Name:_____ Period:_____

# Problem Set: Cells and Microscopy

Complete the following questions on your own. When you are done and your answers have been checked for completion, you may check your work for accuracy using Ms. Paxson's key. This assignment is due Friday, August 17 and is worth 25 points.

1. Which cell structure can be seen **only** with an electron microscope?

**A** cell wall

**B** chromosome

**C** nucleolus

**D** ribosome

2. Which statement is **not** correct in its description of a light microscope or an electron microscope?

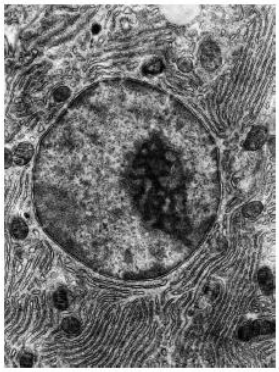
**A** A light microscope has a maximum resolution of 0.2 μm.

**B** An electron microscope has a maximum resolution of 0.05 nm.

**C** A light microscope can resolve specimens as small as 200 nm in diameter.

**D** An electron microscope can resolve specimens as small as 0.5 nm in diameter.

3. The electronmicrograph shows part of an animal cell.



What will be synthesised in large quantities in this cell?

1 ATP

2 glucose

3 RNA

**A** 1 only **B** 2 only **C** 1 and 3 only **D** 1, 2 and 3

4. Which statements about a typical eukaryotic cell are correct?

1 It is smaller than 2 μm.

2 It has a nucleolus.

3 It has linear DNA.

4 It only has small (70S) ribosomes.

**A** 1 and 2 only **B** 1 and 4 only **C** 2 and 3 only **D** 3 and 4 only

5. Which cell organelle does **not** contain nucleic acid?

**A** chloroplast

**B** Golgi apparatus

**C** lysosome

**D** ribosome

6. Which steps are needed to find the actual width of a xylem vessel viewed in transverse section using a ×40 objective lens?

1 Convert from mm to μm by multiplying by $10^{-3}$.

2 Calibrate the eyepiece graticule using a stage micrometer on ×10 objective lens.

3 Measure the width of the xylem vessel using an eyepiece graticule.

4 Multiply the number of eyepiece graticule units by the calibration of the eyepiece graticule.

**A** 1, 2, 3 and 4

**B** 2, 3 and 4 only

**C** 1 and 2 only

**D** 3 and 4 only

7. A specimen is viewed under a microscope using green light with a wavelength of 510 nm.

If the same specimen is viewed under the same conditions, but using red light with a wavelength of 650 nm instead, what effect will this have on the magnification and on the resolution of the microscope?

| | magnification | resolution |
|---|---|---|
| **A** | decreased | decreased |
| **B** | increased | increased |
| **C** | remains the same | decreased |
| **D** | remains the same | increased |

8. The diameter of living cells varies considerably.

The typical diameters are

a eukaryote, such as a white blood cell $1.5 \times 10^{1}$ μm

a prokaryote, such as *Streptococcus* $7.5 \times 10^{2}$ nm

Use these measurements to find the maximum number of each cell type which could fit along a line 1 cm long.

| | number of white blood cells | number of *Streptococcus cells* |
|---|---|---|
| **A** | $6.7 \times 10^{3}$ | $1.3 \times 10^{5}$ |
| **B** | $6.7 \times 10^{2}$ | $1.3 \times 10^{4}$ |
| **C** | $6.7 \times 10^{1}$ | $1.3 \times 10^{3}$ |
| **D** | $6.7 \times 10^{0}$ | $1.3 \times 10^{2}$ |

9. Cells consist of a number of different components.

Which row shows the components present (✓) in both a prokaryotic and eukaryotic cell?

| | lysosomes | Golgi apparatus | ribosomes | cell surface membrane |
|---|---|---|---|---|
| **A** | | ✓ | | ✓ |
| **B** | ✓ | ✓ | | |
| **C** | | | ✓ | ✓ |
| **D** | ✓ | | ✓ | |

10. When making measurements in experiments, which methods could have parallax errors?

1 using a calibrated eyepiece graticule to measure length

2 using a measuring cylinder to measure volume

3 using a ruler to measure length of a shoot

**A** 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

11. Which part of the cell is often continuous with the rough endoplasmic reticulum?

**A** cell surface membrane

**B** Golgi apparatus

**C** mitochondrion

**D** nuclear envelope

12. Which structures are found in both chloroplasts and mitochondria?

1 70S ribsomes

2 80S ribsomes

3 circular DNA

**A** 1 and 3 **B** 2 and 3 **C** 1 only **D** 3 only

13. Tay-Sachs disease occurs when cells are unable to produce an enzyme, leading to a build up of certain lipids in cells.

Which cell structure would **not** function correctly, resulting in the disease?

**A** Golgi apparatus

**B** lysosome

**C** mitochondrion

**D** smooth endoplasmic reticulum

14. Which cell structure can be seen only with an electron microscope?

**A** cell surface membrane

**B** chromosome

**C** nucleolus

**D** vacuole

15. Which is a feature of all prokaryotic cells?

**A** absence of cell surface membrane

**B** division by mitosis

**C** presence of cellulose cell wall

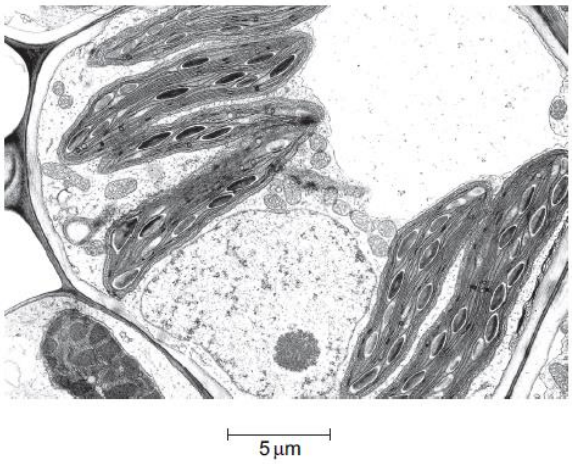
**D** presence of ribosomes

16. A lymphocyte has a diameter of $1 \times 10^{-2}$ millimetres (mm).

What is the diameter in nanometres (nm)?

**A** $1 \times 10^{1}$ **B** $1 \times 10^{2}$ **C** $1 \times 10^{3}$ **D** $1 \times 10^{4}$

17. The photomicrograph of a cell has a 2 cm scale line labelled 5 μm.




What is the magnification of the photomicrograph?

**A** $1 \times 10^3$ **B** $2 \times 10^3$ **C** $4 \times 10^3$ **D** $5 \times 10^3$

18. What is a function of the smooth endoplasmic reticulum?

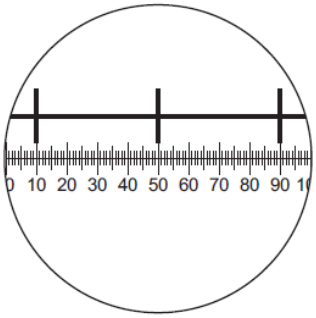
**A** protein synthesis

**B** protein transport

**C** steroid synthesis

**D** steroid transport

19. The diagram shows a stage micrometer, with divisions 0.1 mm apart, viewed through an eyepiece containing a graticule.




What is the area of the field of view of the microscope at this magnification? ($\pi$ = 3.14)

**A** $\pi \times 12.5 \times 12.5 = 4.9 \times 10^2\ \mu m^2$

**B** $\pi \times 55 \times 55 = 9.5 \times 10^3\ \mu m^2$

**C** $\pi \times 125 \times 125 = 4.9 \times 10^4\ \mu m^2$

**D** $\pi \times 250 \times 250 = 2.0 \times 10^5\ \mu m^2$

20. Which feature is found in **both** prokaryotic and plant cells?

**A** cell wall

**B** DNA bound to protein

**C** endoplasmic reticulum

**D** Golgi apparatus

21. Which structures are found in both animal and plant cells?

1 centriole

2 lysosome

3 nucleolus

4 vacuole

**A** 1 and 3 only

**B** 2 and 4 only

**C** 2, 3 and 4 only

**D** 1, 2, 3 and 4

22. The same plant cells were viewed by a student using an electron microscope and a light microscope.

The electron microscope used a magnification of ×1000.

The light microscope used a ×10 eyepiece lens and a ×100 objective lens.

The student concluded that the image of the plant cell obtained using the electron microscope was clearer and more detailed than the image obtained using the light microscope.

Which explanation supports this conclusion?

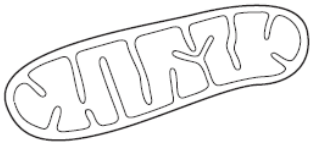
**A** The electron microscope had a poorer resolution than the light microscope, but was better able to distinguish between two separate points.

**B** The magnification used in the two microscopes was the same, but the electron microscope had a better resolution than the light microscope.

**C** The student used the electron microscope at a higher magnification than the light microscope which led to an improved resolution.

**D** The two microscopes had the same resolution, but the magnification used in the electron microscope gave an image that was ten times larger than the light microscope.

23. The diagram shows an organelle drawn at a magnification of ×20 000.



What is the maximum length of the organelle?

**A** $3 \times 10^{-1}$ μm **B** $3 \times 10^{0}$ μm **C** $3 \times 10^{1}$ μm **D** $3 \times 10^{2}$ μm

24. When drawing a plan diagram of a transverse section of a dicotyledonous leaf, which feature should **not** be included?

**A** cuticle on the upper epidermis

**B** palisade mesophyll layer

**C** vascular bundles in the leaf lamina

**D** xylem vessel elements

25. Fig. 1.1 is an electron micrograph of three cells of the same species of bacterium, *Erwinia carotovora*.


**Fig. 1.1**

**(a)** Calculate the magnification of the electron micrograph in Fig. 1.1.

Show your working and give your answer to the nearest 10 000.

magnification × ..... [2]

**(b)** Name three structures, present in animal cells, which are **not** present in the cells shown in Fig. 1.1.

1. .....

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2. .....

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3. .....

..... [3]

26. Fig. 1.1 is a drawing made from an electron micrograph of a mammalian liver cell.

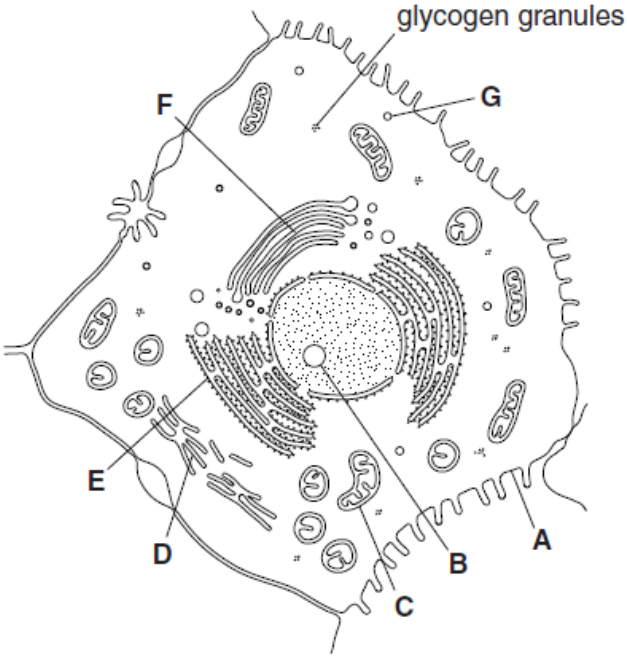



**Fig. 1.1**

**(a)** Complete the table by naming the structures **B** to **G** and stating **one** function of each. The first one (**A**) has been completed for you.

| | **name of organelle** | **function** |
|---|---|---|
| **A** | cell surface membrane | controls movement of substances into and out of the cell |
| **B** | | |
| **C** | | |
| **D** | | |
| **E** | | |
| **F** | | |
| **G** | | |

[6]

27. Fig. 1.1 shows electron micrographs of some eukaryotic cell organelles.

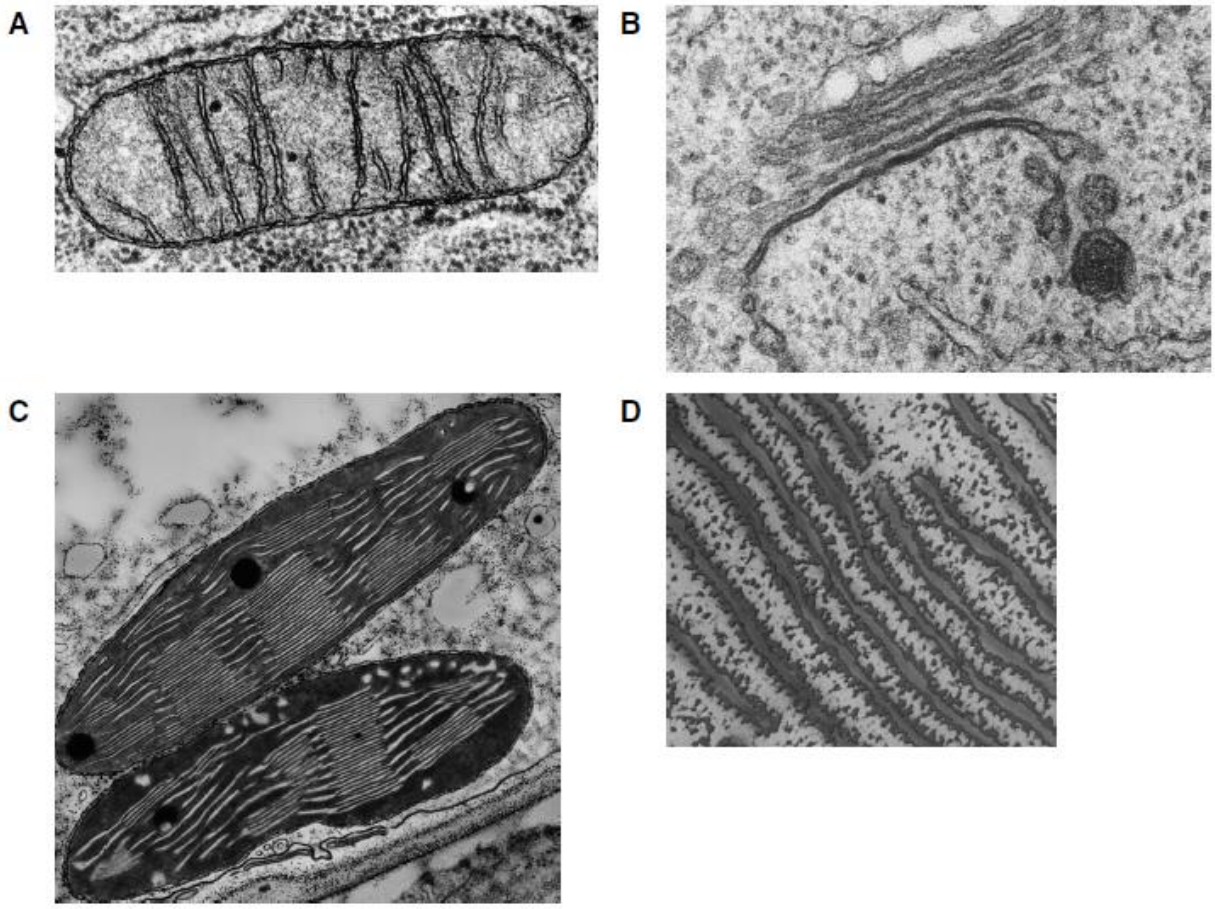



**Fig. 1.1**

For each of the organelles **A**, **B**, **C** and **D**, shown in Fig. 1.1, state the name and function of each.

**A** *name* .....

*function*.....

**B** *name* .....

*function*.....

**C** *name* .....

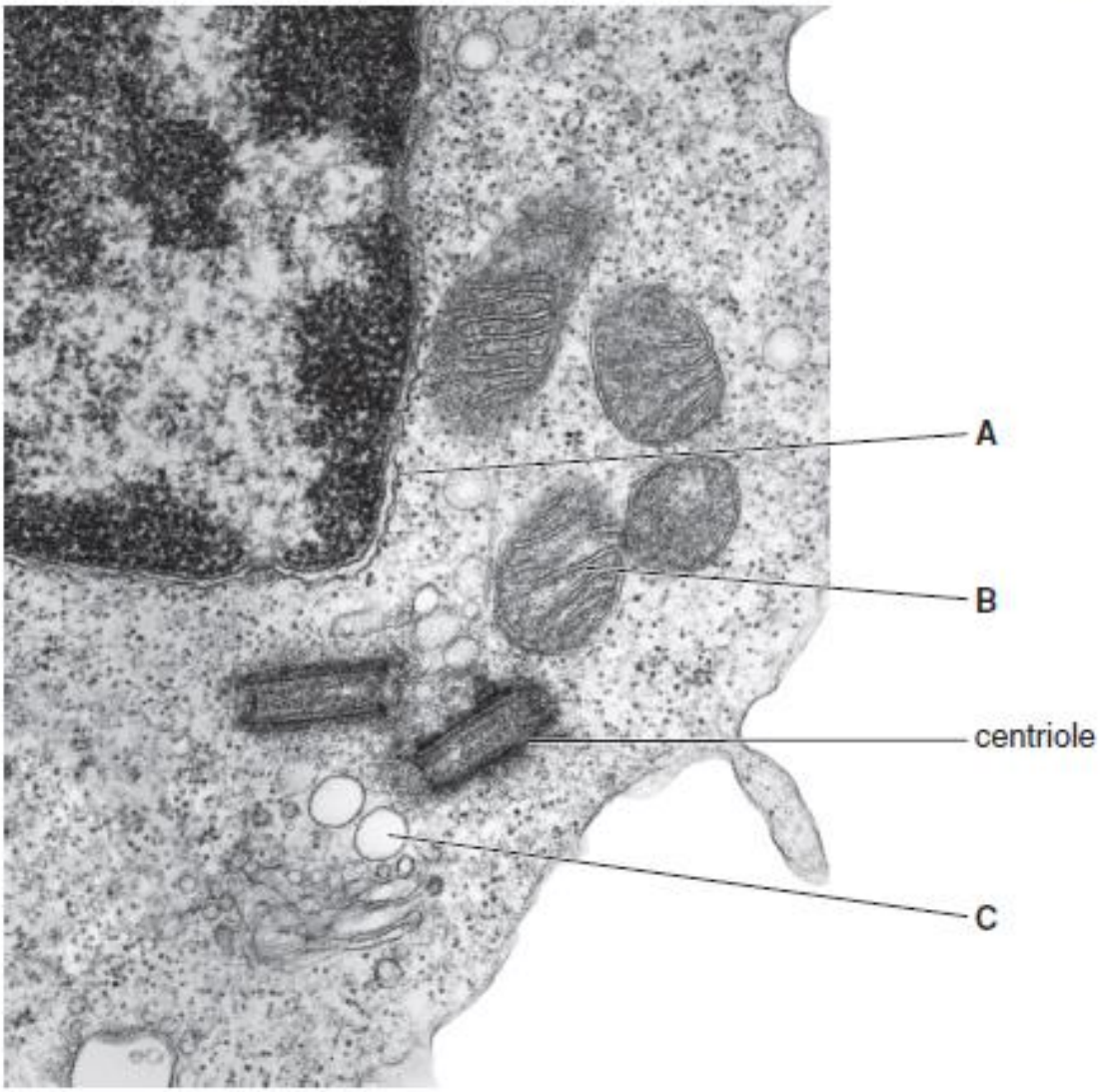
*function*.....

**D** *name* .....

*function*.....[8]

[Total: 8]

28. Fig. 2.1 is an electron micrograph of part of an animal cell. A centriole is labelled.




X 10,000

**Fig. 2.1**

**(a)** Name the structures labelled **A** to **C**.

**A** .....

**B** .....

**C** ..... [3]

28 continued…

**(b)** Describe the roles of centrioles in animal cells.

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..... [3]

**(c)** Explain why it is possible to see the internal membranes of a cell in electron micrographs, such as Fig. 2.1, but it is not possible to see them when using the light microscope.

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..... [3]

**(d)** A student investigated the effect of temperature on beetroot tissue. Beetroot cells contain a dark red pigment known as betalain, which is stored inside their vacuoles.

The student

- cut the beetroot tissue into cubes of the same size
- washed the cubes thoroughly in distilled water
- placed the same number of cubes into distilled water at seven different temperatures.

After 30 minutes, samples of the water were removed and placed in a colorimeter to measure the transmission of light. The lower the percentage transmission the more betalain is present in the water.

The results are shown in Fig. 2.2.

28 continued…

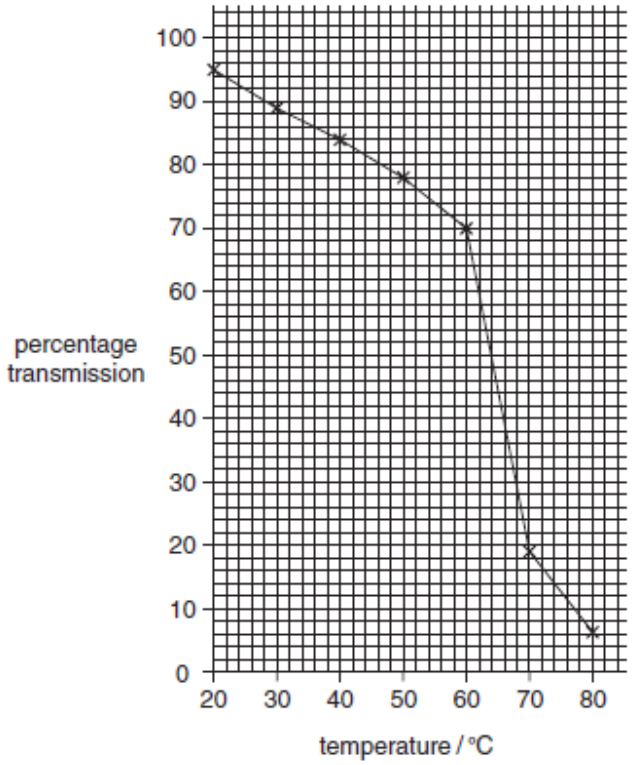


**Fig. 2.2**

Using the information in Fig. 2.2,

**(i)** describe the student's results;

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..... [3]

**(ii)** explain the effect of increasing temperature on the beetroot tissue.

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..... [3]

[Total: 15]

29.

Fig. 1.1 is an electron micrograph of a mitochondrion.

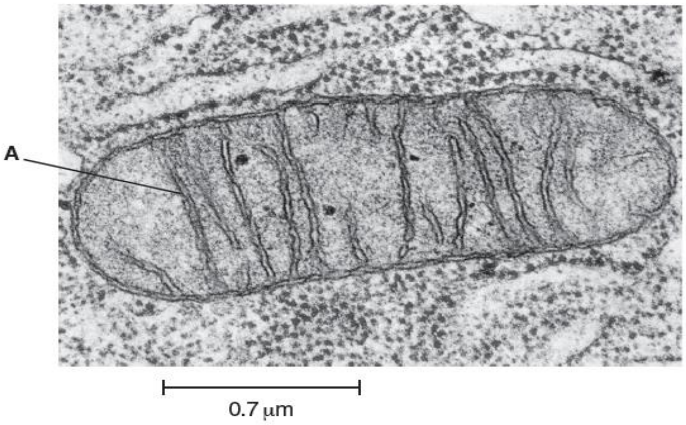


**Fig. 1.1**

**(a)** State the function of mitochondria.

..... [1]

**(b)** Name structure **A**.

..... [1]

**(c)** Calculate the magnification of the image in Fig. 1.1.

Show your working.

magnification × ..... [2]

**(d)** Explain why the light microscope could **not** be used to produce the image in Fig. 1.1.

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..... [2]

**(e)** Scientists think that mitochondria were once prokaryotes. The evidence for this is that mitochondria have features in common with prokaryotes.

State two features that mitochondria have in common with prokaryotes.

1. .....

2. .....

[2]

[Total: 8]