Sydney Boys High School
HSC TRIAL EXAMINATION

Biology 2019

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 Number at the top of this page and also on the multiple choice answer sheet

Total marks – 100

(**Part A**) Pages 2-10

20 marks

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

(**Part B**) **Booklet 1 -** Page 11- 21 (Q 21-33)

Booklet 2 – Page 22- 27 (Q 34 – 39)

80 marks

- Attempt Questions 21–39
- Allow about 2 hours and 25 minutes for this part

1. A potential pathogen was found to be heterotrophic and have a cell wall and membrane bound organelles.
   It should be classified as a:

   (A) prion

   (B) bacterium

   (C) protozoan

   (D) fungus

2. Some farmers have noticed that their sheep are becoming sick and are losing condition. They engage a microbiologist to find the pathogen.

   The microbiologist discovers that all the sick animals have a particular bacterium present in their blood. This bacterium cannot be found in healthy sheep.

   The microbiologist isolates some of the bacteria and grows them in a pure culture. What is the next step that the microbiologist needs to take?

   (A) Find out whether an antibiotic which kills the bacteria also cures the sheep.
   (B) Inoculate healthy sheep with different bacteria to see whether they develop similar symptoms.
   (C) Inoculate healthy sheep with the cultured bacteria to see whether they develop similar symptoms.
   (D) Culture bacteria from sheep with similar, but different, diseases

3. Which one of the following is a structural adaptation of a plant to help it reduce water loss?

   (A) A deep root system
   (B) The ability to close stomates during the heat of the day.
   (C) Dropping leaves during times of severe drought.
   (D) Leaves with a reduced surface area.

4. Which of the following biotechnologies would lead to an increase in genetic diversity?

   (A) Artificial inseminating a number of female heifers (cows) from one desirable bull
   (B) Grafting two or more fruit trees together
   (C) Artificially pollinating an endangered plant species to increase seed production
   (D) Producing a transgenic organism

5. The diagrams below show how the skin cancer, melanoma, grows downwards to invade deeper tissues.

epidermis

dermis

subcutaneous layer

early stage   later stage
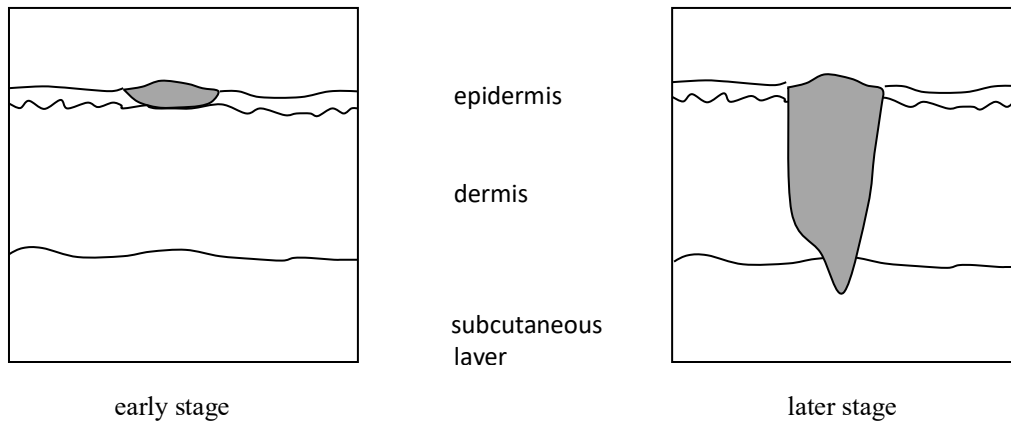
Once it reaches the later stage it can metastasise. Cells break off and are transported to other parts of the body.

Which one of the following is mainly responsible for facilitating metastasis?

(A)   the inflammatory response
(B)   the capillaries
(C)   the killer T lymphocytes
(D)   the lymphatic system

6. A team of researchers wanted to determine the rate of RNA synthesis in a population of yeast cells in culture. Which of the following radioactively-labeled substances should they add to the nutrients provided in the culture medium?

(A)   cytosine
(B)   guanine
(C)   uracil
(D)   thymine

7. In humans, short-sightedness is dominant to normal vision. What are the phenotypic percentages of children if both parents are heterozygous for vision?

(A)   25% normal, 75% short-sighted
(B)   50% normal, 50% short-sighted
(C)   75% normal, 25% short-sighted
(D)   100% short-sighted

8. The electron micrograph below shows chromosomes in one cell during mitosis
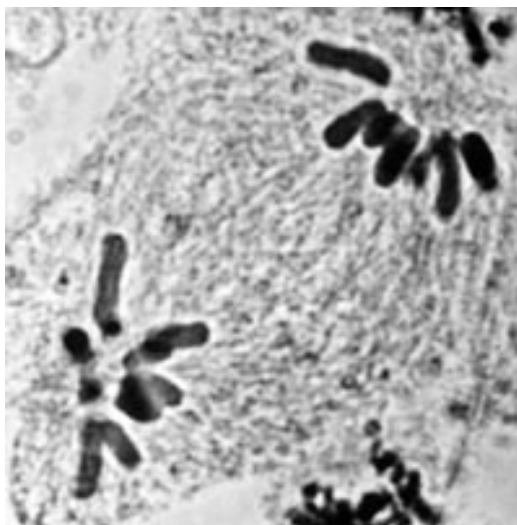
Which stage is this most likely to be?

(A) Prophase

(B) Metaphase

(C) Anaphase

(D) Cytokinesis

9. Sickle cell anaemia is caused by the single substitution of an amino acid in haemoglobin. This change is the result of a:

(A) point mutation.

(B) chromosomal inversion.

(C) frameshift mutation.

(D) polyploidy.

10. Six students each prepared ten agar petri dishes using sterile techniques. Eight of the plates were exposed and the other two left unopen. All plates were placed in a particular location for twenty minutes at the same time of day. After incubation, the total numbers of microbes (bacteria and fungi) in all opened plates were counted and the results tabulated.

The total number of microbes in unopened plates were also counted.
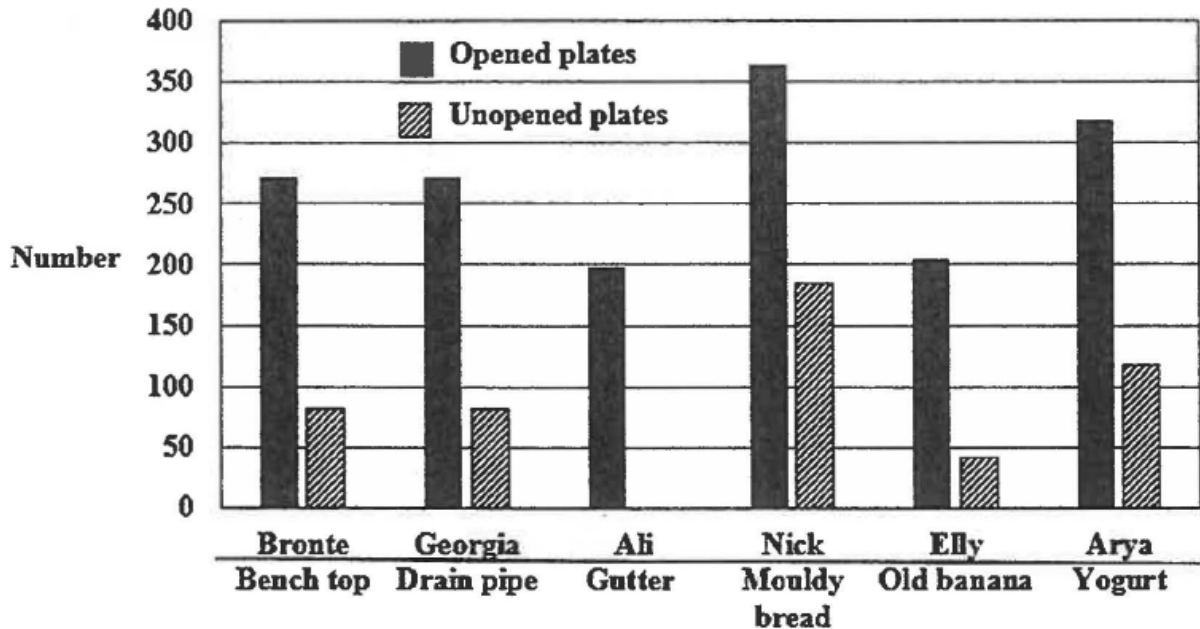
Which of the following would be true from the data presented above?

(A) All of the student's data is valid because they each used a control.

(B) All of the student's data is valid because they each used multiple petri dishes.

(C) Only Bronte's and Georgia's data are valid because their results were identical.

(D) Only Ali's data is valid because his unopened plates had no microbes present.

11. A newborn baby was diagnosed with Patau syndrome. Her karyotype showed three copies of chromosome 13.

This is an example of

(A) frameshift mutation.

(B) block mutation.

(C) aneuploidy.

(D) polyploidy.

12. The diagram below represents a DNA molecule and the position of the recognition sites for the restriction enzymes BamHI, EcoRI, HaeIII and SalI.

DNA
molecule   BamHI   EcoRI   HaeIII   EcoRI   SalI   EcoRI   BamHI SalI
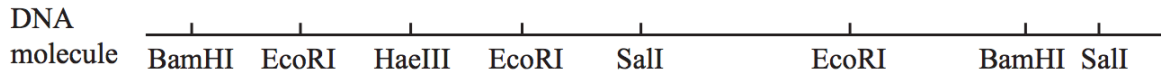
Also shown is a diagram of an electrophoresis gel in which the lanes R, S, T and U show the separation of DNA segments resulting from digestion of the molecule with one of the restriction enzymes
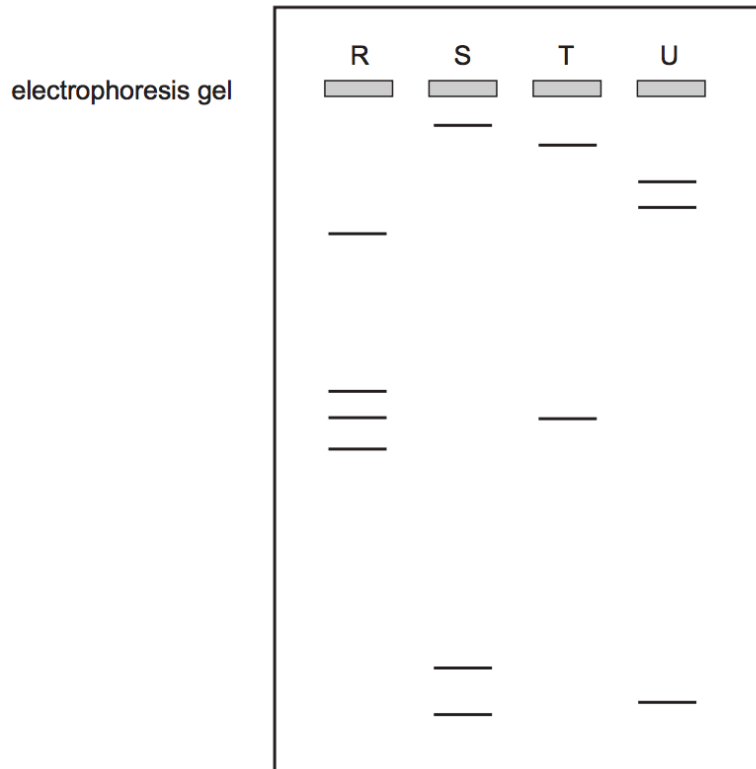
Which of the following shows the correct match between the lane and the restriction enzyme used to digest the DNA molecule?

	R	S	T	U
(A)	SalI	EcoRI	HaeIII	BamHI
(B)	EcoRI	BamHI	HaeIII	SalI
(C)	EcoRI	BamHI	SalI	HaeIII
(D)	HaeIII	SalI	BamHI	EcoRI

6

13. Familial atrial fibrillation is an inherited condition in which individuals have an altered heart rhythm. Shaded individuals in the following pedigree have this condition.
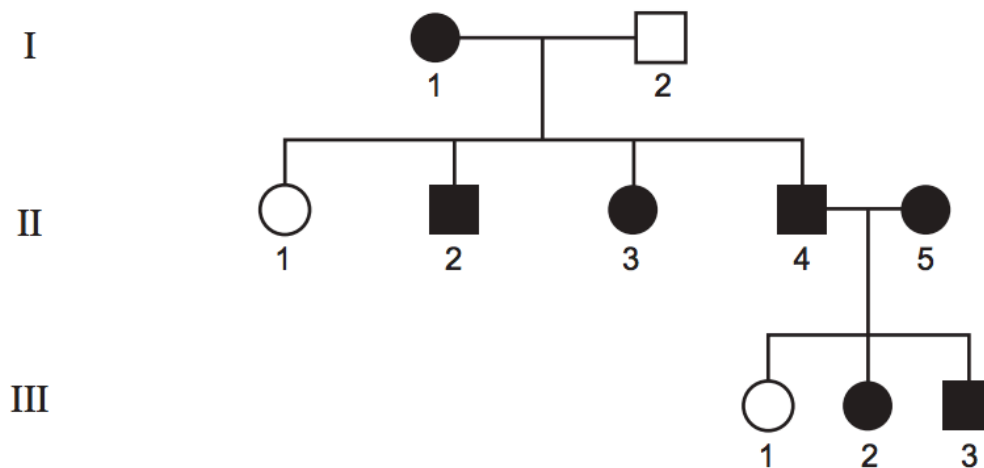
From this information, it would be correct to conclude that

(A) individual I-1 must be homozygous.

(B) individual II-1 must be heterozygous.

(C) individual III-2 must be homozygous.

(D) individual II-3 must be heterozygous

14. Consider the structure and functional importance of proteins.

Which one of the following statements about proteins is correct?

(A) A change in the tertiary structure of a protein may result in the protein becoming biologically inactive.

(B) Proteins with a quaternary structure will be more active than proteins without a quaternary structure.

(C) Two different proteins with the same number of amino acids will have identical functions.

(D) Denaturation will alter the primary structure of a protein

15. Bone conduction implants are devices used to assist with the effects of which disorder:

(A) Sensorineutal hearing loss

(B) Conductive hearing loss

(C) Auditory processing disorders

(D) Visual processing disorders

16. Observe the graph below.

Estimated age-specific incidence and mortality rates for liver cancer, by sex, 2018
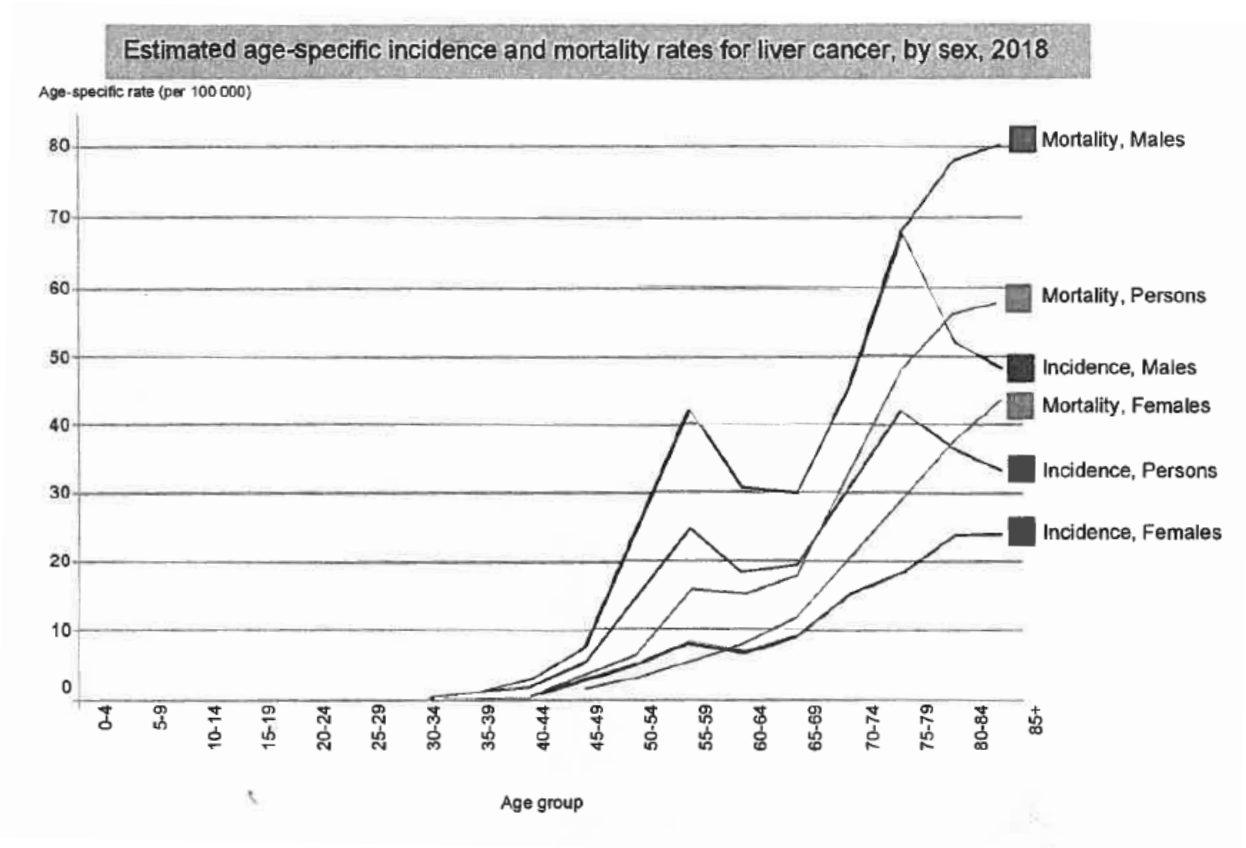
What conclusion is most correct from the graph about liver cancer?

(A)   Females who are diagnosed with liver cancer are just as likely to die from the disease as males who are diagnosed with it.

(B)   The likelihood of dying from liver cancer increases steadily with age.

(C)   Males are more likely to be diagnosed with liver cancer than females.

(D)   The prevalence of males diagnosed with liver cancer increases with age.

17.   To be causally associated with disease, the etiological factor should fulfil the which of the following criteria:

(A)   The factor is present in all subjects with the disease

(B)   Elimination of the factor increases the risk of the disease

(C)   The exposure to this factor should precede the development of the disease

(D)   The factor is more prevalent among those without the disease than those with the disease

18. The table below compares the leading causes of death in high income countries and low income countries in 2002

Disease	% of deaths	
	High Income Countries	Low Income Countries
Coronary heart disease	17.1	10.8
Stroke and similar conditions	9.8	6.0
Lung cancers	5.8	< 1.0
Lower respiratory infections	4.3	10.0
Complications with birth	< 1.0	6.4
Diarrhoeal diseases	< 1.0	5.4
HIV/AIDS	< 1.0	7.5

Information taken from WHO website: http://www.who.int (Some causes of death omitted from this table)

From these data it appears that non-infectious diseases:

(A)   are the major causes of death in both high and low income countries.
(B)   are more significant causes of death in low rather than high income countries.
(C)   are more significant causes of death in high rather than low income countries.
(D)   are fairly insignificant causes of death in both high and low income countries.

19. Mass vaccination was arguably the most important advance in Public Health of the Twentieth Century. It has saved millions of lives.

No vaccine, however, is 100% effective. Typically, a vaccine fails to produce immunity in up to 10% of recipients.

How is it that a vaccine which doesn't make all recipients immune, still effectively provides almost 100% protection to the whole community?

(A)   The vaccine is a weaker strain of the pathogen. The real pathogen will provoke the full immune response in the other 10%.

(B)   The high consumption of antibiotics across the community will ensure that the other 10% are protected.

(C)   If the 10 % are unaffected by the vaccine, they will most likely be immune to the real pathogen anyway.

(D)   The 10% will be protected by the fact that the rest of the population are now unable to pass the pathogen on to them.

20. How can widespread use of artificial insemination alter the genetic composition of a population?

(A) It results in many genetically identical individuals.

(B) It makes certain alleles more common in a population.

(C) It decreases the number of chromosomes in some individuals.

(D) It ensures that only the genetic composition of the males is altered.

Marks

Question 21 (3 marks)

3

Many components of traditional bush medicines have been recently studied by scientists and shown to have therapeutic properties. A variety of plant-based bush medicines traditionally used by indigenous Australians have been shown to be effective treatments for many diseases. Using a named example, discuss a current application of such medicines and comment on any ethical concerns that this has raised.

Question 22 (2 marks)

2

Use a table to describe at least two ways in which the structure of chromosomes differs between eukaryotes and prokaryotes.

Question 23 (6 marks)

In 1972 the biologist Susumu Ohno gave the name "junk DNA" to regions of DNA that do not code for polypeptides and were thought at that time to have no role in cell function. However, it has recently been discovered that certain non-coding regions of DNA have important functions in the cell and the term "junk" is now only used to refer to highly-repetitive regions of DNA

(a)   Outline two functions of non-coding DNA.

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(b)   With the aid of a diagram, explain what a single nucleotide polymorphism (SNP) is.

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(c)   Explain, in terms of evolution, why SNPs are more common in non-coding regions of DNA than coding regions.

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Question 24 (5 marks)

(a) Outline how the polymerase chain reaction can be used to amplify DNA sequences. **2**

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(b) DNA can be inserted into bacterial plasmids to produce recombinant DNA. The diagrams below show a bacterial plasmid in its original form and the recombinant plasmid after a desired gene, X, has been spliced into a particular position. Plasmids are incorporated into bacterial hosts. **3**

Original plasmid   Recombinant plasmid
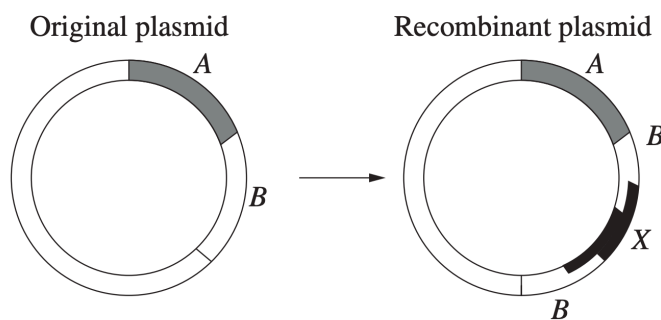
KEY
Gene *A*: codes for resistance to the antibiotic Ampicillin
Gene *B*: codes for the production of a yellow substance
Gene *X*: codes for the production of a human hormone

Explain how gene A and gene B could be monitored to determine which bacterial hosts have successfully incorporated the desired recombinant DNA.

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Question 25 (8 marks)

How does the human immune system respond to exposure to a pathogen?

Question 25 (continued)

Question 26 (3 marks)

Discuss the application and assess the effectiveness of the cochlear implant in assisting with the effects of hearing loss.

3

Question 27 (4 marks)

The human menstrual cycle is under the control of four hormones.

Two, FSH and LH are made by the pituitary gland, and the other two, oestrogen and progesterone, are made within the ovaries.

The information box below describes how they act.

The Hormonal Control of the Menstrual Cycle

1. FSH stimulates the 'ripening' of an egg. As it develops it produces oestrogen which, amongst other things 'switches off' FSH production to make sure that only one egg 'ripens' at once.

2. LH levels remain low throughout the cycle, except for a sudden surge which triggers ovulation -the release of the egg, on about the 14th day.

3. The follicle which released the egg then produces progesterone, which targets the lining of the uterus, making it receptive to a fertilised egg should fertilisation occur.

4. After about 22 days of the cycle, if fertilisation hasn't occurred, progesterone and oestrogen levels drop. Once they get below a certain level menstruation is triggered on around the 28th day of the cycle.

The graph below shows how oestrogen and FSH levels change during the cycle.
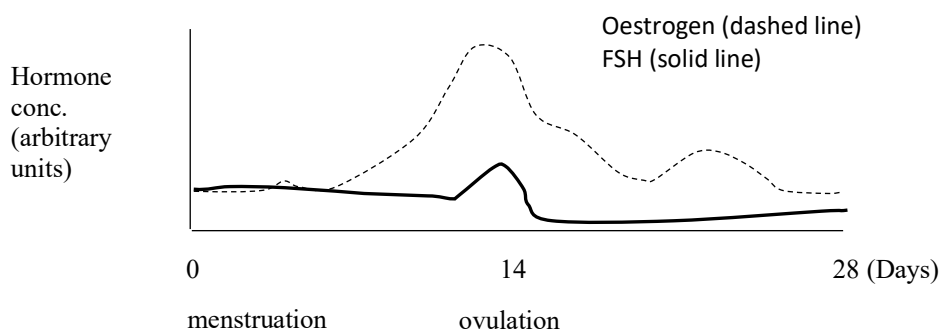
Question 27 continues on page 17

16

(a)   Sketch lines on the axes below to show how levels of LH and progesterone also   **2**
change over the same time. (make sure you label which is which)

Hormone
conc.
(arbitrary
units)

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0                    14                28 (Days)
menstruation         ovulation
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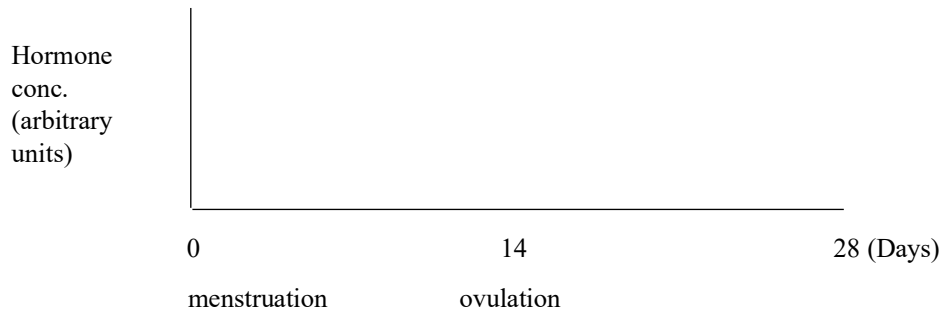
(b)   Outline the steps which occur between the fertilisation of an egg and the   **2**
implantation of a blastocyst in the lining of the uterus.

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Question 28 (4 marks)

A group of university researchers are responsible for 5 families of pandas in different zoo. Each family has been isolated from other families for generations. As the cubs reach sexual maturity, a mating program aims to improve the genetics of the worldwide panda population.

(a)   Explain how the mating program may affect gene flow.   **2**

(b)   Explain how the mating program may affect genetic drift.   **2**

Question 29 (4 marks)

Construct a diagram to summarise the negative feedback loop that maintains homeostasis of blood glucose levels

Question 30 (3 marks)

What is meant by the term epidemic and what are some of the factors that can give rise to an epidemic?

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Question 31 (5 marks)

(a)   For an identified transgenic species outline why it was produced.

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(b)   Discuss the social and ethical implications of developing transgenic species.

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Question 32 (2 marks)

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Identify a type of mutagen and explain how it induces changes in DNA.

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Question 33 (3 marks)
Describe the process of DNA replication using the Watson and Crick model.

Answer Q 34- 39 in Booklet 2

Question 34 (5 marks) **5**

DNA sequencing and profiling are technologies used in investigations into genetics.
Compare these two technologies.

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Question 35 (6 marks)

In 2017 there were 249,882 reported cases of influenza in Australia.

The table below shows the incidence of reported cases by month.

Month	Incidence (No. of new cases)
January	2744
February	2738
March	2810
April	1978
May	3274
June	7761
July	33115
August	98687
September	75549
October	15838
November	3391
December	1997

All data in this question were taken from the immunisation coalition website
https://www.immunisationcoalition.org.au/news-media/2019-influenza-statistics/

Question 35 continues on page 24

(a)   Plot this data on the grid below   **3**

The graph below shows the same data for the following year, 2018.

Monthly incidence of Influenza in Australia in 2018

Marks

(b) Refer to these two graphs to compare the influenza outbreaks of 2017 and 2018.

3

Question 36 (4 marks)

4

Describe the prevalence, symptoms, cause and treatment/management of a named non-infectious disease.

Question 37 (3 marks)

Describe how a named Australian plant responds to a specific pathogen.

Question 38 (4 marks)

Spinifex is a grass common across central Australia where soils are nutrient deficient. It frequently grows as a circular clump of stems and the diameter of the clump increases slowly each year. Initially the leaves are flat and the roots are shallow. As the plant matures, the leaves curl inwards to form long thin tubes with the stomates on the inside, while the roots grow deep into the soil to obtain nutrients and water. Silicon granules make the stems tough.

Explain how TWO of the adaptations outlined above allow Spinifex to conserve water.

Question 39 (6 marks)

Fatty liver disease is a reversible condition wherein large vacuoles of fat accumulate in liver cells, most commonly due to alcoholism or obesity. If not reversed it can develop into hepatitis. Fatty liver disease can be diagnosed through a simple blood test which assesses liver function.

Describe the methodology of an experimental epidemiological study that aims to measure the effectiveness of a named intervention strategy in preventing the development of hepatitis due to fatty liver disease

END OF EXAM