



ANSWER BOOK

The five kingdoms, species concepts and viruses

Classification, biodiversity and conservation · Unit B18

OCR A 4.2.2 · Edexcel A 4.6 · Edexcel B 2.2 i, 2.2 iii, 3.1 ii, 3.1 iii, 3.1 vii · CAIE 18.1

14 questions · 50 marks

NAVY EDITION

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SECTION B · Standard, 3 to 5 marks

- B1** FKS-Q6 **M1** three nucleotides code for one amino acid, so the number needed = 158×3 . **A1** 474 nucleotides, accepting 477 where a stop codon is counted as well. **M1** percentage of the genome = $474 \div 6400 \times 100$. **A1** 7.4 per cent, to two significant figures. **B1** the coat protein is coded once and translated over and over, so a few per cent of the genome supplies every subunit of the capsid, which is why a particle built from many copies of one protein needs so little nucleic acid to specify it. [5]
- B2** FKS-Q1 **B1** the kingdoms are defined by features of cells, and a virus is not a cell: it has no cytoplasm, no ribosomes and no organelles. **B1** a virus carries out no metabolism of its own and can reproduce only inside a living host cell, so it has no nutrition or respiration to classify. **B1** viruses are classified instead by their genome, first as DNA viruses or RNA viruses, since no virus contains both. **B1** and then by whether that nucleic acid is double-stranded or single-stranded, giving four groups, with a named example such as single-stranded RNA for influenza or human immunodeficiency virus. [4]
- B3** FKS-Q8 **B1** in support: it names a real biological boundary rather than a judgement about appearance, because a group whose members breed with one another to give fertile offspring shares a gene pool, and members of two such groups do not. **B1** in support: it has two halves that are both creditable, interbreeding to produce fertile offspring and reproductive isolation from other such groups, so it says why the boundary matters and not only where it lies. **B1** against: the breeding test cannot be run on anything that reproduces asexually, such as a bacterium, nor on a fossil or a museum specimen, and it gives an awkward answer wherever two named species produce fertile hybrids. **B1** a judgement: it is the definition to give first wherever sexual reproduction can be observed, but it cannot be the only one, which is why the morphological concept is used for fossils and the ecological concept for organisms that never interbreed at all. [4]
- B4** FKS-Q9 **B1** the biological species concept defines a species by whether its members interbreed to produce fertile offspring and are reproductively isolated from other such groups, whereas the ecological species concept defines a species by the niche its members occupy. **B1** the biological concept can only be applied where interbreeding can actually be observed or tested, whereas the ecological concept can be applied to organisms that reproduce asexually, since a niche can be described whether or not anything interbreeds. **B1** the biological concept fails on fossils and on species that produce fertile hybrids, whereas the ecological concept fails where niches overlap, or where one species occupies different niches at different life stages, such as an insect with a larval stage. **B1** in practice the biological concept is given first wherever sexual reproduction can be observed, and the ecological concept is brought in specifically for the cases, such as bacteria, that the biological concept cannot handle at all. [4]

- B5** FKS-Q10 **B1** a virus particle consists of a length of nucleic acid, either DNA or RNA, [4]
enclosed within a protein coat called a capsid. **B1** in some viruses the capsid is further enclosed in an envelope derived from the membrane of the host cell in which the particle was assembled. **B1** a virus has no cytoplasm, no ribosomes and no organelles of its own, and carries out no metabolism, so it cannot respire, grow or respond to anything by itself. **B1** it can reproduce only inside a living host cell, using that cell's own ribosomes, enzymes and nucleotides, which is why it is described as an obligate intracellular parasite.
- B6** FKS-Q11 **B1** double-stranded DNA: herpes simplex virus. **B1** single-stranded DNA: canine parvovirus. **B1** double-stranded RNA: rotavirus. **B1** single-stranded RNA: influenza. [4]
- B7** FKS-Q12 **B1** what is right: most plants are green, due to chlorophyll in their chloroplasts, and do not move from place to place, and many fungi do grow in soil and are not green, so the rules describe a common pattern. **B1** against: a seaweed is green and does not move but is classified in Protocista rather than Plantae, since it lacks roots, stems, leaves and vascular tissue, so 'green and stationary' is not sufficient on its own. **B1** against: many soil organisms that are not green are not fungi at all; bacteria and various Protocista also live in soil without photosynthesising, so 'in soil and not green' does not identify a fungus specifically either. **B1** judgement: a kingdom is defined by a combination of features, cellular organisation, cell wall material and method of nutrition among them, not by a single visible trait, so a rule based on colour and movement alone will misclassify organisms that share the trait without sharing the kingdom. [4]
- B8** FKS-Q2 **B1** the cell wall contains chitin rather than cellulose. **B1** it does not photosynthesise and has no chloroplasts or chlorophyll, feeding saprotrophically or parasitically instead. **B1** either of: the body is made of hyphae forming a mycelium, often with many nuclei in shared cytoplasm; or carbohydrate is stored as glycogen rather than as starch. [3]
- B9** FKS-Q3 **B1** it separates the Prokaryotae, whose DNA lies free in the cytoplasm as a circular molecule, from the four eukaryotic kingdoms whose DNA is enclosed in a nuclear envelope. **B1** the difference is not a single feature but a whole cell organisation: prokaryotes also lack membrane-bound organelles and have smaller 70S ribosomes. **B1** it is therefore the deepest division in the living world and reflects the oldest split in ancestry, so it is the division to make before any other. [3]

- B10** **B1** the morphological species concept, which groups organisms by shared observable structural features, because the biological concept cannot be used. **B1** no breeding test is possible on fossils, so whether the two populations could have produced fertile offspring can never be established. **B1** structure can mislead: members of one species can differ in appearance, as males and females and different growth stages do, while two separate species can look nearly identical. [3]
FKS-Q4
- B11** **B1** both are heterotrophic, since neither can make organic molecules from inorganic ones. **B1** a fungus secretes enzymes onto material outside its body and absorbs the soluble products, which is saprotrophic or parasitic nutrition, whereas an animal takes food into the body and digests it internally. **B1** the fungus therefore never handles solid food, which suits a body made of narrow hyphae, whereas an animal needs a gut and, in nearly all cases, the ability to move to its food. [3]
FKS-Q5
- B12** **B1** Protocista is a kingdom defined by exclusion: it holds every eukaryote that is not a fungus, a plant or an animal, rather than by a single positive feature shared by all its members. **B1** a seaweed photosynthesises and has cellulose cell walls, both features shared with Plantae, but it lacks roots, stems, leaves and the vascular tissue that goes with them, which the Plantae in this scheme are defined as having. **B1** because it fails the specific requirements of the Plantae despite the resemblance in nutrition and wall material, a seaweed is placed in the kingdom left over, Protocista, along with organisms that share almost nothing else in common with it. [3]
FKS-Q13
- B13** **B1** the morphological species concept groups organisms by their observable structure, but two genuinely separate species, called cryptic species, can look nearly identical to each other despite being reproductively isolated. **B1** mosquito species that differ in a property as important as whether they transmit malaria could therefore be wrongly treated as a single species if only their appearance is compared, with serious practical consequences for disease control. **B1** comparing DNA sequence between the populations, or testing directly whether they interbreed to produce fertile offspring, could separate species that look alike but are not exchanging alleles. [3]
FKS-Q14
- B14** **B1** antibiotics act on structures and processes that are specific to bacteria, such as bacterial ribosomes, bacterial cell walls and bacterial enzymes. **B1** a virus possesses none of these; it has no ribosomes, no cell wall and no metabolism of its own for an antibiotic to act on, so the antibiotic has no target inside it. **B1** the antibiotic instead reaches the bacteria the patient happens to be carrying elsewhere in or on the body, and any of those that survive by chance, because they carry a resistance allele, are more likely to breed and spread it, so unnecessary prescribing selects for antibiotic resistance without treating the viral infection at all. [3]
FKS-Q15

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