

5.3 Energy transfers in and between organisms (A-Level Only) – Energy and Ecosystem – Mark schemes

Q1.

- (a) Two suitable examples;

Examples

1. amino acid / protein / polypeptide / peptide;
2. nucleic acid / nucleotide / base;
3. DNA;
4. RNA;
5. ATP / ADP;
6. NAD / NADP (reduced or not);
7. Cyclic AMP / cAMP;
8. Chlorophyll;

List rule applies

Reject for either point nitrates / nitrites / ammonia / ammonium / urea

4. *Accept pre-mRNA / mRNA / rRNA / tRNA*

2 max

- (b) Correct answer in the range 90 to 133.2 scores 2 marks;
1 mark for answers where yield calculated correctly for 1970 **OR** 2005;
(1970 in range) 170.8 to 176.4

OR

- (2005 in range) 266.4 to 304.0;

Accept positive or negative values

2

- (c) 1. Using more but getting less response over time;
2. The graph shows correlation but doesn't prove changes in yield due to fertiliser / but there could be other factors;
3. Becomes less cost effective with time;

Idea of over time is important

1. *accept fertiliser becomes less effective over time*
1. *Accept use of figures from graph*
1. *Accept the idea of less grain / crop over time*
2. *Ignore whether correlation is positive or negative*

2 max

[6]

Q2.

- (a) Used to produce named phosphate compound in cells;
e.g. ATP / ADP / phospholipids / DNA / RNA / RuBP / TP / GP etc.

1

- (b) Example of a carbon-containing biological compound e.g. carbohydrate / amino acid / vitamin;

Accept: sugars / organic (compounds).

Ignore: products of photosynthesis.

Ignore: starch.

1

- (c) 1. Represents dry mass / mass of carbon;
2. Represents gross production minus respiratory losses;

2. *Accept: $NPP = GPP - R$.*
 2. *Accept: Chemical energy minus respiratory losses.*
- 1 and 2. Chemical energy store minus respiratory losses = 2 marks.

2

- (d)
1. For the control an increase in phosphate increases (plant) growth;
 2. For *Entrophospora* an increase in phosphate reduces (plant) growth;
 3. *Scutellospora* reduces (plant) growth (compared to control);
 4. *Entrophospora* and *Glomus* increases (plant) growth (compared to control);
 5. No SD / statistical test to determine significance;
 6. Only 20 weeks of growth;
 7. Underground / root growth not known;
5. *Accept: no error bars.*
 7. *Accept: only shows shoot growth.*

4 max

- (e)
1. Answer in range 0.07 to 0.09 = **2 marks**;
 2. Answer in range 9.97 to 12.2
- OR**
Shows division by 140 or $20 \times 7 = 1$ mark;

2

[10]

Q3.

- (a) 1. 35.22 or 35.23% = 2 marks;

Award 1 mark if only fresh and dry masses correct, 1335.59 and 865.13 g;

2

- (b) (After 24 hours)

1. Record mass and reheat;
Accept return to oven = reheat
2. Until constant mass recorded;

2

- (c)
1. Positive correlation (between diameter and biomass);
 2. Not linear / geometric / exponential / gradient gets steeper;

2

- (d)
1. Calculate a mean diameter;
 2. (Use this to) estimate / determine the mean fresh biomass of trees;
 3. Use the percentage water content to find the dried biomass;
 4. Use the dried density to calculate the mass of tree;
 5. Count / estimate the number of trees in plantation and multiply by (mean) carbon content (to find total carbon);

4 max

[10]

Q4.

- (a) 1. To kill any fungus / bacteria on surface of seeds or in soil;
2. So only the added fungus has any effect. 2
- (b) So that only nitrate or ammonia / type of fertiliser affects growth. 1
- (c) 1. So that effects of nitrate or ammonium alone could be seen;
2. So that effects of fungus can be seen. 2
- (d) 1. Weigh samples at intervals during drying;
2. To see if weighings became constant (by 3 days). 2
- (e) With live fungus – showing effects of the fungus:
1. Fungus increases growth of roots and shoots in both;
2. Produces greater growth with nitrate.
- With heat-treated fungus – showing effects of fertiliser:
3. Similar dry masses for roots and shoots;
4. (Probably) no significant difference because SDs overlap. 4
- (f) 1. Dry mass measures / determines increase in biological / organic material;
2. Water content varies. 2
- (g) 1. Fungus with nitrate-containing fertiliser gave largest shoot: root ratio;
2. And largest dry mass of shoot;
3. 6.09:1 compared with ammonium-containing fertiliser 4.18:1 2 max
- [15]**

Q5.

- (a) (i) Unit of energy / mass, per area, per year. 1
- (ii) 1. Less light / more shading / more competition for light;
Neutral: references to animals
2. Reduced photosynthesis.
Accept: no photosynthesis 2
- (b) 1. Pioneer species;
2. Change in abiotic conditions / less hostile / more habitats / niches;
Accept: named abiotic change or example of change e.g. formation of soil / humus / organic matter / increase in nutrients
Neutral: reference to change in environment unqualified
Neutral: more hospitable / habitable / homes / shelters
3. Increase in number / amount / diversity of species / plants / animals.
Accept: other / new species (colonise) 3
- (c) 1. Net productivity = gross productivity minus respiratory loss;

2. Decrease in gross productivity / photosynthesis / increase in respiration. 2
- (d) 1. Conserving / protecting habitats / niches;
 2. Conserving / protecting (endangered) species / maintains / increases (bio) diversity;
 3. Reduces global warming / greenhouse effect / climate change / remove / take up carbon dioxide;
 4. Source of medicines / chemicals / wood;
 5. Reduces erosion / eutrophication.
Accept: tourism / aesthetics / named recreational activity

1 max

[9]

Q6.

- (a) (i) 1. Amino acid / protein / enzyme / urea / nucleic acid / chlorophyll / DNA / RNA / / ATP / ADP / AMP / NAD / NADP;
 2. DNA / RNA / nucleic acid / ATP / ADP / AMP / NADP / TP / GP / RuBP / phospholipids;
1. and 2. Accept any named equivalent examples e.g. nucleotides.
Neutral: ammonia / nitrite / nitrate / phosphate.

2

- (ii) 1. Saprobiotic (microorganisms / bacteria) break down remains / dead material / protein / DNA into ammonia / ammonium;
Accept: saprobionts / saprophytes / saprotrophs
Neutral: decomposer
2. Ammonia / ammonium ions into nitrite and then into nitrate;
Allow correct chemical symbols.
Accept: correct answers which use incorrect bacteria e.g. nitrogen-fixing but then reject m.p. 3.
3. (By) Nitrifying bacteria / nitrification;

3

- (b) 1. Nitrate / phosphate / named ion / nutrients for growth of / absorbed / used by plants / algae / producers;
 2. More producers / consumers / food so more fish / fish reproduce more / fish grow more / fish move to area;
Must have idea of more plants related to some increase in fish.

2

[7]

Q7.

1. Growth of algae / surface plants / algal bloom blocks light;
 2. Reduced / no photosynthesis so (submerged) plants die;
 3. Saprobiotic (microorganisms / bacteria);
3. Accept: Saprobiont / saprophyte / saprotroph
3. Neutral: decomposer

4. Aerobically respire / use oxygen in respiration;
5. Less oxygen for fish to respire / aerobic organisms die;

[5]

Q8.

- (a)
1. Chlorophyll absorbs light energy;
Accept light energy 'hits' chlorophyll
Accept photon for light energy
 2. Excites electrons / electrons removed (from chlorophyll);
Accept higher energy level as 'excites'
 3. Electrons move along carriers / electron transport chain releasing energy;
Accept movement of H^+ / protons across membrane releases energy
 4. Energy used to join ADP and P_i to form ATP;
Negate 'produces energy' for either mark but not for both
Accept energy used for phosphorylation of ADP to ATP
Do not accept P as P_i
 5. Photolysis of water produces protons, electrons and oxygen;
3. and 4.
 6. 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 their own

5 max

- (b)
1. Variation / variety;
 2. Mutation;
Do not accept answers which suggest the mutation is caused by copper
 3. Some plants have allele to survive / grow / live in high concentration of copper / polluted soils;
Reference to immunity disqualifies this mark
Do not disqualify mark for references to allele providing resistance to copper
 4. (Differential) reproductive success / adapted organisms reproduce;
 5. Increase in frequency of allele;
 6. No interbreeding (with other populations) / separate gene pool / gene pool differs (from other populations);
Accept reproductive isolation

5 max

[10]

Q9.

- (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**

Q10.

- (a) (i) 1. Same breed so similar alleles;
1. Allow different alleles have different effects
2. Controls / removes variable / so genes not a factor / only temperature affects results / rate of growth affected by genes;
2. Accept idea worded in such terms as inherited. 2
- (ii) 1. Different growth rates / gained different biomass / grew different amount;
Allow "more food for growth"
Ignore references to efficiency of conversion.
2. Not due to temperature / the independent variable; 2
- (b) (i) Rise then fall with peak at 20 C;
Do not accept 0.85 as alternative to 20. 1
- (ii) 1. Temperature may be between 10 and 30 / 10 and 20 / 20 and 30;
No mark for yes or no.
2. Intervals are 10°C / large / not small / should be smaller / should be intermediates; 2
- (c) (i) 1. Growth rate decreasing / conversion staying same / decreasing;
2. (Scientists would be) looking for high growth rate / conversion / data shows unlikely to improve growth / yield;
3. Wastes time / resources / would not relate to farming conditions;
3. Ignore cruelty to pigs 2 max
- (ii) 1. Will lose more heat / not as much energy used to maintain body temperature;
1. Must be a comparative statement
Accept energy as equivalent to heat in the context of this question
2. Heat resulting from respiration / more respiration;
2. Do not credit answers relating to energy made in respiration
3. More food used in respiration; 2 max
- (d) **In support**
Read standard deviation as standard error
1. Food **B** produces greater mass than control / greater than 100%;
1. Must refer to control

But

2. Error bars for **B** mean **B** could be no better / not different from control;
3. Overlap of error bars for **B** and **A**;
4. A no better than / not different from **B**;
4. Neutral: "Results not significant". Mark must compare A to B

Experimental limitations

5. Experiment only ran for 10 days;
6. Experimental conditions / breed of pig may not be the same as on the farm;
7. No information about cost;

4 max

[15]

Q11.

- (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]

Q12.

(a) 1. High temperature allows enzymes to work faster / allows more collisions / allows more e-s complexes to be formed

OR

A lot of light so light not limiting;

2. Photosynthesis reactions are faster / more photosynthesis;
- Accept enzymes more effective. Ignore references to respiration. Ignore references to optimum (temperature or light).*

2

(b) (i) Gross productivity = net productivity + respiratory loss / respiration;

Accept any correct rearrangement of this equation

Accept recognisable abbreviations

Reject respiratory rate.

1

- (ii) 1. Respiration slower / less respiration;
- Unspecified references refer to August. Allow converse of respiration faster but must specify July / higher temperature*
2. Light-dependent reaction / photosynthesis less affected by temperature increase;
3. Lower (energy) loss;
- Unspecified references refer to August. Allow converse of higher loss but must specify July*
- "Lower respiratory losses (in August)" can meet both points 1 and 3 and gain 2 marks.*

2 max

- (c) 1. Stored as fat / glycogen / biomass;
Reject stored energy. Ignore respiration
2. Used for growth / movement / reproduction / process involved in growth / movement / reproduction;

2 max

- (d) 1. More heat / energy is lost (in March) / colder (in March);
2. Maintain / regulate body temperature / more heat generated;
Accept keep warm.
3. By respiration / metabolism;

2 max

[8]

Q13.

- (a) Heat at 100°C / heat to temp to evaporate water;
Value which would not burn material

Weigh and heat until no further change in mass;

2

- (b) Amount of water present will vary;

This will affect fresh mass / will not affect dry mass;

2

[4]

Q14.

- (a) To see if a difference in hours of sunshine was present / because it is necessary to monitor factors which cannot be controlled;
So that they could eliminate this factor from affecting the yield (with /without extra carbon dioxide);
OR
Duration of light influences length of time for photosynthesis / temperature in glasshouse;
Higher photosynthesis results in higher yield / more carbohydrates / sugars / proteins produced;

2 max

- (b) Named factor;
Explanation of why the factor is important;
E.g.
Density of planting;
Competition for named resource;
or
Same variety of tomato;
Yield will vary with different varieties / with different genotypes;
or
Water (application);
Water needed for expansion of fruit / maintain leaf turgidity / maintain stomatal opening / replace water lost in transpiration / water used in photosynthesis;
For named resource accept 'nutrient' but not 'food'

2

Q15.

- (a) Fertilisers / detergents / slurry / manure / sewage / faeces; 1
- (b) $(31 - 5) / 31 \times 100\%$ / single error in otherwise correct method;
83.87 / 83.9 / 84%; 2
- (c) Have continuous data for phosphate but not for biomass;
Effect of named factor explained; 2
- (d) 1. Increased phosphate causes increase in plant growth / algal bloom;
2. Plants (cover surface and) block out light so plants (under surface) die;
3. Increase in (aerobic) bacteria / decomposers (which break down plants);
4. Bacteria / decomposers use up oxygen / reduce oxygen conc. in water;
5. In respiration;
6. Plants unable to photosynthesise so less oxygen produced;

max 6

[11]

Q16.

- (a) Shows trend of mean temperature rise;
Higher temperatures more frequent since 1984 (in January and February);
Considerable variation in temperature from year to year;
Which may be due to chance;
No mark for yes or no Do not penalise candidates who state there is no trend 2 max
- (b) Construct null hypothesis;
Use Spearman rank (and calculate test statistic);
Look up in table (to find critical value of $P = 0.05 / 5\%$);
Use figure (in table) to accept or reject null hypothesis; 3 max
- (c) (i) (Particular daylength) always occurs at same time of year / valid example;
Birds do not start laying eggs when period of warm weather occurs early in year;
Synchronises breeding behaviour;
Sufficient foraging time for food collection for young; 2 max
- (ii) Birds able to respond to changing climate;
Food availability (mainly) determined by temperature;
As insect / invertebrate development temperature-dependent; 2 max
- (d) A correlation does not indicate a causal relationship;
As may be due to another factor / named factor; 2
- (e) Visits could be up to 5 days apart;
Date of egg-laying may be inaccurate by 5+ days; 2

[13]

Q17.

- (a) (i) decomposers convert (nitrogen in organic compounds) into ammonia / ammonium; suitable example of "organic nitrogen" - protein / urea / amino acid etc. (e.g. linked to process); nitrifying bacteria / correctly named convert ammonium to nitrate; via nitrite; 3
- (ii) convert nitrogen (gas) into ammonium / ammonia / amino acids; add usable / available nitrogen to an ecosystem / eq.; 2
- (b) (i) 1. numbers of dispersed bacteria increase as they feed on organic matter; 3
 2. numbers of free-swimming protoctistans increase because number of bacteria increase;
 3. dispersed bacteria decrease as amount of dispersed organic matter decreases / due to lack of food / as organic matter is converted to flocs / are preyed on by free-swimming protoctistans;
- (ii) 1. (in a succession) organisms (enter an area and) change the environment / conditions creating new niches / habitats; 4
 2. allows different species / different types of organisms to enter / be successful;
 3. dispersed bacteria change dispersed organic matter to flocs;
 4. presence of flocs allows crawling protoctistans to enter / to increase / to be successful;

[12]**Q18.**

- (a) (variation in) temperature will affect the solubility of oxygen / rate of respiration / use of oxygen by cells / diffusion / gas exchange; *to gain credit point made must concern oxygen* 1
- (b) (i) there is no difference between the partial pressure of oxygen in the two groups / the partial pressure of oxygen is the same in each group; 1
- (ii) results may have been due to chance and statistical test allows us to determine the probability of this / of the difference between results being significant; enables acceptance or rejection of null hypothesis; *The key points here are chance and probability used in the correct context.* 2
- (c) **A**; because partial pressure of oxygen only reduced when zinc in water / in **Y** / because when injected zinc / in **X** has no effect on partial pressure of oxygen in blood; 2
- (d) less oxygen transport to cells / in fish / in blood; anaerobic respiration; lactic acid produced / less carbon dioxide removed (from gills);

more H⁺;

3 max

- (e) (i) copper;
calculation based on comparing concentration in woodlice with that in leaves;
accept any suitable method here, giving marks for the method and explanation. For example, calculating ratio of concentration in woodlice to concentration in leaves. 2
- (ii) not absorbed from gut / passes out in faeces / egested / urine / excreted; 1
- (iii) woodlice eat large amount of leaves;
copper stored / accumulates in body; 2
- (f) (i) mutation; 1
- (ii) (as a component of) nucleic acids / DNA / RNA / nucleotides;
phospholipids;
ATP / ADP; 2 max
- (iii) arsenic-tolerant plants would not be able to take up phosphates / take up a little phosphate;
since likely to involve same mechanism / same carrier / protein;
(process of) growth would be poorer than non-tolerant plants; 3

[20]

Q19.

- (a) collect a sample (of insects in each area) and mark unobtrusively / in a way not harmful to insects;
release and allow time to re-integrate with rest of population / eq.;
collect second sample and count number marked;
number in population estimated by:

$$\frac{S1}{\text{Number marked in 2}^{nd} \text{ sample}} \times \frac{S2}{\text{Number marked in 2}^{nd} \text{ sample}} = \frac{\text{Total marked}}{\text{Number marked in 2}^{nd} \text{ sample}} = \frac{\text{Population}}{\text{second sample}};$$

4

- (b) (i) 1; 1
- (ii) (p =) 0.05 / 5%;
(ignore 95%) 1
- (iii) value for χ^2 exceeds critical value / $125.8 > 10.8$;
Results unlikely to be due to chance / have a biological cause;
 $P < 0.1\%$ / $< 5\%$;

2 max

- (c) (i) biomass respired / GPP – respiration = NPP;

biomass lost as CO₂;

2

(ii) more food for insects;

1

[11]

Q20.

(a) (i) $P = C - R - U - F / C - (R + U + F) / \text{eq};$

1

(ii) 3.74;

1

(b) Correct answer: 2.18

(Accept 2.19 or 2.2)

/ correct for candidate's (a)(ii) ;; = 2 marks

Correct use of data but wrong answer:

$$\frac{(a)(i) \times 10^6 \times 100}{21135 \times 8100}$$

= 1 mark

2

(c) Less energy lost as heat / in maintaining body temperature / in movement

1

[5]

Q21.

(a) use of random numbers;
large number of quadrats;
count number of dead and live mussels in unit area;

3

(b) (i) different size organisms / different composition
(of carbohydrate / fat / protein) /
low digestability / not all eaten;

1

(ii) 14;

1

[5]

Q22.

(a) less nitrate taken up;
less amino acid / protein synthesis;

OR

parts of plant higher in protein die;
higher proportion of cellulose / non-protein components in diet;

2

(b) (wildebeest) selective feeders / only some species / parts of plant eaten;
choose to eat species / part of plant with high protein content;

- (c) named protein;
consequences of lack of protein related to failure to escape from predators;

examples:

myosin / actin;
(skeletal) muscles weak / less muscular tissue so slower movement;

OR

relevant named enzyme;
why deficiency of enzyme increases chance of being caught;

OR

haemoglobin;
insufficient oxygen for muscle contraction;

2

[6]

Q23.

- (a) prevents disease / pest organisms from reaching crop plants / prevents herbicides from reaching hedgerow / enables machinery to manoeuvre without damaging crop / hedgerow;

1

- (b) some weeds provide habitats / niche for (beneficial) insects / animals:
allow (insect) pest predators to survive;
conserve (common) weed plants;
weeds are producers in food chains / food source;

2 max

- (c) decomposers / saprophyte / bacteria / fungi / micro organisms (organisms) excrete / produce nitrogenous waste / e.g.; bacteria convert to nitrate / nitrifying bacteria;
(increased) nitrates(in soil) taken up / used by plants;
release of phosphate / potassium;
organisms respire and produce carbon dioxide which is used by plants in photosynthesis;

4

[7]

Q24.

- (a) zooplankton nearer surface at night;
algae only found at surface;
photosynthetic;
no / little light below 30 / 40m;

3

- (b) (i) with increasing time predators have been present in the lake, the greater the depth at which the zooplankton occur during the day;

1

- (ii) variation in migration behaviour;
vertical migration reduces chance of predation / prey can't be seen in low light intensity;
those that migrated more likely to reproduce;

genes / alleles (for behaviour) passed to next generation;
increase in frequency of gene / allele in population;

3 max

[7]

Q25.

(a) transmission / reflected / misses chlorophyll / chloroplasts / wrong wavelength;

1

(b) (larger area) to absorb light;
(larger surface area) to absorb carbon dioxide;
short diffusion pathway for gases / oxygen / CO₂;
light able to penetrate to all cells;

2 max

(c) effect;
detail;
effect on photosynthesis;
some effects are less light / light absorbed by water
different wavelength of light
temperature
availability of carbon dioxide
availability of water

(more than one effect award 1 mark only)

3

[6]

Q26.

(a) (i) respiration;

1

(ii) decomposers;
(accept bacteria / fungi)

1

(b) $\frac{87402}{1.7 \times 10^6} \times 100 = 5.14 / 5.1\%$;
(correct answer = 2 marks)
(principle: energy in producers ÷ energy of light absorbed = 1 mark)

2

(c) excites chlorophyll / electrons;
release electron(s);

2 max

(d) reduced NADP;
reduces GP / to change GP to TP;
ATP;
provides the energy to reduce GP / convert GP to TP / TP to RuBP /
provides phosphate to convert TP to RuBP;

4

[10]

Q27.

With hormone (third column) cadmium produces large / significant / 45% fall in enzyme production;
without hormone (second column) no significant effect on enzyme production with cadmium;.

2 max

[2]

Q28.

- (a) (i) presence of grass causes less nutrients / minerals / nitrates / ammonium ions to be leached;
(do not allow references to less nitrogen)
- (ii) clover contains nitrogen-fixing bacteria;
(do not allow references to nitrifying bacteria)
decomposition (of ploughed clover) introduces nitrates / ammonium ions into soil;
- (b) (i) minimal effect / no significant effect on yield / small increase up to 25 kg ha⁻¹;
increase in protein content of grain with all fertiliser applications;
- (ii) (37 ÷ 44 =) 0.84 : 1.0
(allow 0.8 : 1);

1

2

2

1

[6]

Q29.

- (a) 10
(reject: 9.76)
- (b) isolation (on islands);
variety of habitats / conditions different from origin / other islands;
differing pathways of natural selection;
leading to organisms too different to interbreed.

1

3 max

[4]

Q30.

- (a) source of pests / animals, and effect on crop;
source of weeds / no longer taking nutrients, hence competition / reduced yield; creation of larger fields / leaving room, hence more efficient use of machinery / grow more crops;
hedgerows have to be maintained, so removal saves time / money;
- (b) allows beetles to remain / survive / over winter in the middle of the field / strip of grass;
effect on distribution, e.g. do not normally reach the centre of the field / can reach all parts;

2 max

2

- (c) increases biodiversity;
 source of food for animals;
 habitat / nest for animals;
 reduce need for insecticides / attracts insects away from crop;
 windbreaks / prevent erosion / run-off / leaching;
 migratory corridors;

2 max

[6]

Q31.

- (a) (i) change in community over time;
 either due to change environmental / abiotic factors / change is due to species
 present; 2
- (ii) stable community / no further succession / final community; 1
- (b) (increased) interspecific competition;
 for light / nutrients / named nutrient / water; 2
- (c) fewer leaves / lower surface area / shading of leaves so less photosynthesis to
 produce new biomass / glucose / growth; competition with other species for nitrates /
 named nutrients so reduced synthesis of protein or named compound; ratio of
 leaves to woody parts and roots decreases so higher respiration relative to
 photosynthesis; 3

[8]

Q32.

- (a) (i) mass produced increases then levels off at 17.1 kg m^{-2} /
 concentrations above 40 kg ha^{-1} ; 1
- (ii) replaces nutrients removed;
 fertiliser provides nitrate needed for protein / amino acid
 production; as more fertiliser added, there is more growth /
 protein / amino acid / yield; 2
- (iii) plants already have enough nitrate / nitrate no longer limiting;
 another named factor / element is limiting growth; 2
- (b) because cattle excreted / produced faeces / droppings / cowpats /
 manure; in field B crop used elements / minerals / nitrates /
 nutrients last year; 2

[7]