

Question Number	Answer	Additional Guidance	Mark
1(a)	1. (rate at which) energy {incorporated / eq} into {biomass / organic matter} ;  2. by { plants / producers} ;	<b>1 NOT</b> energy produced, converted, turned into <b>ACCEPT</b> organic material, organic molecules  <b>2 ACCEPT</b> by photosynthesis	(2)

Question Number	Answer	Additional Guidance	Mark
1(b)	1. GPP {depends / eq} on photosynthesis ; 2. higher the temperature the higher the GPP / eq ; 3. enzymes in (photosynthesis / chemical reaction) {can work faster / more kinetic energy / eq} ; 4. higher the {precipitation / eq} the higher the GPP / eq ; 5. idea that water is needed for the light-dependent reaction ; 6. role of water in transport of { mineral ions / named mineral ion / amino acids / sucrose / eq} ;	1 needs to be a clear statement  <b>2 ACCEPT</b> converse  <b>3 ACCEPT</b> increased enzyme activity  <b>4 ACCEPT</b> converse  <b>5 ACCEPT e.g.</b> photolysis, H <sup>+</sup> donor, replacing electrons	(5)

Question Number	Answer	Additional Guidance	Mark
1(c)	1. credit two values that lie in the range: greater than 0 to 11000 ;  2. appropriate justification based on temperature ;  3. appropriate justification based on precipitation ;	<b>1NB</b> (actual value is 126-3100) <b>ACCEPT</b> below 850	(3)

Question Number	Answer	Additional Guidance	Mark
1(d)	1. (trophic level 2) 2300 - 1500 / 800 (kJ) ; 2. (trophic level 3) 760 - 690 / 70 (kJ) ; 3. $((70 \div 800) \times 100) = 8.8 / 8.75$ (%)	<b>Correct answer gains three marks</b>  <b>3 ALLOW</b> ecf for two values used	(3)

Question Number	Answer	Additional Guidance	Mark
2(a)	1. idea that carbon dioxide dissolves (in the water / in the oceans) ; 2. for {carbon fixation / light-independent reaction / eq} ; 3. by {photosynthesis / eq} of {seaweed / algae / (phyto) plankton / autotrophs / eq} ;	<b>1 ACCEPT</b> absorbed / reacts with /diffuses into / becomes carbonic acid  <b>3 ACCEPT</b> plants (that live in the sea) <b>IGNORE</b> organisms	(2)

Question Number	Answer	Additional Guidance	Mark
2(b)	respiration / decomposition / eq ;	<b>ACCEPT</b> description <b>NOT</b> photosynthesis	(1)

Question Number	Answer	Additional Guidance	Mark
2(c)	<b>B</b> carbon dioxide and water		(1)

Question Number	Answer	Additional Guidance	Mark
2(d)	1. decomposition / idea of breakdown of {organic matter / plant material / biomass / eq} ; 2. idea of (bacteria) producing {enzymes (for digestion) / correctly named hydrolytic enzyme} ; 3. respiration {produces / eq} {carbon dioxide / eq} ;	<b>1 ACCEPT</b> animal material decay / rot	(3)

Question Number	Answer	Mark
2(e)	<b>B</b> light-independent reaction	(1)

Question Number	Answer	Additional Guidance	Mark
2(f)(i)	Correct answer gains both marks {332 + 23 + 444 / 799 } and {338 + 450 / 788 } ; (799 – 788) = 11 (au) ;	<b>CE</b> applies	(2)

Question Number	Answer	Additional Guidance	Mark
2(f) (ii)	<ol style="list-style-type: none"> <li>1. idea that rate of production of carbon dioxide is greater than rate of removal of carbon dioxide ;</li> <li>2. idea of using of {fossil fuels / named fossil fuel / forests / eq} {releasing / producing} carbon dioxide ;</li> <li>3. idea that this carbon (in fossil fuels / forests) was {locked up / removed from the air } years ago ;</li> <li>4. idea of deforestation resulting in less {photosynthesis / carbon fixation / light independent reaction / eq} ;</li> </ol>	<p><b>1 ACCEPT</b> carbon dioxide {production / release} is greater than used in photosynthesis</p> <p><b>3 ACCEPT</b> ref to carbon sink</p> <p><b>4 ACCEPT</b> less carbon dioxide used for photosynthesis</p>	<b>(3)</b>

Question Number	Answer	Mark
3(a)	C $\text{kJ m}^{-2} \text{year}^{-1}$	(1)

Question Number	Answer	Mark
3(b)	B $\text{NPP} = \text{GPP} - \text{R}$	(1)

Question Number	Answer	Additional Guidance	Mark
3(c)	<ol style="list-style-type: none"> <li>1. idea that light is reduced by the deeper water ;</li> <li>2. idea that carbon dioxide levels might be lower deeper down ;</li> <li>3. idea that temperature might be lower deeper down ;</li> <li>4. idea that {photosynthesis / eq} will be reduced ;</li> <li>5. idea that less {glucose / hexose / GALP / GP / eq } produced to convert into {biomass / NPP / eq} ;</li> <li>6. idea that GPP goes down but respiration {stays the same / increases} ;</li> </ol>	<p><b>NB ACCEPT</b> converse of mp 1 - 5 if in context of shallow water</p> <p><b>5 IGNORE</b> energy</p>	

Question Number	Answer	Mark
<b>4(a)</b>	<b>C</b> hydrolysis	<b>(1)</b>

Question Number	Answer	Mark
<b>4(b)(i)</b>	<b>B</b> to give a range of values for the independent variable	<b>(1)</b>

Question Number	Answer	Mark
<b>4(b)(ii)</b>	<b>B</b> one	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(b)(iii)</b>	<ol style="list-style-type: none"> <li>1. idea that {bacteria / fungi / decomposers / eq} release enzymes (for decomposition) ;</li> <li>2. idea of the formation of {monomers / glucose / amino acids / small molecules} / eq ;</li> <li>3. that {are soluble / dissolve} ;</li> <li>4. idea that some (soluble) molecules {soak into the ground / taken up (by organisms)} ;</li> <li>5. idea of {respiration / fermentation} of {glucose / eq} (by decomposers);</li> <li>6. carbon dioxide released / eq ;</li> <li>7. idea of water loss ;</li> <li>8. idea of {worm / appropriate named organism} activity;</li> </ol>	<ol style="list-style-type: none"> <li>1. ACCEPT external digestion / extracellular digestion</li> <li>7. .g. evaporation of water / leaves drying out</li> <li>8. e.g. animals eat the leaves, leaves pulled into soil</li> </ol>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
4(b)(iv)	<ol style="list-style-type: none"> <li>1. idea that an increase in temperature would increase the rate of decomposition (up to an optimum temperature) ;</li> <li>2. reference to enzymes (in decomposition) ;</li> <li>3. idea that increased {heat / kinetic} energy results increase in {number of collisions / energy of collisions (between enzymes and substrate) / enzyme-substrate complexes} ;</li> <li>4. idea that increased temperature increases rate at which bacteria increase ;</li> <li>5. idea that above a certain temperature rate of decomposition would {decrease / stop} ;</li> <li>6. idea that at higher temperatures enzymes become denatured OR bacteria killed ;</li> </ol>	<p>6. NOT enzymes start to denature NB need the term 'denaturing' or its derivative</p>	<b>(4)</b>