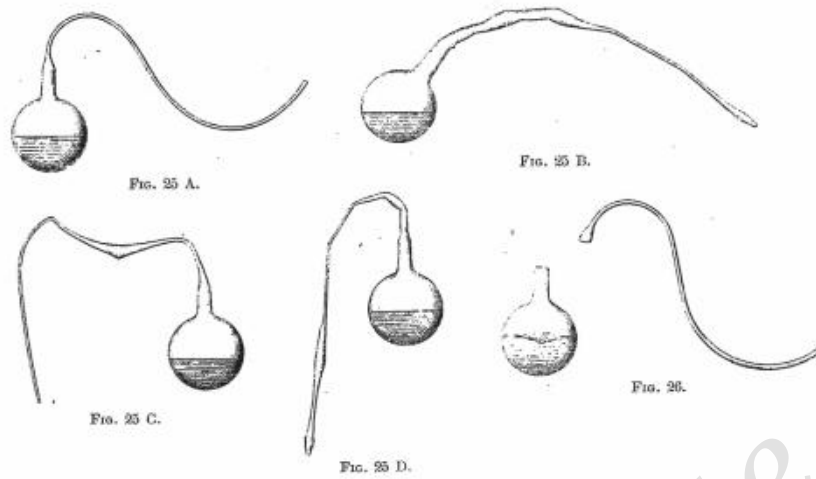


IB Diploma  
**BIOLOGY**  
HL P2  
2017 — 2023

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	<b>Answers</b>	Page 418

1 - (BIOLO/21\_HL\_Summer\_2017\_Q3) - Cell Biology

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



[Source: L Pasteur and L Pasteur Vallery-Radot, (1922), *Cœuvres 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]

.....  
.....

(ii) the contractile vacuole.

[1]

.....  
.....

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

[3]

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2 - (BIOLO/22\_HL\_Summer\_2017\_Q3) - Cell Biology

(a) Outline the properties of water molecules that permit them to move upwards in plants. [2]

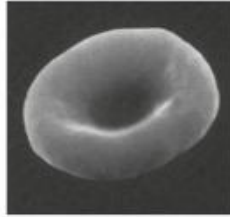
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(b) Define osmolarity. [1]

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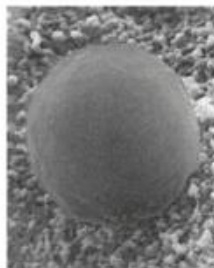
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(c) This image shows a normal red blood cell.

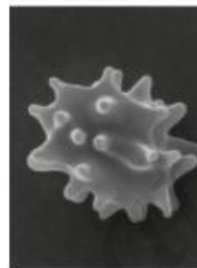


These images show two red blood cells that have been placed in solutions with different concentrations of solutes.

Red blood cell 1



Red blood cell 2



[Source: adapted from [www.acbrown.com](http://www.acbrown.com)]

Deduce, with a reason, which red blood cell has been placed in a hypertonic solution. [1]

.....

.....

(d) State what change there has been in the cell surface area to volume ratio in red blood cell 1. [1]

.....

3 - (BIOLO/22\_HL\_Summer\_2017\_Q8) - *Cell Biology, Genetics, Nucleic Acids (ahl)*

- (a) Cells go through a repeating cycle of events in growth regions such as plant root tips and animal embryos. Outline this cell cycle. [4]
- (b) Draw a labelled diagram of the formation of a chiasma by crossing over. [3]
- (c) Explain the control of gene expression in eukaryotes. [8]

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4 - (BIOLO/20\_HL\_Winter\_2017\_Q6) - *Cell Biology, Animal Physiology (ahl), Evolution & Biodiversity*

Cell biologists play an important role in research into disease, fertility, evolution and many other areas of science.

- (a) Describe the origin of eukaryotic cells according to the endosymbiotic theory. [4]
- (b) Compare and contrast the processes of spermatogenesis and oogenesis. [8]
- (c) Outline the evidence for evolution provided by selective breeding. [3]

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5 - (BIOLO/21\_HL\_Summer\_2018\_Q5) - Cell Biology, Molecular Biology

(a) The image shows a cell in a section of an onion root tip seen under a light microscope.



[Source: Adapted Dr. phil.nat Thomas Geier, Fachgebiet Botanik der Forschungsanstalt Geisenheim, [https://commons.wikimedia.org/wiki/File:Allium-Mitose03-DM100x\\_BL28.jpg](https://commons.wikimedia.org/wiki/File:Allium-Mitose03-DM100x_BL28.jpg). Licenced under the Creative Commons Attribution-Share Alike 3.0 Unported license, <https://creativecommons.org/licenses/by-sa/3.0/legalcode>.]

(i) Identify the structure labelled X. [1]

.....

(ii) State the stage of mitosis of this cell. [1]

.....

(b) Compare and contrast the location of ATP synthase and the movement of protons during aerobic cell respiration and photosynthesis. [2]

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 .....  
 .....  
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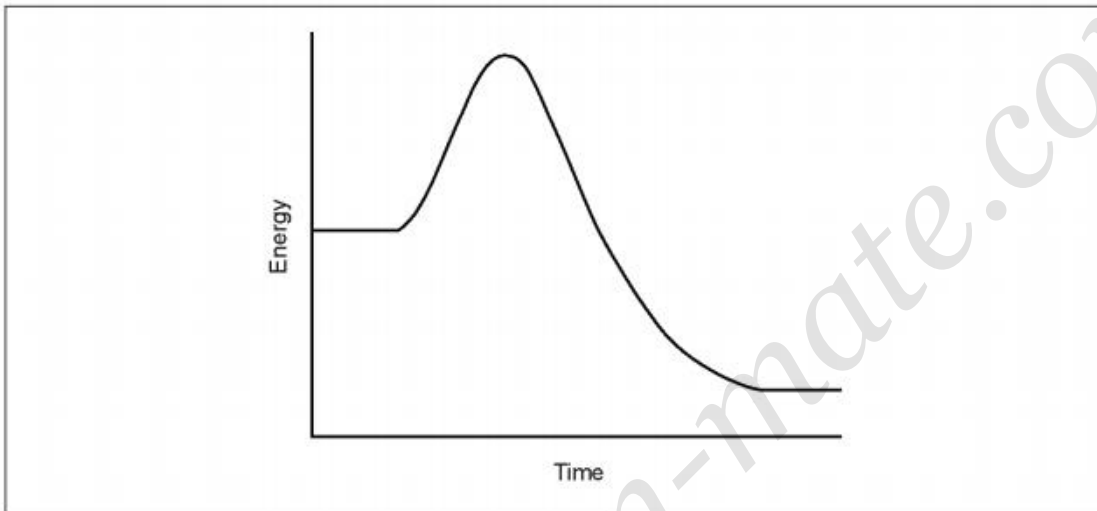
(c) Using the table, distinguish between the production of ATP, use of oxygen and release of CO<sub>2</sub> in aerobic cell respiration between the cytoplasm and the mitochondrion.

[3]

	Cytoplasm	Mitochondrion
ATP production		
Use of oxygen		
Release of CO <sub>2</sub>		

(d) The graph shows energy levels throughout an uncatalysed reaction. Draw a curve to show how the action of an enzyme would affect this reaction.

[1]



# ANSWERS

[www.examinations.com](http://www.examinations.com)

## 1 - (BIOLO/21\_HL\_Summer\_2017\_Q3) - Cell Biology

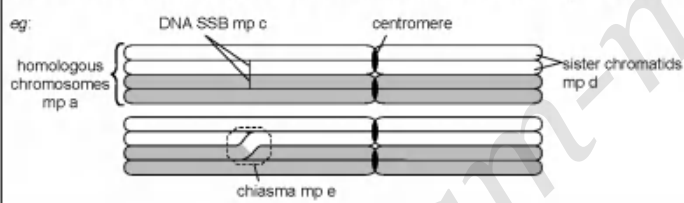
a	<ul style="list-style-type: none"> <li>a. spontaneous generation is life appearing from nothing/from non-living/cells only come from pre-existing cells/life ✓</li> <li>b. broth/culture medium «for bacteria» «used/placed» in flasks ✓</li> <li>c. broth boiled/sterilized «in some flasks» to kill microbes ✓</li> <li>d. no clouding/signs of bacteria growth/reproduction/microbes did not appear «in flasks of boiled broth» ✓</li> <li>e. after necks of flasks snapped boiled broth became cloudy/growth «of microbes» ✓</li> <li>f. because microbes from the air contaminated the «boiled» broth ✓</li> <li>g. curved necks allowed exposure to air but prevented entry of microbes ✓</li> </ul>	Allow bacteria or organisms instead of microbes.	3 max	
b	i	<ul style="list-style-type: none"> <li>movement / locomotion</li> <li>OR</li> <li>feeding/nutrition ✓</li> </ul>	If student has multiple answers do not accept the second answer if the first one is incorrect.	1
	ii	<ul style="list-style-type: none"> <li>homeostasis</li> <li>OR</li> <li>maintain osmotic balance / osmoregulation / expels «excess» water / maintains «cell» water content ✓</li> </ul>	If student has multiple answers do not accept the second answer if the first one is incorrect.	1
c		<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>a. «adult stem cells» can divide «endlessly» / can differentiate ✓</li> <li>b. «adult stem cells» can be used to repair/regenerate «tissues» ✓</li> <li>c. fewer ethical objections «than with embryonic stem cells» ✓</li> <li>d. adult source not killed / «source» would not have grown into new human / no death of embryos used to provide stem cells ✓</li> <li>e. adults can give «informed» consent for use of their stem cells ✓</li> <li>f. no rejection problems / patient's own cells used ✓</li> <li>g. less chance of cancer/«malignant» tumor development «than with embryonic stem cells»</li> <li>h. most tissues in adults contain some stem cells ✓</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>i. difficult to obtain/collect/find in adult body; ✓</li> <li>j. some «adult» tissues contain few/no stem cells/very few available ✓</li> <li>k. (adult stem cells) differentiate into fewer cell types «than embryonic cells»/WTTE ✓</li> </ul>	Maximum [2] if only advantages or only disadvantages are included.	3 max

## 2 - (BIOLO/22\_HL\_Summer\_2017\_Q3) - Cell Biology

a	<ul style="list-style-type: none"> <li>a. water molecules are polar</li> <li>OR</li> <li>can form hydrogen bonds ✓</li> <li>b. cohesion between water molecules allows continuous water columns</li> <li>OR</li> <li>cohesion between water molecules allows transpiration stream «to form in xylem» ✓</li> <li>c. adhesion of water to the walls of xylem vessel «helps water rise» ✓</li> <li>d. water evaporates at environmental temperatures allowing transpiration pull ✓</li> </ul>	OWTTE	2 max
b	«measurement of» solute concentration of a solution ✓	OWTTE	1
c	cell 2 because it has plasmolyzed/lost water/volume has decreased ✓		1
d	decreased ✓		1

3 - (BIOLO/22\_HL\_Summer\_2017\_Q8) - Cell Biology, Genetics, Nucleic Acids (ahl)

<b>a</b>	<p>a. mitosis is the division of a nucleus to produce two genetically identical daughter nuclei ✓</p> <p>b. consists of four phases: prophase, metaphase, anaphase, telophase ✓</p> <p>c. cytokinesis occurs after mitosis ✓</p> <p>d. interphase is the metabolically active phase between cell divisions ✓</p> <p>e. the interphase consists of the S phase, G1 and G2 ✓</p> <p>f. DNA replicates in the S phase ✓</p> <p>g. cell growth</p> <p>OR</p> <p>preparation for mitosis</p> <p>OR</p> <p>duplication of organelles in G1 and G2 ✓</p>	OWTTE	4 max
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<b>b</b>	<p>a. «crossing over/chiasmata shown between» homologous chromosomes ✓</p> <p>b. centromere drawn and labelled ✓</p> <p>c. single strand break «SSB»/DNA cut between homologous chromosomes ✓</p> <p>d. non-sister chromatids labelled</p> <p>OR</p> <p>sister chromatids labelled ✓</p> <p>e. chiasma between homologous chromosomes labelled «shown forming after SSB» ✓</p> <p>eg:</p> 	<p><i>Homologous chromosomes must be labelled and correctly drawn.</i></p> <p><i>It is likely that more than one diagram will need to be included to demonstrate the stages.</i></p>	3 max
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c	<p>a. mRNA conveys genetic information from DNA to the ribosomes «where it guides polypeptide production» ✓</p> <p>b. gene expression requires the production of specific mRNA «through transcription» ✓</p> <p>c. most genes are turned off/not being transcribed at any one time/regulated OR some genes are only expressed at certain times ✓</p> <p>d. some genes are only expressed in certain cells/tissues OR «cell» differentiation involves changes in gene expression ✓</p> <p>e. transcription factors/proteins can increase/decrease transcription ✓</p> <p>f. hormones/chemical environment of cell can affect gene expression ✓</p> <p>g. example of cell environment ✓</p> <p>h. transcription factors/proteins may prevent or enhance the binding of RNA polymerase ✓</p> <p>i. nucleosomes limit access of transcription factors to DNA/regulate gene expression/transcription OR activate or silence genes ✓</p> <p>j. DNA methylation/acetylation appears to control gene expression «as epigenetic factor» OR methylated genes are silenced ✓</p> <p>k. «some» DNA methylation patterns are inherited ✓</p> <p>l. introns may contain positive or negative gene regulators OR gene expression can be regulated by post-transcriptional modification/splicing/mRNA processing ✓</p>	<p>eg: auxin/insulin/cytoplasmic gradient in embryo</p>	8 max
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4 - (BIOL0/20\_HL\_Winter\_2017\_Q6) - Cell Biology, Animal Physiology (ahl), Evolution & Biodiversity

a	<p>a. mitochondria and chloroplasts are similar to prokaryotes ✓</p> <p>b. «host» cell took in another cell by endocytosis/by engulfing «in a vesicle» ✓</p> <p>c. but did not digest the cell/kept the «ingested» cell alive OR symbiotic/mutualistic relationship «between engulfed and host cell» ✓</p> <p>d. chloroplasts and mitochondria were once independent/free-living «organisms» ✓</p> <p>e. DNA «loop» in chloroplast/mitochondrion ✓</p> <p>f. division/binary fission of chloroplast/mitochondrion ✓</p> <p>g. double membrane around chloroplast/mitochondrion ✓</p> <p>h. 70s ribosomes «in chloroplast/mitochondrion» ✓</p>	<p>Allow "taking in" in place of "engulfing"</p> <p>Award up to [2] for evidence from mpe to mph</p>	4 max
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b	a. both result in haploid cells/gametes ✓		<p>A table is not required but both statements in one row of the table must either be explicitly stated or clearly implied to award the mark</p>	8 max																			
	b. both involve mitosis at the start/in the «germinal» epithelium ✓																						
	c. both have cell growth «before meiosis» ✓																						
	d. both involve «two divisions of» meiosis ✓																						
	e. both involve differentiation to produce a gamete ✓																						
	f. both are stimulated by hormones																						
	<b>OR</b> spermatogenesis stimulated by testosterone and oogenesis stimulated by FSH ✓																						
	g.	<table border="1"> <thead> <tr> <th>Oogenesis</th> <th>Spermatogenesis</th> </tr> </thead> <tbody> <tr> <td>in the ovaries</td> <td>in the testes</td> </tr> <tr> <td>starts «in germinal epithelium» during embryo/fetus development</td> <td>starts during puberty/adolescence <b>OR</b> continuously starting «in germinal epithelium»</td> </tr> <tr> <td>pauses occur in prophase I/prophase II/metaphase II</td> <td>no pauses</td> </tr> <tr> <td>large quantity of cytoplasm in egg/cytoplasm split unequally</td> <td>small quantity of cytoplasm «per sperm»/equal division of cytoplasm</td> </tr> <tr> <td>one cell/egg «per meiosis» <b>OR</b> some become polar bodies</td> <td>four sperm «per meiosis» <b>OR</b> all cells become sperm</td> </tr> <tr> <td>one «usually» at a time/per month/per menstrual cycle</td> <td>many/far more/millions daily</td> </tr> <tr> <td>released on about Day 14/in middle of menstrual cycle/at ovulation</td> <td>released continuously «from testis» <b>OR</b> by ejaculation/intercourse</td> </tr> <tr> <td>stops at menopause</td> <td>goes on throughout adult life/until death</td> </tr> </tbody> </table>			Oogenesis	Spermatogenesis	in the ovaries	in the testes	starts «in germinal epithelium» during embryo/fetus development	starts during puberty/adolescence <b>OR</b> continuously starting «in germinal epithelium»	pauses occur in prophase I/prophase II/metaphase II	no pauses	large quantity of cytoplasm in egg/cytoplasm split unequally	small quantity of cytoplasm «per sperm»/equal division of cytoplasm	one cell/egg «per meiosis» <b>OR</b> some become polar bodies	four sperm «per meiosis» <b>OR</b> all cells become sperm	one «usually» at a time/per month/per menstrual cycle	many/far more/millions daily	released on about Day 14/in middle of menstrual cycle/at ovulation	released continuously «from testis» <b>OR</b> by ejaculation/intercourse	stops at menopause	goes on throughout adult life/until death	
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h.		✓																					
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j.		✓																					
k.		✓																					
l.		✓																					
m.		✓																					
n.		✓																					

c	a. crop plants/domesticated animals/livestock produced by selective breeding ✓		<p>For example dogs have been developed from wolves</p>	3 max
	b. specific example of a domesticated animal/crop plant and the wild species from which it was developed <b>OR</b> specific example of a domesticated animal/crop plant and the features in it which have been improved «compared with the wild species» ✓			
	c. artificial selection/crossing selected varieties/eliminating undesirable varieties ✓			
	d. «selective breeding/artificial selection can cause» significant/rapid change over time/from the original wild species ✓			
	e. «changes due to selective breeding/artificial selection» shows natural selection can cause change/evolution «in a species» ✓			

5 - (BIOLO/21\_HL\_Summer\_2018\_Q5) - Cell Biology, Molecular Biology

a	i	cell wall ✓		1
a	ii	metaphase ✓		1
b		<p><b>location of ATP synthase</b> a. cristae/inner mitochondrial membrane versus thylakoid membranes ✓ <b>movement of protons</b> b. protons moved/pumped as a result of <u>electron flow</u>/<u>electron</u> transport in both ✓ c. (pumped by the electron transport chain) from the matrix to the intermembrane space versus from the stroma to the thylakoid space ✓ d. through ATP synthase/synthetase in both (respiration and photosynthesis) ✓ e. protons move (through ATP synthase/synthetase) down the concentration gradient in both ✓ f. move (down concentration gradient) from the intermembrane space to the matrix versus from the thylakoid space to the stroma ✓</p>		2 max