

WJEC (Wales) A-level Biology
Topic 3.5: Population Size and
Ecosystems
Questions by Topic - Mark
Scheme

1.

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
(a)	(i)	1. Carbon in the (molecules of) dead insects/ant faeces (1) 2. Ref to role of decomposers/decomposed by {bacteria/fungi} (1) 3. Carbon dioxide released (1) 4. from respiration (1) Accept respiration of ants or decomposers for MP3 and MP4	2	2		4		
	(ii)	Any 3 × (1) from: {Decomposers/bacteria/fungi} release ammonium ions/ NH_4^+ ammonification/putrefaction (1) Ammonium/ NH_4^+ converted to nitrite/ NO_2^- (1) Reject ammonia Nitrite/ NO_2^- converted to nitrate/ NO_3^- (1) By (both named) nitrifying bacteria/nitrification (1) If allocate named bacteria to each reaction, must be correct	3			3		
(b)	(i)	Any 2 × (1) from: less CO_2 used in photosynthesis (1) More CO_2 produced in combustion (1) More decomposition so more CO_2 (1)		2		2		
	(ii)	Less respiration (by plants/animals/decomposers)		1		1		
Question 1 total			5	5	0	10	0	0

2.

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
(a)		No photosynthesis (1) {Biomass/named respiratory substrate} used in respiration (1)			2	2		
(b)		2.43 (2 marks) If incorrect award 1 mark for sight of: $107-73 = 14$ (2.428 only = 1mark)		2		2	2	
(c)		Sampling area only covers 1m^2 /sample area is too small (1) Trees are {too large to be covered in black plastic/to fit in the sample area} (1) More difficult to find identical areas in the rainforest/higher biodiversity therefore the sample areas may not be representative (1)			2	2		2
(d)		Repeat until constant mass recorded (1) No burning or combustion (1)			2	2		2
Question 2 total			0	2	6	8	2	4

3.

Question		Marking details	Marks Available														
			AO1	AO2	AO3	Total	Maths	Prac									
3	(a)	Anaerobic conditions (1) Nitrates converted to atmospheric nitrogen/ less nitrification - qualified(1) OR Leaching(1) Nitrates washed out of the soil (1)		2		2											
	(b)	Any three (x1) from 1. Use of fertilisers (1) 2. Ploughing increasing aeration/increasing aerobic/decreasing anaerobic conditions (1) 3. Nitrification increases (1) 4. More nutrients in flood water increasing nitrate levels (1)		3		3											
	(c)	1. Land retains the water / acts as sponge (1) Not store flood water 2. Which is only released slowly into the rivers (1) 3. Reducing (flash-)floods (1) 4. Conflict between loss of farmland and conservation/cost of damage from flooding is more than farmers compensation for the loss of use of land(1) 5. Conservation (of rare species/example/ biodiversity) (1)			4	4											
	(d) (i)	Use of transect and use of quadrats(1) Estimate of %cover/number/ frequency of each species (1) NOT count abundance Repeat at {points/ intervals} along footpath (1)	3			3		3									
3	(d) (ii)	There is a higher abundance of greater plantain in the centre of the path and a higher abundance of ribwort plantain at the edges of the path (1) <table border="1" data-bbox="320 898 887 1144"> <tr> <td>Greater plantain is better adapted to heavily trampled ground/ physical damage</td> <td>or</td> <td>Ribwort plantain is less well adapted to heavily trampled sites/ physical damage (1)</td> </tr> <tr> <td>Greater plantain is very tolerant of drought</td> <td>or</td> <td>Ribwort plantain is less tolerant of drought(1)</td> </tr> <tr> <td>Greater plantain has seeds which germinate best on open ground</td> <td>or</td> <td>Ribwort plantain has seeds which germinate best on lightly compacted soil(1)</td> </tr> </table>	Greater plantain is better adapted to heavily trampled ground/ physical damage	or	Ribwort plantain is less well adapted to heavily trampled sites/ physical damage (1)	Greater plantain is very tolerant of drought	or	Ribwort plantain is less tolerant of drought(1)	Greater plantain has seeds which germinate best on open ground	or	Ribwort plantain has seeds which germinate best on lightly compacted soil(1)			4	4		
Greater plantain is better adapted to heavily trampled ground/ physical damage	or	Ribwort plantain is less well adapted to heavily trampled sites/ physical damage (1)															
Greater plantain is very tolerant of drought	or	Ribwort plantain is less tolerant of drought(1)															
Greater plantain has seeds which germinate best on open ground	or	Ribwort plantain has seeds which germinate best on lightly compacted soil(1)															
	(e) (i)	There is insufficient energy available to support a further trophic level (1) NOT 'not enough energy to support more than 6 energy transfers' Energy is lost as metabolic heat/waste/through respiration when the organisms from one trophic level are consumed by organisms from the next level(1) Fewer trophic levels means more energy available for human (food)(1)	1			3											
	(ii)	Need to maintain body temperature (1) NOT keep warm Which means they use (more) food in <u>respiration</u> to produce <u>heat</u> (1)		2		2											
		Question 3 total	4	9	8	21	0	3									

4.

Question		Marking details	Marks Available
	(a)	axes correctly assigned with correct labels; appropriate linear scales; all points correctly plotted and joined with a curve or ruled straight lines; (tolerance ½ small square)	3
	(b)	birth rate must be greater because {population rose/ sensible explanation};	1
	(c) (i)	Any two from nesting / roosting sites (in oakwoods)/ space in habitat; NOT habitat destruction/ shelter source of food/ number of prey; mates; parasites / disease ;	2
	(ii)	Extreme climate/ severe weather / harsh winter /drought/ wind farms/fires/shooting/poisoning/pesticides/egg collecting/ habitat destruction/ deforestation/ flooding/ new top predator;	1
Question 4 total			[7]

5.	Question	Marking details	Marks Available
	(a)	Legumes/ leguminous;	1
	(b)	Contain nitrogen fixing bacteria/ OWTTE; (must be correct context, not plant fixing nitrogen) Such as <i>Rhizobium</i> ; (Some) {nitrogenous compounds/ ammonium ions/ ammonia/ amino acids} pass to the <u>plant</u> ; NOT nitrate/ nitrogen Allows the plant to grow in poor soil/ used for {amino acid/ proteinsynthesis};	max 3
	(c)	<i>Nitrosomonas</i> converts <u>ammonia to nitrites</u> ; <i>Nitrobacter</i> converts <u>nitrites to nitrates</u> ; <i>Accept diagram/equation</i> Which the plant can {absorb/take up} (from the soil); And use for {nucleic acid/eq or protein synthesis};	max 3
	Question 5 total		[7]

6.

Question			Marking details	Marks Available
6	(a)	(i)	repeat experiments; Same area of grassland used for each test/ Same grass covering/ sludge injected to same depth/ Same {volume / mass/ concentration} of sludge/ same sludge applied/ Same soil {type/ gradient/ aspect/ exposure}/ same soil nitrate concentration/ same time of year; NOT temperature/ pH	2
		(ii)	increase in rainfall increases {leaching/ nitrate concentration in soil water}; greater effect on injected sludge with increased rainfall/ ORA; only a small effect at low rainfall;	2 max
		(iii)	apply (to surface) when {dry / little rainfall/ rainfall is less than [any figure less than 120]};	1
	(b)	Algal growth/ algal bloom/ overgrowth of plant; Less <u>light</u> , so {algae/ plants} <u>die</u> ; { <u>Bacteria/ saprobionts/ saprotrophs/ fungi</u> } <u>decompose</u> { <u>plants/ organic material</u> } (and increase in number); (Reject decomposers) Using up <u>oxygen</u> in <u>respiration</u> ;	3 max	
(c)	Leguminous plants/ any named leguminous plant; Rhizobium/ nitrogen fixing bacteria (in root nodules); <i>Reject nitrate fixing Azotobacter</i> Convert nitrogen (gas) into ammonium/ ammonia/ amino acids; Plants {left to decay/ ploughed in};	3		
Question 6 Total				[11]

7.

Question		Marking details	Marks Available
	(a)	Rate of Conversion of light energy into chemical energy (by producers /by photosynthesis); <i>Accept rate at which {products/ organic materials} are formed/ produced</i>	1
	(b)	(net primary production) decreases; More {carbohydrate/ glucose} is {broken down/ used by} respiration (than is produced by photosynthesis);	2
	(c)	(i) (heat lost in) respiration; Excretion; egestion/not all parts of the material are digestible; not all parts eaten;	Max 2
7.	(ii)	Herbivores: {difficult to digest/ less efficient at digesting} cellulose/ have more {indigestible/ fibrous} material (in diet)/ ; <i>Reject cannot digest cellulose</i> Carnivores:{easily digest/ more efficient at digesting } {protein/ fat}; More <u>egested</u> material/ faeces} (lost) by herbivores/ less { <u>egested</u> material/ faeces} lost by carnivores;	Max 2
	(d)	Productivity of producers higher/ primary productivity higher; Secondary productivity higher/ more energy stored in consumers; {Less energy {used/wasted} /respiratory rate is lower} + qualification eg.in cold blooded animals/ buoyancy; Higher {temperature/ light} higher rate of photosynthesis;	Max 1
		Question 7 Total	[8]

8.

Question	Marking details	Marks Available
(a)	Primary: environment not previously colonised/ from bare	2

rock,

Secondary: environment has soil/previous inhabited;

(b) (i) Acid/acidic; NOT low 1

(ii) 3

feature	Betula	Ulex
pH	(from 3.56 to 4.24, difference of 0.68) Increases pH/makes more alkali/ makes less acidic/	(from 3.56 to 3.55 difference of 0.01) Not much/ no change/ no effect/ slight decrease;
Phosphorus	(from 3.88 to 4.7 difference of 0.82) Increases a lot	(from 3.88 to 4.16 difference of 0.28) Small increase;
Nitrate	(from 0.68 to 0.84 difference of 0.14) Increases	(from 0.68 to 2.37 difference of 1.69) Very large increase;

1 mark for valid COMPARISON of each feature

(c) (i) *Ulex europaeus*; 1

(ii) The {invading /dominant/ new/ named species} {change the soil chemistry/ named change}; 2
Giving them a competitive advantage/ competition for named resource/existing species are at a disadvantage/ so are better suited to the environment;

(d) (i) Climax community; 1

(ii) Increases; 1

(iii) *C. vulgaris* /*E. cinerea* /*E. tetralix* are disappearing from plus B and plus PS; 2
These are surviving in plus U;
Names must be included to access any marking points

Question 8 Total [13]

9.

Question	Marking details	Marks Available
(a)	(i) Two from the following for one mark Organic, protein / amino acids/ DNA/ RNA/ ATP/ nucleotides/ chlorophyll/ inorganic, ammonium ions/ nitrites/ nitrates; Reject ammonia.	1
	(ii) C = decomposition / decay / ammonification / putrefaction; D = denitrification;	2
	(iii) Drainage/ ploughing; encouraging aerobic conditions;	2
	(iv) I Rhizobium;	1
	II convert atmospheric nitrogen / soil nitrogen ; Amino acids / protein; Decomposition returns ammonium ions to soil;	3
(b)	13.6kg/ha;	1
(c)	Any two from Urine; faeces; A dung. leguminous plants/ clover; wheat absorbs more/ needs more; increased drainage in ploughed fields;	2
	Question 9 total	[12]

10.

Question			Marking details	Marks Available
10.	(a)	(i)	Run off / Leaching;	1
		(ii)	(Farmers apply) {fertiliser / ammonium nitrate} / (Spreading of) {manure / slurry};	1
	(b)	X	<i>Nitrosomonas / Nitrococcus</i> ;	2
		Y	<i>Nitrobacter</i> ;	2
	(c)	Any 2 from: To be able to be absorbed by root hair cells / plant by <u>active transport</u> ; Used to synthesise {amino acids / proteins / (named)nucleic acids / nitrogenous bases}; To convert toxic ammonia into (non-toxic) nitrate;	2	
		<u>Aerobic</u> conditions encourages nitrification / <u>Anaerobic conditions</u> encourages {denitrification/conversion of nitrates to atmospheric N ₂ }; Decreases soil fertility / less crop growth / less grass growth / ORA;	2	
			Question 10 total	[8]

11.

Question		Marking details	Marks Available
11.	(a)	1 = respiration and 2= photosynthesis;	1
	(b)	Provides <u>aerobic</u> conditions;	1
	(c)	Decomposer / saprobiont / saprotroph;	1
	(d)	Nitrogen fixation;	1
	(e)	Nitrifying bacteria;	1
	(f)	Denitrification;	1
	(g)	Rhizobium;	1
		Question 11 total	[7]

12.

		Marking details	Marks Available
(a)	(i)	(Photosynthetic efficiency is a measure of) how well a plant is able to {capture/convert} light energy (and convert to biomass / chemical energy / product) / the percentage of light captured by the plant; NOT rate	1
	(ii)	Gross is the total {energy / CO ₂ } {transferred / fixed by plant}, net is total energy minus the energy lost in plant respiration / NPP=GPP-{Respiration / R};	1
(b)	(i)	The higher the temperature the higher the {NPP / dry matter productivity} and The higher the rainfall the higher the {NPP / dry matter productivity};	1
	(ii)	Rainforest have high temperature and rainfall;	1
(c)	(i)	$(8820 \div 44100000) \times 100$; = 0.02(%); Correct answer = 2 marks	2
	(ii)	$(35280 - 8820) = 26460 = 2.6 \times 10^4$ [tropical – agricultural crops] $(2.6 \times 10^4) \times (2.1785 \times 10^4) = 5.8 \times 10^8$ [multiply by area of Wales (km ²)] $(5.8 \times 10^8) \times 10^6 = 5.8 \times 10^{14}$ [convert to m ²] Correct answer = 2 marks $57643110 / 5.8 \times 10^7 = 1$ mark	2

	(iii)	<ul style="list-style-type: none"> • Energy is lost in transfer to {next trophic level / description of e.g. plants to cow}; • to respiration of herbivores / movement / keeping warm / excretory products / not all plant {eaten / digested}; 	2
	(iv)	<ul style="list-style-type: none"> • (Cattle produce) {Methane / carbon dioxide} / deforestation occurs so less carbon dioxide absorbed in photosynthesis / the burning of the cut trees produces carbon dioxide; • reference to greenhouse {effect / gas}; NOT global warming 	2
	(v)	<u>Burning</u> the biofuel increases carbon dioxide in the air and <u>photosynthesis</u> removes carbon dioxide (during growth);	1
	Question 12 total		[13]

13. (i) E [1]
- (ii) H [1]
- (iii) F [1]
- (iv) B [1]
- (v) I [1]

[Total 5 marks]

14. (a) (i) day 10 [1]
(ii) day 2 to day 14 [1]
- (b) (i) interspecific [1]
(ii) 240 [1]
(iii) adding more food / *B. pyocyneus* / more food for *B. pyocyneus* /
remove waste. [not: more space] [1]
(iv) increase;
Less competition for food / more food available [2]
- (c) (i) dependent – death rate greater if population size is greater /
depends on population size / greater effect on bigger population
independent – death rate is the same whatever the size of the
population / depends on external factors. [2]
[not: population affecting factors)
- (ii) temperature / pH [1]

[Total 10 marks]

15.	Secondary succession;	
	Pioneer;	
	Climax community;	
	Seres;	
	Gross primary productivity/GPP;	
	Pyramid of energy/energy flow diagram;	6

16. (a)	W-lag, X-exponential/log, Y-stationary, Z-death (allow: decline) (all correct for 2, 1 error = 1)	2
(b) (i)	(I) birth rate = death rate	1
	(II) birth rate is greater than death rate	1
(ii)	no stationary phase/longer lag phase/no death phase/doesn't flatten off	1
(iii)	can influence/build own environment; can reduce death rate with medical advances/e.g.; can increase food supply with intensive agriculture. (any 2)	2
(iv)	natural disasters e.g. earthquakes; man made disasters e.g. wars; climate change; contraception; AVP (any 2)	2
		Total 9 marks

17.	Question	Marking details	Marks Available
	(a)	amino acids / polypeptides / proteins; DNA; RNA; ATP; NAD / FAD; urea	Max 2
	(b)	Nitrobacter, nitrites to nitrates; Nitrosomonas, ammonium ions to nitrites;	2
	(c)	create aerobic conditions; encourage nitrification; prevent denitrification; allow aerobic respiration in roots for active uptake;	Max 2
	(d)	crops absorb nitrate; No / less decay; Less nitrification;	2
	(e)	Leguminous plants / any named leguminous plant; Rhizobium / nitrogen fixing bacteria (in root nodules); Reject nitrate fixing Convert nitrogen gas into ammonium/ ammonia/ amino acids; Left to decay, ploughed in;	Max 3
		Question 17 Total	[11]

18. (a)	W - lag, X-exponential/log, Y-stationary, Z-death (allow: decline) (all correct for 2, 1 error = 1)	2
(b) (i)	(arrow labelled D) pointing to or drawn on the down slope.	1
(ii)	the maximum size of population; (not: optimum size) that can be maintained/supported indefinitely/can be sustained (owtte)	2
(iii)	availability of/competition for food/living space/mates/light; predation; disease/parasitism; accumulation of toxins. (any 2; 1 only from competition; not: competition unequal)	2
(iv)	temperature/weather (extremes)/flood/fire/natural disasters e.g. tsunami avp	1
(v)	dashed line continued in steep downward gradient (down to at least halfway between line and axis, no lag, no upward turn, down before dip in plotted line i.e. second cross over dotted line)	1
		Total 9 marks

19. (a) (i) {maximum number / density/ size} of a population;
Sustained/ maintained (indefinitely) by a particular
environment/ OWTTE; 2
- (ii) 24 to 26; 1
- (iii) I. **Density Dependent** max 2
nutrient / food / yeast levels;
oxygen level / concentration;
disease/ infection/ contamination;
toxins / waste products;
accept pH
NOT mates
- II. **Density Independent** max 1
temperature;
size of container;
accept pH if not awarded in I

20.

Question	Marking details	Marks Available
(a)	{Ammonium/ammonia} ions/ NH_4^+ ;	1
(b)	<i>Azotobacter</i> ;	1
(c)	Root nodules;	1
(d)	<ol style="list-style-type: none"><i>Rhizobium</i> synthesises) {nitrogen containing compounds/cr eg} {which pass to plant/ which plant can use}/ allows legumes to grow in low fertility soil; NOT fixes nitrogen(Plant synthesises) {carbohydrates/organic acids} which pass to the <i>Rhizobium</i>/{Plant/leghaemoglobin} provides anaerobic conditions for the bacteria; NOT Plant provides protection for the bacteria/nutrients passing to bacteria	2

Question 20 total [5]