



**Methodist Ladies' College  
ATAR course examination, Semester 2, SAMPLE EXAM**

**Question/Answer booklet**

**HUMAN BIOLOGY – SOLUTIONS**  
**ATAR Year 11**

Student Name: \_\_\_\_\_

Teacher Name: \_\_\_\_\_

**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

Number of additional  
answer booklets used  
(if applicable):

***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.

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

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

**End of Section One**

**Section Two: Short answer****50% (90 Marks)**

This section has **eleven (11)** questions. Answer **all** questions. Write your answers in the space provided.

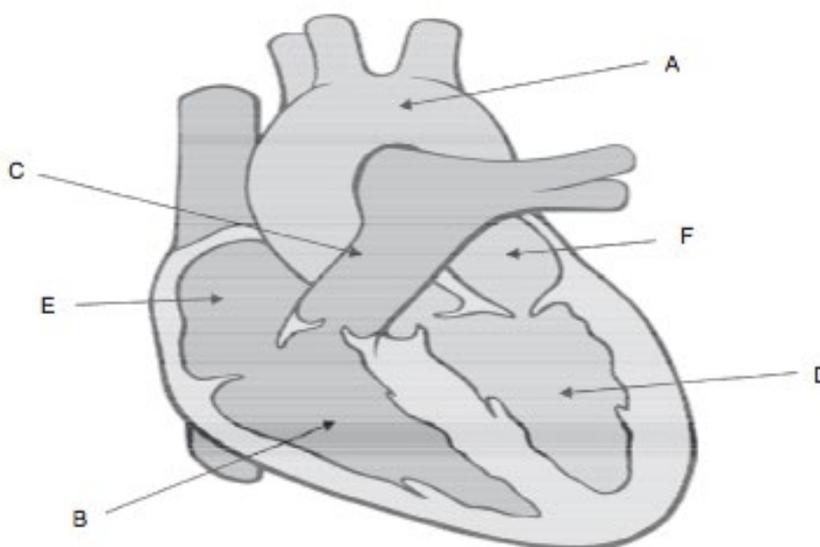
Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time for this section is 90 minutes.

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**Question 31****14 marks**

This question refers to the diagram below, which represents a longitudinal section through the human heart.



- a) Identify the structures labelled A and B. (2 marks)

A: **Aorta**

B: **Right ventricle**

- b) State the function of the structures labelled C and D. (2 marks)

C: **Carries deoxygenated blood to the lungs**

D: **Pumps oxygenated blood into aorta and around the body**

c) In some instances, babies can be born with a hole that connects the structure labelled E with the structure labelled F. Explain why this 'hole in the heart' is a serious problem. (3 marks)

- Mixing of deoxygenated and oxygenated blood
- Transportation of O<sub>2</sub> and CO<sub>2</sub> reduced
- Baby unable to function at optimum rate

d) Describe and explain the difference in structure between an artery and a vein. (5 marks)

- Artery walls contains smooth muscle & elastic fibres that can stretch
- To increase diameter to accommodate extra blood / increase in pressure
- Veins walls are thin & inelastic with very little muscle
- Are not able to change their diameter
- Veins possess valves, preventing backflow of blood (under less pressure)

f) Describe what occurs during atrial systole. (2 marks)

- Contraction of the atria
- Forcing blood into the ventricles

## Question 32

8 marks

- a) Identify the independent variable and dependent variable in this experiment. (2 marks)

Independent: Room temperature

Dependent: Heart rate (and sweating)

- b) Identify the control group in this experiment. Justify your answer. (2 marks)

Group B

They were not subject to the independent variable

- c) State **one** control variable, not mentioned in the information above. (1 mark)

Any reasonable e.g., age of participants, gender of participants, method of recording heart rate

- d) Describe **one** possible method used to select the 200 participants in this experiment that would be valid. (2 marks)

- random selection
- eg drawing names at random from an electoral roll

e) Explain why the subjects in this experiment were asked to lie still during the time interval over which the experiment ran. (2 marks)

- so that only air temperature, and not movement
- was acting as the independent variable in the experiment

f) Can 75 beats/minute be described as the average heart rate of a human? Explain your answer. (2 marks)

- No
- different age groups would have different average heart rates

### Question 33

16 marks

a) A section of one of the strands of a DNA molecule has the sequence of bases shown.

DNA: C T T A C A T T A C T C

In the spaces below, enter the sequence of bases in the corresponding strand of DNA.

(1 mark)

G A A T G T A A T G A G

b) The percentage of base T in a molecule of DNA is 30%. What is the percentage of G bases in the same DNA molecule? Show working. (2 marks)

- 20%
- 1 mark for working

c) Explain why there are pores in the nuclear membrane. (2 marks)

- To allow mRNA to exit the nucleus
- So that protein synthesis can occur

d) Label the cell parts: (2 marks)

A: Nucleolus

D: Golgi body

e) Consider a pancreatic cell producing digestive enzymes to secrete into the alimentary canal. Name **two** of the structures in the above diagram you would expect to find in high quantities in the cell, and explain why you would expect this. (4 marks)

Structure 1:

- Ribosomes/rough endoplasmic reticulum
- as ribosomes are the site for production for these proteins/enzymes

Structure 2:

- Golgi body
- to package and export the proteins/enzymes being made

- f) Name the part of the digestive tract that has both the pancreatic juice and bile emptied into it. (1 mark)

duodenum/beginning of small intestine

- g) It is impossible to live normally without a liver. Describe four reasons why this is the case. (4 marks)

Any 4 below

- the liver removes excess amino acids from the blood stream and breaks them down to urea for export
- metabolises protein, carbohydrates into useful substances
- removes excess sugar from the blood stream and stores it as glycogen
- glycogen/glycerol into glucose when required when blood sugar falls
- stores vitamins and minerals
- produces the bile which helps emulsify the food into fatty acids and glycerol
- converts fatty acids into ATP
- capture & digest bacteria, fungi, worn out cells etc.
- produces some plasma proteins
- detox drugs and alcohol
- helps control acids/base levels

### Question 34

6 marks

A brown eyed woman whose father was blue eyed marries a man with brown eyes. They produce three brown eyed children.

- a) What is the genotype of the mother? (1 mark)

Bb

- b) What genotype(s) could the father be? Explain your answer. (4 marks)

BB (1 ) or Bb (1)

- As all the children are brown eyed they must have the dominant B gene.
- It doesn't matter whether they have the recessive b gene because only B will be expressed in the phenotype so B could have come from the mother or the father.

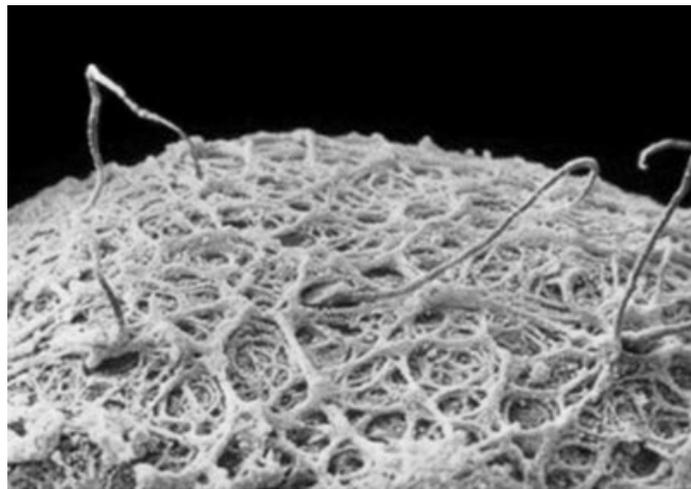
- c) If their next child is blue-eyed, what is the father's genotype? How can you be so sure? Show your workings. (3 marks)

- Father must be Bb
- As only if parents are both heterozygous can a blue eyed child be produced
- 1 mark for Punnett square showing heterozygous cross

### Question 35

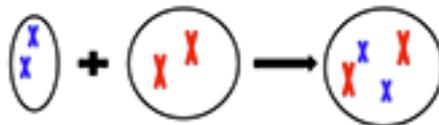
10 marks

The image below shows the egg and sperm uniting.



- a) Draw and label a diagram in the space below showing what happens to the chromosomes of the egg and sperm as fertilisation occurs. Use a model with 2 pairs of chromosomes in the diploid form for ease of representation. (2 marks)

- diagram showing the 2 chromosomes from the sperm (1) joining the 2 chromosomes from the egg (1)



- b) Name the method of reproduction that takes place once fertilisation has occurred. (1 mark)

Mitosis

c) Name and explain **one** way in which meiosis leads to genetic variation in gametes. (2 marks)

- random assortment of chromosomes
  - for each member of the pair of homologous chromosomes, they are randomly placed into either of the new cells
- OR**
- crossing over
  - during prophase I, homologous chromosomes are paired and some chromatids may cross, break and exchange segments.

d) State **two** early symptoms that would indicate a woman was pregnant. (2 marks)

Any 2:

Missed period

Nausea

Presence of HCG in urine

Tender breasts

c) Describe **three** functions of the placenta. (2 marks)

- Secretes a number of hormones like HCG necessary for maintaining pregnancy
- Transports oxygen and glucose from mother to foetus and carbon dioxide and wastes from foetus to mother
- Transport antibodies from mother to foetus to provide immunity to some infectious diseases

## Question 36

14 marks

- a) Name the organ where urea is produced and describe how urea is transported to the kidneys. (2 marks)
- i) Organ: **Liver**
- ii) Means of transport: **via bloodstream**
- b) Use the information in the table above to answer the following questions:
- i) Name **two** components in the table which can pass through the wall of the glomerulus. (2 marks)
- Any 2: urea, glucose, amino acids, salts**
- ii) Explain what happens to glucose in the glomerular filtrate. (2 marks)
- Actively reabsorbed  
back into bloodstream**
- iii) Explain why the urea in the urine is more concentrated than in the glomerular filtrate. (2 marks)
- **water is reabsorbed from the filtrate (and little urea is)**
  - **so the proportion of urea in the solution rises**

c) Explain how **three** features shown in this diagram are important to the functioning of the tubule. (6 marks)

- there are lots of mitochondria in the kidney tubule cells
- this allows energy for active reabsorption
  
- there is just one layer of cells making up the tubule
- this allows closeness to surrounding network of capillaries, reducing time for diffusion
  
- the inside of the tubule cells is highly folded
- increasing surface area to maximise rate of reabsorption

## Question 37

9 marks

a) Describe **two** features of the alveolus and/or capillary that help maintain the concentration gradient of oxygen, and explain how this facilitates efficient gas exchange. (4 marks)

- thin walls capillaries and/or alveoli
- increases rate of diffusion as less distance to travel
- continual flow of blood in capillary
- maintains the concentration gradient so that diffusion continues to occur rapidly

b) Describe **two** features of the red blood cells that allow them to carry oxygen efficiently. (2 marks)

Any 2 below:

- RBC – is donut shaped/biconcave disc
- large surface area for oxygen to move through
- RBC contains haemoglobin – a molecule that actively takes up oxygen,
- helping keep the oxygen concentration low in the plasma so more will diffuse into the blood more rapidly
- RBC lacks a nucleus
- So it can fit more haemoglobin to transport oxygen

c) Name the tissue surrounding the alveoli and describe the feature of this tissue that makes it suited to its protective role in the body. (3 marks)

- (squamous) epithelium
- it is packed closely, with no space between cells,
- to form a barrier – this is protective

**Question 38****16 marks**

a) On what days are oestrogen levels highest? 10, 11, 12 (1 mark)

b) LH levels have quite a sharp peak as seen on the table. Name the feature of the ovarian cycle is this peak linked with? (1 mark)

Ovulation

c) State the function of follicle stimulating hormone in men. (1 mark)

Production of sperm

- d) Graph the oestrogen and progesterone levels. (6 marks)
- Labelled X axis with units
  - Labelled Y axis with units
  - Title
  - Scale
  - Correct plotting
  - Key
- e) Draw a labelled diagram showing what is happening in the ovarian cycle at the equivalent time. (5 marks)
- correctly labelled diagram, 1 mark each (follicle, graafian follicle, egg/ovule, corpus luteum)
  - 1 mark for correct positions
- f) If pregnancy occurs explain what happens to the production of oestrogen and progesterone hormones and why it is important. (2 marks)
- Production of oestrogen and progesterone increases
  - To maintain pregnancy

**End of Section Two**



## Question 39

20 marks

Describe the structure and function of an enzyme and explain how temperature, pH and concentration of the enzyme, affect an enzyme's activity. Include examples in your answer.

*20 points below*

- An enzyme is a protein
- That speeds up a chemical reaction
- without itself being changed
- The enzyme molecule is a very long chain of molecules/amino acids that is folded to form a complex three-dimensional structure
- Within that structure is a site/area, where a specific molecule or molecules can fit
- This is the active site
- This active site will allow the specific substrate/s only to attach to it, forming an enzyme-substrate complex that
- Allows the reaction to occur more efficiently (faster, with less energy)

Temperature

- The shape of an enzyme will be unravelled in temperatures outside a fairly narrow range
- Called denaturation
- enzyme will no longer work
- as the active site is destroyed
- For example, *catalase* which breaks down hydrogen peroxide in the liver (any reasonable example)
- will work most efficiently at about 37 degree Celsius

pH

- Enzymes will denature outside of a narrow, preferred pH range
- For example, *protease* which breaks down proteins in the stomach (any reasonable example)
- will work most effectively in very acidic conditions (pH ~2)
- The temperature or pH that the enzyme works most efficiently at is called its' optimum pH or temperature

Concentration

- The higher the concentration of enzyme, the faster the rate of a chemical reaction
- Because there are more enzyme molecules to influence reactants
- For example, a higher concentration of (salivary) *amylase* in the mouth will increase rate of chemical digestion of starch (any reasonable example)

**Question 40****20 marks**

a) Describe the complete process of aerobic respiration. (10 marks)

- in the cytoplasm
- without oxygen
- 1 molecule of glucose breaks down to produce 2 pyruvic acid molecules
- forming 2 ATPs
- known as glycolysis
- pyruvic acid then enters the mitochondria
- with oxygen
- is broken down to produce 6 carbon dioxide and 6 water
- in the citric acid cycle and electron transport system
- forming 36 ATPs

b) Cells transport substances across their membranes. For two types of cellular transport, diffusion and endocytosis, describe the energy requirements, the process, and give one example of where the process is used. (10 marks)

- Diffusion is the movement of particles from regions of high concentration to low concentration
- Diffusion is a passive process
- requires no energy
- As particles move with the concentration gradient
- Eg the movement of glucose into a cell that has used up its immediate supply of glucose / the movement of dye into a cell on a slide / the movement of coffee through a cup of hot water that is not stirred / any reasonable
- Endocytosis is the uptake of material, into the cell by surrounding the particle and then creating a vesicle that moves inside the cell
- Pinocytosis is taking in liquids/phagocytosis is taking in solids
- Endocytosis is an active process
- requires the input of energy from the cell
- Eg. Phagocytosis by white blood cells where bacteria are taken into the cell by endocytosis, any reasonable


**Question 41**
**20 marks**

- a) Some methods of birth control rely on a female's ability to determine the time of ovulation. Name and explain **three** such methods a female could use and discuss why determining the time of ovulation is helpful to the female. (12 marks)

*3 marks per method*

- Rhythm method
  - Females have a cycle of 28 days
  - Ovulation occurs around day 14
  - Sexual intercourse is avoided around the time ovulation is likely to occur
  - Not regarded as reliable on its own
  
  - Temperature method
  - Female records body temp each morning
  - Ovulation is accompanied by a sharp drop in body temp and then a rise
  - Intercourse can occur 3 days after temp has risen to avoid pregnancy
  
  - Mucus method
  - Monitoring the consistency of cervical mucus
  - At ovulation the mucus is clear
  - Before and after ovulation, mucus is cloudy
  - Intercourse can occur when there is no mucus, and more than 3 days after the last day of clear mucus to avoid pregnancy
- \*Can also discuss symptothermal method*
- Time of ovulation is important because the egg can only survive for 2 days unless fertilised
  - And the sperm can survive for 4 days
  - So to avoid pregnancy, intercourse should not occur between 4 days before and 4 days after ovulation

- b) Describe the events that occur in the three stages of birth. (8 marks)

- First stage – dilation of cervix
- waves of contractions in uterus (labour pains)
- uterus, cervix and vagina form a single, curved passage – birth canal
  
- Second stage – expulsion
- amniotic sac ruptures
- foetus passes through birth canal and is delivered
  
- Third stage – afterbirth
- umbilical cord cut and membranes and placenta expelled



- a) Describe how the information in a diploid cell is reorganised to produce gametes in the female reproductive system. (11 marks)

*Any 11 points below*

- production of ova in process called oogenesis
- oogonia produced by mitosis in ovary of the foetus – diploid in number
- before birth undergo growth to form primary oocytes
- at birth have entered 1<sup>st</sup> prophase
- at puberty primary oocyte completes first meiotic division
- 2 haploid cells produced
- 1 large / most cytoplasm / secondary oocyte and 1 small / without cytoplasm / polar body
- secondary oocyte starts second meiotic division (stops metaphase)
- ovulation
- if fertilised, completes second meiotic division
- 2 haploid cells produced
- 1 large / most cytoplasm / secondary oocyte and 1 small / without cytoplasm / polar body
- crossing over creates variation

- b) During an investigation, a student acquired three photographs of cross sections of the female reproductive tract. The student lost the labels and mixed up the photographs. Describe the structural features of the vagina, fallopian tube and uterus that could help the student identify each photograph correctly. Include in your description the function of each of the structures. (9 marks)

*3 marks per structure*

Vagina

- 2 of: (stratified) epithelial lining, lined with mucous membranes, muscle tissue underlying
- Function: receives penis during sexual intercourse and enlarges to form the birth canal during childbirth

Fallopian tube

- 2 of: ciliated epithelium, smooth muscle underlying, small lumen, fimbriae at the opening near the ovary
- Function: tube that carries the ova from ovaries to uterus

Uterus

- 2 of: endometrium lining, thick muscle underlying, large lumen
- Function: protects and nourishes the developing foetus during pregnancy

**End of questions**