



SHORE

Exam Number:

--	--	--

Year 12

Biology

Trial Examination

2020

General instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board approved calculators may be used
- Write your Student Exam Number where required
- **Note:** Any time you have remaining should be spent revising your answers

Total marks – 100

Part A - 20 marks

- Attempt Questions 1 - 20
- Allow about 35 minutes for this section

Part B - 80 marks

- Attempt Questions 21 - 39
- Allow about 2 hour and 20 minutes for this section

DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

Part A – 20 marks

Attempt Questions 1-20

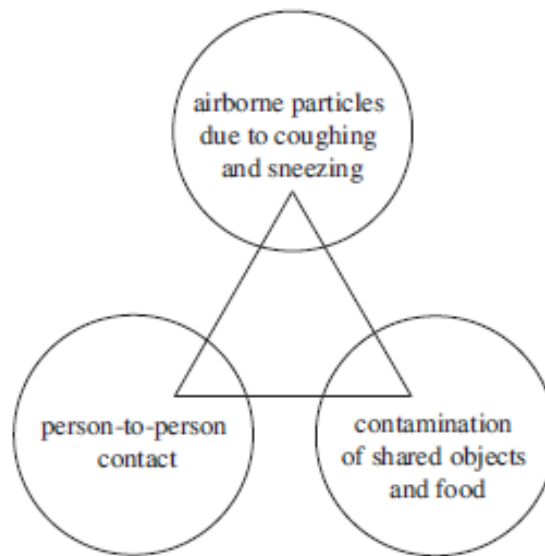
Allow about 35 minutes for this part

Use the multiple-choice answer sheet provided for Questions 1-20

1. What is the advantage of internal fertilisation?
 - (A) A greater number of offspring are produced ensuring species survival.
 - (B) It can take place in aquatic environments.
 - (C) Less care needs to be provided for gametes and offspring.
 - (D) There is less risk of the gametes drying out.

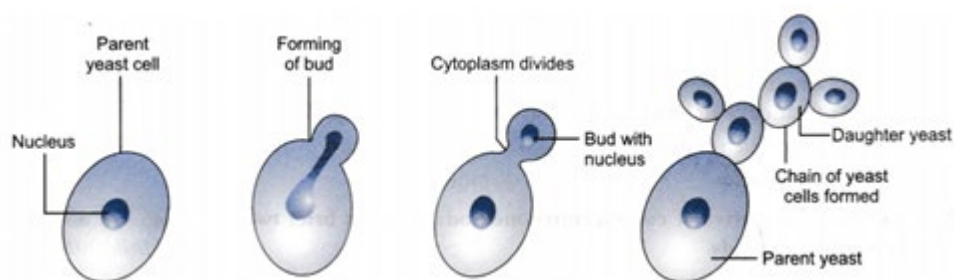
2. A section of DNA was analysed and found to have 40 cytosine bases and 50 thymine bases. What is the total number of deoxyribose sugar molecules in this sample?
 - (A) 20
 - (B) 40
 - (C) 90
 - (D) 180

3. The diagram shows how influenza (the flu) is transmitted.



Based on the diagram, which of the following situations would LEAST likely result in the transmission of the flu virus from one person to another?

- (A) A fly landing on an infected person, then landing on an uninfected person.
 - (B) Drinking from an unwashed cup previously used by an infected person.
 - (C) Being in the same room with someone showing flu symptoms.
 - (D) Eating food prepared by an infected person.
4. Yeast reproduces by asexual reproduction as illustrated in the diagram below:



The offspring produced from this type of reproduction usually have

- (A) half the number of chromosomes of their parents.
- (B) genetic information identical to their parents.
- (C) greater variation in characteristics than their parents.
- (D) fewer organelles than their parents due to division.

5.



Genetically modified tomatoes have been produced to contain a new substance which has health benefits and turns the tomatoes purple.

What is inserted into the DNA of another plant to make it transgenic?

- (A) A gene from another species.
- (B) A different gene from the same species.
- (C) Chromosomes from the same species.
- (D) Proteins from another species.

6. A section of DNA from a plant is shown in the diagram below.



How many codons are shown in this section of DNA?

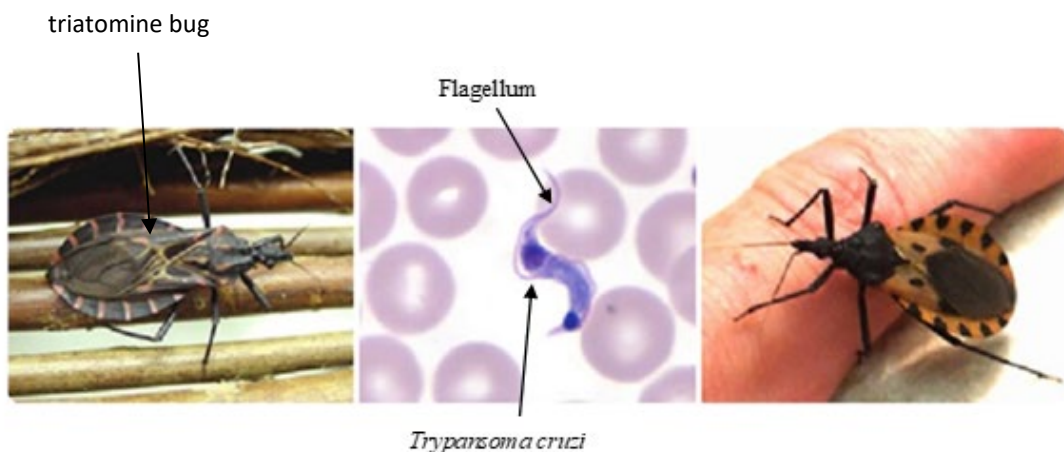
- (A) 2
- (B) 4
- (C) 8
- (D) 12

7. The nasal cavity is lined by stratified squamous epithelium consisting of flat-surfaced cells. Many bacteria and viruses are able to enter mucosal surfaces as they are only one cell thick.

When this occurs, they encounter features of Adaptive immunity, including:

- (A) antihistamines.
- (B) B lymphocytes.
- (C) lysozymes.
- (D) macrophages.

8. Chagas disease is caused by *Trypanosoma cruzi*, shown in the following diagram.



Trypanosoma cruzi have flattened bodies and are transmitted by triatomine bugs, also known as ‘kissing bugs’, from one human to another. *Trypanosoma* are protozoans and live in the blood stream in humans and reproduce there by splitting in two.

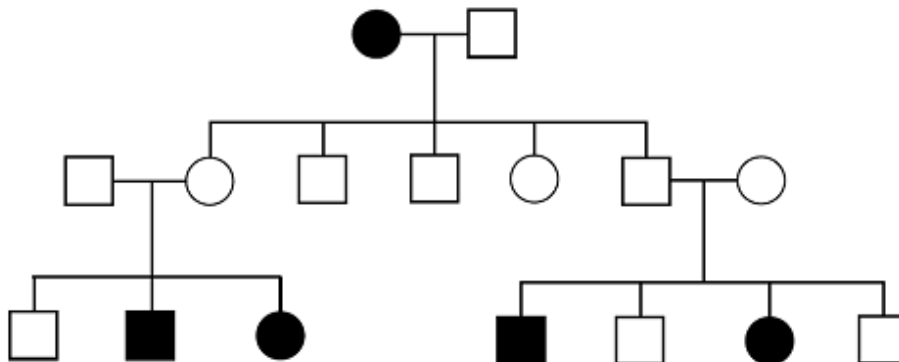
It is reasonable to conclude that:

- (A) *Trypanosoma cruzi* has a digestive system.
- (B) *Trypanosoma cruzi* has a thick cell wall to resist attack by macrophages.
- (C) *Trypanosoma cruzi*’s flagellum is important for locomotion.
- (D) *Trypanosoma cruzi* is likely to be attached to the walls of the intestines.

9. Genetic drift can occur as a result of the variation in the allele frequencies between isolated populations.

When is genetic drift most likely to be observed?

- (A) When environmental pressures select for favourable traits.
 - (B) When many mutations occur in the population.
 - (C) When there is allele flow from one population to another.
 - (D) When there is the chance disappearance of particular alleles as individuals die or do not reproduce.
10. Which of the following is evidence that a plant has an infectious disease?
- (A) Nodules containing nitrogen fixing bacteria found on the roots of a plant.
 - (B) A plant is dark green and stunted due to phosphorus deficiency.
 - (C) The presence of fungal hyphae growing out of stomata.
 - (D) Wilting of the stem and drying out of root hairs during drought.
11. The pedigree below shows the inheritance of Marfan's Syndrome in a family. This condition produces Arachnodactyly, a condition in which the fingers and toes are abnormally long and slender, in comparison to the palm of the hand and arch of the foot. In this pedigree circles represent females, squares represent males and coloured shapes represent affected individuals.



What is the mode of inheritance of Marfan's Syndrome?

- (A) Autosomal dominant.
- (B) Autosomal recessive.
- (C) X-linked dominant.
- (D) X-linked recessive.

12. Chromosomal mutations occur during meiosis, a process that produces gametes (eggs and sperm) within human bodies. These mutations occur when there is an uneven split of chromosomes (non-disjunction) into each gamete. The following table shows 6 of the most common syndromes associated with chromosomal mutations.

Syndrome name	Chromosome Affected	Type of mutation
Polyploidy	Extra complete set of chromosomes	Addition
Patau syndrome	13	Addition
Edwards syndrome	18	Addition
Down syndrome	21	Addition
Klinefelter syndrome	23	Addition
Turner syndrome	23	Deletion

Which of the following is correct?

	Syndrome	Number of chromosomes in genome	Autosomal or sex chromosome affected
(A)	Down	47	Autosomal Chromosome
(B)	Edwards	36	Autosomal Chromosome
(C)	Klinefelter	23	Sex chromosome
(D)	Patau	47	Sex chromosome

13. Australia has one of the world's highest incidences of melanoma which is characterised by abnormal skin cell growth. As with many diseases, it is affected by several environmental and genetic factors.

Which of the following statements regarding melanoma is true?

- (A) Damage to the DNA of a cell is easier to cure than preventing the damage initially.
- (B) Individuals born with a genetic predisposition to melanoma will develop the condition at the same stage in their lives.
- (C) There is a strong correlation between the incidence of melanoma, your age and where you live.
- (D) When the DNA of a cell is damaged melanoma will develop.

14. Tetanus is a bacterial infection caused by *Clostridium tetani*. The bacteria make a toxin in your body that causes the disease. Tetanus causes severe muscle spasms, especially in the neck and jaw (called lockjaw). *C. tetani* lives mainly in soil, dust and manure, but can be found anywhere. You can become infected if the bacterium enters your bloodstream through an open wound. Around 1 in 10 people who get the disease will die from it.

Which of the following is the best strategy for controlling the incidence of tetanus?

- (A) Antibiotics.
- (B) Quarantine.
- (C) Social distancing by two arm lengths.
- (D) Washing your hands with soap for 30 seconds.

15. The oral vaccine, Sabin, was a liquid containing weakened polio viruses. In November 2005, an inactivated polio vaccine (IPV) replaced the oral vaccine in Australia. This vaccine is given by injection, rather than by mouth and, in Victoria, is combined with vaccines for other diseases given to children at two, four and six months and at four years of age.

Why are vaccinated individuals protected against polio?

- (A) The viruses in the vaccine are too weak to cause illness.
 - (B) The vaccine produces an inflammatory response.
 - (C) The viruses in the vaccine prevent further viral invasion.
 - (D) The vaccine stimulates the production of memory cells.
16. There are changes that take place during temperature regulation in mammals.

Which of the following indicates the mechanisms used in response to a decrease in body temperature?

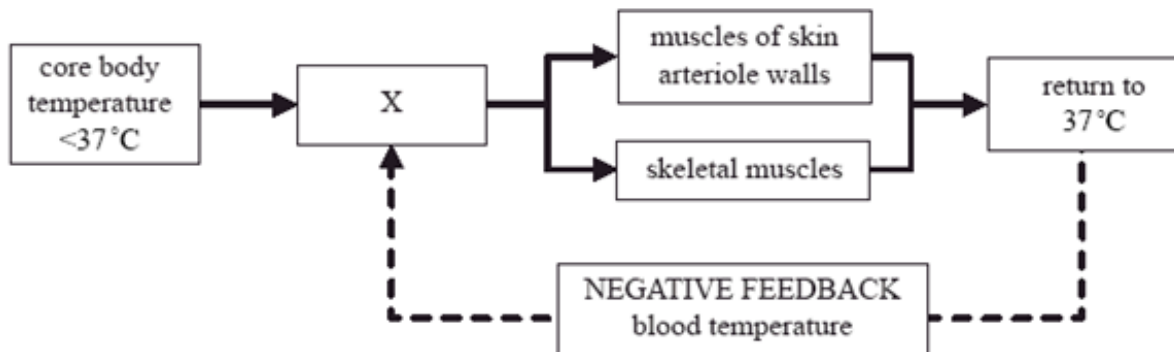
Mechanism for temperature regulation	(A)	(B)	(C)	(D)
Vasodilation	✓			✓
Vasoconstriction		✓	✓	
Contraction of hair erector muscles	✓	✓	✓	
Relaxation of hair erector muscles				✓
Sweating	✓	✓		
Shivering			✓	✓

17. Louis Pasteur designed a procedure to test whether sterile nutrient broth could spontaneously generate microbial life. To do this, he set up two experiments. In both, Pasteur added nutrient broth to flasks, bent the necks of the flasks into S shapes, and then boiled the broth.

Why did Pasteur use a swan-necked flask in his investigation?

- (A) A swan-necked flask allowed him to easily observe his results.
- (B) The curved neck caught the microbes in the air that entered the flask and prevented them from contaminating the broth.
- (C) The glass was easy to sterilise using heat ensuring better microbial growth.
- (D) The curved neck ensured that the broth would condense there on boiling maximising exposure.

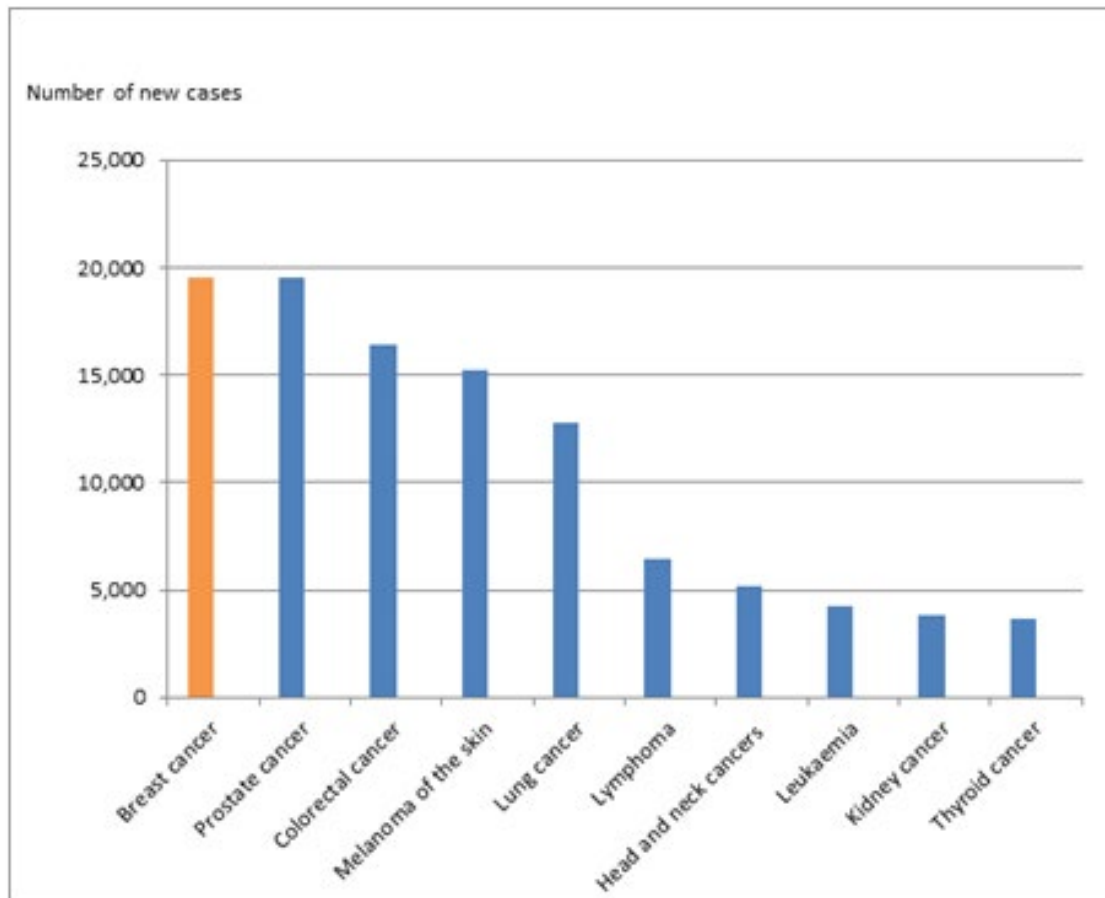
18. The diagram below represents the negative feedback and homeostatic control of body temperature.



What does the part labelled X represent?

- (A) Hypothalamus
- (B) Pituitary
- (C) Brain
- (D) Skin

19. The graph below shows the most common cancers diagnosed in Australia in 2019.



What does this data represent?

- (A) The incidence of the diseases.
- (B) The morbidity rates.
- (C) The mortality rates.
- (D) The prevalence of the disease.

20. The following information is taken from 'Communicable Diseases Intelligence Volume 22, No 10'

Outbreak of Newcastle disease in commercial poultry flocks, NSW

An outbreak of Newcastle disease (ND) occurred, involving two commercial poultry flocks in western Sydney and was linked to a third flock 160 km north-west of Sydney.

ND is a highly contagious virus disease affecting poultry, cage and aviary birds, and wild birds. There are a number of strains of the disease, which differ in the severity of their clinical signs, ranging from inapparent to a rapidly fatal condition. In its highly virulent form, ND can rapidly cause up to 100 per cent mortality in bird flocks and poses a devastating threat to the poultry industry. Strains are found in most countries but the virulent form had not previously occurred in Australia.

The virus belongs to the family Paramyxoviridae and causes digestive, respiratory and/or nervous signs in birds.

ND does not present any public health risk to consumers of poultry products, including poultry meat, eggs and other chicken products. People exposed to high levels of the virus, for example laboratory workers, may experience conjunctivitis and/or mild influenza-like symptoms.

Which is the most effective control measure that could be applied to prevent the spread to other farms and native birds?

- (A) Destruction of all poultry and restocking with unaffected birds.
- (B) Vaccination of the poultry farmers and laboratory workers and surveillance of affected birds.
- (C) Quarantine of the poultry farmers and laboratory workers and disinfection of affected properties.
- (D) Quarantine, destruction of poultry and disinfection of the affected properties.

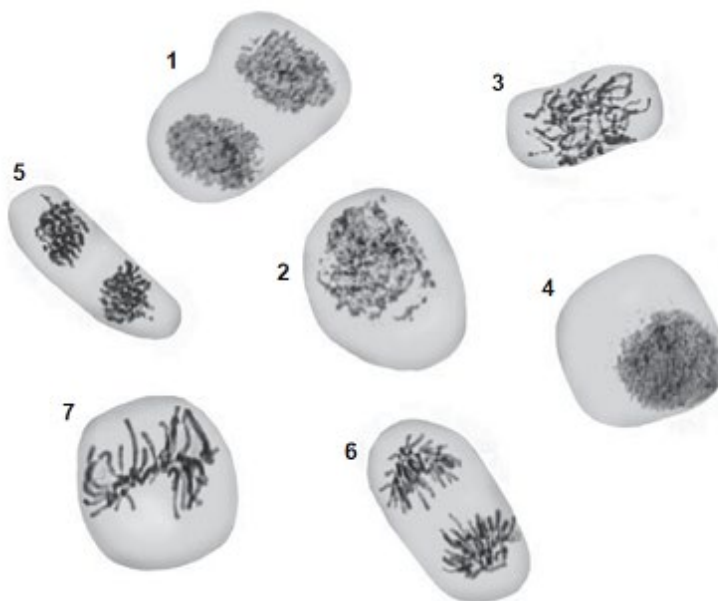
Part B – 80 marks**Attempt Questions 21-32****Allow about 2 hours and 25 minutes for this part**

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Show all relevant working in questions involving calculations.

Question 21 (3 marks)

The following are images of plant cells from tissue which is undergoing meiosis.



- (a) The order of the first 3 stages is 4-2-3.

Write the correct order for the last four stages below.

1

.....

Question 21 continues on the next page.

Question 21 (continued)

In the Heredity module, you had to model the processes involved in cell replication which included mitosis and meiosis.

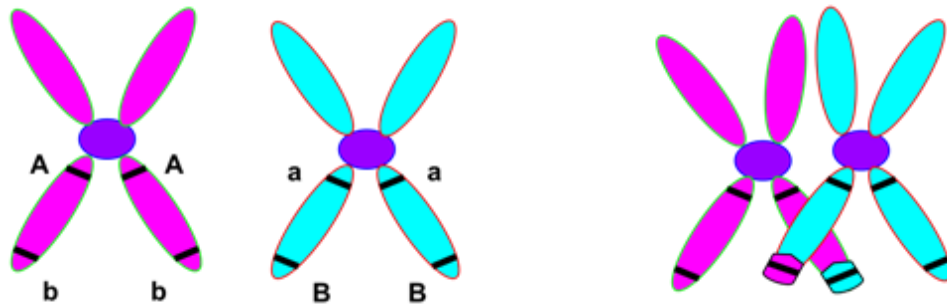
- (b) Complete the table which compares the processes of mitosis and meiosis which you had to model. 2

Feature	Mitosis	Meiosis
<i>Genetically</i>	Produces identical daughter cells	Produces genetically different daughter cells
<i>Type of cells produced</i>	Somatic	
<i>Number of cell divisions</i>		
<i>Number of daughter cells produced</i>		4 daughter cells

End of Question 21

Question 22 (7 marks)

The process below demonstrates the exchange of genetic material between non-sister chromatids of homologous chromosomes during meiosis to form recombinant chromosomes. It occurs between prophase 1 and metaphase 1 of meiosis.



- (a) Identify this process.

1

.....

- (b) Draw the resulting allele combinations on the chromatids.

2



Question 22 continues on the next page.

Question 22 (continued)

- (c) Rh factor is a blood protein that plays a critical role in some pregnancies. People without Rh factor are known as Rh negative, while people with the Rh factor are Rh positive. The Rh-positive allele is dominant. If a woman who is Rh negative is pregnant with a foetus who is Rh positive, her body will make antibodies against the foetus's blood. 2

A mother with Rhesus negative blood, whose husband is heterozygous for the protein, gives birth to a baby with Rhesus positive blood. What is the probability that a sibling will be born with Rhesus negative blood? Show all working.

.....

.....

.....

.....

.....

.....

- (d) What is a possible explanation for why subsequent pregnancies could trigger an immune response? 2

.....

.....

.....

.....

End of Question 22

Question 23 (6 marks)

The Spinifex Hopping Mouse is a desert dwelling marsupial and an endotherm. It has various structural, physiological and behavioural adaptations it shares with many other desert endotherms.

- (a) Outline a physiological and behavioural adaptation this marsupial may have. **2**

.....

.....

.....

.....

- (b) Complete the table outlining TWO mechanisms in plants that allow water balance to be maintained in an arid environment. **4**

Mechanism	How water balance is maintained

End of Question 23

Question 24 (4 marks)



Scientists often study the effects of environment on phenotype by studying identical twins. Discuss this statement using examples of the effect of environment on phenotype.

4

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

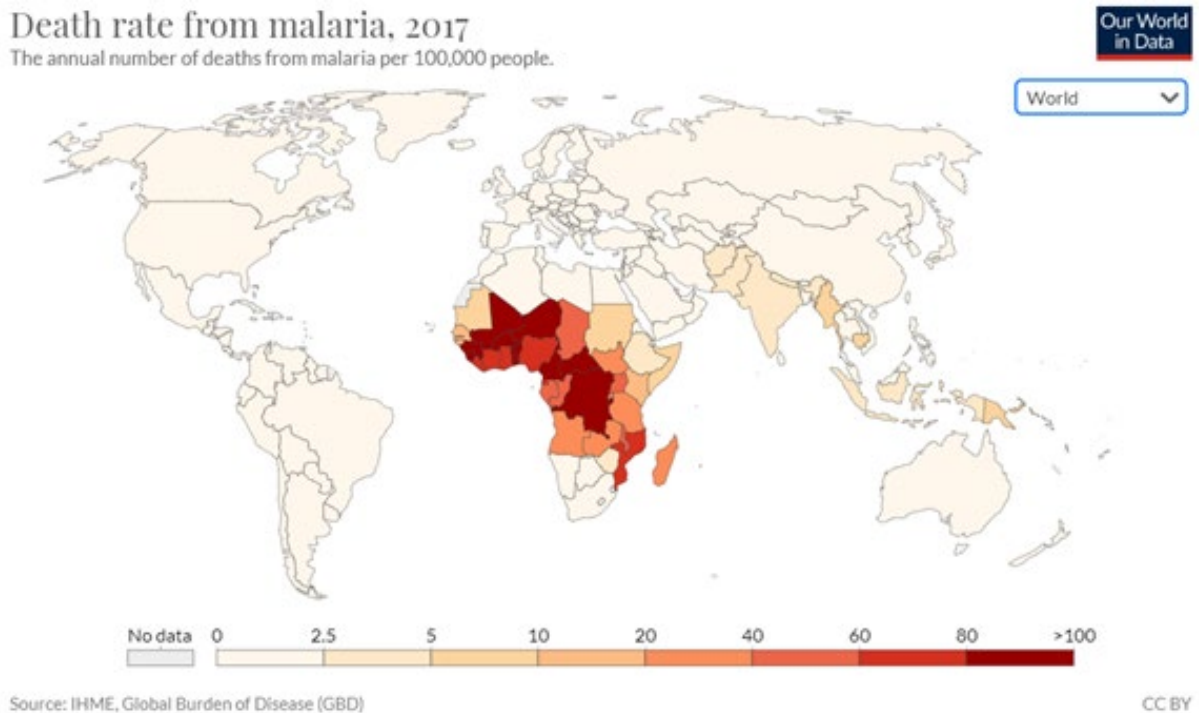
.....

End of Question 24

Question 25 (10 marks)

Malaria is a life-threatening disease caused by parasites that are transmitted to people through the bites of infected female *Anopheles* mosquitoes. It is preventable and curable.

In 2018, there were an estimated 228 million cases of malaria worldwide. The estimated number of malaria deaths stood at 405 000 in 2018.



- (a) Use the map to describe the global mortality rate from malaria in 2017.

1

.....

.....

.....

- (a) Suggest why there is a concentration of deaths closer to the equator.

1

.....

.....

Question 25 continues on the next page

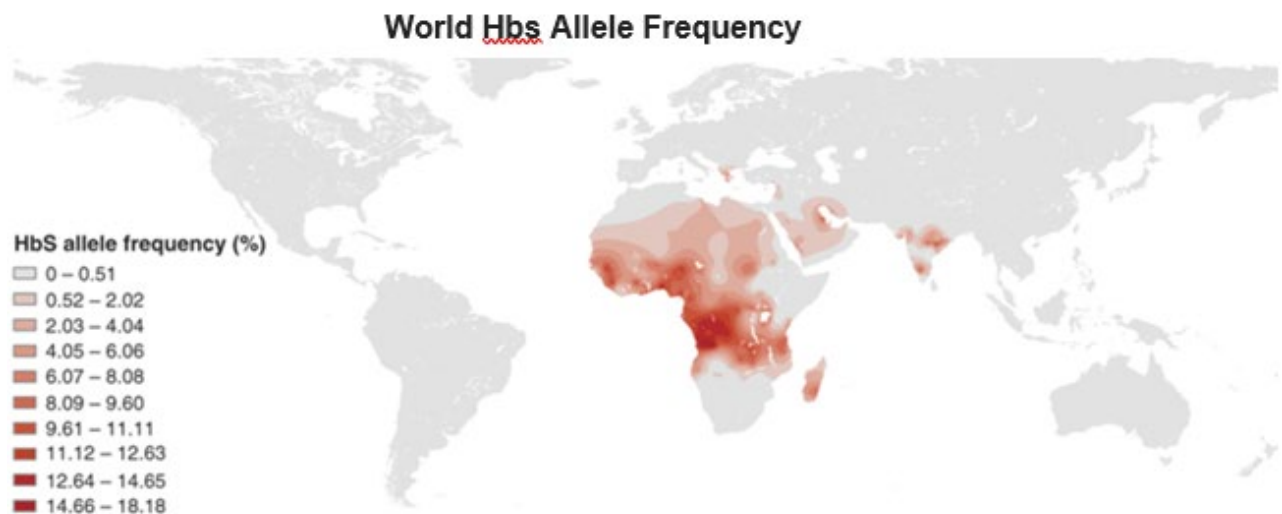
Question 25 (continued)

Sickle cell anaemia is a genetic disease with severe symptoms and can be fatal. The disease is caused by a mutated version of the gene that helps make haemoglobin Hb – a protein that carries oxygen in red blood cells. People with two copies of the sickle cell allele Hbs have the disease. Sickle-cell disease is caused by a mutation of the codon GAG which changes into GUG. The amino acid valine is synthesised rather than glutamic acid.

- (c) What type of mutation is this?

1

.....



Individuals who are carriers for the sickle cell disease (with one sickle allele and one normal haemoglobin allele, also known as sickle cell trait) have some protective advantage against malaria.

- (d) Two heterozygous parents for sickle cell anaemia have a child. What is the probability the child will not develop malaria? Show your working. 2

.....

.....

.....

.....

.....

Question 25 continues on the next page

Question 25 (continued)

Sickle cell anaemia is an example of a Single Nucleotide Polymorphism (SNP).

- (e) In which region of DNA do SNPs more commonly occur? **1**

.....

- (f) With reference to the information above explain how allele frequencies for SNPs could be used to determine the origin of a particular allele. **4**
(Refer to the data in the world Hbs allele frequency map in your answer)

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 25

Question 26 (6 marks)

- (a) Using an example, outline the steps involved in gene cloning. **2**

.....

.....

.....

.....

.....

- (b) Evaluate the effect of mutation, gene flow and genetic drift on the gene pool of populations. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 26

Question 27 (4 marks)

As part of Module 8: Non-Infectious Disease, you investigated the causes and effects of cancer.

For a named cancer describe the cause and effects of the disease.

4

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

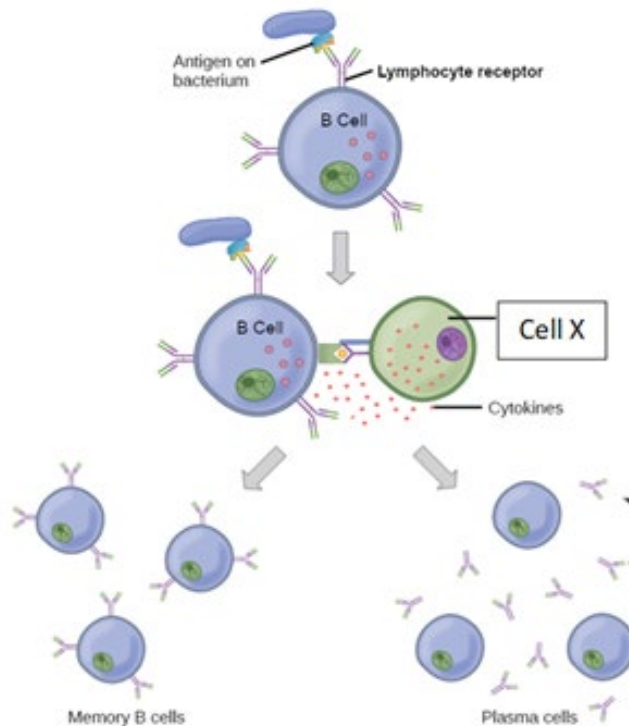
.....

End of Question 27

Question 28 (10 marks)

Pertussis (whooping cough) is a bacterial infection caused by *Bordetella pertussis*. It spreads when an infected person coughs or sneezes and you breathe it in. The bacteria affect the lungs and airways, causing a person to cough violently and uncontrollably. This can make it hard for the infected person to breathe. A vaccine is given to infants at eight-weeks of age.

The diagram below shows an immune response to a *Bordetella pertussis* infection.



- (a) Identify cell X

1

.....

- (a) Describe the role of memory B cells, as shown in the diagram.

2

.....

.....

.....

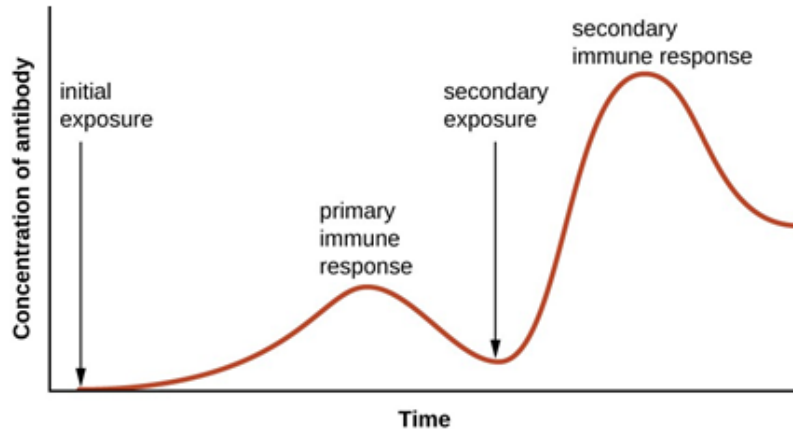
.....

.....

Question 28 continues on the next page

Question 28 (continued)

Parents with infants who are in intensive care units are asked to have booster vaccines for pertussis before their first visit. Their immune response for pertussis is shown below.



- (c) Explain the shape of the graph.

3

.....

.....

.....

.....

.....

.....

.....

Question 28 continues on the next page

Question 28 (continued)

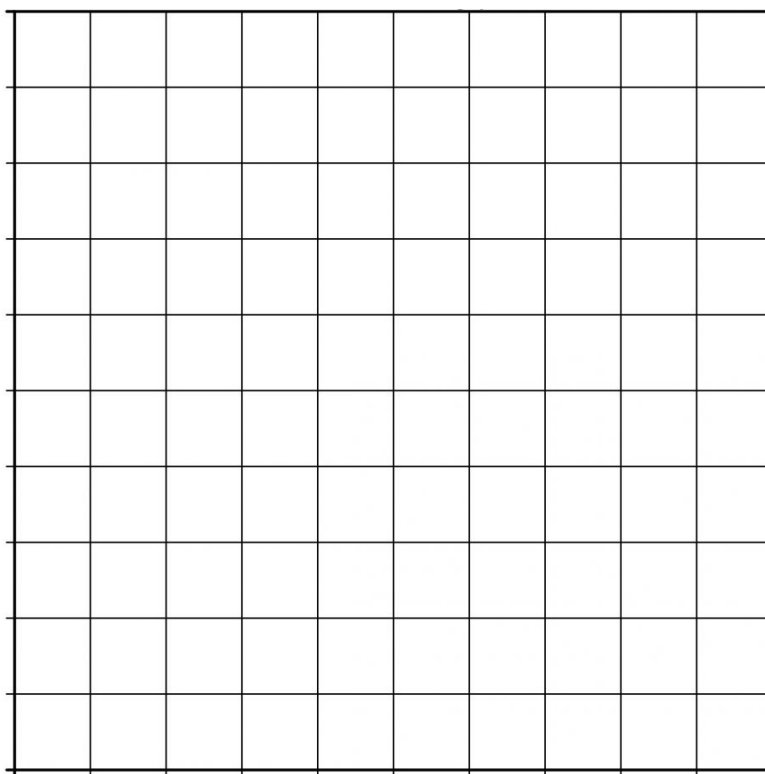
In 2017 there was a pertussis outbreak in a regional area of Australia.

The table shows the number of new cases of pertussis from April to December 2017.

Month	Number of new cases of whooping cough in a region of Australia
April	22
May	65
June	64
July	103
August	120
September	126
October	160
November	104
December	81

- (d) Graph the data shown in the table on the grid below.

3



Question 28 continues on the next page

Question 28 (continued)

- (e) Identify a trend in the graph.

1

.....

.....

.....

.....

End of Question 28

Question 29 (5 marks)

You have been elected the Chief Medical Officer of a European country and in your first few weeks of work you are faced with a new pandemic. The Marburg virus (MV20) disease is a highly virulent disease that causes haemorrhagic fever, with a fatality ratio of up to 88%. It is in the same family as the virus that causes Ebola virus disease. Once an individual is infected with the virus, Marburg can spread through human-to-human transmission via direct contact (through broken skin or mucous membranes) with the blood, secretions, organs or other bodily fluids of infected people, and with surfaces and materials (e.g. bedding, clothing) contaminated with these fluids. The disease has been spread by fruit bats and has an incubation period of 2 – 21 days.

The president has asked you to address and advise the public. Outline and explain procedures that could be employed to prevent the spread of disease.

6

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

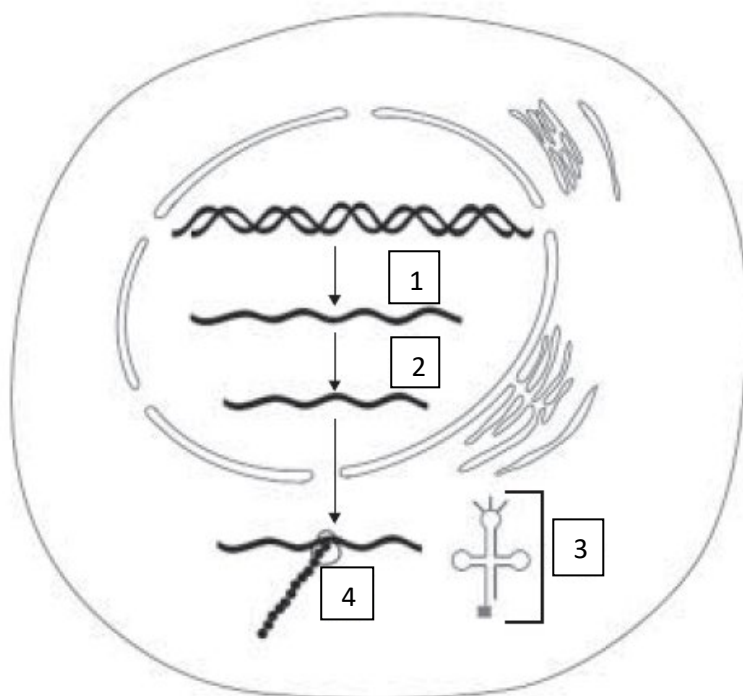
.....

.....

End of question 29

Question 30 (4 marks)

The following diagram outlines events associated with the production of a polypeptide chain in a eukaryotic cell.



- (a) What is the name of the process at step 1? 1

.....

- (b) Name the product of step 1. 1

.....

- (c) Describe what is happening at step 4. 2

.....

.....

.....

.....

.....

End of Question 30

Question 31 (7 marks)

Biotechnology has affected the Earth's biodiversity for many years. Prior to the development of genetic engineering, farmers and scientists used many different methods to increase food production.

Outline ONE example of biotechnology from the past, ONE from the present and ONE potential future example. Evaluate their effects on biodiversity. **7**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 31

Question 32 (13 marks)

Diabetes is a disease where blood glucose levels are not properly controlled in the body. A health authority published the following statistics for a specific population.

For this calendar year:

- population size (16 years and over): 6.1 million
- total cases of diabetes (includes new and existing cases): 192 760
- new cases of diabetes (in calendar year): 29 280

- (a) Use these figures to calculate the prevalence of the disease.

1

.....

.....

.....

Use the data sheet attached (pages 35-36) to answer parts (b) and (c).

- (b) Based on the data provided identify trends for Type I and Type II diabetes.

4

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 32 continues on the next page

Question 32 (continued)

- (c) Analyse factors that could account for the trends described in (b). Support your answer with reference to the data provided

8

[illegible]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of paper

DATA SHEET for question 32

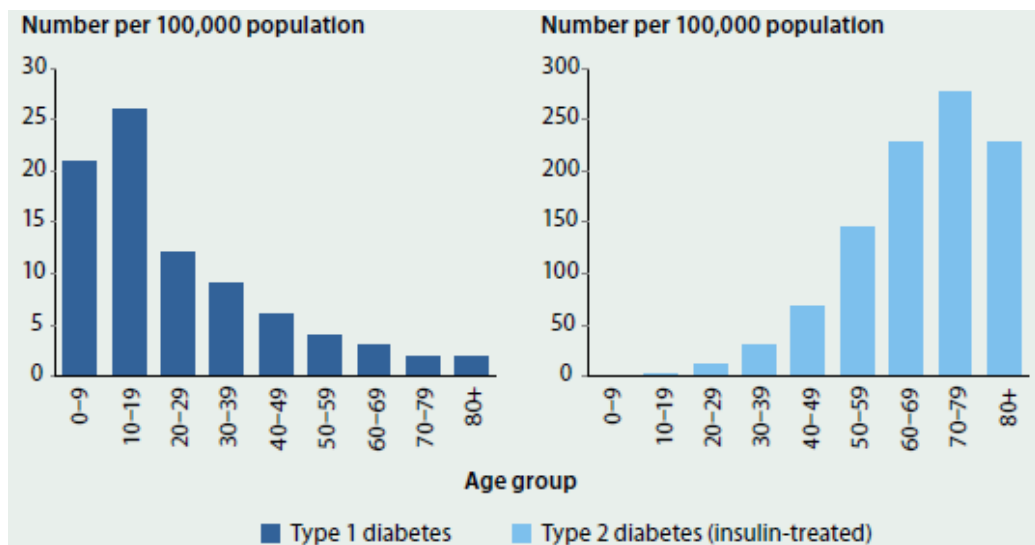
Diabetes comes in two general forms:

Type 1 diabetes occurs when your immune system, the body's system for fighting infection, attacks and destroys the insulin-producing beta cells of the pancreas. Scientists think type 1 diabetes is caused by genes and environmental factors, such as viruses, that might trigger the disease.

Type II diabetes is largely the result of lifestyle factors.

GRAPH 1

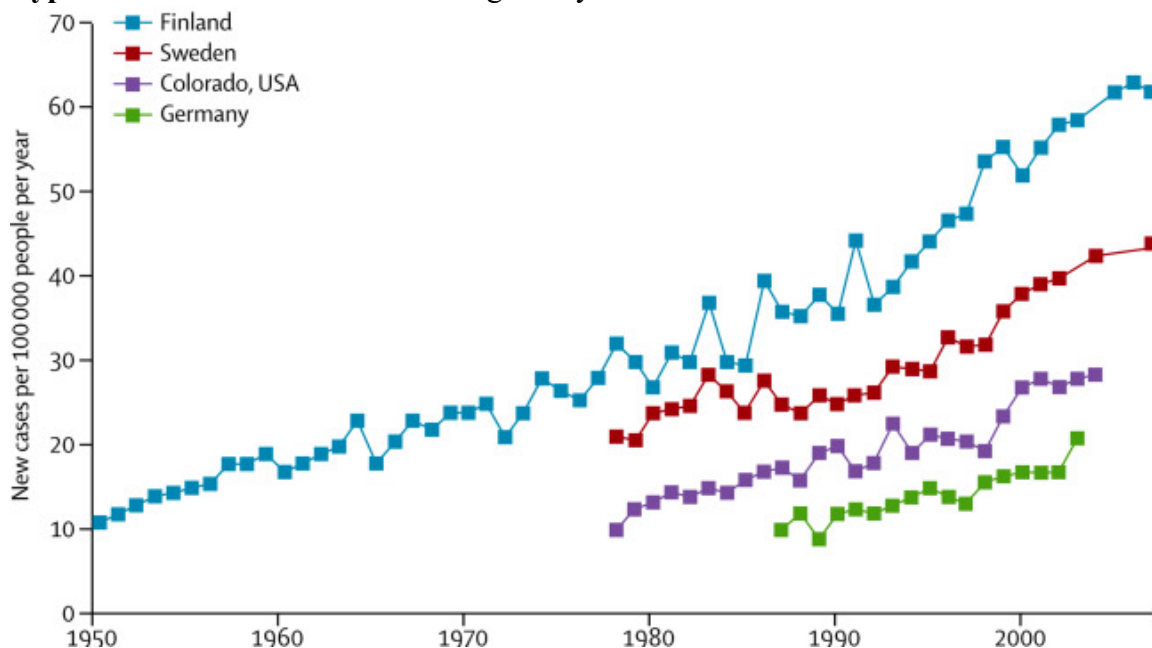
The prevalence of diabetes **Type I and Type II** in Australia. The trends shown in this data are reflected globally.



Source: Australia's Health 2016

GRAPH 2

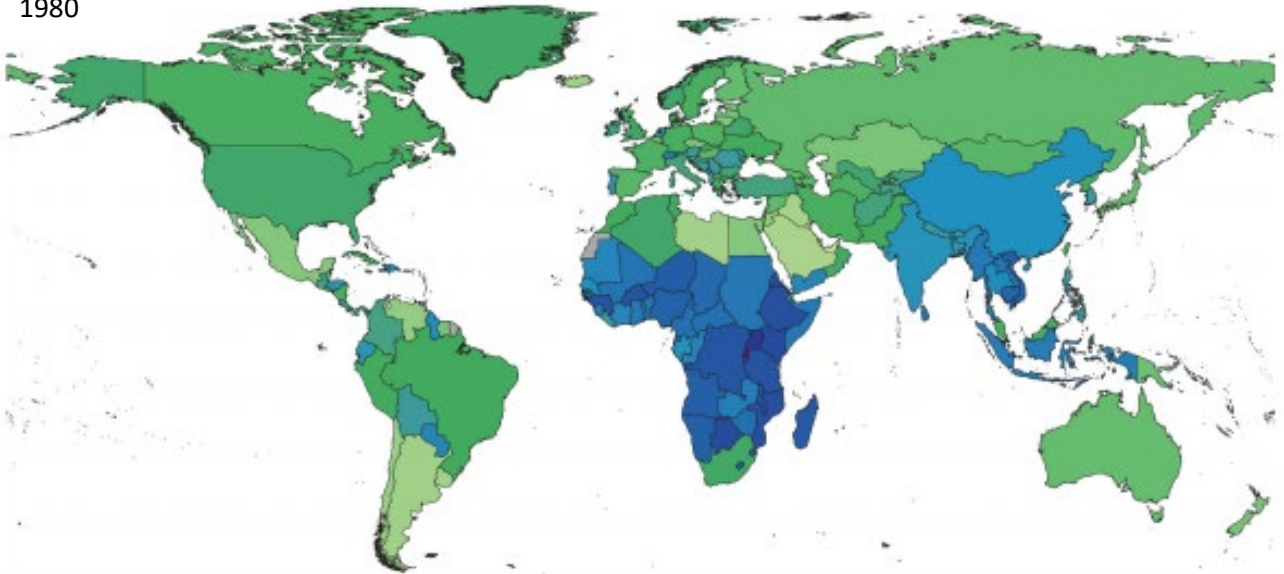
Type I diabetes data that is reflected globally. Source: The Lancet



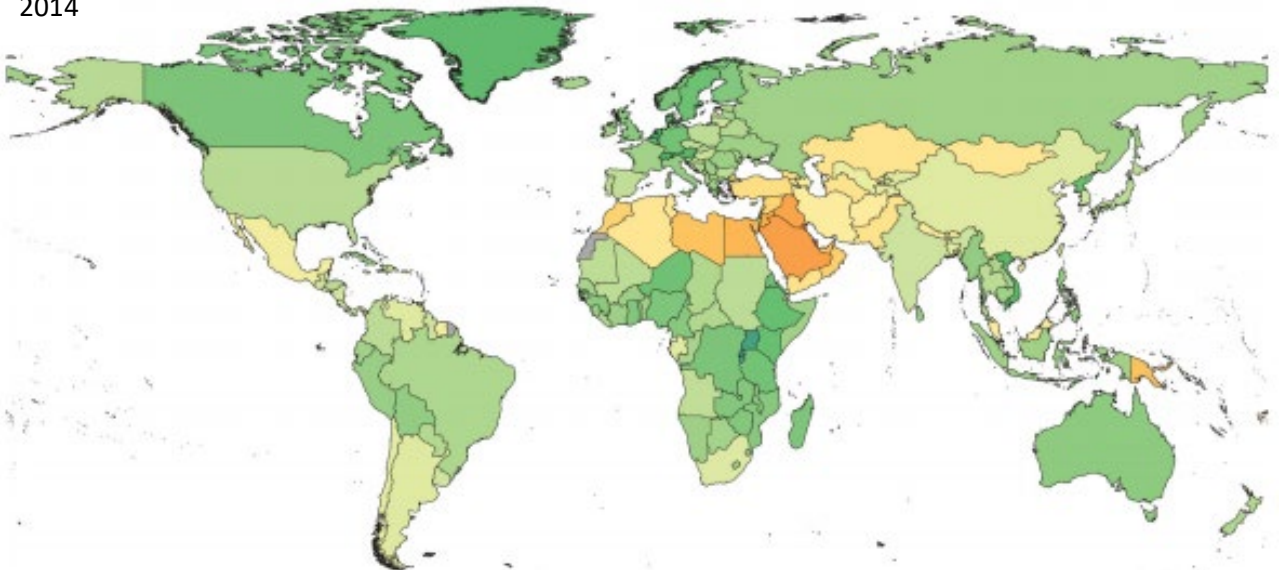
GRAPH 3

Age standardised prevalence of **Type II** diabetes in adult men by country in 1980 and 2014

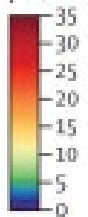
1980



2014



Age-standardised
prevalence of diabetes (%)



Source: The Lancet

2020 SHORE BIOLOGY TRIAL ANSWERS

Part A

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
D	D	A	B	A	B	B	C	D	C	B	A	C	A	D	C	B	A	A	D

Part B

Question 21 (a)

Criteria	Mark
Correct ordering of stages of mitosis	1

Sample answer: 4 2 3 7 6 5 1

Question 21 (b)

Criteria	Mark
All comparisons are made	2
2-3 comparisons are made	1

Samples answer: gametes, 1, 2, 2 daughter cells are made

Question 22 (a)

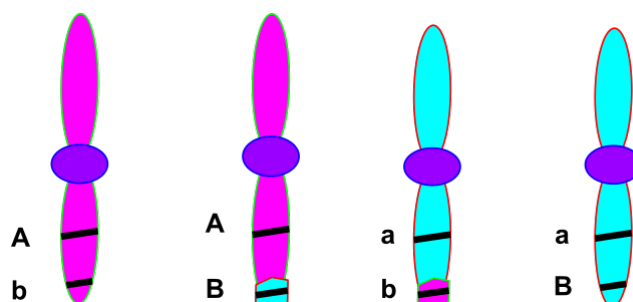
Criteria	Mark
Correct identification of process.	1

Sample answer: Crossing over

Question 22 (b)

Criteria	Mark
Correctly draws the resulting gametes produced from the process	2
Draw the chromatids all separate	1

Sample answer:



Question 22 (c)

Criteria	Mark
• Uses a punnet square correctly • Utilises parent genotypes correctly to calculate probability	2
• Uses a punnet square OR carries out a correct cross	1

Sample answer:Parents: Rh⁺ Rh⁻ X Rh⁺ Rh⁻

	Rh ⁻	Rh ⁻
Rh ⁺	Rh ⁺ Rh ⁻	Rh ⁺ Rh ⁻
Rh ⁻	Rh ⁻ Rh ⁻	Rh ⁻ Rh ⁻

1: 1 or 50% chance that they will have a Rh⁻ Rh⁻ child**Question 22 (d)**

Criteria	Mark
• States that antibodies are developed • States that an immune response occurs in the future	2
• States that antibodies are developed OR states that an immune response occurs	1

Sample answer: Exposure to the Rh⁺ antigen in the first pregnancy triggered the development of antibodies that could attack the blood of a future Rh⁺ baby.

Question 23 (a)

Criteria	Mark
• Sketches in general terms a physiological and behavioural adaptation	2
• Sketches in general terms a physiological or behavioural adaptation OR identifies a behavioural and physiological adaptation	1

Sample answer: Physiological adaptation: Producing concentrated urine to prevent losing too much water the kidneys are designed to extract as much water as possible from urine.

Behavioural adaptation: Nocturnal, only active at night to avoid the heat of the day.

Exemplar:**Question 23 (b)**

Criteria	Mark
----------	------

• Sketches in general terms mechanisms used by plants to maintain water balance	4
• Sketches in general terms a mechanism used by plants to maintain water balance	3
• Identifies mechanisms plants use to maintain water balance	2
• Identifies a mechanism plants use to maintain water balance	1

Sample answer:

Sunken stomates	The stomates are found in pits. This creates a humid environment over the top of the stomate. The saturated air above the stomates prevents water loss.
Thick waxy cuticle	A thick waxy cuticle makes the leaf watertight and this means that water will not evaporate from its cells.

Exemplar:

Comments:

Question 24

Criteria	Mark
• Sketches in general terms examples of the influence of environment on genotype • Relates the influence of the environment to the changes that could occur to twins' phenotypes	4
• Sketches in general terms examples of the influence of environment on genotype • Identifies twins are identical in genome and phenotype initially	3
• Sketches in general terms an example of the influence of environment on genotype • Identifies twins are identical in genome and phenotype initially	2
• Identifies an example of the influence of environment on genotype	1

Sample answer: Many aspects of phenotype are influenced by a number of genes in combination with environmental influences. Genes play an important part in influencing phenotype, but genes are not the only influence. Environmental conditions, such as [temperature](#) and availability of nutrients can affect phenotypes. For example, temperature affects coat [colour](#) in the Arctic Hare. The Arctic hare changes its coat colour, moulting and growing new fur, from brown or grey in the summer to white in the winter. Height in humans is a complex phenotype influenced by many genes, but it is also influenced by nutrition. A person who eats a diet poor in nutrients will not grow as tall as they would have had they eaten a more nutritious diet. They will not reach their genetic potential. If the twins in the picture were to be separated and brought up in different environments with different carers, nutrition, education and different levels of exposure to the outside world then they would be very different if they were brought back together after an extended period of time even though they have the same genome.

Question 25 (a)

Criteria	Mark
• Provides features of the global mortality rate from malaria	1

Sample answer: Australia, the Americas and Europe are relatively free of death from malaria with between 0 – 2.5 deaths per 100000 of the population. The death rate ranges up to 20 deaths per 100000. Africa has the highest death rate from malaria with some countries exceeding 100 deaths per 100000.

Exemplar:

Question 25 (b)

Criteria	Mark
States a feasible reason for the correlation between deaths and vicinity to the equator	1

Sample answer: Tropical and subtropical conditions there are suited to the Anopheles mosquito which is the vector of the plasmodium which causes malaria.

Exemplar:

Question 25 (c)

Criteria	Mark
Correctly identifies type of mutation	1

Sample answer: Point mutation.

Exemplars:

Question 25 (d)

Criteria	Mark
- Uses a punnet square correctly - Utilises parent genotypes correctly to calculate probability	2
Uses a punnet square OR carries out a correct cross	1

Sample answer: Parents: Hb HbS X Hb HbS

	Hb	HbS
Hb	Hb Hb	Hb HbS
HbS	Hb HbS	HbS HbS

50% offspring from the cross are Hb HbS and these heterozygous forms will not develop malaria.

Question 25 (e)

Criteria	Mark
Identifies where SNP's are commonly found	1

Sample answer: SNP's are usually found in non-coding regions of DNA.

Exemplar:**Question 25 (f)**

Criteria	Mark
• Makes evident the relationship between HbS allele frequency and distribution • Concludes allele may have origins in Africa	4
• Sketches in general terms the relationship between HbS allele frequency and distribution • Concludes allele may have origins in Africa	3
• Identifies features of the distribution of HbS alleles	2
• Identifies a feature of the distribution of HbS alleles	1

Sample answer: The frequencies of sickle cell carriers are high in malaria-endemic areas and low in areas where there is little or no disease. This can be shown in the correlation between allele frequencies and region of the world. The highest allele frequency is seen in Central Africa (14.66% - 18.18%) and it becomes lower as we radiate out from Central Africa through the parts of the Middle East and India. The allele is absent or in very low frequency in the rest of the world (0 – 0.25%) as is the incidence of Malaria from the above map. This is evident in the death rate map where very few deaths occur outside Africa and Asia. Those individuals who are carriers for the sickle cell disease have some protective advantage against malaria so there would be many more deaths in regions of the world where malaria occurs if it were not for the mutation. This is an example of how an allele frequency changes with geographic region. The Allele frequency for HbS would have to be determined for different populations around the world. 'This data could be analysed in greater detail to determine where the allele was most likely to have originated and in this case it seems that Africa is the origin of this mutation.

Exemplar:**Question 26 (a)**

Criteria	Mark
• Sketches in general terms a use of gene cloning	2
• Identifies a use of gene cloning	1

Sample answer: Gene cloning is used to make human insulin. The gene is extracted from a cell using a restriction enzyme. *E. coli*'s plasmid is opened using the same restriction enzyme and the gene is inserted. The bacterium divides and passes the gene on to daughter cells. Each cell is now capable of producing the hormone.

Exemplar:**Question 26 (b)**

Criteria	Mark
• Sketches in general terms the effects of all processes on the gene pool • Makes a judgement about the effects on the gene pool of a population	4
• Sketches in general terms the effects of some processes on the gene pool • Makes a judgement about the effects on the gene pool of a population	3

• Sketches in general terms an effect on gene pool • States the meaning of one process	2
• Sketches in general terms an effect on gene pool OR states the meaning of one process	1

Sample answer: The gene pool is the sum of a population's genetic material and all the variations in alleles at a given time. The original sources of genetic variation are mutations, which are changes in the nucleotide sequence of DNA. Mutations create new alleles and increase genetic variability. Most mutations do not cause significant changes to the health or functioning of an organism. However, if a mutation reduces the chances of survival, the organism may die before reproducing.

The gene flow is the transfer of alleles into and out of gene pools, due to migration. This can impact the gene pool if the population is small and the movement of individuals from the population means they take alleles with them.

Genetic drift result from chance events and alter the allele frequencies of a population. A major disturbance, such as a natural disaster, may drastically reduce population size and thereby diminish genetic variation. The resulting composition of the gene pool was selected randomly (i.e., surviving the disturbance was not determined by the genetic make-up of the individual). This effect is magnified if the population is small.

Exemplar:

Question 27

Criteria	Mark
• Provides characteristics and features of the causes and effects of cancer	4
• Sketches in general terms causes and effects of cancer	3
• Identifies a cause of cancer • Identifies an effect of cancer	2
• Identifies a feature of cancer	1

Sample answer: Cumulative sun exposure causes mainly basal cell and squamous cell skin cancer, while episodes of severe blistering sunburns, usually before age 18, can cause melanoma later in life. Other less common causes are repeated X-ray exposure, scars from burns or disease, and occupational exposure to certain chemicals. The most common warning sign of skin cancer is a change on the skin, typically a new [mole](#), a new skin lesion or a change in an existing mole. Basal cell carcinoma may appear as a small, smooth, pearly, or waxy bump on the face, or neck, or as a flat, pink/red- or brown-coloured lesion on the trunk, arms or legs.

Squamous cell carcinoma can appear as a firm, red nodule, or as a rough, scaly, flat lesion that may itch, bleed and become crusty. Both basal cell and squamous cell cancers mainly occur on areas of the skin frequently exposed to the sun but can occur anywhere. These cells also have an ability to metastasise and invade other tissues producing secondary cancers.

Exemplar:

Question 28 (a)

Criteria	Mark
• Correctly identifies the type of cell	1

Sample answer: cell X is a Helper T- Cell.

Question 28 (b)

Criteria	Mark
• Provides characteristics and features of the role of Memory B cells	2
• States a feature of Memory B cells	1

Sample answer: Memory B cells circulate throughout the body until a [specific antigen](#) is re-encountered and triggers a potent [secondary immune response](#). Memory cells respond to antigen much faster, require lower amounts of antigen. The differentiate into plasma cells to produce antibodies.

Exemplar:

Question 28 (c)

Criteria	Mark
• Makes evident the relationship between peaks, immune response and antibody production at different times	3
• Sketches in general terms the relationship between peaks, immune response and antibody production at different times	2
• Identifies a feature of the primary or secondary immune responses	1

Sample answer: The first exposure to a pathogen or vaccine, triggers a primary response and antibodies are secreted first from plasma cells. Upon re-exposure to the same pathogen a secondary response that is faster and stronger occurs. Memory B cells differentiate into antibody-secreting plasma cells that output a greater amount of antibody for a longer period of time.

Exemplar:

Question 28 (d)

Criteria	Mark
• Uses a graph to present all features of the tabulated data	3
• Uses a graph to present most features of the tabulated data	2
• Graphs some features of the presented data	1

Sample answer:

Question 28 (e)

Criteria	Mark
• Recognises a trend in the graphical data presented	1

Sample answer: There is a rapid increase in cases from April to May and then a gradual increase till October. From October there is a decrease for two months.

Question 29

Criteria	Mark
• States a means of identifying the disease	6
• Sketches in general terms methods of containment and control of the disease	
• States a means of identifying the disease	4-5
• Sketches in general terms a method of containment and control of the disease	

- Identifies a procedure used to contain or control the disease - States a means of identifying the disease	2-3
Identifies a procedure used to contain the disease OR states a means of identifying the disease	1

Sample answer: Methods that should be employed include regulation of the environment and modification of behaviours. The disease must be identified, contained and controlled.

Identification would take the form of extensive testing to screen for cases that are showing signs or are asymptomatic.

Containment would include the quarantine and isolation of all suspected individuals or those that have been in contact with infected people.

Control would include screening at borders, use of hygienic procedures including washing surfaces with disinfectant, wearing face masks, sneezing into elbows and washing hands with disinfectants and soap frequently. Social distancing and lockdowns may also help control the spread of the disease. Discouraging bats from roosting in urban areas and disinfection of grounds where they have been.

Question 30 (a)

Criteria	Mark
Correctly names the process at step 1.	1

Sample answer: Transcription

Question 30 (b)

Criteria	Mark
Correctly names the product at step 1.	1

Sample answer: m-RNA

Question 30 (c)

Criteria	Mark
Provides a clear description of what is happening at step 4.	2
Provides some information about what is happening at step 4.	1

Sample answer: Translation: At the ribosome mRNA and tRNA relate their various codes to produce a polypeptide chain.

Question 31

Criteria	Mark
- Describes an example of biotechnology from the past. AND - Describes an example of biotechnology from the present. AND - Describes a possible example of biotechnology for the future. AND - Describes the effect of the biotechnology from the past on biodiversity. AND	7

• Describes the effect of the biotechnology from the present on biodiversity. AND • Describes the possible effect of the biotechnology for the future on biodiversity. AND • Evaluates the effect all of the biotechnologies on biodiversity.	
• Most of the above points	5-6
• Some of the above points	3-4
• Some information relating to biotechnology and biodiversity	1-2

Sample answer: Since the beginning of agriculture the genetic make-up of populations has been changing. When farmers started gathering animals – for example, cows and goats – close to where they lived rather than hunting and gathering their food, they started to limit opportunities for these animal populations to reproduce. This meant that the gene pool available was reduced. The variation in the genes reduced even further when farmers started to select individuals within a population to breed based on their desired traits. This means biodiversity was reduced to artificial selection rather than natural selection. Over centuries farming intensified, causing habitat destruction. This resulted in less biodiversity in agricultural populations and a reduction in wild populations of organisms that evolved through natural selection. More recently, genetic engineering has further reduced biodiversity. Organisms are engineered to have genes that produce desired characteristics. Once the desired product is designed, the organisms are cloned. This practice is used more often in plants than animals and produces crops where every plant is genetically identical. This is a dramatic reduction in biodiversity. Emission of green-house gases increases the concentration of carbon dioxide in the atmosphere and contributes to global warming. Current research is investigating possible ways for crops to have higher yields in this environment. For example, crops could be genetically engineered to withstand higher temperatures. While scientists may be able to engineer these crops, the biotechnology would still reduce the genetic variation in a species, because the crops would be genetically engineered with highly specific traits (such as tolerance to higher temperatures).