

Mark schemes

1

- (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]

- (a) (i) decomposers convert (nitrogen in organic compounds) into ammonia / ammonium;

2 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;
2. numbers of free-swimming protists 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 protoctistsans;

3

(ii) 1. (in a succession) organisms (enter an area and) change the environment / conditions creating new niches / habitats;

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 protoctistsans to enter / to increase / to be successful;

4

[12]

(a) (variation in) temperature will affect the solubility of oxygen / rate of respiration / use of

3

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] (a) (i) P = 3;

4

- Q = acetylcoenzyme A;
- 2
- (ii) 36 ATP, however derived = 2 marks
30 ATP, however derived = 1 mark
- 2
- (iii) *Correct statement in the context of aerobic respiration or anaerobic respiration concerning:*
Oxygen as terminal hydrogen / electron acceptor allowing operation of electron transport chain / oxidative phosphorylation;
Fate of pyruvate;
Significance of ATP formed in glycolysis;
- 3
- (b) (i) Thick walls exclude oxygen;
Produced by photosynthetic cells (of fern and *Anabaena*);
Contain no chlorophyll so do not photosynthesise;
Do not produce oxygen;
Oxygen would inhibit nitrogen fixation process;
- max. 3
- (ii) Decomposers / bacteria / fungi / saprobionts (in fields);

Convert protein / organic nitrogen (in cells of fern) into ammonium ions (*allow ammonia*);
Ammonium ions (ammonia) converted to nitrite, then converted to nitrate;
- Allow 1 mark for $NH_3 / NH_4^+ \rightarrow NO_3^-$*
- By nitrifying bacteria / correctly named;
Nitrate used to form protein / amino acids in rice;

5

- (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:

$$\frac{S1}{\text{Number marked in 2}^{\text{nd}} \text{ sample}} \times \frac{S2}{I}$$

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

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 / $\text{GPP} - \text{respiration} = \text{NPP}$; biomass lost as CO_2 ;

2

- (ii) more food for insects;

1

[11] (a) Fertilisers / detergents / slurry / manure / sewage / faeces;

6

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]

7

(a) Samples collected at random;

Method for choosing random sites – random coordinates / position from tables / calculator / other suitable means;

Other named factor constant e.g.:

Same size of net / same width of opening of net / use of one quadrat / Quadrats of same size / of stated size / same area disturbed / collect each Sample for same time;

3

(b) *Caenidae* in deep water – because highest standard deviation / 'S.D.= 7.92'

1

(c) (i) An organism's role / in the ecosystem / community;
[ALLOW refs. To trophic levels / named]

(IGNORE refs. To habitat)

1

(ii) *Caenidae* found mainly in deep water AND *Baetidae* in shallow water / one family mainly in deep water AND the other in shallow water;

1

(iii) Reduces competition for named factor – e.g. food / shelter / O₂ ; To ensure both types survive / otherwise better adapted type displaces other type;

OR

Ref. to 'Competitive exclusion principle' = 2 marks

max 2

[8] (a) (i) mass produced increases then levels off at 17.1 kg m⁻² /

8

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(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]

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

9

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:

$$\frac{(a)(i) \times 10^6 \times 100}{21135 \times 8100} = 1 \text{ mark}$$

2

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

1

[5] (a) use of random numbers;

10

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] (a) (i) change in community over time;

11

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]

(a) less nitrate taken up;

12

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;

2

- (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]

- 1 (a) prevents disease / pest organisms from reaching crop plants / prevents herbicides from

13 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]

- (a) lactate / lactic acid / pyruvate; ATP;

14 2

- (b) (i) energy demand is very high / high respiration rate; unable to supply enough oxygen to muscles / tissues / cells / insufficient time for oxygen to reach muscles / tissues / cells / insufficient oxygen in muscles / tissues / cells;

2

- (ii) break down with oxygen / oxidise lactate into pyruvate / glucose / glycogen / CO_2 + water; by aerobic respiration;

2

- [6] (a) transmission / reflected / misses chlorophyll / chloroplasts / wrong wavelength;

15

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] (a) zooplankton nearer surface at night;

16

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]

- (a) source of pests / animals, and effect on crop;

17

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;

2 max

- (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

- (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;

[6] (a) (i) 2 max
respiration;

18 **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 \div 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] With hormone (third column) cadmium produces large /

19

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

2 max

[2] (a) (i) presence of grass causes less nutrients / minerals / nitrates /

20

ammonium ions to be leached;
(do not allow references to less nitrogen)

1

- (ii) clover contains nitrogen-fixing bacteria;
(do not allow references to nitrifying bacteria)

decomposition (of ploughed clover) introduces nitrates / ammonium ions into soil;

2

- (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;

2

- (ii) $(37 \div 44 \Rightarrow) 0.84 : 1.0$
(allow 0.8 : 1);

1

[6] (a) 10

21

(reject: 9.76)

1

- (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.

3 max

[4]