

## 6 Ecology and the environment

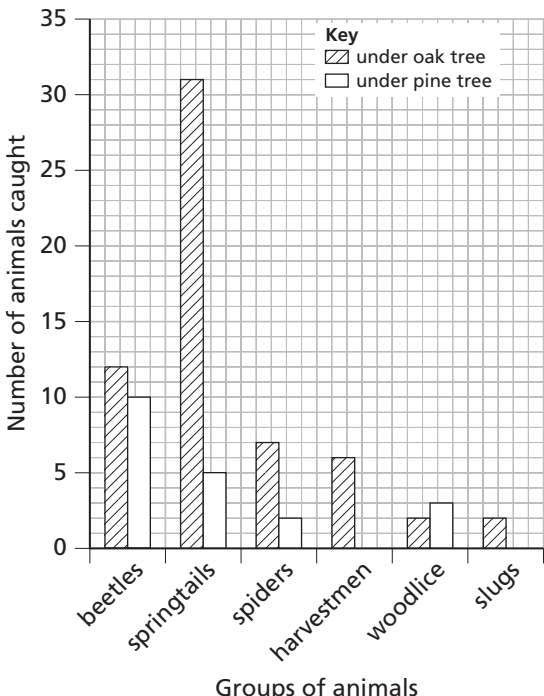
### Using and interpreting data

Question	Mark scheme	Marks
1 a) i)	<ul style="list-style-type: none"> <li>pH 4.5 = 3.4 (allow 1 mark if additions/working shown but divided by incorrect number [likely to do 10 rather than 9])</li> </ul>	2
ii)	<ul style="list-style-type: none"> <li>if more acid / lower pH / figures quoted, seedlings show reduced growth / eq</li> <li>(growth at) pH 5.5 less than 7.0 / (growth at) pH 4.5 less than pH 5.5 / pH 7.0 / eq</li> <li>progressive decrease (in growth) with decreasing pH / increasing acidity / eq</li> </ul>	2
b)	<ul style="list-style-type: none"> <li>sulfur dioxide</li> <li>dissolves in water in atmosphere / rain becomes acid / contains sulfuric acid / eq</li> </ul>	2
c)	<ul style="list-style-type: none"> <li>acid gases / sulfur dioxide / eq from factory fall as acid rain / eq</li> <li>pH becomes lower in lake / eq</li> <li>(lake more transparent) because (microscopic) plant material affected / does not grow / eq</li> <li>effects through food webs / eq</li> <li>reduced food supply for fish / eq</li> <li>direct effect of acidity on fish (e.g. mucus on gills so gas exchange difficult) / eq</li> </ul>	4
<b>Total</b>		<b>10</b>

Question	Mark scheme	Marks
2 a) i)	<ul style="list-style-type: none"> <li>respiration (<math>\times 2</math> marks – allow two from plants / animals / microorganisms / eq)</li> <li>combustion / burning / eq</li> </ul>	2
ii)	<ul style="list-style-type: none"> <li>photosynthesis / uptake of carbon dioxide in synthesis of carbohydrate / eq</li> </ul>	1
iii)	<ul style="list-style-type: none"> <li>(fluctuations) due to different rates of photosynthesis / uptake carbon dioxide by plants / eq</li> <li>(changes / fluctuations) in light intensity / eq</li> <li>(changes / fluctuations) in temperature / eq</li> <li>in different seasons / different times of year / eq (allow <b>ONCE</b>)</li> <li>different vegetation cover in different seasons (e.g. deciduous trees, growth of plants) / eq</li> <li>suitable ref to different hemispheres / eq</li> <li>eq</li> </ul>	3
b) i)	<ul style="list-style-type: none"> <li>(greenhouse gases) form layer around Earth / in atmosphere / eq</li> <li>(solar) radiation (from sun) passes through layer / eq</li> <li>warms surfaces on Earth / eq</li> <li>greenhouse gases trap warmth / absorb some radiation when reflected / eq from Earth's surface / does not escape back into outer space / eq</li> </ul>	3
ii)	<ul style="list-style-type: none"> <li>(gas) methane</li> <li>(source – one from)               <ul style="list-style-type: none"> <li>(1) rice paddy fields / eq</li> <li>(2) belching / eq cattle / ruminants / eq</li> <li>(3) decay of waste material / landfill sites / biogas / eq</li> </ul> </li> <li>OR</li> <li>(gas) nitrous oxide</li> <li>(source) exhaust from motor vehicles / nitrogen fertilisers / eq</li> <li>OR</li> <li>(gas) CFCs</li> <li>(source) human manufacture / named example (e.g. CFC11 / CFC12) / use described (e.g. refrigerant / aerosol cans / foam packaging)</li> </ul>	4
c)	<ul style="list-style-type: none"> <li>increase (in the activities listed) – <b>stated or implied</b></li> <li>burning fossil fuels (e.g. coal, oil, natural gas) / factory / industrial emissions</li> <li>use of motor vehicles (linked to carbon dioxide + burning of fossil fuels) / eq</li> <li>deforestation / removal of trees (reduces CO<sub>2</sub> uptake by plants)</li> </ul>	3
<b>Total</b>		<b>16</b>

Question	Mark scheme	Marks
<b>3 a) i)</b>	<ul style="list-style-type: none"> <li>• (green plants) → caterpillars → blue tits / robins → (sparrowhawks)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• (green plants) → earwigs → blue tits → (sparrowhawks)</li> </ul> <p><i>(2 correct organisms [other than green plants or sparrowhawks] = 1 mark)</i>  <i>(correct sequence [for whole food chain] = 1 mark)</i>  <i>(direction of arrows = 1 mark)</i></p>	3
<b>ii)</b>	<ul style="list-style-type: none"> <li>• sun / sunlight / eq</li> </ul>	1
<b>b) i)</b>	<ul style="list-style-type: none"> <li>• (earthworms) → woodmice / ground beetles → (tawny owls)</li> </ul> <p><i>(1 correct organism [between earthworm and tawny owl] = 1 mark)</i>  <i>(ignore order and ignore direction of arrows [not asked for in this part])</i>  <i>(ignore 'dead plant material' – organisms in the chain must be living organisms)</i></p>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>• (detritivores / earthworms) feed on dead material (plant or animal) / eq</li> <li>• release energy in dead material / respiration / eq</li> <li>• pass energy on to next organism(s) / woodmice / ground beetles / tawny owls in food chain / eq</li> </ul>	2
<b>c)</b>	<ul style="list-style-type: none"> <li>• food chain too simple / does not reflect complex feeding relationships that exist (in natural communities) / eq</li> <li>• organisms feed on variety of other organisms / eq</li> <li>• examples (e.g. ground beetles feed on ants, caterpillars, earthworms / tawny owls feed on earthworms, ground beetles, woodmice + many other possibilities to quote from table)</li> <li>• organisms feed at different trophic levels / eq</li> <li>• examples (e.g. woodmice feed on nuts + caterpillars)</li> <li>• food chain may start with plant material (producer) or dead plant material (detritivore)</li> <li>• examples (e.g. earwigs feed on dead plant material + living plants)</li> <li>• eq</li> </ul>	3
<b>d)</b>	<ul style="list-style-type: none"> <li>• wide base represents (energy in) producers / detritivores / eq</li> <li>• energy losses from one trophic level to the next / eq</li> <li>• examples of how energy lost (e.g. respiration / parts not eaten / lost in excretory materials / eq) / eq</li> <li>• narrow top represents top consumers / top carnivores / less energy at this level / eq</li> </ul>	3
<b>Total</b>		<b>13</b>

# Practical activities

Question	Mark scheme	Marks																					
1 a) i)	<ul style="list-style-type: none"> <li>vertical axis labelled 'Numbers of animals' / eq</li> <li>horizontal axis labelled 'Group of animals' / eq</li> <li>correct plotting (× 2 marks)</li> <li>key to bars (oak tree or pine tree)</li> </ul> <p><i>(note that the bar chart can also be plotted horizontally, so vertical and horizontal can be reversed in axes marks)</i></p>  <table border="1"> <caption>Data from Bar Chart</caption> <thead> <tr> <th>Group of animals</th> <th>Under oak tree</th> <th>Under pine tree</th> </tr> </thead> <tbody> <tr> <td>beetles</td> <td>12</td> <td>10</td> </tr> <tr> <td>springtails</td> <td>31</td> <td>5</td> </tr> <tr> <td>spiders</td> <td>7</td> <td>2</td> </tr> <tr> <td>harvestmen</td> <td>6</td> <td>0</td> </tr> <tr> <td>woodlice</td> <td>2</td> <td>3</td> </tr> <tr> <td>slugs</td> <td>2</td> <td>0</td> </tr> </tbody> </table>	Group of animals	Under oak tree	Under pine tree	beetles	12	10	springtails	31	5	spiders	7	2	harvestmen	6	0	woodlice	2	3	slugs	2	0	5
Group of animals	Under oak tree	Under pine tree																					
beetles	12	10																					
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spiders	7	2																					
harvestmen	6	0																					
woodlice	2	3																					
slugs	2	0																					
ii)	<ul style="list-style-type: none"> <li>total caught under oak tree = 60, total caught under pine tree = 20</li> <li>percentage under pine tree = <math>20 \div 80 = 25\%</math></li> </ul> <p><i>(2 marks for 25% without showing working)</i>  <i>(allow 1 mark for percentage correctly calculated from incorrect figures)</i></p>	2																					
b)	<ul style="list-style-type: none"> <li>animals may be active at different times of day / nocturnal / allows time to catch reasonable sample / eq</li> </ul>	1																					
c)	<ul style="list-style-type: none"> <li>repeat in different areas under each tree / eq</li> <li>repeat under different pine or oak trees / eq</li> <li>repeat for several days / eq</li> <li>repeat at different times / seasons of the year / eq</li> <li>record numbers within groups of animals (for abundance) + range of animals (for diversity) / eq</li> <li>eq</li> </ul>	2																					
<b>Total</b>		<b>10</b>																					

Question	Mark scheme	Marks
2 a) i)	• 86	1
ii)	• $63 \div 0.25$ / eq • = 252 (flowers per m <sup>2</sup> ) (correct answer with no working = 2 marks)	2
b) i)	• more daisy plants in trampled area / area A / eq	1
ii)	• form of plant survives trampling / ref leaves tough / flat / rooting system / eq • competition from other plants in untrampled area / features described / eq	2
c) i)	• (quadrats provide) method for sampling area / eq • not easy to count all daisies in whole area / eq • estimates in quadrats / sample area more accurate / eq	2
ii)	• avoid bias / not select area with lots of daisy plants / with no daisy plants / eq	1
iii)	• draw up grid with numbers on coordinates for two sides / eq • use random numbers to select squares within grid / eq • eq	2
d) i)	• bare patches from trampling / variable effects from trampling / other factors influence / favour growth / distribution of daisy plants / eq	1
ii)	• two from pH / mineral ions / water in soil / light / shade / eq	2
<b>Total</b>		<b>14</b>

Question	Mark scheme	Marks
3 a) i)	• repeats / replication, increased reliability / reduce effect of anomalous records / eq	1
ii)	• more accurate judgement of (percentage) cover / eq	1
iii)	• place quadrats at same height / aspect / eq • to ensure any differences related to the tree species (ash or sycamore) and not to other factors (e.g. rainfall, wind) / eq	2
b) i)	• A1 = (vertical) axis labelled 'percentage cover' + suitable scale • A2 = (horizontal) axis + names of organisms (algae + foliose lichen + crustose lichen + moss + bare bark) • plots $\times$ 2 marks • key or suitable label for ash and sycamore bars (axes can be drawn the other way round though expected orientation given in mark scheme)	5
ii)	(sycamore) • quote selection of figures for sycamore (to illustrate highs and lows / range) / eq (ash) • quote selection of figures for ash (to illustrate more even distribution)	2
c) i)	• fungus (in foliose or crustose lichen) • from association / eq with alga (in the lichen) / saprophytic / eq	2
ii)	• no xylem • (no xylem so) no transport system (limits size) / eq • (no xylem so) no supporting tissue (for larger size) / eq	2
<b>Total</b>		<b>15</b>

Question	Mark scheme	Marks
4 a) i)	<ul style="list-style-type: none"> <li>12</li> </ul>	1
ii)	<ul style="list-style-type: none"> <li>heat ethanol (in boiling tube) in water bath</li> <li>reduce danger of ethanol catching fire/eq</li> </ul>	2
b) i)	<ul style="list-style-type: none"> <li>highest total scores on west/per tree/total across three trees/eq</li> <li>quote figures to support above statement/eq</li> <li>lowest total scores on south/per tree/total across three trees/eq</li> <li>(next lowest) total scores on north/per tree/total across three trees/eq</li> <li>quote figures to support any of statements relating to low scores/eq</li> <li><i>(allow 3 marks from any of these points or suitable variations)</i></li> </ul>	3
ii)	<ul style="list-style-type: none"> <li>most moisture on west side, need moisture (for photosynthesis/growth)/eq/converse for suitable ref to another side/eq</li> <li>least light on north side, need light for photosynthesis/eq/converse/eq</li> <li>most exposure to wind (passing the tree) on north/south sides, more difficult to grow/eq</li> <li>eq</li> </ul>	3
c)	<ul style="list-style-type: none"> <li>more samples (on different trees)/different heights on the tree/different species of tree/eq</li> </ul>	1
<b>Total</b>		<b>10</b>

## Applying principles

Question	Mark scheme	Marks
1 a)	<ul style="list-style-type: none"> <li>producers = phytoplankton</li> <li>primary + secondary consumers = cod + krill</li> <li>tertiary consumers (any two from) elephant seal + leopard seal + killer whale + penguin</li> <li><i>(1 mark per line of table – if two organisms required [lines 2 + 3], both are needed to gain the mark)</i></li> </ul>	3
b) i)	<ul style="list-style-type: none"> <li>total mass of living organisms (in an area)/eq</li> <li><i>(ignore references to time or units or trophic levels)</i></li> </ul>	1
ii)	<ul style="list-style-type: none"> <li>phytoplankton/producers</li> </ul>	1
c)	<ul style="list-style-type: none"> <li>pesticide passed through different organisms/trophic levels in the food web/when one organism feeds on another/eq</li> <li>does not break down, so same molecule passed on/not lost in excretion/eq</li> <li>so accumulates/becomes more concentrated in tissues of highest trophic levels (such as killer whale)/eq</li> </ul>	2
d)	<ul style="list-style-type: none"> <li>more zooplankton, (because) not eaten by cod/eq</li> <li>more krill, (because) not eaten by cod/more zooplankton, (therefore) more food/eq</li> <li>fewer/less food (cod) for leopard seal/eq</li> <li>more squid (because more zooplankton) so more elephant seal/killer whale/leopard seal/eq</li> <li>eq</li> <li><i>(other effects possible and accepted if correctly linked)</i></li> </ul>	2
e) i)	<ul style="list-style-type: none"> <li>phytoplankton/producers</li> </ul>	1
ii)	<ul style="list-style-type: none"> <li>two from nitrate/magnesium /phosphate/calcium/eq</li> </ul>	2
<b>Total</b>		<b>12</b>

Question	Mark scheme	Marks
<b>2 a) i)</b>	<ul style="list-style-type: none"> <li>• (bacteria) high numbers / sudden increase / eq</li> <li>• (increase in) respiration</li> <li>• use oxygen (so level falls) / eq</li> </ul>	3
<b>ii)</b>	<ul style="list-style-type: none"> <li>• (algae) increase in numbers / eq</li> <li>• population explosion / algal bloom / eq</li> <li>• eq</li> </ul>	2
<b>iii)</b>	<ul style="list-style-type: none"> <li>• algae / plants in river produce oxygen</li> <li>• photosynthesis</li> <li>• numbers of bacteria decrease (so) less oxygen used (for respiration) / eq</li> <li>• ref other form of aeration in water (e.g. weir / waterfall) / eq</li> <li>• eq</li> </ul>	2
<b>b)</b>	<ul style="list-style-type: none"> <li>• low levels of oxygen (continue) / eq</li> <li>• other organisms in food chain / food web affected / eq</li> <li>• changes in types of organisms present / organisms better adapted for low oxygen survive / eq</li> <li>• fish may die / 'fish kill' / fish need adequate supply of oxygen / eq</li> <li>• eq</li> </ul>	3
<b>Total</b>		<b>10</b>

Question	Mark scheme	Marks
<b>3 a) i)</b>	<i>any two of the squares with following grid points:</i> <ul style="list-style-type: none"> <li>• 4C, 4D, 4E, 5C, 5D</li> </ul> <i>(accept similar interpretation of grid squares if clear)</i>	2
<b>ii)</b>	<ul style="list-style-type: none"> <li>• sulfur dioxide / oxides of nitrogen / eq</li> </ul>	1
<b>iii)</b>	<ul style="list-style-type: none"> <li>• (gas) dissolves in water / moisture / eq</li> <li>• to form sulfuric acid / nitric acid / acid rain / eq</li> </ul>	2
<b>b)</b>	<ul style="list-style-type: none"> <li>• more records / more squares / higher abundance of lichens shown / eq</li> <li>• on west / south-west / southern parts of map / eq</li> <li>• quote grid squares as supporting evidence (e.g. 1B, 2B) / eq</li> </ul>	2
<b>c) i)</b>	<ul style="list-style-type: none"> <li>• alga</li> </ul>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>• carbon dioxide + water <i>(or left hand side of equation)</i></li> <li>• sunlight / light / eq <i>(e.g. over arrow if equation given)</i></li> <li>• chlorophyll <i>(e.g. over arrow if equation given)</i></li> </ul> <i>(no mark for right hand side of equation as question asks for what is required)</i>	3
<b>d) i)</b>	<ul style="list-style-type: none"> <li>• (absorb from) air / dissolved in water films on rock / in mist / rain / eq</li> </ul>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>• lichens can grow in extreme conditions / eq</li> <li>• can obtain materials required (for nutrition) without need for soil / eq</li> <li>• obtain supplies of carbohydrate / eq by photosynthesis / eq</li> <li>• material from lichen decomposes / eq</li> <li>• accumulation of material where lichens grow / eq</li> <li>• allows other simple plants / eq to find a place to grow / eq</li> <li>• links into food chain / food web / build into more complex communities / eq</li> </ul> <i>(allow reference to weathering, but not expected within limits of spec)</i>	3
<b>Total</b>		<b>15</b>

## Extended writing

Question	Mark scheme	Marks
1	<ul style="list-style-type: none"> <li>• vegetation / soil on ground exposed / no longer protected by trees / eq</li> <li>• less water taken up by trees from soil / eq</li> <li>• water can run off more easily (if on slope) / eq</li> <li>• (vegetation) does not bind / hold soil / eq</li> <li>• soil eroded / washed away / eq</li> <li>• (washed away soil) accumulates in rivers / blocks waterways in valleys (leading to flooding) / eq</li> <li>• soil can become saturated (because trees do not take up the water), leading to flooding / eq</li> <li>• mineral ion content (of soil) washed away / removed / leaching / eq</li> <li>• microorganisms (in soil) washed away / eq</li> <li>• (therefore) disturbance to soil recycling / eq</li> <li>• less vegetation on surface / eq that would break down / decompose / eq</li> <li>• mineral ions / eq not released from decaying vegetation / eq</li> <li>• soil less fertile / eq</li> </ul>	6
<b>Total</b>		<b>6</b>

Question	Mark scheme	Marks
2	<ul style="list-style-type: none"> <li>• (wide) base trophic level shows (many) producers / eq</li> <li>• (narrow) top trophic level shows fewer (top) carnivores / (top) consumers / eq</li> <li>• width of bar represents / eq (total) energy in the trophic level / eq</li> <li>• more energy in producers than in other trophic levels / diagram labelled showing trophic levels and relative energy content / eq</li> <li>• loss of energy from one trophic level to the next / eq</li> <li>• mention energy losses approx 90% / eq (from one trophic level to next) / approx 10% passed on / eq</li> </ul> <p><i>energy losses (allow 3 marks from):</i></p> <ul style="list-style-type: none"> <li>• not all parts eaten / digested / eq</li> <li>• e.g. plant parts too woody / animal bones / fur not digested / eq</li> <li>• (energy) used by consumer in metabolic processes / movement / eq</li> <li>• (energy) lost in respiration / generation of heat / eq</li> <li>• (energy) lost in excreta / urine / eq</li> <li>• (energy) lost in feces / eq</li> <li>• eq</li> </ul>	6
<b>Total</b>		<b>6</b>

Question	Mark scheme	Marks
3	<ul style="list-style-type: none"> <li>• (microorganisms are) decomposers</li> <li>• e.g. fungi / bacteria</li> <li>• digest / break down / decay / decompose dead plant / dead animal material / eq</li> <li>• respiration (using dead material) releases carbon dioxide / eq</li> <li>• (carbon dioxide) into atmosphere / carbon cycle / eq</li> <li>• (breakdown) releases ammonia / ammonium ions / eq</li> <li>• into nitrogen cycle / eq</li> <li>• nitrifying bacteria</li> <li>• (nitrifying bacteria) convert ammonium / eq into nitrite</li> <li>• (nitrifying bacteria) convert nitrite into nitrate</li> <li>• denitrifying bacteria</li> <li>• (denitrifying bacteria) reduce available nitrate / eq</li> <li>• convert nitrate into nitrogen gas</li> <li>• nitrogen-fixing bacteria</li> <li>• in nodules / leguminous plant roots / free living</li> <li>• fix / convert nitrogen gas into nitrogen compounds / in proteins / eq</li> </ul> <p><i>(for full marks must refer to BOTH C cycle and N cycle [allow up to 4 marks for N cycle])</i></p>	6
<b>Total</b>		<b>6</b>

Question	Mark scheme	Marks
4	<ul style="list-style-type: none"> <li>• carbon dioxide (contains C atom) released (by respiration)</li> <li>• carried in blood to lungs / eq</li> <li>• diffuses into alveoli / lungs / eq</li> <li>• (carbon dioxide) breathed out into atmosphere / ref to passage along bronchioles / bronchi / trachea / eq</li> <li>• (carbon dioxide) taken up by green plants / grass / producers / eq</li> <li>• photosynthesis / synthesis of glucose / starch / eq</li> <li>• producer / (green plant) / grass / eq eaten by primary consumer / herbivore / rabbit / eq</li> <li>• carbohydrate contains C atom / eq</li> <li>• (carbohydrate / eq) digested by primary consumer / rabbit / eq</li> <li>• digested food transported, assimilated / eq</li> <li>• incorporated into muscle (in primary consumer / rabbit) / eq</li> </ul>	6
<b>Total</b>		<b>6</b>