Semester Two

Examination, 2024

Question/Answer Booklet

HUMAN BIOLOGY
UNITS 1 & 2

Name: _____

Teacher: _____

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time for the paper: two hours and thirty minutes

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: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course 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.

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	25	25	30	25	30
Section Two Short answer	7	7	80	90	50
Section Three Extended answer Unit 1	2	1	40	15	20
Unit 2	2	1		20	
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian examinations are detailed in the *Year 12 Information Handbook 2024: Part II Examinations*. 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. 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.

   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 of 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. The process whereby chromosomes separate during the first meiotic division, leading to variation in alleles in the gametes, is known as

   (a) random fertilsation.
   (b) non-disjunction.
   (c) independent assortment.
   (d) crossing over.

2. Andrea, who has the autosomal recessive condition known as cystic fibrosis (CF), marries a man whom has no history of CF in his family. What is the most likely probability, as a percentage, of their children having CF?

   (a) 0%
   (b) 25%
   (c) 75%
   (d) 100%

3. Which of the following is not a structural feature of the alveoli that makes them suited to gas exchange?

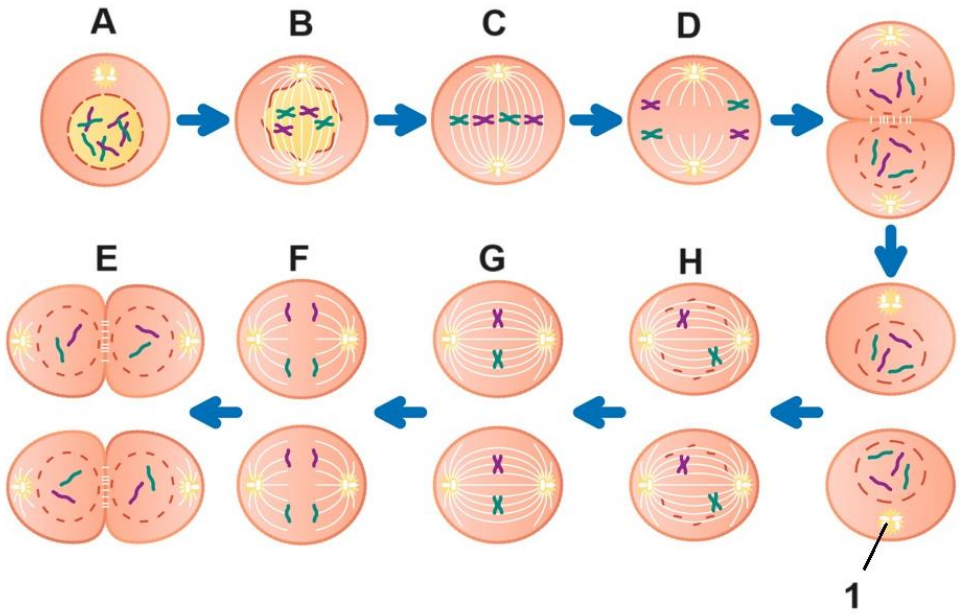
   (a) They have a low surface area.
   (b) They are surrounded by blood vessels.
   (c) They have a very thin wall.
   (d) They are covered by a thin layer of moisture.

4. Which of the following contraception methods cannot help prevent transmission of sexually transmitted infections?

   (a) chemical spermicides
   (b) condoms
   (c) abstinence
   (d) female condoms

See next page

Questions 5 to 7 refer to the following diagram showing the process of meiosis.



5. During which of the phases labelled on the diagram does crossing over occur?

(a) A
(b) B
(c) C
(d) D

6. The organelles labelled with the number 1 are known as

(a) centromeres.
(b) chromatin.
(c) microtubules.
(d) centrioles.

7. During oogenesis, in which phase labelled on the diagram above does meiosis stop at, after ovulation occurs?

(a) E
(b) F
(c) G
(d) H

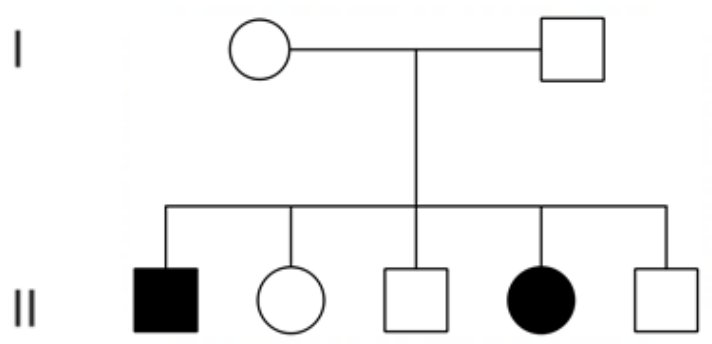
See next page

8. Which of the following structures is not formed by the mesoderm during embryonic development?

(a) cartilage
(b) lymphoid tissue
(c) hair
(d) muscles

Question 9 and 10 refer to the following pedigree chart showing the inheritance of alleles that results in the production of the antigens from the ABO blood grouping system. The shaded individuals have type O blood.

Note: this pedigree does not include information about inheritance of the Rhesus factor.



9. Which of the following is the correct annotation for the genotype of the shaded individuals?

(a) ii
(b) oo
(c) I^oI^o
(d) II

10. If the female in generation I has type A, and the male has type B blood, what type of blood do their children **without** type O have?

(a) type A
(b) type B
(c) type AB
(d) not enough information provided to determine blood type

11. Which of the following terms refers to how correct, or true, the results of an investigation are?

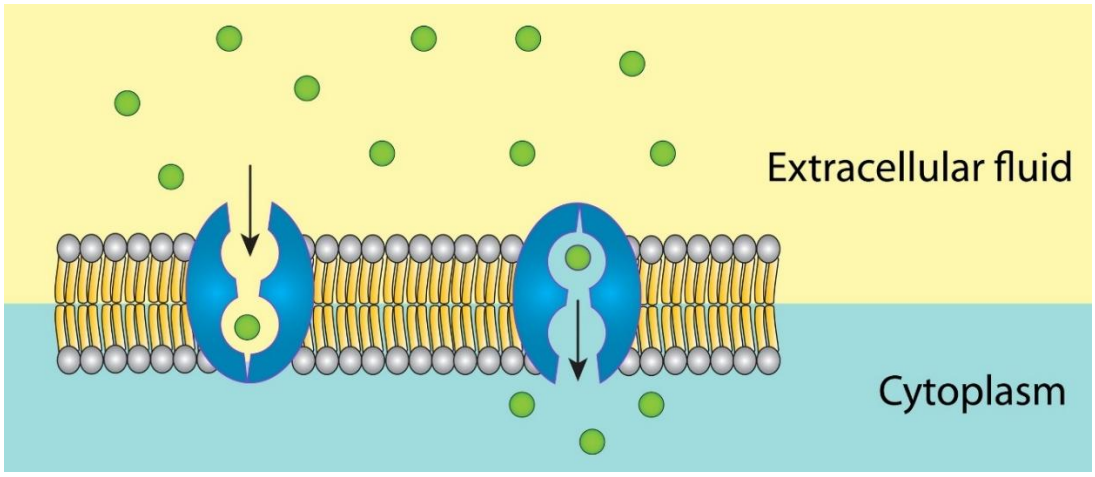
(a) reliability
(b) validity
(c) accuracy
(d) precision

See next page

12. Before gas exchange occurs in the alveoli,

(a) the blood in the capillaries has a high concentration of oxygen, but a low concentration of carbon dioxide.
(b) the blood in the capillaries has a low concentration of oxygen, and a low concentration of carbon dioxide.
(c) the blood in the capillaries has a high concentration of oxygen, and a high concentration of carbon dioxide.
(d) the blood in the capillaries has a low concentration of oxygen, but a high concentration of carbon dioxide.

Question 13 and 14 refer to the diagram below of the cell membrane.



13. The correct name for the protein found in the diagram is a

(a) carrier protein.
(b) channel protein.
(c) receptor protein.
(d) diffusion protein.

14. Which of the following best describes the transport across the membrane shown in the diagram?

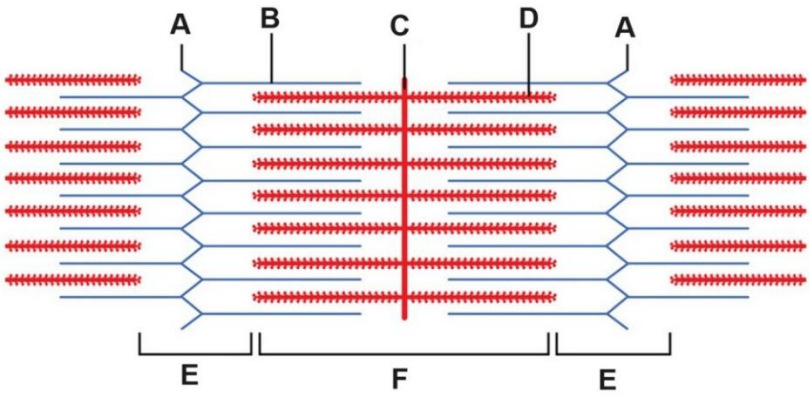
(a) passive, against the concentration gradient
(b) active, against the concentration gradient
(c) passive, with the concentration gradient
(d) active, with the concentration gradient

15. Fertilisation occurs in the

(a) ovary.
(b) fallopian tube.
(c) uterus.
(d) vagina.

See next page

Question 16 and 17 refer to the following diagram illustrating the structure of a sarcomere.



16. The part labelled B is known as

(a) myosin.
(b) actin.
(c) the A band.
(d) the I band.

17. During muscle contraction

(a) Structure D decreases in length.
(b) The distance represented by E shortens.
(c) The distance represented by F lengthens.
(d) Structure A increases in length.

18. Which of the following is the correct name given to the biotechnological technique that can allow scientists to produce a DNA profile?

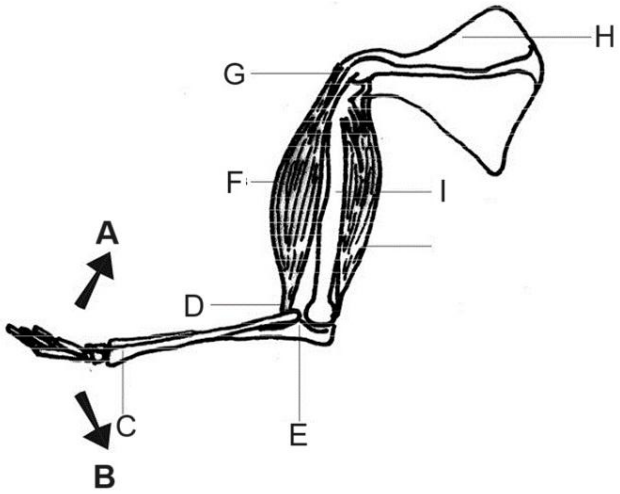
(a) polymerase chain reaction
(b) genetic engineering
(c) gel electrophoresis
(d) genetic probing

19. The type of cartilage found in the vertebral discs is known as

(a) hyaline cartilage.
(b) articular cartilage.
(c) elastic cartilage.
(d) fibrocartilage.

See next page

Questions 20 to 22 refer to the following diagram showing muscles and bones at the elbow joint.



20. The type of movement, indicated by the letter A is known as

(a) flexion.
(b) extension.
(c) adduction.
(d) abduction.

21. The muscle group F during movement A is referred as the

(a) antagonists.
(b) agonists.
(c) synergists.
(d) biceps.

22. The structure labelled G is known as the

(a) insertion.
(b) tendon.
(c) cartilage.
(d) ligament.

See next page

23. An imbalance between the actions of osteoclasts and osteoblasts can lead to which of the following conditions?

(a) osteoarthritis
(b) osteonecrosis
(c) osteoporosis
(d) osteogenesis

24. Tissue containing branched, striated cells, with intercalated discs is most correctly referred to as

(a) muscular tissue.
(b) smooth muscle.
(c) cardiac muscle.
(d) skeletal muscle.

25. The ductus venosus allows for blood to bypass which of the following organs during foetal circulation?

(a) lungs
(b) kidneys
(c) stomach
(d) liver

End of Section One

See next page

Section Two: Short answer **50% (90 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: 80 minutes.

Question 26 **(16 marks)**

A combination of chemotherapy and radiotherapy is being recommended for some forms of small tumour lung cancer. One randomised clinical trial tested the effect of this combined treatment on lung cancer sufferers.

This trial involved splitting a group of 200 people with lung cancer, at random, into a control group and an experimental group. Those in the experimental group were given the treatment once-daily over a period of 6 months, while those in the control group received a placebo. The patients were given a CT scan monthly to determine the percentage change in the size of the tumour.

The table below show the reduction in the size of tumours, as a percentage, in the two groups over time.

	Average percentage (%) of tumour remaining each month					
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Experimental Group	90	82	70	63	51	38
Control Group	97	94	92	95	88	90

(a) Explain the purpose of the control group in this investigation. (2 marks)

_____

_____

_____

(b) Identify **two** controlled variables in this investigation. (2 marks)

_____

_____

(c) Suggest a possible hypothesis for this investigation. (2 marks)

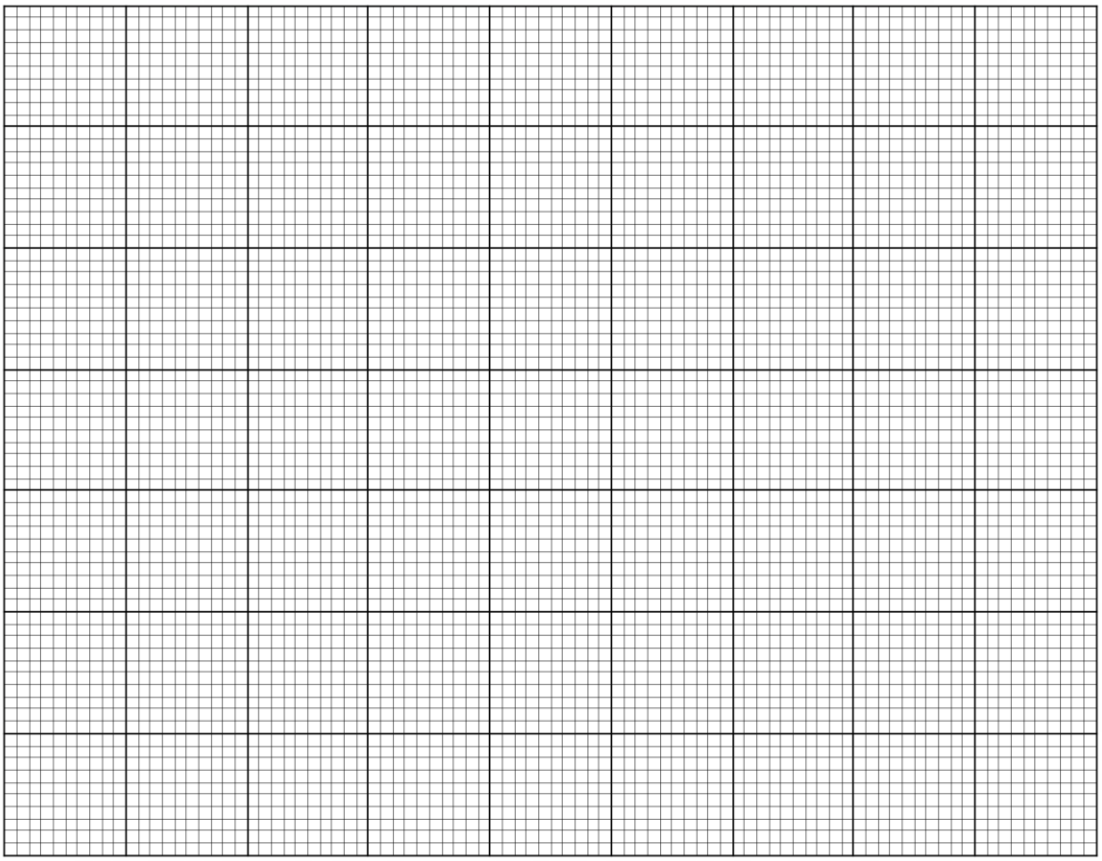
_____

_____

_____

_____

(d) Graph the results of the clinical trial on the grid below. (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.

Question 26 (continued)

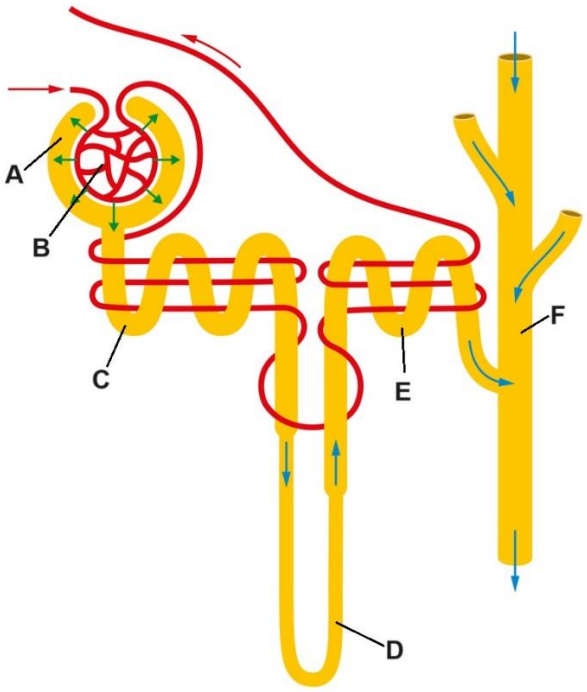
(e) Outline a conclusion based on the data in the graph. (2 marks)

(f) Define what cancer is and explain the impact that a tumour can have on the functioning of normal body cells/tissues. (3 marks)

See next page

Question 27 **(16 marks)**

The diagram below shows the structure of the nephron in the human kidneys.



(a) Complete the table below by identifying the parts labelled in the diagram. (3 marks)

Label	Name of structure
C	
D	
F	

(b) Name and describe the processes involved in the formation of urine that occur at D, E and F. (4 marks)

(c) Explain how the structure of A and B make them suited for the process that occurs at this location. (4 marks)

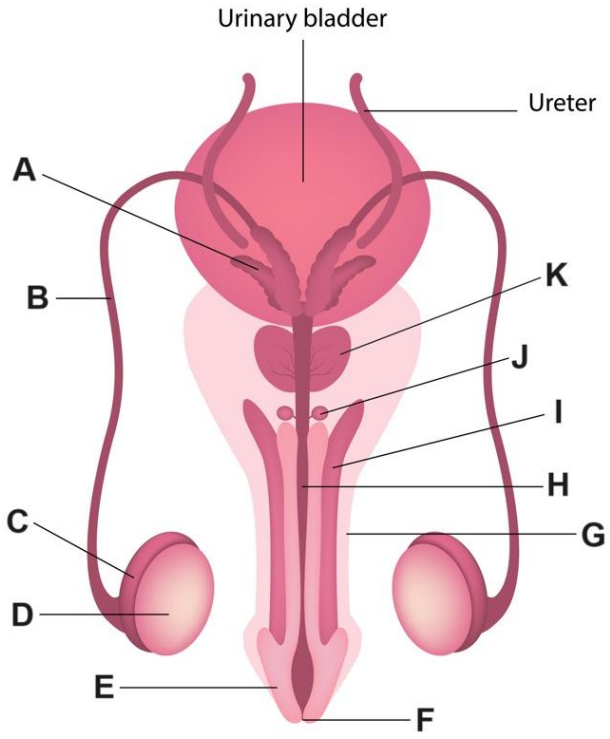
Someone suffering from diabetes mellitus can have a higher than normal amount of sugar dissolved in their blood stream, this ultimately causes the fluid in the nephron tubule at D and E on the diagram to have a higher than usual solute concentration.

(d) Describe and explain the effect this might have on osmosis at these locations, and what this might mean for the concentration and amount of urine produced by a diabetic. (5 marks)

See next page

Question 28 **(10 marks)**

The diagram below shows the structures of the male reproductive system.



(a) Complete table below, outlining the function of the labelled parts. (3 marks)

Label	Function
C	
D	
H	

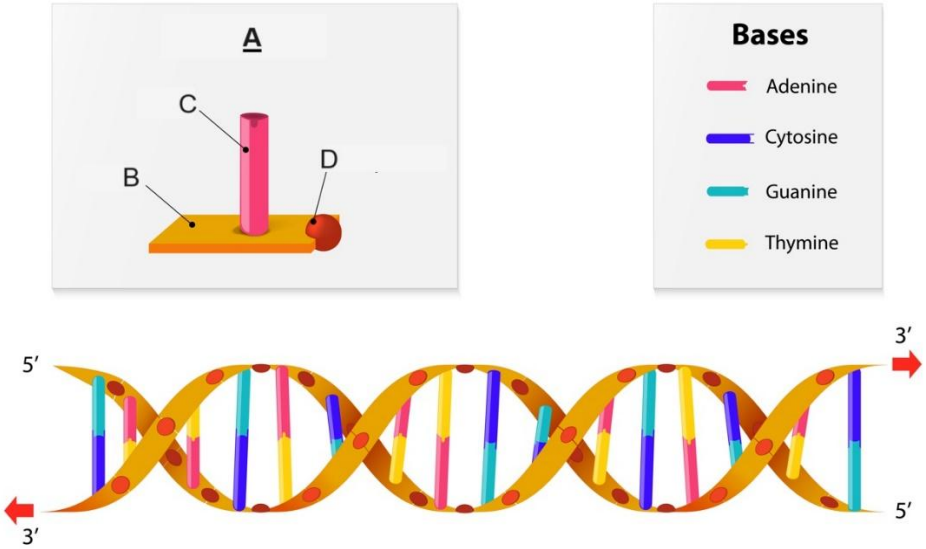
(b) Name and explain the sterilisation method of contraception that involves making an incision to remove part of the structure labelled B. (3 marks)

(c) Explain, referring to the relevant labelled structures in the diagram, why a man can still produce seminal fluid even after undertaking the procedure from part (b). (4 marks)

See next page

Question 29 **(12 marks)**

The diagram below shows the structure of DNA.



(a) State the name and describe the structure of the building blocks of DNA, labelled **A** on the diagram. (4 marks)

(b) DNA needs to be replicated before mitosis takes place. Explain the importance of DNA replication for mitosis. (3 marks)

See next page

(c) During mitosis DNA can be found in structures known as chromosomes. Describe the structure of chromosomes, and outline what occurs to chromosomes during metaphase and anaphase in mitosis. (5 marks)

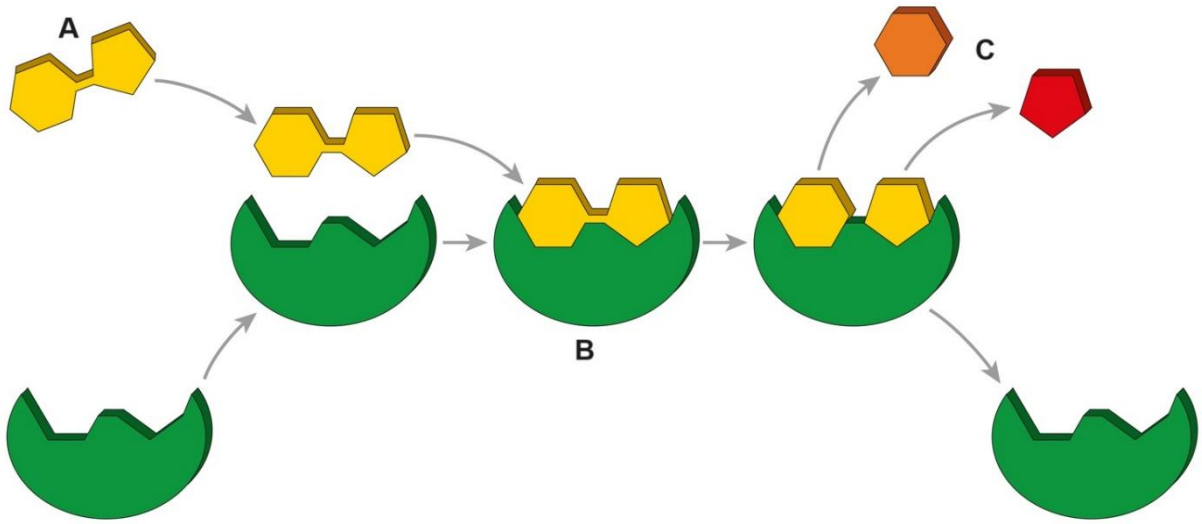
See next page

Question 30 **(11 marks)**

During heavy or intensive exercise, the skeletal muscles demand a high amount of energy. Due to a limited supply of oxygen, the muscle cells resort to anaerobic respiration.

(a) Describe the process of anaerobic respiration, including the location, inputs and outputs of the process. (5 marks)

Enzymes, such as dehydrogenase, are needed during the anaerobic respiration process. The diagram below shows the lock and key model of enzyme function.



(b) Name the structures in the diagram labelled A and B. (2 marks)

A _____

B _____

After intensive exercise the body may be in oxygen debt, this may trigger an increase in rate and depth of breathing.

(c) Describe and explain the process of inspiration during breathing. (4 marks)

_____

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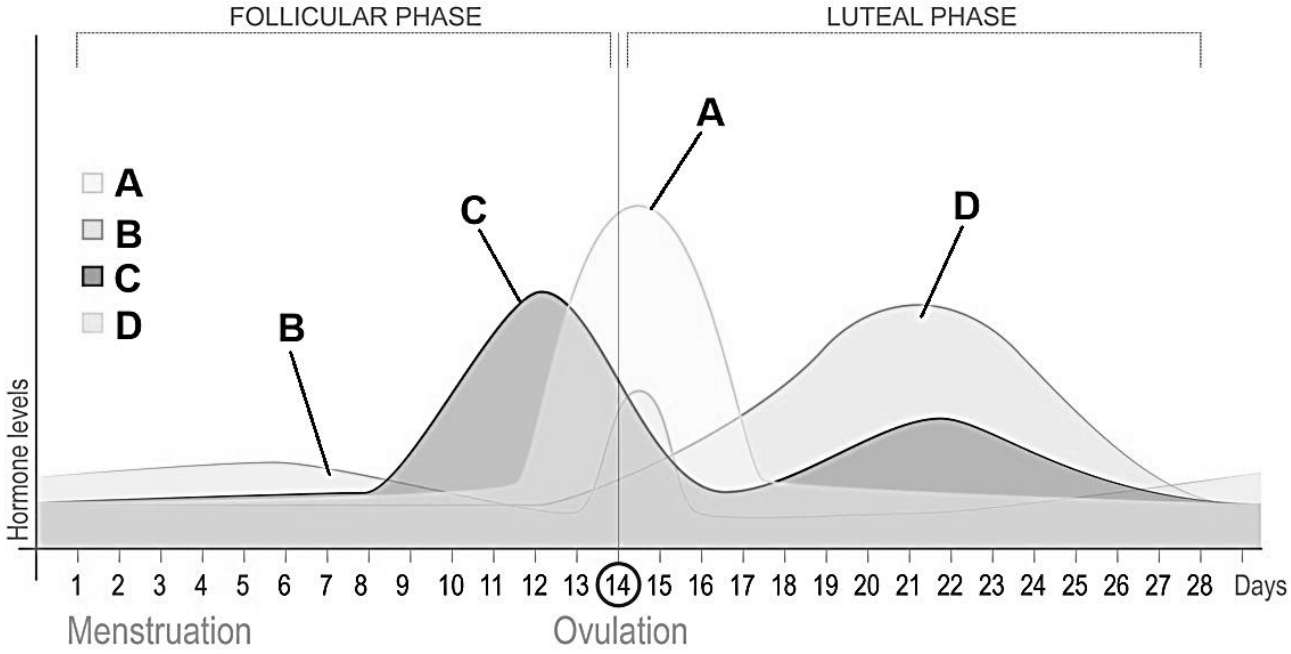
See next page

Question 31 **(11 marks)**

The figure below shows the changes in hormones levels in females during the ovarian and menstrual cycle.



(a) Identify hormones A and C. (2 marks)

A _____

C _____

(b) Describe the role of hormone D in the ovarian and menstrual cycle. (2 marks)

_____

_____

_____

_____

See next page

(c) State which **two** hormones from the diagram can be found in the female contraceptive pill and explain the role of **one** of these hormones used in this form of contraception. (4 marks)

(d) During the process of in-vitro fertilisation (IVF), the woman needs to produce a large number of eggs to increase the likelihood of the procedure being effective. State which hormone from the diagram would be given synthetically to stimulate this process and, explain your answer. (3 marks)

See next page

Question 32 **(12 marks)**

The small intestine is the primary site for absorption of nutrients into the blood after mechanical and chemical digestion has taken place.

(a) Describe the mechanical and chemical digestion that takes place in the mouth before the food reaches the small intestine. (4 marks)

(b) Explain the role of active transport and simple diffusion in the absorption of nutrients. (4 marks)

See next page

Question 32 (continued)

The small intestine is comprised of different types of tissue, which suit its function in both absorption and digestion.

(c) Name and describe the structure of the two different types of tissue that would be involved in digestion and absorption in the small intestine. (4 marks)

End of Section Two

Section Three: Extended answer **20% (35 Marks)**

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

Questions 33 and 34 are from Unit 1. Questions 35 and 36 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; list 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: 40 minutes.

Unit 1

Choose **either** Question 33 **or** Question 34.

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 33 and indicate on that page the second question you will answer.

☐ **Question 33** **(15 marks)**

The body's main internal transport system is the circulatory system. It is the link between the cells inside the body, which have certain requirements and the environment outside the body, which supplies those requirements.

(a) Describe the normal flow of blood to and from the heart. (8 marks)

(b) Some circulatory conditions can result in the need for a blood transfusion. Explain how the ABO blood grouping system influence who can donate or receive blood transfusions. (7 marks)

Question 34 **(15 marks)**

Gerald and Hecuba were catching up over a delicious dinner of steak and chips with pepper sauce, a meal rich in proteins, complex carbohydrates and fats.

(a) Describe the mechanical and chemical digestive processes that will occur throughout Gerald and Hecuba's digestive system to break down their dinner. (10 marks)

(b) Enzymes in the digestive system work in specific, optimal conditions. Describe the pH in the stomach and explain the impact that pH has on enzyme function during digestion. (5 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 35** **(20 marks)**

Gene expression refers to the phenotypic expression of genes and is achieved through protein synthesis. The expression of genes is determined by a combination of alleles which are expressed dependent on their mode of inheritance.

(a) Describe transcription and translation. (12 marks)

(b) Describe how autosomal recessive and sex-linked recessive genetic disorders are inherited and expressed. Use examples of these disorders to support your answer. (8 marks)

☐ **Question 36** **(20 marks)**

Germline, or germ cells, are the cells that give rise to the gametes in the ovaries and testes. These diploid cells are formed during embryonic and foetal development as a result of differentiation from unspecialised cells known as stem cells.

(a) Name and describe the three types of stem cells, based on differing levels of potency. (8 marks)

(b) Describe how gametes are produced through the processes of spermatogenesis and oogenesis. (12 marks)

End of questions

See next page

Question number: _____

See next page

Question number: _____

See next page

Question number: _____

See next page

Question number: _____

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Question number: _____

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Supplementary page

Question number: _____

Supplementary page

Question number: _____

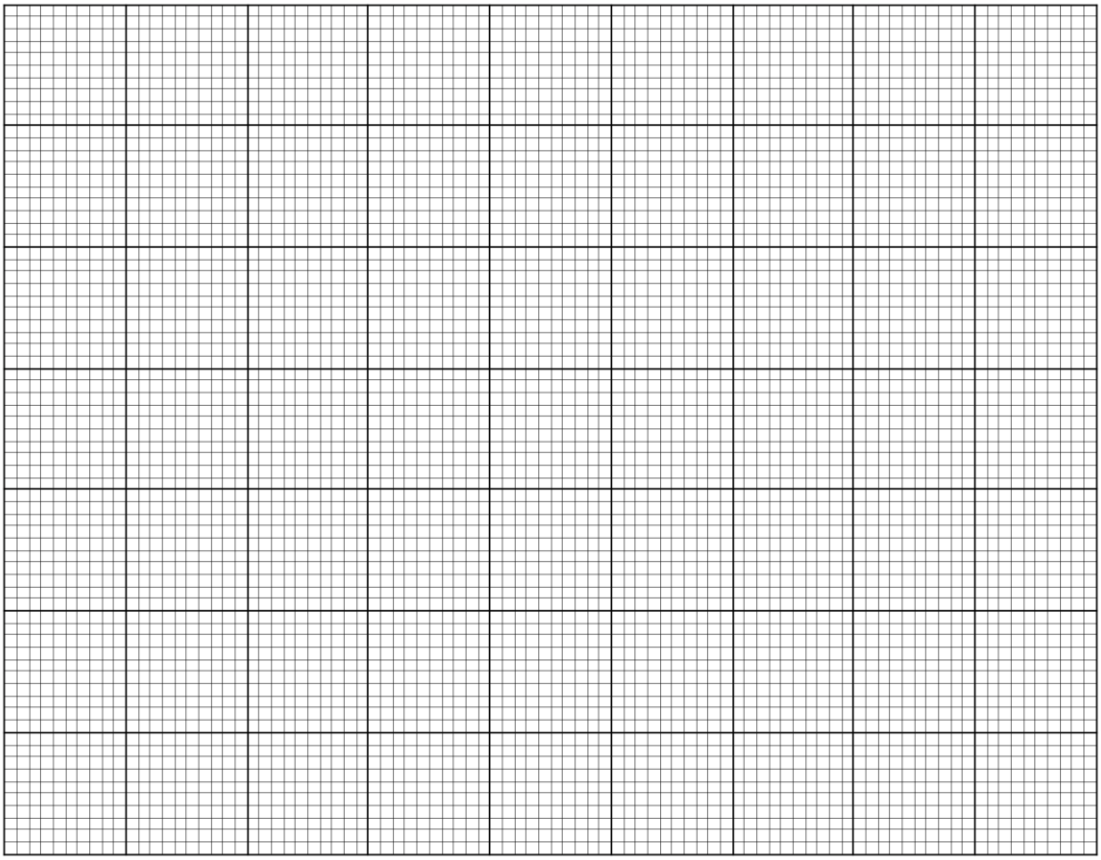
Supplementary page

Question number: _____

Supplementary page

Question number: _____

Spare grid



ACKNOWLEDGEMENTS

Question 5 – 7 Adapted from: Vectormine. (n.d) [Stages of meiosis diagram]. Retrieved from https://www.dreamstime.com/stages-meiosis-vector-illustration-labeled-cell-division-process-scheme-explanation-genetic-aspect-interphase-image179364753

Questions 14 – 15 Adapted from: Watiporn (n.d.) [Carrier protein function diagram]. Retrieved from https://www.dreamstime.com/carrier-protein-function-small-green-molecules-transport-cytoplasm-extracellular-fluid-using-plasma-membrane-image185994294

Question 17 – 18 Adapted from: CNX OpenStax. (2016) Retrieved from File:Figure 38 04 04.jpg - Wikimedia Commons

Question 27 – 29 Adapted from: Sunshineconnelly (2007) Retrieved from File:Anatomy and physiology of animals Antagonistic muscles, flexion&tension.jpg - Wikimedia Commons

Question 31 Adapted from: Griskeviciene, A. (n.d.) [Nephron diagram]. Retrieved from https://www.dreamstime.com/nephron-minute-microscopic-structural-functional-unit-kidney-composed-renal-corpuscle-tubule-consists-tuft-image241569200

Question 33 Adapted from: Khaipet, V. (n.d.) [Male reproductive system diagram]. Retrieved from https://www.dreamstime.com/male-reproductive-system-anatomy-male-reproductive-system-anatomy-image148692264

Question 34 Adapted from: Designua (n.d.) [DNA structure diagram]. Retrieved from DNA structure stock vector. Illustration of helix, cell - 56366025 (dreamstime.com)

Question 35 Adapted from: Griskeviciene, A. (n.d.) [Lock and key model diagram]. Retrieved from https://www.dreamstime.com/lock-key-model-enzymes-proteins-act-as-biological-catalysts-biocatalysts-catalysts-accelerate-chemical-reactions-lock-image241462870

Question 36 Adapted from: Designua (n.d.) [Menstrual cycle diagram]. Retrieved from https://www.dreamstime.com/stock-illustration-menstrual-cycle-hormone-level-ovarian-follicular-luteal-phase-image97174422