InkBiology

ANSWER BOOK

The carbon cycle and climate change

Ecology, populations and environmental change · Unit B20

OCR A 4.2.1, 6.3.1 · Edexcel A 4.1, 5.12, 5.13, 5.14, 5.15, 5.16, 5.21, 5.22, 6.1, 6.2 · Edexcel B 10.4 i

14 questions · 46 marks

NAVY EDITION

Every question in this book has a code beside its number.
Type inklearning.co.uk/q/ followed by the code to open that question online.

inklearning.co.uk/biology/ · youtube.com/@InkPhysics

SECTION A · Short, 1 to 2 marks

A1 CCPD-Q14

B1 a store is a place where carbon is held, such as the atmosphere, living organisms, soil, the ocean, sedimentary rock or fossil fuels. **B1** a transfer is a process that moves carbon from one store to another, such as photosynthesis, respiration, decomposition or combustion. [2]

A2 CCPD-Q15

B1 the atmosphere, sedimentary rock and fossil fuels are stores, each a place where carbon is held. **B1** photosynthesis, respiration and decomposition are transfers, each a process that moves carbon from one store to another. [2]

SECTION B · Standard, 3 to 5 marks

B1 CCPD-Q1

B1 each species survives only within a range of temperatures, and rising mean temperature has moved the area in which those conditions occur northwards. **B1** individuals dispersing into the newly suitable area can now survive and reproduce there, so the recorded limit moves, while the southern limit retreats as conditions there become too warm. **B1** species already at the northern edge of a land mass, or at the top of a mountain, have nowhere suitable to move to and are lost. **B1** the species a population depends on, such as a larval food plant or the insects a bird feeds its chicks, may not shift by the same amount or at the same time, so ranges and timings no longer overlap. [4]

B2 CCPD-Q7

B1 both are transparent to the short-wavelength radiation arriving from the Sun and both absorb part of the long-wavelength radiation the warmed Earth emits, so both raise the mean surface temperature. **B1** methane absorbs far more strongly per molecule than carbon dioxide, but there is far less of it in the air, so carbon dioxide accounts for more of the warming overall. **B1** the carbon dioxide added comes chiefly from burning fossil fuels, from deforestation and from cement manufacture, whereas the methane added comes chiefly from cattle, rice paddies, landfill and thawing permafrost. **B1** the methane from thawing permafrost is released by the warming itself, so that transfer grows as the temperature rises, whereas the size of the carbon dioxide transfer depends on how much fuel people burn. [4]

B3 CCPD-Q8

B1 the arithmetic is right: photosynthesis removes about 120 gigatonnes of carbon a year, while combustion and deforestation together add about 11.5, which is under a tenth of it. **B1** against the claim: the natural transfers are a balanced pair, because respiration and decomposition return each year about as much as photosynthesis takes, so the natural cycle leaves the amount held in the air unchanged. **B1** against the claim: the human transfer has no matching return, and although the oceans and land plants take up roughly half of it, about 5.5 gigatonnes stays in the air every year and the surplus accumulates year on year. **B1** a judgement: comparing one transfer with another is the wrong test, and the right one is whether a transfer is balanced; the accumulation is what has taken the concentration from about 280 parts per million before industrialisation to over 420 today. [4]

B4 CCPD-Q9

B1 caterpillar emergence is triggered by temperature, so warming has brought the caterpillar peak forward in the year. **B1** the bird's laying date is cued by day length, which does not change as the climate warms, so when its chicks hatch, and need most food, has not shifted by the same amount. **B1** the two events, once closely matched, have drifted apart, so chicks now hatch after rather than at the peak of the food supply. **B1** chicks receive less food during their critical growth period, so fewer survive to fledge, which can reduce the size of the bird population over time. [4]

B5 CCPD-Q10

B1 a corridor of suitable habitat linking fragments gives individuals a route by which they can disperse from an area becoming unsuitable into one that has newly become suitable, rather than being blocked by farmland, a city or a motorway. **B1** a species able to reach the newly suitable area can survive and breed there, so its population, and the local biodiversity, is maintained rather than lost as its old range becomes unsuitable. **B1** a corridor does not help a species already at the top of a mountain or the edge of a landmass, since there is no further suitable area beyond it for a corridor to lead to. **B1** nor does it help a species that must shift faster than it can disperse even along a clear route, since a corridor removes the barrier to movement without increasing the rate at which the species itself can move. [4]

B6 CCPD-Q11

B1 population size is one factor behind the demand for energy, food and land, but it is not the whole account of that demand. **B1** consumption per person also matters, since energy use per person has risen over the same period that population has risen, so total demand has grown faster than population alone would predict. **B1** the technology used changes how much carbon dioxide a given amount of consumption releases, for example whether energy is generated by burning fossil fuels or by a low-carbon method. **B1** land-use choices, such as clearing forest for farming, add a further transfer of carbon to the atmosphere that is independent of how many people there are or how much each one consumes. [4]

B7 CCPD-Q2 **B1** photosynthesis, carried out by producers. **B1** respiration, carried out by all living organisms. **B1** decomposition, which is respiration carried out by saprobiotic bacteria and fungi on dead material and faeces. [3]

B8 CCPD-Q3 **B1** it formed from the remains of plants, chiefly the trees of swamp forests, that were buried under sediment. **B1** the conditions were anaerobic, so decomposers could not respire the remains and the organic material was not broken down. **B1** over millions of years heat and pressure converted it to coal, so the carbon that photosynthesis had removed from the air stayed out of the cycle. [3]

B9 CCPD-Q4 **M1** total human addition = 10 + 1.5 = 11.5 gigatonnes. **A1** net gain = 11.5 − 6.0 = 5.5 gigatonnes of carbon a year. **A1** 5.5 ÷ 120 × 100 = 4.6 per cent, to two significant figures. [3]

B10 CCPD-Q5 **B1** most of the world's land, and therefore most of its vegetation, lies in the northern hemisphere. **B1** in the northern summer the rate of photosynthesis across that vegetation exceeds the rate of respiration and decomposition, so more carbon dioxide is removed from the air than is returned to it. **B1** in the northern winter many plants have lost their leaves or are dormant, so photosynthesis falls below respiration and decomposition and the concentration rises again. [3]

B11 CCPD-Q12 **B1** carbon dioxide dissolves into the ocean from the air and comes back out of the ocean into the air, so the ocean is both a carbon store and the site of a two-way transfer with the atmosphere. **B1** the rate of each direction depends on temperature, and cold water is able to hold more dissolved gas than warm water. **B1** as the ocean warms, its capacity to hold dissolved carbon dioxide falls, so it is expected to absorb a smaller proportion of what is emitted over time. [3]

B12 CCPD-Q13 **B1** above a threshold temperature, corals expel the photosynthetic protoctists living in their tissues, which is called bleaching, and repeated bleaching kills the coral. **B1** a coral reef is the habitat for a very large number of other species, so losing the reef removes their habitat as well as removing the coral that built it. **B1** the loss of the species that depended on the reef habitat is therefore a loss of both habitat diversity and species diversity, beyond the direct effect on the corals. [3]

THIS BOOK ONLINE

Scan the code, or type the address, to open the questions in this book online:

inklearning.co.uk/biology/practise/questions/the-carbon-cycle-and-climate-change/