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# **BIOLOGY**

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2001–2014 by Module  
2015–2018 by Year

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# Sample HSC Examination Paper with 2018 HSC Questions

## Biology

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**General****Instructions**

- Reading time — 5 minutes
- Working time — 3 hours
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- For questions in Section II, show all relevant working in questions involving calculations

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**Total marks:****100****Section I – 20 marks**

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

**Section II – 80 marks**

- Attempt Questions 21–34
- Allow about 2 hours and 25 minutes for this section

## Section I

20 marks

Attempt Questions 1–20

Allow about 35 minutes for this section

1 Which of the following is a known cause of non-infectious diseases in humans?

- A. Diseases due to morbidity
- B. Diseases caused by fungal pathogens
- C. Diseases caused by environmental exposure
- D. Diseases caused by viral pathogens

(Sample question)

2 In your study you investigated technologies that are used to assist with the effects of disorders in humans. Which technology in the table is correctly matched to the disorder it is designed to assist with the effects of?

	<i>Technology</i>	<i>Disorder</i>
A.	Laser surgery	Hearing loss
B.	Cochlear implants	Visual disorder
C.	Haemodialysis	Loss of kidney function
D.	Haemodialysis	Nutritional disease

(Sample question)

3 Which defence adaptation in the table is correctly matched with one of its features?

	<i>Defence adaptation</i>	<i>Feature</i>
A.	Inflammation	Constriction of blood vessels
B.	Phagocytosis	Production of antibodies by white blood cells
C.	Lymph system	Transportation of blood to help fight pathogens
D.	Cell death	Formation of barrier around the pathogen

(2018 HSC)

4 Which of the following describes the daughter cells produced as a result of mitosis?

- A. Two genetically different cells
- B. Two genetically identical cells
- C. Four genetically different cells
- D. Four genetically identical cells

(2018 HSC)

5 Which ONE of the following factors is most likely involved in limiting the spread of an infectious disease at the local level?

- A. Border surveillance and protection
- B. Travel bans
- C. Screening of travellers
- D. Public health and community-level measures

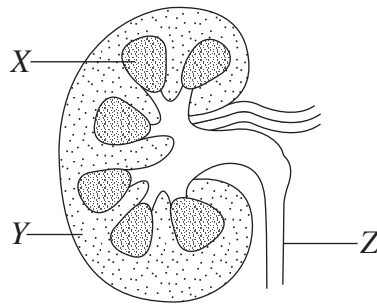
(Sample question)

6 Why is mRNA important in polypeptide synthesis?

- A. It reads the genetic code to insert amino acids into the polypeptide chain.
- B. It transfers the genetic code from DNA in the nucleus to the ribosome in the cytoplasm.
- C. It leaves the nucleus and enters the cytoplasm.
- D. It leaves the cytoplasm and enters the nucleus.

(Sample question)

- 7 Students dissected a mammalian kidney and drew the following diagram.



Which row in the table shows the correct labels for *X*, *Y* and *Z*?

	<i>X</i>	<i>Y</i>	<i>Z</i>
A.	Cortex	Medulla	Ureter
B.	Renal pyramid	Bowman's capsule	Renal artery
C.	Medulla	Cortex	Ureter
D.	Bowman's capsule	Cortex	Renal artery

(2018 HSC)

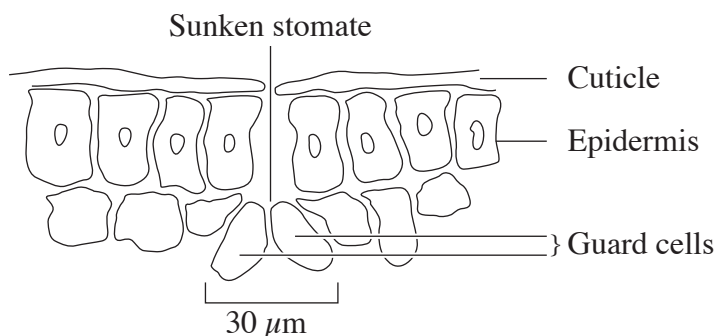
- 8 An organism suspected of causing a disease is described as being unicellular, having a cell wall and lacking a nucleus.

How is this organism classified?

- A. A bacterium
- B. A fungus
- C. A protozoan
- D. A virus

(2018 HSC)

- 9 Sunken stomata can be found in the leaves of some Australian plants. A section of such a leaf is shown.



How do sunken stomata assist the plant to conserve water in a dry environment?

- A. They trap moist air, reducing humidity.
- B. They prevent entry of gases into the leaf.
- C. They accumulate moist air, reducing transpiration.
- D. They increase the surface area available for transpiration.

(2018 HSC)

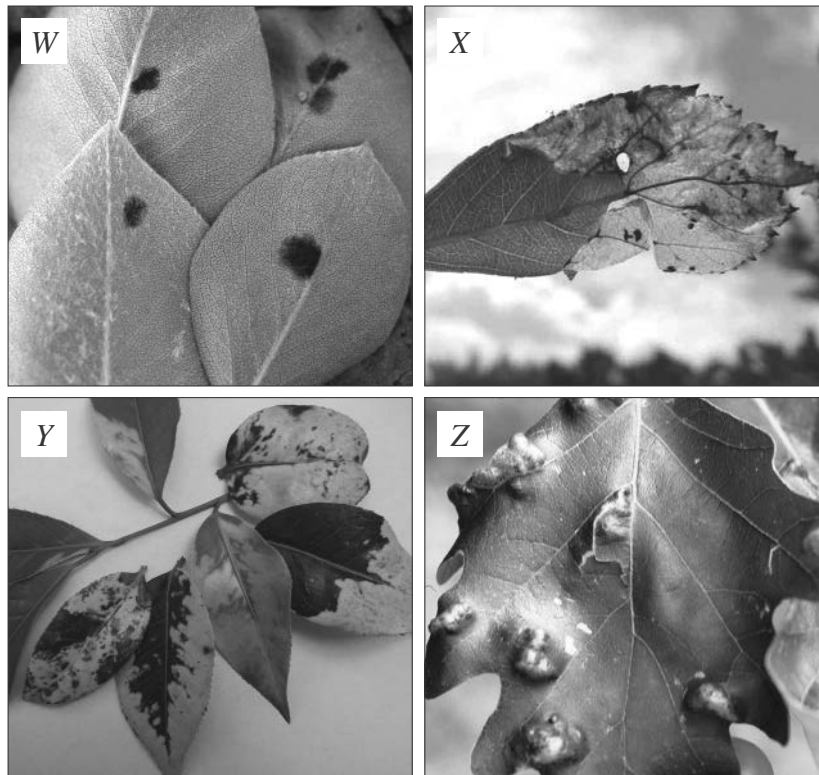
- 10 Both artificial insemination and cloning are reproductive techniques that can decrease the genetic diversity of a population.

Which row of the table provides a correct reason for each technique's contribution to this decrease?

	<i>Artificial insemination</i>	<i>Cloning</i>
A.	Random fertilisation takes place	Large numbers of individuals are produced
B.	One male has many offspring	All gametes are genetically identical
C.	All male gametes are identical	All individuals have the same phenotype
D.	Fewer males are used to reproduce	All individuals have the same genotype

(2018 HSC)

- 11 The following plants were presented to a quarantine office in Australia as part of a shipment of plants entering Australia for the plant nursery trade.

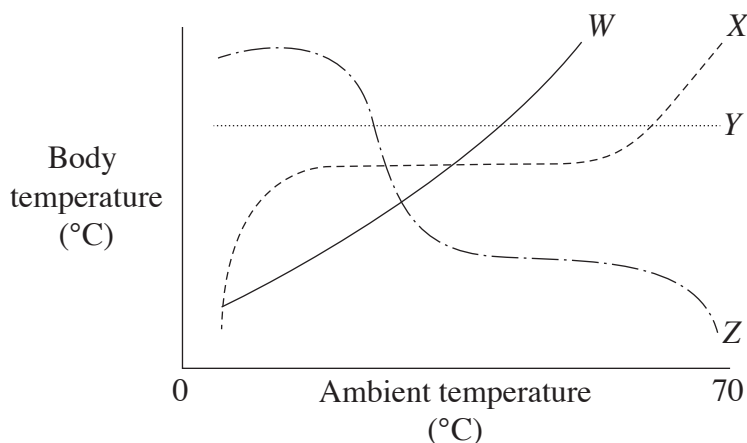


Which of the following is a decision that the quarantine office is likely to make?

- A. Plant *W* can enter Australia as it looks like it has 'black spot' which already occurs in Australia.
- B. Plant *X* can enter Australia as it is unlikely the disease it has will transfer to Australian species.
- C. Plant *Y* cannot enter Australia as it has a disease caused by shortage of soil magnesium.
- D. Plant *Z* cannot enter Australia because its appearance suggests it may be carrying live insects.

(2018 HSC)

- 12 The graph shows four possible relationships between ambient temperature and body temperature.



Which line on the graph represents the relationship between ambient temperature and body temperature for an endotherm in a terrestrial environment?

- A. W
- B. X
- C. Y
- D. Z

(2018 HSC)

- 13 Bt cotton is a type of cotton now commonly grown that contains a gene from the soil bacterium *Bacillus thuringiensis*. As in the bacterium, the gene in the Bt cotton produces a protein that is toxic to insect larvae. The benefit of this technology is the reduced need for pesticides.

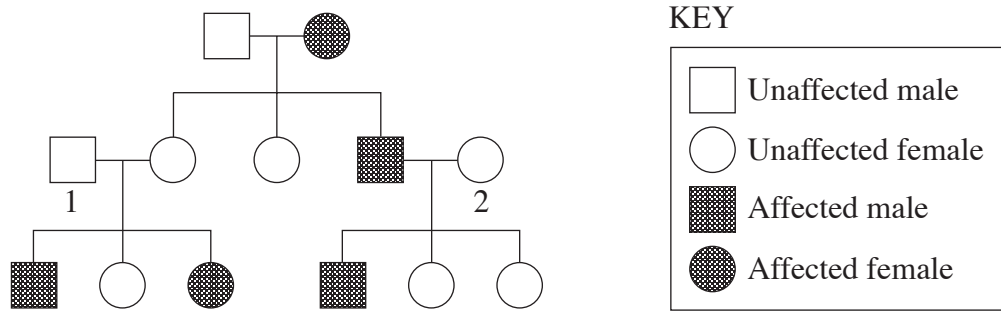
This is an example of:

- A. a genetically modified organism.
- B. whole-organism cloning.
- C. propagation.
- D. artificial selection.

(Sample question)



14 The following pedigree shows the inheritance of a disorder.



Which row of the table shows the genotypes of individuals 1 and 2?

	<i>Individual 1</i>	<i>Individual 2</i>
A.	Aa	Aa
B.	AA	Aa
C.	X <sup>A</sup> Y	X <sup>A</sup> X <sup>a</sup>
D.	X <sup>a</sup> Y	X <sup>A</sup> X <sup>a</sup>

(2018 HSC)

15 Which row of the table is correct with respect to the substances that pass through the nephron?

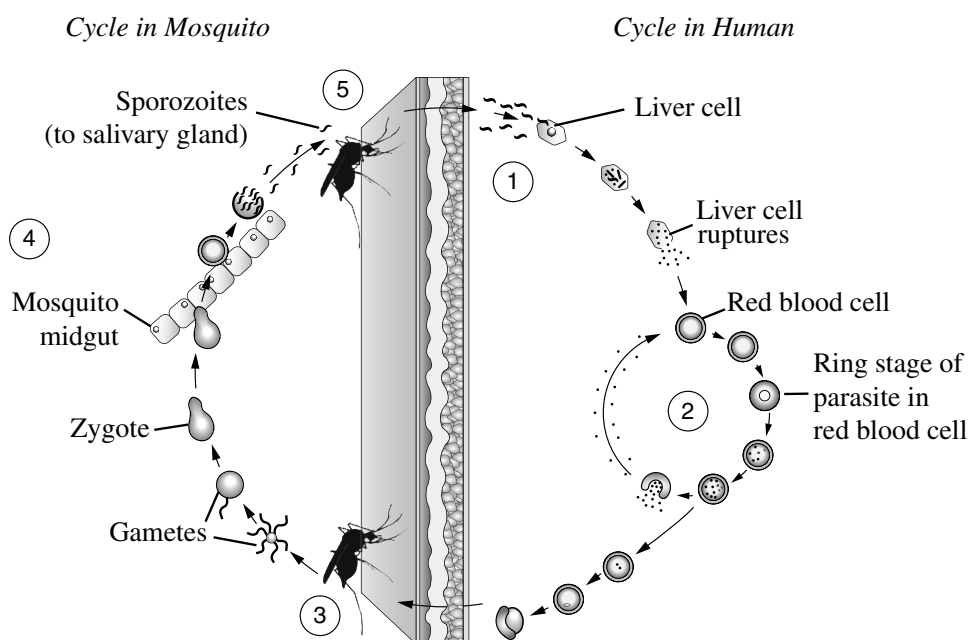
	<i>Bowman's capsule</i>	<i>Proximal convoluted tubule</i>	<i>Collecting duct</i>
A.	Chloride ions are at the same concentration as in plasma	All chloride ions are reabsorbed	Water is reabsorbed in the presence of aldosterone
B.	Plasma proteins are at the same concentration as in plasma	Water is reabsorbed by osmosis	Water is reabsorbed in the presence of ADH
C.	Glucose is at the same concentration as in plasma	All glucose is reabsorbed	Water is reabsorbed in the presence of aldosterone
D.	Sodium ions are at the same concentration as in plasma	Sodium ions are reabsorbed	Water is reabsorbed in the presence of ADH

(2018 HSC)

- 16 How do helper T cells assist in raising a specific immune response to a pathogen?
- They mass produce specific antibodies.
  - They stimulate the cloning of specific T cells.
  - They are cloned and differentiate to become specific cytotoxic T cells.
  - They produce cytokines that stimulate the cloning of specific phagocytes.

(2018 HSC)

- 17 The diagram shows the life cycle of the malaria parasite, *Plasmodium sp.* Five stages in this life cycle are numbered on the diagram.



To prevent malaria, the following four strategies have been used:

- taking anti-malarial drugs
- spraying swamps with insecticides
- using mosquito nets over beds
- administering a malaria vaccine.

Which row in the table shows the stage in the life cycle in which each of these strategies would be most effective?

	<i>Taking anti-malarial drugs</i>	<i>Spraying swamps with insecticides</i>	<i>Using mosquito nets over beds</i>	<i>Administering a malaria vaccine</i>
A.	5	1	3	2
B.	2	5	1	3
C.	1	4	2	5
D.	2	3	5	1

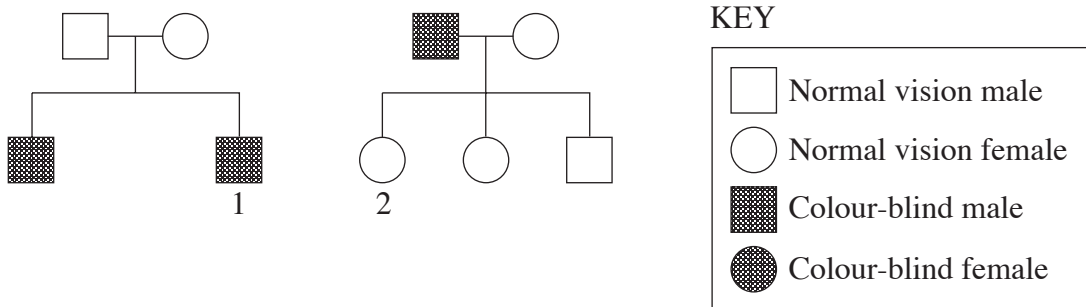
(2018 HSC)

18 In your study you evaluated the historical, culturally diverse and current strategies used to predict the spread of infectious disease. Which of the following is an example of a current strategy?

- A. Genetic screening
- B. Integrated global data and surveillance
- C. Pharmaceuticals
- D. Data from healthcare centres

(Sample question)

19 Colour blindness in humans is determined by a sex-linked gene. Two family trees are shown.



Which row of the table shows the probability of colour-blind offspring of each sex if individuals 1 and 2 were to have children together?

	<i>Male offspring</i>	<i>Female offspring</i>
A.	0%	0%
B.	50%	0%
C.	50%	50%
D.	0%	0%

(2018 HSC)

- 20 The table below provides data on the number of new cases of three cancers diagnosed in a population in a year. What does this data represent?

<i>Type of cancer</i>	<i>Number of new cases diagnosed in a year</i>
Breast cancer	17 586
Melanoma of the skin	13 941
Lung cancer	11 556

- A. Survival rates
- B. Mortality rates
- C. Prevalence rates
- D. Incidence rates

(Sample question)

# Biology

## Section II Answer Booklet

**80 marks**

**Attempt Questions 21–34**

**Allow about 2 hours and 25 minutes for this section**

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**Instructions**

- 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.

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**Please turn over**

**Question 21** (4 marks)

**Marks**

- (a) Identify TWO responses of a named endotherm to a decrease in body temperature.

**2**

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- (b) Outline the role of the nervous system of an endotherm in maintaining homeostasis when its body temperature changes.

**2**

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**Question 22** (5 marks)

- (a) Pasteur performed an experiment to identify the role of microbes in decay.

**2**

Justify a conclusion that can be drawn from his results.

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- (b) Describe the contribution of Robert Koch to our understanding of disease.

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(2018 HSC)

**Question 23** (5 marks)**Marks**

- (a) A student plans to conduct a practical investigation relating to microbial testing of water or food samples. **3**

Complete the table, identifying features that this student should include to ensure valid experimental design.

Dependent variable	•
Control	•
Variables to be kept constant	• •

- (b) Describe TWO safety precautions that the student could undertake to minimise risks associated with this practical investigation. **2**

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(Sample question)

**Question 24** (6 marks)

**Marks**

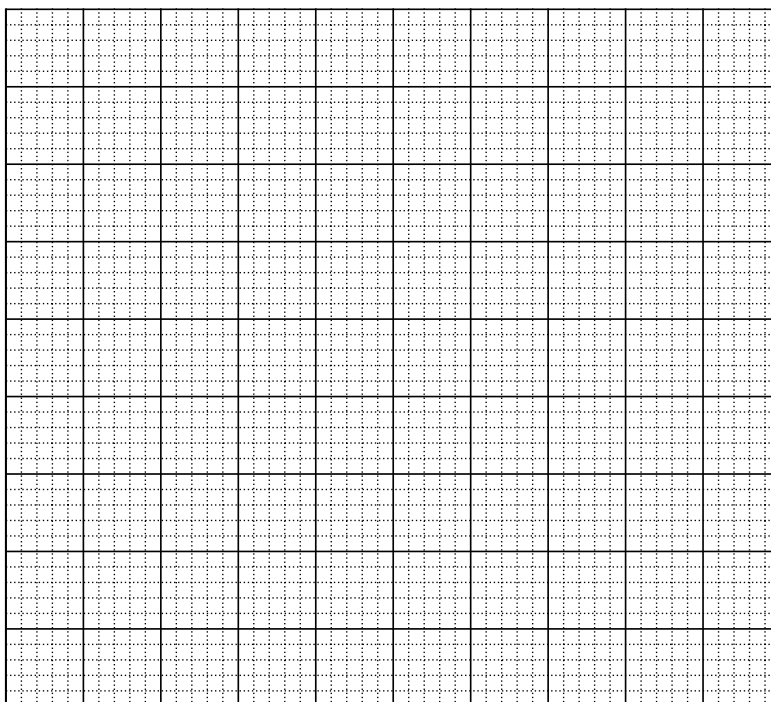
A new flu vaccine is prepared each year to protect the population against the current strains of influenza virus. The effectiveness of flu vaccines varies from year to year and can be measured using the overall vaccination effectiveness (VE) index. A VE of 60% means that a vaccinated individual’s chance of getting the flu is reduced by 60%.

The following data show the VE over a 10-year period.

<i>Influenza season</i>	<i>VE (%)</i>
2006–2007	52
2008–2009	41
2010–2011	60
2012–2013	49
2014–2015	19

- (a) Draw an appropriate graph to represent the data on the following grid.

**3**



**Question 24 continues**



Question 24 (continued)	Marks
(b) Provide a possible explanation for the vaccination effectiveness (VE) index in 2014–2015.	3
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(2018 HSC)	

**End of Question 24**

**Question 25** (4 marks)

Construct a table to compare the processes and outcomes of two reproductive technologies: artificial insemination and artificial pollination. 4

(Sample question)

Question 26 (6 marks)	Marks
(a) Compare proteins and polypeptides.	2
<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	
(b) Antidiuretic hormone (ADH) is a protein produced by cells in the hypothalamus. The AVP gene codes for the production of ADH.	
(i) Outline the steps to show how a mutation in the AVP gene could result in changes in the ADH protein.	3
<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	
(ii) Identify ONE possible effect of the AVP mutation on kidney function.	1
<p>.....</p> <p>.....</p>	
	(2018 HSC)

**Question 27** (6 marks)

**Marks**

(a) Define the terms *genotype* and *phenotype*.

**2**

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(b) A population of mammals living in a very cold climate have long, thick fur which assists their survival. At times, a widespread infestation of mites causes their fur to become thin, and bald patches appear in their coats. In this population some individuals are resistant to the mites. This is due to the presence of a co-dominant allele ( $M^R$ ). Individuals that are homozygous for this allele ( $M^R M^R$ ) are infertile.

**4**

Explain how both genotype and phenotype influence the inheritance of genes and natural selection in this population.

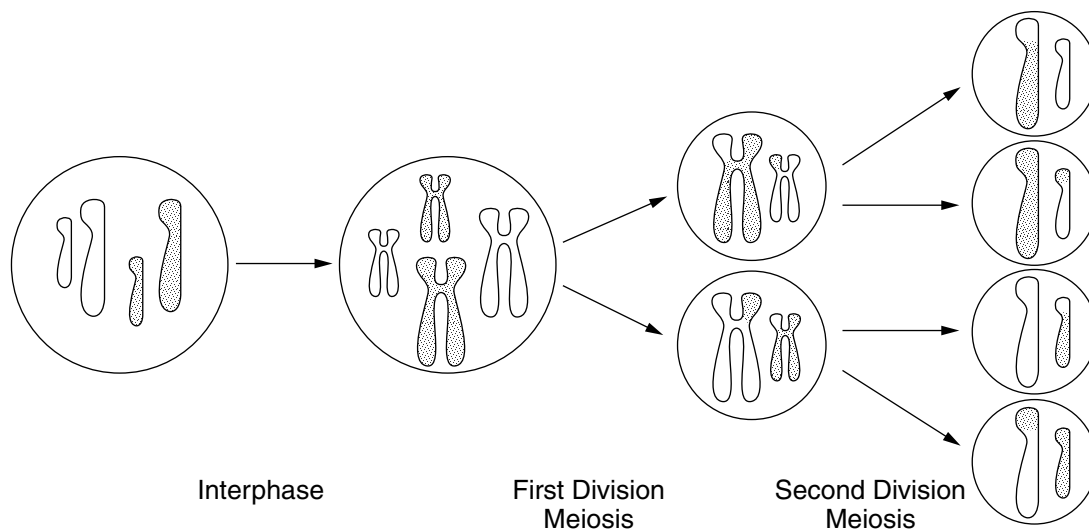
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(2018 HSC)

**Question 28** (7 marks)

**Marks**

The diagram models the process of meiosis.



- (a) Describe the process that accounts for the changes shown in the model during interphase. 2

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**Question 28 continues**

Question 28 (continued)	Marks
(b) Explain the structure and behaviour of chromosomes in the first division of meiosis. Include detailed reference to the model.	5
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(2018 HSC)	

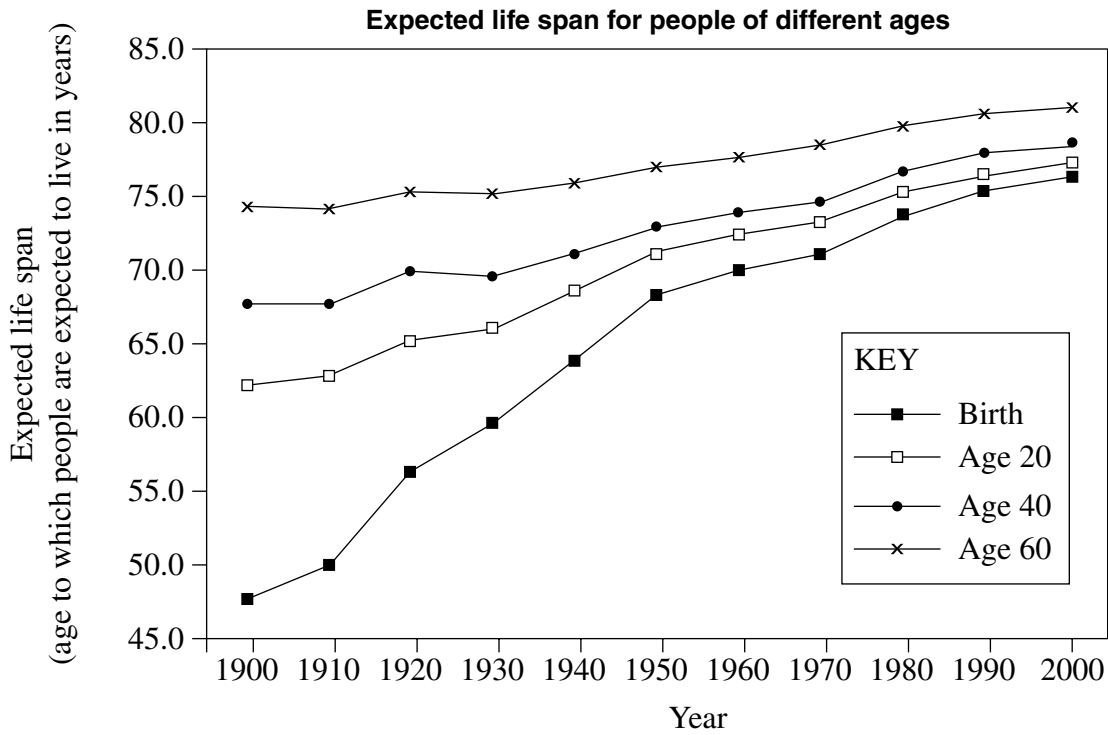
**End of Question 28**

**Question 29** (8 marks)

**Marks**

The graph shows the expected life span (the age to which people are expected to live in years) for people of different ages during the 20th century in one country.

**8**



There have been many biological developments that have contributed to our understanding of the identification, treatment and prevention of disease.

Evaluate the impact of these developments on the expected life span. In your answer, include reference to trends in the data provided.

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**Question 29 continues**

Question 29 (continued)

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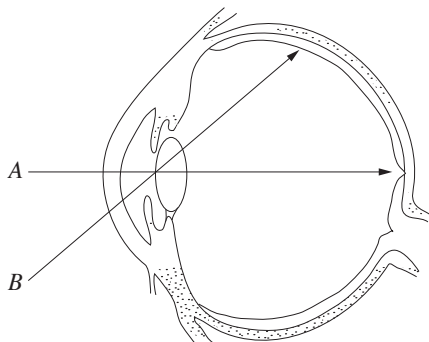
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(2018 HSC)

End of Question 29

**Question 30** (9 marks)**Marks**

- (a) (i) Identify TWO structures that refract light as it passes through the eye. **2**
- (ii) The diagram shows the human eye. The two lines labelled *A* and *B* represent two beams of light passing through the eye and stimulating different areas of the retina. **2**



The visual perception will be different at the two stimulated areas.

Identify TWO of these differences.

(2018 HSC)

- (b) A person with normal vision and a person with myopia are both looking at an object in the distance. **5**

Construct THREE labelled diagrams of an eye to show the light path through the eye of the person with:

- normal vision
- myopia
- myopia corrected with a suitable lens.

(2018 HSC)



**Question 31** (5 marks)**Marks**

Data from Australia's Health Tracker 2017 provides information on factors that increase the risk of some non-infectious diseases. For one non-infectious disease prevalent in Australia:

- (a) name the disease and list TWO risk factors that can cause it. 2

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- (b) describe the treatment and/or management of the disease. 1

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- (c) explain how epidemiological studies can be of benefit in the treatment and management of the disease. 2

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(Sample question)

**Question 32** (4 marks)

Diversity in a gene pool may result from factors such as population size and diverse environments. List and describe TWO other factors that can affect the gene pool of populations, especially small populations. 4

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(Sample question)

**Question 33** (5 marks)**Marks**

'Immunisation is an important public health intervention to stop the spread of diseases that can cause serious illness and death. Worldwide immunisation programs prevent an estimated 3 million deaths every year.' (Australian Institute of Health and Welfare, 2016)

- (a) What is immunisation? 1

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- (b) Provide TWO examples of how immunisation has prevented disease world-wide and in Australia. 2

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- (c) Describe TWO other public-health interventions that help stop the spread of disease. 2

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(Sample question)

**Question 34** (6 marks)**Marks**

'Globalisation appears to be causing profound and sometimes unpredictable changes in conditions that shape the burden of diseases in some populations. Evidence suggests that changes in these conditions have led to changes in prevalence, spread and geographical range and control of many infectious diseases, particularly those transmitted by vectors.

**6**

Discuss this statement.

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(Sample question)

# Sample HSC Examination Paper with 2018 HSC Questions

## Sample Answers

### Section I

- 1 C Some non-infectious diseases, such as lung and skin cancer, are known to be caused by environmental exposure. Morbidity refers to the rate of disease in a population. Fungal and viral pathogens cause infectious diseases.
- 2 C Haemodialysis is an artificial way of removing waste substances from the blood, which is a function usually performed by the kidneys.
- 3 D Cell death is a defence adaptation that can seal off an infected area.
- 4 B Mitosis is cell replication resulting in two genetically identical cells.
- 5 D Public health and community-level measures are implemented locally to limit the spread of infectious diseases. Other factors such as border protection are interrelated.
- 6 B mRNA transfers the genetic code from DNA in the nucleus to the ribosome in the cytoplasm. It does leave the nucleus and enter the cytoplasm but this option doesn't explain its importance. tRNA reads the genetic code to insert amino acids into the polypeptide chain.
- 7 C The outer layer of the kidney is the cortex that contains the glomeruli.
- 8 A Prokaryotic bacteria lack nuclei but can have cell walls and be unicellular.
- 9 C Sunken stomata reduce air flow around the point of transpiration.
- 10 D Artificial insemination increases the reproductive potential of a small number of males and cloning results in offspring genetically identical to the nuclear donor parent and each other.
- 11 D Quarantine attempts to prevent the entry of pathogens.
- 12 B Endotherms maintain a relatively constant body temperature over a narrow range of temperature change.
- 13 A Bt cotton is an example of gene technology or genetic engineering that results in genetically modified organisms (GMO).
- 14 A The condition is autosomal recessive. Both individuals are unaffected but carry one allele for the condition.
- 15 D Filtration in Bowman's capsule results in only larger molecules remaining in the blood and then active reabsorption of sodium ions occurs in the proximal distal tubule. ADH is a hormone that increases the permeability of the collecting ducts so

that water can be reabsorbed.

- 16 D Helper T cells release cytokines and help activate macrophages.
- 17 D Prevention of malaria by spraying swamps stops mosquito vectors from breeding and the nets prevent transfer of sporozoites from the mosquito saliva into humans.
- 18 B The question asks for current strategies used to **predict** the spread of infectious disease. Current strategies use computer technologies for fast processing of data gathered globally. Data from health-care facilities is still used but is more traditional. Genetic screening is a prevention strategy. Pharmaceuticals are often treatment strategies.
- 19 C A colour-blind male and a female carrier of the condition have a 50% chance that either male or female offspring will have the condition.
- 20 D Incidence is the number of new cases diagnosed in a given period of time.

## Section II

### Question 21 (Total 4 marks)

- (a) Humans are endotherms that in response to a decrease in body temperature may experience vasoconstriction in the region of the skin and increase metabolic heat production by shivering. *(2 marks)*
- (b) The nervous system is responsible for thermoreceptors detecting the change in body temperature and then through the central nervous system activating effector organs such as the muscles that commence shivering or control the constriction or dilation of blood vessels. *(2 marks)*

### Question 22 (Total 5 marks)

- (a) A conclusion that can be drawn from the results of Pasteur's swan-neck flask experiment is that microbes do not spontaneously generate but are a result of direct contact with the air. The conclusion is justified as the flask that was exposed to air became contaminated whereas the one that was sealed from the air by the convoluted shape of the neck of the flask remained uncontaminated. *(2 marks)*
- (b) Koch developed rules of procedure (Koch's postulates) that if followed would demonstrate a direct causal link between the presence of a pathogen and the disease it causes. The steps involved developing pure cultures from infected organisms and infecting healthy organisms with the pure culture and comparing the cultures once the exposed organisms became infected. He identified the bacterial causes of diseases such as anthrax and tuberculosis. *(3 marks)*

**Question 23** (Total 5 marks)

(a) Dependent variables are the variables that change in response to the independent variables.

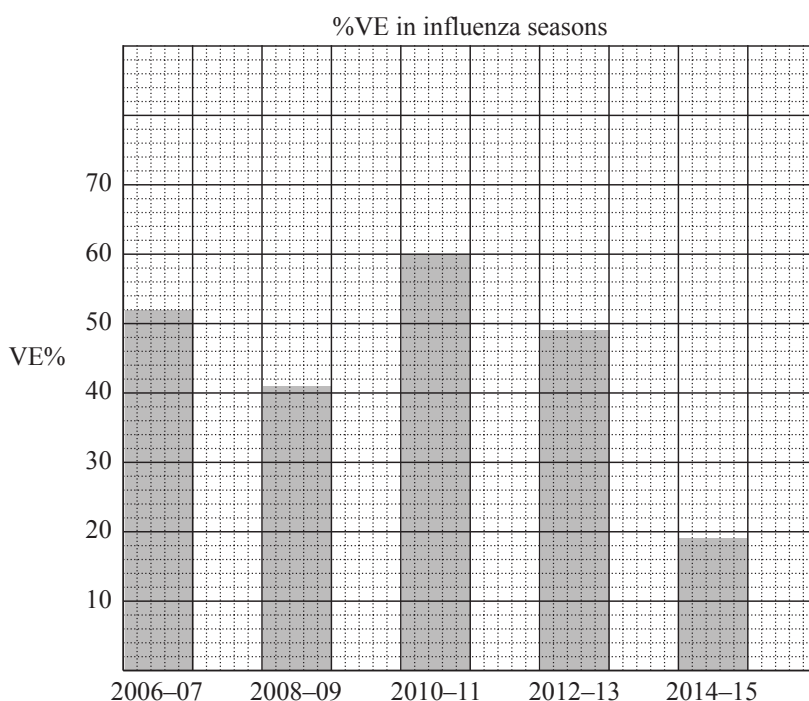
Dependent variable	<ul style="list-style-type: none"> <li>The types of colonies that grew from the water or food sample</li> </ul>
Control	<ul style="list-style-type: none"> <li>An agar petri dish on which no sample was grown but which was treated in exactly the same way otherwise; that is, not inoculated</li> </ul>
Variables to be kept constant	<ul style="list-style-type: none"> <li>The same amount of agar medium</li> <li>The same temperature for each petri dish</li> </ul>

(3 marks)

(b) Autoclaving of agar plates following incubation and the use of protective clothing, gloves and eyewear (2 marks)

**Question 24** (Total 6 marks)

(a)



(3 marks)

(b) In 2014–15 an individual’s chance of contracting the influenza as a result of having the flu vaccine was only reduced by 19%. This was possibly the result of the large number of mutations that occur in viruses such as the flu virus so that many strains survive simultaneously. The vaccines are developed using a specific strain and may be ineffective against other strains. Because of the highly contagious nature of flu viruses, the strains that remain virulent spread widely or quickly. The effectiveness of a vaccine is dependent on the vaccine promoting the development of artificially acquired immunity. (3 marks)

**Question 25** (Total 4 marks)

Process and outcomes of two reproductive technologies

<i>Reproductive technology</i>	<i>Processes</i>	<i>Outcomes</i>
Artificial insemination	Collection, storage and transport of semen from male animals with desirable qualities to fertilise a large number of females	Larger numbers of more desirable animals Global benefits from storage and transport of semen
Artificial pollination	Involves the transfer of pollen to stigmas to enable pollination and fertilisation	Improved plant cultivars such as plant hybrids with more vigour and therefore increased productivity beyond that of either parent

(4 marks)

**Question 26** (Total 6 marks)

(a) A polypeptide is a chain of specific amino acids joined together by peptide bonds. Secondary and tertiary polypeptide structures result from folding and twisting of the amino-acid chain. A protein consists of at least one polypeptide chain that has a specific conformation. The shape of the combination of polypeptide chains (called quaternary structure) is the result of the interacting forces between the chains. The resultant protein structure is significant for its function. (2 marks)

(b) (i) A mutation in the AVP gene could result in:

- a substitution of a nitrogenous base in the DNA that could result in a different amino acid in the polypeptide chain that is part of the ADH protein. This may affect the structure and function of the protein or may prematurely terminate the process of polypeptide synthesis
- a deletion or insertion of a DNA base that results in a frameshift mutation that greatly impacts on AVP formation and its ability to function as a hormone.

(3 marks)

(ii) An AVP mutation could affect the ability of the kidney to reabsorb water and hence the water balance in the blood. (1 mark)

**Question 27** (Total 6 marks)

(a) The term *genotype* means the genetic make-up. It may refer to the make-up of a pair of specific alleles for a specific characteristic. The term *phenotype* refers to the manifestation of the genotype as a physical or physiological trait, such as eye colour in humans or blood type. The phenotype results from the expression of the genotype and the interaction with the environment of the organism. (2 marks)

- (b) Codominance results from the interaction of two different alleles that are both expressed in the heterozygous form. In the case of resistance to the mite the heterozygous mammals will have the advantage of not developing bald patches and having a phenotype resulting in them being better able to resist the cold climate. Heterozygous individuals will pass on to half their offspring the  $M^R$  allele, thus continuing the allele frequency in the population. Homozygous individuals for the mite-resistant gene are not able to pass on the allele as they have the phenotype that results in them being infertile, tending to reduce the frequency of the allele that conveys resistance to mites. Natural selection will favour the heterozygous phenotype and genotype and maintain a certain level of allele frequency in the population. *(4 marks)*

**Question 28** (Total 7 marks)

- (a) The model shows the chromosomes replicating during interphase. Each chromosome as a result consists of two identical chromatids joined by a centromere. Before this occurs the DNA that is an important component of chromosomes must replicate. This means the double helix unwinds, the strands separate and new strands build using the original strand as a template. The replicated chromosomes contain replicated DNA and hence can carry the genetic material to the next generation. *(2 marks)*
- (b) Key events in the first division of meiosis following the formation of identical chromatids include the crossing over of adjacent chromatids from homologous chromosomes. As a result of crossing over, new combinations of alleles are formed on some of the chromatids that eventually separate to become chromosomes. Another process in the first meiosis division is the alignment of the homologous pairs in a random assortment. When the spindles contract, drawing the homologous pairs of chromosomes to opposite poles (and hence different cells), new combinations of chromosomes result. The other key event in the first division is the reduction of the chromosome number from the diploid to the haploid number. This allows gametes to form with the haploid chromosome number, and when they return to the diploid number the potential for genetic variation increases even further. *(5 marks)*

**Question 29** (Total 8 marks)

The graph indicates that in the country shown life expectancy for people born in 1900 was relatively low (about 48 years), but in that year 20-year-olds could expect to live until 65 years and 60-year-olds could expect to live a further 14–15 years, to about 75. This suggests a high infant mortality rate. The data suggests that a high incidence of infectious diseases reduced life expectancy, but once exposure to pathogens in people with healthy immune systems had resulted in naturally acquired immunity, people were able to live relatively long lives. A relatively active lifestyle, little global travel, and nutrition that was not based on ‘fast foods’ and sugary drinks might also have contributed to a reasonably high life expectancy for those surviving childhood and adolescence.

In about 1950 in most countries improved hygiene, better food preservation and refrigeration, improved treatment in hospitals, the recent introduction of antibiotics and the expansion of vaccination programs resulted in dramatic improvements in the life expectancy of newborn



babies. Some improvement in life expectancy for 20-, 40- and 60-year-olds had also occurred with an increasing understanding of viruses such as poliovirus, resulting in improvements in treating infectious diseases. Non-infectious diseases were to become of increasing concern. This time was also marked by the new awareness of the molecular basis of inheritance and so the beginning of the possibilities of understanding and treating inherited disorders.

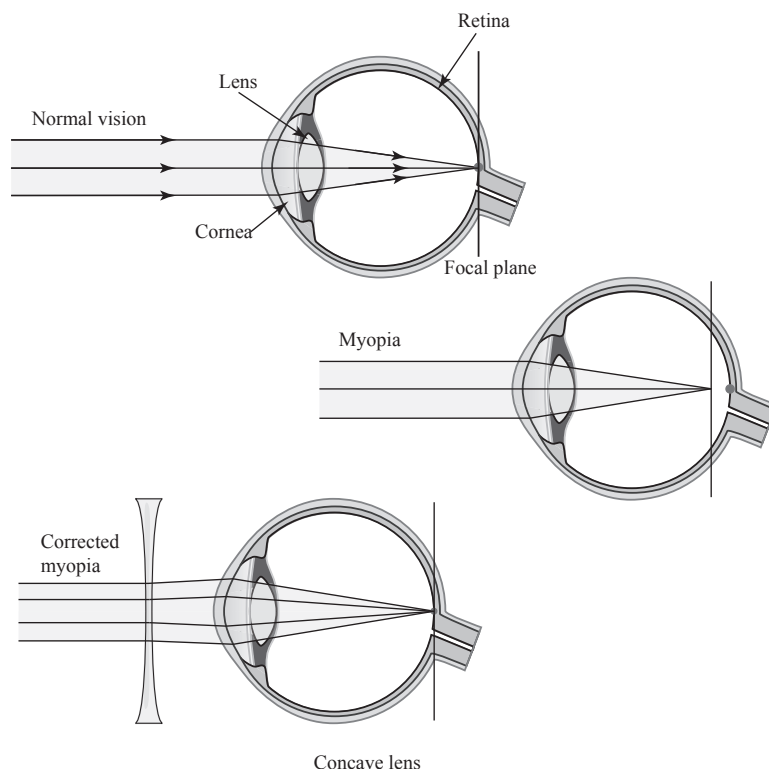
Improvements in life expectancy since the 1950s has remained almost parallel for the four different age groups, with only a slightly better improvement for newborn babies. These improvements could be the result of recently improved understanding of inherited disorders that has led to earlier (even prenatal) diagnosis and screening. Widespread use of antibiotics has been impeded by the development of resistant strains of bacteria. New drugs for the treatment of viruses and better vaccines and vaccination programs have contributed to life expectancy improvements. Expansion of worldwide travel has resulted in some epidemics such as SARS becoming pandemics. This has been countered by attempts at better quarantine. Non-infectious diseases such as Type II diabetes, strokes and ischaemic heart disease have become the focus of public-health campaigns to reduce obesity and improve lifestyle. Environmental exposure to carcinogens has led to changes in regulations about smoking and drinking and ‘slip, slop, slap’ campaigns. Genetic engineering now has the potential to reduce the spread of vector-borne diseases such as malaria although up until 2000 the use of pesticides was an important prevention method. New technologies have improved the treatment of disorders such as kidney failure and the development of artificial body parts such as heart valves has improved quality and quantity of life. (8 marks)

**Question 30** (Total 9 marks)

- (a) (i) The cornea and the lens refract light as it passes through the eye. (2 marks)
- (ii) The light passing horizontally through the eye (*A*) interacts at the fovea in the central macula of the retina. This area contains a high concentration of cones that are responsible for colour vision and visual acuity. Light ray *B* strikes the peripheral region of the retina that contains a high proportion of rods that detect shape and movement and discriminate between shades of light and dark in low-light intensities. (2 marks)

- (b) Normal vision involves accommodation. The shape of the lens changes to result in incoming light focusing on the retina. The first diagram shows normal vision of a distant object.

The second diagram shows myopia (the eyeball is too long so the image is blurred) and the third shows correction using a concave lens that lengthens the distance at which an image is formed on the retina.



(5 marks)

**Question 31** (Total 5 marks)

- (a) Type 2 diabetes is a nutritional disease in which the body becomes resistant to the normal effects of insulin and/or gradually loses the ability to produce enough insulin in the pancreas. Two risk factors that can lead to Type 2 diabetes include insufficient physical activity and high saturated fat intake. (2 marks)
- (b) These risk factors are modifiable; therefore management and prevention include increased levels of physical activity and changes to the diet. (1 mark)
- (c) Epidemiology is the study of the patterns and causes of disorders and diseases in a defined population. The studies help identify trends in data such as changes over time. For example, studies that show a correlation between overweight and obesity and the increased risk of having Type 2 diabetes provide data to help prevent and manage the disease. Data from epidemiological studies has reduced the incidence of certain diseases such as lung cancer resulting from smoking. (2 marks)

**Question 32** (Total 4 marks)

Mutations and gene flow affect the gene pool of populations. The effect is much greater in smaller populations. (You could have also given the answer as gene drift.)

Mutations are changes in DNA that increase the variety of alleles in the gene pool.

Gene flow is the movement of genes between populations due to migration. This results in genetic diversity. (4 marks)

**Question 33** (Total 5 marks)

- (a) Immunisation is the process of using vaccines to protect against illnesses caused by infection. Immunisation means both receiving a vaccine and becoming immune to a disease post-vaccination. *(1 mark)*
- (b) The effectiveness of vaccines in preventing infectious diseases is shown by the disappearance, or near disappearance, in Australia of deaths from, for example, diphtheria and worldwide from polio. *(2 marks)*
- (c) Two other public-health interventions are quarantine that prevents pathogens from coming into the state or country and public-health campaigns that focus on prevention and control through strategies such as health-promotion information and disease-prevention programs. *(2 marks)*

**Question 34** (Total 6 marks)

The incidence (the number of new cases) and prevalence (the number or proportion of cases) of infectious diseases is influenced by a wide range of factors that includes the mobility of individuals and the proportion of the population that are immune or immunised. For most of human history regional and global populations have been isolated from one another. New infectious diseases could only spread as fast or as far as people could walk. Wars, exploration and trade have brought greater population movement and mobility of individuals and therefore the spread of diseases into populations that had evolved with relatively small gene pools along with no exposure to particular diseases and therefore no immunity. Now the speed and volume of mobility of individuals and human populations is unprecedented in human history. Vector-transmitted diseases, such as malaria, are now able to spread further and faster. Increased mobility through migration and tourism, for example, increases the contact between humans and vectors, bringing humans who are more susceptible or have no immunity to vector-borne diseases to areas where vectors thrive. New arrivals, refugees, displaced populations, and legal and illegal workers can bring disease vectors and drug-resistant strains, such as anti-malarial drug resistance, into areas where they were not present.

Changes in geographical distribution of vector-transmitted diseases such as malaria and dengue fever occurs as a result of population movement, population growth and rapid urbanisation. *(6 marks)*