1.24 Biodiversity, Cycles and Human Impact: 1-hour Pack

Total Marks

AQA 8464 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Large areas of tropical rainforest are cleared each year, a process called deforestation.

(a) Give two reasons why large-scale deforestation takes place in tropical regions. **(2)**

(b) Explain two ways in which deforestation contributes to an increase in atmospheric carbon dioxide concentration. **(2)**

(c) Explain why deforestation can lead to a reduction in biodiversity in the affected region. **(2)**

(Total for Question 1 is 6 marks)

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2 Required practical: a student investigated the effect of temperature on the rate of decomposition, using lipase enzyme to model the breakdown of a lipid. Full-fat milk powder solution (a source of lipid), sodium carbonate solution (an alkali) and a few drops of phenolphthalein indicator (pink in alkaline conditions) were mixed in a test tube. The tube was placed in a water bath at a chosen temperature. Lipase solution was then added, the tube was mixed, and a stop clock was started immediately. As the lipase broke down the lipid into fatty acids, the pH inside the tube fell, and the indicator changed from pink to colourless. The time taken for this colour change was recorded. This was repeated three times at each of five temperatures, keeping the volumes and concentrations of milk powder solution, sodium carbonate solution, indicator and lipase the same each time.
The results are shown in the table below.

Temperature (°C)	Repeat 1 (s)	Repeat 2 (s)	Repeat 3 (s)	Mean time (s)
20	330	327	336	331
30	180	174	183	179
40	93	90	87	(to be calculated)
50	128	205	132	(to be calculated)
60	240	249	246	245

Rate of reaction can be calculated using: rate = 1000 / mean time (arbitrary units).

(a) State the independent variable in this investigation. **(1)**

(b) State one variable that must be controlled in this investigation. Explain why it must be controlled, and what would happen to the validity of the results if it were not. **(3)**

(c) Calculate the rate of reaction at 40°C, using the mean time from the table. Give your answer to 3 significant figures. **(2)**

(d) Identify the anomalous result in the table and suggest one possible cause for it. **(2)**

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(e) Describe the pattern shown by the rate of reaction as temperature increases from 20 to 60°C, and explain this pattern in terms of enzyme action. **(4)**

(f) Evaluate the method used to determine when the colour change had occurred, and suggest one improvement that would make the results more precise. **(3)**

(g) Explain why this experiment can be used as a model for the process of decomposition, and suggest one way in which it differs from decomposition occurring naturally in the environment. **(3)**

(Total for Question 2 is 18 marks)

3 Fertiliser and sewage that enter rivers and lakes can pollute the water and harm aquatic organisms.

(a) Name two substances that can be washed from farmland into rivers and lakes, causing water pollution. **(2)**

(b) Describe how excess fertiliser entering a lake can lead to the death of fish and other aquatic organisms. **(4)**

(Total for Question 3 is 6 marks)

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4 Plastic waste that enters rivers and oceans can cause serious harm to wildlife.

(a) Describe two ways in which plastic waste entering rivers and oceans can harm wildlife. **(2)**

(b) Microplastics (tiny plastic fragments) are increasingly detected in marine food chains. Explain how microplastics could become more concentrated in organisms at higher trophic levels. **(3)**

(Total for Question 4 is 5 marks)

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5 A population of an endangered woodland bird was estimated at 2400 breeding pairs in 2005. By 2025, numbers had fallen to 1560 breeding pairs due to habitat loss.

(a) Calculate the percentage decrease in the number of breeding pairs between 2005 and 2025. **(2)**

(b) A conservation programme aims to increase the population back to 70% of its 2005 level within 10 years. Calculate the target number of breeding pairs. **(2)**

(Total for Question 5 is 4 marks)

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6 Governments and individuals can take action to reduce the negative effects of waste on biodiversity.

(a) Explain how increasing the proportion of household waste that is recycled, rather than sent to landfill, could help to maintain biodiversity. **(3)**

(b) Government policy can also encourage biodiversity by paying farmers to leave unplanted strips of land at the edges of their fields (field margins). Suggest how this policy could increase biodiversity on farmland. **(2)**

(Total for Question 6 is 5 marks)

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7 Carbon dioxide and methane released by respiration, decomposition and combustion are part of the carbon cycle.

(a) The equation below shows aerobic respiration but is not balanced. Balance the equation and add the correct state symbols. **(2)**

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

(b) Methane gas produced by decomposing organic waste in landfill sites is sometimes collected and burned rather than being released directly into the atmosphere. The equation below shows the combustion of methane but is not balanced. Balance the equation and add the correct state symbols. **(2)**

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

(c) Using the equations above, explain why both the natural decomposition of waste in landfill sites and the combustion of fossil fuels contribute to rising atmospheric carbon dioxide concentrations. **(2)**

(Total for Question 7 is 6 marks)

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Mark scheme · 1.24 Biodiversity, Cycles and Human Impact: 1-hour Pack

Question 1

(a) to clear land for cattle grazing or growing crops (e.g. rice), to meet the increasing global demand for food (oe) **B1**

(a) to grow crops that are used to produce biofuels (oe) **B1**

(a) Answer: To clear land for cattle grazing or growing food crops such as rice, to meet increasing global demand for food, and to grow crops used to produce biofuels.

(b) fewer trees means less photosynthesis, so less carbon dioxide is removed from the atmosphere (oe) **B1**

(b) burning the cleared trees releases the carbon stored in the wood directly into the atmosphere as carbon dioxide (oe) **B1**

(b) Answer: There are fewer trees to remove carbon dioxide from the atmosphere by photosynthesis, and burning the cleared trees releases the carbon they had stored directly into the atmosphere as carbon dioxide.

(c) deforestation destroys habitats that many species depend on for shelter, food or breeding sites, so organisms may die or be forced to migrate (oe) **B1**

(c) species with a very narrow niche may become extinct if their only habitat is destroyed, reducing the variety of species (and genes) in the area (oe) **B1**

(c) Answer: Deforestation destroys habitats that many species rely on for shelter, food and breeding, forcing organisms to migrate or die; species with a narrow niche may become extinct if their only habitat is destroyed, reducing the variety of species in the region.

Question 2

(a) temperature (of the water bath) **B1**

(a) Answer: Temperature.

(b) any one suitable control variable, e.g. the volume/concentration of milk powder solution, sodium carbonate solution, indicator, or lipase used **B1**

(b) controlling it ensures that temperature is the only variable that could affect the rate of reaction between the tubes (oe) **B1**

(b) if it were not controlled, any difference in the time taken could be caused by this other variable rather than by temperature, so it would not be a valid (fair) test and no valid conclusion about the effect of temperature could be drawn **B1**

(b) Answer: The volume and concentration of lipase solution added (or an equivalent variable such as the milk powder solution, sodium carbonate solution or indicator) must be kept the same in every tube, so that temperature is the only variable that could affect the rate; if it were not controlled, any difference in results could be due to this other variable rather than temperature, making the test invalid.

(c) mean time at 40 C = (93+90+87)/3 = 90 s; rate = 1000/90 **M1**

(c) 11.1 (arbitrary units), awrt **A1**

(c) Answer: 11.1 (arbitrary units).

(d) the repeat 2 reading of 205 s at 50°C is anomalous, as it does not fit the pattern of the other two repeats at that temperature (128 s and 132 s) **B1**

(d) any suitable cause, e.g. the tube may not have reached the stated temperature before timing started, there may have been a delay in adding the lipase or starting the stop clock, or the student may have misjudged the colour change end point **B1**

(d) Answer: The 205 s reading (repeat 2 at 50°C) is anomalous, since it is much higher than the other two repeats (128 s and 132 s) at that temperature; a possible cause is a delay in adding the lipase or starting the stop clock, or the tube not having reached 50°C before timing began.

(e) the rate of reaction increases as temperature rises from 20 to 40°C **B1**

(e) the rate then decreases as temperature rises further, to 50 and 60°C **B1**

(e) up to 40°C, increasing temperature gives the enzyme and substrate more kinetic energy, increasing the frequency of successful collisions between the enzyme's active site and the substrate, so more enzyme-substrate complexes form per second **B1**

(e) above the optimum temperature (40°C), the enzyme begins to denature: the shape of its active site changes so it is no longer complementary to the substrate, so fewer enzyme-substrate complexes can form and the rate decreases **B1**

(e) Answer: The rate of reaction rises as temperature increases from 20 to 40°C, because more kinetic energy leads to more frequent successful collisions between the enzyme's active site and its substrate; above 40°C the rate falls, because the enzyme starts to denature, changing the shape of its active site so it no longer fits the substrate as well.

(f) judging by eye exactly when the solution becomes colourless is subjective, so different people (or the same person on different occasions) could record slightly different times, reducing precision (oe) **B1**

(f) a colorimeter could be used to measure the light transmission/absorbance of the solution at set time intervals, giving an objective, quantitative measurement of the colour change **B1**

(f) this would allow a more precise determination of the exact point at which the colour changes, improving the precision/reliability of the calculated rate **B1**

(f) Answer: Judging the colour change by eye is subjective and can vary between observers, reducing precision; using a colorimeter to measure light transmission or absorbance at set time intervals would give an objective, quantitative measurement of the colour change, improving the precision of the results.

(g) the lipase breaking down lipid into fatty acids represents the type of chemical breakdown carried out by decomposer microorganisms during natural decomposition (oe) **B1**

(g) the pH/colour change models the production of acidic products as complex organic matter is broken down **B1**

(g) however, this experiment uses only one enzyme, one substrate and one controlled temperature at a time, whereas natural decomposition involves many species of decomposer microorganisms and enzymes acting on a range of substrates (proteins, carbohydrates and lipids) under conditions (temperature, moisture, oxygen) that are not controlled **B1**

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(g) Answer: The breakdown of lipid by lipase, and the resulting pH change, models the type of chemical breakdown and acidic products produced during natural decomposition; however, the experiment uses only one enzyme and substrate at a controlled temperature, whereas natural decomposition involves many species of decomposer microorganisms acting on a range of substrates under uncontrolled environmental conditions.

Question 3

(a) fertiliser (containing nitrates and/or phosphates) **B1**

(a) sewage or animal slurry (accept pesticide) **B1**

(a) Answer: Fertiliser (containing nitrates and phosphates) and sewage or animal slurry (pesticide is also accepted).

(b) fertiliser increases the concentration of nutrients (e.g. nitrate) in the water **B1**

(b) this causes algae and other aquatic plants near the surface to grow rapidly (an algal bloom), which blocks light from reaching plants below the surface, so they cannot photosynthesise and die **B1**

(b) decomposer microorganisms break down the dead plant/algal material; their population increases and they use up dissolved oxygen in the water through respiration **B1**

(b) oxygen levels fall too low for fish and other aquatic animals to survive, so they die **B1**

(b) Answer: Excess fertiliser raises nutrient levels in the water, causing an algal bloom that blocks light from reaching plants below the surface, which die and are broken down by decomposers; the rapidly increasing decomposer population uses up dissolved oxygen through respiration, and oxygen levels fall too low for fish and other aquatic animals to survive.

Question 4

(a) animals may mistake plastic for food and eat it, which can cause blockages, starvation or injury (oe) **B1**

(a) animals may become entangled in plastic debris, causing injury, restricted movement, or drowning (oe) **B1**

(a) Answer: Animals may mistake plastic for food and eat it, causing blockages or starvation, or they may become entangled in plastic debris, causing injury or drowning.

(b) microplastics ingested by small organisms (e.g. plankton) are not broken down or excreted, so they build up in the organism's body (oe) **B1**

(b) when a predator eats many of these prey organisms, the plastic from all of them accumulates in the predator's body **B1**

(b) this process repeats up the food chain, so organisms at higher trophic levels (e.g. large fish or seabirds) can build up much higher concentrations of microplastics than organisms lower down the chain **B1**

(b) Answer: Microplastics eaten by small organisms such as plankton are not broken down or excreted, so they accumulate in the body; when predators eat many of these prey organisms, the plastic builds up further, and this repeats up the food chain so that organisms at higher trophic levels can accumulate much higher concentrations than those lower down.

Question 5

(a) decrease = 2400 - 1560 (= 840); (840/2400) x 100 **M1**

(a) 35% cao **A1**

(a) Answer: 35%.

(b) 0.7 x 2400 **M1**

(b) 1680 breeding pairs cao **A1**

(b) Answer: 1680 breeding pairs.

Question 6

(a) recycling reduces the amount of raw material (e.g. wood, metal ore, crude oil) that needs to be extracted from the environment, so less land needs to be cleared or mined, protecting habitats (oe) **B1**

(a) recycling reduces the amount of waste sent to landfill, so less land is needed for landfill sites (oe) **B1**

(a) less landfill also reduces the risk of pollutants leaching into soil or water and harming organisms (oe) **B1**

(a) Answer: Recycling reduces the amount of raw material that needs to be extracted from the environment, so less land is cleared or mined; it also reduces the amount of waste sent to landfill, meaning less land is needed for landfill sites and less risk of pollutants leaching out and harming organisms.

(b) unplanted field margins can provide habitat, food or shelter for species (e.g. wildflowers, insects, small mammals, birds) that would not be present in intensively farmed (monoculture) land (oe) **B1**

(b) field margins can act as corridors connecting isolated habitats, allowing species to move between areas (oe) **B1**

(b) Answer: Unplanted field margins provide habitat, food and shelter for species such as wildflowers, insects, small mammals and birds that would not survive in intensively farmed land, and can act as corridors connecting isolated habitats, allowing species to move between them.

Question 7

(a) correct balancing numbers: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ **M1**

(a) all correct state symbols added: $C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ **A1**

(a) Answer: $C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$.

(b) correct balancing numbers: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ **M1**

(b) all correct state symbols added: $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ **A1**

(b) Answer: $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$.

(c) both processes release carbon dioxide (decomposition also releases methane, another greenhouse gas) directly into the atmosphere (oe) **B1**

(c) because these processes occur on a very large scale worldwide, releasing carbon that would otherwise stay locked away (in fossil fuels) or only be released slowly, they add carbon dioxide faster than it can be removed by processes such as photosynthesis, increasing the overall atmospheric concentration **B1**

(c) Answer: Both processes release carbon dioxide (and decomposition also releases methane) directly into the atmosphere; because they happen on a very large scale worldwide, they add carbon dioxide faster than photosynthesis and other processes can remove it, so the overall atmospheric concentration rises.

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