

Multiple choice questions

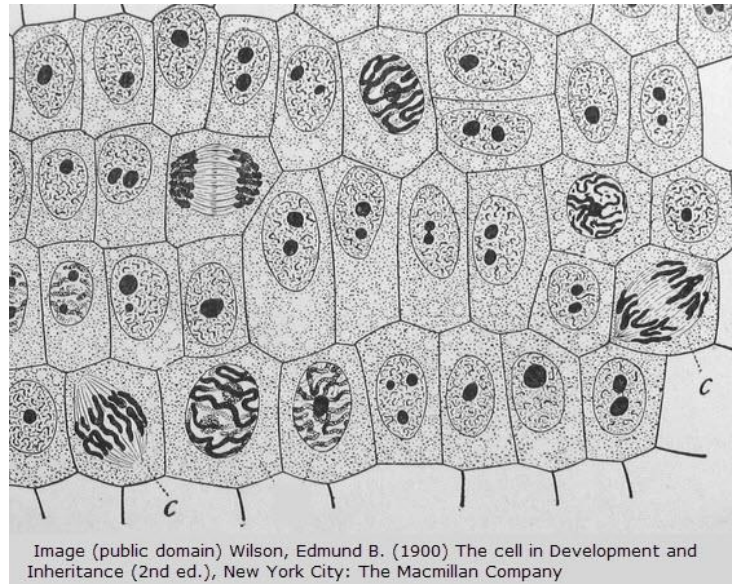
- Which of the following is the correct sequence of the four phases of mitosis?
 - Prophase, anaphase, metaphase, telophase
 - Anaphase, prophase, metaphase, telophase
 - Prophase, metaphase, anaphase, telophase
 - Prophase, metaphase, telophase, anaphase
- How did Pasteur's experiment with sterile broth in open flasks demonstrate the principle that cells only come from pre-existing cells?
 - By demonstrating that sterile broth would not ferment in contact with air alone.
 - By demonstrating that the air contained microbes.
 - By demonstrating that broth would not ferment if sterile.
 - By demonstrating that sterile broth fermented in contact with air
- Emergent properties are found in some biological systems. Which of the following properties is necessary for emergent properties to occur?
 - The system is evolving
 - The system is complex
 - Cells or tissues are differentiated
 - Cells or tissues interact to function as a unit
- Which of the following organelles are surrounded by a single membrane?
 - Ribosome
 - Rough endoplasmic reticulum
 - Chloroplast
 - Lysosome
 - I and III only
 - II and IV only → flawed Question, RER = double membrane!!!!
 - I and II only
 - I, II and IV only
- Which of the following are properties of cholesterol found in plasma membranes?
 - Reduces permeability of the membrane to hydrophilic ions
 - Acts as a channel for ion movement
 - It is amphipathic
 - Reduces fluidity of the membrane
 - I and III only
 - II and IV only

- C. I and IV only
- D. I, III and IV only (Note: Cholesterol has a small, water-soluble polar region that dissolves in water, but nearly the entire cholesterol molecule is non-polar.. This makes cholesterol an example of an **amphipathic** molecule)
6. Which of the following are properties of phospholipids
- I. They have a hydrophilic phosphate head
 - II. they form a bilayer in water
 - III. III They are amphipathic
 - IV. IV They have a hydrophobic fatty acid region
- A. All of the above
- B. II and IV only
- C. I and II only
- D. I, II and IV only
7. The medium in which a donor organ for transplant is bathed in an isotonic medium, a solution of the same concentration as the cell cytoplasm. Why?
- A. The donated organ requires oxygen
 - B. The organ must take up minerals from the solution
 - C. The organ is delicate
 - D. The organ must not lose or gain water
8. Which of the following can cause the formation of a primary tumour, or cancer?
- I Oncogenes
 - II Mutagens
 - III Proto-oncogenes
 - IV Metastasis
- A. All of the above
- B. II and IV only
- C. I and II only (proto-oncogenes are normal genes which, when altered by mutation, become **oncogenes**)
- D. I, II and III only
9. Which of the following events happens during mitosis in a plant cell?
- A. Condensation of chromosomes (occurs by supercoiling during prophase of mitosis)
 - B. Cell wall formation (cytokinesis - not strictly part of mitosis)
 - C. Sister chromatids attach to each other at the centromere (while they remain attached into prophase, they actually attach in interphase during DNA replication)
 - D. Chloroplasts duplicate (interphase)
10. Which statement best describes the movement of water molecules in osmosis?

- A. From a dilute to a more concentrated solution across a membrane
- B. From a concentrated solution to a dilute solution across a membrane
- C. From a dilute to a concentrated solution across a membrane using energy from ATP
- D. From a concentrated solution to a dilute solution using energy from ATP.

Structured answer questions

11. The following image shows cells in the root tip of a garlic bulb.
Identify and label clearly one cell in prophase and one cell in anaphase. (2 marks)



12. Calculate the mitotic index of the tissue in the diagram above. Show your working.

There are 32 cells clearly visible. (2 marks)

1 mark for correctly counting the number of cells in phases of mitosis = 8 cells;

1 mark for correctly working out the ratio 8:32 or simplified ratio 1:4

13. Outline how the mitotic index can be used in the diagnosis of cancer? (1 mark)

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One mark for any of the point below

Mitotic index is a measure for how fast the cells are dividing (also known as proliferation) A high mitotic index means that the cells might be cancerous;

Mitotic Index is defined as the ratio between the number of cells actively dividing (in mitosis) and the total number of cells / a low mitotic index means that the cells are dividing slowly.

Mitotic index has been shown to be a strong predictor of / to correlate to survival / prognosis / treatment success in (some) cancers.

14. List two sources of stem cells that can be used in therapeutic treatment. (2 marks)

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Two from this list

- The patient's own cells / tissues / donated tissues from another person;
- The foetal umbilical cord (blood);
- Early-stage embryos (specially created);

15. Outline two similarities between the structure of prokaryote cells and eukaryote cells.

(2 marks)

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Both cells have;

- plasma membrane
- ribosomes (although they are 70s in prokaryotes and 80s in eukaryotes)
- both cells contain DNA

16. Outline the role of cyclins in living cells (2 marks)

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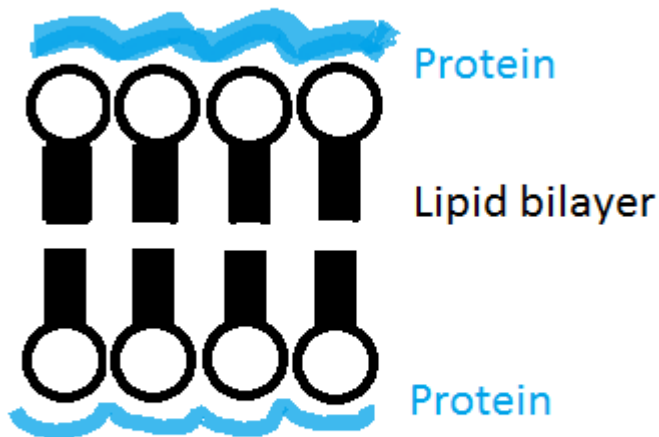
Two points from this list

- Cyclins control different stages of the cell cycle;
- Concentrations of each cyclin rise and fall in each stage;
- The rise and fall of the concentrations activates proteins;
- The activated proteins carry out reactions specific to the stage of the cell cycle / allow the cell cycle to continue;

17. Describe one type of cell which is atypical to the concept of cell theory. (2 marks)

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- Striated muscle – many nuclei along the length of a single cell/muscle fibre
- Giant algae – Large organisms containing only one nucleus
- Hyphal aseptate fungi – hyphae are not divided into cells and contain many nuclei in a single hypha
- Or equivalent example



Danielli & Davson model

18. The Davson-Danielli model of the membrane structure proposed a layer of protein on the outside edges of membranes. Biological evidence caused them to refine their model and later the Singer-Nicholson model became accepted as a better model of membrane structure.

Describe one piece of evidence that falsified the Davson-Danielli model in support of the Singer-Nicholson model (3 marks)

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(Hubbell and McConnell 1968 improved methods of) freeze-etching to reveal details of the structure of membranes.

Freeze etching experiments strongly suggest that protein is found deeply embedded in the membrane;

A frozen membrane is fractured and splits along the interior hydrophobic part of the membrane;

A smooth matrix/layer is seen interrupted by particles/proteins is seen;

Allow marks for the following explanations - even if freeze etching is not mentioned;

There was evidence that proteins were present in the middle of the bilayer;

This proved that the Danielli Daveson model couldn't be correct as this model has no protein in the middle of the lipid bilayer;

19. Define the term “cell differentiation”. (1 mark)

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Cell differentiation is the process by which a cell changes from one cell type (an undifferentiated cell / a stem cell) to another cell type / specialised cell (by expressing some of its genes and not others)

20. Explain the evidence which supports the endosymbiotic theory of the evolution of the eukaryotic cell (3 marks)

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One mark for each of the points below (max 3)

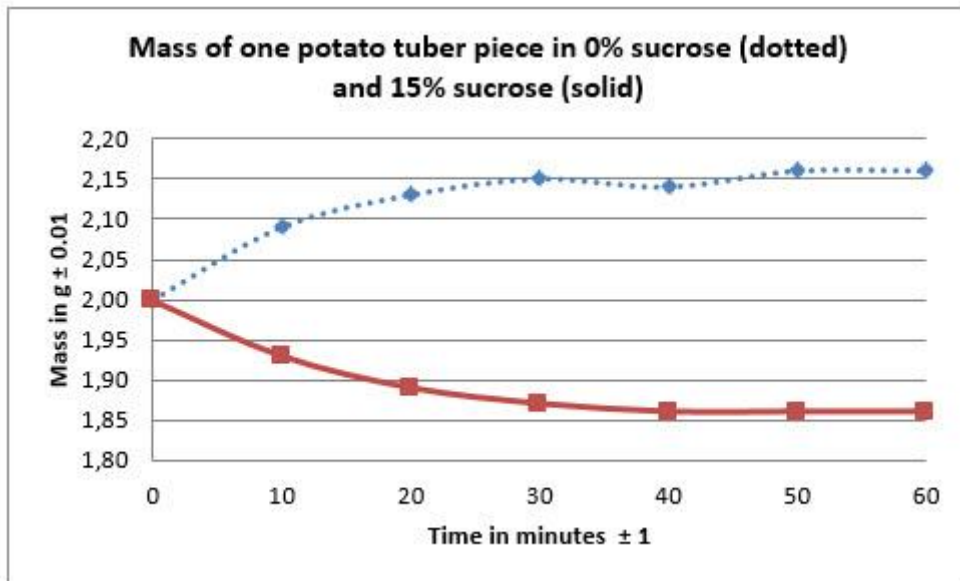
- Mitochondria **and** chloroplasts are believed to have been free living (they are endosymbionts);
- Mitochondria and Chloroplasts have double membrane **which is evidence for** endocytosis of the organelle;
- they have 70s ribosomes **which** are found in Prokaryotes;
- they have a DNA loop/naked DNA **as found** in Prokaryotes;
- they are self replicating **which is evidence** for them having been free living origin;

21. Eukaryotic cells contain organelles which each have specific functions. Complete the table below, to identify the missing organelle names and the missing functions.

(4 marks)

Organelle	Structure	Function
Nucleus	Large structure surrounded by a double membrane with DNA and proteins inside.	Contains the cell's DNA and is the site of DNA replication
Golgi apparatus	A stack of four or more flattened membrane disks	Processes and packages proteins into vesicles
Lysosome	A round organelle with a single membrane containing digestive enzymes.	Digestion of molecular debris inside the cell.
Mitochondrion	An organelle with a double membrane. The outer membrane makes the shape of the organelle but the inner membrane folds into cristae	Carries out the reactions of the Krebs cycle / aerobic respiration

22. The graph below represents the mass change over 60 minutes of two potato tuber "chips" in distilled water (dotted line) and 15% sucrose (solid line). The chips were cylinders of 5 cm length and 1 cm diameter.



1. Calculate the percentage loss in mass of the potato chip in 15% sucrose at 20 minutes.

(2 marks)

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Accept answers in the range of 5 to 8%

- Starting mass = 2.00 to 1.88 after 20 minutes = decrease of 0.12
- As a % of the starting mass = $0.12 / 2.00 \times 100\%$ (1 mark for working)
- 6% (1 mark).

2. Compare the results in 15% sucrose with those in distilled water. (2 marks)

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The change in mass was similar / 0.15 - 0.18 / in both;

Both potato stopped changing mass after about 30 minutes;

Reject: "The potato in distilled water increased mass but the potato in 15% sucrose decreased mass;"

because this is a difference, and "compare" requires students to point out similarities only.

3. Explain why the potato chip in distilled water gained mass. (2 marks)

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The cytoplasm of the potato cells has a higher salt concentration / osmotic concentration / osmolarity than the distilled water;

Distilled water is hypotonic / has a lower water potential / osmolarity than potato cells

Water enters the cells by osmosis;

4. State two variables that should be controlled to give valid results in this experiment.

(2 marks)

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Any two variables

- Temperature of the solution
- Potato tissue from the same tuber/area of tuber
- Shape of potato / Surface area of the potato

5. Suggest why data collection was stopped at 60 minutes? (2 marks)

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The graph plateaus/shows no further gain/data from 50 and 60 minutes is constant;

Indication that (net) water movement is complete/equilibrium achieved/no further mass change will occur;

6. Explain two ways that the experiment could be improved so that the data collected would have more validity. (4 marks)

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Repeats to collect more data

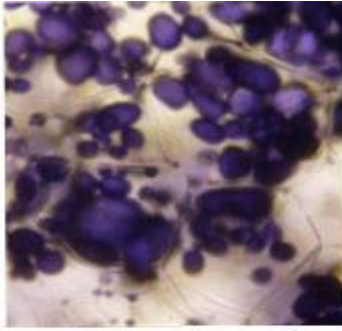
Using more/ 5 potato "chips" in each solution

Using intermediate concentrations/example

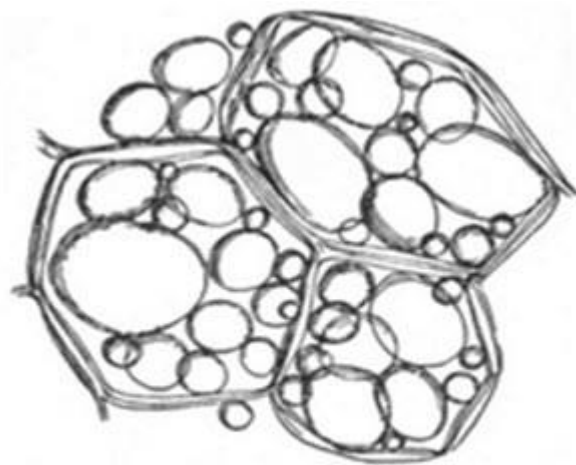
7. The images below show potato cells from the experiment containing starch grains.

The true size of the cell labeled A was measured to be 300µm across.

Measure the image size of the microscope image and the student's diagram then calculate the magnification of each image. Show your calculations (4 marks)



A



B

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The size of the images depends on browser size and printer so these answers are model answers showing the working.

A - measures 15mm which is equal to 15000 μ m.

As the size of the cell is 300 μ m the magnification is $15000 / 300 = 50$. X50 magnification

B - measures 20mm which is equal to 20000 μ m

As the cell is still 300 μ m the magnification is $20000 / 300 = 200 / 3 = 67$. X67 magnification.