

Cell Structure, Reproduction and Development practice questions

43 questions · 129 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 / 129

Cells, tissues and organelles **Spec 3.1-3.6**

1 UNIT 2 STYLE [1 mark]

Which organelle is the site of synthesis of ribosomal RNA?

- A. ☐ Golgi apparatus
- B. ☐ Nucleolus
- C. ☐ Rough endoplasmic reticulum
- D. ☐ Lysosome

2 UNIT 2 STYLE [1 mark]

Which statement correctly describes a prokaryotic cell?

- A. ☐ Linear DNA associated with histones and 80S ribosomes
- B. ☐ Circular DNA with no nuclear envelope and 70S ribosomes
- C. ☐ Circular DNA inside a nucleus and 70S ribosomes
- D. ☐ Linear DNA with no nuclear envelope and 80S ribosomes

3 UNIT 2 STYLE [3 marks]

State what is meant by the term tissue, and describe how tissues are organised into organs and organ systems.

4 UNIT 2 STYLE

[4 marks]

Describe the structure of a mitochondrion and explain how its structure is related to its function.

5 UNIT 2 STYLE

[5 marks]

Cells of the pancreas make digestive enzymes that are secreted from the cell. Describe the roles of the rough endoplasmic reticulum and the Golgi apparatus in the production and secretion of these enzymes.

6 UNIT 2 STYLE

[4 marks]

Bacteria that cause infections often have a capsule, a flagellum and plasmids. Explain how each of these structures helps the bacterium to survive or to spread an infection.

7 UNIT 2 STYLE [3 marks]

A student looked at an electron micrograph of a liver cell. She identified one structure as rough endoplasmic reticulum and another as a mitochondrion. State the features she would have seen to identify each organelle.

8 UNIT 2 STYLE [3 marks]

Lysosomes contain hydrolytic enzymes. Explain why the enzymes are enclosed within a membrane and describe one function of lysosomes.

Microscopy and measuring cells Spec 3.7, 3.8

9 UNIT 2 STYLE [1 mark]

Which statement explains why an electron microscope can resolve smaller structures than a light microscope?

- A. ☐ Electrons have a longer wavelength than light
- B. ☐ Electrons have a shorter wavelength than light
- C. ☐ Electron microscopes can view living specimens
- D. ☐ Electron microscopes use glass lenses of higher quality

10 UNIT 2 STYLE [1 mark]

An image of a cell is 45 mm long and the magnification is $\times 900$. What is the actual length of the cell?

- A. ☐ 5 μm
- B. ☐ 50 μm
- C. ☐ 0.5 mm
- D. ☐ 0.05 μm

11 UNIT 2 STYLE [2 marks]

State what is meant by the terms magnification and resolution.

12

[4 marks]

[illegible]

13

[3 marks]

Answer = ...

[illegible]

14

[3 marks]

[illegible]

15 UNIT 3 STYLE**[4 marks]**

A student wants to measure the length of cheek cells using an eyepiece graticule. Describe how she should calibrate the graticule and use it to find the mean length of the cells.

16 UNIT 3 STYLE**[3 marks]**

A student made a drawing of some stained animal cells seen through a light microscope. State three rules she should follow to make a good drawing.

17 UNIT 3 STYLE**[2 marks]**

The student used her own cheek cells. State two safety precautions she should take.

Chromosomes, meiosis and gametes

Spec 3.9-3.13

18 UNIT 2 STYLE**[1 mark]**

Which event in meiosis results in independent assortment of chromosomes?

- A. ☐ Crossing over in prophase I
- B. ☐ Random orientation of homologous pairs in metaphase I
- C. ☐ Separation of sister chromatids in anaphase II
- D. ☐ Replication of DNA before meiosis I

19 UNIT 2 STYLE**[1 mark]**

What is the function of the cortical reaction in fertilisation?

- A. ☐ To digest a path through the zona pellucida
- B. ☐ To fuse the nuclei of the sperm and egg
- C. ☐ To prevent more than one sperm entering the egg
- D. ☐ To provide energy for the movement of the sperm

Define the term locus. Explain why two genes on the same chromosome may not be inherited independently.

Explain how meiosis produces genetically different gametes.

The domestic cat has a haploid number of 19 chromosomes. Calculate the number of different combinations of chromosomes that can occur in the gametes of one cat because of independent assortment alone. Show your working.

Answer = ...

Describe how a mammalian sperm cell is adapted for its function.

24 UNIT 2 STYLE [5 marks]

Describe the events that take place from the time a sperm reaches the zona pellucida of an egg until a zygote forms.

25 UNIT 2 STYLE [4 marks]

Describe how fertilisation takes place in a flowering plant, from the arrival of a pollen grain at the stigma.

Mitosis and the cell cycle Spec 3.14–3.16

26 UNIT 2 STYLE [1 mark]

Which statement describes what happens during anaphase of mitosis?

- A. ☐ Chromosomes condense and the nuclear envelope breaks down
- B. ☐ Chromosomes line up on the equator of the cell
- C. ☐ Centromeres divide and sister chromatids move to opposite poles
- D. ☐ Nuclear envelopes re-form around the chromosomes

27 UNIT 2 STYLE [1 mark]

A student counted 200 cells in a root tip squash. 30 of the cells were in mitosis. What was the mitotic index?

- A. ☐ 0.15
- B. ☐ 0.17
- C. ☐ 6.7
- D. ☐ 0.85

[4 marks]

[illegible]

[3 marks]

[illegible]

[5 marks]

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[3 marks]

[illegible]

The table shows a student's counts of cells from one root tip squash. Calculate the mitotic index. Show your working.

Cells counted in several fields of view	
Stage	Number of cells
Prophase	18
Metaphase	9
Anaphase	6
Telophase	7
Interphase	280

Answer = ...

The mitotic index of region X of a root tip was 0.02 and of region Y was 0.18. Suggest what this shows and one way the student could make the results more reliable.

Stem cells, gene expression and phenotype

Spec 3.17-3.21

Which of the following is formed by the cleavage of a zygote into a solid ball of cells?

- A. ☐ Blastocyst
- B. ☐ Morula
- C. ☐ Inner cell mass
- D. ☐ Trophoblast

35 UNIT 2 STYLE

[1 mark]

Which statement about histone acetylation is correct?

- A. ☐ It makes the DNA wind more tightly and switches off the gene
- B. ☐ It loosens the DNA from the histones and allows the gene to be transcribed
- C. ☐ It changes the sequence of bases in the gene
- D. ☐ It removes the introns from the pre-mRNA

36 UNIT 2 STYLE

[3 marks]

Explain what is meant by the terms stem cell and pluripotent.

37 UNIT 2 STYLE

[6 marks]

Discuss the ways in which society uses scientific knowledge to make decisions about the use of embryonic stem cells in medical therapies.

38 UNIT 2 STYLE

[4 marks]

A pancreatic cell and a muscle cell from the same person contain the same genes. Explain how they become different in structure and function.

Explain how one gene can give rise to more than one protein.

Describe how epigenetic modification can alter the activation of genes and explain how the changes can be passed on to daughter cells.

Identical twins have the same genotype. Explain why they may have different phenotypes as adults.

A man with blood group A (genotype $I^A I^O$) and a woman with blood group AB have a child. Draw a genetic diagram and give the probability that the child has blood group B.

The table shows the heights of 100 students. Describe the pattern shown by the data, identify the modal class and explain what causes this type of variation.

Heights of 100 students	
Height range (cm)	Number of students
150 to 154	4
155 to 159	14
160 to 164	30
165 to 169	32
170 to 174	15
175 to 179	5

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 (nucleolus)

2. [1]

B B

3. [3]

- tissue is a group of similar (specialised) cells (1)
- working together to perform a particular function (1)
- an organ is made of different tissues working together (1)
- an organ system is a group of organs working together to carry out a major function (1)
- Max 3

4. [4]

- double membrane / outer and inner membrane (1)
- inner membrane folded into cristae (1)
- large surface area for the enzymes of the electron transport chain / ATP synthesis (1)
- matrix contains enzymes (for the Krebs cycle / link reaction) (1)
- site of aerobic respiration / produces ATP (1)
- Max 4

5. [5]

- ribosomes on rough ER synthesise the (enzyme) protein (1)
- protein enters the lumen of the rough ER and is folded (1)
- transport vesicles bud off the rER and carry the protein to the Golgi apparatus (1)
- Golgi apparatus modifies the protein (for example adds carbohydrate) (1)
- protein packaged into secretory vesicles (1)
- vesicles fuse with the cell surface membrane and release the enzyme by exocytosis (1)
- Max 5

6. [4]

- capsule protects the bacterium from the host's immune system / phagocytes / from drying out (1)
- capsule helps it stick to surfaces / host cells (1)
- flagellum allows it to move towards nutrients / the host (1)
- plasmid carries genes such as antibiotic resistance (1)
- plasmids can be passed to other bacteria, spreading resistance (1)
- Max 4

7. [3]

- rough ER: flattened sacs / cisternae (1)
- with black dots / ribosomes on the surface (1)
- mitochondrion: oval / rod-shaped with a double membrane (1)
- inner membrane folded into cristae (1)
- Max 3

8. [3]

- membrane keeps the enzymes separate from the cytoplasm (1)
- so that they do not digest / damage the cell's own contents (1)
- digest worn-out organelles / bacteria engulfed by phagocytosis / material taken in by the cell (1)
- Max 3

9. [1]

B B

10. [1]

B B ($45\text{ mm} = 45\,000\text{ }\mu\text{m}$; $45\,000 \div 900 = 50\text{ }\mu\text{m}$)

11. [2]

- magnification: how many times larger the image is than the real object / $\text{image size} \div \text{actual size}$ (1)
- resolution: the smallest distance between two points at which they can be seen as separate (1)

12. [4]

- TEM has a higher resolution / shows more detail (1)
- TEM uses electrons, which have a shorter wavelength than light (1)
- TEM can show ultrastructure / organelles such as ribosomes (1)
- light microscope can be used to view living cells, TEM only dead specimens (in a vacuum) (1)
- light microscope image is in colour (if stained), TEM is black and white (1)
- light microscope specimens are easier / quicker to prepare, TEM may produce artefacts (1)
- Max 4

13. [3]

- $40\text{ mm} = 40\,000\text{ }\mu\text{m}$ (1)
- $40\,000 \div 25\,000$ (1)
- $1.6\text{ }\mu\text{m}$ (1)
- correct answer with no working gains full marks; do not accept 1.6 mm or $0.0016\text{ }\mu\text{m}$

14. [3]

- most cell structures are transparent / have little contrast (1)
- stain binds to structures and absorbs light, making them visible / increases contrast (1)
- electron microscopes use electrons, not light, so stains must scatter / absorb electrons (1)
- heavy metal salts such as lead or uranium are used (1)
- Max 3

15. [4]

- use a stage micrometer of known scale (1)
- line up the graticule scale with the micrometer scale (1)
- count graticule divisions that match a known number of micrometer divisions (1)
- calculate the length of one graticule division (in μm) (1)
- calibrate separately for each objective lens (1)
- measure several cells in graticule divisions, multiply by the calibration value and calculate the mean (1)
- Max 4

16. [3]

- sharp pencil and clear, continuous lines (1)
- no shading or colouring (1)
- labels drawn with ruled lines that touch the structure (1)
- drawing large enough, including a title and magnification / scale bar (1)
- Max 3

17. [2]

- use only her own cells / do not share swabs (1)
- dispose of the swab / slide in disinfectant (1)
- wear eye protection / take care with glass (1)
- Max 2

18. [1]

B B

19. [1]

C C

20. [3]

- locus is the position / location of a gene on a chromosome (1)
- genes on the same chromosome are linked / on the same chromosome (1)
- the alleles are passed on together / stay on the same chromosome during meiosis (1)
- unless separated by crossing over (1)
- Max 3

21. [5]

- crossing over occurs in prophase I (1)
- between non-sister chromatids of homologous chromosomes / at chiasmata (1)
- exchanging alleles / sections of DNA, giving new combinations of alleles (1)
- in metaphase I homologous pairs line up at the equator (1)
- each pair orientated independently / randomly, so maternal and paternal chromosomes assort independently (1)
- giving different combinations of chromosomes in the gametes (1)
- Max 5

22. [2]

- $2^n / 2^{19}$ (1)
- 524 288 (1)
- correct answer with no working gains 2 marks

23. [4]

- flagellum / tail for swimming / movement (1)
- many mitochondria in the midpiece to produce ATP (1)
- acrosome contains hydrolytic enzymes to digest the zona pellucida (1)
- haploid nucleus carries the paternal genes (1)
- small size / streamlined (1)
- Max 4

24. [5]

- sperm binds to receptors on the zona pellucida (1)
- acrosome reaction: the acrosome releases enzymes (1)
- enzymes digest a path through the zona pellucida (1)
- sperm and egg cell surface membranes fuse and the sperm nucleus enters the egg (1)
- cortical reaction: cortical granules release enzymes, the zona pellucida hardens, preventing polyspermy (1)
- haploid nuclei fuse to form a diploid zygote (1)
- Max 5

25. [4]

- pollen grain germinates and a pollen tube grows down the style (1)
- tube is guided by chemicals from the ovule (1)
- tube enters the ovule through the micropyle (1)
- two male nuclei released from the tube (1)
- one male nucleus fuses with the egg nucleus to form the zygote (1)
- the other fuses with the polar nuclei to form the endosperm (nucleus) (1)
- Max 4

26. [1]

C C

27. [1]

A A ($30 \div 200 = 0.15$)

28. [4]

- cell grows / organelles and proteins made in G1 and G2 (1)
- DNA replicated in S phase (1)
- each chromosome then consists of two (sister) chromatids joined by a centromere (1)
- in prophase chromosomes condense / become visible (1)
- nuclear envelope breaks down / nucleolus disappears (1)
- centrioles move to the poles and spindle forms (1)
- Max 4

29. [3]

- DNA is replicated (semi-conservatively) in interphase, so the two sister chromatids are identical (1)
- sister chromatids are separated, so each daughter cell receives one copy of every chromosome / same number of chromosomes as the parent (1)
- any two uses from: growth / repair / replacement of cells / asexual reproduction (1)
- Max 3

30. [5]

- cut 2 to 3 mm from the end of the root tip (1)
- warm in (1 M) hydrochloric acid to separate / fix the cells (1)
- stain with acetic orcein / toluidine blue to show the chromosomes (1)
- squash under a coverslip to make a layer one cell thick, so that light passes through (1)
- do not slide the coverslip, to avoid damaging / smearing the cells (1)
- root tip used because it has meristem cells that divide (1)
- Max 5

31. [3]

- hydrochloric acid is an irritant / corrosive (1)
- wear eye protection and rinse spills with water (1)
- hot water bath can scald (1)
- use a thermostatically controlled bath, keep it away from the edge of the bench (1)
- scalpel sharp (1)
- cut on a hard surface away from the body (1)
- Max 3

32. [3]

- total cells in mitosis = $18 + 9 + 6 + 7 = 40$ (1)
- total cells = $40 + 280 = 320$ (1)
- mitotic index = $40 \div 320 = 0.125$ / 12.5% (1)
- accept 0.13 / 13%; do not accept $40 \div 280 = 0.14$

33. [3]

- Y has a higher proportion of cells dividing / is the meristem (1)
- X is a region where cells are elongating / not dividing (1)
- count more cells / more fields of view / more root tips (1)
- Max 3

34. [1]

B B

35. [1]

B B

36. [3]

- stem cell: an undifferentiated cell (1)
- that can divide by mitosis / self-renew and differentiate into specialised cells (1)
- pluripotent: can differentiate into almost any / many types of cell in the body, but not extra-embryonic (placental) cells (1)
- Max 3

37. [6]

- scientists provide evidence about the potential benefits, for example treating diseases such as diabetes / spinal injury (1)
- and about the risks, for example tumour formation / rejection (1)
- ethical objections: embryo destroyed / embryo has the right to life (1)
- religious / moral views differ (1)
- spare IVF embryos would be destroyed anyway (1)
- laws / regulatory bodies license and control the research (1)
- decisions use the evidence together with public opinion / ethics committees (1)
- alternatives such as adult stem cells may avoid the ethical issue (1)
- Max 6

38. [4]

- different genes are expressed / switched on in each cell (1)
- only these genes are transcribed to produce (active) mRNA (1)
- mRNA is translated into different proteins (1)
- proteins act as enzymes that control cell processes / determine the cell's structure (1)
- for example the pancreatic cell expresses the insulin gene, the muscle cell expresses the actin and myosin genes (1)
- Max 4

39. [4]

- gene is transcribed to give pre-mRNA containing introns and exons (1)
- introns are removed and exons joined (splicing) (1)
- post-transcriptional change / happens before translation (1)
- exons can be joined in different combinations / some exons left out (alternative splicing) (1)
- different mature mRNAs are made and translated into different proteins (1)
- Max 4

40. [5]

- DNA methylation: methyl groups added to cytosine bases (1)
- this prevents transcription / switches the gene off (1)
- histone modification: acetylation loosens the DNA so the gene can be transcribed (1)
- deacetylation / (some) histone methylation makes the DNA more tightly wound so the gene is not transcribed (1)
- the DNA base sequence is not changed (1)
- methylation pattern copied on to the new DNA after replication, so passed on to daughter cells (1)
- Max 5

41. [2]

- phenotype is the result of the interaction of genotype and the environment (1)
- different diets / lifestyles / environments affect gene expression, for example by epigenetic changes (1)

42. [4]

- gametes of man: I^A and I^O (1)
- gametes of woman: I^A and I^B (1)
- offspring genotypes $I^A I^A$, $I^A I^B$, $I^A I^O$, $I^B I^O$ (1)
- probability of group B ($I^B I^O$) = $\frac{1}{4}$ / 25% (1)

43. [4]

- bell-shaped / normal distribution, with most students near the middle and fewer at the extremes (1)
- modal class is 165 to 169 cm (1)
- continuous variation caused by many genes (polygenic), each with a small additive effect (1)
- plus environmental effects such as diet / nutrition (1)
- a range of heights with no distinct categories / heights are measured, not counted (1)
- Max 4