PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 10: ECOSYSTEMS

ENERGY TRANSFER THROUGH ECOSYSTEMS

SCORE	PERCENTAGE
/66	%

STEMUP

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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following: • increase in number of species in 1974 **and** increase in number of species after 1985 / 1989 (1) • no increase in number of species between 1978 and 1985 (1) • birds bring seeds (1) • birds release {waste / faeces / organic waste} containing minerals (1) • seagulls reduce number of herbivores / create new niches (1)	**ACCEPT** Number of species increases after both seagull species arrive	**4**

Q2.

Question Number	Answer	Mark
	B NPP = GPP - R	**(1)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • add losses and subtract from 12 (1) • calculate percentage (1)	Correct answer gains full marks Correct answer: 8% 127 503 – 117 303 = 10 200 (10 200 ÷ 127 503) x 100 = 8(%) If answer wrong award one mark for 10 200 or division by 127 503 x 100	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference three of the following: • different {organisms / trophic levels} {use / lose} different proportions of energy (1) and **two** from: • because of respiration for {movement / maintaining body temperature} (1) • because of material that is not digested (1) • because some parts are not consumed (1) • because some is lost due to excretion (1)	**ACCEPT** different {organisms / trophic levels} {use / lose} energy in different ways **ACCEPT** heat loss **ACCEPT** material is lost as faeces **ACCEPT** shedding of skin	**(3)**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: divide energy in producers by energy in sunlight (1) multiply by 100 (1)	 85 000 ÷ 7 000 000 × 100 = 1.21 Correct answer gains full marks, with no working shown.	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to one of the following: • light reflected (from leaf) (1) • light misses {chloroplast / chlorophyll} (1) • only certain wavelengths absorbed (1)	 Accept transmitted / not absorbed by {chloroplast / chlorophyll} Accept limiting factors eg lack of CO_2, water etc may reduce rate	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: • because some of the energy is lost through {respiration / heat / movement} (1) • some of the producers not eaten (1) • some of the producers not digested (1)		(2)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct calculation of energy in primary consumers(1) • correct calculation of percentage efficiency of energy transfer (1)	1.2×10^4 / 12000 (1200 / 14000) x 100 = 8.6 % Allow 8.57	2
(ii)	An explanation that makes reference to three from: • (large amounts of) energy from producers is not transferred to primary consumers as producers havemore {indigestible parts / inedible parts / parts not consumed}(1) • animals / primary consumers / secondary consumershave higher respiration rates than producers (1) • as more energy lost in {movement / heat loss} (1) • animals / primary consumers / secondary consumers lose more energy as {urea / excretion}(compared with producers) (1)	**Allow** more faeces released when consuming producers **Allow** different organisms have different amounts of indigestible /inedible parts **Allow** different organisms have different respiration rates **Allow** organisms have different levelsof movement /heat loss	3

Q6.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • fungi colonise new areas (1) • fungi cause decomposition (1) • so mineral ions are recycled within the ecosystem (1)		(2)

Q7.

Question Number	Indicative content
*	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. <u>Succession (S)</u>: • succession begins with seeds / roots (from previous crops etc), followed by herbaceous plants, shrubs and trees • increased plant diversity increases number of niches for animals, resulting in an increase in index of diversity • steep increase in diversity at approximately 20 years with herbaceous plants / shrubs providing high numbers of niches • index of diversity stabilises and then decreases as trees shade area • shade reduces herbaceous / shrub plant species reducing niche number and index of diversity <u>NPP (N):</u> • NPP increases as more herbaceous plants and shrubs with higher leaf areas grow • NPP reduces as the community ages due to increase in proportion of non-photosynthetic tissue (wood / roots) reducing photosynthesis rate compared to respiration rate • reduced mineral ion content due to lack of decay of leaves may reduce NPP <u>Mineral ions (M):</u> • starting mineral ions are low due to farming • mineral ions in soil increase with time due to humus / dead organic material from plants and animals • organic material is decomposed by microbes to release minerals • mineral ion content decreases in climax community as few leaves are dropped from pine trees so there is less decay

Level	Marks	Descriptor
0	0	No awardable content
1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made. **Level 1: Description of succession (S) with little / no reference to graph**
2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made. **Level 2: Explanation of succession (S) as shown in the graph linked to either N or M with some errors.**
3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made. **Level 3: Detailed explanation of succession (S) as shown in the graph over 50 years using N and M with only minor errors.**

Q8.

Question Number	Answer	Additional Guidance	Mark
(a)	1. (rate of) { energy incorporated into / production of / eq} {biomass / organic material} ; 2. in {plants / producers} ;	**2. Accept** from photosynthesis	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. very little GPP in seagrass / majority present in {microphytobenthos and phytoplankton / phytoplankton} ; 2. (roughly) equal distribution (of GPP) between microphytobenthos and phytoplankton ;	**1. Accept** only 2.5 to 5% in seagrass, 95% in micro and phyto, more than 50% or about 55% of phyto 2. **Accept** about 50% in each **Accept** idea that GPP in microphytobenthos is slightly lower than in phytoplankton	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. idea of obtaining a value from the chart e.g. percentage, area, degrees, ratio ; 2. idea of how to use this to calculate GPP ;	**Ignore** units **1. Accept** appropriate figures in range 50 – 55 % **2. Accept e.g. (**percentage) multiplied by 8.4 x 10^6 **NB** $\frac{\text{angle}}{360} \times 840 \times 10^6$ = 2 marks $\frac{\text{area of segment}}{\text{area of circle}} \times 840 \times 10^6$ = 2 marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. {more / fast / high / eq} photosynthesis ; 2. water less {cloudy / churned up } / shallow water / high light penetration / eq ; 3. high {nutrient / carbon dioxide} levels in the sea / eq ; 4. {high / optimum} temperatures ; 5. high light intensity (in this area) / eq ; 6. idea of less respiration ;	**2. Accept** less current, less tidal	**(2)**

Question Number	Answer	Additional Guidance	Mark
(c)	1. NPP = GPP – R / eq ; 2. energy lost as heat / eq ; 3. named use of energy (released by respiration);	**1. Accept** correct description in words **3. Accept** e.g. movement, opening of flowers, glycolysis, metabolic processes	**(2)**

Q9.

Question Number	Answer	Additional Guidance	Mark
	An answer that includes the following • the rate at which producers make organic material (by photosynthesis) / the rate at which light energy is incorporated into organic matter (by plants / producers) / rate at which carbon is fixed into organic matter (by photosynthesis) (1) • suitable units of biomass per area per time or energy per area per time (1)	Accept organic matter / carbon compounds/ biomass Accept plants / autotrophs Do not accept: energy produced Accept energy converted / turned into Accept eg g m^{-2} $year^{-1}$, kg m^{-2} $year^{-1}$, kJ m^{-2} $year^{-1}$ g (of carbon) m^{-2} $year^{-1}$ Accept cm^{-2} or min^{-1} as units Accept m^{-3}	**Exp (2)**

Q10.

Question Number	Answer	Mark
	C kJ m^{-2} $year^{-1}$	**(1)**

Q11.

Question Number	Indicative content
*	Answers will be credited according to candidate's deployment of knowledge and understanding of material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • mistletoe lowers the NPP of apple trees over time (D) • NPP of trees without mistletoe shows an upward trend over 20 years (D) • NPP of trees with mistletoe shows an downward trend over 20 years (D) • mistletoe decreases the transpiration rate of the trees (D) • mistletoe has a higher transpiration rate than the apple tree (D) • higher transpiration rate of mistletoe diverts transpiration stream to mistletoe rather than apple tree / mistletoe takes the water from apple tree (E) • so less minerals are given to the apple tree (E) • less water for photosynthesis (E) • nitrogen content of apple trees is lower (D) • less amino acid / protein synthesis occurs (E) • less enzyme production so less photosynthesis (E) • lowering NPP (due to less enzymes) (E) • less nucleic acid synthesis (E) • less chlorophyll synthesis (E) • calcium content of the apple trees is lower (D) • so there is less production of cell walls / calcium pectate (E) **Level 1: one or two D or E** **Level 2: three or four from both D and E** **Level 3: five or six from both D and E, must explain effect of either low nitrogen / calcium and have no major errors**

Level	Marks	
Level	Marks	
0	0	No awardable content
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer the makes reference to on following: gross primary productivity – respira OR {energy / biomass} in producers which transfers to {next trophic level / primary consumers}	**ACCEPT** GPP – R	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • NPP increases as daylight and temperature increase (1) • because photosynthesis is greater than respiration (1) • NPP falls if respiration rate rises more than photosynthesis rate / GPP (1) • light is limiting factor (of photosynthesis) between {June and July / December and January} (1)	**ACCEPT** converse **ACCEPT** NPP is negative if the rate of respiration exceeds GPP / NPP is negative when respiration is greater than photosynthesis **ACCEPT** other correct examples of where light is a limiting factror	**(3)**

Q13.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following • {gross primary productivity / total energy fixed by photosynthesis} minus energy released from {respiration / metabolism}	**Accept** energy available to other organisms / next trophic level **Accept** NPP = GPP – R / GPP - R	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • (at high light intensities) as temperature increases NPP increases because light is not limiting photosynthesis (1) • (at low light intensities) as temperature increases NPP decreases because respiration increases more than photosynthesis (1)	**Accept** increasing temperature increases rate of photosynthesis more than respiration **Accept** photosynthesis rate {does not increase / is limited by light} but respiration rate does increase	**(2)**

Q14.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	NPP = 4680 ; R = 5720 ;	**NB** If there are no answers in the box, look for answers in the space below question If answers are the wrong way round, award 1 mark If both answers are wrong, **accept** R = 10168.9 / 10169	**(2)**

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	1. NPP = GPP – R / eq; 2. 55% (GPP energy) is lost / eq ; 3. energy lost as heat / eq ; 4. to provide energy for {active transport / any other named energy-requiring process} ; 5. NPP is {(stored) energy / energy available for next trophic level / eq} ;	**Accept** correct description in words eg movement (opening of flowers, turning of leaves), glycolysis **Ignore** idea that energy is **used** for respiration unqualified **Accept** biomass	**(3)**

Question Number	Answer	Additional Guidance	Mark
(b)	1. cattle {are primary consumers / herbivores / eat grass / eat plants / eq} ; 2. (therefore) gain energy (available as NPP) ; 3. idea of grazing capacity of the grassland ; 4. idea of affect on yield of {meat / milk / eq} ; 5. idea of changing to a more {efficient / NPP yielding} crop ;	**Accept** idea that farmer is ensuring that there is enough NPP available for his cattle **Accept** growth rate	**(3)**

Question Number	Answer	Additional Guidance	Mark
(c)	1. idea of variation over short periods of time; 2. idea that whole year gives an {average / overall / eq} value ; 3. idea that biomass includes {all / undigestible / inedible / eq} organic material ; 4. idea that rate of productivity may influence how much grazing is possible ;	eg more NPP on a sunny day, seasonal	**(2)**

Q15.

Question Number	Answer	Additional Guidance	Mark
	A description that includes two of the following: • (energy passes) to other animals (1) • (energy remains) in plant biomass (1) • (energy) released in respiration (in plants) (1)	Accept eaten by insects / rabbits etc Accept plants grow / energy stored in plants (remain in the field and) broken down by decomposers remains in humus in the soil Accept lost as heat from respiration used for active transport / other correct metabolic processes	**Exp (2)**

Level	Marks	
0	0	No awardable content
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.