle vulgaris</i>	3
<i>Plantago maritima</i>	19
<i>Ranunculus acris</i>	3
<i>Hieracium pilosella</i>	3
<i>Calliargon cuspidatum</i>	10
<i>Prunella vulgaris</i>	16
<i>Pseudoscleropodium purum</i>	6

Calculate the index of diversity for this site using the formula:

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

$d =$ _____(2)

- (b) Outline a method the ecologists could have used to determine the plant species richness at one site.

_____ (3)

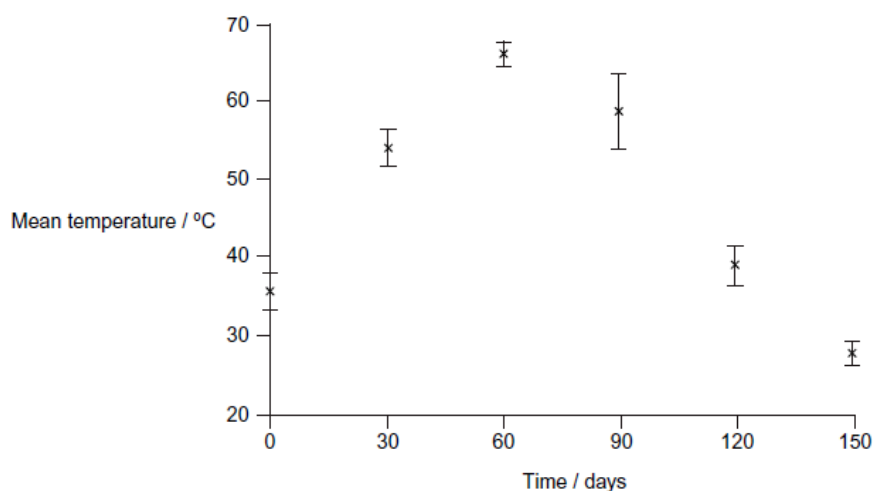
- (c) Some of the ecologists' results are shown in **Table 2**. They carried out a statistical test to find out whether any differences between the 1975 and 2010 means were significant. The values for P that they obtained are also shown in **Table 2**.

Island	Change in mean species richness between 1975 and 2010	Value of P	Change in mean index of diversity between 1975 and 2010	Value of P
Islay	+8.89	≤0.001	+0.22	>0.05
Colonsay	+14.70	≤0.001	+2.68	≤0.01
Harris	−5.13	≤0.001	−2.44	≤0.01

Do these data show that there were any significant changes in the grassland communities on these islands? Give reasons for your answer.

[illegible]

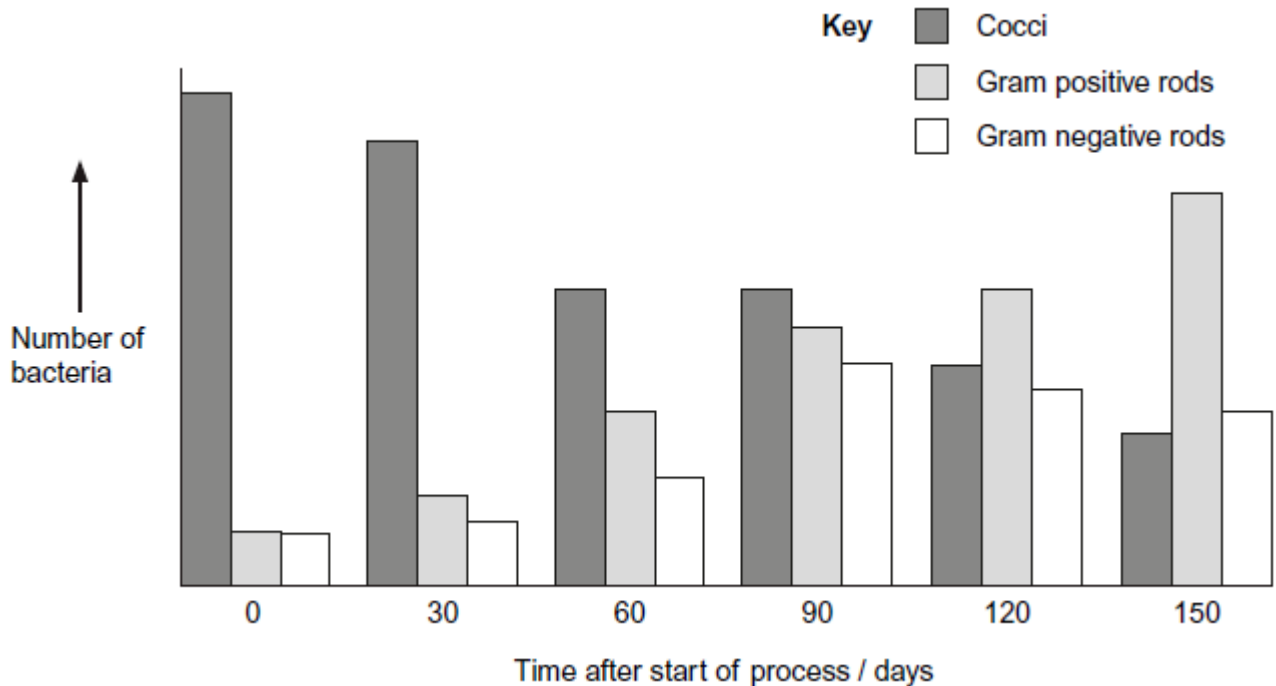
Q2. The organic material in household waste can be used to make compost for use as a fertiliser. Scientists investigated changes during one process used to make this compost. The method involved placing the waste in large containers for 150 days. At regular intervals the containers were rotated. The scientists measured the temperature of samples of waste during the investigation. **Figure 1** shows the results they obtained. The vertical bars show standard deviations.



- (a) Explain the advantage of showing the data using standard deviations rather than ranges.

(2)

- (b) The scientists took a sample of the waste at the start of the process. They then took samples every 30 days. In each sample, they determined the numbers of particular types of bacteria. **Figure 2** shows the changes in the number of three types of bacteria during the process.



The scientists concluded that the results in **Figure 1** and **Figure 2** are evidence for a form of succession during the process. Use the information to suggest how they reached this conclusion.

(3)

Q3. *Hydrilla (Hydrilla verticillata)* is an aquatic plant which has become a major pest of waterways in parts of the USA. *Hydrilla* is not a native species of the USA. It was introduced into natural habitats from aquariums. In many freshwater habitats it has rapidly become the dominant plant species.

- (a) In many freshwater habitats Hydrilla has rapidly become the dominant plant species. Suggest **two** reasons why.

1. _____

2. _____

_____ (2)

- (b) The spread of Hydrilla has had economic consequences for commercial activities and for the government's environmental agency. Suggest **two** economic consequences of the spread of Hydrilla.

1. _____

2. _____

_____ (2)

- (c) Scientists investigated the effect of the chemical fluridone as a method of controlling Hydrilla. The study was carried out using samples of Hydrilla grown under controlled laboratory conditions. Several samples of the plant were grown at different concentrations of fluridone. The results are shown in the following table.

	Days of treatment			
	0	20	40	60
Concentration of fluridone / $\mu\text{g dm}^{-3}$	Mean biomass of Hydrilla / g			
0.0	5.0	16.4	20.4	33.4
0.5	5.0	14.1	18.2	31.3
1.0	5.0	9.7	8.9	7.4
5.0	5.0	4.6	2.8	1.3
25.0	5.0	3.2	1.6	0.4

- (i) The scientists obtained the biomass of each sample by heating it at 75 °C for 2 hours. They then weighed the sample, reheated it for 15 minutes and weighed it again. They continued this cycle of reheating and weighing until they found the sample had a constant mass.

Explain how this method helped to provide a reliable measurement of the biomass.

_____ (2)

- [illegible]

- Experiment 1 – Hydrilla left untreated
- Experiment 2 – Hydrilla treated with the fungus
- Experiment 3 – Hydrilla treated with fluridone
- Experiment 4 – Hydrilla treated with both fluridone and the fungus.

(i) Experiment **1** acted as a control. Explain why the scientists carried out experiment **1**.

(1)

(a) Use the information above to suggest how feather mites could affect breeding in great tits.

(2)

(b) The scientists located a large number of great tit nests. They sampled these at random.

For each nest they recorded

- the total number of eggs laid
 - the number of chicks that hatched from the eggs
 - the number of chicks that survived to leave the nest
 - the total number of feather mites on the two parent birds.
- (i) The scientists calculated the percentage of each pair's eggs from which chicks survived to leave the nest. They called this 'breeding success per pair'. The table shows some of the data that the scientists obtained.

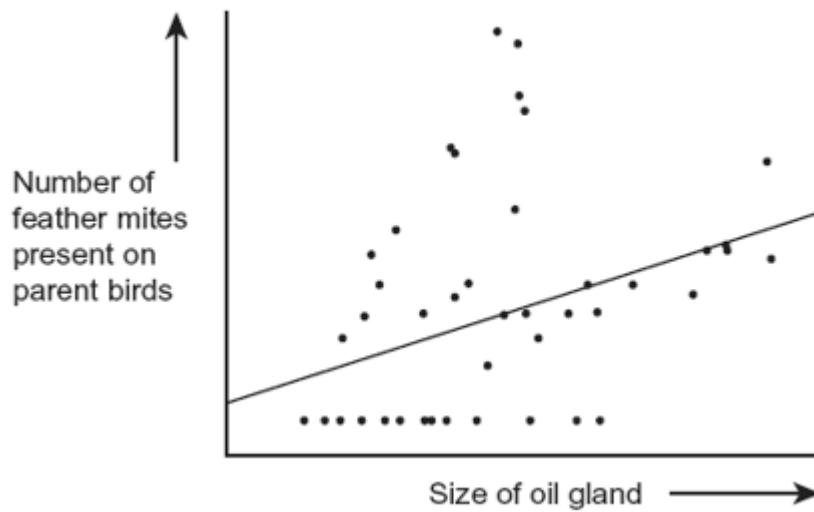
Total number of feather mites on both parent birds	Breeding success per pair
0	86
2	100
5	64
10	82
14	70
15	85
170	42

Do these data support the hypothesis that the presence of feather mites reduces the ability of great tits to reproduce successfully? Give reasons for your answer.

(3)

(c) The oil that a great tit puts on its feathers is made in an oil gland at the base of the tail. The bird uses its beak to spread the oil over its feathers. This is called preening. Preening takes place in early morning and evening and empties the oil gland each time. After preening, the oil gland is considerably smaller.

At the same time that the scientists recorded the number of feather mites on each great tit, they also measured the size of the oil gland. The graph shows their results and includes the scientist's line of best fit.



- (i) Describe the relationship between the number of feather mites present on each great tit and the size of the oil gland.

(2)

- (ii) Explain how measuring the oil gland at the same time as counting the feather mites may have affected the reliability of the data.

(2)

#

Q5. After harvesting, the remains of crop plants are often ploughed into the soil.

Explain how microorganisms in the soil produce a source of nitrates from these remains.

[illegible]

Q6. Residual food intake (RFI) is the difference between the amount of food an animal actually eats and its expected food intake based on its size and growth rate. Scientists have selectively bred cattle for low RFI.

- (a) (i) Explain the advantage to farmers of having cattle with a low RFI.

(2)

- (ii) When RFI is calculated, low values are negative. Explain why they are negative.

_____ **(1)**

- (b) Scientists have developed a standard procedure for comparing RFI in cattle. They control **two** factors. These are type of food and environmental temperature. Explain why each of these factors needs to be controlled.

Type of food

Environmental temperature

(4)

Q7. (a) The control of water balance in the body involves negative feedback.

- (i) Describe what is meant by *negative feedback*.

(1)

- (ii) Water is removed from the body via the kidneys. Give **two** other ways in which water is removed from the body.

1. _____

2. _____ (2)

- (iii) Name the part of the brain which acts as the coordinator in the control of water balance.

(1)

- (b) **Figure 1** shows the cells lining the collecting duct in a human kidney. ADH molecules bind to the receptor proteins and this triggers the vesicles containing aquaporins to bind with the plasma membrane next to the lumen. **Figure 2** shows an aquaporin which is a large channel protein.

Figure 1

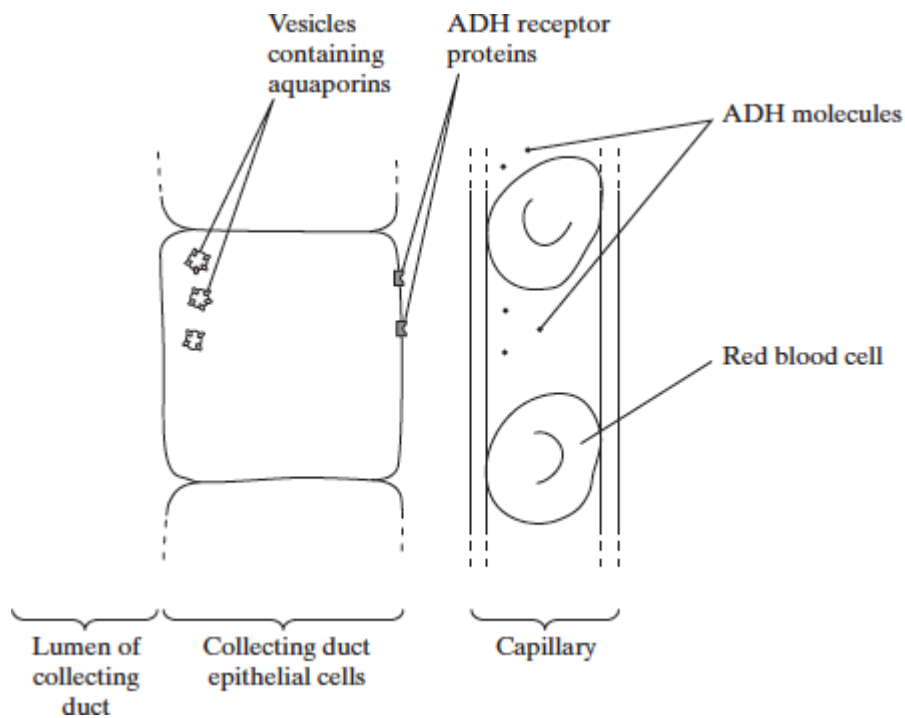
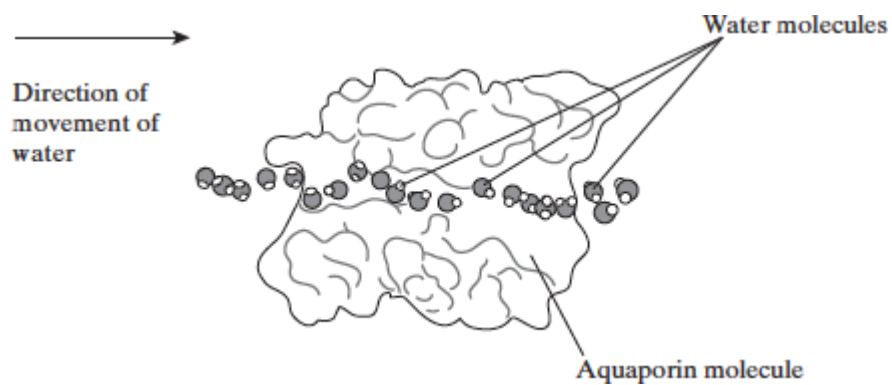


Figure 2



- (i) From which gland is ADH released?

_____ (1)

- (ii) Use the information given to explain how ADH increases the movement of water from the lumen of the collecting duct into the blood.

_____ (4)

Q8. Mammals and fish remove nitrogenous waste from their bodies in different forms.

(a) Name **two** polymers present in mammals and fish that contain nitrogen.

1. _____

2. _____ (2)

(b) In a mammal urea is removed from the blood by the kidneys and concentrated in the filtrate.

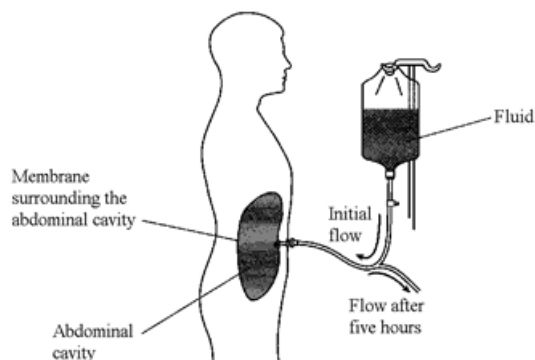
(i) Describe how urea is removed from the blood.

_____ (2)

(ii) Explain how urea is concentrated in the filtrate.

_____ (4)

(c) The diagram shows one way in which a person who has kidney disease can have the condition managed. In the process a fluid is put into the abdominal cavity. Exchange of materials takes place across the membrane that surrounds the abdominal cavity. This removes waste products from the blood. After five hours the fluid is drained out of the cavity and discarded. The cavity is then refilled with fresh fluid.



The table shows the concentration of solutes in the fresh fluid.

Solute	Concentration / mmol dm ⁻³
Sodium ions (Na ⁺)	132
Chloride ions (Cl ⁻)	96
Calcium ions (Ca ²⁺)	1.25
Magnesium ions (Mg ²⁺)	0.25
Glucose	76
Urea	0

- (i) By what process does urea enter the fluid in the abdominal cavity from the blood?

_____ (1)

- (ii) Explain why the fluid is changed every five hours.

_____ (1)

- (iii) Fluid of the composition shown in the table is used instead of distilled water.
Explain why.

_____ (2)

This is the end of the test. You will have till 3pm to upload the completed test AS A PDF document onto connect.

If you are having issues then please email your Biology teacher ASAP.

Total for Exam: 66 marks.

Total: ____/66 %: ____

Mark schemes

Q1.

- (a) Correct answer of 4.92, 2 marks;
If $N(N-1) = 3540$, **OR** $\sum n(n-1) = 720$, then award 1 mark
Accept 4.916 / 4.917 / 4.9

2

- (b) 1. A method of selecting sampling sites at random;
2. Use of quadrat;
3. Identify (plant) species (at site / in each quadrat)
OR
Count number of (different plant) species (at site / in each quadrat);
1. *E.g. grid with coordinates selected using random number table*
2. *Frame or point*
3. *Reject refs to % cover, or counting individuals*

3

- (c) 1. Significant increase in species richness on Islay and Colonsay **and** (significant) fall on Harris;
2. Change in diversity on Islay not significant;
3. Greater than 0.05 / 5% probability of getting this change / difference by chance (on Islay)
OR
(For other differences) less than 0.001 / 0.1% probability of getting this change / difference by chance (for species richness on Colonsay, Harris, Islay)
OR
Less than 0.01/1% probability of getting this change/difference by chance (for diversity index on Colonsay, Harris);
2. *Accept converse about significance of differences in other cases*
3. *Reject **results** are due / not due to chance*
3. *Ignore refs to P unqualified*

3

[8]

Q2.

- (a) 1. Respiration/metabolism/ammonification;
2. (Releases/produces) heat;
Reject: 'produces energy'.

2

- (b) 1. SD is spread of data around the mean;
Accept: variation around the mean.
*Accept: range is difference between highest and lowest values/extremes **or** range includes anomalies/outliers.*
2. (SD) reduces effect of anomalies/ outliers;
Reject: (SD) removes anomalies/outliers.
3. (SD) can be used to determine if (difference in results is) significant/not significant/due to chance /not due to chance;

Ignore: reliability/accuracy/validity.

2 max

- (c) 1. Distributes heat / prevents 'hot' spots;
2. Distributes microorganisms;
3. More enzyme-substrate complexes;
4. Increases rate of decomposition;
Accept: increases nitrification/ammonification or 'breaks down waste faster'.
5. Aeration/provides oxygen;

2 max

- (d) 1. Microorganisms change the abiotic conditions/temperature/organic waste /provide nutrients;
Must refer to microorganisms or bacteria/named bacteria causing the change.
Ignore: change the environment.
2. Less hostile conditions;
3. Decline in Cocci **and** increase in rods;
Accept: 'decrease in cocci, others are going up'.
Accept: decrease in cocci and increase in either rod type or increase in both types.
4. Gram positive outcompete / better competitors;
Accept: rods outcompete (cocci) / better competitors.

3 max

[9]

Q3.

- (a) 1. No / few consumers / pests / pathogens;
Accept: No / few predators.
Accept: description of competition for a named resource with reference to 'other species'.
Accept: More resistance to disease.
2. Outcompetes / better competitor for resources / light / CO₂ / abiotic factor / ideal niche;
Neutral: competition for food.

2

- (b) 1. (Cost of) control / removal;
2. (Cost of) restoring habitat / conservation;
3. (Loss of income) from fishing;
4. (Loss of income) from boating / tourism / recreation;
Accept: any valid recreational activity e.g. canoeing.

2 max

- (c) (i) 1. Removes water;
2. Water content can vary in sample / plant;
Note: Reweighing / constant mass indicates all water removed = 2 marks. ;

- (ii) 1. 0.5 is not effective / has little effect / 1.0 is less effective (than 5.0) / concentrations below 5.0 less effective;
Accept: for first 3 mark points effect on growth / biomass as a measure of effectiveness.
Accept: references to 'this concentration' = 5.0.
Accept: 5.0 is the minimum effective concentration.
 1. and 2. 5.0 is the minimum effective concentration that reduces growth = 2 marks.
2. At 5.0 biomass / growth is reduced;
3. Small difference between using 5.0 and 25.0;
4. Using 5.0 is cost effective / using 25.0 is expensive / high concentrations may affect the environment / other organisms / chemical may remain in habitat / bioaccumulation;
Accept: any impact on the habitat e.g. contaminate water supply.
- 4
- (d) (i) To compare / see effect with / without fungus / fluridone / control agent / S;
Neutral: for comparison on its own.
Neutral: to see effect of variables / results / treatments / factors without further qualification.
- 1
- (ii) 1. Is specific / grows / survives in Hydrilla / habitat;
Accept: 'known to work'
2. Can reproduce / only one application required;
3. Does not become a pest;
- 2
- (iii) 1. Fluridone / chemical acts quickly / quickly reduces Hydrilla;
2. Fungus / biological control keeps Hydrilla in low numbers / fungus / biological control works over a long time / can reproduce / resistance does not develop against fungus / biological control;
- 2
- [15]**

Q4.

- (a) 1. Breeding less successful;
2. Feathers in poor condition;
3. Less energy for breeding / reproduction / stated aspect of reproduction;
 1. *Reject cannot breed.*
 2. *Ignore "wings damaged".*

2 max

- (b) (i) 1. Avoids bias / data representative / choice of nest not influencing results;
2. Allows use of statistical tests / named statistical test; 2
- (ii) Accept general statements or statements based on data that make the required points.
1. Correct statement about range of 0 – 15;
2. Correct statement about 0;
3. Correct statement about 170;
4. Correct statement about gap between 15 and 170;
1. e.g. No pattern / no correlation between 0 and 15.
2. e.g. Birds with no feather mites did not have (the) high(est) breeding success / 86%.
3. e.g. Highest number of feather mites linked to lowest breeding success.
4. e.g. No data between 15 and 170. 3 max
- (c) (i) There is no correlation between the number of feather mites and breeding success / the number of feather mites does not affect breeding success;
These specific variables must be stated.
Reject difference between feather mite and breeding success. 1
- (ii) Breeding success decreases as feather mites increases / negative correlation between feather mites and breeding success;
Accept reproductive or breeding success. 1
- (d) (i) 1. The larger the size of the oil gland the larger the number of feather mites;
2. Positive correlation;
3. (Wide) scatter of points / points not on line;
3. Accept any answer that conveys the idea of a wide spread.
Ignore any reference to anomalies. 2max
- (ii) No mark for effect on reliability, marks are for explanation.
1. Oil gland size / number of mites could vary;
2. At different times of the day / due to preening;
Ignore responses that state oil gland affects numbers of mites.
Allow preening affects mite numbers / size of oil gland.

- (e) 1. Improve health of birds / reduces disease / reduces harm;
2. Healthier birds may find more food for young / do not pass on disease / have greater specified aspect of breeding success;
1. Ignore death of birds.
2. Specified aspect can include longer breeding life.

2

[15]

Q5.

- (a) 1. Excites electrons / electrons removed (from chlorophyll);
- Accept: higher energy level as 'excites'.*
2. Electrons move along carriers/electron transfer chain releasing energy;
- Accept: movement of H⁺/protons across membrane releases energy.*
- Reject: 'produces energy' for either mark but not for both.*
3. Energy used to join ADP and Pi to form ATP;
- Reject: 'produces energy' for either mark but not for both.*
- Accept: energy used for phosphorylation of ADP to ATP*
- Do not accept P as Pi but accept phosphate.*
4. Photolysis of water produces protons, electrons and oxygen;
5. NADP reduced by electrons / electrons and protons / hydrogen;
- Accept: NADP to NADPH (or equivalent) by addition of electrons/hydrogen.*
- Do not accept NADP reduced by protons on its own.*

5

- (b) 1. Protein/amino acids/DNA into ammonium compounds / ammonia;
- Accept: any named nitrogen containing compound e.g. urea.*
2. By saprobionts;
- Accept: saprophytes.*
3. Ammonium/ammonia into nitrite;
4. Nitrite into nitrate;
5. By nitrifying bacteria/microorganisms;
- Reject: nitrifying bacteria in root nodules.*
- 1, 3 and 4. Accept: marks for conversion even if incorrect type of bacteria named as being involved.*
- 2 and 5. Reject: marks for type of bacteria if linked to incorrect process e.g. nitrite converted to nitrate by saprobionts.*
- 3 and 4. Accept: for one mark ammonia/ammonium into nitrate if neither mark point 3 or 4 awarded.*
- Note: there are no marks for the role of nitrogen-fixing bacteria as the question refers to producing a source of nitrates from the remains of crops.*

5

[10]

Q6.

- (a) (i) Reduced cost;

Less feed / less land use / more growth rate with same amount of food;

Allow is 'cost effective'

2

- (ii) Amount of food taken in less than expected.

Allow 'expected food intake is higher,

Allow 'food intake is lower than it should be'

1

- (b) Type of food (not a mark)

1. May vary in protein / fat / carbohydrate / fibre / roughage / vitamins / minerals;
2. May affect absorption / digestibility / energy value / tastiness / growth / overall food intake;

*For mark point 1 allow appropriately named food compound
e.g. cellulose, glucose*

*For mark point 2 it must be clear that these factors are
affected by the type of food.*

Temperature (not a mark)

3. Will affect heat loss / gain / respiration / metabolism;
4. More food / energy can be used for growth;

Note: two maximum marks for effect of temperature.

4

- (c) RFI does not affect methane production /

There is no difference in the rate of methane production for low and high RFI values /

The difference between the rates of methane production is due to chance /

No correlation / relationship / link between RFI and methane production;

*Any clear statement that there is no link between RFI and
methane production should be credited.*

1

- (d) (i) Sulfate without straw;

1

- (ii)
1. May affect yield / damages rice crop;
 2. Substance / treatment may affect other organisms / environment;
 3. Cost of substance / application / labour;
 4. Method / frequency / timing of application / amount of substance required;

2 max

- (iii) Not flooded aerobic conditions / more oxygen / with flooding anaerobic conditions / less oxygen;

Not flooded fewer / less active anaerobic microorganisms / respiration / not flooded more / more active aerobic microorganisms / respiration;

2

[13]

Q7.

- (a) 1. Is widely / commonly used;

2. Provides a standard / benchmark / reference;

Allow a variety of descriptors for marking point 2 e.g.

'provides a base line',

'produces known amount of carbon dioxide'

Mark point 2, do not accept 'for comparison' on its own as 'comparison' is in stem of question

3. Produces large amount of carbon dioxide;

4. Is a decreasing resource / could be replaced by biofuel;

Ignore reference to a control

2 max

- (b) 1. Independent / no bias / trustworthy;

2. Non-profit making;

3. (Focused on) effect on environment / climate;

2 max

- (c) 1. CO₂ taken up in photosynthesis;

2. More taken up than produced (when it is used) with less CO₂ produced than petrol;

2

- (d) 1. (These microorganisms) don't have (cellulose-digesting) enzymes;
Accept 'don't make enough of these enzymes' for mark point 1

2. (Cellulose) is a polysaccharide / polymer / long (molecule / chain);
Accept 'large' for mark point 2

3. (Cellulose) is insoluble / glucose / product of digestion is soluble;

4. Broken down into glucose / monomers / monosaccharides;
Ignore (alpha) glucose for mark point 4.
Do not accept sugars for mark point 4

5. Sugars / glucose used in glycolysis / glucose can be converted to pyruvate;

6. Produces more ethanol / fuel produces ethanol / fuel quicker;
Accept 'speeds up process' for mark point 6

3 max

- (e) 1. Removes species / fewer species / growth of single crop / single plant species / monoculture;
Deforestation or removal of hedges on its own should not be credited
2. Removes habitats / fewer habitats / niches / only one habitat;
3. Removes variety of food sources / fewer food sources / only one food source;

2 max

[11]

Q8.

- (a) (i) where a change triggers a response which reduces the effect of a change;

1

- (ii) e.g. sweating, breathing, defaecating, other valid example;
*(reject respiration
evaporation not acceptable as a 2nd mark if sweating or breathing given)*

2 max

- (iii) hypothalamus;

1

- (b) (i) pituitary;

(ignore anterior pituitary)

1

- (ii) 1. ADH causes vesicles containing aquaporins / aquaporins to be inserted into membrane / collecting duct wall / plasma;
2. water enters cell through aquaporins;
3. by osmosis / diffusion / down a water potential gradient;
4. (from cell) to capillary;
5. via interstitial fluid;

4 max

- (c) (i) excessive urination / drinking / diluted urine / thirst;

1

- (ii) because males only have one X chromosome / do not have Y chromosome;
a single copy of the recessive allele will be expressed;

2

- (iii) recessive alleles can be carried by individuals without showing effects / dominant allele always expressed;
organism that are carriers more likely to reproduce / affected organism less likely to reproduce;
therefore recessive alleles are more likely to be passed on / dominant alleles less likely to be passed on;

3

[15]

Q9.

- (a) any two named polymers [subsets = 1 max. (e.g. protein / haemoglobin)]

2

- (b) (i) hydrostatic pressure / description of pressure;
causes ultrafiltration at Bowman's capsule / glomeruli / renal capsule;
through basement membrane;
enabled by small size of urea molecule;

max 2

- (ii) reabsorption of water; [water out]
by osmosis;
at the PCT / descending LoH;
at the DCT / CD;
active transport of ions / glucose creates gradient (in context);

max 4

- (c) (i) by (simple) diffusion;
[reject facilitated]

1

- (ii) to maintain concentration gradients / stop reaching equilibrium;
[idea of maintaining concentration gradients]

1

- (iii) ions, glucose and amino acids would diffuse into the dialysate;
because of their concentration gradients;
Causing deficiency in these substances;

OR

the WP of the dialysate would be higher / less negative than the WP of
the surrounding tissues;
therefore osmosis would take place into the cells surrounding the
abdominal cavity;
causing these cells to burst / damaging these cells / cannot be excreted;

max 2

[12]