PRESBYTERIAN LADIES' COLLEGE
A COLLEGE OF THE UNITING CHURCH IN AUSTRALIA

HUMAN BIOLOGY ATAR
SEMESTER TWO EXAM 2016

STUDENT NUMBER: In figures: | | | | | | | | | |

In words: _____

_____

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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 TEACHER
This Question/Answer Booklet
Multiple Choice Answer Sheet

TO BE PROVIDED BY THE CANDIDATE
Standard items: Pens (blue/black preferred), pencils (including coloured), sharpener, eraser or correction fluid/tape, highlighters and ruler

Special Items: Graphic Calculators **are not** permitted in the examination room; non-programmable calculators **are** permitted in the examination room.

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	Suggested working time	Number of questions available	Number of questions to be attempted	Marks	Student's score
SECTION ONE: Multiple-choice	40 minutes	30	All	60	
SECTION TWO: Short answers	90 minutes	10	All	100	
SECTION THREE: Extended answers	50 minutes	3	2	40	
			Total marks	**200**	**%**

Instructions to candidates

1. Please ensure you write your **student number** in the space provided on page 1.

2. 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. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Sections Two and Three: Write your answers in this Question/Answer Booklet.

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

4. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
   - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
   - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Section One: Multiple-choice **30% (60 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. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. 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 for this section is 40 minutes.

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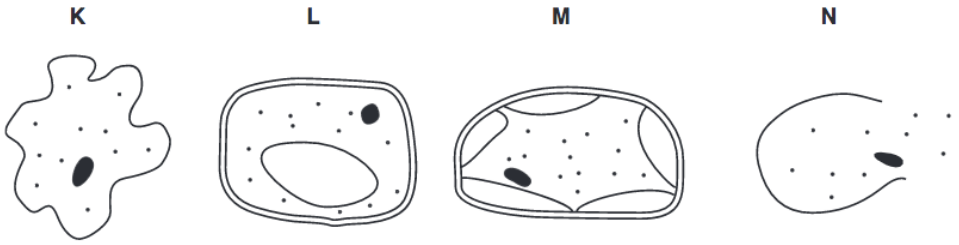
1. All cells in the human body contain the hereditary material which is isolated from the rest of the cell by

   a) cell membrane
   b) nuclear envelope
   c) nucleoplasm
   d) nucleolus

2. Which of the following is not a function of the liver?

   a) formation of glycogen
   b) formation of urea
   c) production of bile
   d) secretion of digestive enzymes

3. Identify the diagram that represents what will happen to an animal cell placed in a hypertonic solution.



   a) Diagram K
   b) Diagram L
   c) Diagram M
   d) Diagram N

4. Which of the following does not use ATP produced by respiration?

   a) Passage of nerve impulses
   b) Maintenance of a constant body temperature

c) Diffusion of oxygen across the alveolar surface
d) Active transport of glucose into the villi

5. Which of the following describe changes that occur when a person inhales?

	Diaphragm	External intercostal muscles
a)	contracts	contract
b)	contracts	no change
c)	contracts	relax
d)	relaxes	contract

6. Which of the following correctly matches each large organic molecule with the subunits from which it is made?

	Starch	DNA	Protein
a)	Monosaccharides	Nucleotides	Amino acids
b)	Amino acids	Organic bases	Glucose
c)	Glucose	Phosphate sugars	Glycogen
d)	Fructose	Disaccharides	Dipeptides

7. About 170 litres of fluid are filtered by the kidneys every day. Only 1.5 litres are excreted in the urine. What happens to the remaining 168.5 litres?

a) It is lost in the perspiration as sweat
b) It becomes tissue fluid
c) It is stored in the urinary bladder
d) It is reabsorbed into the blood

8. Which of the following cell type lacks a nucleus?

a) White blood cells
b) Red blood cells
c) Liver cells
d) Cheek cells

9. Which of the following sexually transmitted diseases can be easily treated with antibiotics?

a) herpes simplex

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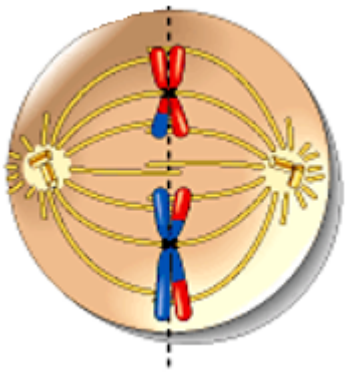
b) genital warts
c) chlamydia trachomatis
d) scabies

10. At which phase of cell division can we observe the following?

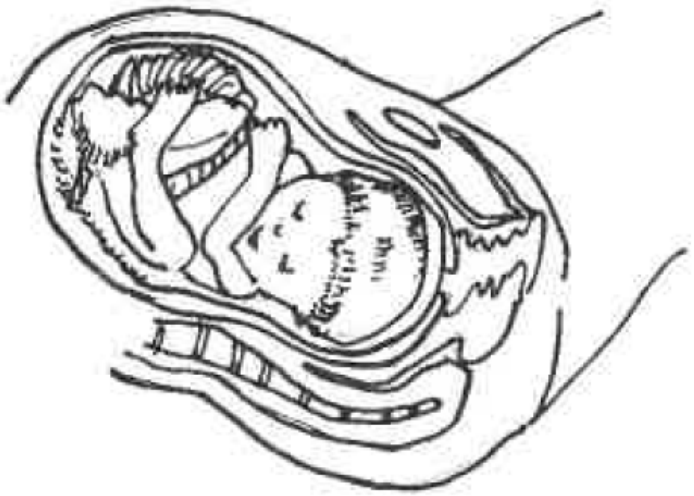


a) metaphase 1 of meiosis
b) metaphase 2 of meiosis
c) anaphase 1 of meiosis
d) anaphase 2 of meiosis

11. The dominant hormone controlling the secretory phase of the uterine endometrium is

a) progesterone
b) follicle-stimulating hormone
c) luteinising hormone
d) human chorionic gonadotropin (HCG)

12. The diagram shows a foetus at a stage of pregnancy where the hormonal system plays an important role in initiating it. Which of the following hormones cause uterine contractions?



a) oestrogen
b) progesterone and oestrogen
c) oxytocin and prostaglandins
d) oxytocin

The table below shows the amino acid and its corresponding mRNA codon. Use the table to answer Question 13.

mRNA codons for 6 amino acids

Amino acid	**Codon**
alanine	GCA
leucine	UUG
methionine	AUG
arginine	CGU
histidine	CAU
tyrosine	UAC

13. What is the base sequence on a DNA molecule that will allow the amino acid arginine to be incorporated into a polypeptide chain?

a) GCT
b) CGU
c) GCA
d) CGA

14. Gas exchange surfaces are well suited to their function as they:

a) have a large surface area, are highly vascularised, are moist

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b) are protected by the ribcage, are close to the heart, have many villi
c) contain many white blood cells, have many nephrons, are small
d) have a large surface area, are highly vascularised, have many gastric pits

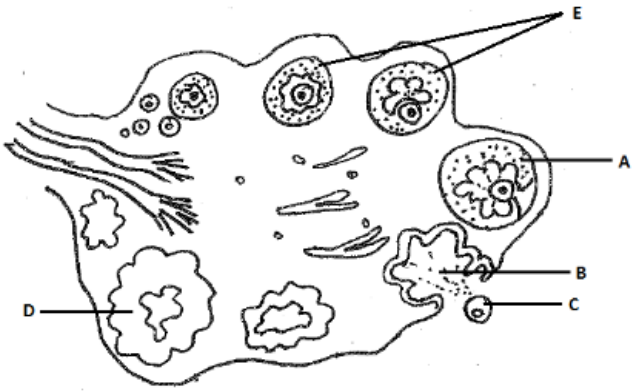
15. Peristalsis moves food material _____.

a) in the stomach and small intestine only.
b) in the stomach and intestines only.
c) from the pharynx to the anal canal.
d) none of the above is correct.

16. Brown eye colour is dominant and blue eye colour is recessive. A boy with brown eyes and a girl with blue eyes have a mother with blue eyes. What eye colour would their father have and why?

a) Blue as at least one of the parents must be heterozygous for eye colour.
b) Blue as at least 50% of the siblings must have blue eyes.
c) Brown as at least one parent must have brown eyes.
d) Brown as eye colour is a co-dominant trait.

17. The following diagram shows the changes during the ovarian cycle. Letter A represents:



a) corpus albicans
b) graffian follicle
c) secondary follicle
d) primary oocyte

18. When a soldier salutes to his superior, the movement of his forearm may be described as:

a) extension
b) flexion
c) bending

d) straightening

19. Which of the following screening methods uses high frequency sound waves to monitor foetal development?

a) Fetoscopy
b) Amniocentesis
c) Ultrasound
d) Chorionic Villus Sampling

20. The ectoderm is the primary tissue which gives rise to

a) the digestive system.
b) muscle, bone and blood vessels.
c) embryonic tissue.
d) skin and nervous system.

Refer to the following diagram to answer Question 21 and 22.

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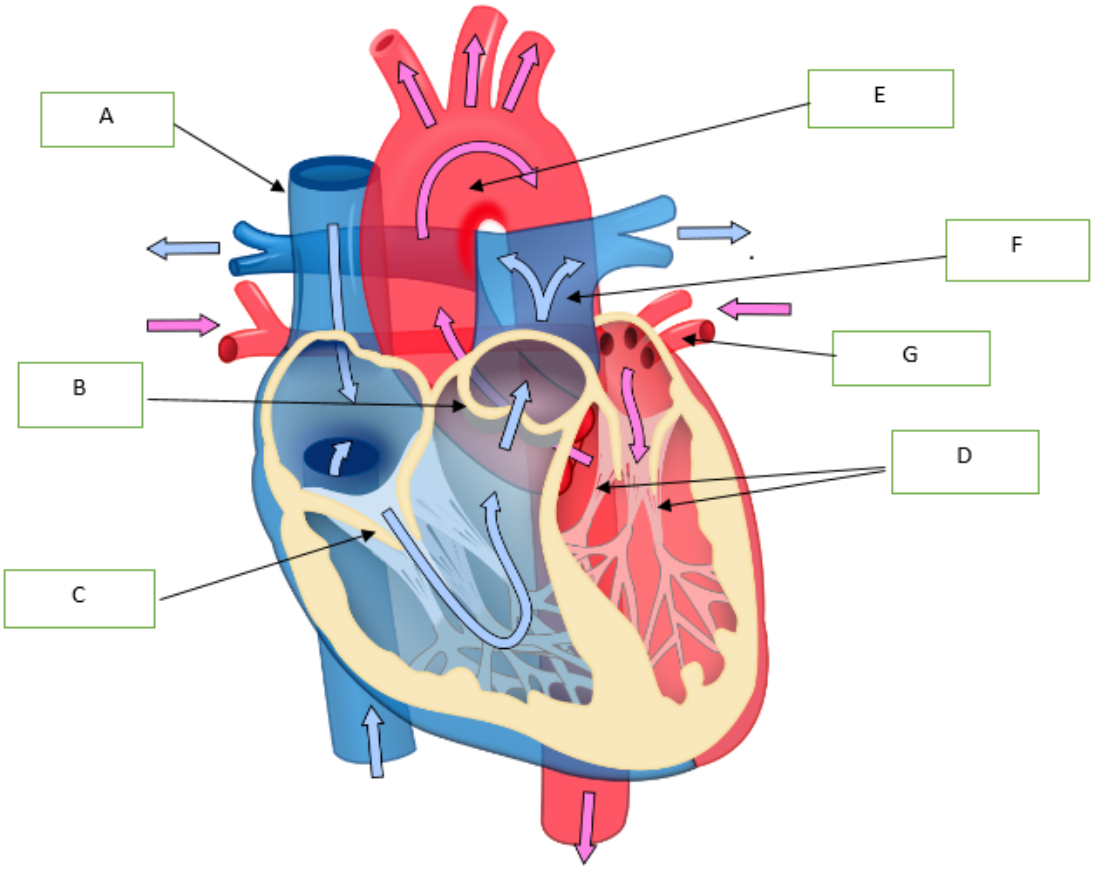


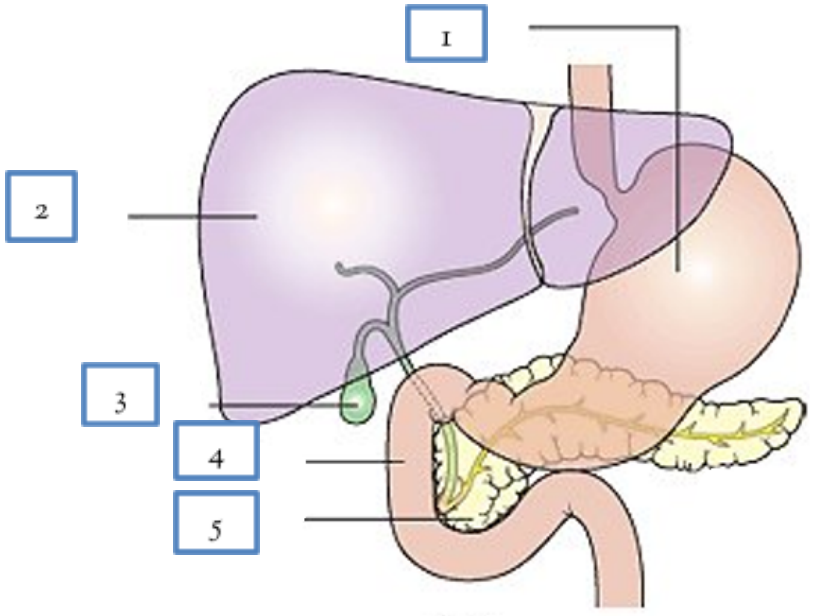
21. The parts of the heart labelled B and D are _____ and _____respectively.

a) aorta, left ventricle
b) chordae tendineae, semi-lunar valves
c) semi-lunar valves, chordae tendineae
d) semi-lunar valves, atrioventricular valves

22. Oxygenated blood flow into and out of the heart is described by the pathway

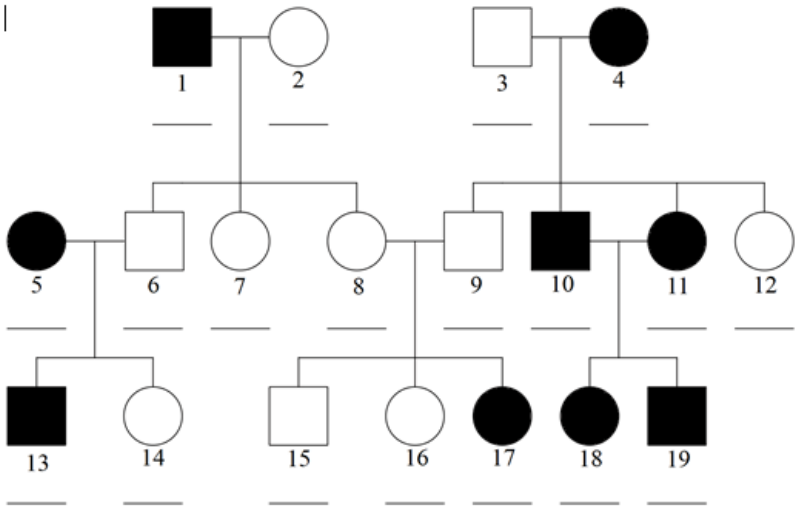
a) A & B right atrium right ventricle F
b) A & B left atrium left ventricle F
c) G left atrium left ventricle E
d) G right atrium right ventricle E

23. Refer to the diagram below, which shows part of the human digestive system. Identify the two structures that produce substances involved in fat digestion.



a) 1 and 2
b) 2 and 3
c) 3 and 4
d) 2 and 5

24. What kind of inheritance is represented by the following pedigree chart?



a) sex-linked
b) co-dominant
c) autosomal recessive

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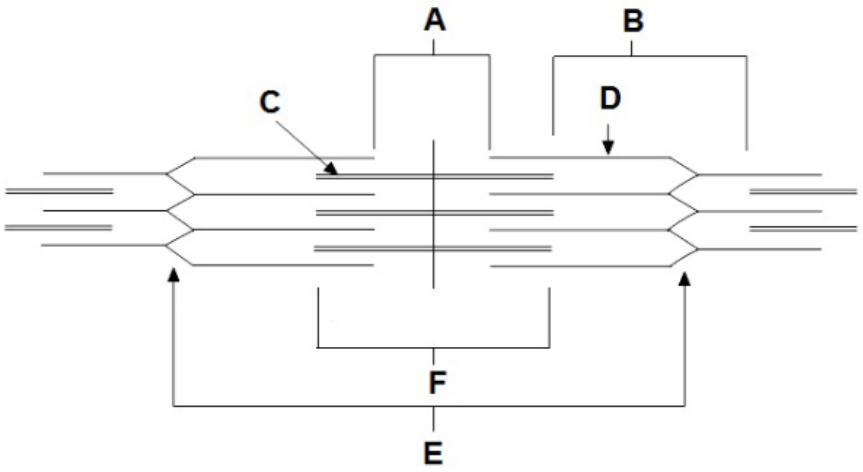
d) autosomal dominant

25. A cell in the germinal epithelium of the seminiferous tubules has a mass of 12 units of DNA. Which of the following indicate the correct number of units of DNA in a primary spermatocyte, a secondary spermatocyte and a spermatid?

	a primary spermatocyte	a secondary spermatocyte	a spermatid
a)	12	6	6
b)	12	12	6
c)	12	6	3
d)	12	12	12

Questions 26-27 refer to the diagram of the functional unit of skeletal muscle shown below.



26. During muscle contraction

a) Structure C decreases in length.
b) the distance represented by B shortens.
c) the distance represented by A lengthens.
d) Structure D increases in length

27. In the diagram, the proteins actin and myosin are represented by

	Actin	**Myosin**
a)	A	C
b)	F	D

c)	D	C
d)	C	D

28. 30% of the nucleotide bases in (human) DNA are adenine. What is the percentage of guanine bases in DNA?

a) 20%
b) 30%
c) 40%
d) 70%

29. During ventricular systole

a) the ventricles relax and the semi-lunar valves close.
b) the atria contract and the atrio-ventricular valves open.
c) the ventricles contract and the atrio-ventricular valves close.
d) the atria relax and the semi-lunar valves close.

30. Mitosis and meiosis are both forms of cell division. One difference between them is:

a) Mitosis produces 2 identical daughter cells; meiosis produces 2 non-identical daughter cells.
b) Mitosis produces 2 identical daughter cells; meiosis produces 4 identical daughter cells.
c) Mitosis produces 2 identical daughter cells; meiosis produces 4 non-identical daughter cells.
d) Mitosis produces 4 non-identical daughter cells; meiosis produces 2 identical daughter cells.

End of Section One

Section Two: Short answer **50% (100 Marks)**

This section has **ten (10)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time for this section is 90 minutes.

Question 31 **(17 marks)**

At 48 medical centres in Western Australia, 2008 otherwise healthy, postmenopausal women with bone mass density (BMD) lower than the premenopausal adult mean were randomly assigned to receive the oral drug alenodronate 10 mg (n=1020) or placebo (n=998) once daily for 15 months. All patients received 500 mg of elemental calcium daily. Baseline characteristics of patients in the two treatment groups were similar.

At every three months, change in BMD was measured and incidences of non-vertebral fractures were recorded.

This randomised, double blind, placebo-controlled experiment evaluated the effects of the alenodronate on bone mass density (BMD) in the state population of post-menopausal women with observed low bone mass.

The results are shown in Table 1.

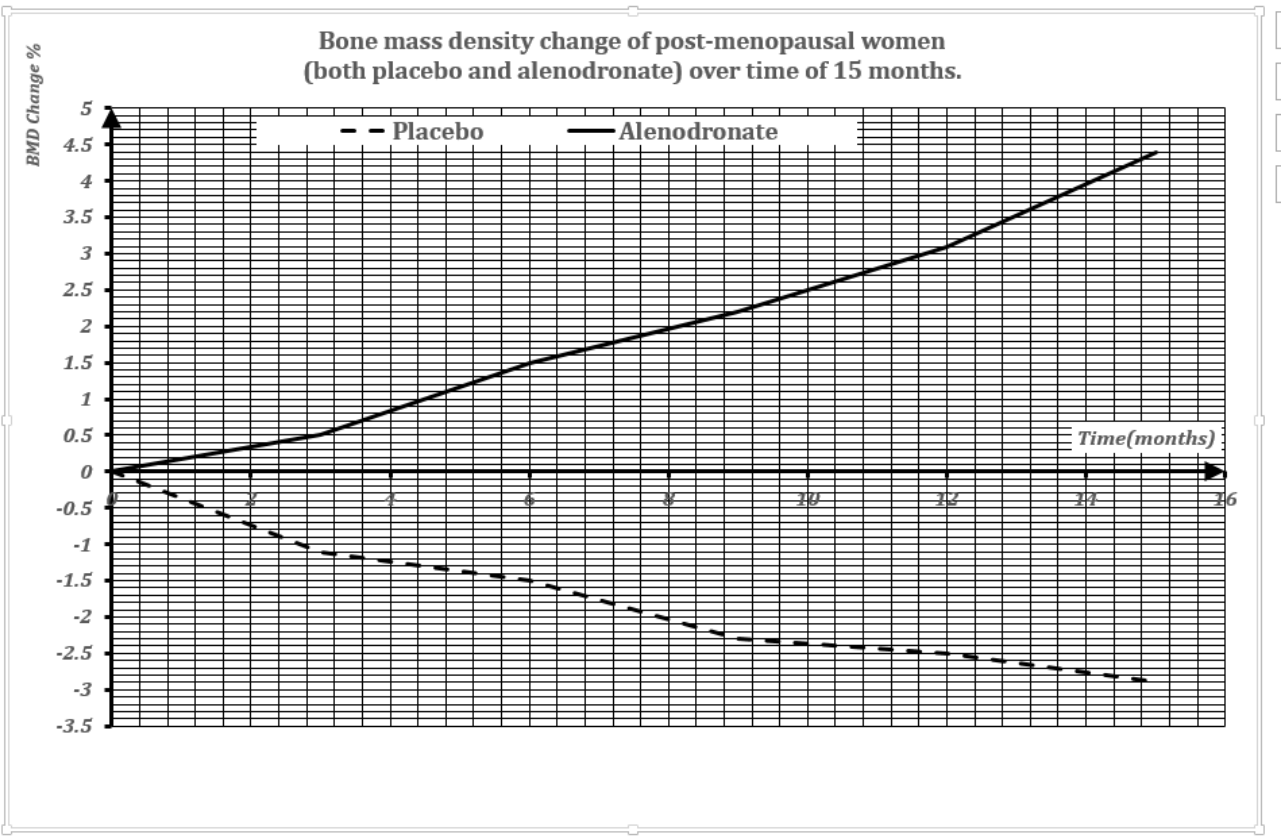
Table 1 of Results:

	Bone Mass Density Change (%)	
	Placebo	**Experimental Drug**
After 3 months	- 1.1	0.5
After 6 months	- 1.5	1.5
After 9 months	- 2.3	2.2
After 12 months	- 2.5	3.1

After 15 months	- 2.9	4.4

a) Construct a graph of the data in Table 1 using the grid provided on the next page.

(5 marks)



(1) for the independent and dependent variable axis labelled correctly
(1) for units on axis

(1) for title
(1) for correctly plotting data points including the negative values (minus ½ per incorrect data point to a max of 1)
(1) for a key/labelled lines for placebo and drug

-½ inconsistent scale
- 1 variable headings wrong way around
- 1 wrong graph
- 1 x-axis in the wrong place

If you make an error, clearly cross out your attempt and use the spare grid on page 38.

b) State the hypothesis for the experiment.
Taking alenodronate/experimental drug increases the bone mass density of post-menopausal woman
(-1/2 if no mention of postmenopausal women) (1 mark)

c) From the information given, name one variable that was controlled in this experiment
Frequency of intake, general health condition with observed low bone mass, controlled amount of calcium intake (any 1, 1 mark)

Note: not accepted women were use, amount of drug given (1 mark)

d) What steps were taken to ensure the reliability of the data collected?
Experiment with a large number of subjects /randomised mode of operation/ involves a localised group of post-menopausal women (Any 1, 1 mark)

Note: not accepted baseline chararcteristics were similar, measurements taken 3 monthly (1 mark)

e) What is a double blind, placebo-controlled experiment?
Double blind' means neither the researcher (½) nor the participant (½) know who is receiving the treatment or the placebo'

`Placebo-controlled' means `the control group' is taking an inactive substance that looks like the experimental drug (1)

(2 marks)

f) What is the conclusion of this experiment?
Alenodronate appears to increase bone mass density (of post-menopausal women)

(1 mark)

g) Why were postmenopausal women considered as subjects of this experiment?
Menopause brings about a drop in oestrogen levels which brings about gradual decrease in bone density (1)

(1 mark)

h) Name **two (2)** bone conditions that affect ageing / elderly population and outline the difference between these two bone conditions.
Osteoarthritis (1) – gradual change in joints due to joint **cartilage deterioration** (1)

Osteoporosis – (1) **loss of bone mass** / density leading to high risks of fractures (1)

(4 marks)

Question 32 **(11 marks)**

a) State **two (2)** differences in the composition of blood and lymph?

Blood contains RBC's while lymph does not contain RBCs (1)
Blood contains platelets while lymph does not contain platelets (1)
Blood contains plasma proteins while lymph does not contain plasma proteins (1)

Any 1, 1 mark, but must compare a difference.

(2 mark)

b) Use the information provided in the diagram above to describe the main role of the lymph vessel.

To collect the fluid that escapes from the capillaries (½) and return it to the circulatory system (½)

(1 mark)

c) Complete the missing sections in the table below:

Blood Group	Antigens on red blood cells	Antibodies in the plasma
A	Antigen A	Anti-B
B	Antigen B	Anti-A
AB	Antigen A and Antigen B	Neither anti-A nor anti-B
O	Neither antigen A nor antigen B	Anti A and Anti B

½ mark for each correct

(3 marks)

d) Why is it important to match the blood groups of the donor and recipient during blood transfusions?
If receivers blood is incompatible then it could make antibodies (½) against the antigens on the donor cells (½)

This causes foreign cells will to clump together or agglutinate (½) and disintegrate (½)

(2 marks)

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e) One component of blood is platelets. Suggest why some people may require platelet transfusions rather than whole blood transfusions.

They may have low platelet count/abnormal platelets and require more platelets

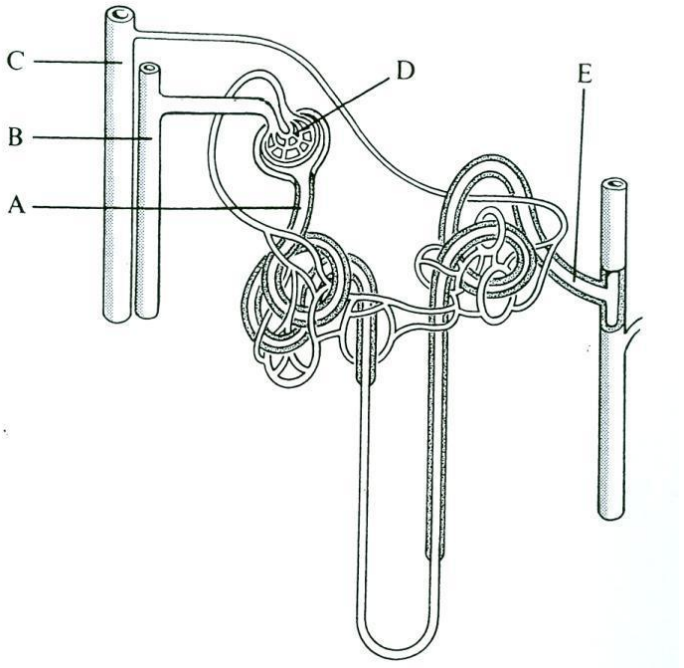
(1 mark)

f) Describe how a phagocyte destroys a microorganism such as a bacterium.
Engulf bacteria (½) by phagocytosis (½)
Cell membrane folds/wraps around the bacterium to form a vesicle (1)
Enzymes digest the vesicle (½)

(2 marks)

Question 33 **(7 marks)**

The diagram shows a structure found within the kidneys.



a) Identify the structures B, D and E from the diagram above. (3 marks)

B = renal artery (1)

D= glomerulus (1)

E= distal convoluted tubule (1)

b) Describe the processes that occur at D and A. (4 marks)

D
Filtration of the blood (½) in the capillary under high pressure/ ultrafiltration (½)
Forms the filtrate (½) in the glomerular capsule (½)

A

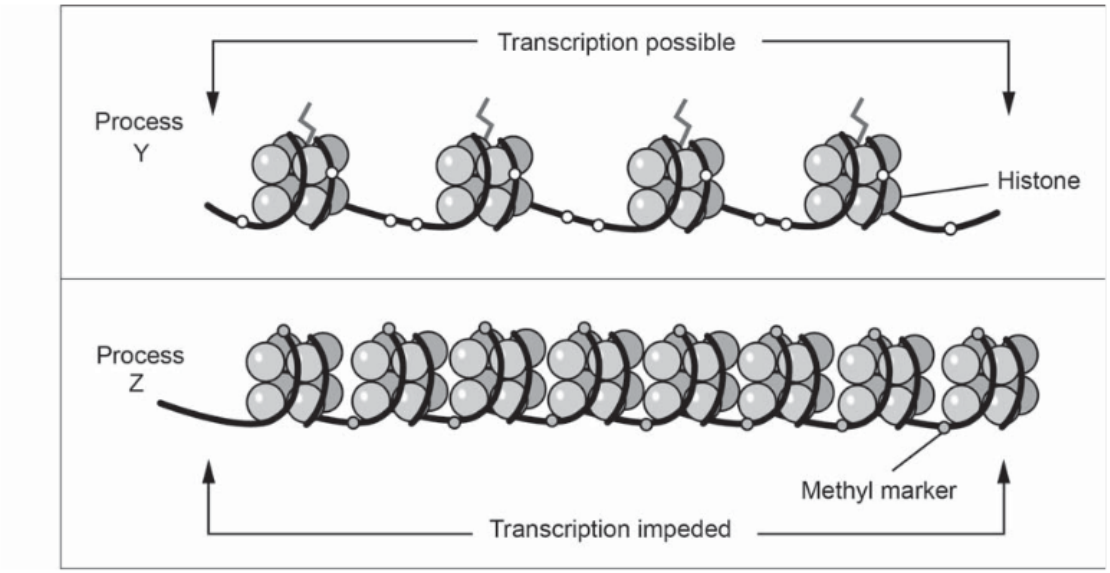
Selective reabsorption (½) of substances from filtrate back into blood (½)
Examples: include glucose/ions/water/amino acids (1 mark for 2 examples)

Question 34 **(8 marks)**

a) What is meant by epigenetics? (1 mark)

Changes in gene expression as a result of changes to chemicals (non-DNA material) rather than changes to the DNA itself.

Part b) of the question refers to the diagram below, which represents histone modification of DNA.



b) Explain what is occurring in the process labelled 'Y' in the diagram. (3 marks)

The addition of an acetyl group to the histone called acetylation (1)
Opens up the condensed chromatin structure (1) opens up/spread out histones
Allows RNA polymerase ½ access to the gene for transcription ½

c) Using your understanding of epigenetics, explain why identical twins are preferred subjects for research rather than fraternal twins and why twins chosen for study cover a large span of ages. (2 marks)

Identical twins share identical genome so any difference may be attributed to epigenetic factors. [1]

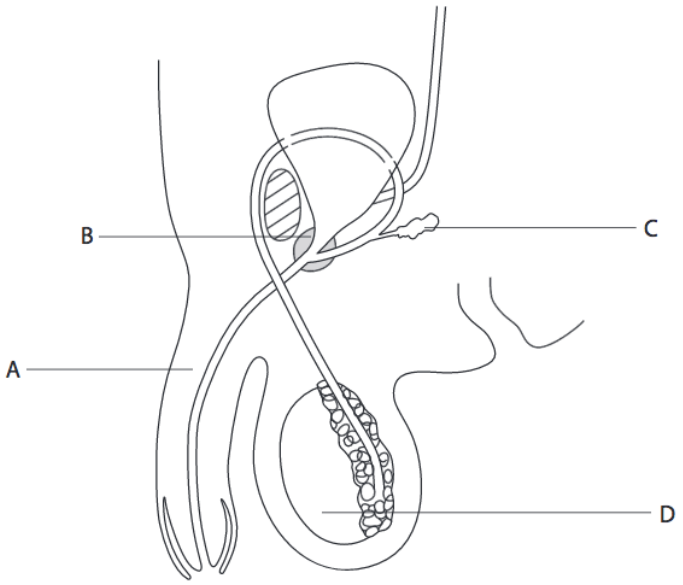
A large span of ages are chosen for subject to study the cumulative effect of epigenetic factors and more time given in terms of exposure to environmental effects. [1]

d) How is epigenetic inheritance different from genetic inheritance?
Genetic inheritance happens by DNA passing from the parent to offspring through gametes/germline cells. (1)
While, epigenetic inheritance, is by epigenetic tags/methylation tags on gametes being passed down [1].
This epigenetic tags are influenced by environmental factors. (1)

(2 marks)

Question 35 **(5 marks)**

The diagram shows a side view of the male reproductive system.



a) Name the following structures: (2 marks)

A Penis (½) B bulbo-urethral gland (½)

C Seminal Vesicle (½) D Testis (½)

b) Explain the function of structures B and C (2 marks)

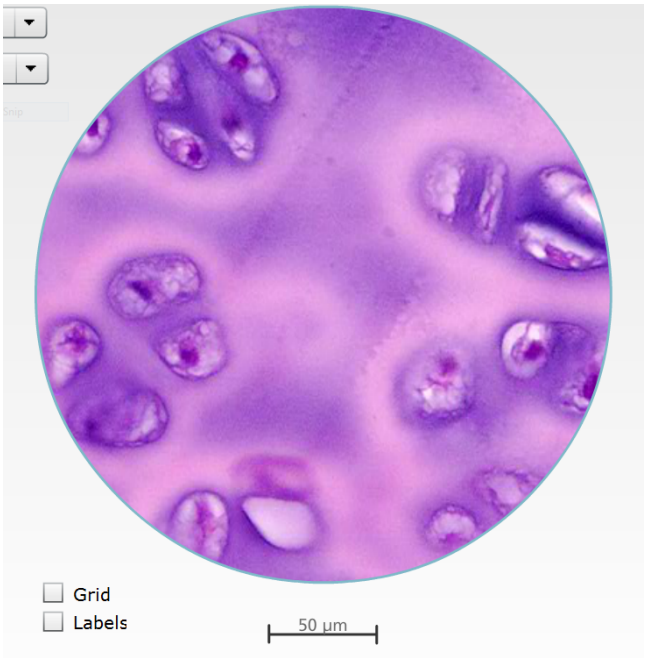
B – Secretes clear mucus as part of the semen that transports the sperm /lubricant (1)
C - Clear mucus that acts as a lubricant / sugary fluid – energy source for sperm (1)

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

Stimulates the seminiferous tubules to produce sperm.

Question 36 **(10 marks)**

The following histology slide shows a picture of a type of Tissue A.



a) To which of the four categories of tissue type does Tissue A belong? (1 mark)
Connective tissue

b) Name **one (1)** characteristic of Tissue A seen in the slide. (1 mark)

The cells are separated from each other (1/2) by large amounts of material that is not made of cells/ non-cellular matrix

c) Name **one (1)** location Tissue A is found in the human body. (1 mark)

Surface of bones at joints, trachea, bronchi, nose, larynx and outer ear (this is hyaline cartilage)/ tendons/ ligaments
Blood – liquid matrix

d) What is the function of Tissue A? (1 mark)

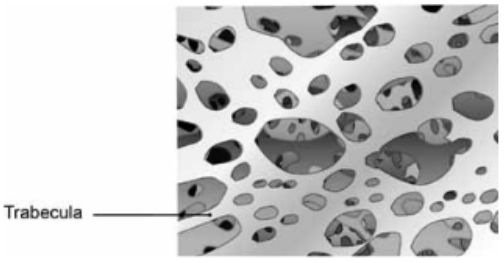
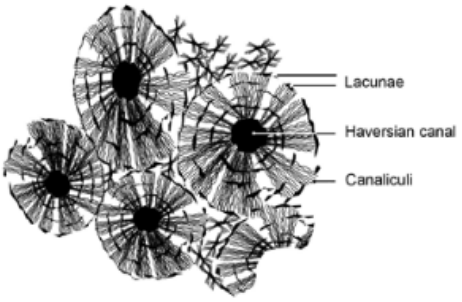
This provides structural support for the body and helps to hold all body parts together, (yet with some flexibility).
If just said – maintain structure 1/2

e) Name **one (1)** other tissue type found in the body and state a location it can be found.

Muscular tissue ½ – correct example ½
Nervous tissue ½ – correct example ½
Epithelial tissue ½ – correct example ½

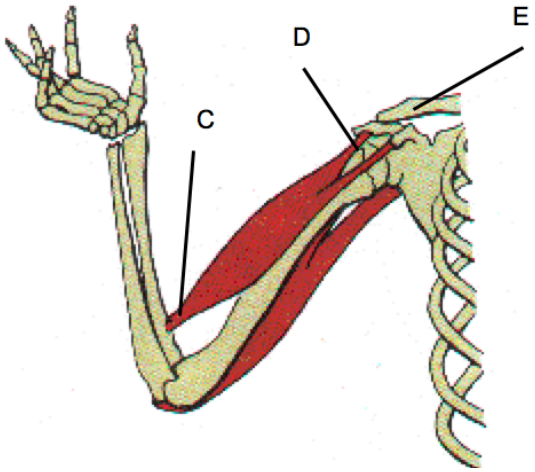
(1 mark)

f) The diagrams below show the **two (2)** types of bone structure. Complete the table, stating the name, location and a function of each type of bone.

		
Name	Spongy bone/ trabaculae/ cancellous	Compact bone/haversian system
Location	• Heads/ ends of long bones/ epiphysis • Irregular shaped bones • Within flat bones	• Shafts/middle of long bones/ diaphysis • Immediately below cartilage • On surface/ outer layer of most bones
Function	• Provide strength with lightness • Spaces allow for lightness • Lowers density • Stores red bone marrow • Shock absorption/ elasticity • Did not accept contains RBC	• Provide strength/ solidness/ support/ rigidity/ stiffness • Provide a cavity for bone marrow • Mineral storage

(3 marks)

The diagram below shows the shoulder joint.



g) With reference to structures C and D, explain the difference between a tendon of origin and a tendon of insertion.

D – tendon of origin is attached to the shoulder, which is the stationary/immovable bone (1)
C – tendon of insertion is attached to the radius, which is the movable bone (1)

(2 marks)

Question 37 **(11 marks)**

a) Human reproduction involves the fusion of a sperm and an ovum. What is the name given to the fusion of a sperm and an ovum?

fertilisation (1 mark)

b) After the fusion of a sperm and an ovum there is cell division to produce an embryo of four cells. Tick the row in the table that correctly describes the type and the number of cell divisions that produced this embryo of four cells.
Mitosis 2 **(1 mark)**

c) A developing embryo is shown in the diagram below:

(i) State the function of structure Y. (1 mark)

- Protects the embryo from physical injury by acting as a shock absorber
- Helps maintain a constant temperature for the developing embryo then later foetus
- Allows the developing foetus to be able to move around freely in the later stages of development

(1 mark for any 1)

(ii) Structure X allows the exchange of substances between maternal and foetal blood. Complete the table below to name some of these substances.

	Substance 1	**Substance 2**
Two harmful substances that can move from maternal to foetal blood.	Viruses/ alcohol/ drugs/ nicotine (½ for each max to 1) Did not accept – bacteria need specific eg.	
Two substances that might move from foetal blood to maternal blood.	Carbon dioxide, urea, uric acid, ammonia, creatinine (½ for each max to 1)	

(2 marks)

d) Name **two (2)** dietary requirements that a pregnant women needs to consider in maintaining healthy foetal development and explain why.

Increased vitamin A ½ – for production of cells in foetus/prevent deformities ½
Folic acid ½ – prevent Spina bifida ½
Increased calcium ½ – necessary for normal bone growth/reduce chance osteoporosis ½

(2 marks)

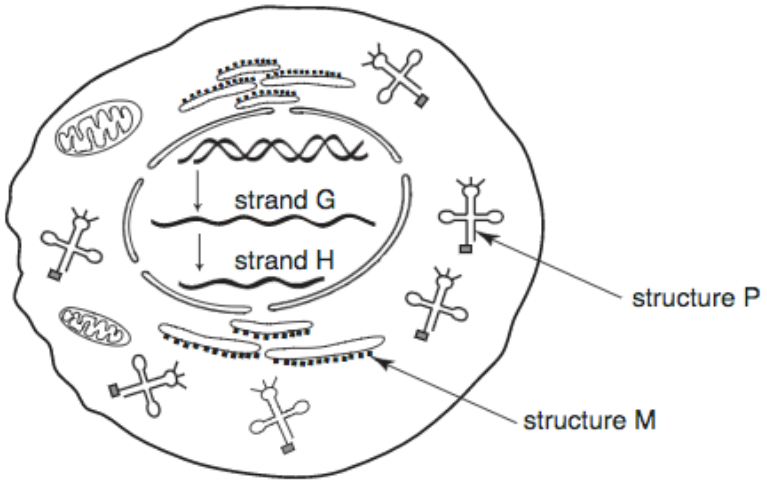
e) Infertile couples may use assisted reproductive technologies (ART) to help them conceive. Complete the table below to summarise how **two (2)** of these technologies work.

Assisted Reproductive Technology	**What do the initials stand for?**	**How does the process work?**
ICSI	Intracytoplasmic sperm injection (1)	Single sperm is injected directly into a single egg (1)
GIFT	Gamete intrafallopian transfer (1)	Where eggs and sperm are collected, mixed together, and then injected into the womens fallopian tube. (1)

(4 marks)

Question 38 **(9 marks)**

The following diagram outlines the structures within a cell.



a) In this cell where would RNA polymerase be found? (1 mark)

The nucleus

b) Describe the function of RNA polymerase. (1 mark)

To join nucleotides together/ form sugar phosphate backbone (1/2) to form a messenger RNA strand (1/2) (during transcription)

c) State **two (2)** structural differences between DNA and strand G. (2 marks)

- DNA is double stranded whereas RNA/strand G is single stranded
- DNA is made of the nucleotides A, T, C, G whereas RNA/strand G has uracil not thymine
- DNA has deoxyribose sugar and RNA has ribose

d) Outline the function of structure P in protein synthesis. (2 marks)

- Transfer a specific amino acid to the mRNA on the ribosomes
- The anticodon on tRNA determines which amino acid to transfer

e) Give **three (3)** examples of end products from protein synthesis and state their role in cellular functions. (3 marks)

Haemoglobin - oxygen carrying molecule in red blood cells
Hormones -regulating cell functions
Enzymes – speed up rate of reactions eg. respiration
Immunoglobulins – act as antibodies in fighting foreign matter
Actin and myosin – proteins involved in muscle contraction
Fibrin – protein involved in blood clotting
Collagen – main component of teeth, bones, cartilage, ligaments and tendon
Integral/ carrier proteins in cell membrane – cell transport
Specific digestive enzymes accepted to max 2 marks
(any 3, 1 mark each but need both name and function)

Question 39 **(8 marks)**

The ability to discriminate between the colours red and green is controlled by a gene located in the X chromosome. Individuals who are unable to distinguish between the two colours possess the recessive allele of this gene.

a) Why would colour blindness be more common in males than in females? (1 mark)

Only 1 recessive allele required for men to have phenotype

b) An unaffected woman who carries a recessive allele is considered to be heterozygous. What term can be used to describe a colour blind man? (1 mark)

Hemizygous

c) Describe a scenario where a couple produce daughters who all have normal vision and sons who are all colour blind. Use a punnett square to illustrate this, describing the genotypes of both parents and their children. (3 marks)

Parents: Genotypes – X^bX^b and X^BY (1 mark)

	X^b	X^b
X^B	X^BX^b	X^BX^b
Y	X^bY	X^bY

(1 mark)

1 mark for correct offspring - X^BX^b, X^bY

d) Explain why we inherit nuclear DNA from both our parents but mitochondrial DNA from our mothers. (2 marks)

After the sperm has penetrated the egg at fertilisation, only the head of the sperm penetrates the egg. The mid-piece/ neck of the sperm containing the mtDNA does not penetrating the egg. (1)

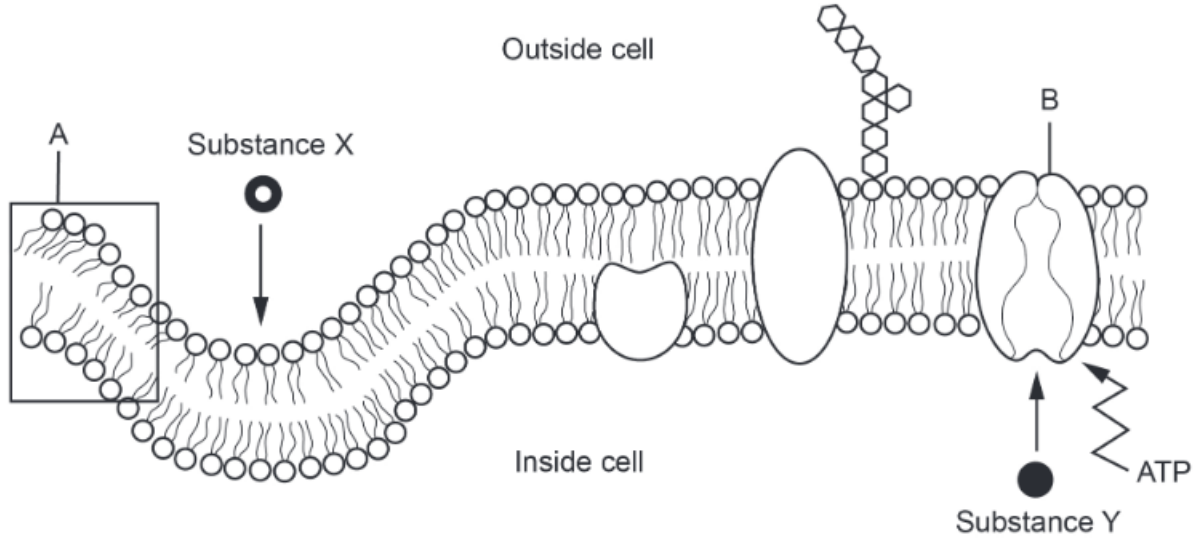
Hence, our nuclear DNA comes from the nucleus of the egg and sperm but the mtDNA only comes from the egg. (1)

e) Describe an example where the study of mitochondrial DNA would be extremely useful (1 mark)

As mitochondrial DNA is only inherited from the maternal line it would be useful for genetics to study ancestral lineage (1), track human migrations,(1) population genetics (1), mutations, (1) evolutionary history (1), etc.

Question 40 **(15 marks)**

The diagram below shows a cross-section of part of the cell membrane. The arrows (→) indicate the direction of movement by substances X and Y as they are about to cross the cell membrane.



a) Name and describe the structure of the part of the cell membrane labelled A. (3 marks)

Phospholipid (1/2) bilayer (1/2)
have a hydrophilic (1/2) phosphate head (1/2)
have a hydrophobic (1/2) fatty acid tail (1/2)

b) Identify the type of protein labelled as B in the diagram. (1 mark)

Carrier protein

c) Explain how Substance X is able to move from the outside to the inside of the cell.

- Substance X is lipid soluble/steroid (1)
- Diffuses across cell membrane/ does not require energy to move across membrane (1)

(2 marks)

d) Give **one (1)** example of a substance that could be represented by X. (1 mark)
Oxygen, fat-soluble vitamins/molecule, alcohol, lipids (any 1)

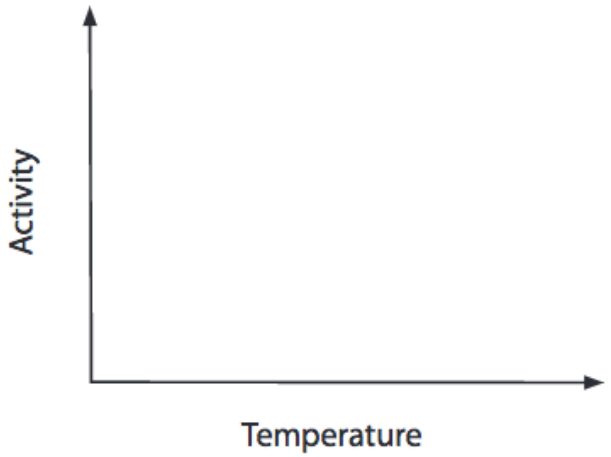
e) Why is ATP required to move substance Y across the membrane? (1 mark)
to move substance against the concentration gradient

f) Describe what happens to the ATP molecule to assist with moving substance Y across the membrane. (2 marks)

ATP is broken down to ADP and Phosphate (1)
Removal of the third phosphate group releases the energy stored in a high chemical bond (1)

g) Moving substance Y across the membrane also involves the enzyme ATPase. The enzymes activity may be affected by temperature and pH.

(i) Sketch on the axes below how the activity of ATPase is likely to be affected by temperature in the human body. (2 marks)



2 marks for correct drawing of graph

(ii) Explain how an enzymes activity is usually affected by pH. (2 marks)

Enzymes have an optimum pH for working efficiently (1)
Outside of their optimum pH range the enzyme is denatured (1)

(iii) Name **two (2)** other factors that can affect the activity of an enzyme. (1 mark)

- Temperature
- Co-factors
- Co-enzymes
- Enzyme Inhibitors
- Surface area
- Substrate/ enzyme concentration

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

This section contains **three (3)** questions. **You must answer two (2) questions**. You can choose Question 41 or Question 42 or Question 43. Write your answers in the space provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
Continuing an answer: If you need to use more space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Write the number of the question(s) that you are continuing to answer at the top of the additional space page.

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.

Suggested working time for this section is 50 minutes.

Question 41 **(20 marks)**

a) Describe the changes involved from fertilisation to implantation of the embryo in the uterine wall of the mother. You may use diagrams to support your answer.

(8 marks)

- Zygote (½) forms when the sperm fertilizes the egg (½)
- Undergoes mitosis/cleavage divisions (1)
- Becomes a morula /a solid ball of cells (1)
- Becomes a blastocyst (1)
- Blastocysts has an inner cell mass (1)
- Surrounded by a trophoblast (1)
- Blastocyst enters into the uterus (½) around days 5-7 (½)
- Trophoblast secretes enzymes (½) allows blastocyst to burrow into endometrial lining (½)
- Attaches to uterine wall firmly (½) to gain nourishment (½)

b) Describe the processes of osmosis and vesicular transport that result in transport of materials in and out of cells. (6 marks)

Osmosis
- Diffusion of water (½) across a semi-permeable/differentially permeable membrane (½)
- Water moves from an area of low solute concentration/high water concentration to an area of high solute/low water concentration (1)

Vesicular Transport
- Movement of substances across the membrane using vesicles/membranous bags (1)
- Cell membrane pinches off to form vesicle (1)
- Active process (½) that requires energy (½)
- Endocytosis (½) is taking liquids or solids into the cell from outside (½)
- Exocytosis (½) is moving substances outside of the cell (½)

c) Name the three different types of stems cells and describe their potency. In your answer provide an example of each type of stem cell. (6 marks)

Type of Stem Cell	Potency description	Example
Totipotent stem cells ½	Give rise to all cell types of the body (½) and embryonic membranes. (½)	Zygote/ morula ½
Pluripotent stem cells ½	Give rise to all cell types of the body (½) but NOT those of embryonic membranes. (½)	Inner cell mass of a blastocyst./ embryonic stem cells ½
Multipotent stem cells ½	Can develop into more than one cell type of the body but not all (1)	Umbilical cord/placenta Various locations in the body e.g. teeth, bones, skin, blood vessels, brain, gut liver ½

SEE NEXT PAGE

Question 42 **(20 marks)**

a) Describe how genetic variation occurs during the process of meiosis and indicate how non-disjunction can occur. Include in your answer a description of the outcome of non-disjunction. (10 marks)

Random/independent assortment of chromosomes (1)

- In meiosis 1 the arrangement of the 23 homologous pairs on cell equator is independent of each other/random (1)
- When these pairs separate they do so independently of each other/at random (1)
- Resulting in gametes with genetic variation (½)

Crossing Over (1)

- During Meiosis/prophase 1 (½) homologous chromosomes pair up (½) and non-sister chromatids get tangled/cross over (½)
- Chromatids may break and reattach to chromatid of different chromosome (1)
- Results in new combination of alleles in chromosome (½)

Non-disjuction

- Non-disjunction can occur during Meiosis 1 (½) when one or more pairs of the chromosomes fail to separate when the cell divides. (½)
- Non-disjunction can also occur during Meiosis 2 (½) when one or more of the chromatids may fail to separate. (½)
- This leads to a daughter cell getting an extra chromosome and the other daughter cell lacking that chromosome. (1)
- Non-disjunction can cause severe and distinctive birth defects and sometimes miscarriage early in pregnancy. (1)

b) Discuss each of the following contraceptive methods, including how they work, and the advantages and disadvantages associated with their use:

(i) rhythm method
(ii) contraceptive pill
(iii) cervical cap (10 marks)

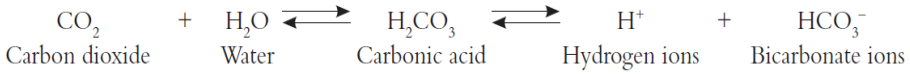
Method	**How it works**	**Advantages**	**Disadvantages**
Rhythm method	Female monitors 28 day cycle to detect when ovulating (½) Abstains from sex during ovulation/ has sex on safe days. (½)	No costs involved/ no ethical concerns/ no side effects/ acceptable for certain religious groups (1 mark for 1 reason)	No reliable due to early ovulation/late ovulation No STI protection (1 mark for 1 reason)
Contraceptive pill	Oestrogen and progesterone taken orally (½) Taken for 21 days then 7 day break (½) Prevents ovulation (½) Alter endometrium lining so less receptive for implantation (½)	Very reliable; regular periods; reduced incidence of ovarian and uterine cancer (1 mark for 1 reason)	Regular doctors prescriptions; pill must be taken daily; possible side effects No STI protection (1 mark for 1 reason)
Cervical cap	Barrier that fits over the cervix (½) Prevents sperm reaching the uterus (½)	Does not affect menstrual cycle; Can be used during menstruation; Can be inserted ahead of time (1 mark for 1 reason)	Difficult or unpleasant in inserting Must be correctly sized by doctor Spermicide must be used to improve reliability No STI protection (1 mark for 1 reason)

Question 43 **(20 marks)**

a) The human body performs a number of important functions on the molecular as well as systemic level to ensure waste products are effectively removed from the body. Describe how carbon dioxide is transported away from the body cells to the exterior.

(8 marks)

- Carbon dioxide diffuses into capillaries surrounding tissues/cells due to concentration gradient (1)
- Some combines with haemoglogin to form carbaminohaemoglobin (1)
- Most is carried as bi-carbonate ions in the plasma (1)
- Small amount dissolves in the plasma to be transported (1)
- Chemical equation given as follows: (1)



- Gas exchange occurs at the alveolar surface / capillary/ lung surface (1)
- Blood capillaries surrounding the alveoli has low CO_2 concentration
- Carbon dioxide diffuses out of blood into alveoli due to concentration difference (1)

b) The main role of the final part of the small intestine is the absorption of nutrients. Describe this process, including ways in which the small intestine's structure ensures efficient absorption.

(8 marks)

- Small intestine has large surface area (1)
- Mucosa is folded (½)
- Presence of villi (1)
- Surface of villi covered in microvilli (½)
- Inside villus are capillaries (½) carrying blood (½) And lacteal (½) carrying lymph (½)

- Glucose/monosaccharides/sugars + amino acids pass into blood (1)
- Fatty acids/fats and glycerol/fat soluble vitamins pass into lymph (1)
- By diffusion ½ and active transport ½
- Water absorbed by osmosis (1)

c) Describe the process of deamination in the liver.

(4 marks)

Deamination occurs in the liver (1)
Amino acids have amino group/NH_2 removed (1)
Requires oxygen (½)
This is converted to ammonia/NH_3 (½)
Ammonia reacts with carbon dioxide (½)
To produce urea ½ and water ½

(Points may be presented in the form of chemical equations.)

END OF EXAM

Question number: _____

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Question number: _____

Question number: _____

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Question number: _____

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Spare grid for question 31 (a)