



Plant Structure and Function, Biodiversity and Conservation practice questions

40 questions · 141 marks · mark scheme at the back

For Pearson Edexcel International AS Biology XBI11 and International A Level Biology YBI11. **A Level only** is IA2 content (Units 4 to 6), not needed for the International AS.

Name

Total / 141

Plant cells and cell walls **Spec 4.1-4.4**

1 UNIT 2 STYLE [1 mark]

Which organelle in a plant cell contains starch grains but no chlorophyll or thylakoid membranes?

- A. ☐ Chloroplast
- B. ☐ Amyloplast
- C. ☐ Vacuole
- D. ☐ Mitochondrion

2 UNIT 2 STYLE [4 marks]

Compare and contrast the structure of a plant cell with the structure of an animal cell.

3 UNIT 2 STYLE [3 marks]

Describe the structure and function of plasmodesmata.

4

UNIT 2 STYLE

[4 marks]

An electron micrograph of a leaf cell shows an organelle surrounded by two membranes. Inside it are stacks of flattened, disc-shaped membranes and a few pale oval grains. (a) Identify the organelle. (1) (b) Give two features visible in the micrograph that support your identification. (2) (c) State the function of this organelle. (1)

5

UNIT 2 STYLE

[4 marks]

Explain why cellulose microfibrils have high tensile strength.

6

UNIT 2 STYLE

[3 marks]

Explain why starch is a suitable molecule for storing glucose in a plant cell.

7

UNIT 2 STYLE

[4 marks]

Explain how the structure of the wall of a xylem vessel makes it suited to supporting the plant and transporting water.

11 UNIT 3 STYLE

[5 marks]

A student is asked to draw a plan diagram of a transverse section of a stem seen under the light microscope. (a) Describe how a good plan diagram should be drawn. (4) (b) On the outer side of each vascular bundle the student sees a group of cells with very thick walls, stained red by phloroglucinol, and very small lumens. Identify this tissue. (1)

[illegible]

12 UNIT 3 STYLE

[3 marks]

A plan diagram of a stem section is 84 mm wide. The real width of the section is 2.4 mm. Calculate the magnification of the drawing. Show your working.

Answer = ...

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13 UNIT 2 STYLE

[3 marks]

A gardener notices that the leaves of a plant are yellow between the veins. A soil test shows that the soil is low in magnesium ions. Explain why a lack of magnesium ions causes yellow leaves.

[illegible]

Explain how the use of plant fibres and starch-based plastics could contribute to sustainability, and give one limitation.

Describe how you could compare the tensile strength of fibres from two different plants. Include the measurements you would make and how you would control other variables.

In an investigation, the masses at which five fibres from the same plant broke were: 4.4 kg, 4.6 kg, 4.5 kg, 4.4 kg and 4.6 kg. The fibres had a mean diameter of 0.30 mm. Calculate the tensile strength of the fibre in N mm^{-2} . Use $g = 9.81 \text{ N kg}^{-1}$. Show your working.

Answer = ...

Bacterial growth, plant medicines and drug testing Spec 4.10–4.13

17 UNIT 2 STYLE [1 mark]

Which precaution during Core practical 9 helps to prevent contamination of a bacterial culture?

- A. ☐ Sealing the Petri dish completely with tape
- B. ☐ Flaming the neck of the culture bottle after opening it
- C. ☐ Incubating the dish at 37 °C
- D. ☐ Leaving the lid of the dish off while spreading the bacteria

18 UNIT 2 STYLE [3 marks]

State three conditions that bacteria need for growth.

19 UNIT 2 STYLE [4 marks]

Explain why aseptic technique is used when handling bacteria.

20 UNIT 3 STYLE [6 marks]

A student wants to compare the antimicrobial effect of extracts from three plants on a non-pathogenic bacterium. Describe a method that the student could use, including the control variables and how the results should be processed.

A student placed discs soaked in three plant extracts and one disc soaked in solvent only on a bacterial lawn, then measured the clear zone around each disc. The table shows the mean diameter of each zone. Calculate the area of the clear zone for extract B and state which extract was the most effective.

Mean diameter of the clear zone of inhibition	
Disc	Mean diameter of clear zone (mm)
Extract A	14
Extract B	9
Extract C	6
Solvent only	0

Answer = ...

Suggest why chemicals from plants may be useful as new medicines.

Explain the importance of using a placebo and a double-blind design in a drug trial.

24 UNIT 2 STYLE

[5 marks]

William Withering used a herbal mixture to treat dropsy in the 18th century. Compare and contrast his approach with modern drug testing.

[illegible]

Classification and biodiversity Spec 4.14–4.18

25 UNIT 2 STYLE

[1 mark]

Which feature describes a cell of a bacterium rather than an archaeon?

- A. ☐ Cell wall containing peptidoglycan
- B. ☐ Ether-linked lipids in the membrane
- C. ☐ Linear DNA associated with histones
- D. ☐ 80S ribosomes

26 UNIT 2 STYLE

[3 marks]

State what is meant by the term species and give one reason why the species concept cannot be used to classify all organisms.

[illegible]

27 UNIT 2 STYLE

[4 marks]

Explain how new molecular evidence led to the three-domain system of classification and why the scientific community evaluates new data critically.

[illegible]

The table shows the number of individuals of each species found in a survey of a woodland. Use the formula $D = N(N - 1) \div \sum n(n - 1)$ to calculate the index of diversity. Show your working.

Number of individuals of each species	
Species	Number of individuals
A	20
B	10
C	5
D	3
E	1
F	1

Answer = ...

A pond has 8 species and a stream has 8 species. The index of diversity of the pond is 6.4 and of the stream is 2.1. Explain how the two habitats can have the same species richness but different indices of diversity.

Niche, allele frequency and conservation Spec 4.19–4.21

Which condition must be true for the Hardy-Weinberg equation to predict that allele frequencies stay the same?

- A. ☐ The population is small
- B. ☐ Mutations occur frequently
- C. ☐ There is no migration into or out of the population
- D. ☐ Individuals mate with others of the same genotype

[4 marks]

Answer = ...

[illegible]

[3 marks]

[illegible]

[4 marks]

[illegible]

37 UNIT 2 STYLE

[5 marks]

Describe how reproductive isolation can lead to the formation of new species.

38 UNIT 2 STYLE

[4 marks]

Define the term niche. Describe one behavioural and one anatomical adaptation of an organism to its environment.

39 UNIT 2 STYLE

[6 marks]

Evaluate the use of zoos and seed banks in the conservation of endangered species and their genetic diversity.

40 UNIT 2 STYLE

[3 marks]

Seeds stored in a seed bank are dried and then kept at -20°C . Suggest why.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B: amyloplast (stores starch, colourless, no thylakoids)

2. [4]

- similarity: both have a nucleus / cell surface membrane / mitochondria / ribosomes / RER / Golgi apparatus (any one)
- plant cell has a cellulose cell wall, animal cell does not
- plant cell has chloroplasts, animal cell does not
- plant cell has a large permanent vacuole (with a tonoplast), animal cell has none or small temporary vacuoles
- plant cell stores starch, animal cell stores glycogen
- Max 4. Do not accept a statement about one cell type only, as compare needs both.

3. [3]

- narrow channels / gaps that pass through the cell walls between adjacent cells
- lined with cell surface membrane and containing a strand of cytoplasm
- allow movement of substances / chemical signals / water between cytoplasm of neighbouring cells

4. [4]

- (a) chloroplast
- (b) double membrane / envelope
- (b) stacks of thylakoids / grana
- (b) starch grains (accept stroma as a feature)
- (c) site of photosynthesis
- Max 4. In (b) any two features, one mark each.

5. [4]

- cellulose is made of β -glucose and alternate glucose units are rotated through 180°
- this forms long, straight, unbranched chains
- many hydrogen bonds form between the -OH groups on adjacent chains
- each hydrogen bond is weak but there are very many, so together they are strong
- many chains bundled together form microfibrils, which are laid in layers / embedded in a matrix in the wall
- Max 4

6. [3]

- insoluble, so does not affect the water potential / does not move out of the cell by osmosis or diffusion
- compact (amylose coiled into a helix) so stores a lot of glucose in a small space
- amylopectin is branched, giving many ends where enzymes can hydrolyse it quickly to release α -glucose

7. [4]

- secondary thickening with cellulose microfibrils gives a strong, rigid wall that supports the plant / resists compression
- lignin is waterproof, so water cannot leak out of the vessel
- wall does not collapse inwards under tension / negative pressure from transpiration pull
- pits (thin areas of wall without thickening) allow water to move sideways into neighbouring cells
- Max 4

8. [3]

- fibres are sclerenchyma: long cells with thick lignified secondary walls
- cellulose microfibrils in layers / parallel to the length give high tensile strength, so the rope is difficult to break
- cells overlap / are long and narrow, so they can be twisted together and remain flexible

9. [1]

A A: xylem vessels are dead, lignified tubes; sieve tube elements are living (they lose their nucleus but are supported by companion cells)

10. [5]

- similarity: both are elongated cells / joined end to end forming tubes / found in vascular bundles / involved in transport (any one)
- xylem vessels are dead / sieve tube elements are living
- xylem has thick lignified walls; phloem walls are thin / not lignified
- xylem has no end walls between cells; sieve tubes have sieve plates (perforated end walls)
- xylem transports water and mineral ions; phloem transports organic solutes / sucrose / amino acids
- xylem transports upwards only / phloem transports in both directions; xylem also gives support (any one of these)
- Max 5. Differences must refer to both xylem vessels and sieve tubes; at least one similarity is needed for full marks.

11. [5]

- (a) use a sharp pencil / single clear continuous lines / no shading or colouring
- (a) draw the outline of the section and the boundaries between tissues
- (a) do not draw individual cells
- (a) draw large / in proportion / use most of the space available
- (a) labels drawn with ruled lines that do not cross, touching the structure
- (a) give a title / state the magnification or include a scale
- (a) Max 4
- (b) sclerenchyma fibres (do not accept xylem or phloem)

12. [3]

- magnification = size of image $\div$ size of real object (1)
- $84 \div 2.4$ (1)
- $\times 35$ (1); allow 35 without $\times$, but do not accept an answer with a unit

13. [3]

- magnesium ions are needed to make chlorophyll / are the central atom of chlorophyll
- less chlorophyll is made, so the leaves are yellow (chlorosis)
- so less light is absorbed, less photosynthesis, less growth

14. [4]

- renewable: crops can be regrown / not a finite resource unlike oil
- biodegradable / broken down by microorganisms, so less waste accumulates
- carbon dioxide absorbed in photosynthesis, so lower net carbon dioxide release / fewer fossil fuels used
- limitation: needs land / water / fertiliser, may compete with food crops or reduce biodiversity (any one)
- Max 4

15. [6]

- cut fibres of the same length from each plant / same age and moisture content
- measure the diameter at several points with a micrometer (or microscope and graticule) and calculate cross-sectional area (πr^2)
- clamp one end of the fibre and hang a mass holder from the other end
- add masses in equal increments until the fibre breaks
- record the total mass at which it breaks and convert to force (mass $\times$ 9.81)
- calculate tensile strength = breaking force $\div$ cross-sectional area
- repeat with several fibres of each plant and calculate a mean
- safety: soft box to catch masses / eye protection
- Max 6

16. [4]

- mean mass = 4.5 kg (1)
- force = $4.5 \times 9.81 = 44.1$ N (1)
- radius = 0.15 mm, so area = $\pi \times 0.15^2 = 0.0707$ mm² (1)
- $44.1 \div 0.0707 = 620$ N mm⁻² (1); accept 620 to 625; ecf from earlier steps; unit required; do not accept use of the diameter instead of the radius (about 156 N mm⁻²)

17. [1]

B B: flaming the neck of the bottle (sterilises the opening, prevents entry of microorganisms)

18. [3]

- nutrients / carbon source / nitrogen source / mineral ions
- suitable temperature
- oxygen (for aerobes) / correct oxygen level
- suitable pH
- water / moisture
- Max 3. Do not accept warmth, food or air without qualification.

19. [4]

- to prevent contamination of the culture by unwanted microorganisms
- so results are due only to the bacteria / extract being tested (valid results)
- to prevent the bacteria escaping into the environment
- to protect the person / prevent infection of the worker by pathogens
- Max 4

20. [6]

- make extracts using the same mass of plant and volume of solvent for each plant
- using aseptic technique spread a standard volume of bacterial culture over agar to form a lawn
- place sterile discs soaked in each extract for the same time on the lawn
- negative control: disc with solvent only (and positive control: antibiotic disc)
- tape the lid loosely, invert and incubate at 25 °C for a set time (for example 48 hours)
- measure the diameter of the clear zone of inhibition in two directions and take a mean
- calculate area (πr^2) and compare; repeat to calculate means
- control variables: type of bacteria, agar depth, disc size, temperature, time (any two for 1 mark)
- Max 6

21. [3]

- radius = $9 \div 2 = 4.5$ mm (1)
- area = $\pi \times 4.5^2 = 64$ mm² (accept 63.6) (1)
- extract A is most effective as it has the largest zone / area of inhibition (1)

22. [3]

- many plants make chemicals (to defend themselves) that kill or inhibit microorganisms
- plants have not been fully tested / many species have not been screened
- extracts can be purified, tested and developed into drugs (for example aspirin from willow, digitalis from foxglove)

23. [4]

- placebo allows for the placebo effect / patients improving because they believe they are being treated
- placebo group is a control to compare with the drug group
- in a double-blind trial neither patients nor researchers know who gets the drug
- prevents bias in assessment / patients' or researchers' expectations affecting the results
- patients are randomly allocated to groups so the groups are similar / differences are due to the drug
- Max 4

24. [5]

- Withering tested on patients, modern drugs are first tested in the laboratory / on cells and animals
- Withering had no control group / placebo; modern trials use a placebo or existing treatment as a control
- Withering's patients and doctor knew the treatment; modern trials are double-blind
- modern trials use three phases, starting with small groups of healthy volunteers to test safety (Phase 1)
- modern trials use large, randomly allocated groups of patients (Phase 3) so results are more reliable / less chance of bias
- both identify an effective dose / test whether the drug works (similarity)
- Max 5

25. [1]

A A: peptidoglycan cell wall (archaea have no peptidoglycan; eukaryotes have linear DNA with histones and 80S ribosomes)

26. [3]

- a group of organisms with similar characteristics / genes that can interbreed
- to produce fertile offspring
- reason: asexually reproducing organisms (such as bacteria) do not interbreed / fossils cannot be tested / hybrids can form between species (any one)

27. [4]

- comparisons of rRNA / DNA / protein sequences showed that prokaryotes contain two very different groups
- archaea differ from bacteria (for example membrane lipids / cell walls / RNA sequences) and are in some ways more like eukaryotes
- so the organisms were placed into three domains: Archaea, Bacteria and Eukarya
- new data are checked by other scientists / peer review / repeated by others
- to check that the methods and conclusions are valid before classification is changed
- Max 4

28. [3]

- biodiversity: the variety of living organisms / species
- in an area / habitat / on Earth (credit reference to species, genetic or habitat diversity)
- endemism: a species found in only one geographical location / region and nowhere else

29. [4]

- habitat destruction / deforestation / land cleared for agriculture, housing or roads, so species lose their habitats
- pollution damages organisms / habitats
- climate change, so organisms may no longer be adapted to their habitat
- overexploitation / overhunting / overfishing reduces populations
- introduced species outcompete or prey on native species
- Max 4. Each threat must be linked to an effect on species.

30. [3]

- total number of plants = $25 + 6 + 9 = 40$ (1)
- heterozygotes = 6 (1)
- $6 \div 40 = 0.15$ (1)

31. [4]

- $N = 20 + 10 + 5 + 3 + 1 + 1 = 40$ (1)
- $N(N - 1) = 40 \times 39 = 1560$ (1)
- $\Sigma n(n - 1) = 380 + 90 + 20 + 6 + 0 + 0 = 496$ (1)
- $D = 1560 \div 496 = 3.1$ (1); allow 3.15

32. [3]

- species richness counts only the number of species
- the index of diversity also takes into account the number of individuals of each species
- in the stream one species (or a few) probably dominates / individuals are not evenly spread among species, giving a lower D

33. [1]

C C: no migration (gene flow) in or out; must also be large, random mating, no mutation, no selection

34. [4]

- $q^2 = 1 \div 2500 = 0.0004$ (1)
- $q = 0.02$ (1)
- $p = 1 - 0.02 = 0.98$ (1)
- $2pq = 2 \times 0.98 \times 0.02 = 0.039$ / 0.0392 (1)

35. [3]

- calculate the expected genotype frequencies (p^2 , $2pq$, q^2) from the allele frequencies
- compare with observed genotype / allele frequencies in later generations
- a difference / change in frequency means allele frequency is changing (the population is evolving)

36. [4]

- mutation produced the resistance allele
- antibiotic is a selection pressure / kills non-resistant bacteria
- resistant bacteria survive and reproduce
- pass on the resistance allele to offspring, so the frequency of the allele increases in the population
- over many generations / bacteria divide rapidly, so the change happens quickly
- Max 4

37. [5]

- populations are separated / cannot interbreed (for example by a geographical barrier)
- no gene flow between the populations
- mutations occur independently, creating different alleles
- different environments give different selection pressures, so different alleles are selected
- allele frequencies / gene pools change and become increasingly different
- eventually the populations cannot interbreed to produce fertile offspring
- Max 5

38. [4]

- niche: the role of a species in its habitat / how it obtains resources and its interactions with other species
- behavioural: named behaviour (for example nocturnal activity, hibernation, migration) in a named organism
- anatomical: named structural feature (for example thick fur, rolled leaves with hairs) in a named organism
- link of one adaptation to survival (for example reducing heat loss or water loss)

39. [6]

- zoos: captive breeding programmes increase numbers of endangered animals
- zoos: managed breeding / exchanging animals between zoos maintains genetic diversity and avoids inbreeding
- zoos: reintroduction and research and education support wild conservation
- zoos: limitation: expensive, few individuals, small populations lose genetic diversity, animals may not adapt to the wild
- seed banks: cheap, small space, store many seeds from many species and alleles
- seed banks: limitation: some seeds cannot be stored, seeds lose viability, plants do not adapt to changing conditions
- reasoned conclusion: both are useful but habitat protection is also needed
- Max 6

40. [3]

- drying reduces water content so seeds do not germinate / metabolic reactions slow / fungi do not grow
- low water content prevents ice crystals forming that would damage cells
- low temperature slows respiration / metabolism / enzyme activity, so seeds remain viable for longer