

IB Diploma

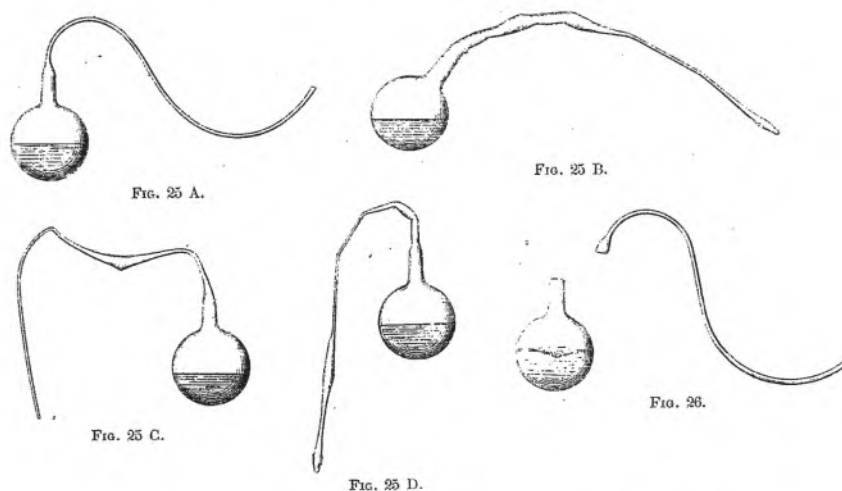
BIOLOGY

SL P2
2017 — 2024

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1 - (BIOLO/21_SL_Summer_2017_Q2) - Cell Biology, Ecology

Pictured below are Louis Pasteur's original drawings of swan-necked flasks.



[Source: L Pasteur and L Pasteur Vallery-Radot, (1922), *Œuvres de Pasteur*, Vol II Fermentations et générations dites spontanées, pages 260–261]

- (a) Describe how Pasteur's experiments provided convincing evidence to falsify the concept of spontaneous generation.

[3]

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(b) State the function of life in *Paramecium* that is carried out by:

(i) cilia.

[1]

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(ii) the contractile vacuole.

[1]

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(c) Discuss the advantages and disadvantages of the use of adult stem cells.

[3]

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(d) Explain the role of decomposers in an ecosystem.

[2]

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2 - (BIOL0/22_SL_Summer_2017_Q2) - *Cell Biology, Human Physiology*

- (a) Glands are organs that secrete and release particular chemical substances. Melatonin is an important hormone secreted in the pineal gland in the brain. Describe its role in mammals.

[2]

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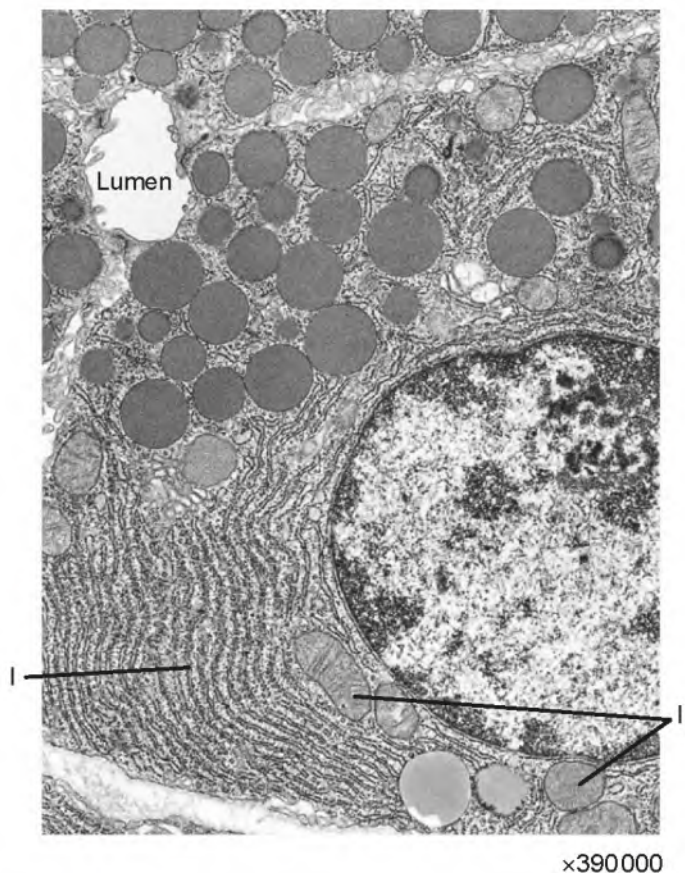
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- (b) The electron micrograph shows the structures in an exocrine gland cell of the pancreas.



[Source: Meschner AL, *Junqueira's Basic Histology: Text and Atlas*, 12th edition. Copyright McGrawHill Education.]

- (i) State the principal product of this cell.

[1]

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- (ii) Using the table, identify the organelles labelled I and II on the electron micrograph with their principal role.

[2]

Organelle	Name	Principal role
I		
II		

3 - (BIOLO/22_SL_Summer_2017_Q3) - *Cell Biology*

- (a) Outline the use of human embryonic stem cells (hESC) to treat Stargardt's disease. [2]

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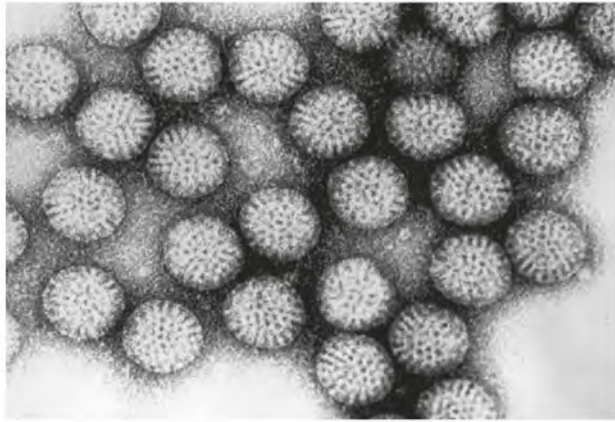
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- (b) The most common form of Stargardt's disease is known to be autosomal recessive. Using a Punnett grid, deduce the probability of a child inheriting Stargardt's disease, if both of the parents are carriers of the disease but do not have the disease themselves. [3]

4 - (BIOLO/20_SL_Winter_2017_Q2) - *Cell Biology, Genetics, Human Physiology*

The figure shows a transmission electron micrograph of rotavirus particles. Each rotavirus is about 70 nanometres in diameter.



[Source: CDC / Dr. Erskine L. Palmer]

- (a) State a reason for using an electron microscope to view this virus rather than a light microscope.

[1]

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- (b) Rotavirus causes diarrhea and vomiting. Explain why viral diseases cannot be treated using antibiotics.

[2]

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- (c) State an application of plasmids in biotechnology.

[1]

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5 - (BIOLO/20_SL_Winter_2017_Q6) - *Cell Biology, Human Physiology, Genetics*

Reproduction in eukaryotes can be sexual or asexual.

- (a) Describe the origin of eukaryotic cells according to the endosymbiotic theory. [4]
- (b) Explain how hormones are used to control the human menstrual cycle. [8]
- (c) Outline natural methods of cloning in some eukaryotes. [3]

6 - (BIOLO/20_SL_Winter_2017_Q7) - *Cell Biology, Molecular Biology, Ecology*

Plants have widespread influences, from food chains to climate change.

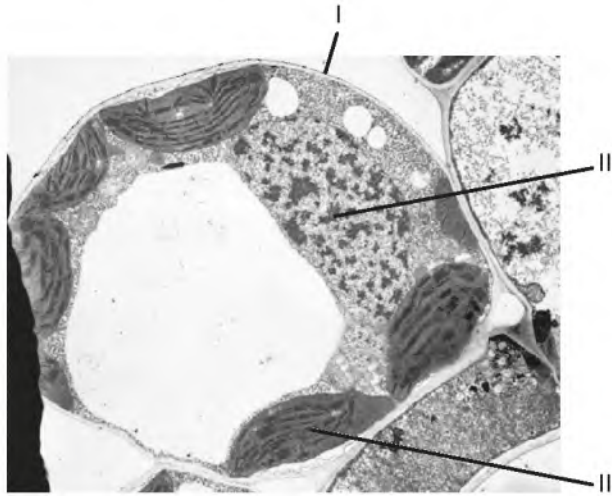
- (a) Draw a diagram of a palisade mesophyll cell labelling only the structures that would not be present in a pancreatic cell. [3]
- (b) Explain the process of photosynthesis. [8]
- (c) Describe the process of peat formation. [4]

7 - (BIOLO/21_SL_Summer_2018_Q5) - *Cell Biology, Ecology*

- (a) Draw a labelled diagram to show the fluid mosaic model of the plasma membrane. [4]
- (b) Unicellular and multicellular organisms share the same functions of life. Outline four functions of life. [4]
- (c) The structure of organisms is based on organic molecules containing carbon. Explain the cycling of carbon in an ecosystem. [7]

8 - (BIOLO/22_SL_Summer_2018_Q3) - *Cell Biology, Ecology*

(a) The electron micrograph shows a palisade mesophyll cell.



[Source: BIOPHOTO ASSOCIATES/Getty Images]

(i) State the name of the structures labelled I and II. [1]

- I.
- II.

(ii) Outline the function of the structure labelled III. [2]

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-

(iii) The plant from which this cell was taken is in the group angiospermophyta. State **one** characteristic that is unique to this group of plants. [1]

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(b) Distinguish between autotrophic nutrition and heterotrophic nutrition.

[2]

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(c) Explain how energy and nutrients are transferred in ecosystems.

[3]

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9 - (BIOLO/22_SL_Summer_2018_Q5) - *Cell Biology, Human Physiology*

Every cell is surrounded by a cell surface membrane which regulates the movement of materials into and out of the cell.

(a) Draw an annotated diagram of the fluid mosaic model of membrane structure.

[4]

(b) Describe the processes involved in absorbing different nutrients across the cell membrane of villus epithelium cells lining the small intestine.

[4]

(c) Explain the events that occur during a nerve impulse and how the impulse is propagated along an axon.

[7]

10 - (BIOLO/20_SL_Winter_2018_Q5) - *Cell Biology*

(a) The structure of prokaryotic cells has been investigated using electron microscopy. Draw a labelled diagram to show prokaryotic cell structure.

[4]

(b) Outline the reasons for differences between the proteomes of cells within a multicellular organism.

[4]

(c) Discuss the cell theory and its limitations.

[7]

11 - (BIOLO/20_SL_Winter_2019_Q3) - Cell Biology

(a) Outline the cell theory. [2]

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(b) State **two** functions of life. [2]

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(c) List **three** characteristics of eukaryotic homologous chromosomes. [3]

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(d) Using the following table, compare and contrast anaerobic cell respiration in yeasts and in humans. The first row has been completed as an example. [3]

	Yeasts	Humans
Small yield of ATP	yes	yes
Require oxygen		
Produce ethanol and CO ₂		
Produce lactate		

12 - (BIOLO/20_SL_Winter_2019_Q5) - *Cell Biology, Evolution & Biodiversity, Ecology*

- (a) Draw a section of the Singer-Nicolson model of an animal cell membrane. [4]
- (b) Outline the principles used by scientists to classify organisms. [4]
- (c) Explain the movement of energy and inorganic nutrients in an ecosystem. [7]

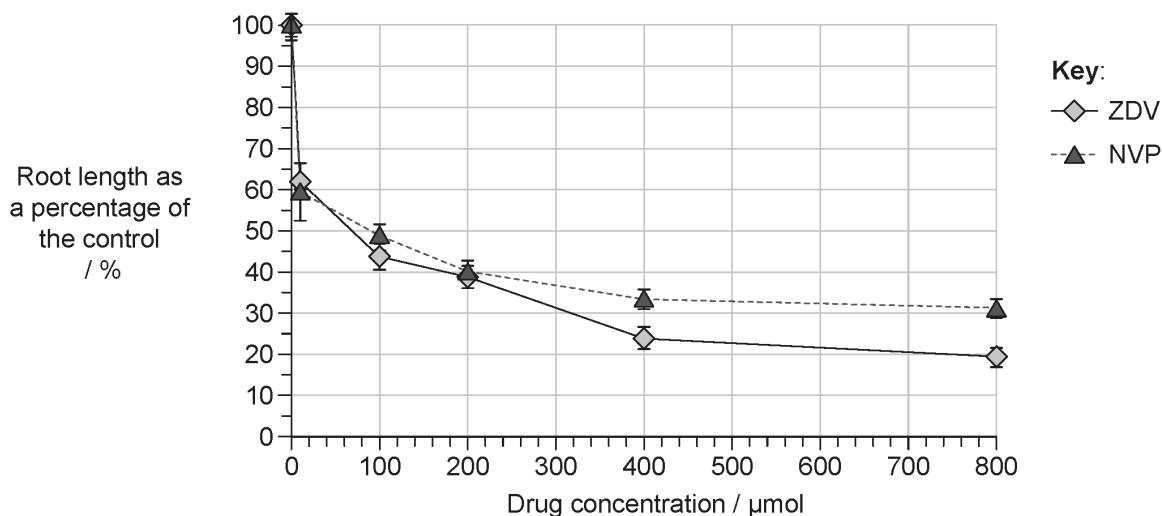
13 - (BIOLO/20_SL_Winter_2020_Q6) - *Cell Biology, Genetics, Human Physiology*

According to the cell theory, living organisms are composed of cells.

- (a) Draw the ultrastructure of a prokaryotic cell based on electron micrographs. [3]
- (b) Outline what occurs in cells in the first division of meiosis. [5]
- (c) Explain the role of cells in the defence against infectious disease. [7]

14 - (BIOLO/21_SL_Summer_2021_Q1) - *Cell Biology*

Antiretroviral drugs are used to treat Human Immunodeficiency Virus (HIV) infections. Zidovudine (ZDV) and nevirapine (NVP) are examples of antiretroviral drugs. There are concerns that these drugs may be toxic to body cells in mitosis. In a study using *Allium cepa*, root tips were exposed to the drugs for 96 hours at a range of concentrations. The control treatment was a drug concentration of 0 μmol . In the graph, root lengths after the 96-hour treatment period are expressed as a percentage of the length of the control.



- (a) (i) Deduce the concentration of ZDV that would cause a 50% reduction in root growth compared to the control. [1]

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- (ii) Identify the root length, as a percentage of the control, resulting from a ZDV concentration of 400 μmol . [1]

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- (b) Compare and contrast the effect of ZDV and NVP on the growth of *Allium* roots. [2]

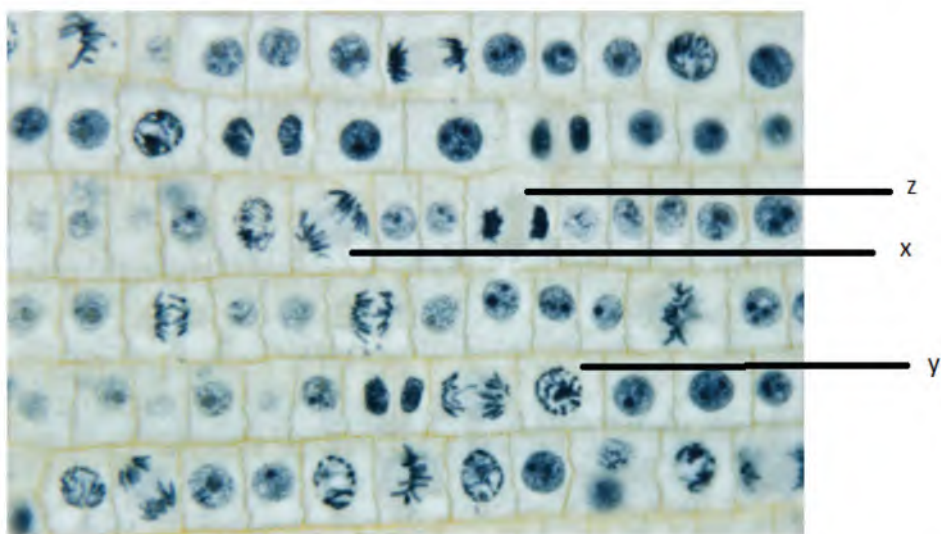
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Both ZDV and NVP are believed to have a damaging effect on the process of mitosis but ZDV in particular is believed to block the formation of the spindle.



- (c) Based on this information, suggest with a reason which of the labelled cell types will become more common in *Allium* root tips treated with ZDV. [2]

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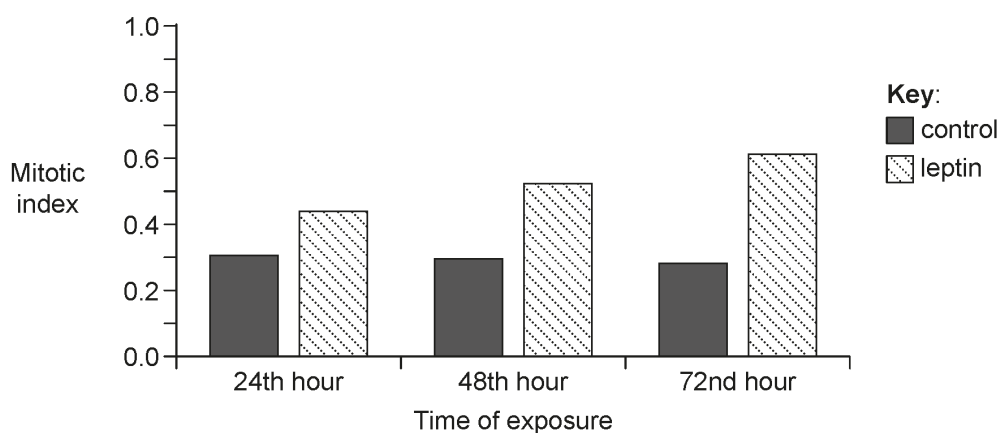
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- (d) *Allium* root tips continue to show some growth even at high concentrations of NVP. Suggest a possible reason for the growth seen in root tips with 800 μmol NVP.

[1]

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Mitosis plays an important role in tissue regeneration and can be an important factor in recovery from surgery. The hormone leptin has been shown to promote mitosis in certain circumstances. The bar chart shows the mitotic indices of liver tissue exposed to leptin and control tissue during 72 hours after surgery.



- (e) Deduce the change in mitotic index after 72 hours compared to the control.

[1]

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- (f) Based on the data, evaluate the evidence for leptin promoting regeneration of liver tissue.

[3]

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- (g) Outline the role of leptin in appetite control.

[1]

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15 - (BIOLO/22_SL_Summer_2021_Q6) - *Cell Biology, Human Physiology, Evolution & Biodiversity*

Tuberculosis (TB) is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*.

- (a) Outline the structures in *M. tuberculosis* that are not present in a human cell. [3]
- (b) Explain the production of antibodies when a patient is infected with the TB bacterium. [7]
- (c) Describe the risk to the human population of indiscriminate use of antibiotics. [5]

16 - (BIOLO/20_SL_Winter_2021_Q5) - *Cell Biology, Human Physiology*

Substances can move into and out of cells through the cell membrane.

- (a) Outline the significance of surface area to volume ratio in the limitation of cell size. [4]
- (b) Describe transport across cell membranes by osmosis. [4]
- (c) Explain the adaptations of the small intestine to its function. [7]

17 - (BIOLO/21_SL_Summer_2023_Q6) - *Cell Biology, Human Physiology*

In eukaryotes, the chromosomes are located in the nucleus, and the nucleus can divide by mitosis or meiosis.

- (a) Outline the sequence of events that occurs during mitosis. [5]
- (b) Describe the processes that occur in the nucleus of a cell during interphase. [7]
- (c) Explain how the presence of a Y chromosome in the cells of a human embryo causes it to develop as a male. [3]

18 - (BIOLO/21_SL_Winter_2023_Q4) - Cell Biology

The electron micrograph shows parts of two cells.



(a) Identify organelles I to III.

[3]

I:
II:
III:

(b) Using evidence from the micrograph, deduce whether the cells are prokaryotic or eukaryotic.

[2]

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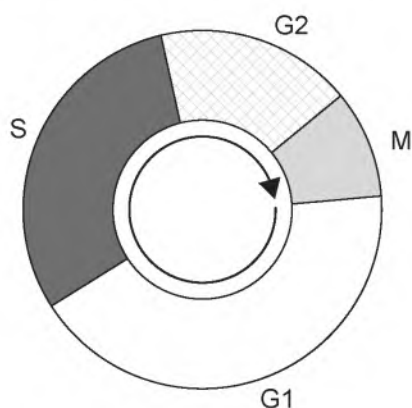
(c) State the function of flagella and ribosomes in prokaryotic cells.

[2]

Flagella:
Ribosomes:

19 - (BIOLO/21_SL_Summer_2024_Q2) - Cell Biology, Molecular Biology

The diagram shows the stages of the cell cycle.



- (a) (i) List the stages when the cell is in interphase. [1]

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- (ii) Distinguish between the quantity of DNA of the cell at G1 and G2. [1]

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- (b) Explain the properties of phospholipids that allow bilayers to form in cell membranes. [3]

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20 - (BIOLO/21_SL_Summer_2024_Q4) - Cell Biology, Genetics

The image shows a cell in the anther of a lily (*Lilium sp.*) plant during the first division of meiosis.



- (a) Identify the stage of meiosis shown in the image. [1]

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- (b) Outline the reason for diploid organisms producing haploid cells by meiosis. [2]

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- (c) Explain how non-disjunction during meiosis can lead to Down syndrome. [3]

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ANSWERS

1 - (BIOLO/21_SL_Summer_2017_Q2) - Cell Biology, Ecology

a		a. spontaneous generation is life appearing from nothing / from non-living / cells only come from pre-existing cells/life ✓ b. broth/culture medium (for bacteria) (used/placed) in flasks ✓ c. broth boiled/sterilized «in some flasks» to kill microbes ✓ d. no clouding/signs of bacterial growth/reproduction / microbes did not appear «in flasks of boiled broth» ✓ e. after necks of flasks were snapped boiled broth became cloudy/growth of microbes ✓ f. because microbes from the air contaminated the «boiled» broth ✓ g. curved necks allowed indirect exposure to air but prevented entry of microbes ✓	Allow bacteria or organisms instead of microbes.	3 max
b	i	movement / locomotion OR feeding/nutrition ✓		1
	ii	homeostasis OR maintain osmotic balance / expels «excess» water / maintains «cell» water content ✓		1
c		Advantages: a. «adult stem cells» can divide «endlessly» / can differentiate ✓ b. «adult stem cells» can be used to repair/regenerate «tissues» ✓ c. fewer ethical objections «than with embryonic stem cells» ✓ d. adults can give «informed» consent for use of their stem cells ✓ e. adult source is not killed / «source» would not have grown into new human / no death of embryos used to provide stem cells ✓ f. no rejection problems / patient's own cells used ✓ g. less chance of cancer/«malignant» tumor development «than from embryonic stem cells» ✓ h. most tissues in adults contain some stem cells ✓ Disadvantages: i. difficult to obtain/collect/find in adult body/very few available ✓ j. some «adult» tissues contain few/no stem cells ✓ k. «adult stem cells» differentiate into fewer cell types «than embryonic cells» / OWTTE ✓		3 max
d		a. saprotrophs/decomposers feed on/break down dead «organic» matter ✓ b. saprotrophs/decomposers release energy «heat» accelerating decomposition/warming soil ✓ c. saprotrophs/decomposers recycle nutrients / make nutrients available (to producers) OR improves soil fertility / returns nutrients (minerals/nitrates/phosphates/carbon) to soil/water/environment ✓ d. saprotrophs/decomposers detoxify waste ✓		2 max

2 - (BIOLO/22_SL_Summer_2017_Q2) - Cell Biology, Human Physiology

a		a. controls circadian rhythms/biological clocks «in mammals» ✓ b. production is controlled by amount of light detected by the retina ✓ c. high production/secretion in the dark OR no production/secretion in the day OR production/secretion is directly proportional to night time duration ✓ d. affects «seasonal» reproduction/sleep-wake cycles/jet lag ✓		2 max									
b	i	«digestive» enzymes ✓		1									
	ii	<table><tr><th>organelle</th><th>name</th><th>principal role</th></tr><tr><td>I</td><td>rough endoplasmic reticulum OR ribosome</td><td>protein production/synthesis «for excretion»</td></tr><tr><td>II</td><td>mitochondrion/mitochondria</td><td><u>aerobic</u> «cell» respiration OR ATP/energy production</td></tr></table>	organelle	name	principal role	I	rough endoplasmic reticulum OR ribosome	protein production/synthesis «for excretion»	II	mitochondrion/mitochondria	<u>aerobic</u> «cell» respiration OR ATP/energy production	✓ ✓	2
organelle	name	principal role											
I	rough endoplasmic reticulum OR ribosome	protein production/synthesis «for excretion»											
II	mitochondrion/mitochondria	<u>aerobic</u> «cell» respiration OR ATP/energy production											

3 - (BIOLO/22_SL_Summer_2017_Q3) - Cell Biology

a	a. «an inherited form of» degeneration of retinal layer/photoreceptor cells/blindness OR eye genetic disorder ✓ b. «hESC/stem cells» can provide/differentiate into healthy <u>retinal</u> cells ✓ c. injecting «hESC/stem cells» into the retina/eye can restore vision in animal/human trials ✓	OWTTE	2 max									
b	a. correct allele identification ✓ «eg: S = dominant/normal; s = recessive/disease» b. correct Punnett grid ✓ c. correct phenotypic ratio/outcome ✓	example: s =recessive, disease-causing form of gene, S =dominant, normal form parents =Ss. Any letter can be used as capital and lower case but a legend/key is not required if correct notation is used. <table><tr><td></td><td>S</td><td>s</td></tr><tr><td>S</td><td>SS</td><td>Ss</td></tr><tr><td>s</td><td>Ss</td><td>ss</td></tr></table> Do not award mp b if the gametes do not show heterozygous organisms phenotypic ratio: $\frac{3}{4}$ normal : $\frac{1}{4}$ with disease OR 3 normal : 1 with disease OR «75 % normal :» 25 % disease		S	s	S	SS	Ss	s	Ss	ss	3
	S	s										
S	SS	Ss										
s	Ss	ss										

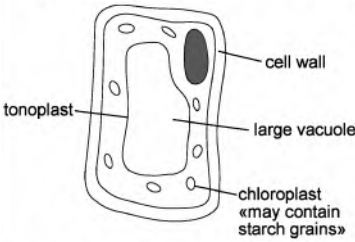
4 - (BIOLO/20_SL_Winter_2017_Q2) - Cell Biology, Genetics, Human Physiology

a	electron microscope has greater resolution/magnification OR 70 nm is too small/viruses are too small to be viewed by a light microscope ✓		1
b	a. viruses are not living ✓ b. viruses lack metabolism/lack enzymes «for metabolism»/lack cell walls ✓ c. antibiotics target metabolic «pathways»/cell wall production ✓		2 max
c	transfer/vector of genetic material/genes/DNA fragments OR to produce insulin/useful protein ✓		1

5 - (BIOLO/20_SL_Winter_2017_Q6) - Cell Biology, Human Physiology, Genetics

a	a. mitochondria and chloroplasts are similar to prokaryotes ✓ b. «host» cell took in another cell by endocytosis/by engulfing «in a vesicle» ✓ c. but did not digest the cell/kept the «ingested» cell alive OR symbiotic/mutualistic relationship «between engulfed and host cell» ✓ d. chloroplasts and mitochondria were once independent/free-living «organisms» ✓ e. DNA «loop» in chloroplast/mitochondrion ✓ f. division/binary fission of chloroplast/mitochondrion ✓ g. double membrane around chloroplast/mitochondrion ✓ h. 70s ribosomes «in chloroplast/mitochondrion» ✓	Allow "taking in" in place of "engulfing" Award up to [2] for evidence from mpe to mph	4 max
b	a. FSH stimulates the development of follicles ✓ b. follicles produce estrogen ✓ c. estrogen stimulates the repair of the uterus lining ✓ d. estrogen stimulates LH secretion ✓ e. LH causes/stimulates ovulation ✓ f. LH causes/stimulates the development of the corpus luteum ✓ g. corpus luteum secretes progesterone ✓ h. progesterone causes/stimulates thickening of the uterus lining OR prepares uterine lining for implantation OR maintains the endometrium ✓ i. progesterone/estrogen inhibits the secretion of LH/FSH ✓ j. falling progesterone levels at the end of the cycle allow FSH production/menstruation ✓ k. negative/positive feedback «control» described correctly ✓ l. LH/FSH are pituitary hormones ✓		8 max
c	a. clones are genetically identical organisms OR group of cells derived from a single parent cell ✓ b. asexual reproduction in plants such as tubers/runners/bulbs ✓ c. common in non-vertebrates such as budding in hydra ✓ d. budding in yeast/fungi ✓ e. identical twins «in humans» are clones because they originate from the same cell ✓	Allow other verifiable examples of plants Allow other verifiable examples of invertebrates Allow other verifiable examples of fungi	3 max

6 - (BIOLO/20_SL_Winter_2017_Q7) - Cell Biology, Molecular Biology, Ecology

a		Allow [2 max] if any features common to both plant cells and animal cells are labelled  Must be shown as a double line Labelled either inside or on the membrane a. cell wall ✓ b. large vacuole ✓ c. chloroplast/plastid ✓ d. starch grain ✓ e. tonoplast ✓	3 max
b	a. <u>autotrophs</u> perform photosynthesis ✓ b. carbon dioxide and water are the reactants/raw materials required for «photosynthesis» ✓ c. light splits water molecules/causes photolysis ✓ d. «photolysis» releases oxygen as a «waste» product ✓ e. light energy is converted into chemical energy ✓ f. «photosynthesis» produces organic compounds/glucose/carbohydrates ✓ g. photosynthesis occurs in chloroplasts ✓ h. chlorophyll «photosynthetic pigment» absorbs light ✓ i. different pigments absorb different wavelengths «of light» ✓ j. chlorophyll absorbs red and blue light/ends of the spectrum ✓ k. carbon dioxide concentration/temperature/light intensity are limiting factors ✓	Award only [1] for correct display of equation unless further annotated or explained Allow up to [2] for correct use of understandings specified as AHL topic 8	8 max
c	a. formed from dead plant material/leaves/mosses/<i>Sphagnum</i> ✓ b. formed in waterlogged sites/bogs/mires/swamps ✓ c. where bacteria/fungi/saprotrophs are not active/are inhibited ✓ d. organic matter not fully decomposed ✓ e. «occurs» in acidic conditions ✓ f. «occurs» in anaerobic conditions ✓ g. «very» slow process/takes a long time ✓	Reject anaerobic respiration	4 max

7 - (BIOLO/21_SL_Summer_2018_Q5) - Cell Biology, Ecology

a	Draw a labelled diagram to show the fluid mosaic model of the plasma membrane. a. two correctly oriented layers of <u>phospholipids/phospholipid bilayer</u> shown with heads facing in opposite directions ✓ b. phospholipids shown with two parts labelled <u>hydrophilic/phosphate</u> head AND <u>hydrophobic/hydrocarbon</u> tail c. <u>protein</u> (any) shown as a globular structure embedded in one/both layers of phospholipid ✓ d. <u>peripheral protein</u> shown as globular structure at the surface of the membrane AND <u>integral protein</u> shown as embedded globular structures ✓ e. <u>glycoprotein</u> shown as embedded globular structure with antenna-like carbohydrate protruding / <u>carbohydrate</u> shown as a branched/antenna-like structure either on a protein or on a phospholipid OR <u>channel</u> protein(s) shown with a pore passing through it OR <u>pump</u> protein shown as a transmembrane globular structure ✓ f. <u>cholesterol</u> shown in between adjacent phospholipids ✓	Do not award the mark unless the structure is labelled with the underlined name.	4 max
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b	a. nutrition: process by which organisms take in and make use of food//nutrients OWTTE ✓ b. metabolism: conversion of organic molecules/chemical reactions in an organism ✓ c. growth: increase in size/mass/number of cells within an organism ✓ d. response/irritability/sensitivity: reactions/responsiveness to stimuli/factors ✓ e. homeostasis: regulating/maintaining constant/stable interior environment ✓ f. reproduction: production of similar cells/organisms from existing ones/offspring ✓ g. excretion: elimination of (metabolic) wastes ✓	4 max
c	a. autotrophs/producers absorb carbon (dioxide) from atmosphere/air/water ✓ b. autotrophs make carbohydrates/organic compounds / perform photosynthesis ✓ c. carbon (compounds) pass along food chains/trophic levels (as consumers feed) ✓ d. respiration releases carbon (dioxide) into atmosphere/water ✓ e. carbon (dioxide) is released from dead matter /by decomposition/respiration ✓ f. methane is produced during anaerobic respiration of organic matter / by methanogens in cattle/herbivores ✓ g. methane is oxidized into carbon dioxide in the atmosphere ✓ h. fossil fuels/peat were made from partially decomposed organic matter ✓ i. combustion of fossil fuels/forest fires/biomass releases carbon (dioxide) into the atmosphere ✓ j. volcanic eruptions may add large quantities of carbon (dioxide) into the atmosphere ✓ k. limestone (from shells/reefs/trees/permafrost are <u>sinks</u> of carbon ✓	7 max

8 - (BIOLO/22_SL_Summer_2018_Q3) - Cell Biology, Ecology

a	i	I. cell wall ✓ II. nucleus/chromatin ✓	Both needed.	1												
a	ii	a. necessary for photosynthesis/converts light energy into chemical energy ✓ b. contains chlorophyll to absorb light ✓ c. (contains enzymes) for production of carbohydrate/glucose/starch ✓		2 max												
a	iii	a. produce flowers ✓ b. enclosed seeds/have fruit ✓		1 max												
b		<table><tr><th></th><th>autotroph</th><th>heterotroph</th></tr><tr><td>a.</td><td>inorganic source of carbon</td><td>organic source of carbon compounds ✓</td></tr><tr><td>b.</td><td>synthesizes organic molecules from inorganic sources ✓</td><td>obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓</td></tr><tr><td>c.</td><td>autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓</td><td>heterotrophs require chemical energy from ingested nutrients ✓</td></tr></table>		autotroph	heterotroph	a.	inorganic source of carbon	organic source of carbon compounds ✓	b.	synthesizes organic molecules from inorganic sources ✓	obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓	c.	autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓	heterotrophs require chemical energy from ingested nutrients ✓	Table format not required. Must be paired statements.	2
	autotroph	heterotroph														
a.	inorganic source of carbon	organic source of carbon compounds ✓														
b.	synthesizes organic molecules from inorganic sources ✓	obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓														
c.	autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓	heterotrophs require chemical energy from ingested nutrients ✓														

c	a. energy enters ecosystems from the <u>Sun</u> / continuous supply from the <u>Sun</u> ✓ b. light energy is converted into chemical energy and lost with movement along food chains OR energy needs to be «constantly» added «to ecosystem» as lost with movement along food chains / energy lost as <u>heat</u> with movement along food chains ✓ c. nutrients are recycled within ecosystems / nutrients in an ecosystem are finite and limited ✓ d. nutrients not lost but transformed into different compounds ✓ e. nutrients «carbon compounds»/energy flow through food chains by means of feeding ✓		3 max
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9 - (BIOLO/22_SL_Summer_2018_Q5) - Cell Biology, Human Physiology

a	a. <u>phospholipid bilayer</u> – with head and tails ✓ b. hydrophilic/phosphate/polar heads AND hydrophobic/hydrocarbon/fatty acid/non-polar tails labelled ✓ c. <u>integral/intrinsic protein</u> – embedded in the phospholipid bilayer ✓ d. <u>protein channel</u> – integral protein showing clear channel/pore ✓ e. <u>peripheral/extrinsic protein</u> – on the surface ✓ f. <u>glycoprotein</u> with carbohydrate attached ✓ g. <u>cholesterol</u> – shown embedded in bilayer ✓	<i>Award [1] for each structure clearly drawn and correctly labelled.</i> <i>Both needed.</i>	4 max
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b	a. «simple» diffusion of nutrients along/down a concentration gradient ✓ b. example of simple diffusion, eg: fatty acids ✓ c. facilitated diffusion of nutrients involves movement through <u>channel proteins</u> ✓ d. example of nutrient for facilitated diffusion eg: fructose ✓ e. active transport of nutrients against a concentration gradient / involving <u>protein pumps</u> ✓ f. example of active transport, eg: (iron) ions/glucose/amino acids ✓ g. endocytosis / by means of vesicles ✓ h. example of nutrient for endocytosis, eg: cholesterol in lipoprotein particles ✓		4 max
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c	a. nerve impulses are action potentials propagated along axons of neurons ✓ b. resting potential is -70 mV OR relatively negative inside in comparison to the outside ✓ c. Na^+/K^+ pumps maintain/re-establish «the resting potential» ✓ d. more sodium ions outside than inside «when at the resting potential» OR more potassium ions inside than outside «when at the resting potential» ✓ e. action potential stimulates «wave of» depolarization along the membrane/axon ✓ f. «when neuron is stimulated» if threshold potential is reached Na^+ channels open ✓ g. sodium ions diffuse/move in ✓ h. «Na^+ move in» causing depolarization / inside of the neuron becomes more positively charged than the outside of the neuron ✓ i. potassium ion channels open OR potassium ions diffuse/move out ✓ j. «K^+ move out» causing repolarization ✓ k. local currents OR description of Na^+ ion diffusion between depolarized region and next region of axon to depolarize ✓ l. myelination increases propagation speed/allows saltatory conduction ✓	Accept any of the points clearly explained in an annotated diagram.	7 max
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10 - (BIOLO/20_SL_Winter_2018_Q5) - Cell Biology

a	a. cell wall — a uniformly thick wall ✓ b. pili — hair-like structures connected to cell wall OR flagellum — at one end only, longer than pili ✓ c. plasma/cell membrane — represented by a continuous single line ✓ d. «70S» ribosomes — drawn as small discrete dots not circles ✓ e. naked DNA/nucleoid — region with DNA not enclosed in membrane ✓ f. cytoplasm — the non-structural material within the cell ✓	Award [1] for each structure clearly drawn and correctly labelled Award [2 max] if any eukaryotic structure is drawn and labelled May be labelled as the innermost wall line	4 max
b	a. all the genome is the same in all the cells of an organism ✓ b. the genome/DNA/genes instructs the production/expression of proteins/proteome ✓ c. the proteome is all the proteins produced by a cell ✓ d. the proteome varies with the function/location/cell differentiation/environmental conditions of the cell ✓ e. specific genes are expressed/turned on/off in different cells ✓ f. «turning on/off» according to a required function ✓	Accept a specific example (eg: insulin only produced in pancreas)	4 max

c	<i>cell theory:</i> a. cell theory is the accepted explanation of life ✓ b. organisms are composed of «one or more» cells ✓ c. cells are the basic/fundamental/smallest units of life ✓ d. cells can only come from pre-existing cells ✓ e. spontaneous generation of life has been disproven ✓ <i>limitations:</i> f. striated muscle cells contain many nuclei «while most eukaryotic cells have one nucleus» OR red blood cells have no nucleus «while most eukaryotic cells have one nucleus» ✓ g. giant algae have complex single cell structure OR organisms as large as giant algae would be expected to be multicellular, but they have only one cell with one nucleus ✓ h. aseptate fungal hyphae are tube-like structures that contain no cell membranes between the many nuclei OR slime molds contain many nuclei ✓ i. viruses have some characteristics of living organisms but are not cells ✓ j. if all cells come from pre-existing cells, where did the first one come from? ✓	<i>Allow description of Pasteur's experiments</i> <i>Do not accept a list of limitations without explanation</i>	7 max
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11 - (BIOLO/20_SL_Winter_2019_Q3) - Cell Biology

a		a.	cells can only arise from preexisting cells ✓		2 max
		b	living organisms are composed of cells/smallest unit of life ✓		
		c	organisms consisting of only one cell carry out all functions of life in that cell/cells perform life functions «at some point in their existence» ✓		
		d	although most organisms conform to cell theory, there are exceptions ✓		
b		a	nutrition ✓	<i>Do not allow "feeding", plants do not "feed".</i> <i>Mark the first two answers only.</i>	2 max
		b	metabolism/respiration ✓		
		c	growth ✓		
		d	response/irritability ✓		
		e	excretion ✓		
		f	homeostasis ✓		
		g	reproduction ✓		

c	a	linear DNA molecules OR DNA associated with histone «proteins» ✓		3 max		
	b	carry the same sequence of <u>genes</u> ✓				
	c	«but» not necessarily the same <u>alleles</u> «of those genes» ✓				
	d	both are present when nucleus is in diploid state ✓ OR occur in pairs ✓				
	e	have <u>same</u> size/length/banding patterns ✓				
	f	centromeres are in the same position ✓				
	d	a				Yeasts
Small yield of ATP			yes	yes		
require oxygen			no	no ✓		
produce ethanol and CO ₂			yes	no ✓		
produce lactate			no	yes ✓		

12 - (BIOLO/20_SL_Winter_2019_Q5) - Cell Biology, Evolution & Biodiversity, Ecology

a			<i>Elements should be clearly drawn, correctly positioned and annotated.</i>	4 max
	a	bilayer of phospholipids with both "tails" towards the inside «of the bilayer» ✓	<i>This can be taken unlabeled from diagram.</i>	
	b	hydrophilic/polar and hydrophobic/non-polar annotation ✓		
	c	cholesterol between phospholipid tails ✓		
	d	glycoprotein ✓		
	e	integral proteins/channel proteins ✓		
	f	peripheral proteins ✓	<i>Allow this if it does not extend across the membrane</i>	

b	a	use of the binomial system ✓	Names of the seven taxa not required. OWTTE Allow example e.g. fossil record comparison	4 max
	b	agreed/developed by scientists / OWTTE ✓		
	c	hierarchy of taxa used ✓		
	d	three domains used/three domain names ✓		
	e	genome/DNA sequence similarities OR amino acid sequence of specific proteins ✓		
	f	species from a common ancestor are grouped together OR included in the same clade/branch in cladogram ✓		
	g	use evidence of evolutionary origin ✓		
	h	shared characteristics within a group OR similar embryonic development ✓		

c	a.	autotrophs/producers/plants obtain inorganic nutrients from the «abiotic» environment ✓	Allow OWTTE for mpf for passed up trophic levels.	7 max
	b.	energy provided «mainly» by sunlight ✓		
	c.	light energy converted «to chemical energy» through photosynthesis ✓		
	d	photosynthesis/producers/autotrophs convert inorganic carbon/carbon dioxide and water into carbon/organic compounds ✓		
	e	«these» carbon compounds/foods contain/are a source of «useable» energy «for life» ✓		
	f	carbon compounds/energy are transferred along food chains when eaten by consumers/heterotrophs ✓		
	g	respiration returns carbon «dioxide» to the environment ✓		
	h	respiration releases stored/chemical energy as ATP/heat ✓		
	i	energy/ATP is used to carry out life functions/synthesis/growth/movement ✓		
	j	energy is lost/not recycled ✓		
	k	nutrients are recycled / example of recycled nutrient e.g. carbon ✓		
	l	decomposers recycle minerals/inorganic nutrients ✓		

13 - (BIOLO/20_SL_Winter_2020_Q6) - *Cell Biology, Genetics, Human Physiology*

a a. cell wall; b. plasma membrane; <i>Clearly shown as a separate line under the cell wall or the inner line</i> c. cytoplasm AND 70S ribosomes; <i>Do not allow (small) circles</i> d. nucleoid/naked DNA; e. plasmid OR pili OR flagella/flagellum;	<i>Structures correctly drawn and labelled.</i> <i>Award [2 max] if any exclusively eukaryotic structures are shown.</i> <i>Do not allow cilia as they are not found in prokaryotes.</i>	3 max
b a. halves the chromosome number/produces haploid cells; b. at start of meiosis each chromosome consists of two sister chromatids attached by a centromere; c. prophase (I): pairing of homologous chromosomes; d. crossing over occurs; e. chromosomes condense by supercoiling; f. metaphase (I): pairs of homologous chromosomes/bivalents move to equator of spindle OR metaphase (I): orientation of pairs of homologous chromosomes (prior to separation) is random; g. anaphase (I): centromeres do not divide OR anaphase (I): spindle fiber pulls chromosome/whole centromere with two sister chromatids to opposite poles; h. telophase (I): arrival of centromere with sister chromatids at opposite poles;	<i>Some of these can be awarded for correctly annotated diagrams.</i> <i>No credit for events in meiosis II.</i>	5 max
c a. cells of skin provide a physical barrier/produce fatty acids/lactic acid/lysozyme which stops entry of microbes OR mucous membranes produce mucus to trap pathogens OR stomach cells produce hydrochloric acid which kills microbes; b. platelets start the clotting process preventing access of pathogens; c. (two types of) white blood cells fight infections in the body; d. phagocytes ingest pathogens (by endocytosis/phagocytosis); e. gives non-specific immunity to diseases / ingest any type of pathogen; f. production of antibodies by lymphocytes/B cells; g. in response to particular pathogens/antigens; h. gives specific immunity; i. lymphocyte/B cell makes only one type of antibody; j. plasma cells produce large quantity of (one type of) antibody; k. some lymphocytes act/remains as memory cells; l. can quickly reproduce to form a clone of plasma cells if a pathogen carrying a specific antigen is re-encountered; m. results in faster defence against second exposure to specific antigen/pathogen/disease;		7 max

14 - (BIOLO/21_SL_Summer_2021_Q1) - *Cell Biology*

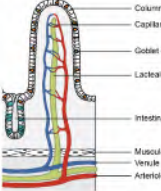
a	i	75 μmol ✓	Deduce Allow answers in the range of 70 μmol-80 μmol	1
a	ii	24 % ✓	Identify Allow answers in the range 23%-25%	1
b		<i>Similarities:</i> a. reduce root length (compared to the control) ✓ b. (ZDV and NVP) have greatest change (in growth) at lowest concentrations (of ZDV and NVP) ✓ c. same effect at 200 μmol ✓ d. above/at about 400 μmol effect levels off ✓ <i>Differences:</i> e. the change/differences become significant after 200 μmol ✓ f. ZDV has a (slightly) larger effect / NVP has a (slightly) smaller effect / WTTE OR above 400 μmol effect of ZDV remains higher / NVP remains lower ✓	Compare and contrast Answer must contain one similarity and one difference Credit may be given for numeric differences when accurately stated	2 max
c		a. Y (will become more common) ✓ b. spindle not formed yet OR cells x and z have spindles ✓ c. cells in Y cannot progress (into Z/into metaphase) ✓	Suggest	2 max

d	a. still some mitosis ✓ b. individual cells grow/elongate (expand by absorbing water) ✓ c. NVP is not 100% effective / does not enter all of the cells / not all cells have come in contact with NVP ✓ d. roots have reached maximum saturation of NVP and are no longer functionally affected ✓ e. some cells are resistant to the drug ✓	<i>Suggest</i> <i>Accept reasonable suggestions. If in doubt contact your team leader.</i>	1 max
e	0.3 / 100% increase / doubling ✓	<i>Deduce</i> <i>Do not penalize errors in significant figures. For example, 0.34 would be acceptable.</i>	1
f	a. mitotic index in treatment greater than in control/leptin appears to promote mitosis ✓ b. mitotic index increases with time suggests ongoing regeneration/growth OR positive correlation between exposure to leptin and increased mitotic index ✓ c. but experiment limited to 72 hours/regeneration/recovery may take longer than 72 hours ✓ d. no error bars shown/no information on significance/sample size ✓	<i>Evaluate</i> <i>Acknowledge WTTE</i>	3 max
g	a. acts on receptors in the hypothalamus/appetite centre ✓ b. inhibits appetite ✓	<i>Outline</i> <i>Accept WTTE for mpb</i>	1 max

15 - (BIOLO/22_SL_Summer_2021_Q6) - Cell Biology, Human Physiology, Evolution & Biodiversity

a	a. cell wall ✓ b. pili/flagella ✓ c. 70S ribosomes ✓ d. nucleoid / circular DNA OR naked DNA ✓ e. plasmids ✓	<i>As candidates do not need to know the structure of Mycobacterium tuberculosis, all prokaryotic structures are accepted.</i> <i>Ignore references to membrane bound organelles</i>	3 max
b	a. phagocytes/lymphocytes are white blood cells ✓ b. TB bacterium has a specific antigen ✓ c. this antigen is recognised by white blood cells ✓ d. a clone of lymphocytes/plasma cells/B cells are produced ✓ e. antibodies are produced by lymphocytes ✓ f. each lymphocyte produces just one type of antibody ✓ g. (this is) specific immunity ✓ h. (part of the) antibody/immunoglobulin binds to the antigen / specific antibody binds to the specific antigen ✓ i. antibodies are proteins/immunoglobulins ✓ j. (some) plasma cells become memory cells ✓ k. memory cells reproduce quickly ✓ l. memory cells prevent infection in the future ✓	<i>Allow annotated diagrams to explain the process.</i>	7 max
c	a. antibiotics block bacterial processes ✓ b. example of bacterial process ✓ c. variations exist naturally in a population / some are naturally resistant to the antibiotic ✓ d. bacteria that are not resistant to this antibiotic will die / only resistant will survive (when antibiotic given) ✓ e. this characteristic could be passed to next generation ✓ f. (natural selection) leads to changes in the proportions/frequency in the population ✓ g. human population will be exposed to antibiotic resistant bacteria and will not have antibiotic to kill them ✓ h. (antibiotic resistant bacteria) may pass resistance to other bacteria species/types by means of plasmids (so other bacteria species turn resistant too) ✓	<i>e.g. cell wall formation</i>	5 max

16 - (BIOLO/20_SL_Winter_2021_Q5) - *Cell Biology, Human Physiology*

a	a. surface area of the cell affects the rate of material exchange; b. when the cell increases in size, so does its chemical activity/metabolism; c. (when the cell increases in size/grows) more substances need to be taken in / more waste products need to be excreted; d. as the volume of the cell increases, so does the surface area, however not to the same extent OR when the cell gets bigger, its surface area to volume ratio gets smaller; e. substances will not be able enter the cell fast enough/cell volume will not be supplied OR metabolic rate will exceed the rate of exchange OR when the surface area:volume ratio is higher, the diffusion rate increases; f. some cells have adaptations to increase their surface area/flatten/microvilli/shape of red blood cells; g. cells in growth areas tend to divide and remain small OR cells divide when maximum size is reached;		4 max
b	a. form of diffusion; b. osmosis is the movement of water molecules; c. (movement) across a <u>selectively/semi/partially permeable</u> membrane/cell membrane; d. from a region of <u>low solute</u> concentration to a region of <u>high solute</u> concentration (until equilibrium is reached) OR movement of <u>water</u> molecules from a high concentration of <u>water</u> to a low concentration of water molecules; e. it is a passive transport mechanism/does not use ATP; f. channel proteins/aquaporins are used;		4 max
c	a. small intestine is where nutrients are absorbed into the <u>bloodstream</u>; b. very long to maximize absorption; c. (the small intestine) is lined with (smooth) muscle to allow for the mixing/ and moving of digested food; d. muscles are circular <u>and</u> longitudinal; e. that perform peristalsis; f. the pancreas (and gall bladder) secretes substances into the small intestine to aid digestion; g. contain villi, to <u>increase surface area</u>; h. villi have microvilli to increase surface area even more; i. villi absorb products of digestion/mineral ions/vitamins/glucose; j. dense capillary network rapidly transports absorbed products; k. lacteal absorbs lipids from the intestine (into the lymphatic system); l. (most of the) chemical digestion (into monomers) occurs in small intestine/description of specific enzyme action;	Accept annotated diagrams as part of the explanation. 	7 max

17 - (BIOLO/21_SL_Summer_2023_Q6) - Cell Biology, Human Physiology

a	a. supercoiling/condensation of <u>chromosomes</u>; b. breakup of nuclear membrane; c. growth of spindle/microtubules; d. attachment of spindle/microtubules to chromosomes/centromeres; e. chromosomes line up at the equator/middle f. division of centromeres; g. separation of sister chromatids/chromosomes OR sister chromatids/chromosomes move to opposite poles; h. reformation of nuclear membranes around chromosomes at each pole;	outline <i>If events are not in the correct order, then award a maximum of 4 marks.</i> <i>Names of phases of mitosis not required.</i> <i>Award a max of 1 mark for listing the phases in the correct order when the list constitutes the entire response.</i>	[5 max]
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b	a. DNA is replicated; b. unwinding of the double helix/DNA (by helicase) OR supercoiled DNA is relaxed (by gyrase); c. hydrogen bonds broken OR strands separate; d. synthesis of new strands of DNA (by DNA polymerase); e. DNA replication occurs semi-conservatively OR existing strand used as a template (for a new strand of DNA); OR DNA replication is continuous on the leading strand, but discontinuous on the lagging strand; f. copying base sequences occurs through complementary base pairing (in both transcription and replication); g. DNA is transcribed; h. synthesis of RNA/mRNA (by RNA polymerase); i. copy of a gene produced/only one gene transcribed; j. introns are removed; k. RNA/mRNA exported/moves to the cytoplasm;	<i>describe</i>	[7 max]
c	a. gene/genetic information on Y chromosome causes embryo to develop testes; b. (developing) testes in embryo secrete testosterone; c. testosterone causes male genitalia/penis to develop;	<i>explain</i> Accept SRY gene in mp-a	[3 max]

18 - (BIOLO/21_SL_Winter_2023_Q4) - Cell Biology

a	I = nucleus; II = Golgi (apparatus/body); III = mitochondrion;		3
b	a. eukaryotic because cytoplasm is compartmentalized / there are <u>membrane-bound</u> organelles; b. eukaryotic because a nucleus is present; c. eukaryotic because a mitochondrion is present/other named eukaryotic cytoplasmic organelle that can be seen in micrograph; d. eukaryotic, as scale shows that it is far bigger than a prokaryotic cell;	<i>'organelles' on its own is insufficient.</i>	2 max
c	flagella = movement/locomotion; ribosome = protein synthesis/translation;		2

19 - (BIOLO/21_SL_Summer_2024_Q2) - Cell Biology, Molecular Biology

a	i	G1, S, G2;		1
a	ii	G2 doubles G1;		1
b		a. phospholipids are amphipathic/have hydrophobic/nonpolar and hydrophilic/polar regions; b. <u>phosphate heads</u> are hydrophilic/polar and <u>fatty acid/hydrocarbon tails</u> are hydrophobic/nonpolar; c. hydrophilic/polar (phosphate) heads face/are attracted to water (inside and outside of cell); d. hydrophobic/nonpolar (fatty acid) tails face each other inwardly/away from water/ not attracted to water;	<i>Accept each marking point in a labelled diagram.</i>	3 max

20 - (BIOLO/21_SL_Summer_2024_Q4) - Cell Biology, Genetics

a		anaphase / anaphase I;	<i>Do not accept anaphase II.</i>	1
b		a. haploid cells contain half the number of chromosomes; b. at fertilization/male and female gametes combine; c. diploid number is restored/maintain chromosome number; d. increases genetic diversity;		2 max
c		a. non-disjunction occurs when chromosomes fail to separate (during meiosis); b. this leads to a gamete with an extra chromosome; c. if fertilization occurs with this gamete the zygote will have an extra chromosome; d. Down syndrome is when an individual has trisomy 21/an extra chromosome 21;		3 max

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