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**HERITAGE COLLEGE**  
A CHRISTADELPHIAN SCHOOL  
*ADELAIDE, AUSTRALIA*

STAGE 2 BIOLOGY  
FORMATIVE SACE TEST  
**TOPIC: CELLS (2.1 – 2.6)**

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NAME \_\_\_\_\_

DATE \_\_\_\_\_

## Stage 2 Biology

## Cells as the Basis of Life – Formative Test

Specific features		Grade	Comments
KA1	<i>Demonstration of knowledge and understanding of biological concepts</i>		
KA2	<i>Application of biological concepts in new and familiar contexts</i>		
KA3	<i>Exploration and understanding of the interaction between science and society</i>		
KA4	<i>Communication of knowledge and understanding of biological concepts and information using appropriate terms conventions and representations</i>		



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STAGE 2 BIOLOGY  
FORMATIVE SACE TEST

**TOPIC: CELLS AS THE BASIS OF LIFE**

**Multiple Choice Answer Sheet**

1. Show your answer to each question by drawing a bubble over the correct answer like this:



2. No marks can be awarded for a question that has more than one answer. If you change your mind, ensure that your final choice of answer is perfectly clear by crossing out your previous choice like this:

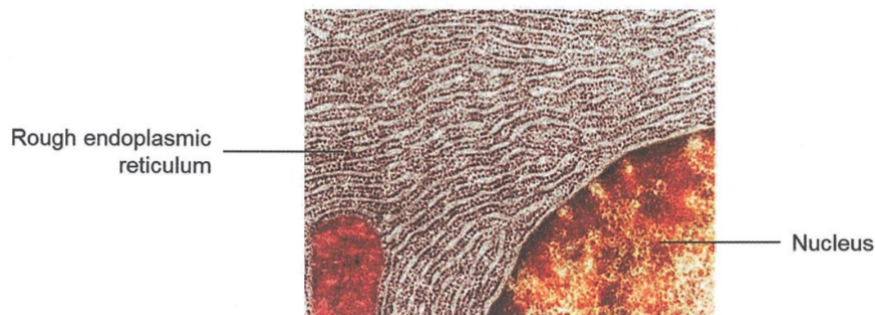


<b>1</b>	J	K	L	M	<b>8</b>	J	K	L	M
<b>2</b>	J	K	L	M	<b>9</b>	J	K	L	M
<b>3</b>	J	K	L	M	<b>10</b>	J	K	L	M
<b>4</b>	J	K	L	M					
<b>5</b>	J	K	L	M					
<b>6</b>	J	K	L	M					
<b>7</b>	J	K	L	M					



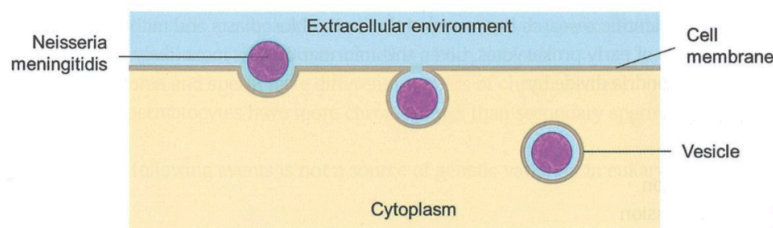
**Section A: Multiple-Choice Questions**

1. The diagram below shows the nucleus and rough endoplasmic reticulum in a eukaryotic cell.



The small dots on the membrane of the rough endoplasmic reticulum are:

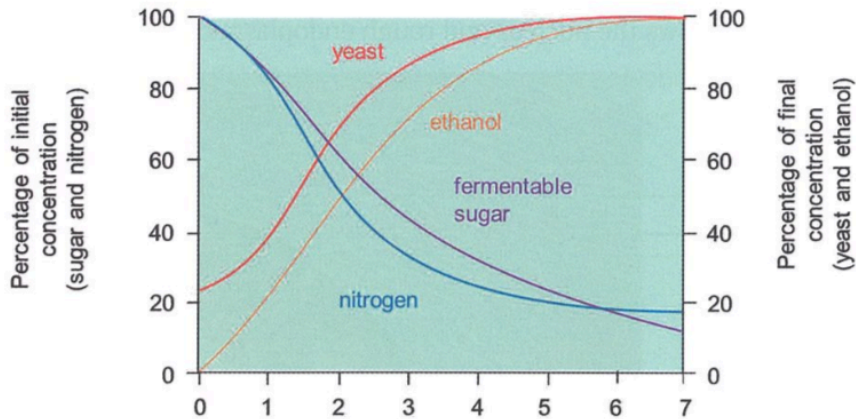
- J Vesicles
  - K Vacuoles
  - L Ribosomes
  - M Lysosomes
2. *Neisseria meningitidis* is a pathogenic bacterium that causes bacterial meningitis. Meningitis causes inflammation of the tissue in both the brain and spinal cord. The process by which *Neisseria meningitidis* enters a cell is illustrated in the diagram below.



The process shown in the diagram is:

- J simple diffusion
- K exocytosis
- L endocytosis
- M facilitated diffusion

3. The graph shows changes in the concentration of some important materials during the industrial production of ethanol by yeast.



The population of yeast becomes constant after 5 days.

The most likely reason for this is:

- J** A high concentration of ethanol inhibits growth in yeast.
  - K** The amount of fermentable sugar is too low for respiration to continue.
  - L** Increased competition for nutrients between yeast cells.
  - M** All of the above.
4. Chloroplasts and mitochondria are organelles in eukaryotic cells. Chloroplasts and mitochondria contain a circular DNA molecule with between 30 and 100 genes.

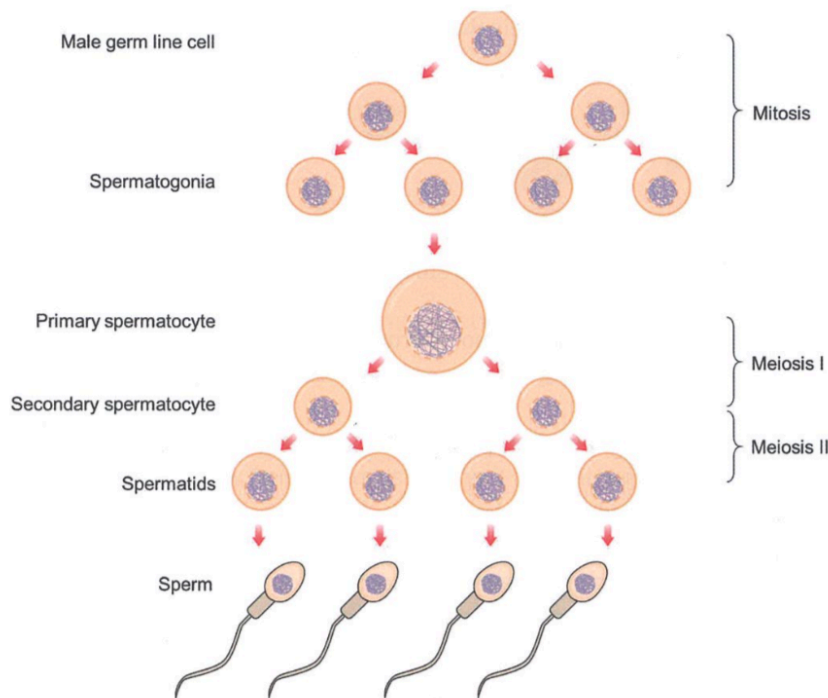
Extensive scientific research has revealed that both chloroplasts and mitochondria are likely descendants of early prokaryotes (according to the theory of evolution). Given this information, it is most likely that chloroplasts and mitochondria divide by:

- J** Mitosis
- K** Meiosis
- L** Fertilization
- M** Binary fission

5. The cytoskeleton in eukaryotes is made from proteins called microtubules. The cytoskeleton is broken down before mitosis, and the microtubules are recycled to produce spindle fibres. Taxol is a drug used to treat certain types of cancer. Taxol bonds with microtubules and prevents the cytoskeleton from being broken down. Given this information, it is likely that Taxol is effective at preventing:

- J Prophase only
- K Prophase and metaphase
- L Metaphase only
- M All stages of mitosis

6. The diagram below shows the stages involved in the production of sperm cells (spermatogenesis).



Which one of the following statements is **incorrect**?

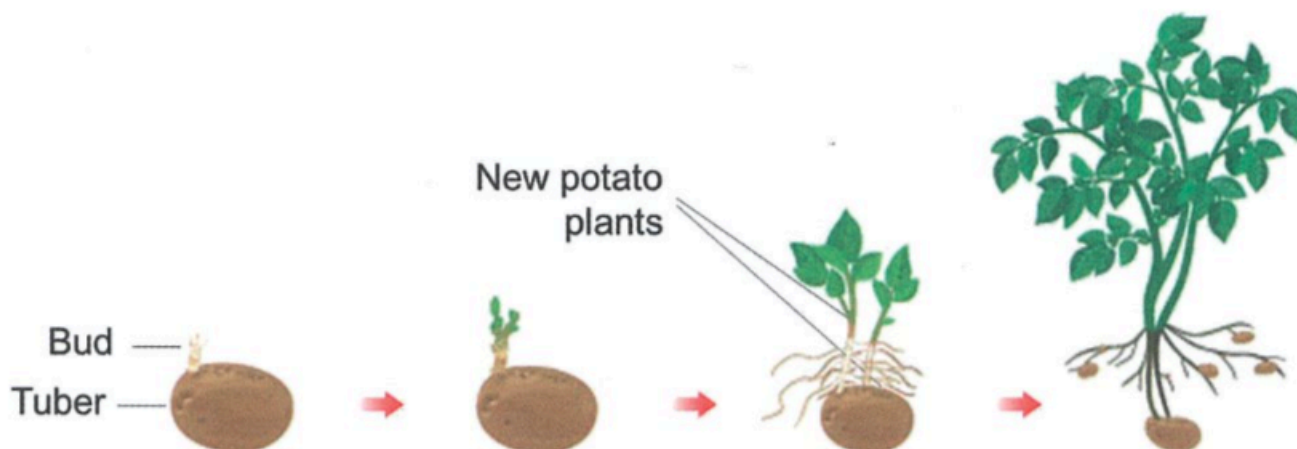
- J Male germ line cells are diploid and primary spermatocytes are haploid.
- K Secondary spermatocytes and spermatids are both haploid.
- L Spermatogonia and sperm have different numbers of chromosomes.
- M Primary spermatocytes have more chromosomes than secondary spermatocytes.

7. Which of the following events is not a source of genetic variation in eukaryotic organisms?
- J** Mutation
  - K** Independent assortment
  - L** Mitosis
  - M** Fertilisation
8. A cell has 20 picograms of DNA at metaphase in mitosis.  
The mass of DNA in the cell immediately after telophase is:
- J** 20 picograms
  - K** 10 picograms
  - L** 40 picograms
  - M** 5 picograms
9. p16 is a protein in humans encoded by the CDKN2A gene.  
P16 inhibits a cyclin-dependent kinase in the cell cycle.
- Given this information, it is most likely that the CDKN2A gene is a:
- J** Proto-oncogene
  - K** Tumor suppressor gene
  - L** Both J and K
  - M** Neither J or K
10. HeLa cells are a common cell type used to study human cells in cell culture.  
The original parent HeLa cells originate from the cervical cancer cells of Henrietta Lacks. She died of cervical cancer in 1951. Her cells have been used to create the important HeLa cell line.
- Which one of the following sets of properties describes the growth of HeLa cells?
- J** Anchorage dependent and density dependent.
  - K** Anchorage dependent but not density dependent.
  - L** Density dependent but not anchorage dependent.
  - M** Neither anchorage dependent and density dependent.

## Section B: Short Answer

### Question 1

A potato plant (*Solanum tuberosum*) usually reproduces from tubers that grow beneath the soil surface.



Potato tubers are full of starch. Starch is a large molecule **made from glucose**.

(a) Write a chemical equation to show the formation of glucose in potato plants.

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(2)

(b) New potato plants grow from tubers using starch as an energy source.  
Name the process by which starch is broken down to release energy for growth.

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(1)

(c) Name one synthesis reaction that occurs during growth in all the cells of potato plants.

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(1)

(d) New potato plants grow from buds situated on the tuber.  
Growth occurs through the process of mitosis.  
Explain why the amount of DNA in a cell is doubled before mitosis.

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(1)



(e) The diagram below shows a phase in mitosis in plant cells.



(i) Identify and describe the events occurring in the phase of mitosis shown in the diagram.

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(2)

(ii) The cell plate is composed of vesicles.

State and explain the function of vesicles in eukaryotes.

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(2)

(f) Potato blight is an infectious disease that occurs in potato plants.

The disease is caused by a eukaryotic microorganism named *Phytophthora infestans*.

(i) Explain why potato plants that have been cloned in vitro for use in large scale crops are more at risk to pathogens such as *Phytophthora infestans*.

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(2)

(ii) Potato blight was the cause of over a million deaths in Ireland between 1845 and 1852.

State how potato blight resulted in the deaths of humans if the pathogen only infected plants.

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(1)

(g) Metalaxyl is a pesticide used to control the growth of *Phytophthora infestans*.

(i) State one benefit to potato farmers in using metalaxyl.

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(1)

(ii) In 1980 geneticists discovered that a population of *Phytophthora infestans*, in a large Irish potato crop, had become resistant to metalaxyl.

*Phytophthora infestans* can, within the same crop, reproduce sexually and asexually.

Explain why it was likely the *sexually reproducing* potato plants that developed (or evolved) this pesticide-resistance over time.

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(2)

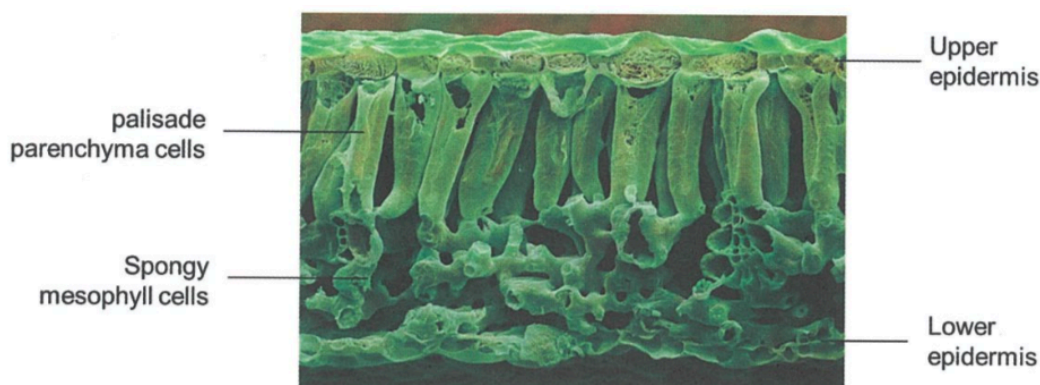
## Question 2

Sucrose is synthesized from glucose in the leaves of potato plants.

The diagram below is a colored scanning electron micrograph (SEM) of a transverse section of a potato leaf.

The upper and lower surfaces of the leaf are covered in a single layer of closely packed cells called the epidermis. Below the epidermis is a layer of palisade parenchyma cells containing many chloroplasts.

Beneath this layer is the spongy mesophyll which has large intracellular spaces for gaseous exchange with the outside of the leaf.



(a) Chloroplasts have their own circular loop of DNA. State why this is useful for this organelle given its function.

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(1)

(b) Chloroplasts have a several unique membrane structures within them. State one of these structures and explain why it helps to increase the rate of photosynthesis.

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(2)

(c) Glucose is produced in photosynthesis in palisade parenchyma cells.

Explain the advantage of palisade parenchyma cells being oriented at 90° to cells in the upper epidermis surface.

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(2)

(d) Glucose is converted to sucrose which is then transported from the leaves to roots by way of phloem vessels.

Phloem vessels contain different cell types that synthesis ATP for use in active transport

Explain why it is important for the plant to convert glucose into sucrose before it sends it through the phloem vessels to the roots.

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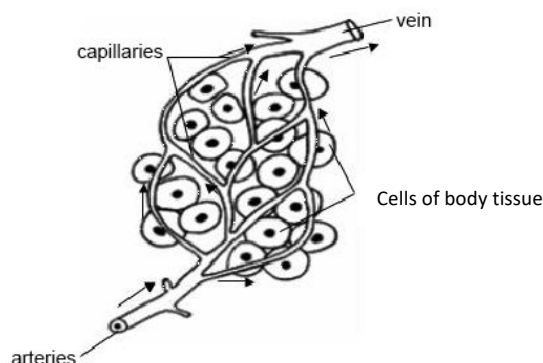
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(2)

### Question 3

Blood is composed of plasma and several types of blood cells including white blood cells, red blood cells and platelets. Plasma is the yellowish liquid portion of the blood which contains water, salts, enzymes, nutrients and other proteins.

Blood flows through blood vessels to deliver needed materials to body tissue cells (such as muscle cells). The smallest blood vessels are called capillaries and they surround body cells. Materials move in and out of the capillaries from the surrounding body tissue cells mainly by diffusion and osmosis.



(a) Haemoglobin is an important protein molecule found in the human red blood cells.

Explain why more water than normal would move from the tissue cells into nearby blood capillaries if haemoglobin were in the plasma **rather than** in the red blood cells.

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(2)

(b) Blood flows around the body continuously. State why the efficient exchange of materials by diffusion and osmosis at the capillaries and tissue cells depends on **continuous** blood flow.

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(2)

### Section C: Extended Response

1. Parents in the United States in the 1940s and 50s lived in a state of fear for their children's health because a highly infectious disease was preying on the young. Polio (poliomyelitis) is a highly infectious viral disease that mainly affects children under 5 years of age. One in 200 infections leads to irreversible paralysis, and among those who are paralyzed, 5-10% die when their breathing muscles become immobilised.

A vaccine was developed in the lab of Dr. Jonas Salk, and first used in 1955. Dr. Salk's team removed cells from a monkey kidney and grew them by cell culture in the lab. These cells were then used for ongoing trials and research by infecting the kidney cells with poliovirus. This research was used to eventually develop a safe vaccine for polio. As of 2020 all variations of the polio virus are now considered eradicated globally.

**Explain the process of dissection** that would have been needed to obtain cells from the monkey that could be cultured.

**Describe the importance and role** that growth hormones would have in the culturing process of kidney cells that were obtained from the monkey.

**Discuss possible limitations** of attempting to develop vaccines using cells culturing techniques.

(8)

*Rough planning space:*

