Servite College
Semester Two Examination, 2021

Question/Answer Booklet

HUMAN BIOLOGICAL SCIENCE

Unit 1 & 2

Name:

Student Number: In figures | | | | | | | | |

In words _____

_____

Time allowed for this paper

Reading time before commencing work: Ten minutes

Working time for paper: 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, pencils, eraser or correction fluid, ruler, highlighter, ruler.

- Special items: Calculators satisfying the conditions set by the Curriculum Council for this subject.

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 notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	30	30	40	30	30
Section Two Short answer	7	7	90	112	50
Section Three Extended answer Unit 1	2	1	50	20	10
Unit 2	2	1		20	10
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian examinations are detailed in the *Year 12 Information Handbook 2021*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Only use a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Section Two: Write your answers in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided.

   Section Three: Consists of two parts each with two questions. You must answer one question from each part. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet.

4. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

5. 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.

See next page

Section One: Multiple–choice **30% (30 Marks)**

This section has **30** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 40 minutes.

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1. Which of the following statements about muscles is true?

   (a) muscles are attached to bones by ligaments
   (b) muscles become shorter when they are relaxed
   (c) muscles never work in pairs
   (d) muscles join to bones by tendons

2. Which of the following passes from a mother to her baby via the placenta?

   (a) urea
   (b) carbon dioxide
   (c) blood
   (d) glucose

3. Bone, cartilage, and muscle are examples of

   (a) cells.
   (b) organelles.
   (c) organs.
   (d) tissues.

4. Which of the following is **not** an organ of excretion?

   (a) kidney
   (b) liver
   (c) lung
   (d) skin

5. Which of the following **best** distinguishes an embryo from a zygote?

   (a) An embryo is multicellular, while a zygote is a single cell.
   (b) An embryo is multicellular and diploid, while a zygote is a single cell and haploid.
   (c) An embryo is multicellular and haploid, while a zygote is a single cell and diploid.
   (d) An embryo has fully differentiated tissues while a zygote lacks differentiated tissues.

See next page

6. Which of the following statements is correct?

(a) A gene is a section of DNA.
(b) An allele contains two genes.
(c) A chromosome contains only one gene.
(d) A gene is made up of several chromosomes.

7. A human sperm cell contains

(a) 4 chromosomes.
(b) 23 chromosomes.
(c) 46 chromosomes.
(d) 92 chromosomes.

8. A patient with type A blood requires a transfusion. Which of the following lists the blood types that this patient can receive?

(a) blood types A and O
(b) blood types AB and A
(c) blood type O only
(d) blood types AB, A and O

9. In a mating between a man with genotype Dd and a woman with genotype dd, the expected proportion of homozygous offspring would be

(a) 25%
(b) 50%
(c) 75%
(d) 100%

10. The genotype of an individual

(a) is always the same as the phenotype.
(b) refers to the visible traits of an individual.
(c) refers to the types of alleles a person has.
(d) is indicated by the presence or absence of an X or Y chromosome.

11. A certain abnormality in cell membranes renders the cell unable to take up amino acids from their external environment. How would this condition impact gene expression in affected cells?

(a) Translation would not occur in the nucleus of a cell.
(b) mRNA synthesis would not occur in the ribosomes.
(c) tRNA molecules would not be able to locate their partner amino acid for translation.
(d) Vital genes could no longer be replicated.

See next page

12. Which of the following best describes the structure of a protein? They

    (a) always contain carbon, hydrogen and oxygen. The number of hydrogen atoms is always twice the number of oxygen atoms.
    (b) always contain carbon, hydrogen, oxygen, nitrogen and phosphorous. They are made up of small units called nucleotides.
    (c) always contain carbon, hydrogen, oxygen and nitrogen. They are made up of many small molecules called amino acids.
    (d) contain carbon, hydrogen and oxygen. Each molecule consists of disaccharides.

13. Which process in a cell requires energy from respiration?

    (a) absorption of amino acids by active transport into a villus
    (b) movement of oxygen from the alveolus into the bloodstream
    (c) movement of water into a cell by osmosis
    (d) release of carbon dioxide by diffusion from a cell

Question 14 refers to the following information.

Between 1944 and 1954 over 17,000 cases of polio were contracted in Australia and approximately 1000 deaths occurred as a result. One of the symptoms of polio is the inability to breathe easily because it affects the muscles of the respiratory system. Often patients were placed in a machine called an iron lung for an extended period. The person's head remains outside the chamber and an airtight seal is placed around their neck. Changes in air pressure within the iron lung allow the flow of air into and out of the lungs.

14. Which of the following statements about the iron lung is correct?

    (a) Breathing with an iron lung is still possible if the trachea is completely blocked.
    (b) During exhalation, the iron lung causes the patient's lungs to expand.
    (c) During inhalation, the pressure in the iron lung is increased.
    (d) Inhalation and exhalation are possible even if the patient's lung is punctured.

15. Blood does not usually come into direct contact with the cells it supplies. Exchange of nutrients and wastes between the blood and the cells occurs through

    (a) plasma.
    (b) lymphatic vessels.
    (c) intercellular fluid.
    (d) intracellular fluid.

16. Gonorrhoea is a sexually transmitted infection that

    (a) affects the mucous membranes of the urinary and genital tracts.
    (b) has three main stages.
    (c) can affect an embryo via the placenta.
    (d) is caused by a virus.

See next page

17. The importance of DNA replication in mitosis is to ensure that when a cell divides the

(a) hereditary material will accumulate random variations.
(b) resulting daughter cells each has a full complement of DNA.
(c) chromosome number is halved equally between resulting cells.
(d) resulting cell expresses all alleles present as protein products.

18. When trying to view a blood smear under a microscope a student placed a drop of blood onto a glass slide and added a drip of distilled water to it before placing the coverslip over it. When viewed, the slide appeared to be empty. Which of the following best explains this?

(a) The blood cells had burst.
(b) The blood had dried before the water was added.
(c) The water spaced the cells too far apart from each other.
(d) The water caused the cells to shrink.

19. The semilunar valves

(a) are found in the veins that exit the heart.
(b) are found between the atria and ventricles.
(c) prevent backflow of blood into the atria.
(d) prevent backflow of blood into the ventricles.

20. Gametogenesis produces

(a) 4 viable sperm cells in males, each with N chromosomes.
(b) 4 viable egg cells in females, each with N chromosomes.
(c) 2 viable sperm cells in males, each with 2N chromosomes.
(d) 1 viable egg cell in females with 2N chromosomes.

21. Which of the following methods of contraception prevent fertilisation from occurring?

(a) the morning after pill and the condom
(b) the morning after pill and an IUD
(c) an IUD and a diaphragm
(d) a diaphragm and sterilisation

22. The hormone testosterone

(a) is produced by the seminiferous tubules.
(b) has no influence on the production of sperm in the testes.
(c) results in the secondary sex characteristics of males.
(d) is secreted by sperm as they mature.

See next page

23. Which of the following statements regarding the oesophagus and trachea is **incorrect**?

(a) During swallowing, the epiglottis covers the trachea to prevent food from entering the trachea.
(b) The common opening to the oesophagus and trachea is the larynx.
(c) The movement of food down the oesophagus is active while the movement of air down the trachea is passive.
(d) The oesophagus is mainly made up of layers of muscles while the trachea is mainly made up of c-shaped cartilage rings.

24. Histone modification and DNA methylation

(a) modify gene expression.
(b) both switch genes on.
(c) cause changes that are not inherited.
(d) both switch genes off.

25. A group of 1594 women who had been through menopause (post-menopausal) and with diagnosed osteoporosis were recruited into a research study looking at the effect of treatment with *Risedronate* over a three-year period. Women were separated into two groups; one group received a placebo (inactive) treatment and the other group received a daily dose of *Risedronate*. Both the placebo and *Risedronate* were in identical forms so the women were not aware of which medication they were taking. The women kept a diary and recorded any fractures over the 3-year period.
The results are shown below.

Cumulative fracture rates in post-menopausal women with osteoporosis when given placebo and *Risedronate* over a period of 3 years

	Cumulative fracture rate (%)	
Time since taking drug (months)	Placebo group	*Risedronate* group
6	2	2
12	5	3
16	7	4
22	11	6
30	13	9
36	16	10

A valid hypothesis for this study would be

(a) if we give post-menopausal woman who have osteoporosis *Risedronate* then they will not get fractures.
(b) *Risedronate* reduces the incidence of fractures in post-menopausal women with osteoporosis.
(c) *Risedronate* reduces the incidence of osteoporosis in post-menopausal women.
(d) post-menopausal women with osteoporosis should take *Risedronate.*

See next page

26. An experiment is valid if it produces data that

(a) is accurate and reliable.
(b) measures what it was designed to measure.
(c) was collected consistently and reliably.
(d) is consistent with the aim of the experiment.

27. Spongy bone

(a) contains osteons running in a transverse direction.
(b) helps with the storage of fat.
(c) contains red bone marrow.
(d) consists of Haversian systems.

28. A microscope with an objective lens of 10X and an eyepiece lens of 4X has a field of view of 4200µm. If the objective lens is changed to 10X, what is the new field of view?

(a) 420 µm
(b) 10 500 µm
(c) 1680 µm
(d) 8750 µm

29. Oestrogen and progesterone are hormones secreted by the ovaries. Oestrogen causes the repair and growth of the uterine lining while progesterone maintains the lining and causes further thickening. During which phases of the menstrual cycle would the levels of oestrogen and progesterone surge?

	Oestrogen surge	**Progesterone surge**
(a)	days 5 to 15	days 15 to 25
(b)	days 15 to 25	days 5 to 15
(c)	days 1 to 5	days 5 to 10
(d)	days 5 to 10	days 1 to 5

30. The ectoderm layer develops into several body systems and organs in an embryo. This includes the

(a) reproductive system.
(b) nervous system.
(c) skeletal system.
(d) skeletal muscles.

End of Section One

See next page

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Section Two: Short answer **50% (112 Marks)**

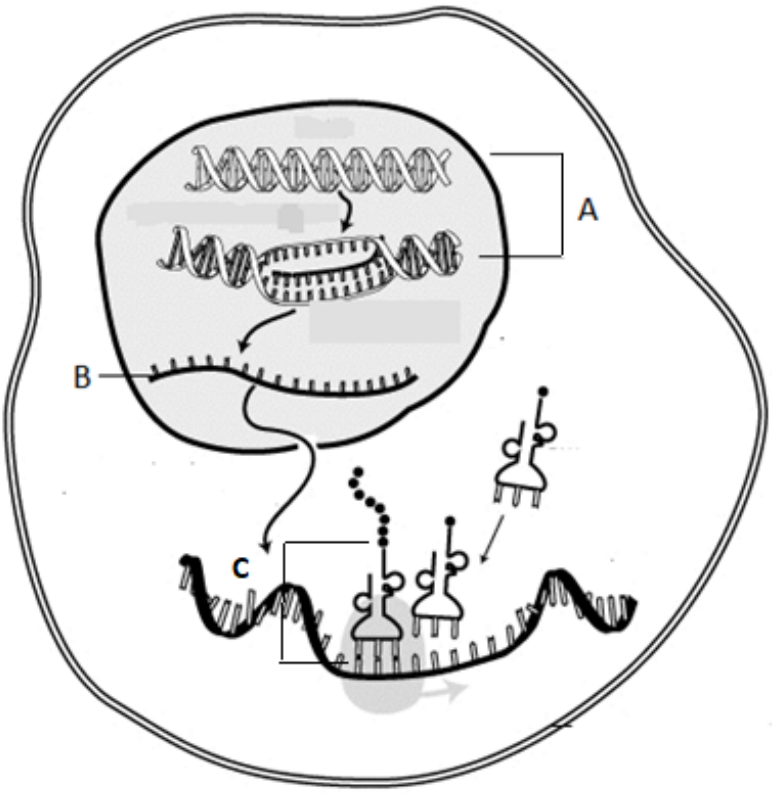
This section has **seven** questions. Answer **all** questions. Write your answers in the spaces provided.

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)**

The diagram below shows the process of protein synthesis occurring within a cell.



(a) Identify (3 marks)

(i) Process A _____

(ii) Structure B _____

(iii) Process C _____

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

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

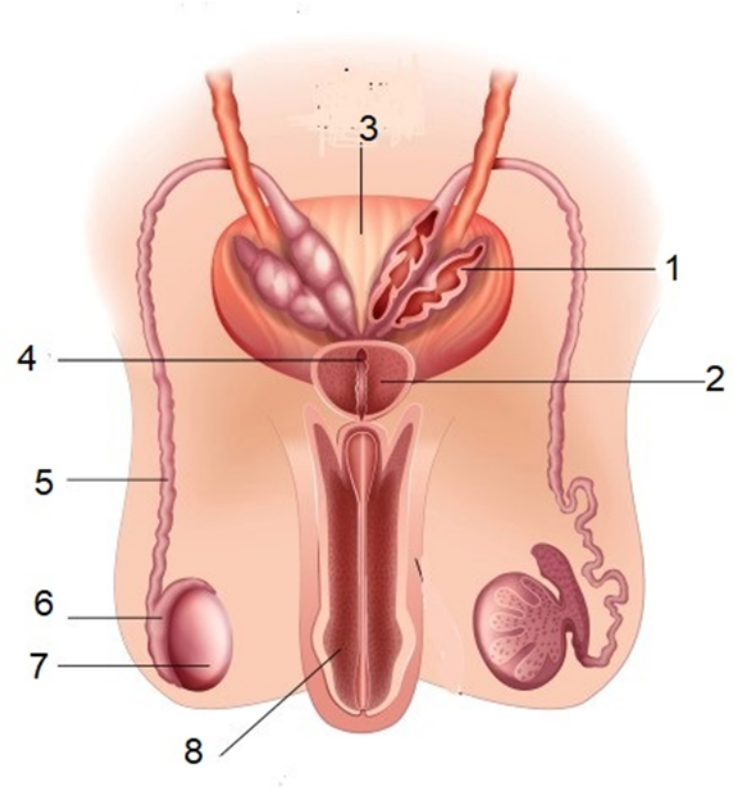
The way in which enzymes work can be shown using a lock and key model.

(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)

See next page

Question 32 **(18 marks)**

The diagram below shows the male reproductive system.



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

Number	Structure name
5	
6	
8	

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

See next page

(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)

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.

Stage	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)

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

(3 marks)

See next page

(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)

See next page

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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.

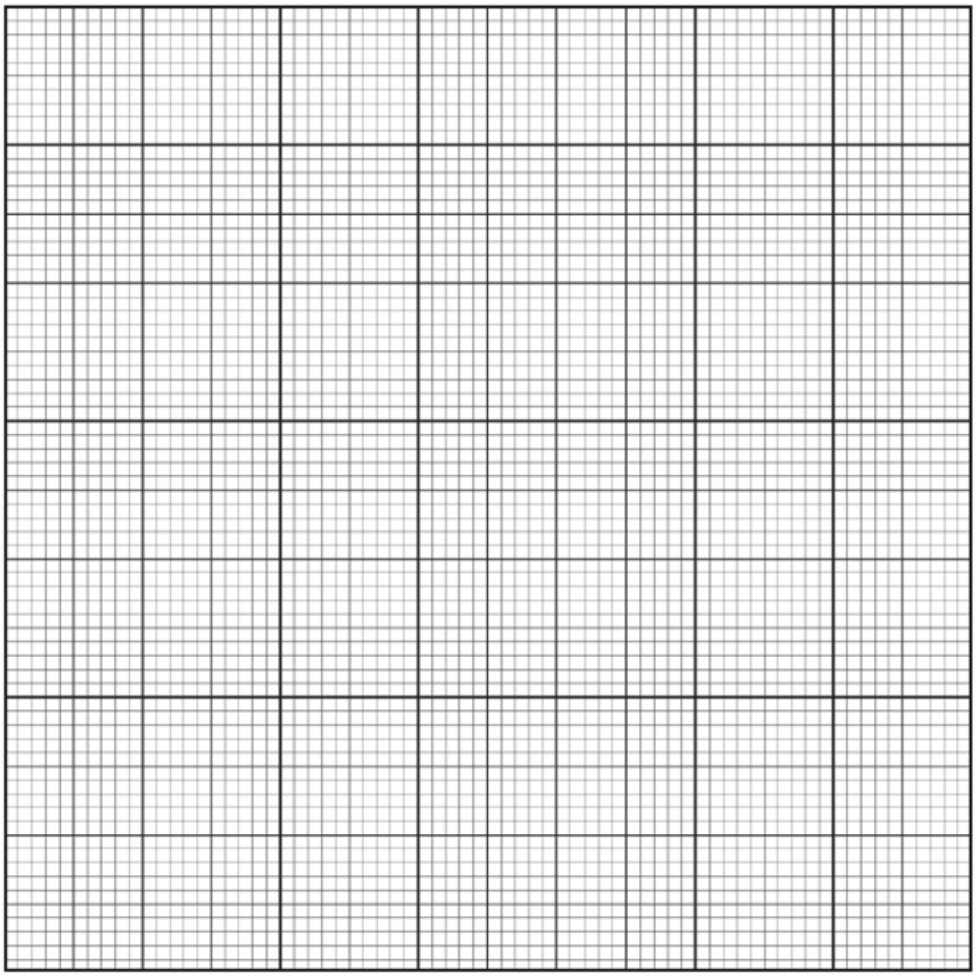
Altitude (metres above sea level)	**Mass of haemoglobin (gL^{-1})**
0	121
500	121
1000	122
1500	125
2000	130
2200	134
3000	140

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

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

See next page

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



A spare grid is provided at the end of this Question/Answer Booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid.

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

See next page

(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)

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

See next page

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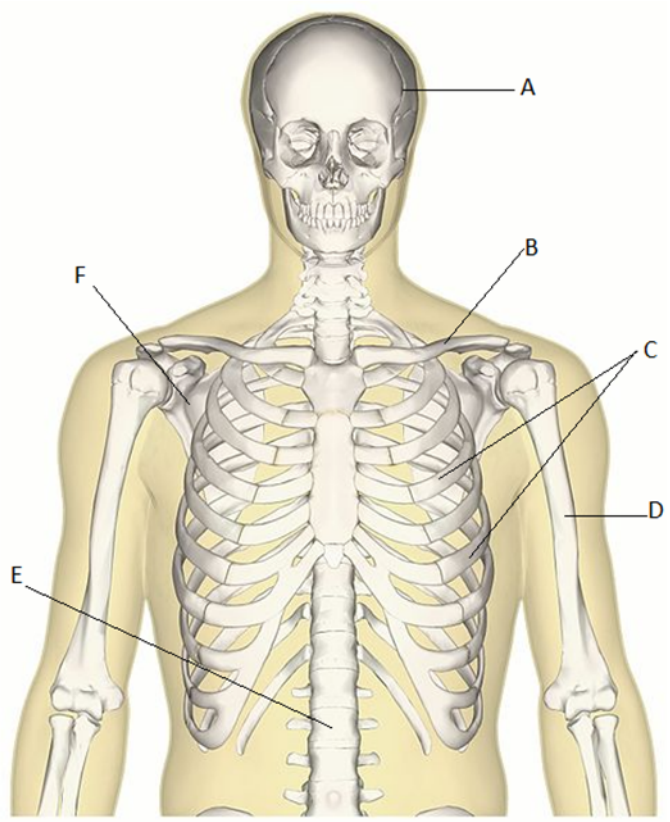
See next page

Question 34 **(14 marks)**

The diagram below shows the bones of the upper torso.



(a) Using the 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)

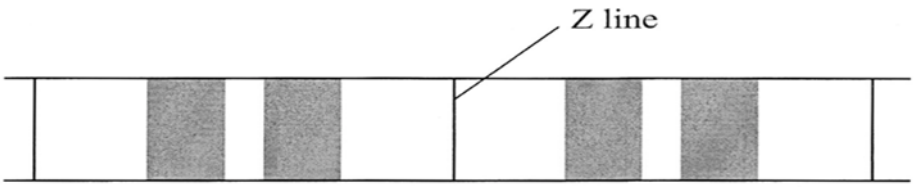
Axial skeleton	Appendicular skeleton

See next page

(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		
Cartilaginous		
Synovial		

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



(c) On the diagram above 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)

See next page

Question 35 **(18 marks)**

Blood groups in humans are 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)

Blood group	Genotypes
A	
B	
AB	
O	

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

(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)

See next page

(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. Their 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)

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

Elaine

_____

Ethan

_____

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

_____

_____

_____

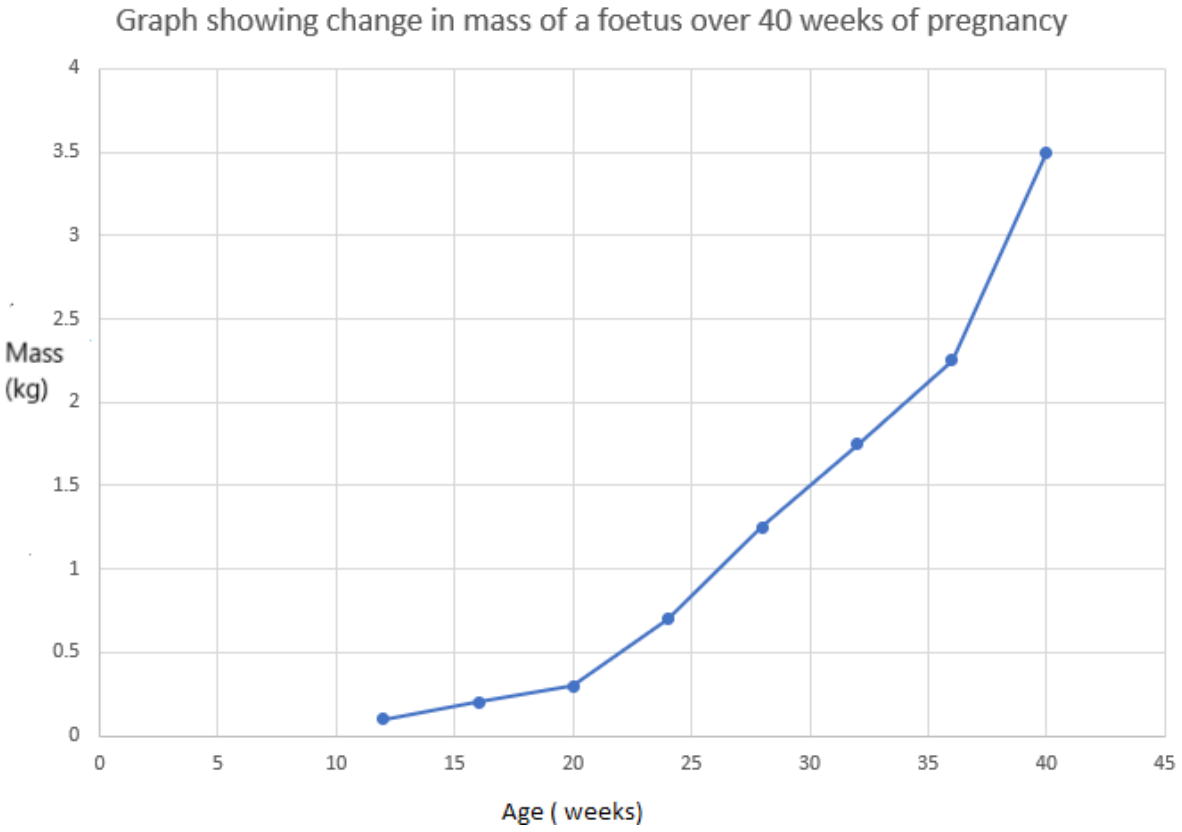
(iv) If Ella has children, what do you automatically know about the phenotype of her sons? (1 mark)

_____

See next page

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

(i) the fastest (1 mark)

_____

(ii) the slowest (1 mark)

_____

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

_____

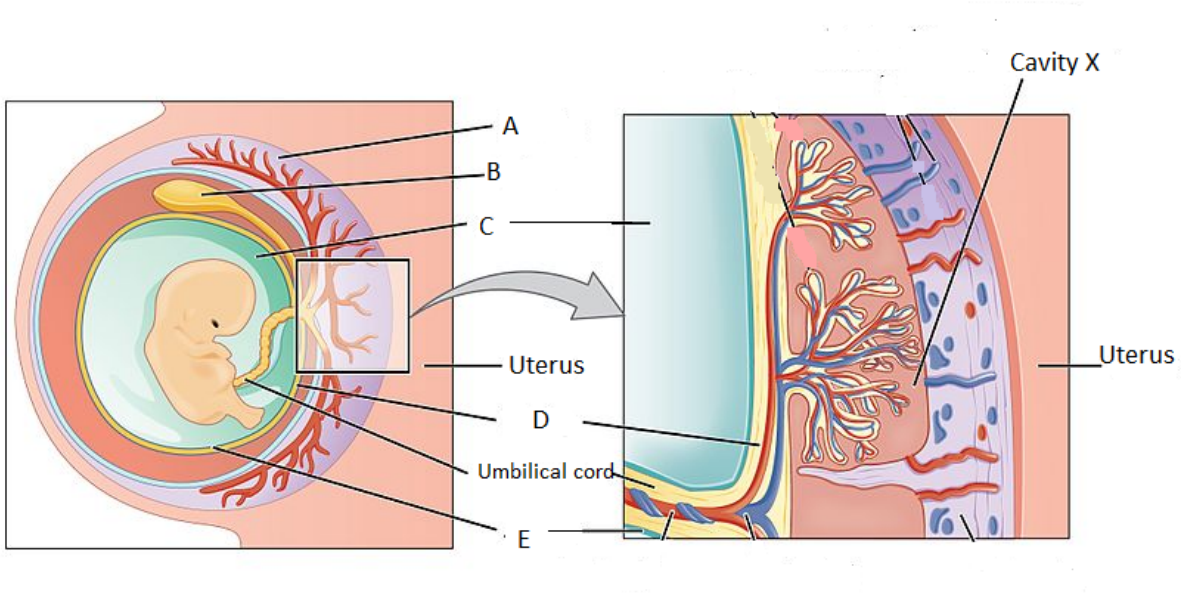
See next page

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

(c) (i) On the graph from the previous page, sketch a line that could indicate the effect on foetal growth if a mother continued to smoke whilst pregnant. (1 mark)

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

The diagram below shows part of the placenta and the umbilical cord attached to a foetus.



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

(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)

(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)

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

(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)

See next page

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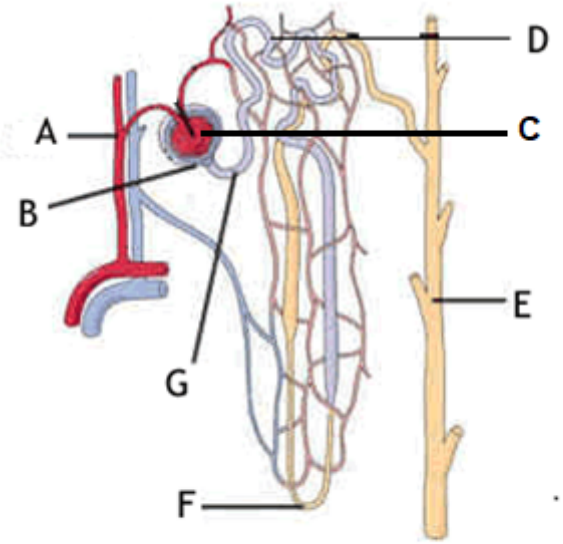
See next page

Question 37 **(13 marks)**

The diagram below shows a nephron and some of its associated blood vessels.



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

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

See next page

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:

(i) has molecules that are too large to fit through the walls of a capillary. (1 mark)

(ii) is a metabolic waste product. (1 mark)

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

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)

End of Section Two

See next page

Section Three: Extended answer **20% (40 Marks)**

This section contains **four** questions. You must answer **two** questions.

Questions 38 and 39 are from Unit 1. Questions 40 and 41 are from Unit 2. Answer **one** question from Unit 1 and **one** question from Unit 2.

Responses could include clearly labelled diagrams with explanatory notes; lists of points with linking sentences; clearly labelled tables and graphs; and annotated flow diagrams with introductory notes.

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: 50 minutes.

Unit 1

Choose **either** Question 38 **or** Question 39.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 27- 31. When you have answered your first question, turn to page 32 and indicate on that page the second question you will answer.

☐ **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)

(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)

☐ **Question 39** **(20 marks)**

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

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

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

See next page

Question number: _____

See next page

Question number: _____

See next page

Question number: _____

See next page

Question number: _____

See next page

Question number: _____

See next page

Unit 2

Choose **either** Question 40 **or** Question 41.

Indicate the question you will answer by ticking the box next to the question. Write your answer on the pages provided.

☐ **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)

(b) Define the term epigenetics and explain how chromatin modification can affect gene expression. (8 marks)

☐ **Question 41** **(20 marks)**

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

(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)

End of questions

Question number: _____

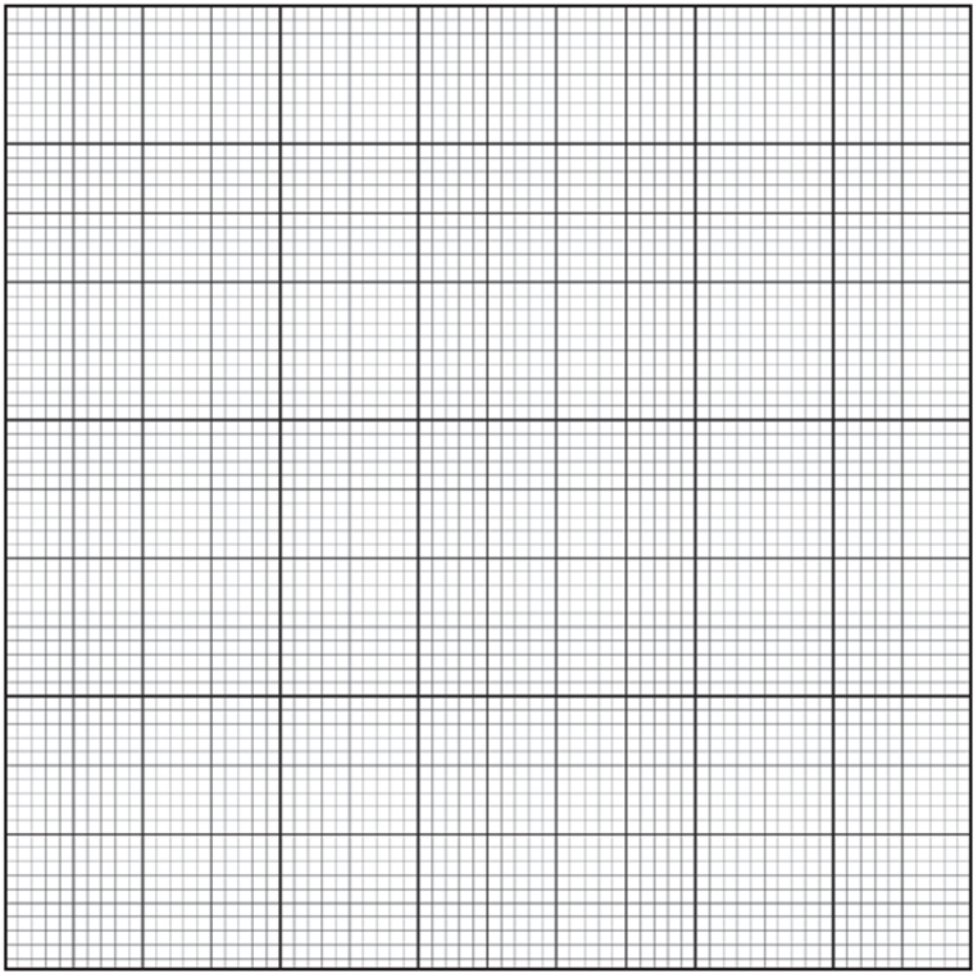
Question number: _____

Question number: _____

Question number: _____

Supplementary page

Question number: _____



ACKNOWLEDGEMENTS

Section	Source
Qu 31	Protein synthesis https://en.wikipedia.org/wiki.png Accessed October 2020
Qu 32	Image [male reproductive system] Credit Istock Photos by Bluering Media
Qu 34(a)	Image [bones of the upper torso] https://en.wikipedia.org/wiki/Xiphoid_process#/media/File:Xiphoid_process_frontal.png Accessed October 2020
34(c)	Myofibril diagram produced by author.
Qu 36	Graph produced by author
Qu 36 (d)	Image [Placenta] https://commons.wikimedia.org/wiki/File:2910_The_Placenta-02.jpg Accessed October 2020
Qu 37	Nephron https://www.biologycorner.com/quiz/quiz_kidney.html accessed November 2020