Student number: _____

PENRITH SELECTIVE HIGH SCHOOL

2019

TRIAL EXAMINATION

HSC BIOLOGY

General Instructions

- Reading time – 5 minutes
- Exam time – 3 hrs
- Board-approved calculators may be used
- Write using **blue or black** pen
- Answers written in pencil may be disqualified from review

PART A - *Multiple Choice (20)*

- Attempt Questions 1 – 20
- Allow about 30 minutes for this part
- Use the multiple choice answer sheet found at the end of this paper

PART B - *Free Response Questions* (80)

- Attempt Questions 16 – 34

TOTAL MARKS /100

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PART A – MULTIPLE CHOICE QUESTIONS

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Which of the following is a correct definition of a pathogen?

(A) A chemical substance that is recognised as foreign by the immune system

(B) A bacterium or virus

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(D) A disease caused by a parasite

Question 2

The best explanation for the reason why organ transplants should trigger an immune response is

(A) Antigens on transplanted organs are recognised as foreign by the patient's immune system

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Question 3

Advantages of internal fertilisation in animals include;

(A) More offspring produced and reduced risk of desiccation of gametes

(B) Increased desiccation of gametes and increased opportunity to consume mate during intercourse

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Question 4

A researcher was investigating the pathogens associated with a potentially life threatening, infectious disease. She identified the likely cause of the disease to be a bacterium. In planning her research she decided to use nutrient agar plates to grow colonies of bacteria.

Safe work practices involved in this investigation would aim to;

(A) Kill all likely pathogens before they infect researchers

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(C) Prevent handling organisms from contaminating the laboratory and prevent organisms in a laboratory environment from contaminating the work

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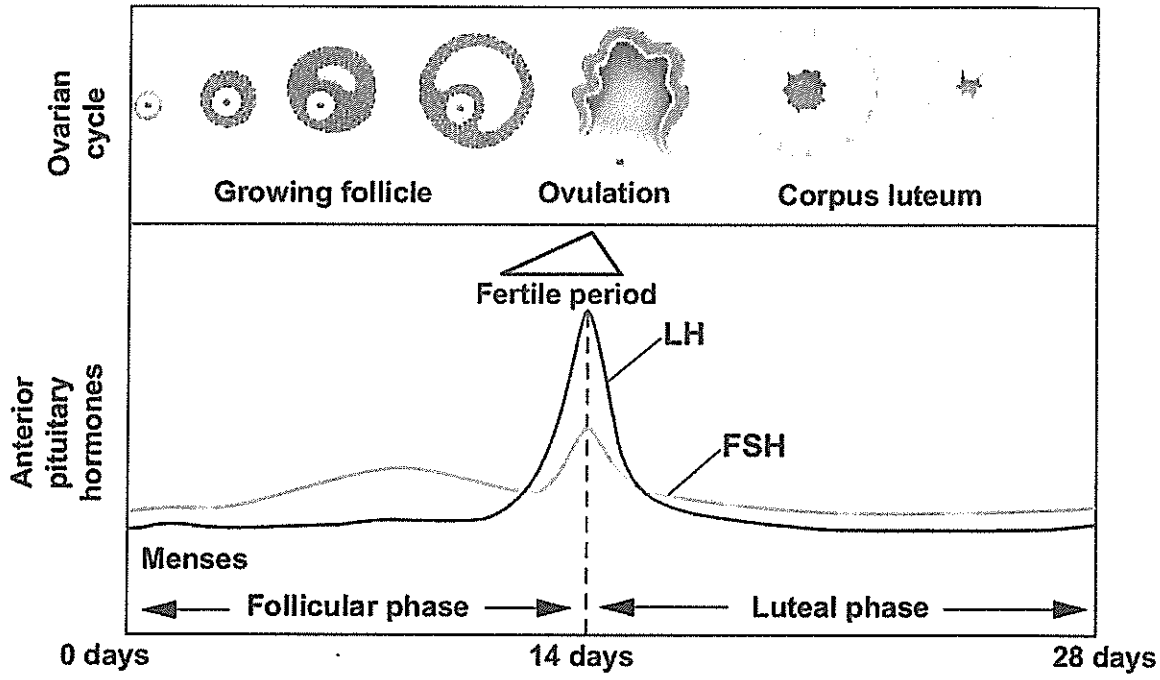
Question 5

Consider the diagram of the human menstrual cycle



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Koch's postulates remain a useful tool for many infectious diseases. Major issues with their use for some diseases are;

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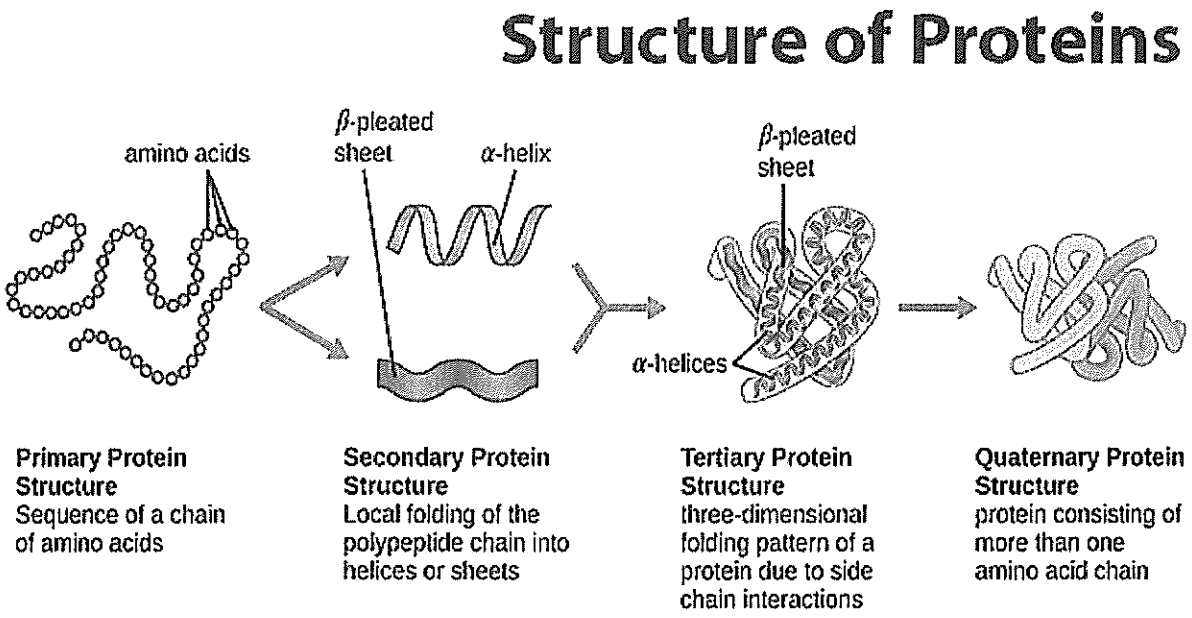

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Haemophilia is a sex-linked recessive trait in humans. If a father and a son are both haemophiliacs, but the mother does not have the condition, her genotype must be:

(A) X^hX^h

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Adaptations of pathogens to overcome host defences include;

(A) Complex lifecycles and antibodies

(B) Attachment structures and complex lifecycles

(C) Phagocytosis and transcription

(D) Endospores and thermophiles

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Malaria and Dengue fever can be effectively controlled using pesticides because;

(A) They are both viral diseases

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Which one of the following responses might you expect an ectotherm to make in low temperatures?

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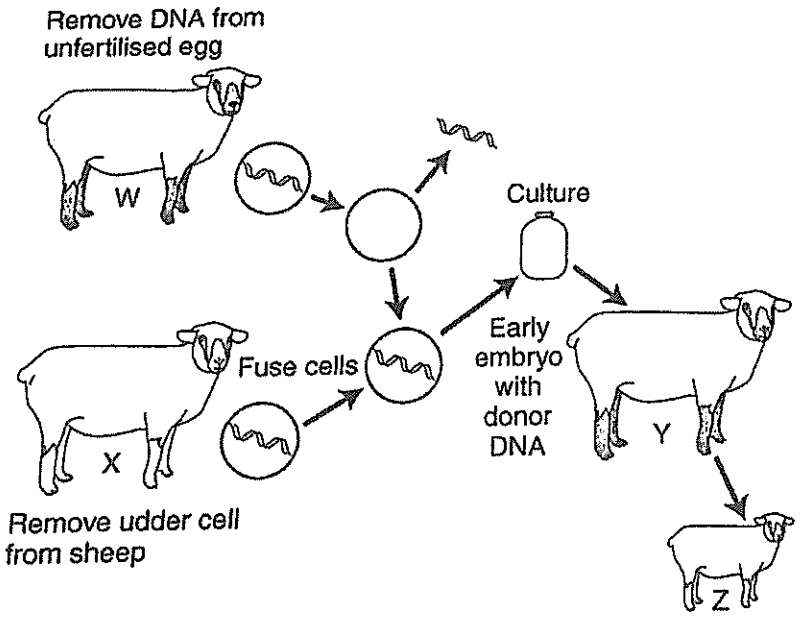
The diagram shows a process used in current reproductive techniques



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(A) Biodiversity needs to be maintained in all crops

(B) Potato seed bank should store more potato seeds

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(D) Farmers should have chosen a different species more suited to Irish conditions

Question 16

Some bacteria can be induced to take up donor DNA by treating them with calcium chloride. The treatment can make the bacteria take up both single stranded and double stranded DNA. In many instances the transferred DNA is a plasmid. Many naturally occurring plasmids have an antibiotic resistant gene that is used as a marker.

If an experiment was carried out to insert a plasmid with antibiotic resistance into another bacteria, how could you test the bacteria to find out if the process was successful?

(A) Grow the culture on agar plates containing the antibiotic and see which bacteria survive

(B) Study the bacteria under a microscope to see if they have plasmids

(C) Stain the bacteria with a dye to see if the plasmid contains the antibiotic

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Which is NOT an example of homeostasis?

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Which of the following would assist temperature control in plants?

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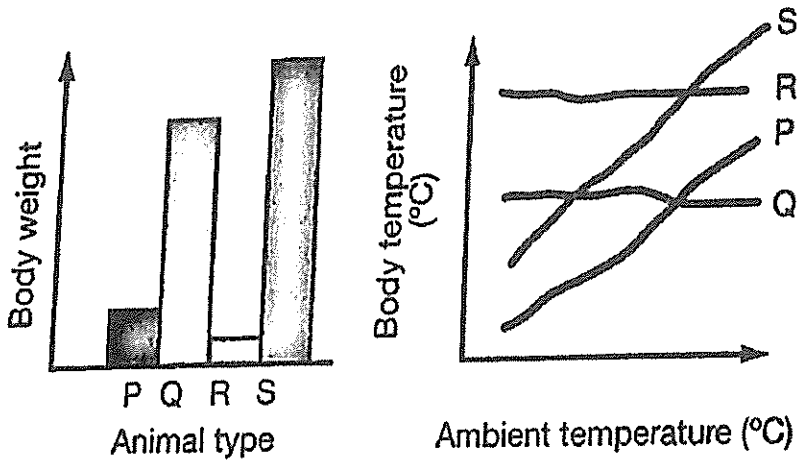
Question 20

The two graphs shows the body weight and how body temperature varies for four different Australian animals



Which animal would most likely be a desert mammal?

(A) Animal P
(B) Animal Q
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PART B – FREE RESPONSE QUESTIONS

Attempt Questions 21 – 35
Allow 2.5 hours for PART B

Question 21

The table below show various pathogens and the diseases that they cause

Pathogen	*Description*	*Example of disease*
B	An abnormal form of a normally harmless protein	Creuzfeld-Jakob Disease
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Bacteria	Single-celled prokaryotic microorganism	**A**
Protozoa	Unicellular eukaryotic organisms related to animals	Malaria
Fungi	Eukaryotic parasitic organisms	Tinea
Macroparasite	Multicellular animals	Fascioliasis (liver fluke)

Identify A: **1m**

Identify B: **1m**

Question 22

Describe the use of **ONE** named plant that continues to be employed in Aboriginal Bush Medicine. **3m**

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Question 23

Construct a flow diagram to summarise the stages of an acquired immune response to a pathogen. **5m**

Question 24

Consider the data below which presents information on Dengue fever.

Table 3. Reported number of dengue cases, deaths, and case fatality rates (CFRs) from Cambodia, the Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Viet Nam and Australia, 2007 to 2011*

Country	2007			2008			2009			2010			2011		
	Cases	Deaths	CFR (%)	Cases	Deaths	CFR (%)	Cases	Deaths	CFR (%)	Cases	Deaths	CFR (%)	Cases	Deaths	CFR (%)
Australia	316	0	0	56	0	0	1 401	0	0	1 171	0	0	820	0	0
Cambodia	39 851	407	1.02	9 542	65	0.68	11 699	38	0.32	12 500	38	0.30	15 980	73	0.46
Lao People's Democratic Republic	4 943	4	0.08	4 149	21	0.51	7 214	12	0.17	22 929	46	0.20	3 905	7	0.18
Malaysia	48 846	98	0.20	49 335	112	0.23	41 486	88	0.21	48 171	134	0.29	19 884	36	0.18
Philippines	55 639	533	0.96	39 620	373	0.94	57 819	548	0.95	135 355	793	0.59	125 975	654	0.52
Singapore	8 826	24	0.27	7 031	10	0.14	4 497	8	0.18	5 363	6	0.11	5 330	6	0.11
Viet Nam	104 393	88	0.08	96 451	97	0.10	105 370	87	0.08	128 831	55	0.04	69 680	61	0.09
Total	262 814	1154	0.44	206 692	678	0.33	229 486	781	0.34	352 321	1070	0.30	241 574	837	0.35

* Source: World Health Organization Western Pacific Regional Office based on data provided by the Member States

* Dengue surveillance and reporting systems vary by country.

a) Apart from Australia, which **TWO** countries have the lowest average case fatality rate for the years in the data? **2m**

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b) Dengue fever is a viral disease transmitted by a mosquito vector. Explain why dengue fever up until the 20th century was restricted to South East Asia, is now found throughout the tropical regions of the world **3m**

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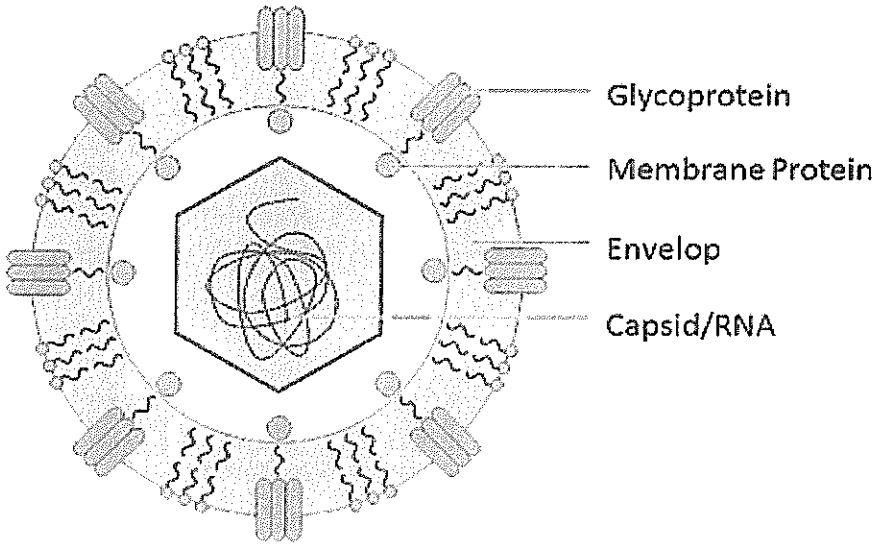
Question 25

The diagram below shows a model of a virus.



a) Explain how changes in the nucleic acid sequence of a virus could affect the immune system's ability to recognise the virus and thereby combat a possible infection. Discuss the effectiveness of a vaccine created to prevent the development of this disease **9m**

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Question 26

As part of an independent research project, a student studied a genetic condition suffered by members of his family. The student wrote the following summary:

- I am male and I have the condition
- My mother does not have the condition
- My father and his brother have the condition
- My father's sister and my father's mother do not have the condition
- My father's father has the condition

a) Construct a pedigree for this family **4m**

b) The student made the following conclusion from his study. " as only males have the condition, it must be a sex-linked genetic condition." Assess the validity of the student's conclusion, and provide support for your assessment. **4m**

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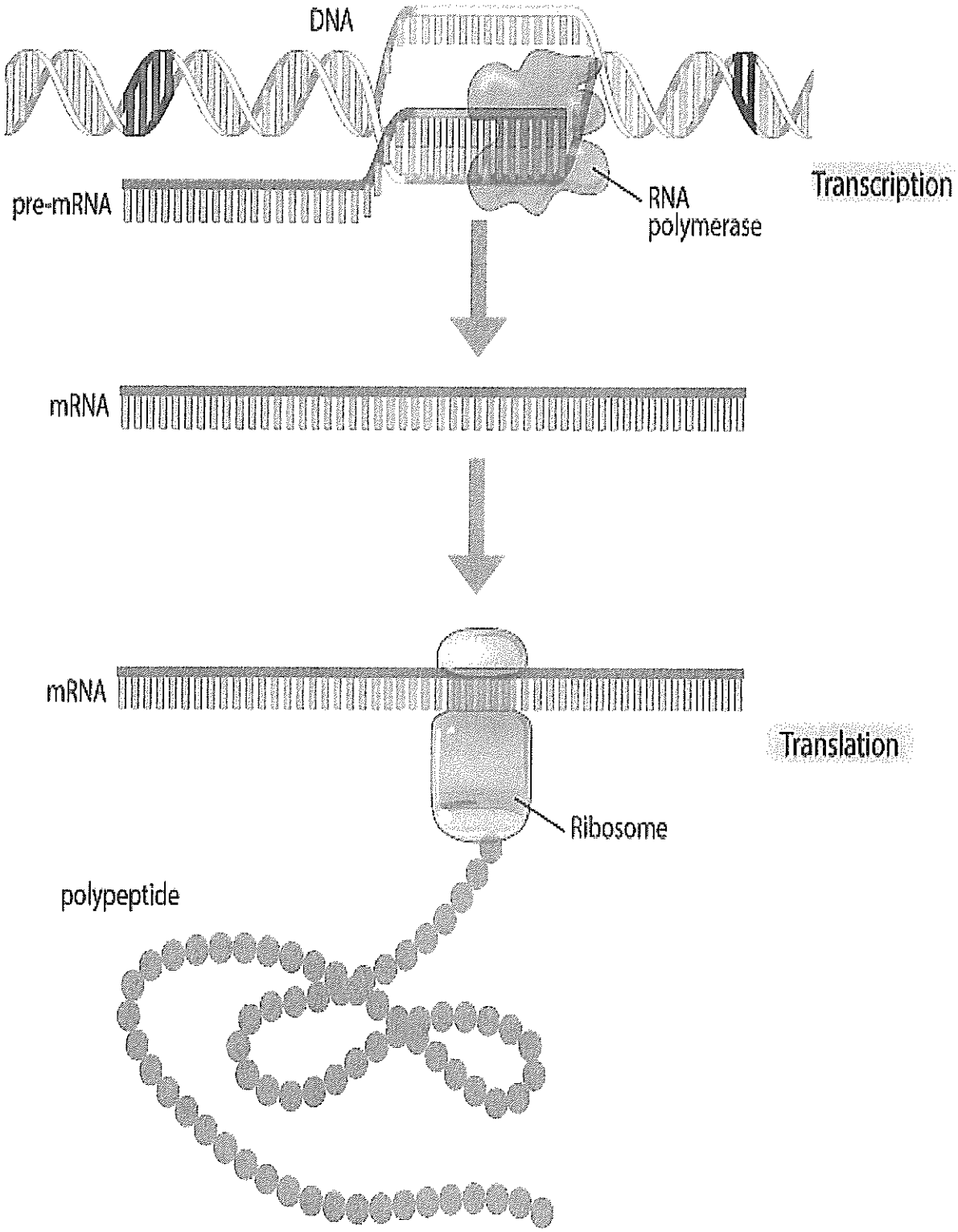
Question 27

Use labelled diagrams to highlight the essential differences between mitosis and meiosis. **4m**

Question 28

Consider the diagram below which shows the processes of transcription and translation.



Evaluate the usefulness of the models of transcription and translation shown in the diagram.

6m

Naomi

Student Number: 30619463

PART A – MCQ ANSWER SHEET

1.	A ○	B ○	C ●	D ○	✓
2.	A ●	B ○	C ○	D ○	✓
3.	A ○	B ○	C ●	D ○	✓
4.	A ○	B ○	C ●	D ○	✓
5.	A ●	B ○	C ○	D ○	✓
★ 6.	A ●	B ○	C ○	D ○	✓
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8.	A ○	B ●	C ○	D ○	✓
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11.	A ●	B ○	C ○	D ○	✓
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13.	A ○	B ●	C ○	D ●
14.	A ●	B ○	C ○	D ●	✓
15.	A ●	B ○	C ○	D ○	✓
16.	A ●	B ○	C ○	D ○	✓
17.	A ○	B ●	C ○	D ○	✓
18.	A ○	B ○	C ●	D ○	✓
19.	A ○	B ●	C ○	D ●	✓
20.	A ●	B ○	C ●	D ○

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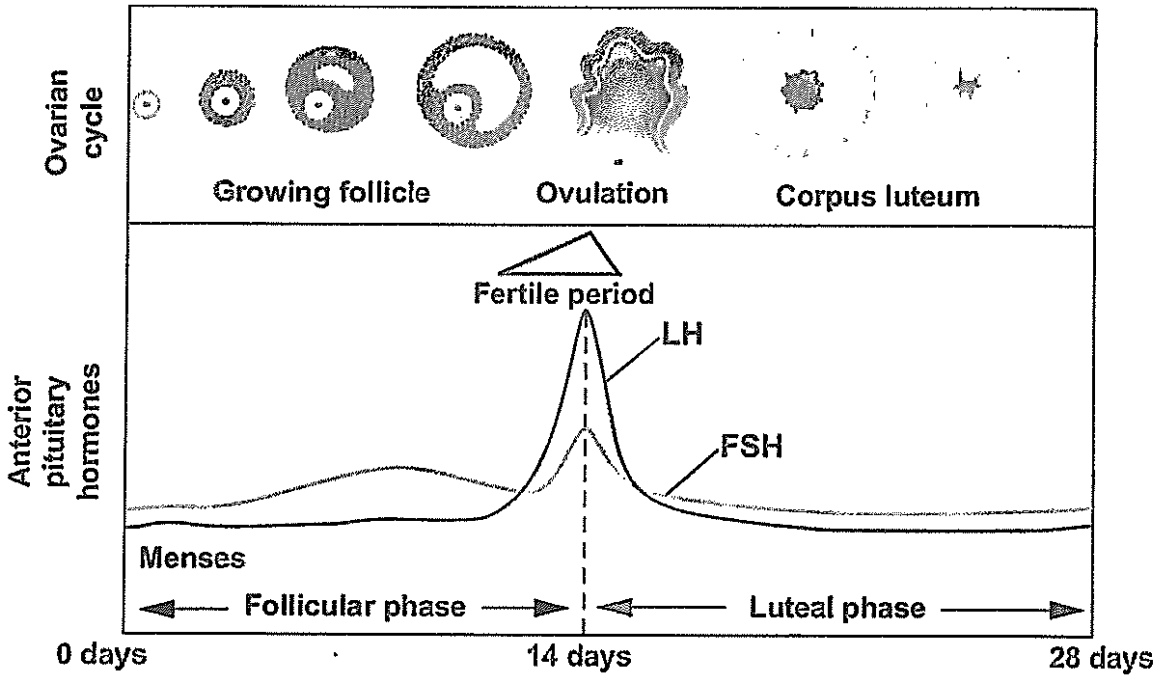

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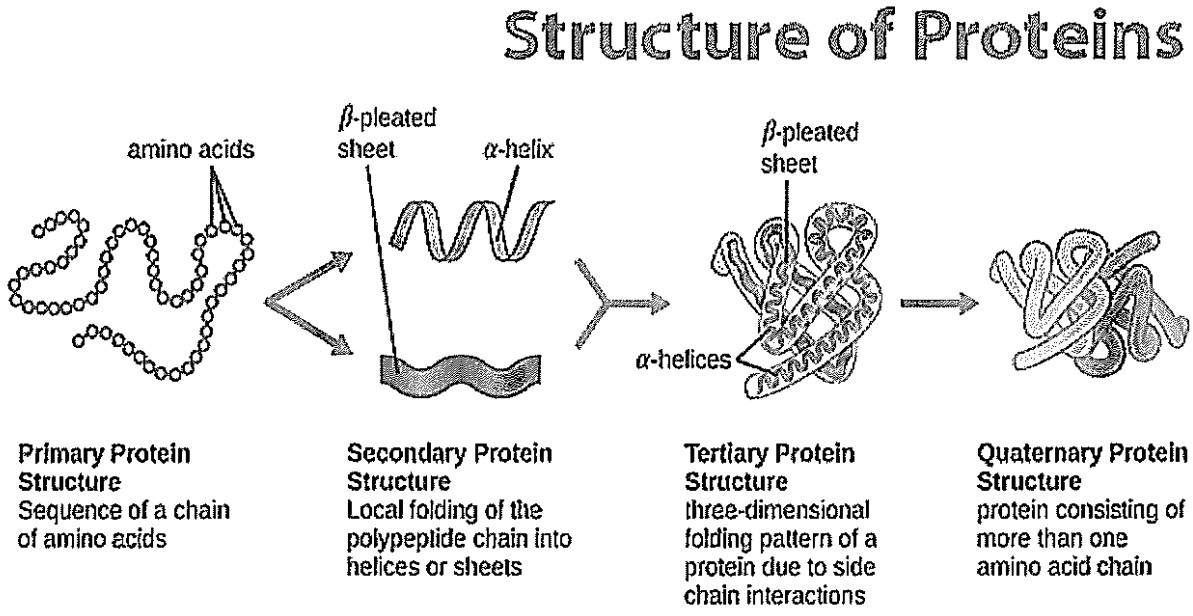

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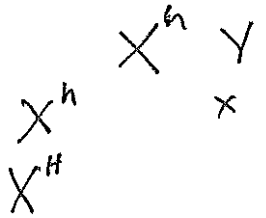

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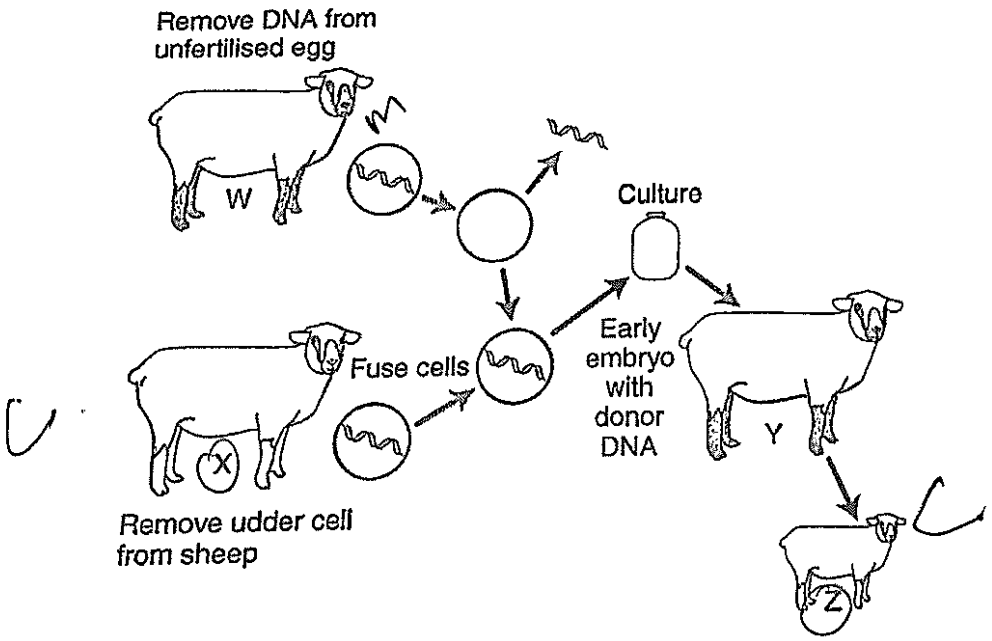

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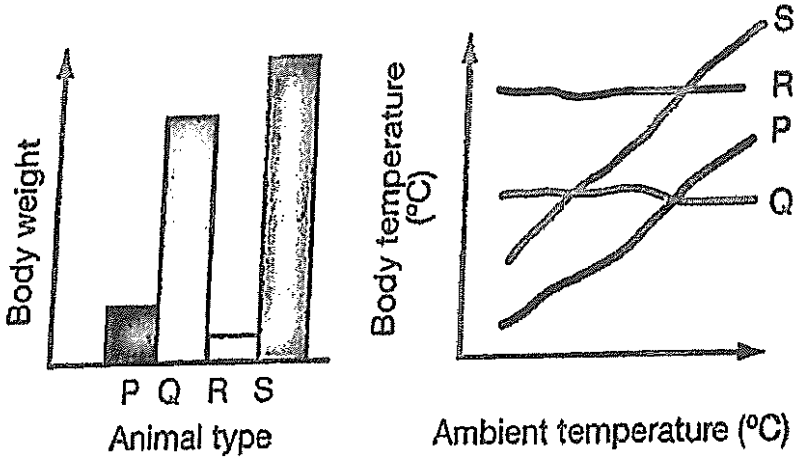

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Identify A: Prions 1m

Identify B: Influenza 1m

Question 22

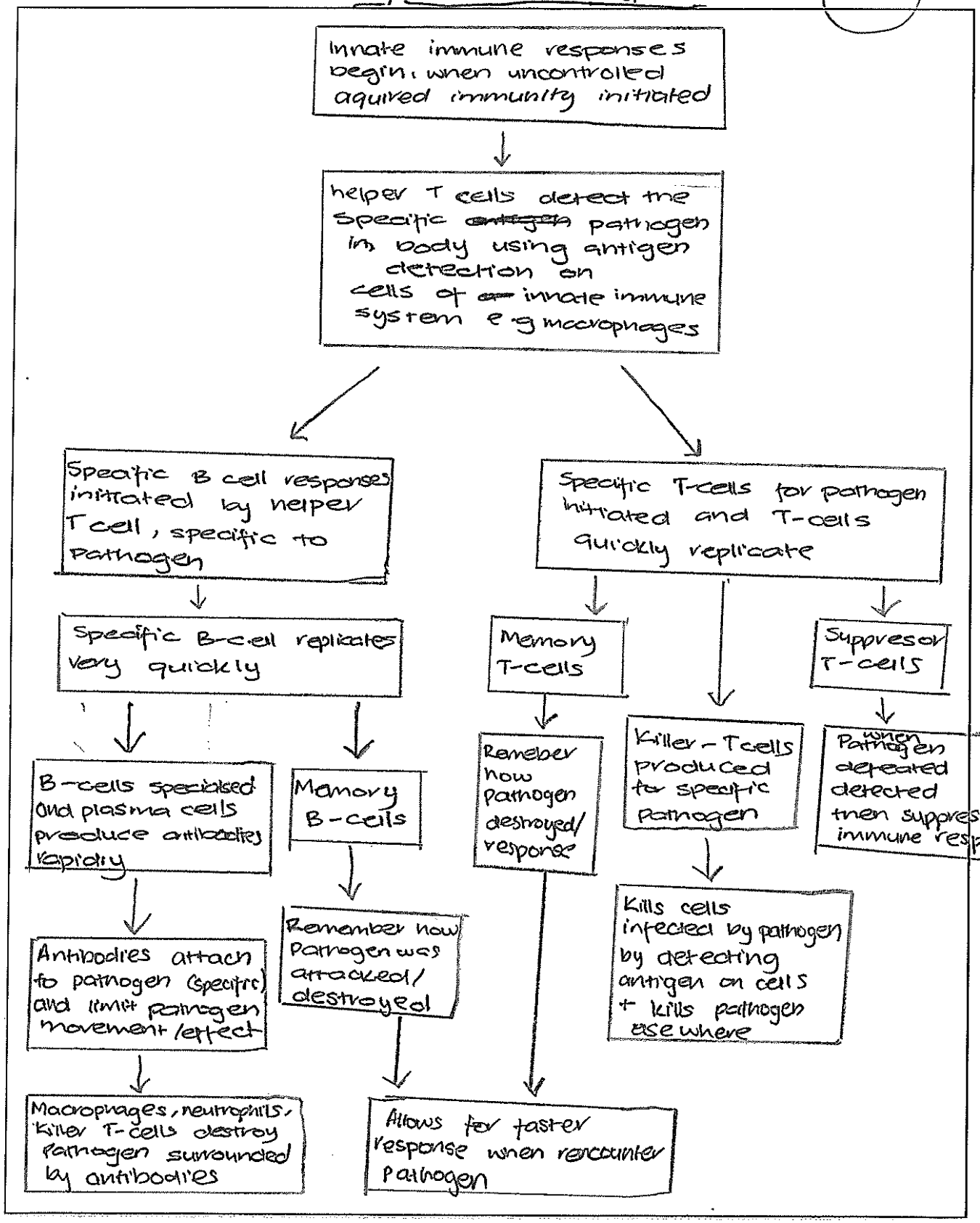
Describe the use of **ONE** named plant that continues to be employed in Aboriginal Bush Medicine. 3m

The Gumbi Gumbi is employed in Aboriginal Bush medicine to a help with pain relief, blood pressure, antioxidisation and has been counted to treat cancers within the aboriginal community in anecdotal proof. It is extracted and crushed into pieces then mixed with other essential ingredients such as eucalyptus oils to make bush medicine.

Question 23

Construct a flow diagram to summarise the stages of an acquired immune response to a pathogen.

5m



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Viet Nam	104 393	88	0.08	98 451	97	0.10	105 370	87	0.08	128 831	55	0.04	69 680	61	0.09
Total	262 814	1154	0.44	206 692	678	0.33	229 486	781	0.34	352 321	1070	0.30	241 574	837	0.35

* Source: World Health Organization Western Pacific Regional Office based on data provided by the Member States.

* Dengue surveillance and reporting systems vary by country.

a) Apart from Australia, which **TWO** countries have the lowest average case fatality rate for the years in the data? **2m**

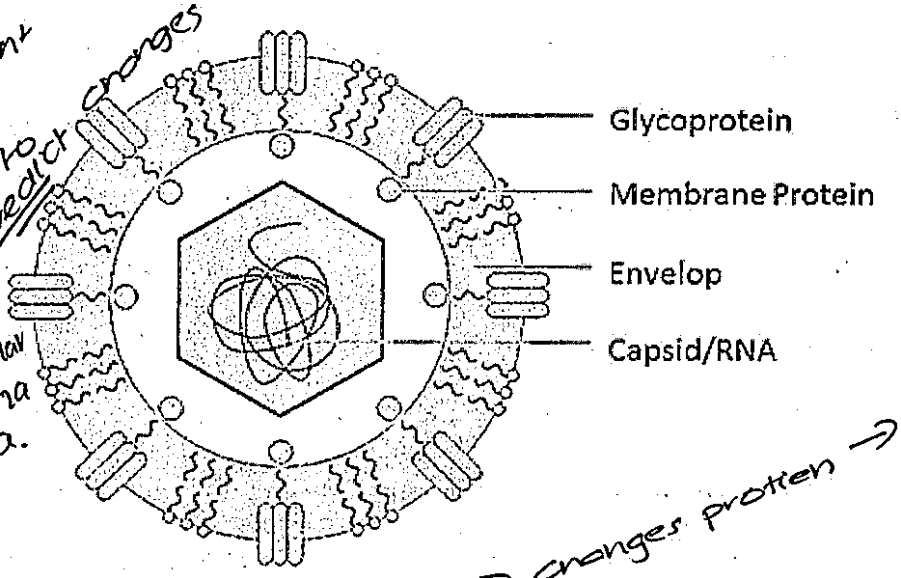
Vietnam / Singapore

b) Dengue fever is a viral disease transmitted by a mosquito vector. Explain why dengue fever up until the 20th century was restricted to South East Asia, is now found throughout the tropical regions of the world **3m**

Vectors are agents that carry pathogens to infect. As this viral disease is transmitted by a mosquito vector it was restricted to South East Asia as it was unable to move into other areas and countries as human population movement was comparitively lower before the 20th century in comparison to now and in addition the life cycle of mosquito limited its own movement with carries over continents/oceans. However as in the 20th Century human movement was increased through planes and accecability to planes have increased the ability for these vectors to move as well as the ability for humans to move has increased thus now making dengue fever prevalent in tropical regions in which there are also many mosquitoes to act as well

Question 25

The diagram below shows a model of a virus.



a) Explain how changes in the nucleic acid sequence of a virus could affect the immune system's ability to recognise the virus and thereby combat a possible infection.
Discuss the effectiveness of a vaccine created to prevent the development of this disease

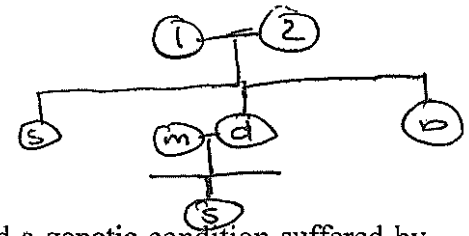
define all terms. 9m 8

...Changes with the nucleic acid sequence of the virus... evidently effects specifically the memory cell (B cells + T cells) ability to recognise the pathogen. This occurs because the nucleic acid sequence directly relates to the production of proteins through polypeptide synthesis (translation + transcription). This change in proteins due to change in nucleic acid sequence Changes the glycoprotein and membrane proteins depicted within the diagram as this counts as the antigen which is what the immune system recognises to provide specific immune response. If Because the antigen changes as the nucleic acid sequence of the virus changes the helper T-cells, memory B and T cells are unable to recognise it and provide fast effective responses.

specific
through the production of killer T cells and B cell antibodies. As a result it is treated as a new pathogen and adaptive response will become slower as it isnt recognised by immune system to effectantly combat it, this is an adaptation of the pathogen for entry. Thus inregards to the effectiveness of vaccinations to prevent the development of the disease would be limited as the virus will continually (seasonly) change its nucleic acid, and as described up not allow the immune systems memory cells to detect the virus. Vaccinations are injections of either dead, fragmented or weak pathogen designed to allow the immune system to develop a specific immune response to the pathogen before the live one makes contact with the organism, thus allowing for when this happens to have fast response with larger concentrations of the immune response cells as the pathogen will be detected. Essentially this method would only be effective if the proteins and thus antigen wasnt changed as this is what the immune system detects. This method although if used similarly to the way influenza bacteria vaccinations are used may be slightly more effective. If trends of change in nucleic sequence is studied and predictions in new change can be made thus determining new antigen that will possibly come, then vaccinations can be made based of this. Although this may not be accurate for the change of the virus it is a better strategy

Great response - you need to define all key technical terms. Answer

Conclusion - thus it is evident due to the viruses change in nucleotide composition → change in protein → change in antigen vaccinations will not be effective using prorous virus models unless predictions are made to predict what virus will look like (antigen). Although vaccinations are great in building immune response and memory cells in this case effectiveness is [illegible] due to changing nature of virus



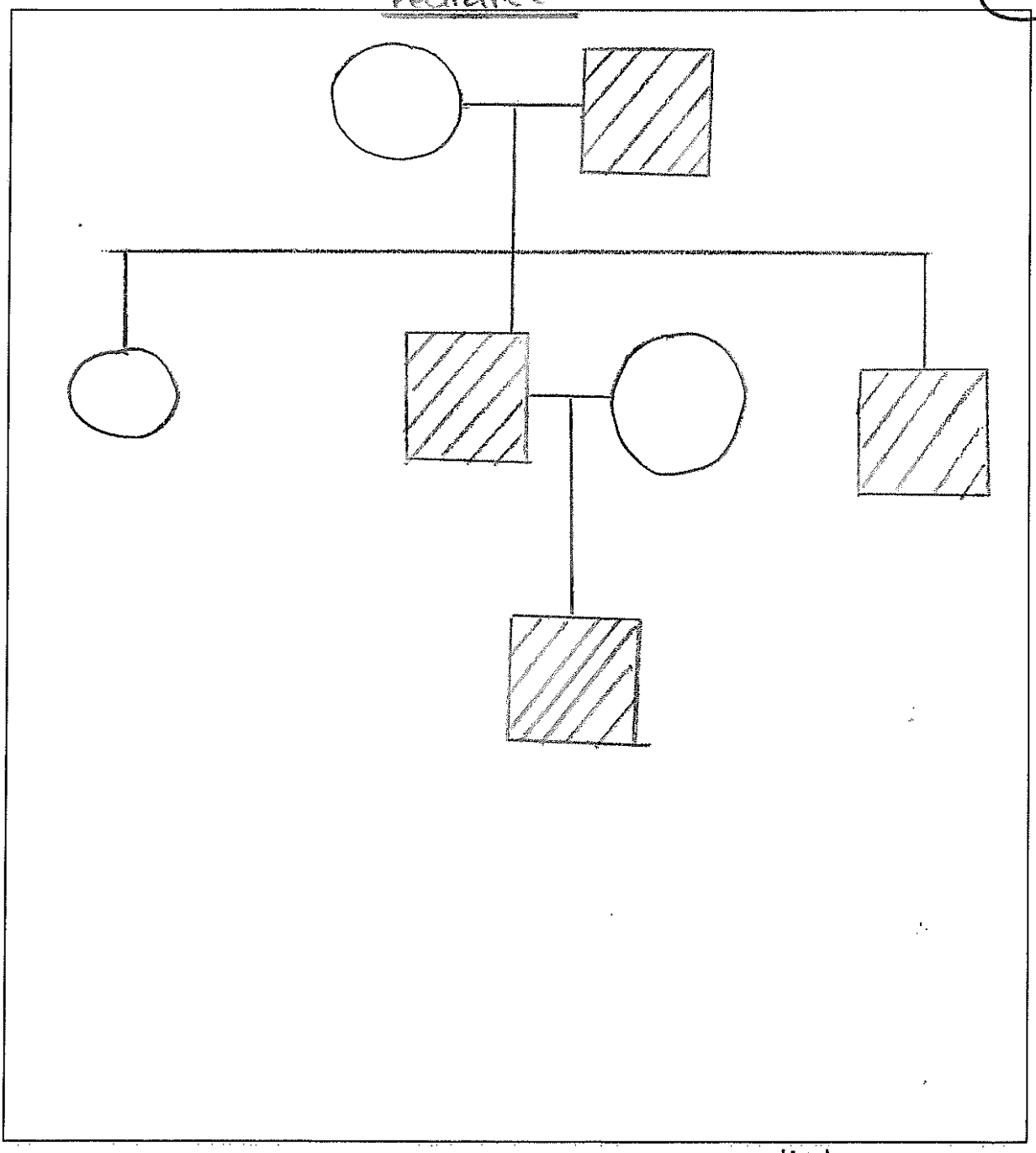
Question 26

As part of an independent research project, a student studied a genetic condition suffered by members of his family. The student wrote the following summary:

- I am male and I have the condition X^hY
- My mother does not have the condition X^hX^H
- My father and his brother have the condition X^hY X^hY
- My father's sister and my father's mother do not have the condition X^hX^H $m\ X^hX^H$
- My father's father has the condition X^hY or X^HX^H

a) Construct a pedigree for this family **4m**

Pedigree



Key

- male without condition
- female without condition
- male with condition
- female with condition

b) The student made the following conclusion from his study. " as only males have the condition, it must be a sex-linked genetic condition." Assess the validity of the student's conclusion, and provide support for your assessment. **4m**

Sexlinked means a condition carried on sex chromosome X or Y

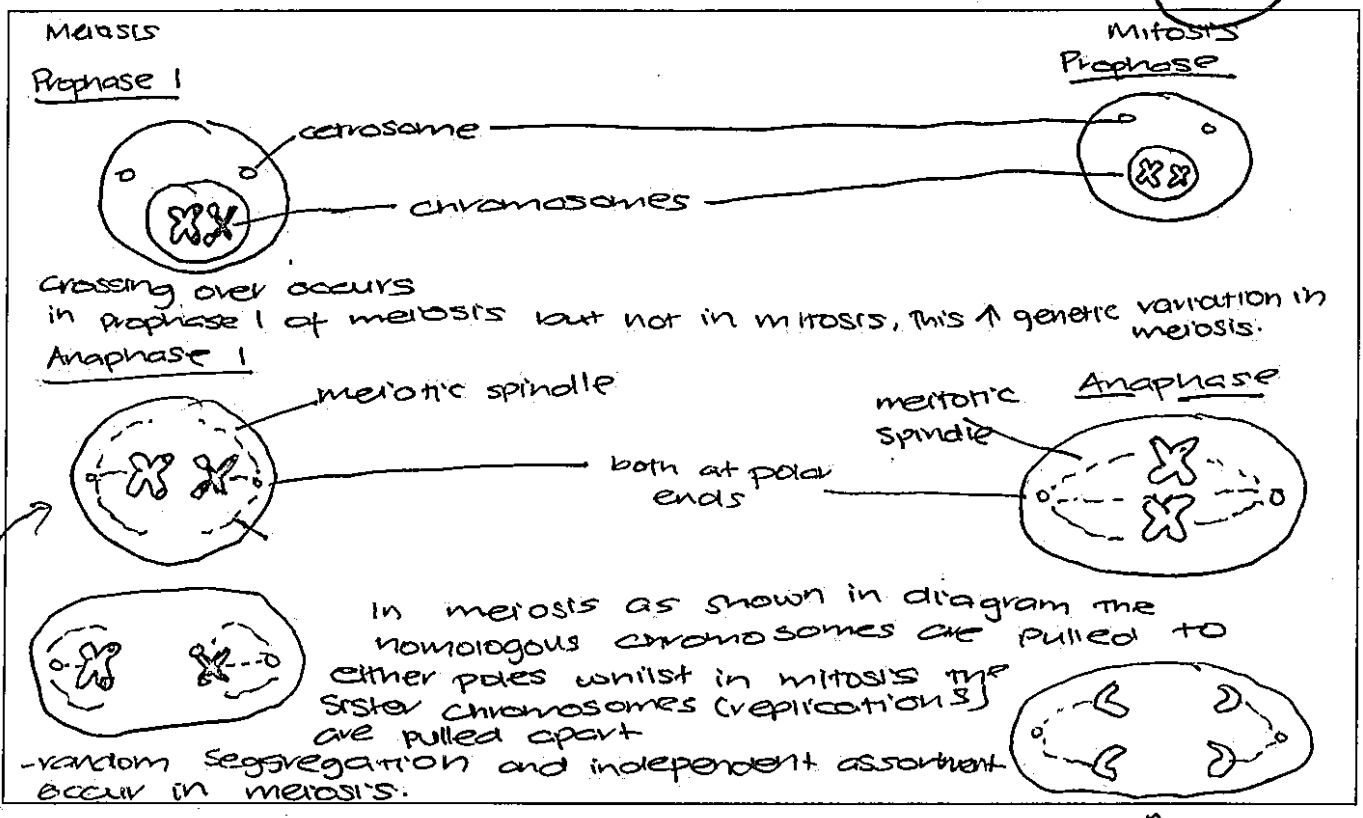
Validity refers to the variables being controlled and the method being testing the hypothesis. In this case the method of constructing the pedigree is valid and his variables were correctly monitored. His conclusion that this is a sexlinked genetic condition is valid to a moderate extent due to only males gaining the disease however a consideration that the women married into family (Grandmother + mother) must be taken into consideration and only one female daughter is in the family compared to 4 by 3 biological sons (grandson + son). Hower although this is the case the possibility of this occuring is high and it being a sexlinked disease, if further research into family pedigree is established an less females gain the disease this conclusion is highly valid.

3

could be explored.

Question 27

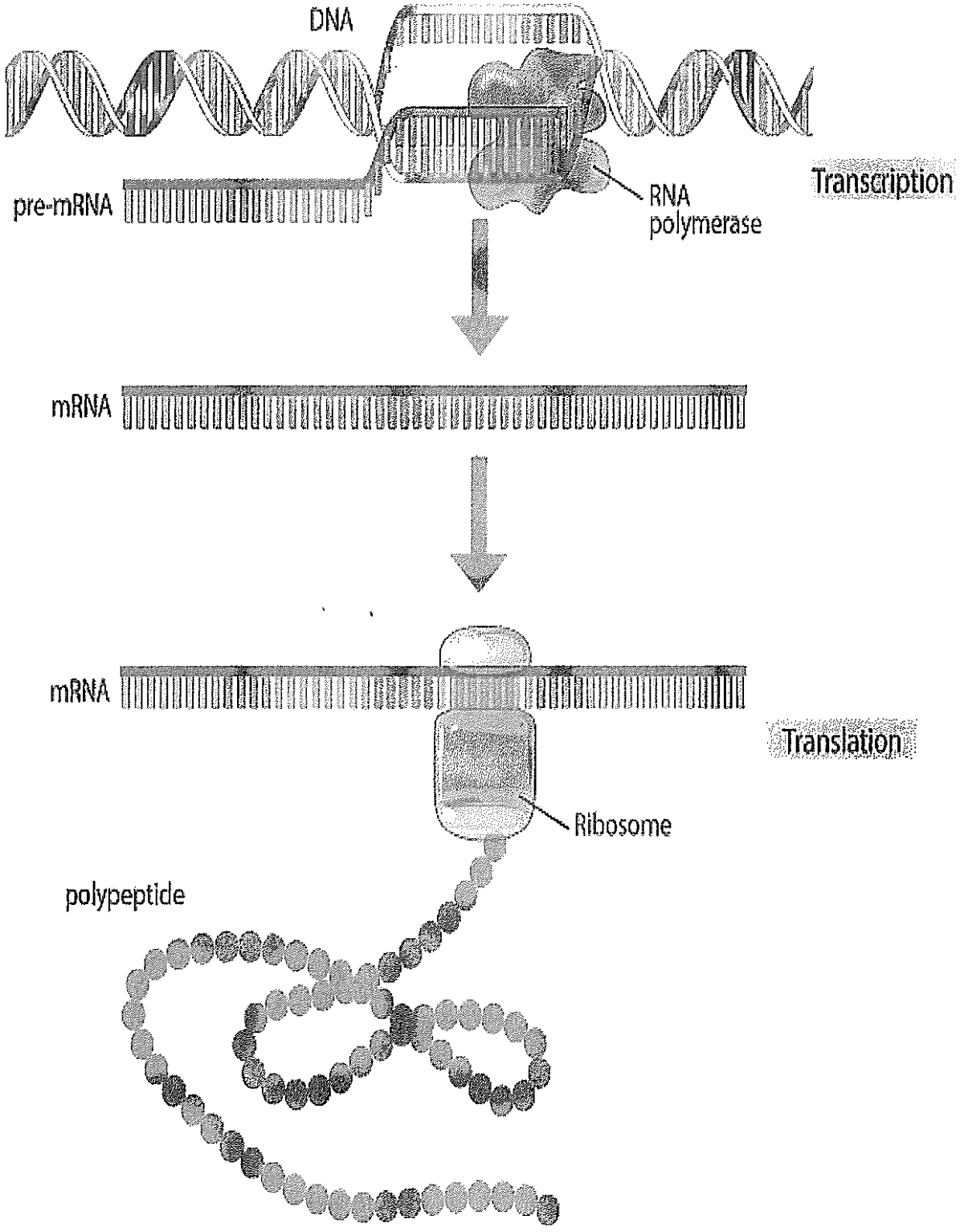
Use labelled diagrams to highlight the essential differences between mitosis and meiosis. **4m**



Continued in book 2

Question 28

Consider the diagram below which shows the processes of transcription and translation.



Transcription is the process of making being created using complimentary base pairs from DNA for polypeptide synthesis, while translation is when tRNA reads 3 bases (codons) to creat amino acid → polypeptide

Evaluate the usefulness of the models of transcription and translation shown in the diagram.

6m

Models are representations of phenomena/processes in other forms used to show its function

The models of transcription and translation as shown in the diagram are useful in representing how polypeptide synthesis occurs which is the making of proteins. The evaluation of its usefulness is judged by the following criteria, (1) accuracy in representation, (2) ability to illustrate complex process in an understandable way.

criteria (1) - Effectively the representation of transcription and translation depicting the process of polypeptide synthesis in the diagram is very accurate in its representation. Although it hasn't labbeled tRNA in the translation process it still effectively represents the steps accurately. It broadly models the process and is accurate in what it portrays although it could go into a bit more depth it is accurate.

criteria (2) - In terms of its ability to illustrate the complex process of polypeptide synthesis it is very effective and useful, as it diagramatically with labels highlights the process and uses arrows to indicate the order. It highlights how transcription uses mRNA and how that is used to be translated using ribosomes into polypeptides as seen in the diagram. Thus this diagram mode is very useful in illustrating the complex process in an understandable way without changing or innaccurately representing the processs

Evaluation - The usefulness of the models of transcription and translation shown in the diagram is very very high in regards to the two presented criteria as it is accurate and effectively represents the processes in an understandable way although to extend its usefulness text can be added to specify descriptions of the process and elements like tRNA can be labbeled. and base pair connections highlighted

Question 29

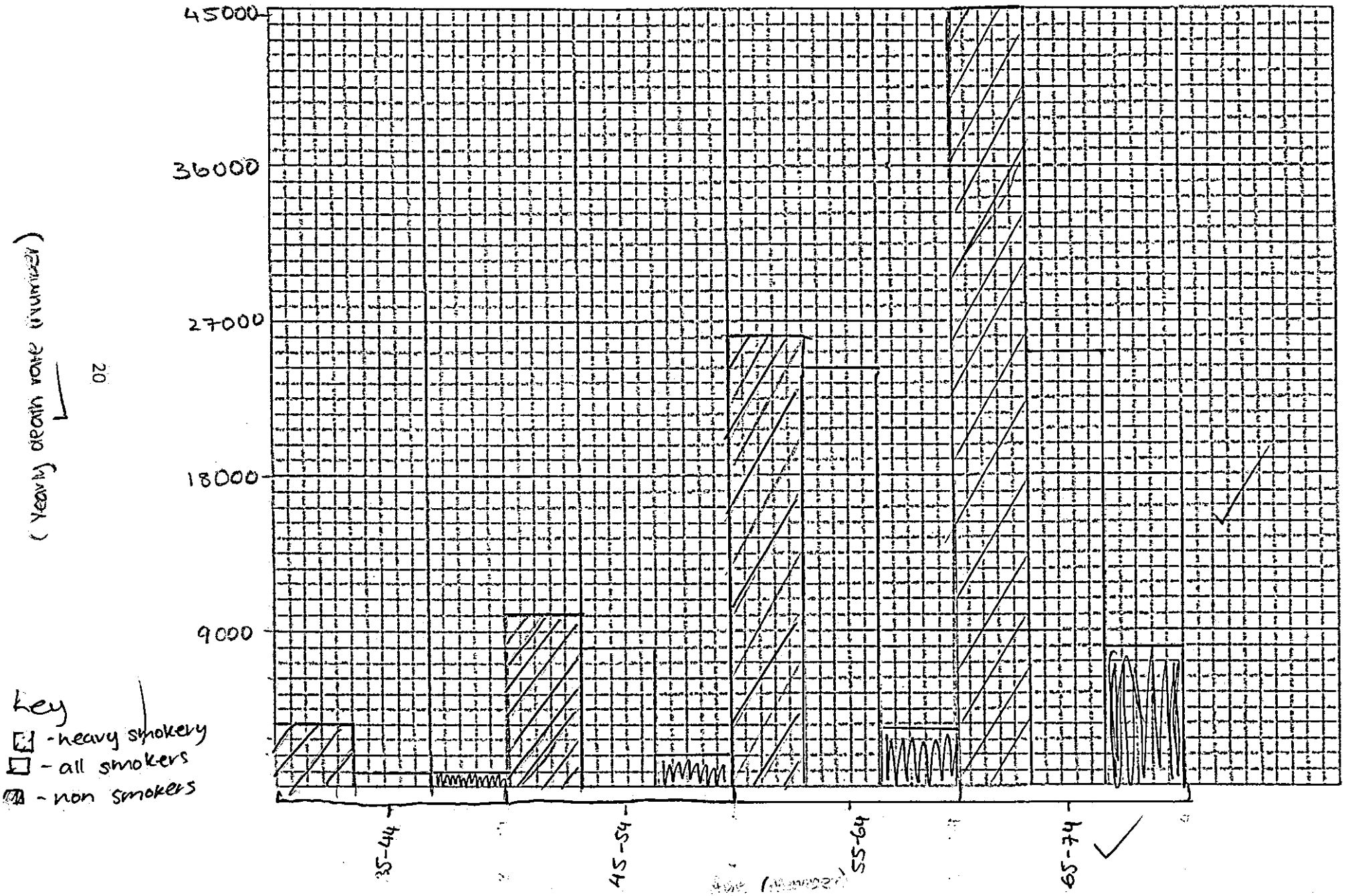
Lung cancer is the uncontrolled growth of tumours in the lungs. Researchers have been for many years trying to investigate the link between smoking and lung cancer. At the same time tobacco companies have been fighting against the cause and effect link between their products and lung cancer. Observe the following table illustrating the death rates from lung cancer of individuals with different levels of smoking.

Age	Yearly death rate from lung cancer for heavy smokers	Yearly death rate from lung cancer for all smokers	Yearly death rate from lung cancer for non smokers
35-44	3 400	1 000	1 000
45-54	10 000	7 000	2 000
55-64	26 000	24 000	4 000
65-74	45 000	25 000	8 000

a) Construct a suitable graph on the next page (on the graph paper) **5m**

Yearly rate of death from lung cancer

15



b) Describe the relationship between age and lung cancer **2m**

As age groups increased the death rate from ~~same~~ lung cancer increased for all groups respectively. Specifically as age groups increased heavy smoker death rate doubled.

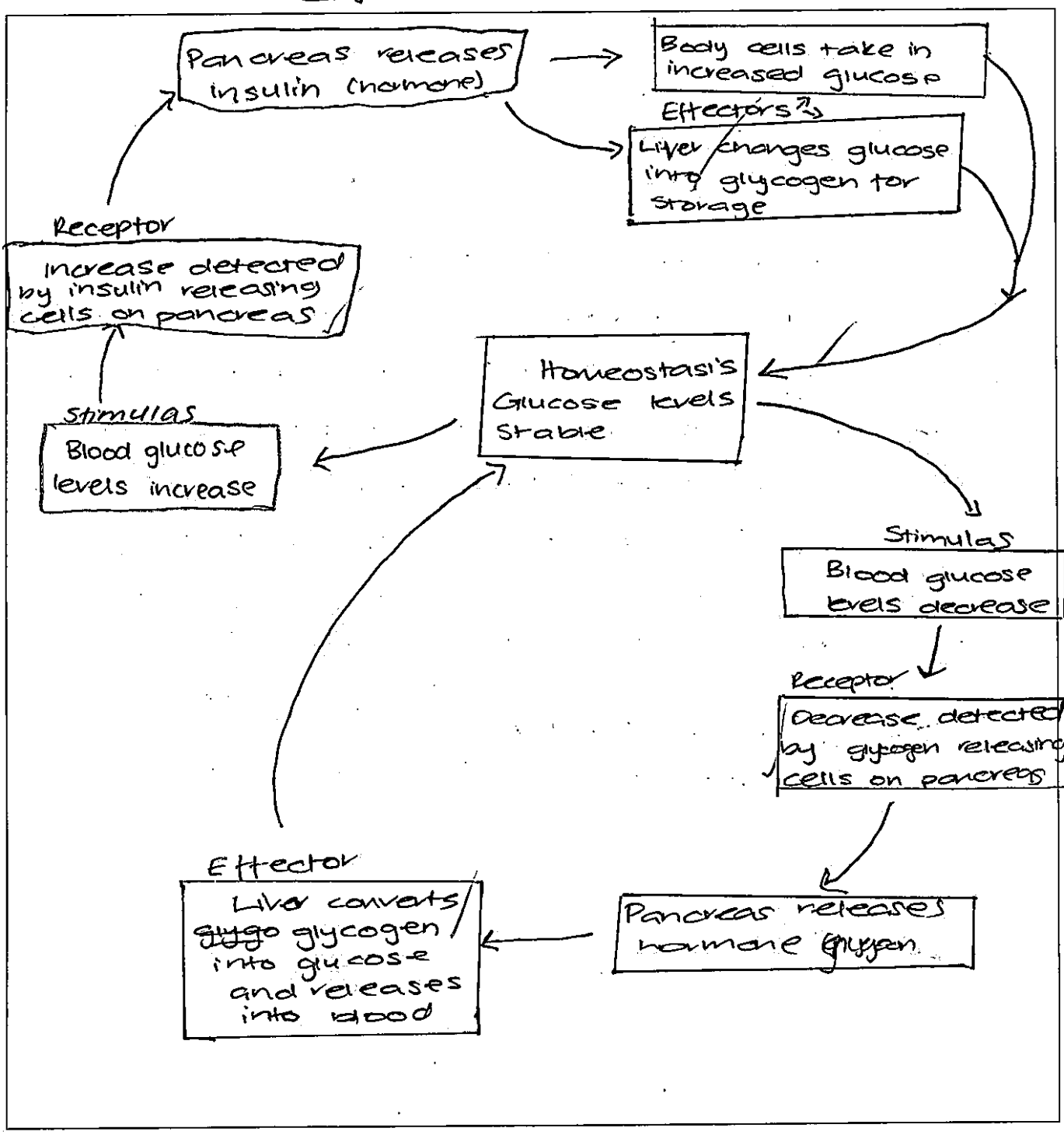
c) Explain the relationship between smoking and lung cancer **3m**

As seen by the data there is a direct correlation between increased smoking causing increased deaths from lung cancer in all age group as this is a disease developed from the environment specifically smoking. As their are much fewer deaths from non-smokers in all age groups compared to 'all smokers' and 'heavy smokers' ~~as~~ it is evident to conclude their is a direct cause and effect relationship as smoking causes lung cancer and death due to it.

Question 30

a) Draw a flow diagram to summarise the negative feedback control of blood glucose in mammals.

5m



Question 31

a) Describe the process of homeostasis **2m**

Homeostasis is the process in establishing equilibrium internally depending on the changes that occur e.g temp change, glucose level change, and it is established through feedback loops with effectors, receptors and control centres, predominantly through hormone and neuron signaling.

b) With reference to a specific example, explain how endotherms use a variety of adaptations to maintain a constant internal environment **4m**

The Red Kangaroo is an endotherm with adaptation to maintain internal environment. Physiological and structural adaptations include larger ears with increased blood vessels and blood flow which thus increases surface area for heat loss when temperature is high thus cooling them down. They also lick themselves in increased ambient temperatures as when the saliva evapourates their body is cooled down. In contrast in cold times they utilise their adaptation of raising thick fur to act as an insulating agent to keep warm as well as constricting blood vessels thus lessening surface area and as a result lowering heat loss.

- baby produce for those who have trouble + 'designer babies'
- strawberry + salmon
recombinant DNA Bt cotton, insulin

Question 32

Analyse the social implications and ethical use of biotechnology include examples. **6m**

Biotechnology is a means of exploitation of biological process using technology to produce outcomes that maybe used in medicine, agriculture, industry etc. Many social and ethical implications exist as a result of this ranging from positives like advancements in medical treatment, greater produce for farmers, creation of plants that can address the population growth plus resource, negative implications include ~~to problems such as~~ the idea of undistinguishability in foods because of transgenics, artificial selection of traits and allowance of only those in higher socio-economic statuses using the new products.

In terms of positive social implications biotechnology has allowed for great growth in medical treatment of diseases such as the creation of insulin production effectively through recombinant DNA on bacteria. This has increased the production of insulin for those who suffer type 1 diabetes, in addition to this it has provided permanent treatment methods such as therapeutic cloning to treat diseases in the future. Similarly both socially and economically farmers and society have had implications as production of consistent crops with desired traights have been possible through artificial polination and cloning. In addition to this the biotechnological advancements in the creation of hybrid food and resources like golden wheat has provided positive social implications in directly providing solutions the worlds problem of growing population and limited resources. Specifically Golden wheat contains increased Vitamin A which in developing countries is a neccesity as many die from malnutrition and vitamin A deficiency.

x Continued in booklet

somatic | germline | similarity

effect

Question 33

Use a table to compare the effect of somatic and germ-line mutations on an organism 4m

	Somatic Mutation	Germ line.	Similarity
Passing on effect	A mutation on a somatic cell ~~ma~~ does not effect all cells in the organism but it's replicated down to cells which duplicate from e this cell	A mutation in germline cell effects the functionality of the whole orgganism it produces through sexual reproduction and will be prevalent in all cells of fetus	Both mutations are passed on through replication to other cells that branch of effected cell
If on coding DNA. effect	A mutation on a somatic cell effects the functionality of that specific cell and others after it as proteins made will be incorrect and function changed.	The functionality of the organism with germline mutation will not be drastic but for its offspring proteins will be incorrect and organism functionality thus inhibited	The functionality of organism effected (either offspring or mutated organism) will be changed as protien will be incorrect.
If on non coding DNA	The effect will be limited no major effet	The effect will be limitated	Both will have limited effects.

Question 34

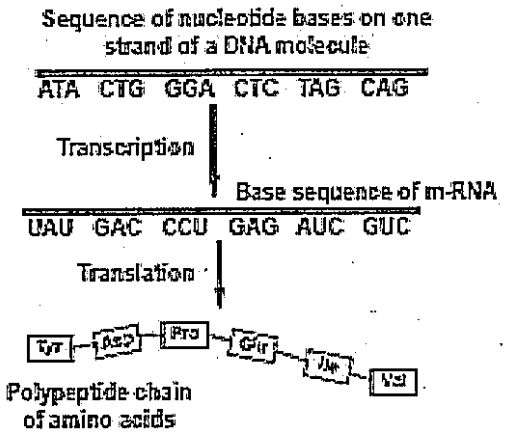
Explain how population size will impact the effect of genetic drift. 3m

Pg Genetic drift is the process of allele frequency being lowered and variation in alleles being lowered as they leave a particular species (e.g to create new species). In a large population size the effect of this wont be too much as it already contains high alleles frequencies and variety if genetic drift were to occur the population is able to reproduce and repopulate. In comparison if genetic drift were to occur in a population with less individuals (small population) which would already have limited allele frequency and variety, the gene pool would be made smaller further and variation would drastically decrease making repopulation by reproduction harder. In addition to this if an environmental or other selection pressure were to exist the population lack of genetic variety will heavily impact it even cause extinction.

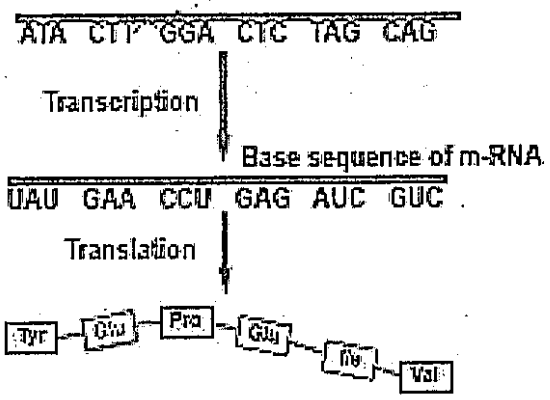
Question 35

Below is a diagram showing a type of mutation

Before mutation



After mutation



a) What type of mutation is being shown **1m**

Point mutation - a misence substitution

b) Explain how this type of mutation might affect an organism **3m**

A point mutation is the change of a single nucleotide base within the DNA, this specific mutation is a misence substution which substitutes another base thus causing a different amino acid to be formed ↑ as seen in diagram resulting in a different protein. This can effect an organisms functionality as the protein produced is changed thus not allowing it to ~~~~ allow for successful cell function if in a coding DNA as this one is. An example of this is sickle cell disease caused by ~~shorter~~ similar mutation.

-END OF EXAMINATION -

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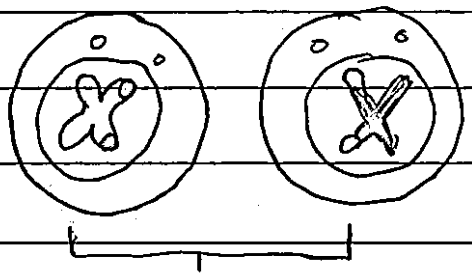
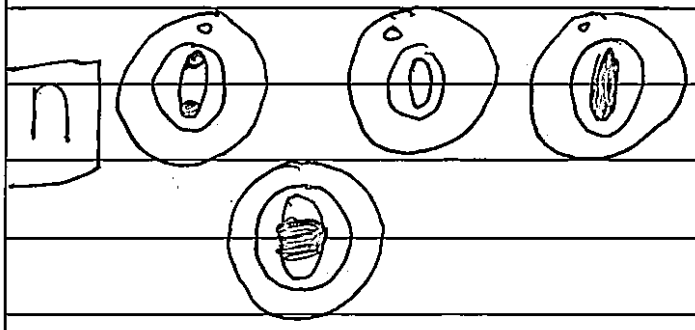
Meiosis

Telophase/Cytokensis 1



First produces chromasomes not identical to go through process of Meiosis 2 which mitosis doesn't have as it is only a one stage process

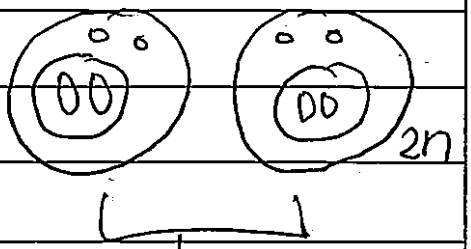
Telophase 2/cytokensis 2



produces finally, 4 unidentical daughter cells which are haploid (n) in comparison to mitosis

Mitosis

Telophase/Cytokensis



produces 2 identical daughter cells. diploid cells.

3	0	6	1	4	4	6	3	

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Ethically the positive implications of this is the growing possibility to help those who are malnutritioned and treat them to adress the problem of malnutrition in developing nations.

In contrast their are also negative social and ethical implications. Transgenic species change the natural process of reproduction and selection in organisims. Specifically seen in race horse breeding, it limits genetic variety through artificial insemination and thus is highly unethical. In addition to this many animals, dogs, cattle and horses have been domesticated ~~to~~ and their gene pool manipulated using artificial insemination restricting their freedom. In addition medical advancement in creating insulin etc, provides social implications as only those with high socio-economic abilities can access these solutions. ~~In addition it was had social implications~~

Conclusion - through analysis it is evident that the use of biotechnology has many negative and positive social and ethical implications ~~of~~, however it has enforced scientific abilities and knowledge and if used taking ethical & social effects into consideration can provide many more positive

implications to society.

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