

HUMAN BIOLOGY

UNITS 1 & 2

2021

Name: **MARKING GUIDE**

Teacher: _____

Time allowed for this paper

Reading time before commencing work: ten minutes

Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet

Multiple-choice answer sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in this examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Question	Answer
1	D
2	D
3	D
4	B
5	A
6	A
7	B
8	A
9	B
10	C
11	C
12	C
13	A
14	D
15	C
16	A
17	B
18	A
19	D
20	A
21	D
22	C
23	B
24	A
25	B
26	B
27	C
28	C
29	A
30	B

Section Two: Short answer

50% (112 Marks)

This section has **seven** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 31

(15 marks)

(a) Identify (3 marks)

Description	Mark
Process A: Transcription	1
Structure B: mRNA	1
Process C: Translation	1
Total	3

(b) Explain the role of the nucleus in protein synthesis. (4 marks)

Description	Mark
Nucleus controls all cellular activities	1
DNA makes up chromosomes/ DNA made up of segments called genes	1
Information in a gene is transcribed into mRNA	1
Nucleus transmits mRNA to the cytoplasm/ to attach to ribosome	1
Other roles include: - ribosomes, used for synthesis, are produced in the nucleus - nucleus has receptors for inducing protein synthesis	
Total	4

(c) The enzymes DNA helicase and DNA polymerase are involved in DNA replication. Describe the functions of these enzymes. (2 marks)

Description	Mark
Helicase : separates two strands of DNA molecule	1
Polymerase : adds new nucleotides to create new DNA strand	1
Total	2

The way in which enzymes work can be shown using a lock and key model.

- (d) Describe, using diagrams to support your answer, the lock and key model. Include in your answer why this model supports the specific nature of enzymes. (6 marks)

Description	Mark
<p>Diagram: Labels correct- enzyme, enzyme substrate complex, products, active site labelled</p> <p>Enzyme + Substrate Enzyme-Substrate Complex Enzyme + Products</p>	1-4
Active sites are a specific shape/ configuration	1
Complementary to substrate/ perfect fit between active site and substrate	1
	6

Question 32

(18 marks)

- (a) Name the following structures: (3 marks)

Description	Mark
Structure 5: vas deferens	1
Structure 6: epididymis	1
Structure 8: penis/ glans/ erectile tissue	1
Total	3

- (b) Structures 1 and 2 are known as accessory glands. State the role of these structures within the male reproductive system. (2 marks)

Description: Any two of the following	Mark
1. seminal vesicles – secretions rich in sugar to nourish, enhance motility of sperm	1-2
2. Prostate glands – alkaline secretion to neutralise the vaginal secretion – increase sperm viability	
Total	2

- (c) The first stage of the fertilisation of an oocyte by a single spermatozoan involves the acrosome. Describe the role of the acrosome during the first stage of fertilisation.

(4 marks)

Description	Mark
Acrosome/sperm comes into contact with zona pellucida/oocyte	1
Acrosome releases enzymes	1
Enzymes break down zona pellucida	1
Sperm (head) reaches oocyte/sperm nucleus enters oocyte	1
Total	4

In women the menstrual cycle is controlled by hormones secreted from the pituitary gland and the ovary. The chart below lists **some** of the events that occur during the menstrual cycle. They are not in the correct order.

	Event
A	FSH secreted by the pituitary
B	Oestrogen stimulates growth of the endometrium
C	Follicles begin to mature in the ovary
D	Ovulation occurs
E	Oestrogen is secreted by follicles
F	LH is secreted by the pituitary gland
G	Corpus luteum develops

- (d) (i) List the stages in the correct sequence beginning at Day 1 of the menstrual cycle. (3 marks)

A	C	E	B	F	D	G
---	---	---	---	---	---	---

Subtract 1 mark for each error

- (ii) Describe the role of the corpus luteum in the ovarian and menstrual cycles. (3 marks)

Description	Mark
Secretes oestrogen and progesterone	1
Progesterone thickens/ vascularises the endometrium	1
Inhibits release of FSH	1
Total	3

- (e) Fertility drugs are taken by some women who are having trouble conceiving. Describe how these drugs improve the chances of a woman becoming pregnant. (3 marks)

Description: Any two of the following	Mark
Drugs (clomiphene) can stimulate secretion of FSH	1
hCG used to trigger ovulation	1
Increased levels of FSH may enable more than one follicle to mature at a time/ Increases amount of eggs that can be harvested each cycle/ released at ovulation	1
Total	3

Question 33**(14 marks)**

To study the effect of altitude on the mass of haemoglobin found within human blood, samples were taken from individuals living at different altitudes around the world. The results are shown below.

Altitude (metres above sea level)	Mass of haemoglobin (gL ⁻¹)
0	121
500	121
1000	122
1500	125
2000	130
2200	134
3000	140

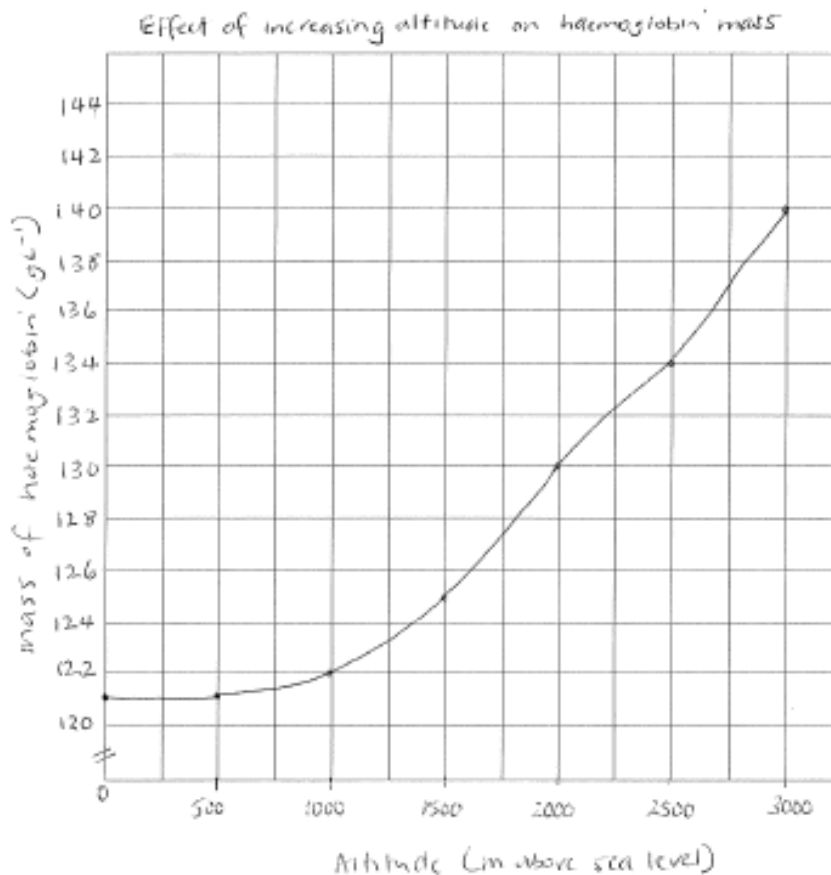
- (a) Identify the independent variable in the information shown above. (1 mark)

Description	Mark
Independent : Altitude	1
Total	1

- (b) Propose a hypothesis for this study. (1 mark)

Description	Mark
Increasing altitude increases/ decreases/has no effect on mass of haemoglobin in blood	1
Total	1

(c) Graph the results from the table above onto the grid provided. (5 marks)



Description	Mark
Title Axes around correct way Axes- label and units Correct scale/s Line graph	1-5
Total	5

(d) Using data from your graph, describe how altitude affects the mass of haemoglobin in human blood. (2 marks)

Description	Mark
Direct relationship/ as altitude increases so too does haemoglobin mass	1
Specific data points from graph used to support statement	1
Total	2

- (e) Scientists obtained the blood samples from the individuals using a sterile needle attached to a syringe. The sample was taken from a vein rather than an artery. Suggest **two** reasons for this. (2 marks)

Description: Any two of the following	Mark
Pressure in arteries too high/ venous pressure lower Veins easier to access/ closer to the surface Veins have thinner walls Veins are larger than corresponding artery in area	1-2
Total	2

- (f) Many elite athletes will often train for competitions at high altitudes. Explain the reason for this. (3 marks)

Description	Mark
Increase mass of haemoglobin in blood/ produce more red blood cells	1
Greater oxygen carrying capacity	1
Muscles receive more oxygen for respiration/ muscles more efficient	1
Total	3

Question 34

(14 marks)

- (a) Using letters from the diagram above, fill in the table below indicating which of the labelled bones comprise the axial and appendicular section of the skeleton. (3 marks)

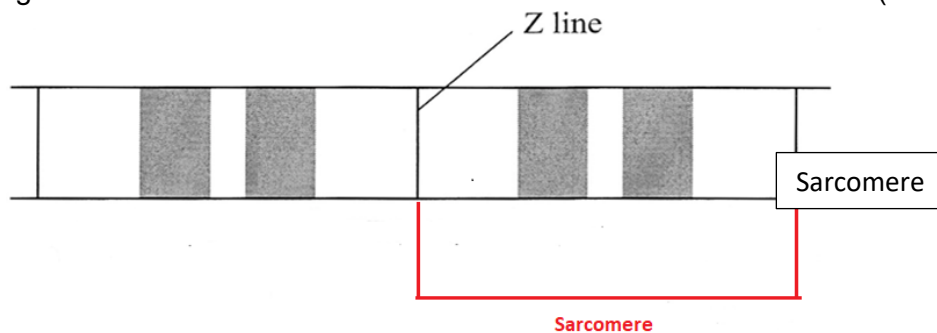
Description	Mark
Axial A C E	Subtract 1 mark for each letter in incorrect section
Appendicular B D F	
Total	3

- (b) A joint is defined as a location where two or more bones meet. There are three types of joints found in the human body. Complete the table below by stating the movement allowed at each joint and give **one** example for each joint type. (6 marks)

Joint type	Movement allowed	Example
Fibrous	No movement/immoveable (1)	Sutures in skull/teeth and jawbone (1)
Cartilaginous	Slight movement (1)	Pubic symphysis/ intervertebral discs/ ribs and sternum (1)
Synovial	Freely moveable (1)	Ball and socket /hinge/ pivot/ gliding/ saddle/ condyloid/ any named specific example (1)

The diagram below shows part of a myofibril from a relaxed muscle fiber.

- (c) On the diagram label one sarcomere. (1 mark)



- (d) When a muscle contracts the Z lines move closer together. Explain what must happen inside a myofibril for this to occur. (4 marks)

Description- Any four of the following	Mark
Thin actin slides over thick myosin/ myofilaments overlap	1-4
Myosin heads bond to actin/cross-bridges form	
Myosin heads pull on actin filaments/power stroke occurs	
Z lines move closer together	
Sarcomere shortens/muscle fibre shortens	4

Question 35

(18 marks)

Blood groups in humans is an example of a phenotype that can be determined by multiple alleles.

- (a) Complete the table below showing the possible genotypes for each blood group. (4 marks)

Description	Mark
A: $I^A I^A$ and $I^A i$ (must have both for mark)	1
B: $I^B I^B$ and $I^B i$ (must have both for mark)	1
AB: $I^A I^B$	1
O: ii	1
Total	4

- (b) The ABO blood grouping system is an example of codominance. Define this term. (1 mark)

Description	Mark
Two or more alleles are equally dominant/ both alleles expressed in phenotype	1
Total	1

- (c) Mrs Smith has Type A blood but she is not sure if she is homozygous or heterozygous. Mr Smith is completely unsure of his blood type. Their children have the following blood types: Daniel has Type O blood, Michael and Nathan have type A blood, Kyla has type B blood and Oliver has type AB blood.

What are the possible genotypes of both Mr and Mrs Smith? Use a Punnett square to justify your answer. (4 marks)

Mrs Smith $I^A i$ x Mr Smith $I^B i$

	I^A	i
I^B	$I^A I^B$	$I^B i$
i	$I^A i$	ii

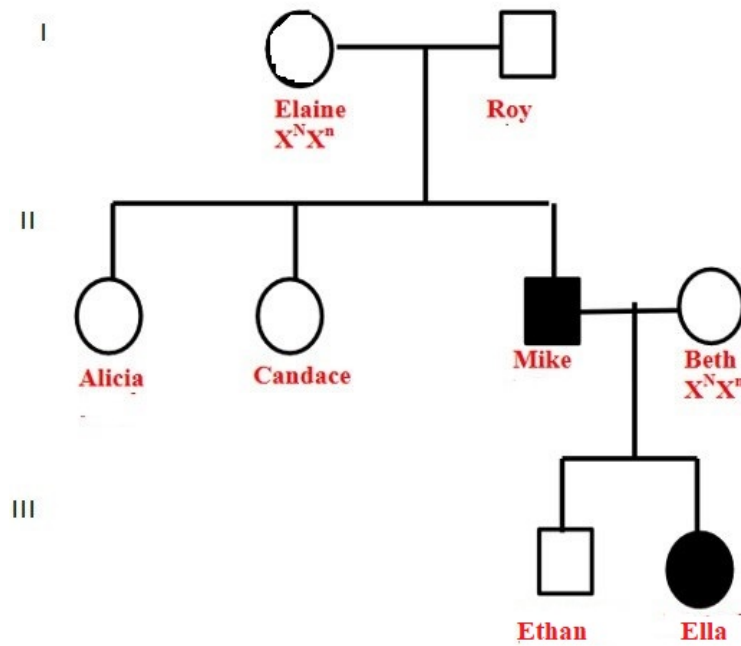
Daniel : $ii = O$
Michael/Nathan $I^A i = A$
Kyla: $I^B i = B$
Oliver: $I^A I^B = AB$

Description	Mark
Correct genotypes of parents listed (Mrs Smith = $I^A i$; Mr Smith = $I^B i$)	1-2
Correct genotypes of potential offspring inside Punnett square	1
Genotypes correctly matched with phenotypes	1
Total	4

- (d) Haemophilia is a recessive, sex-linked disorder which causes an inability to clot when bleeding.

Roy and Elaine Brown were married in 1986. Neither Roy nor Elaine had haemophilia. They had two daughters and then a son. Both daughters, Alicia and Candace, had normal clotting abilities and never had any children of their own. The son, Mike, had haemophilia and married Beth, who did not have the disease. They had two children of their own, first Ethan and then Ella. Surprisingly, Ella had haemophilia but Ethan did not.

- (i) Draw the pedigree that traces the haemophilia disorder in this family. (4 marks)



Description	Mark
Generations labelled	1
Males and females identified correctly/circles for females and squares for males	1
Individuals labelled/named correctly	1
Mike and Ella shaded	1
Total	4

- (ii) Write the genotypes for: (2 marks)

Description	Mark
Elaine - $X^N X^n$	1
Ethan - $X^N Y$	1
Total	2

(iii) Why is it surprising that Ella had haemophilia but Ethan did not? (2 marks)

Description	Mark
More common for males to have sex linked disorders than females	1
Ella would have had to receive two recessive alleles to have haemophilia whereas Ethan would have only had to receive one allele	1
Total	2

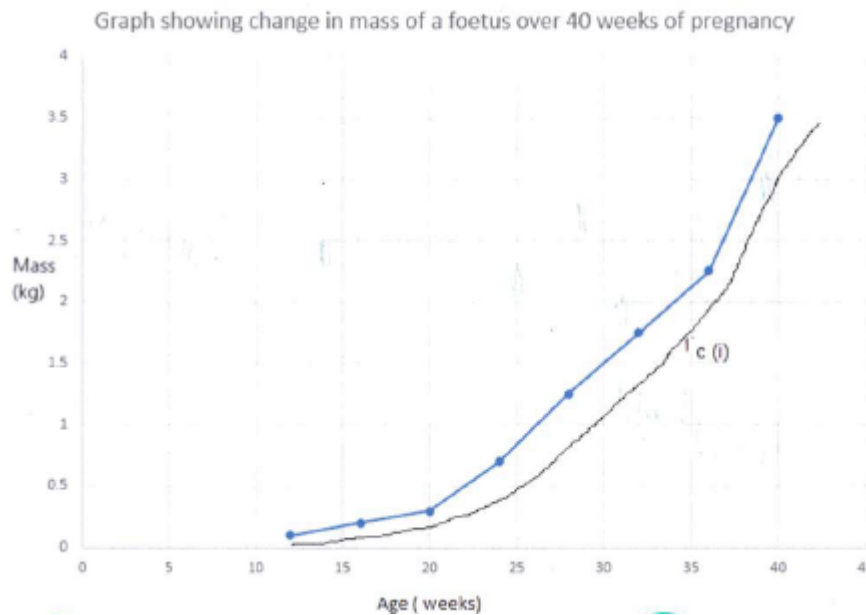
(iv) If Ella has children, what do you automatically know about the phenotype of her sons? (1 mark)

Description	Mark
All of her sons will have haemophilia	1
Total	1

Question 36

(20 marks)

The graph below shows the change in mass of a foetus over the 40 weeks of a human pregnancy.



(a) Using the graph, determine the age bracket(time frame) when mass changes occur (2 marks)

Description	Mark
The fastest: 36-40 weeks	1
Slowest: 12-16 weeks (accept 12-20)	1
Total	2

- (b) State the mass of the foetus at 35 weeks. (1 mark)

Description	Mark
2.1 kg	1
Total	1

Lifestyle choices of a pregnant mother can impact on the development of a foetus.

- (c) (i) Sketch on the graph a line that could indicate the effect on foetal growth if a mother continued to smoke whilst pregnant. (1 mark)

Description	Mark
Line should follow original line but be underneath (smoking slows down growth rate) *see graph above for suggested placement of line	1
Total	1

- (ii) Describe the impacts that drinking alcohol may have on the developing foetus. (3 marks)

Description- Any three of the following	Mark
Foetal alcohol syndrome (FAS)/ Foetal alcohol spectrum disorder (FASD) Malformations of foetus Foetal nervous system development affected Under nourishment of foetus Facial deformations	1-3
Total	3

- (d) (i) Name **two** substances that would be in higher concentration in the umbilical vein than in the umbilical artery. (2 marks)

Description: Any two of the following	Mark
Glucose Oxygen Nutrients	1-2
Total	2

- (ii) Cavity X contains maternal blood. Suggest why it is advantageous to have this blood in a cavity rather than contained within a blood vessel. (3 marks)

Description	Mark
Chorionic villi get bathed/ surrounded by blood	1
Increase surface area to volume ratio for chorionic villi to access blood	1
This enhances diffusion/active transport	1
Total	2

- (e) (i) It is possible to remove some of the fluid labelled as C in the diagram during pregnancy to examine foetal cells that are found within the fluid. Name the fluid and describe this process. (4 marks)

Description	Mark
Amniotic fluid	1
Any 3 of the following	
Amniocentesis	1-3
Carried out at 16-20 weeks	
10-20ml of fluid removed using a needle	
Foetal cells examined for genetic/chromosomal defects	
Total	4

- (ii) State **one** risk associated with this method of prenatal testing. (1 mark)

Description – Any one of the following	Mark
Infection Miscarriage Damage to baby	1
Total	1

- (f) Placenta previa, or low-lying placenta, can occur in some mothers during the last part of pregnancy. The placenta often covers all the cervix. Explain why this could lead to a woman having to deliver her baby by caesarean rather than have a vaginal delivery. (3 marks)

Description	Mark
Vaginal delivery involves baby moving through cervix into vagina/Placenta is blocking exit of baby	1
Placenta may rupture/tear	1
Mother may suffer haemorrhage/blood loss/ baby may suffer oxygen deprivation	1
Total	3

Question 37

(13 marks).

- (a) Describe the main process that occurs at the regions labelled as C and D. (4 marks)

Description	Mark
Region C Filtration/ glomerular filtration Water and dissolved blood components moved into capsule	1-2
Region D Reabsorption Material's such as water, amino acids and ions are reabsorbed from tubule into blood	1-2
Total	4

- (b) Explain why the process that occurs at the region labelled D requires both passive and active transport mechanisms. (3 marks)

Description	Mark
Ions, glucose, and amino acids move by active transport	1
Water moves by passive transport/osmosis	1
Due to movement of the ions by active transport	1
Total	3

The table below shows the concentrations of some substances in the fluid found at A, G and E.

Substance	Concentration (g per 100cm ³)		
	Blood at A	Fluid at G	Urine at E
W	0.1	0.1	0.0
X	7.0	0.0	0.0
Y	0.3	0.3	0.5
Z	0.03	0.03	2.0

- (c) State which of the substances shown in the table above: (2 marks)

Description	Mark
(i) X	1
(ii) Z	1
Total	2

- (d) If substance Y is sodium ions explain why the concentration is greater at E than at G. (2 marks)

Description	Mark
Other ions have been reabsorbed prior to E	1
Water has been reabsorbed	1
Total	2

People who have acute kidney failure are given dialysis treatment. In dialysis machines the blood flows through narrow tubes made from permeable material that are surrounded by dialysis fluid. Dialysis fluid contains sodium ions.

- (e) Use the information from the table above to suggest what concentration of sodium ions should be in the fluid. Justify your answer. (2 marks)

Description	Mark
0.3 g/100cm ³	1
Isotonic to blood plasma	1
Total	2

End of Section Two

Section Three: Extended answer

20% (40 Marks)

Unit 1

Question 38

(20 marks)

- (a) Explain why concentration gradients are important to the functioning of the lungs and how a concentration gradient is maintained between the circulatory and respiratory systems. (12 marks)

Description	Mark
<p>Why concentration gradient is important</p> <ul style="list-style-type: none"> • Oxygen and carbon dioxide move by diffusion • The steeper the concentration gradient the faster the diffusion will occur • Therefore, removing cellular wastes and supplying oxygen more rapidly 	1-3
<p>How concentration gradient is maintained: Any nine of the following</p> <ul style="list-style-type: none"> • When air is inhaled into the lungs it is high in oxygen and low in carbon dioxide • The blood that travels to the lungs is high in carbon dioxide and low in oxygen • Due to this difference in concentration the oxygen will diffuse out of the alveolus and into the surrounding capillaries • Where it will bind to the haemoglobin in red blood cells • Which transport the oxygen away maintaining this concentration difference • The carbon dioxide travels dissolved in plasma and most of it has reacted with the water in plasma to form bicarbonate ions • Once this deoxygenated blood reaches the alveolus the carbon dioxide is released • The concentration is now higher than that in the alveolus so it can diffuse out of the blood into the lungs • The constant movement of blood through the capillaries will maintain the concentration difference • The constant movement of air in and out of the lungs will maintain the concentration difference in the lungs 	1-9
Total	12

- (b) Describe what happens to a protein from the time it enters the stomach to the time the products of its digestion enter the bloodstream. (8 marks)

Description: Any eight of the following	Mark
<ul style="list-style-type: none"> • Mechanical digestion through churning in stomach • HCl activates pepsinogen into pepsin • Pepsin /gastric protease in stomach breaks proteins to polypeptides/ peptides and peptones • Pancreatic protease/trypsin breaks down proteins into peptides in duodenum/ileum • Intestinal juice contains peptidase • Which breaks down peptides into amino acids • Amino acids absorbed by active transport • Into blood capillaries of villi 	1-8
Total	8

Question 39**(20 marks)**

- (a) (i) Explain how oxygen and carbon dioxide are transported within the circulatory system. (6 marks)

Description	Mark
Oxygen <ul style="list-style-type: none"> • Red blood cells contain haemoglobin • Oxygen binds to haemoglobin to form oxyhaemoglobin • Small percent is dissolved into plasma 	1-3
Carbon dioxide <ul style="list-style-type: none"> • Dissolved in blood plasma • Some may attach to haemoglobin molecule and form carbaminohaemoglobin • Carried in plasma as bicarbonate ions 	1-3
Total	6

- (ii) Explain how oxygen and glucose are transferred from the blood into the cells.
(8 marks)

Description	Mark
Oxygen (Any four of the following) <ul style="list-style-type: none"> Tissue fluid has a low concentration of oxygen compared to blood Oxyhaemoglobin breaks down to haemoglobin and oxygen Oxygen moves by diffusion into tissue fluid Then moves by diffusion from tissue fluid into cells Across the semi permeable membrane of the cell 	1-4
Glucose (Any four of the following) <ul style="list-style-type: none"> Facilitated diffusion Down a concentration gradient Membrane transporter/ carrier protein required Glucose attached to a binding site on carrier protein Protein changes shape and glucose released to inside of cell 	1-4
Total	8

- (b) Describe the structure of arteries and explain how their structure allows them to carry out their functions.
(6 marks)

Description	Mark
Structure: any three of the following <ul style="list-style-type: none"> Outer layer composed of collagen and elastic fibres Middle layer contains smooth muscle and elastic fibres Inner layer contains smooth endothelium/ membrane Small lumen 	1-3
Function: any three of the following <ul style="list-style-type: none"> Elastic fibres stretch to accommodate extra blood Elastic fibres recoil to maintains pressure/movement of blood Smooth muscle can contract and relax Carry out vasoconstriction and vasodilation 	1-3
Total	6

Unit 2

Question 40

(20 marks)

- (a) Name **two** causes of male and **two** causes of female infertility and explain **two** ways in which infertility can be treated. Include in your explanation the name of the treatment, how the treatment is carried out and any disadvantages that might be associated with the treatment. (12 marks)

Description	Mark
Female infertility: any two of the following <ul style="list-style-type: none"> • Age (over 36) • Polycystic ovarian syndrome • High levels of prolactin • Cancer treatments • Endometriosis • Fibroids • Uterine tube blockages • Hormonal imbalances • Untreated STI's 	1-2
Male infertility: any two of the following <ul style="list-style-type: none"> • Low numbers of sperm • Low motility of sperm • Abnormal sperm • Blockage of vas deferens • Hormonal imbalances 	1-2
Treatment of infertility: Any two of the following	
1. IVF- In vitro fertilisation	1
<ul style="list-style-type: none"> • Hormonal treatment used to stimulate woman's ovaries to produce multiple follicles • Egg and sperm are collected and egg is fertilised in a lab. • An embryo is then inserted into the uterus via a catheter 	1-2
Disadvantages (any of the following) <ul style="list-style-type: none"> • Multiple pregnancies • Surgery risk when harvesting eggs • Miscarriages are common • Hormone treatment is unpleasant and has side effects 	1
2. ZIFT – Zygote intrafallopian transfer	1
<ul style="list-style-type: none"> • Hormonal treatment used to stimulate woman's ovaries to produce multiple follicles • Egg and sperm united in a lab • The zygote is implanted into uterine tubes 	1-2
Disadvantages (any of the following) <ul style="list-style-type: none"> • Surgery risk when harvesting eggs • Miscarriages are common • Hormone treatment is unpleasant and has side effects 	1
3. ICSI- Intracytoplasmic sperm injection	1

<ul style="list-style-type: none"> Eggs collected and examined for suitability Sperm injected into cytoplasm of the egg Resulting cells monitored to ensure they develop normally before being placed into uterus 	1-2
Disadvantage <ul style="list-style-type: none"> genetic defects could be passed on to offspring 	1
4. GIFT- gamete intrafallopian transfer	1
<ul style="list-style-type: none"> Female ovaries stimulated to produce more than one egg Sperm and egg are collected and mixed together in a lab then injected into the fallopian tubes. 	1-2
Disadvantages (any of the following) <ul style="list-style-type: none"> Surgery risk when harvesting eggs/ injecting gamete into fallopian tube Lower pregnancy rate Hormone treatment is unpleasant and has side effects 	1
5. AI- artificial insemination	1
<ul style="list-style-type: none"> Sperm collected from partner or donor male Sperm is processed and concentrated Sperm is released into the uterus using a catheter 	1-2
Disadvantage <ul style="list-style-type: none"> Success rate is low per cycle May be hard to find a suitable donor 	1
Accept any other reasonable answers	Total
	12

Question 41

(20 marks)

- (a) Compare the processes of meiosis and mitosis. Explain why each process is important in humans. (10 marks)

Description		Mark
Similarities: Any three of the following		
<ul style="list-style-type: none"> • both are types of cell division • both start with a diploid cell • both have same/similar substages or prophase, metaphase, anaphase, telophase • DNA replication occurs before mitosis/meiosis starts/during interphase • sister chromatids separate (to different poles) in mitosis and meiosis II 	1–3	
Differences: Any five of the following- must be linked for the mark		
Mitosis	Meiosis	1–5
daughter cells identical	daughter cells not identical/ different	
one division	two divisions	
results in two daughter cells	results in four daughter cells	
daughter cells diploid	daughter cells haploid	
homologous chromosomes do not pair	homologous chromosomes pair (in meiosis I)	
no crossing-over and/or independent assortment	crossing-over and/or independent assortment occur (in meiosis I)	
Importance		1
Meiosis (Any of the following) <ul style="list-style-type: none"> • Produces sex cells • Required for sexual reproduction to occur 		
Mitosis (Any of the following) <ul style="list-style-type: none"> • Helps to repair old/damaged cells/ maintenance Needed for growth of organisms		1
Total		10

- (b) Cellular respiration is vital to the functioning of the human body. Contrast aerobic and anaerobic respiration with reference to the reactants, products, location and the breakdown of energy produced. (10 marks)

Description: Any six of the following points			Mark
Contrast	Aerobic Respiration	Anaerobic respiration	1
Location	Mitochondria (starts in cytoplasm)	Cytoplasm	
Reactants	Glucose and oxygen (1)	Glucose (1)	2
Products	Carbon dioxide Water Energy in the form of ATP (1)	Lactic acid Energy in the form of ATP (1)	2
Amount of energy produced	2 ATP from glycolysis (1) 2 ATP Krebs Cycle (1) 36 ATP Electron Transport Chain (1)	2 ATP from glycolysis (1) 2 ATP from Lactic acids (1)	5
Total			10

End of questions

Acknowledgments

Qu 31 d enzyme lock and key model
<https://opentextbc.ca/introductorychemistry/chapter/catalysis-2/>
 Accessed January 2021

Qu 35b(i) Examiner supplied