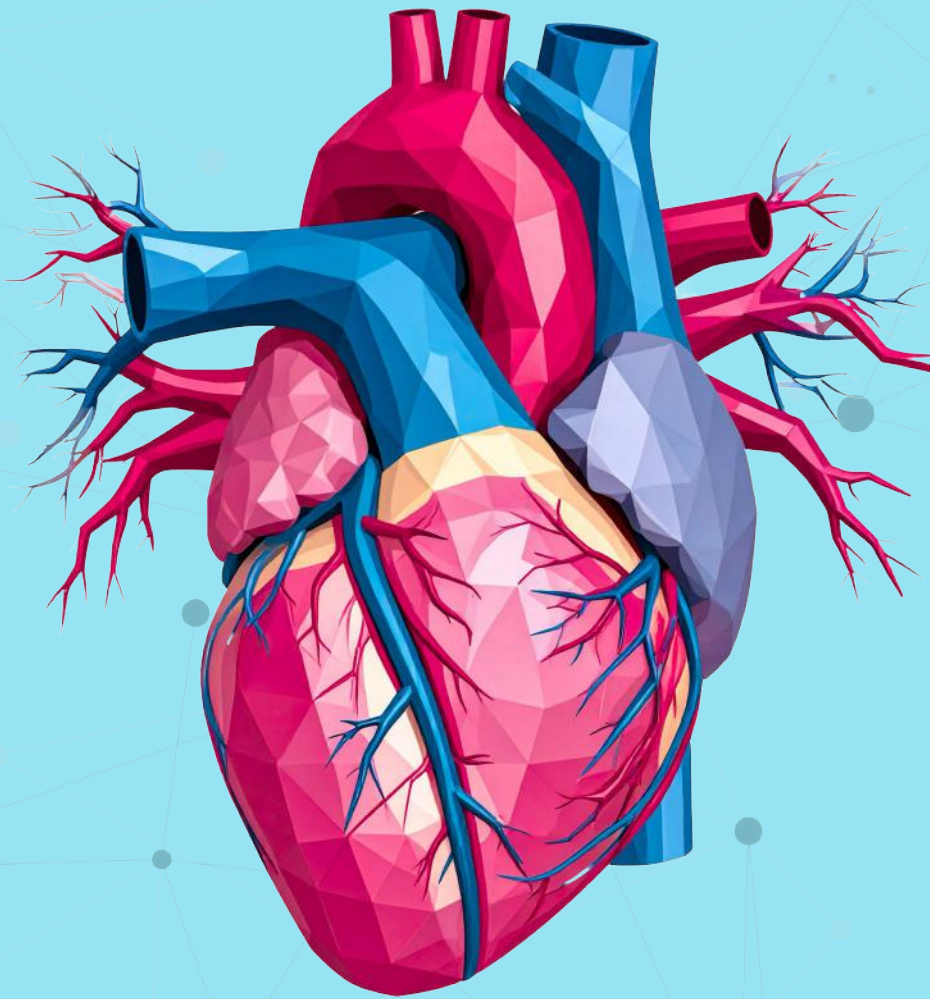


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Edexcel IAL Biology

Unit 2 (WBI12/01) · Questions & Answers by Topic

Past-paper questions classified by topic · [click a chapter to jump](#)

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Edexcel IAL Biology - Solved Past Paper

January 2026 · Unit 2: Cells, Development, Biodiversity and Conservation (WBI12/01)

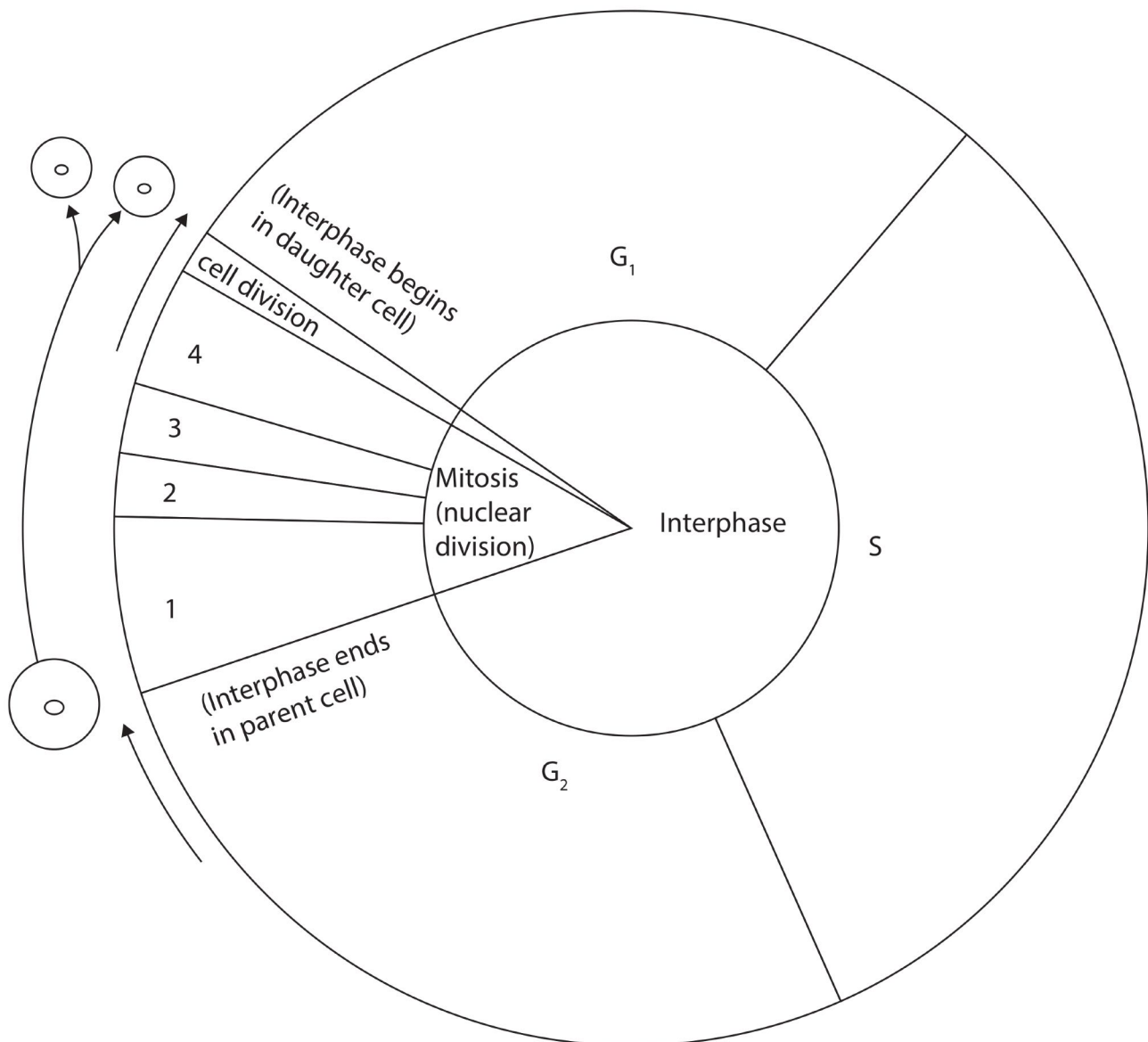
Question 7 · The cell cycle, DNA methylation & cancer

● hard ● medium ● easy

● 7 (a)(i)

State · [1 mark]

DNA methylation and DNA replication occur in interphase. State one OTHER process that occurs in the NUCLEUS during interphase.



Model answer

✓ **Transcription** (the formation of mRNA).

Mark scheme 1 mark

✓ Transcription / formation of mRNA (1)

Accept: histone modification / post-transcriptional modification

Examiner's insight

DNA replication was already given, so it didn't count - and it must be a NUCLEAR process, so organelle replication and cell growth were wrong. Transcription is the safe answer.

● **7 (a)(ii)**

Compare and contrast · [3 marks]

Compare and contrast the metaphase and the beginning of telophase stages of mitosis.

Model answer

- ✓ **Similarity:** in both, the chromosomes are condensed and there is no nuclear envelope, and spindle fibres are present. ✓ **Difference:** in metaphase the chromosomes are at the centre (equator) of the cell, whereas at the beginning of telophase they are at the poles. ✓ **Difference:** the spindle fibres are attached to the centromeres in metaphase, whereas they are beginning to break down at the start of telophase (and the nuclear envelope begins to reform).

Mark scheme

Three of the following (must include both a similarity and a difference; max 2 of each):

- ✓ Similarity: both have condensed chromosomes (1)
 - ✓ Similarity: both have no nucleus / nuclear envelope (1)
 - ✓ Similarity: both have spindle fibres (1)
 - ✓ Difference: spindle fibres attached in metaphase vs breaking down at start of telophase (1)
 - ✓ Difference: chromosomes at the equator in metaphase vs at the poles in telophase (1)
 - ✓ Difference: chromosomes condensed in metaphase vs beginning to uncondense in telophase (1)
 - ✓ Difference: no nuclear envelope in metaphase vs reforming at start of telophase (1)
- Accept:** chromatin/chromatids for chromosomes; cleavage furrow forming at start of telophase but not metaphase

Examiner's insight

Make COMPARATIVE statements (both... whereas...) and include at least one similarity and one difference. Separate paragraphs on each stage don't score for this command word.

● **7 (b)**

Explain · [3 marks]

Methylation of DNA can inhibit the production of mRNA. Explain how DNA methylation could inhibit the production of mRNA.

Model answer

- ✓ Methyltransferase adds methyl (-CH₃) groups to the cytosine bases (at CpG sites) of the DNA. ✓ This makes the DNA coil more tightly around the histones, forming heterochromatin. ✓ So RNA polymerase / **transcription** factors cannot bind to the promoter region, and no mRNA is produced.

Mark scheme

3 marks

- ✓ Methyl / -CH₃ groups added to cytosine / CpG by methyltransferase (1)
- ✓ Heterochromatin formed / DNA coiled more tightly around histones (1)
- ✓ Prevents RNA polymerase / transcription factors binding to the promoter region (1)

Do not accept: methylation of histone / lysine / cysteine

Ignore: 'DNA' unqualified; 'transcription' (the question already says mRNA production)

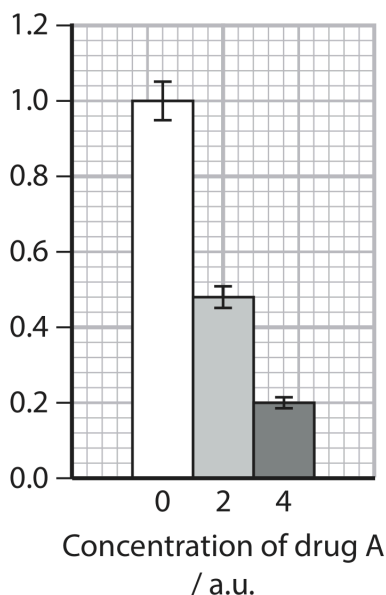
Examiner's insight

The methyl group goes on CYTOSINE (not histones here). Then take it to heterochromatin and RNA polymerase being unable to bind the promoter.

7 (c)

Explain · [6 marks]

*Drug A inhibits methyltransferase (see the graph). DNA methylation of a tumour suppressor gene (TSG) inhibits its mRNA, and active TSG proteins inhibit DNA replication and prevent spindle-fibre formation. Explain how drug A can prevent the growth of tumours. Use all of Question 7 and your own knowledge.



Model answer

✓ The graph shows that as the concentration of drug A increases, the activity of methyltransferase decreases (the differences being significant where the error bars do not overlap). ✓ With less methyltransferase activity, fewer methyl groups are added to the cytosine of the tumour suppressor gene. ✓ So the TSG's DNA stays as euchromatin, RNA polymerase can bind, and the gene is transcribed and translated – the TSG remains active. ✓ The TSG proteins then inhibit DNA replication and prevent spindle fibres forming, so **mitosis** and cell division are blocked. ✓ Therefore the cancer cells cannot keep dividing rapidly, so the tumour cannot grow.

Mark scheme

Levels question (6 marks) · indicative content:

Data

CELLS & PROTEIN TRAFFICKING

7 Suggest why neither meiosis nor mitosis take place in prokaryotic organisms.

(2)

because they do not have a nucleus

and because they do not have linear chromosomes

meiosis in particular doesn't happen because they don't produce gametes

(d) The table below shows some features of prokaryotic cells and eukaryotic cells.

For each feature, put **one** cross ☒ in the appropriate box, in each row, to show whether the feature is found in prokaryotic cells and eukaryotic cells, prokaryotic cells only, eukaryotic cells only or not found in either.

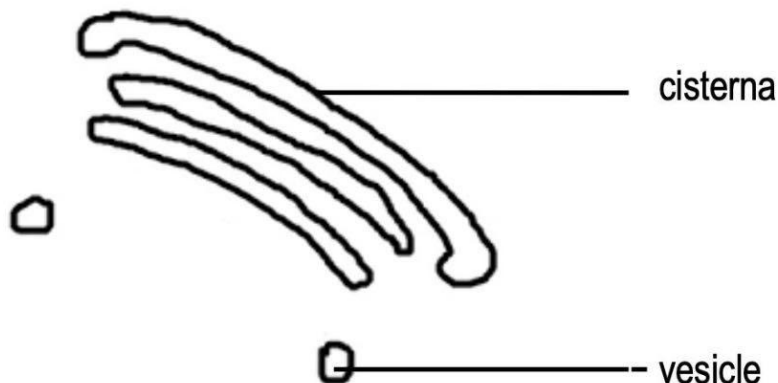
(2)

Feature	Prokaryotic cells and eukaryotic cells	Prokaryotic cells only	Eukaryotic cells only	Not found in either prokaryotic cells or eukaryotic cells
cell membrane	☒	☐	☐	☐
ribosomes	☒	☐	☐	☐

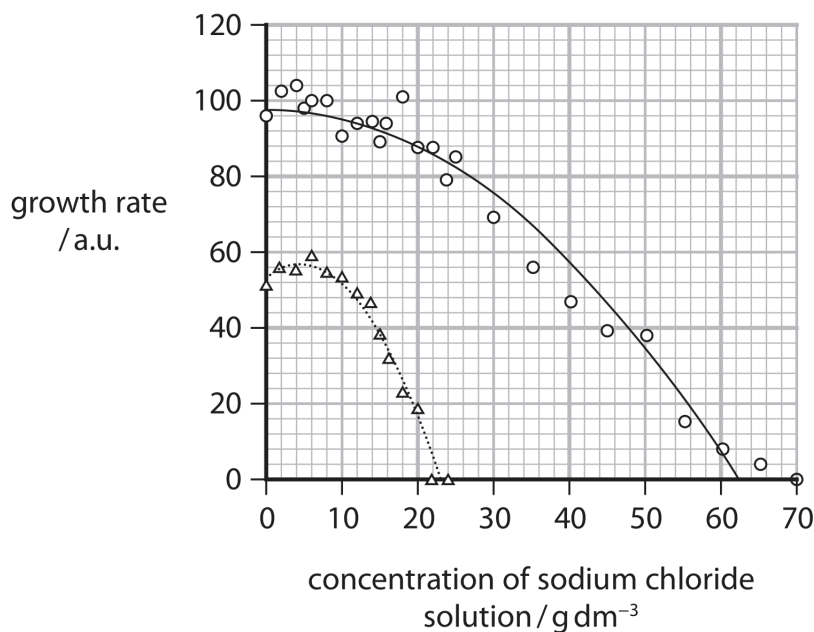
(e) The Golgi apparatus is found in eukaryotic cells only.

In the space below, draw and label a diagram to show the structure of the Golgi apparatus.

(3)



(Total for Question 7 = 10 marks)

**Model answer**

- ✓ For both bacteria, increasing the sodium chloride concentration above about 10 g dm⁻³ decreases the growth rate (a negative correlation). ✓ Between 0 and about 6 g dm⁻³ there is an initial increase (or roughly constant) growth rate. ✓ B. thermosphacta has a higher growth rate than L. piscium at all concentrations, and L. piscium's rate falls more steeply.
- ✓ B. thermosphacta tolerates higher salt - it keeps growing at concentrations above ~22-25 g dm⁻³ where L. piscium has already stopped.

Mark scheme Four of the following:

- ✓ Increasing salt (above 10 g dm⁻³) decreases the growth rate of both (1)
- ✓ Initial increase / constant rate between 0-6 g dm⁻³ (1)
- ✓ More rapid decrease in L. piscium growth rate / B. thermosphacta higher growth rate throughout (1)
- ✓ B. thermosphacta continues growing at higher salt than L. piscium (more tolerant) (1)
- ✓ Data more scattered about the line of best fit for B. thermosphacta (1)

Accept: negative correlation

Accept: B. thermosphacta more tolerant/resistant of higher salt

Examiner's insight

State the effect CLEARLY (salt decreases growth in both); the initial rise and the degree of scatter were rarely spotted.

Revise from your notes

- Prokaryotes: The prokaryotic cell · Growth conditions for bacterial growth

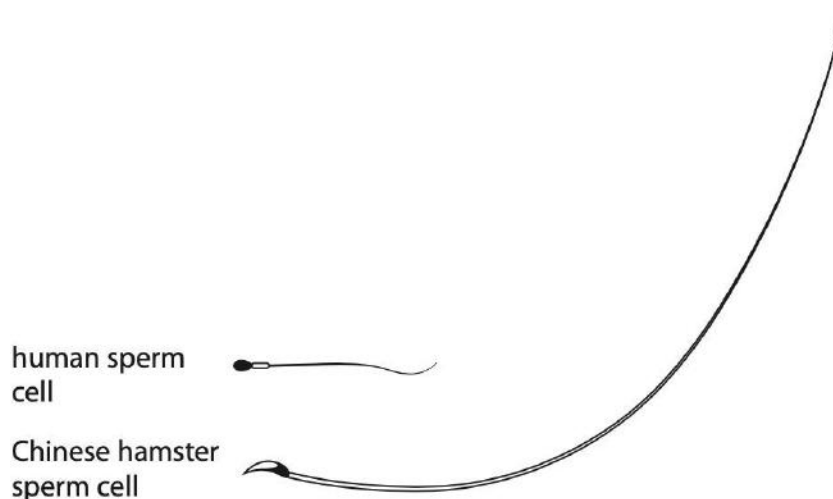
MEIOSIS & FERTILISATION

(b) The photograph shows a Chinese hamster.



A female Chinese hamster **mates with many males** in a short period of time.

The diagram shows the relative size of a Chinese hamster sperm cell compared with a human sperm cell.



Suggest why the Chinese hamster sperm cell has such a long flagellum.

(3)

the sperm with longer flagellum will swim faster to the egg cell

this will ensure that the sperm will compete with sperms from other males

so there is an increased chance of fertilising the egg cell

(c) Explain the role of the cortical reaction in the process of fertilisation in mammals.

(3)

cortical granules fuse with the egg cell surface membrane and release enzymes

this makes the zona pellucida hardens to prevent polyspermy

/ to ensure that the nucleus is diploid

(Total for Question 2 = 11 marks)

✓ Preventing self-fertilisation (date palm, orchid) forces cross-fertilisation, increasing the **genetic diversity** of the offspring and reducing inbreeding – so the **population** is less likely to be wiped out by a new selection pressure or environmental change. ✓ But it reduces the chance of fertilisation: separate male and female date palms (or a lack of nearby plants of the same **species**, or of pollinators) can mean no pollination, so no seeds – risking extinction. ✓ The fireweed's backup self-fertilisation guarantees seed production even when no cross-pollination has occurred, reducing the **risk** of extinction and helping maintain the **population**. ✓ The dandelion's unfertilised egg cells developing into seeds guarantees reproduction without any pollen, and (unlike simple cloning) these seeds are not necessarily genetically identical. ✓ However, self-fertilisation and this asexual seed production lower **genetic diversity**, so those populations are more vulnerable if the environment changes.

Mark scheme Indicative content (levels-marked, 6 marks):

Prevent self-fertilisation

- ✓ Preventing self-fertilisation -> increased genetic diversity / reduced inbreeding -> population more likely to survive a new selection pressure
- ✓ But reduced chance of pollination / fertilisation (need both sexes / nearby plants / pollinators) -> no seeds -> risk of extinction

Backup fertilisation

- ✓ Fireweed self-fertilises as a backup -> guaranteed seed production even without cross-pollination -> reduced risk of extinction
- ✓ Dandelion egg cells develop into seeds -> guaranteed reproduction without pollen (and not necessarily genetically identical)
- ✓ But self-/asexual reproduction lowers genetic diversity -> more vulnerable to environmental change

How to reach full marks

Discuss ALL the strategies (both those preventing self-fertilisation AND those producing seeds without cross-fertilisation), each with an advantage AND a disadvantage in terms of genetic diversity vs guaranteed reproduction, for level 3.

Examiner's insight

Structure the answer around the four plants and make clear which you mean; the weakest area was the disadvantages of PREVENTING self-fertilisation (fewer chances of pollination).

Revise from your notes

- Meiosis & reproduction: Main events of meiosis · Crossing over · Independent assortment · Gametes of flowering plants
-

MEIOSIS & FERTILISATION

- 12 The photograph below shows a human sperm cell fusing with a human female gamete.



Magnification $\times 2000$

- (a) The diameter of a human female gamete is about 30 times bigger than the length of the head of a human sperm cell.

- (i) Measure the length of the head of the sperm in the photograph.

(1)

Answer **range of 9-10 mm**

- (ii) Use your measurement to calculate the actual diameter of the female gamete. Show your working.

(2)

$$10 / 2000 \times 30 = 0.15 \text{ mm}$$

Answer

- (b) Give **two** differences, other than size, between the structure of a sperm cell and the structure of a female gamete.

(2)

1... **Only the sperm has a flagellum**.....

..... **sperm has an acrosome**.....

..... **no cortical granules in a sperm**.....

2... **no food store in a sperm**.....

..... **no zona pellucida in a sperm**.....

4. GENE EXPRESSION & STEM CELLS

4 Type 1 diabetes occurs when beta cells in the pancreas do not produce insulin.

Stem cells produced from skin cells can be used to replace these beta cells in mice. The skin cells can be stimulated to become pluripotent stem cells.

- (i) Place a cross ☒ in the box next to the correct definition to complete the following statement.

Pluripotent stem cells are

(1)

- ☒ **A** specialised cells that can differentiate to give rise to almost any type of cell in the body, including totipotent cells
- ☒ **B** specialised cells that can differentiate to give rise to any type of cell in the body, excluding totipotent cells
- ☒ **C** unspecialised cells that can differentiate to give rise to almost any type of cell in the body, excluding totipotent cells
- ☒ **D** unspecialised cells that can differentiate to give rise to any type of cell in the body, including totipotent cells

The table below shows some features of two types of stem cell. If the feature applies to the stem cell place a tick (✓) in the box and if it does not apply, place a cross (✗) in the box.

(2)

Features	Totipotent stem cell	Pluripotent stem cell
Can give rise to totipotent stem cells	✓	
Can give rise to differentiated cells	✓	✓

- (ii) The pluripotent stem cells were injected into the mice. After eight weeks, these cells had developed into insulin-secreting beta cells.

Describe how these pluripotent stem cells became specialised beta cells.

(4)

1. Chemical stimulus

2. causes some genes are to be activated (switched on)

3. Activated genes get transcribed (mRNA produced)

4. mRNA is gets translated to produce protein

5. this protein permanently modifies cell and determines cell structure and function

(Total for Question 4 = 7 marks)

4. GENE EXPRESSION & STEM CELLS

*(b) Using the information in the diagram and the table, explain how the four different cell types are formed from the stem cells.

(6)

Mitosis increases the number of cells

Under a certain chemical stimulus differential gene expression takes place

The gene for the production of insulin is switched on in pancreatic cells

While the same gene is switched off in nerve cells or heart cell for instance

Once the gene is switched on transcription of it occurs and mRNA is made

Proteins are produced from the mRNA by translation

These proteins permanently modify the cell

/ as they determine the structure and function of the cell

(c) Discuss how regulatory authorities control the use of embryonic stem cells in research.

(3)

These authorities will issue license for stem cell research

They'll monitor the research and ensure that it's done for necessary reasons

They will monitor the sources of stem cells

And they will ensure that only early-stage embryo are used as the stem cells source

They will also prevent any an ethical use of stem cells

(Total for Question 7 = 11 marks)

Mark scheme 4 marks

- ✓ Differential gene expression (1)
- ✓ By epigenetic modification / histone modification / DNA methylation (1)
- ✓ Proteins / enzymes synthesised (from active genes) that permanently modify the cell (1)
- ✓ Description of the modification to become a sclerenchyma cell (e.g. synthesis of lignin / secondary thickening) (1)

Accept: only some genes are switched on / others switched off

Examiner's insight

Don't just define totipotent/pluripotent - go through differential gene expression and epigenetic modification, THEN apply it: lignification / secondary thickening makes a sclerenchyma cell.

● **7 (c)**

Comment on · [4 marks]

Flower colour and pollen grain length genes are on chromosome 1; the pea pod shape gene is on chromosome 4. Comment on the role of meiosis in the inheritance of these traits.

Model answer

✓ Meiosis increases **genetic variation** through **crossing over** and independent (random) assortment (and produces **haploid** gametes). ✓ The genes for flower colour and pollen grain length are on the same chromosome (1), so they are linked. ✓ So their alleles tend to be inherited together and are unlikely to be separated by **crossing over**. ✓ The gene for pea pod shape is on a different chromosome (4), so it is inherited independently of the others by **independent assortment**.

Mark scheme Four of the following:

- ✓ Meiosis increases genetic variation / crossing over and independent assortment occur (1)
- ✓ The genes for colour and grain length are linked (same chromosome) (1)
- ✓ So their alleles are inherited together / unlikely to be separated by crossing over (1)
- ✓ The pea-pod-shape gene is not linked to the others (1)
- ✓ So it is inherited independently by independent assortment (1)

Accept: linkage is when genes are close together on the same chromosome

Examiner's insight

Link the diagram to the answer - colour and grain length are LINKED (chromosome 1) so inherited together; pod shape (chromosome 4) assorts independently.

Revise from your notes

- Development & linkage: Double fertilisation in flowering plants · Different types of stem cells
- Cell differentiation · Crossing over · Independent assortment

5. VARIATION

- 6 Crohn's disease is an irritable bowel disease (IBD). It is a medical condition that affects the digestive system.

Approximately 15% of people with Crohn's disease have a close relative who also has this disease.

If one identical twin has Crohn's disease, there is a 70% probability that the other twin will also have this disease.

- (a) Explain how this information demonstrates that the causes of Crohn's disease are only partially genetic.

(3)

The percentage would be higher if only genetic

And if it was only genetic then an identical twin would have 100% probability of having Crohn's if their twin had it

85% of people with Crohn's do not have a relative with the disease

Environmental factors must influence the development of the disease

- (b) In some people, several genes at different locations in the genome contribute to Crohn's disease.

Put a cross ☒ in the box next to the correct word to complete each of the following statements.

- (i) The term that refers to the pattern of inheritance where a single characteristic is determined by more than one gene is

(1)

- ☐ A monogenic
☐ B monohybrid
☒ C polygenic
☐ D polyhybrid

6 NATURAL SELECTION

10 Sloths are mammals that live **high up in trees** and eat leaves. The photograph below shows a pygmy three-toed sloth.



www.ourendangeredworld.com

Magnification $\times 0.2$

These sloths live on a small island off the coast of Panama. Other species of sloth, including the brown-throated sloth, are found on the mainland.

(a) Using the sloth as an example, explain what is meant by the term **niche**.

(2)

the role of an organism in its habitat

sloths are herbivores / they provide food for carnivores

(b) Pygmy three-toed sloths range from 48 cm to 53 cm in length.

Brown-throated sloths are 15% longer than pygmy sloths.

Calculate the range in length of brown-throated sloths.

Show your working.

(2)

$$48 \times 15 \div 100 + 48 = 55.2$$

$$53 \times 15 \div 100 + 53 = 60.95$$

55.2 - 60.95 cm

CELLS & PROTEIN TRAFFICKING

(v) The organelles that are surrounded by double membranes are

(1)

- ☒ A chloroplasts, lysosomes and nuclei
- ☒ B chloroplasts, mitochondria and nuclei
- ☒ C lysosomes, mitochondria and nuclei
- ☒ D mitochondria, nuclei and vacuoles

(b) Compare the **structure** of the rough endoplasmic reticulum with the structure of the smooth endoplasmic reticulum.

(2)

Both consist of membrane bound sacs called cisternae
in both organelles, the cisternae are interconnected
rER has 80s ribosomes while sER does not

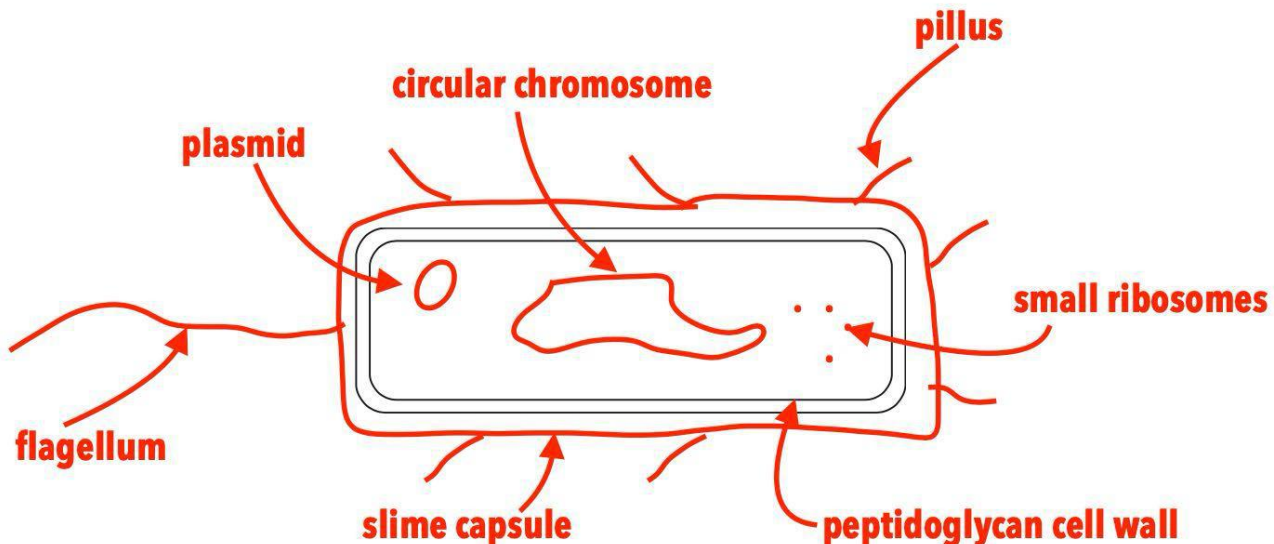
(c) Organisms can be classified into one of three taxonomic groups called domains.

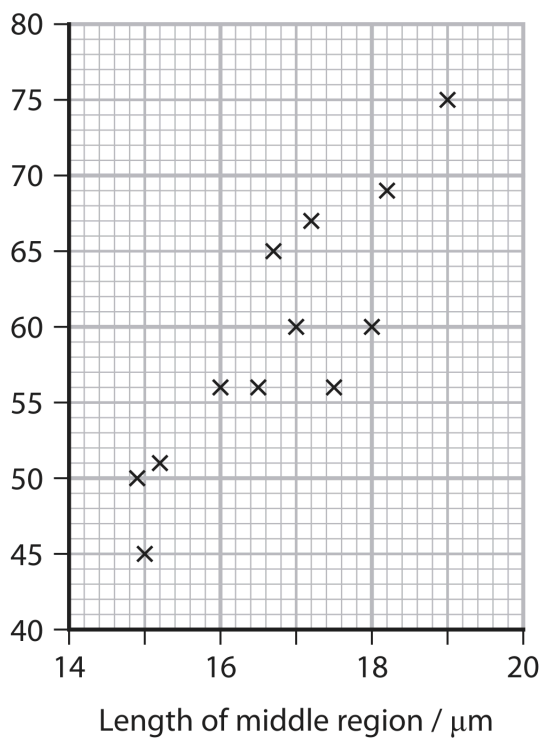
The Archaea and Bacteria are two of these domains. Organisms belonging to these two domains have prokaryotic cells.

(a) The diagram below shows the outline of a typical rod-shaped bacterial cell.

Draw and label **three** features on this diagram that may be found in a prokaryotic cell, but **not** in a plant cell.

(3)



**Model answer**

✓ A longer sperm middle region increases swimming speed, because it holds more **mitochondria** supplying more **ATP** to move the flagellum - increasing that male's chance of fertilising the eggs first (reproductive success). ✓ This is a selection pressure favouring males with alleles for longer mid-sections; but many offspring then share the same father, which could reduce genetic diversity (though many males fertilising many eggs could raise it). ✓ The spermatophore provides sperm plus **nutrients** the female uses to make more or better eggs, and its chemicals reduce her attractiveness to other males - raising that male's reproductive success but lowering the offspring's genetic diversity. ✓ Storing sperm lets the female produce fertilised eggs even in years she doesn't mate, giving reproductive success for her and the earlier males. ✓ Because she mates with numerous males, the stored sperm come from different fathers, so the offspring inherit different alleles - increasing genetic diversity (though not mating with new males each year could reduce it).

Mark scheme Indicative content (levels-marked, 6 marks):**Longer middle region**

- ✓ Longer mid region -> faster swimming (more mitochondria -> more ATP for the flagellum) -> reaches / fertilises eggs first
- ✓ Selection pressure for longer-mid alleles; more offspring share one father -> possible reduced genetic diversity (or many males / eggs -> increased)

Spermatophore

- ✓ Spermatophore gives sperm + nutrients (more / better eggs); chemicals deter other males -> male reproductive success; offspring share a father -> reduced diversity

Sperm storage

- ✓ Stored sperm -> fertilised eggs laid without mating that year -> reproductive success for the female and earlier males
- ✓ Sperm from many different males -> offspring inherit different alleles -> increased genetic diversity (not mating yearly could reduce it)

How to reach full marks

Cover all three strategies and, for each, address BOTH reproductive success (of males and females) AND the effect on the offspring's genetic diversity - using the graph for the swimming-speed point.

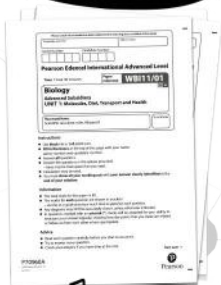
Revise from your notes

- Fertilisation & selection: Fertilisation in mammals · The mammalian gametes · Natural selection
-

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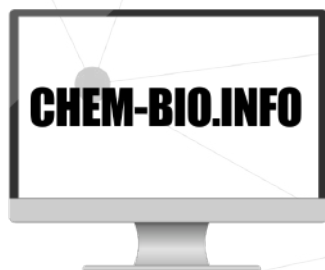


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