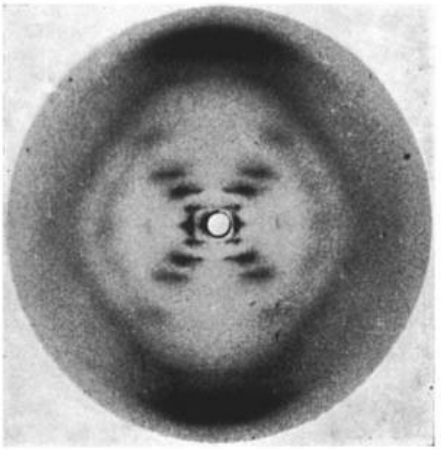
ATAR BIOLOGY YEAR 12

SEMESTER 2

Unit 3– Continuity of Species
Unit 4 – Surviving in a Changing Environment



Rosalind Franklin's Photo 51, showing x-ray diffraction pattern of DNA

STRATEGIES FOR ATAR EXAMINATION SUCCESS

REGIONAL LEARNING SPECIALIST SUPPORT PACKAGE

NAME:

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Edited by Liz Rayner 2021

Examination practicalities

Preparing for the day of the examination

- Review the front cover and inside page of your exam booklet. This contains useful information to help you prepare.
- Check the list of materials you, the student candidate, are expected to provide. These include (but are not limited to):

    - Blue or black pens
    - Pencils (including coloured)
    - Eraser
    - Sharpener
    - Ruler
    - Highlighters
    - Dry correction fluid / tape
    - Non-programmable calculator

- Items must not be in an opaque pencil case. (it is suggested that you use a transparent zip-lock bag to carry your items).
- Prepare the necessary materials and put them in your bag the night before the exam.
- Determine how many minutes you will have for each section of the exam and how long you should spend on each section. The total number of marks for each section will allow you to work out approximately how fast you need to work through each section (e.g. 30 marks in 30 minutes means a working speed of 1 mark per minute).
- All mobile phones must be switched off and left in your bag. Anyone found using a mobile phone during the exam will be deemed to have been cheating and will have their examination terminated by the supervisor.
- Bags must be left in a collection area designated by the supervisor.

During the examination

- Please follow all instructions given for the exam on the inside cover and at the heading of each section. Failure to follow instructions correctly may mean that you are not able to be awarded full marks.
- Please write neatly and legibly when answering questions as this enables the marker to clearly assess your answer and award marks where appropriate.

Using Reading Time Effectively

- Use your ten minutes of reading time to go over the short answers (Section Two) of the exam first and use this time to read each question carefully. This lets you think about these questions before you have to answer them. It may also help you to find clues and prompt your memory when completing the multiple choice section.
- You should avoid focusing on the multiple choice questions (Section One) during your reading time as this is not an effective use of your time – you will have to read each question again when answering them and cannot make any notes in your reading time.
- Familiarise yourself with the list of verbs commonly used in exams and what each verb means. Instructions such as state, describe and explain all mean very different things when answering questions.

Study well before the day of the examination

Review your course program to ensure you understand each of the objectives listed – these objectives tell you what you can be examined on. Use the Syllabus Study Checklists on Schoology to help you if you like. You may like to revisit some of the references given that relate to these objectives or clarify with your teacher any objectives you are unsure of or do not understand.

Examiners Reports

Biology Examiners Report 2017

Advice for candidates

- Read the question carefully and make sure that you answer the question asked.
- Use formal and precise language and scientific terminology in answering questions.
- Communicate clearly in your written answers. 2017 ATAR course examination report: Biology 2

Advice for teachers

- Instruct your students to answer questions according to the 'instruction' verb supplied by the question e.g. state, define, discuss, explain.
- Give your students practice at decoding questions.
- Prepare students to be able to provide in-depth, detailed answers for the extended answer questions in Section Three.

Biology Examiners Report 2018

Advice for candidates

- Include units with quantitative data (e.g. when reporting data from a graph or table).
- Read the question carefully and make sure that you answer the question asked. Take particular care with the extended answer questions in Section Three which often have subtle components that require attention.
- Use formal and precise language and scientific terminology in answering questions.
- Communicate clearly in your written answers.

Advice for teachers

- Instruct students how to answer questions according to the 'instruction' verb in the question (e.g. state, define, discuss, and explain).
- Give students practice at decoding questions.
- Prepare students to provide coherent answers to extended answer questions in Section Three (e.g. where information is logically organised, connects different points and demonstrates an understanding the key concepts).

Biology Examiners Report 2019

Advice for candidates

- Develop an in-depth understanding of important concepts.
- Read the question carefully and make sure that you answer the question asked. Take particular care with the extended answer questions in Section Three which often have subtle components that require attention.
- Communicate clearly in your written answers.
- Use formal and precise language and scientific terminology.
- Include units with quantitative data (e.g. when reporting data from a graph or table).

Advice for teachers

- Prepare students to provide in-depth answers about the life cycle, impact, mode of
- transmission, spread and management for all of the pathogens/diseases in the syllabus.
- Instruct students how to answer questions according to the instructional verb in the
- question (e.g. state, define, discuss, explain).
- Give students practise at decoding questions.
- Prepare students to provide coherent answers to extended answer questions in Section
- Three (e.g. where information is logically organised, connects different points and
- demonstrates an understanding of key concepts).
- Prepare students to apply their understanding of key concepts in a range of contexts.

Biology Examiners Report 2020

Advice for candidates

- Use formal and precise language and scientific terminology in answering questions.
- Communicate clearly in your written answers.
- Read the question carefully and make sure that you answer the question asked. Be alert to subtle components that require attention.
- Spend some time planning your answers to extended response questions so that you do not miss crucial details and repeat points.
- Develop an in-depth knowledge of key topics and concepts so that you can provide full answers to short and extended answer questions.
- When including diagrams in your answers, text should refer to the diagram and the information in the diagram should be fully explained.

Advice for teachers

- Give more attention to those areas of the syllabus where candidates did poorly (e.g. structural features of protists, reliability versus validity in experiments, hypothesis versus prediction, applications population dynamics and biogeography in conservation planning).
- Prepare students to apply their knowledge and understanding of topics in a range of contexts.
- Instruct students how to answer questions according to the key verb in the question (e.g. state, define, discuss, explain, compare) and to include a systematic evaluation of similarities and differences when asked to compare. Give students practice at decoding questions.

Biology Exam Cover Page 2021

Government of **Western Australia**
School Curriculum and Standards Authority

ATAR course examination, 2021

Question/Answer booklet

BIOLOGY

Place one of your candidate identification labels in this box.
Ensure the label is straight and within the lines of this box.

WA student number: In figures | | | | | | | | | |

In words _____

_____

Number of additional answer booklets used (if applicable):

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet
Multiple-choice answer sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Ref: 21-008

2021/41581 BLY

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	30	30	40	30	30
Section Two Short answer	5	5	90	100	50
Section Three Extended answer Unit 3	2	1	50	20	10
Unit 4	2	1		20	10
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2021: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. Answer the questions according to the following instructions.

   Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

   Section Two: Write your answers in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided.

   Section Three: Consists of two parts, each with two questions. You must answer one question from each part. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet.

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

5. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

See next page

Top Question Verbs Biology Exam 2020

Complete	Finish an outlined task	0
Deduce	Draw conclusions	0
Describe	Provide characteristics and features	7
Discuss	Identify issues and provide points for and/or against	0
Explain	Relate cause and effect; make the relationships between things evident; provide why and/or how	15
Estimate		0
Graph		1
List	Provide a series of related words, names, numbers or items that are arranged in order, one after the other	4
Show	Give information; illustrate	0
Identify	Recognise and name	
Predict	Suggest what may happen based on available information	1
Define	State meaning and identify essential qualities	3
State	Express the main points of an idea or topic, perhaps in the manner of 'describe' (see above)	2
Outline	Sketch in general terms; indicate the main features of	1
Compare	Show how things are similar and different (Must answer using a table)	2
Assess	Make a judgement of value, quality, outcomes, results or size	1 (extended response)

NOTE: some question verbs did not feature in the 2020 Exam but have been used in previous exams but have been left in the table to demonstrate top verbs used in Biology Exams

How to study – tips from science

Do	*Do not*
• Plan short sessions…not long cram sessions • Use flash cards • Draw • study an achievable concept (Nerve Impulse) or a topic within the subject (Nervous System) • Have a sacred spot where you study – it primes your brain • Practice mindfulness and meditation	• Read and highlight text – it is not study • study a whole "subject"(e.g. Human Biology)… • Have music on it can be detrimental to study • Have your phone in the same room

How to study – tips from successful students

They have a study timetable that prioritises the fun stuff

They practice exams

They are mindful.

Most Examinable Concepts

DNA, Cell Reproduction, Protein Synthesis

- Asexual reproduction (binary fission, mitosis)
- DNA structure, DNA packaging into nucleus (histones, nucleosomes, chromosomes)
- DNA replication (enzymes involved, steps, leading vs lagging strand)
- Protein synthesis (transcription – mRNA, translation – tRNA , mRNA into protein)
- Phenotypic expression (switching on and off of genes, DNA methylation, acetylation, effect of environment on gene expression e.g. temp, pH)

Biotechnology

- Recombinant DNA technology (plasmids, creating recombinant DNA process)
- DNA profiling (STRs, restriction enzymes, gel electrophoresis, applications in forensics and conservation biology)
- DNA sequencing (Sanger method –chain termination, ddNTs, automated sequencing, applications)
- Transgenic organisms (applications in agriculture, medicine, environmental)
- Pros and cons of transgenic organisms

Inheritance

- Punnet squares and probability
- Test cross
- Determining mode of inheritance (autosomal v sex-linked, dominant v recessive)
- Polygenic inheritance and codominance
- Pedigrees

Natural selection and evolution

- Sources of variation (meiosis – crossing over and independent assortment, mutations, random fertilisation)
- Natural selection (key points and case studies)
- Population genetics (gene pools, sexual selection, genetic drift, artificial selection)
- Speciation (allopatric and sympatric, steps in process, types of reproductive isolation)
- Extinction (characteristics of a viable population, role of biogeography, reproductive behaviour and population dynamics in maintaining viable populations)

Evidence for Evolution

- Fossils (relative and actual dating, index fossils, fossilisation process, why fossil record is incomplete)
- Comparative anatomy (homologous structures, analogous structures, vestigial structures)
- Embryology
- Comparative Biochemistry (DNA hybridisation and proteins)
- Phylogenetic trees

Homeostasis

- What is homeostasis (definition)
- Tolerance levels (pH, CO_2, oxygen, temperature)
- Thermoregulation
- Negative feedback loops
- Osmoregulation (salt and water balance, nitrogenous waste)
- Xerophytes (arid) and Halophytes (salt)

Infectious Disease

- What is infectious disease vs non infectious
- Pathogen groups (bacteria, viruses, protozoa, fungi, prions)
- Disease case studies (crown gall, TB, Malaria, Dieback, Amphibian chytrid, Influenza, Bat Lyssa Virus)
- Modes of transmission
- Factors affecting disease transmission (Host, environmental, pathogen)
- Investigating disease outbreak (case definition, trace contacts etc)
- Management strategies (vector control, quarantine, sanitation, vaccination,

Multiple Choice Tips

- Read every question during reading time…but not the answer options
- Answer the question in your head first, before looking at the options
- If you are unsure, eliminate the obvious distractor
- Ask yourself…"what is the examiner getting at?" or "what part of the course are they testing"
- If you have read the question well, your first response is usually correct

Short Answer Suggestions

- Think before you write. Don't let your mind jump to the first thing that comes to mind. Think
  - what is it really asking? Some questions have got a long context paragraph which can make the question look complex. Often the question itself is quite simple.
  - what is the examiner trying to get me to do?
  - what part of the course is it testing?
  - what question verb is being used?
- Keep to the number of lines if you can

2016 (35)

(c) A number of people who had visited a particular dental practice were later found to be infected with a hepatitis virus. Health authorities suspected that these people had contracted the virus through the dental practice. Explain how DNA profiling could be used to determine whether these people had contracted the virus through the dental practice.
(4 marks)

<u>Extended Answer</u> Tips for Maximising Marks

- More thinking, less writing. It's not an essay. The marker does not wish to know how much better the world is because of biotechnology.
- Highlight the question verb if there is one
- Highlight the number of marks for each section. The number of marks indicates the number of points that the markers are looking for. If a section is worth 6 marks, write 8 points, just in case the examiners interpret the question slightly differently to you. Exception: If the question specifies a number of points/examples/differences, they will only mark that number. Get your points right!
- Plan before you write
- Aim to get a mark from your first sentence

- The best responses are quick to mark. A 10 mark question should take about ten seconds to mark. How do you do this?
  - Try to keep a 10-12 mark section to a single page
  - Use dot points, with semi-complete sentences
  - Highlight the "marking key" for the marker
  - Do not write sideways on the page or * if possible. That is why you need to plan
  - Write neatly.
  - Choose a pen that scans well
- "Compare" or "contrast" questions should always be done using a three column table

2017

Question 37 **(20 marks)**

(a) Describe the process of allopatric speciation. (10 marks)

(b) Explain how fossils, comparative anatomy, comparative embryology and comparative genomics can each provide evidence for the theory of evolution. (10 marks)

-

Scientific Method

Independent Variable: is the *one* that is changed by the scientist. Why just one? Well, if you changed more than one variable it would be hard to figure out which change is causing what you observe.

Dependent Variable: What you measure. The things that the scientist focuses his or her observations on to see how they respond to the change made to the independent variable.

Controlled Variables: What is kept the same. Quantities that a scientist wants to remain constant, and she must observe them as carefully as the dependent variables.

Hypothesis: A hypothesis is a tentative, testable answer to a scientific question

Written as a "If _____ then _____" statement.

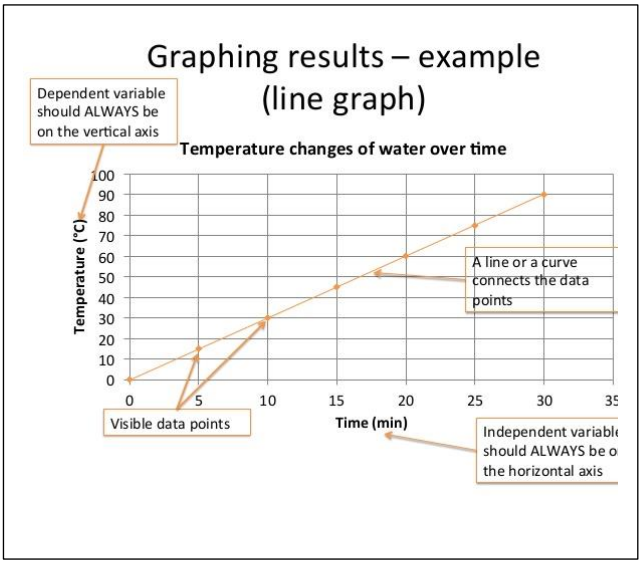
Includes both the independent variable and the effect it will have on the dependent variable.

For TABLES:
- Table should be completely enclosed
- Title for the table
- Independent variable must be either first column or row.
- Dependent variables can go in the rest of the column or rows.

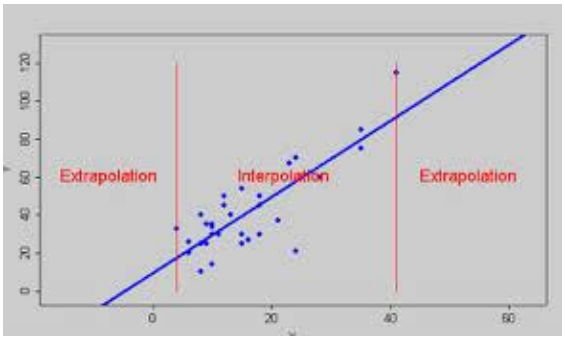
Table 1: Salt Concentration and Light Transmittance

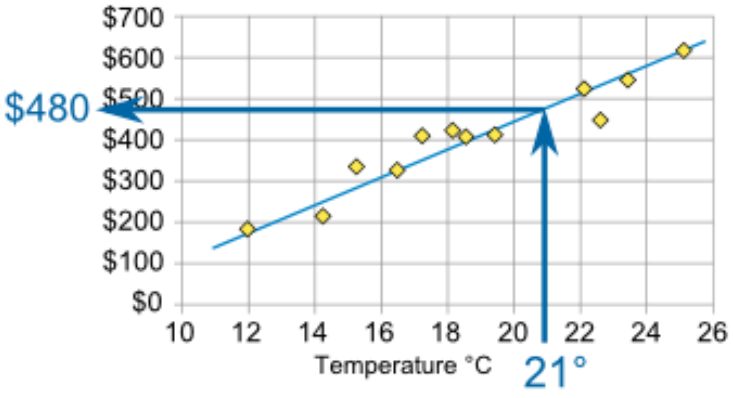
Salt Concentration (%)	Transmittance (%T)				
	Trial #1	Trial #2	Trial #3	Trial #4	Trial #5
0	77.23	74.50	64.88	75.27	54.66
3	85.23	92.82	78.91	60.71	57.96
6	88.39	100.05	73.66	66.51	64.54
9	80.71	100.05	68.29	64.91	52.96
12	82.66	117.18	71.01	56.91	46.95
15	72.55	115.40	65.72	66.03	55.38

For GRAPHS remember to:
- Title the graph
- Correctly label the axis
- x-axis=Independent variable
- y-axis=Dependent variable
- Scale on each axis must have correct identified units
- Scale must be uniformly increasing

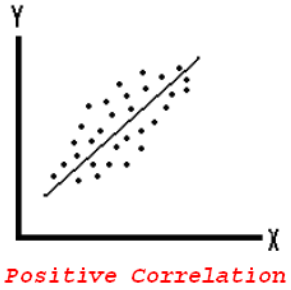


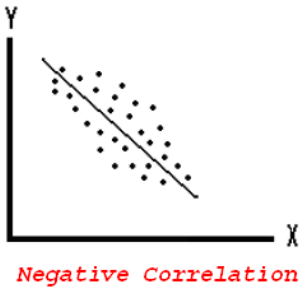
Interpolation and extrapolation of data

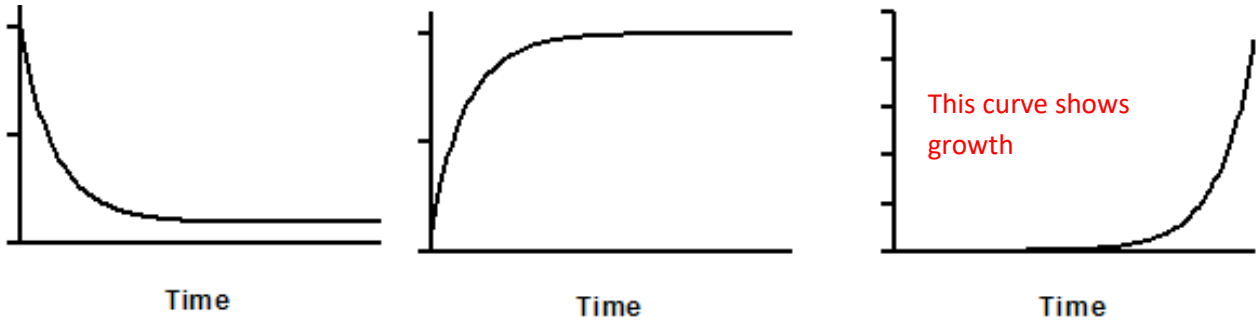




Analysis of Data







Exponential Curves

- When forming a trend it is important to cover the entire graph.
- Multiple trends in a graph should be individually described, using data as evidence.
- State the relationship between the independent and dependent variable
- Use figures/numbers from the graph to support your answer

Conclusions

- Make a claim, was your hypothesis supported or not supported
- Include evidence from your data
- Explain using scientific principles

Evaluation

Validity:

how well a scientific test or piece of research actually measures what it sets out to (i.e. the procedure actually tests the hypothesis and the experiment includes an appropriate range of values).

An experiment is valid if…
• It incorporates suitable equipment (e.g. measuring cylinder to measure volume rather than a beaker).
• Variables are controlled.
• Appropriate measuring procedures are included.

Discussions about validity must…
• Identify what validity is.
• Identify the factors that affect validity of the particular experiment you are considering (the variables that must be controlled, appropriate equipment, the range of values etc). When identifying variables that should be controlled think of variables that would affect the dependent variable
• Assess the overall validity of the experiment.

Reliability:

A reliable experiment has results which can be obtained consistently.

To ensure the results are reliable…
• The experiment must be repeated and consistent results must be obtained (within an acceptable margin of error).

- The experiment should have trials (i.e. carried out three times) and the results averaged.
- This ensures that the effect of random error is minimised or that the outliers can be disregarded or removed.
- Random errors are errors that might affect your experiment the first time you do it but not the second or third time for example.

  Note: Measurements can be reliable without being valid. However they cannot be valid unless they are reliable.

  Discussions about reliability must ….
- Identify what reliability is.
- Identify that reliability is increased by repeating the experiment and comparing results to ensure they are consistent
- Identify that reliability is increased by increasing the sample size (having more trials) and averaging the results.
- Identify that this minimises the effect of random errors/outliers and/or allows them to be removed or disregarded.
- Give examples of possible random errors that may have crept into the experiment you are considering.
- Assess the overall reliability of the experiment.

Rough Guide to Graphing in Biology

1. Line or column graph? Get it right!

Continuous	=	Line Graph
Discrete	=	Column Graph

2. Independent Variable on the X axis, Dependant on the Y

3. Make sure that you have a regular scale on both axis. Generally start with "0" at the origin.

4. Label the X and Y axis and include units

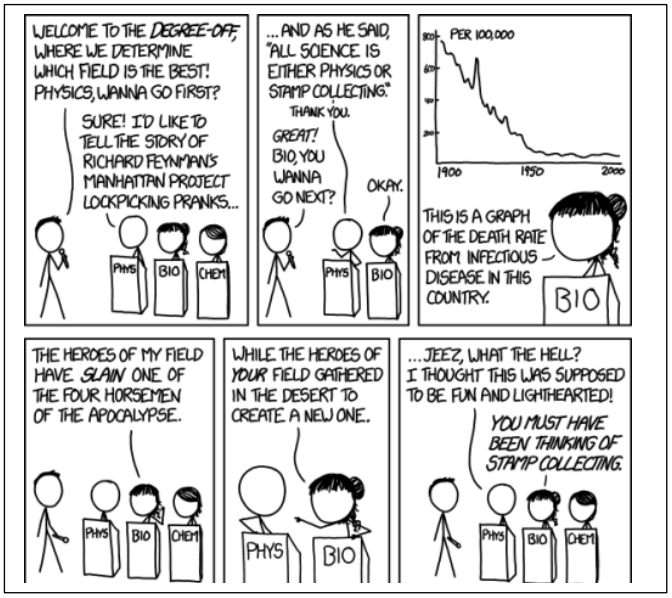
5. Join the dots . . . unless

   - you are graphing a scatter plot
   - there is a mathematical relationship between the IV and DV
   - you are asked to interpolate. Then add a line of best fit, to the existing graph with the dots joined.

6. Your title must include the IV and DV

7. If you are graphing more than one set of data, ensure that you include a key

8. Use a pencil

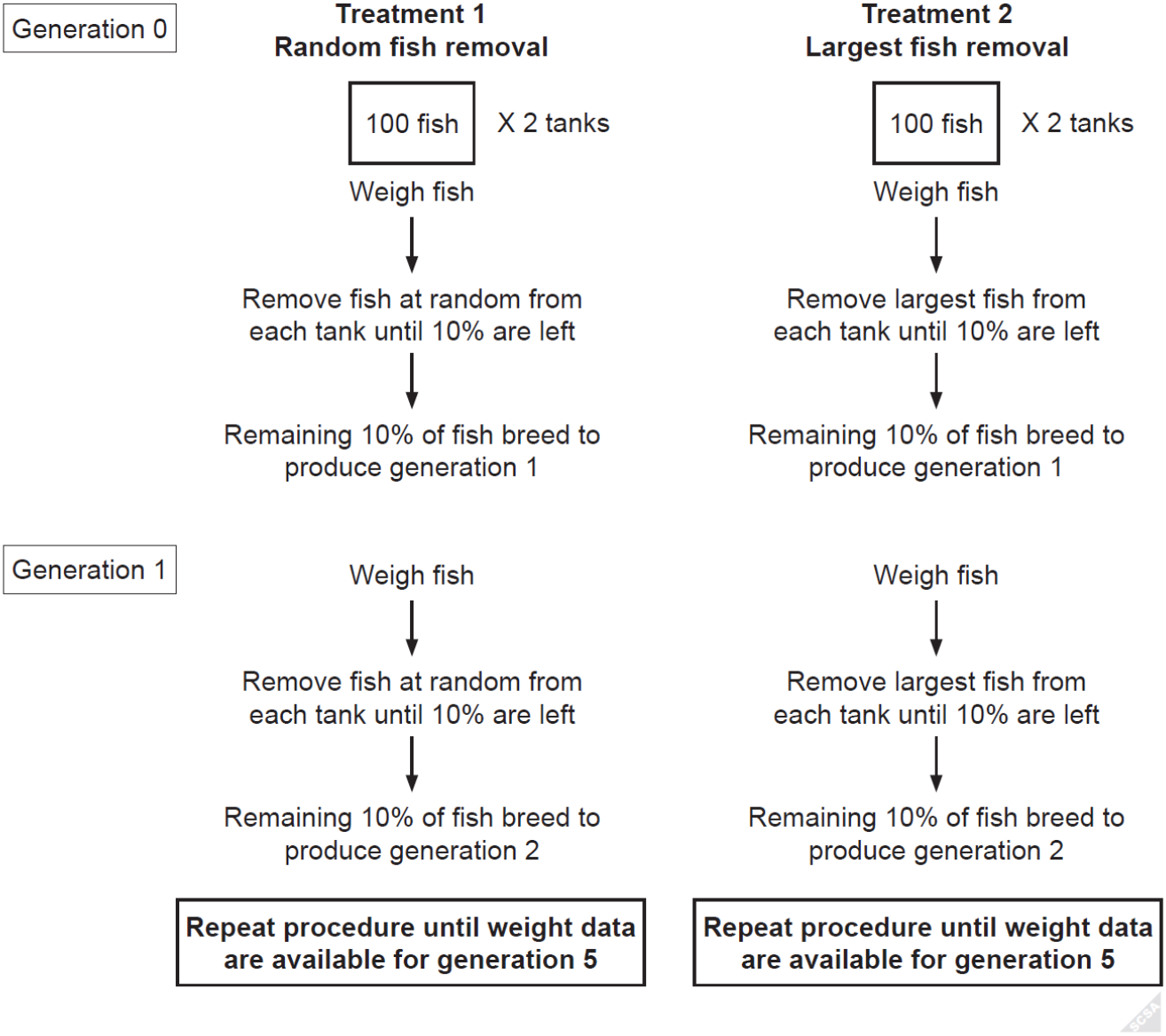


Graphing questions past 5 years….

2020

Question 32 **(20 marks)**

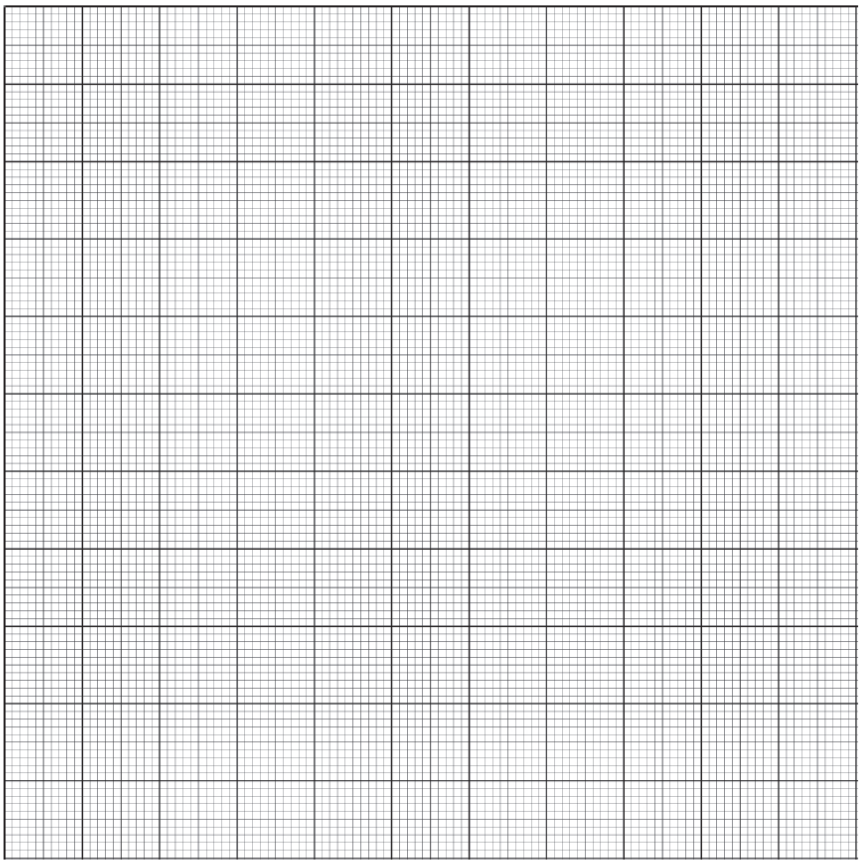
A team of biologists conducted a laboratory experiment to investigate whether removing the largest individuals from a fish population would affect the size (weight) of individuals in subsequent generations. The experiment is described in the diagram below.



The results of the experiment are shown in the table below.

	Mean weight of fish (g)	
Generation number	**Treatment 1 Random fish removal**	**Treatment 2 Largest fish removal**
0	3.3	3.4
1	3.5	3.4
2	3.6	3.3
3	3.4	3.2
4	3.5	3.0
5	3.4	3.0

(a) Graph the mean weight of fish for both the random fish removal treatment and the largest fish removal treatment against generation. (6 marks)



(b) (i) Identify the dependent variable in the experiment. Give a reason for your answer. (2 marks)

(ii) Would conducting the experiment for more generations improve the reliability or validity of the experiment? Give a reason for your answer. (2 marks)

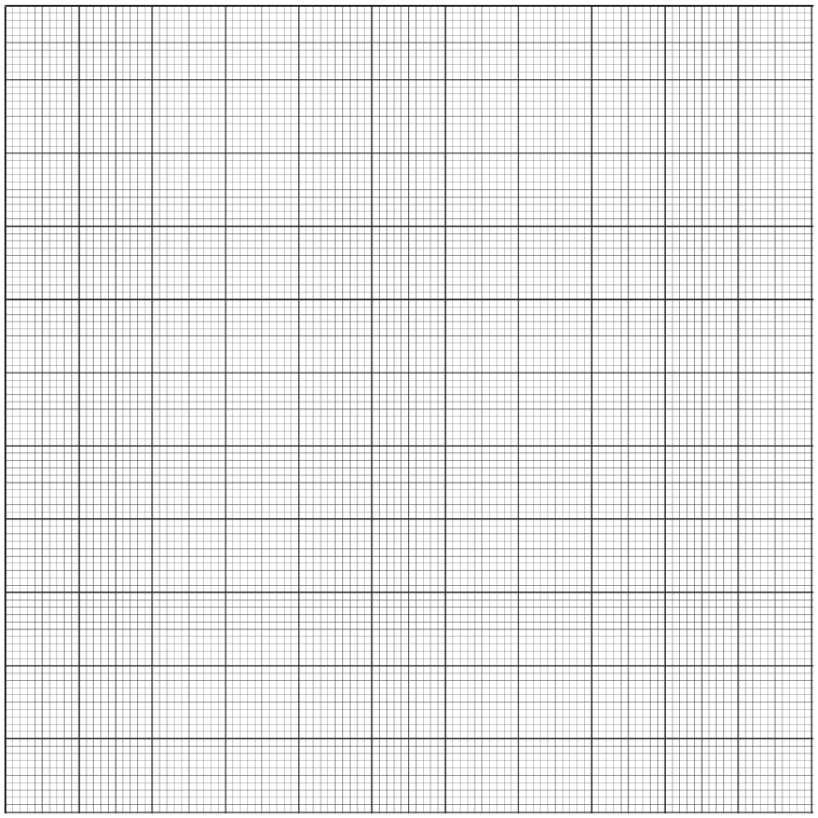
(iii) Why did the biologists remove fish at random from the two tanks in Treatment 1. (2 marks)

Question 32 **(21 marks)**

The water flea, *Daphnia*, is a small crustacean that lives in freshwater. When *Daphnia* are examined under low magnification with a microscope, the heart is clearly visible and the beats can be counted. A biologist wanted to study the influence of temperature on the heart rate of *Daphnia*. He collected 50 *Daphnia*, randomly assigned 10 individuals to each of five temperatures and measured the heart rate of each individual after 15 minutes at the assigned temperature. The results are shown in the table below.

	Heart rate of 10 *Daphnia* (beats per 20 seconds)	
Temperature °C	**Mean**	**Range**
2	59	39–85
10	119	82–151
20	142	92–234
30	257	178–328
40	401	206–596

(a) Graph the mean heart rate of the *Daphnia* against temperature. (6 marks)



(b) (i) Estimate the heart rate for *Daphnia* at 15 °C. (1 mark)

(ii) Estimate the heart rate for *Daphnia* at 45 °C. (1 mark)

(iii) In which estimate do you have the greater confidence? Give a reason for your answer. (2 marks)

(c) (i) What is the independent variable in this study? Give a reason for your answer. (2 marks)

(ii) State **one** way of improving the reliability of the study. (1 mark)

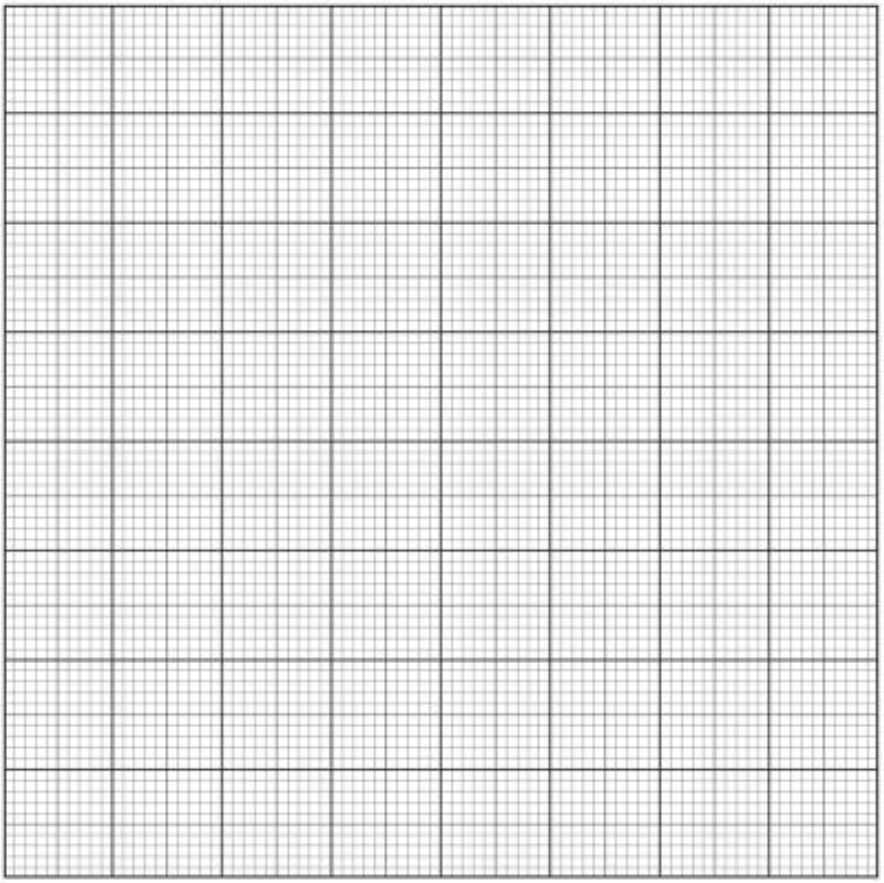
(iii) Propose an hypothesis for the study. (1 mark)

Question 34 **(20 marks)**

Soil salinity is a problem in agricultural areas because many crop species cannot tolerate high concentrations of salt. Biologists conducted an experiment to investigate why barley is more tolerant of soil salt than lupins. They germinated 90 barley plants and 90 lupin plants and grew the plants in identical conditions except for the variation in the concentration of salt in the soil. After six weeks, the biologists measured the concentration of salt in the xylem tissue of the plants. The results are shown in the table below.

	Mean salt concentration in the xylem (mM)	
Salt concentration in soil (mM)	**Barley**	**Lupins**
0	0	0
25	2	No data
50	2	3
75	No data	7
100	5	6
125	No data	6
150	4	No data
175	No data	59
200	7	No data

(a) Graph the mean salt concentration found in the xylem for both barley and lupins against the salt concentration in the soil. (6 marks)



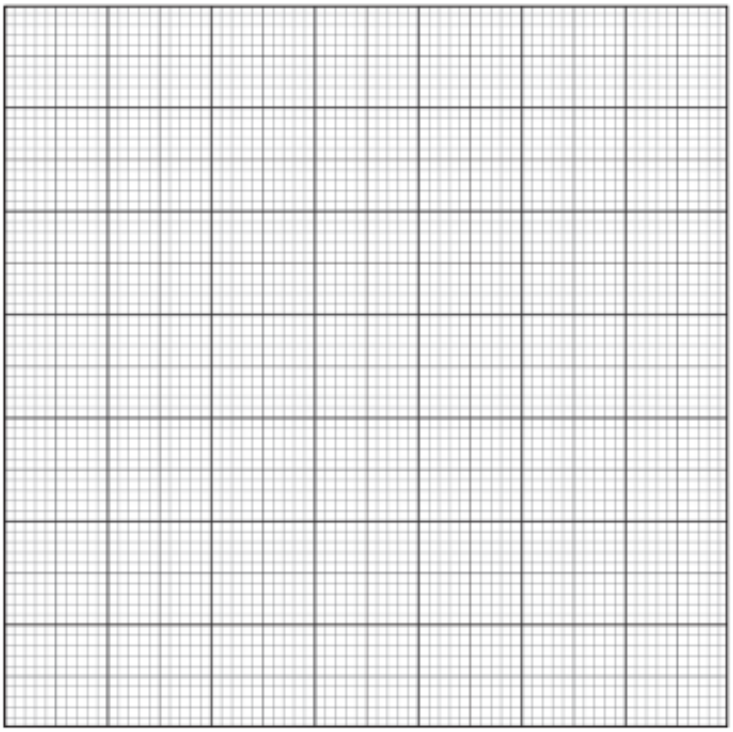
Question 33 **(20 marks)**

Biologists suspected that a species of fruit fly was developing resistance to a commonly-used insecticide. They collected 1000 fruit flies from an orchard sprayed regularly with this insecticide. In the laboratory they sprayed the fruit flies from the orchard with the recommended dose of insecticide and measured the percentage survival of the flies over the next 100 hours. At the same time, they also sprayed a group of 1000 laboratory-reared fruit flies of the same species that had never been exposed to insecticide and recorded their percentage survival over the next 100 hours. Fruit flies in both groups were kept under identical culture conditions. The data are shown below.

Time in hours since spraying	% fruit flies from the orchard surviving	% fruit flies from the laboratory surviving
0	100	100
20	97	8
40	51	4
60	50	2
80	49	2
100	49	0

(a) On the grid below, graph the percentage of fruit flies surviving over time for both the fruit flies from the orchard and those from the laboratory. (6 marks)

A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt.



2016

Question 33 **(20 marks)**

Biologists calculated the home ranges (the maximum area over which an animal moves) of cats at a variety of housing densities in suburban Perth. The results are shown in the table below.

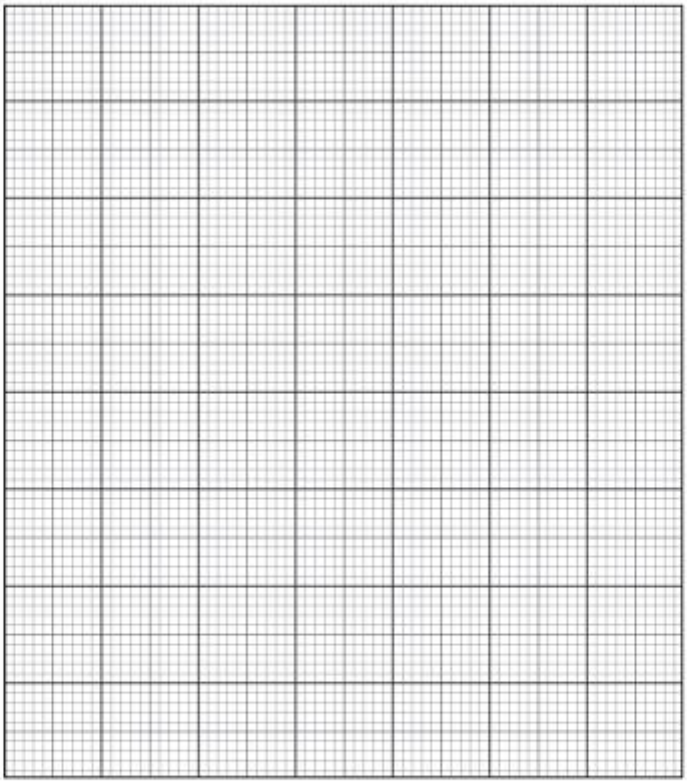
Cat's name	Housing density (dwellings/hectare)	Home range of the cat (hectares)
Angel	0.5	9.0
Blueberry	0.5	6.0
Bob	0.5	19.0
Boris	0.5	18.0
Comet	15.0	3.0
Elliot	15.0	1.0
Hazelnut	15.0	2.0
Jay	15.0	2.0
Misty	15.0	2.0
Rex	15.0	2.0
Scaboo	20.0	1.0
Sparkles	20.0	1.0
Timba	20.0	1.0
Toby	20.0	1.0
Widget	20.0	1.0
Zimba	20.0	1.0
Bobby	30.0	0.5
Casa	30.0	1.0
Hugo	30.0	0.5
Indigo	30.0	1.0

(a) The table below was constructed to summarise the data. Some cells are filled in as examples. Complete the summary table by placing the requested data in the empty cells. (3 marks)

Housing density (dwellings/ hectare)	Number of cats	Mean home range (hectare)	Median home range (hectare)	Range of home range (hectare)
0.5	4	13.0		6.0-19.0
15.0		2.0	2.0	
20.0	6	1.0	1.0	1.0-1.0
30.0	4	0.75	0.75	0.5-1.0

(b) Graph the relationship between the mean home range (hectare) of cats and housing density (dwellings/hectare). (6 marks)

A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt.



(c) (i) Using your graph, estimate the mean home range (hectare) of cats at the housing densities below. (2 marks)

8 dwellings/hectare

_____

22 dwellings/hectare

_____

(ii) In which of the estimates should you have the greater confidence? Give a reason for your answer. (2 marks)

_____

_____

_____

_____

(d) Does the study on home range in cats have an independent variable? Explain your answer. (3 marks)

_____

_____

_____

_____

Only 20 cats were used in the study on home range in cats.

(e) (i) Explain an advantage of using more cats in the study. (2 marks)

_____

_____

_____

_____

(ii) Explain a disadvantage of using more cats in the study. (2 marks)

_____

_____

_____

_____

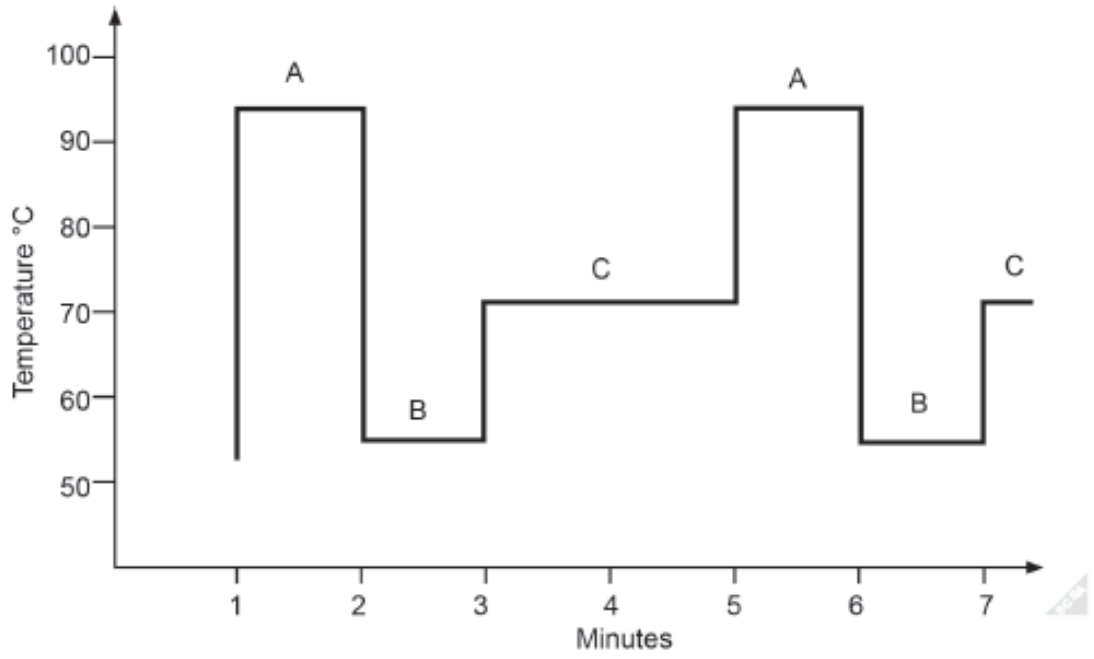
Just in case….

This is what examiners are doing in Human Biology.

2018

Question 33 **(13 marks)**

Polymerase chain reaction (PCR) is a biotechnological technique used to amplify very small amounts of DNA. The diagram below is a graphical representation of the PCR process.



(a) The graph above is missing some important information. Identify **two** pieces of information that should have been included when drawing the graph. **(2 marks)**

_____

_____

_____

If you had to draw a graph, what would the marking key look like?-

_____

_____

_____

_____

_____

_____

_____

_____

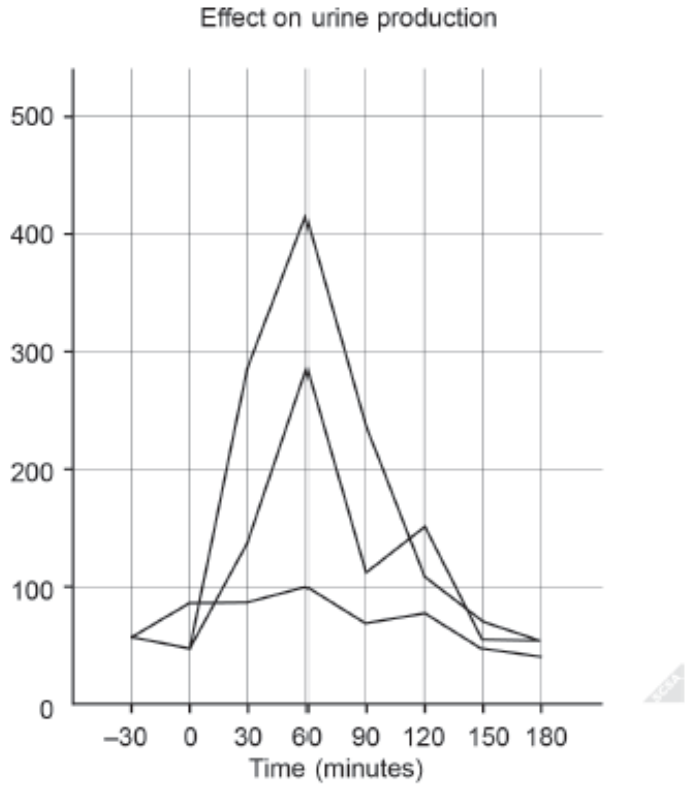
_____

Question 33 **(11 marks)**

Scientists decided to investigate how urine production was affected by drinking different salt solutions. They chose three groups of 10 volunteers. Each group drank 1 litre of different solutions: Group 1 distilled water; Group 2 10% salt solution; and Group 3 30% salt solution. Urine samples were collected from each person that participated in the experiment 30 minutes before they drank the solution and then every 30 minutes afterward, and the volume of urine was then recorded. The graph and table below show the average volume of urine collected every 30 minutes from each group.

Time (minutes)	Average urine production (mL)		
	Group 1 Distilled water	Group 2 10% Salt solution	Group 3 30% Salt solution
–30	56	58	55
0	48	47	51
30	287	138	85
60	415	285	98
90	235	112	67
120	103	82	77
150	68	54	46
180	54	52	40

The graph shown below is a student's attempt to represent the data shown in the table.



(a) Identify **three** errors in the graph. (3 marks)

_____

_____

_____

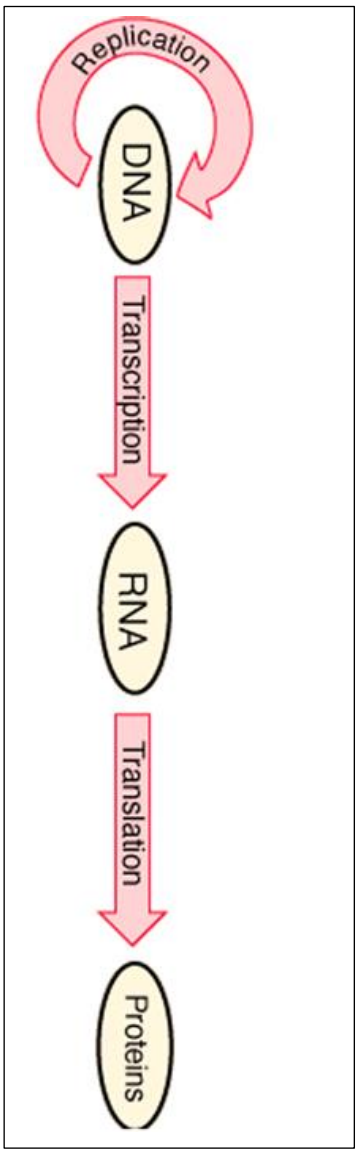
_____

_____

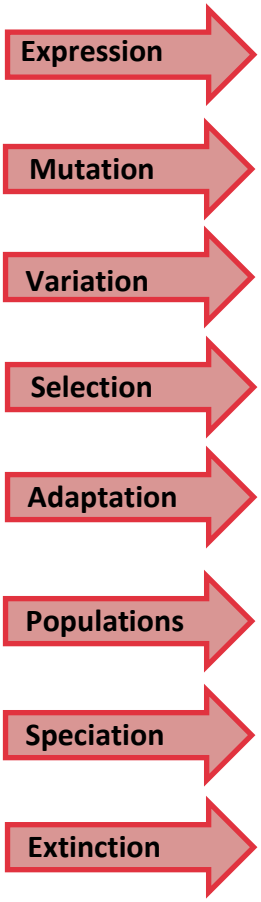
DNA, Cell Reproduction, Protein Synthesis

- Asexual reproduction (binary fission, mitosis)
- DNA structure, DNA packaging into nucleus (histones, nucleosomes, chromosomes)
- DNA replication (enzymes involved, steps, leading vs lagging strand)
- Protein synthesis (transcription – mRNA, translation – tRNA , mRNA into protein)
- Phenotypic expression (switching on and off of genes, DNA methylation, acetylation, effect of environment on gene expression e.g. temp, pH)

Central dogma of molecular biology



And…..



Key Questions….

- Explain the relationship between DNA, genes and chromosomes.

_____

_____

- Name the enzyme that would transcribe the gene shown above.

_____

- State whether the top or bottom strand would serve as a template if the enzyme were to transcribe the gene from left to right.

_____

- Write the sequence of mRNA that will be produced. Include the position of the 3' and 5' ends.

_____

- Describe the three events that occur allowing the mRNA strand to be translated.

_____

_____

_____

_____

_____

_____

- Asides from the change of Thymine to Uracil, describe 2 other differences between DNA and mRNA in regards to protein synthesis.

_____

_____

_____

Normal Gene: 3' – GGCATATGCGATAGTCGA – 5'

Altered Gene: 3' – GGCATATGCCGATAGTCGA – 5'

- State the type of mutation shown above.

_____

- Define the term mutagen.

_____

- Explain the possible effects of this mutation on the protein.

_____

_____

- Draw a diagram of a labelled nucleotide

- The two DNA strands run in an anti-parallel direction. In which direction are new nucleotides added?
  _____

- Write the correct name for DNA. _____

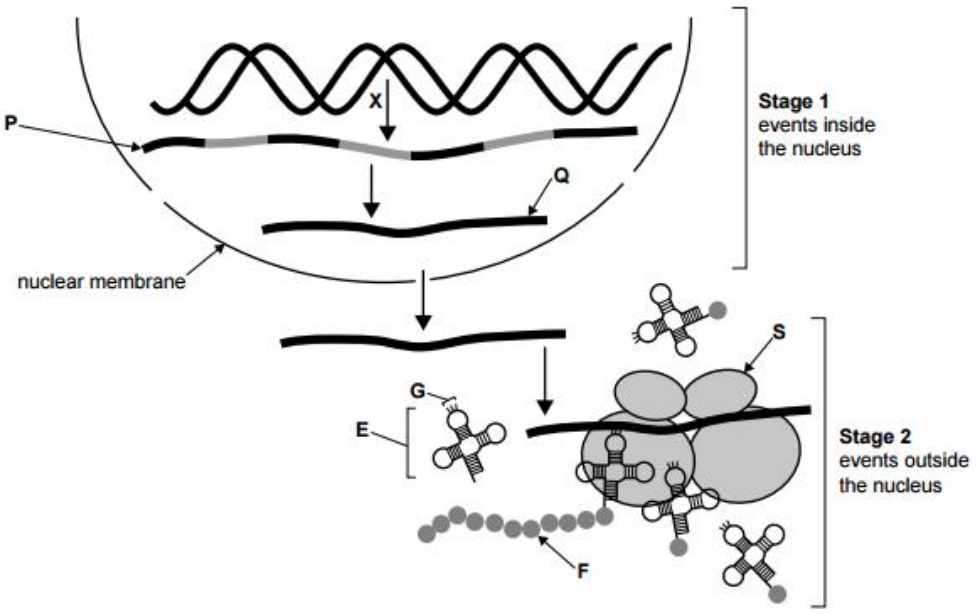
- i) Write the corresponding tRNA code for the following DNA strand:

  DNA T A T C G G C T A C A A T T
  tRNA _____

  ii) At which anticodon is translation initiated?

  _____

Consider the diagram below



Label:

i) Process X: _____

ii) Structure Q: _____

iii) Structure E: _____

d) Describe the events occurring in stage 2, including the role of each of the structures S, F, E and G.

e) A phenomenon known as *codon degeneracy* results in many amino acids being specified by more than one codon. Describe how this is possible and its biological importance.

f) The complimentary DNA (cDNA) strand can be synthesised using the analysis of the amino acids. However, if scientists use this analysis of the protein to form cDNA, it may not have the same code sequence as cDNA formed using mRNA.

Discuss why this situation occurs.

- Explain the process of budding and both the advantages and disadvantages of asexual reproduction.

- Describe the differences between meiosis and mitosis.

- Draw a diagram detailing how bacteria reproduce

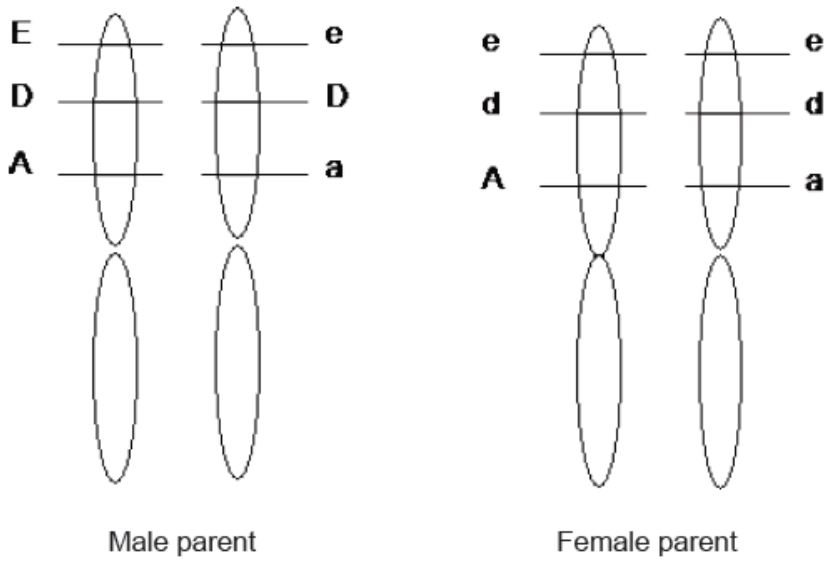
Inheritance

- Punnet squares and probability
- Test cross
- Determining mode of inheritance (autosomal v sex-linked, dominant v recessive)
- Polygenic inheritance and codominance
- Pedigrees

A species of mammal has 20 chromosomes in its cells, including 18 autosomal chromosomes plus a pair of sex chromosomes (XX or XY, as in humans). Some of the genes on autosomal chromosome number 1 are shown in the table below.

Characteristic controlled	Alleles
Ear shape	E – ear rounded e – ear pointed
Coat colour	D – coat dark grey d – coat light grey
Eye size	A – eye large a – eye small

The number 1 autosomal chromosomes of a mating pair of this species are shown below.



Male parent Female parent

- (i) List the characteristics for which the male parent is heterozygous. (2 marks)

_____

(ii) List the characteristics for which the female parent is homozygous. (2 marks)

_____

- Give the probability of an offspring of this pair having pointed ears. Explain your answer, showing your working. (4 marks)

- (i) Describe the phenotype of the male parent for all characteristics. (2 marks)

  _____

  (ii) Describe the phenotype of the female parent for all characteristics. (2 marks)

  _____

- Is it possible that the male parent's mother had a light-grey coat? Explain your answer, showing your working. (4 marks)

  _____

  _____

  _____

- What is the probability that the first offspring of this pair is a female with rounded ears and a dark coat? Show your working. (4 marks)

  _____

  _____

  _____

- a) Name the type of inheritance that controls skin colour in humans

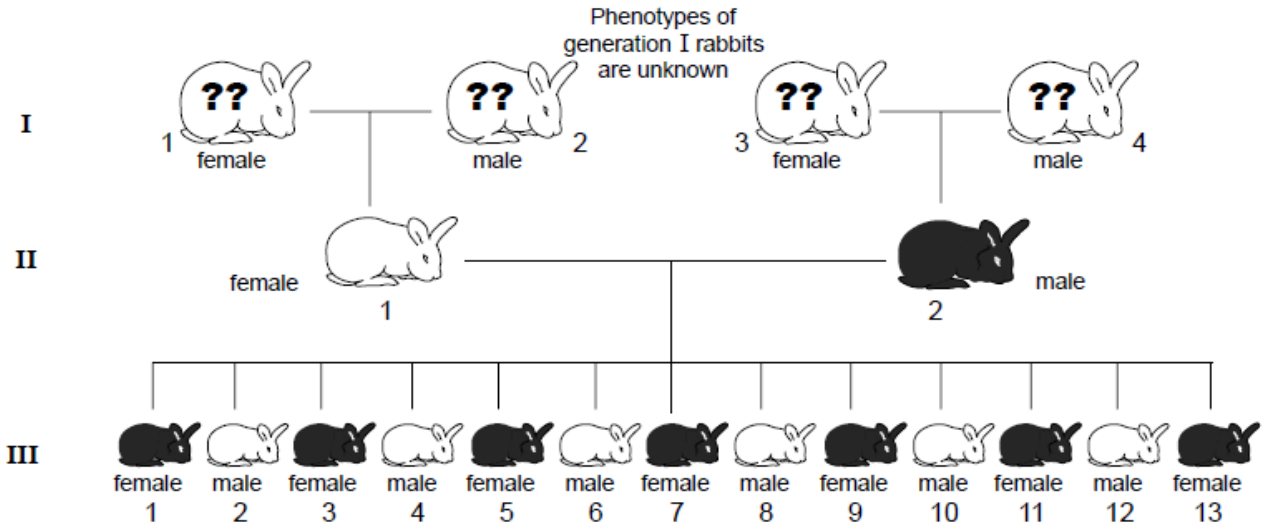
  _____ (1 mark)

  b) List two other human characteristics that follow the same mode of inheritance

  i) _____

  ii) _____ (2 marks)

- The pedigree below represents a family of rabbits. The shaded rabbits have inherited a disease. The phenotypes of rabbits I-1, I-2, I-3 and I-4 are not known.



On the basis of the offspring from generations II-1 and II-2 it has been suggested that the disease is an **X-linked dominant** characteristic.

a) What evidence from generations II and III support this suggestion?

_____

_____

_____ (1 mark)

- Explain how each of the following have deviated from Mendel's conclusions. Include an example of each inheritance.
  i. Multiple alleles
  ii. Sex-linked (X-linked) inheritance and
  iii. Polygenic (multiple-gene) inheritance.

Natural selection and evolution

- Sources of variation (meiosis – crossing over and independent assortment, mutations, random fertilisation)
- Natural selection (key points and case studies)
- Population genetics (gene pools, sexual selection, genetic drift, artificial selection)
- Speciation (allopatric and sympatric, steps in process, types of reproductive isolation)
- Extinction (characteristics of a viable population, role of biogeography, reproductive behaviour and population dynamics in maintaining viable populations)

The Western Ground Parrot is a critically endangered species. Small populations have been found in Fitzgerald National Park and Cape Arid National Park. Reduced home ranges, predation and competition from introduced species have greatly affected their numbers. The selection pressures that they have been exposed over the past 200 years are very different to those that they were exposed to previously. With the small numbers of parrots remaining, wildlife officers are not sure if they still have a viable gene pool.

a) Natural selection occurs when selection pressures in the environment confer a selective advantage on a specific phenotype to enhance its survival and reproduction. State the outcome of natural selection to a population_____

b) What is a gene pool _____

c) Explain what is meant by "a viable gene pool" _____

d) What is meant by the term "extinction"?_____

c) Name the **three (3)** areas that conservation planners consider important to maintain viable gene pools of a specific species. _____

_____

_____

d) Establishing small breeding populations of Western Ground Parrots, exposes them to fluctuations in allele frequencies.

Explain the meaning of random genetic drift and bottleneck effect with relation to allele frequencies (2 marks)

Term	Explanation
Genetic drift	
Bottleneck effect	

Artificial, or selective breeding, is a term utilised by Charles Darwin to help explain the concept of natural selection. It is currently used in the Australian agricultural industry in Australia and allows for the rapid development of individuals with certain desirable traits.

State the main difference between artificial selection and natural selection.

_____

Describe how the rapid changes in phenotypes of organisms occur due to artificial selection.

The manes of male lions are an example of sexual selection within nature, with lionesses tending to choose males with large, dark manes as mates.

(a) Describe why these manes are considered sexual selection rather than other forms of selection pressures.

(b) Gene flow and genetic drift also contribute to allele frequency changes in gene pools. Describe the differences between these two processes of evolution.

- Asides from mutations, identify three factors that increase genetic diversity and describe how these factors contribute to the genetic diversity of sexually reproducing organisms.

- Describe the process that could lead to a few initial super weeds potentially becoming the dominant type of weed in the wheat belt.

- Explain the characteristics of a viable population and the role of biogeography, reproductive behaviour and population dynamics in maintaining a viable gene pool in an artificially-selected area.

Evidence for Evolution

- Fossils (relative and actual dating, index fossils, fossilisation process, why fossil record is incomplete)
- Comparative anatomy (homologous structures, analogous structures, vestigial structures)
- Embryology
- Comparative Biochemistry (DNA hybridisation and proteins)
- Biogeography
- Phylogenetic trees

Glossopteris is a genus of flowerless seed ferns, common 250 million years ago, it is now extinct. Many species of *Glossopteris* have been identified from leaf fossils.

(a) (i) Define the term 'fossil'. (1 mark)

(ii) Outline how fossils can provide evidence for evolution. (3 marks)

It has not been possible to determine the total number of *Glossopteris* species because the fossil record is incomplete.

(b) List **four** reasons why the fossil record is incomplete. (4 marks)

One:

Two:

Three:

Four:

(c) (i) Approximately when did life first evolve on Earth? (1 mark)

(ii) Describe the first life forms on Earth. (3 marks)

The table below shows the number of amino acid differences in a protein molecule in five different types of monkey.

	Saki	Macaque	Colobus	Squirrel	Woolly
Saki					
Macaque	6				
Colobus	8	2			
Squirrel	4	7	9		
Woolly	1	8	8	4	

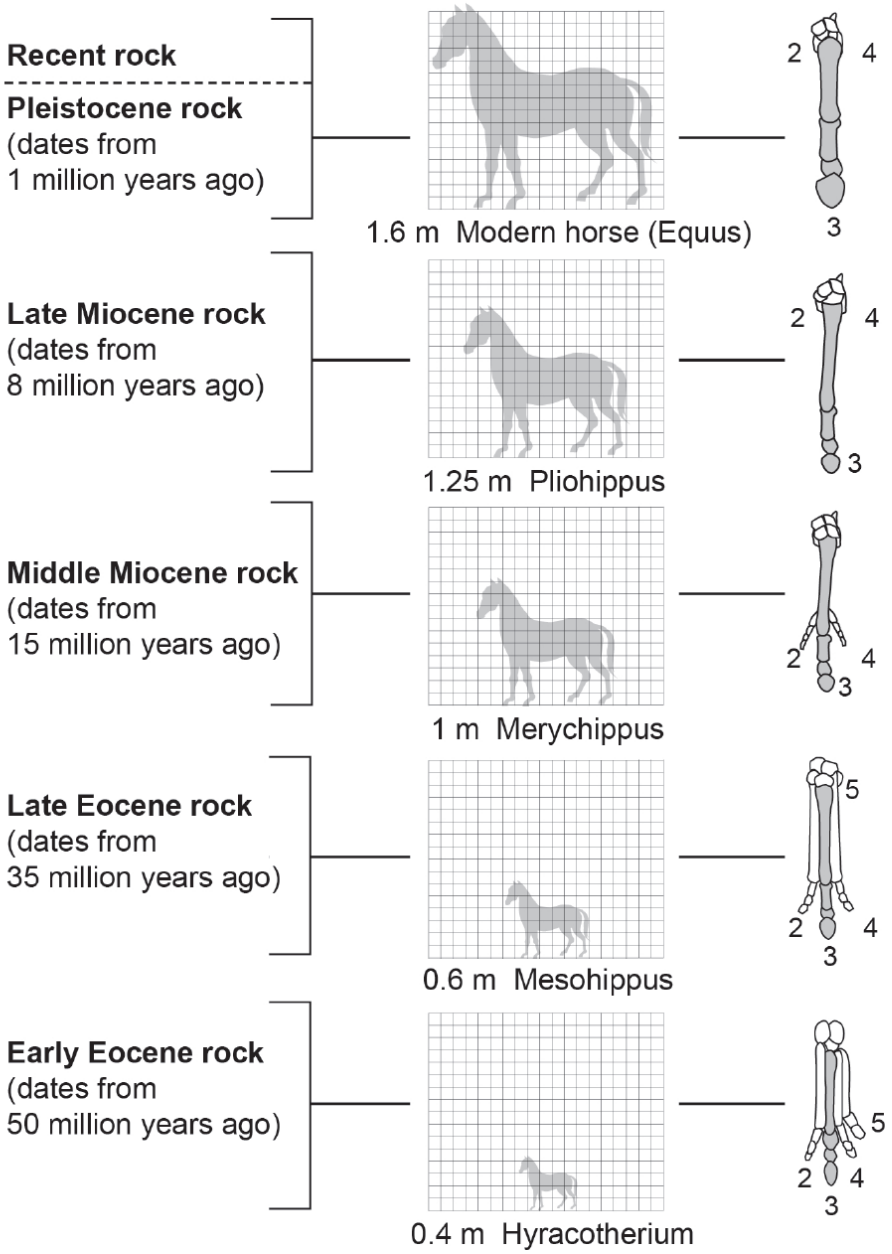
(d) Use these data to describe the evolutionary relationships of these monkeys. (4 marks)

(e) Explain how differences in the amino acid sequence of a protein can provide evidence of evolutionary relationships between organisms. (4 marks)

A biologist constructed a phylogenetic tree showing the evolutionary relationships among the Australian species of dung beetle.

(e) Explain how a phylogenetic tree can represent the evolutionary relationships among different species. (4 marks)

The following diagram shows the evolution of height and forefeet in modern horses and their extinct ancestors over the past 50 million years. The different digits ('fingers') of the forefeet are labelled 2 to 5.



(c) Describe the main features of the evolution of the forefeet in horses over the past 50 million years. (4 marks)

(d) Explain how biologists know about the evolution of the forefeet in horses over the past 50 million years. (4 marks)

(e) Is the evolution of horse forefeet an example of microevolution or macroevolution? Explain your answer. (4 marks)

A biologist calculated the percentage similarity in DNA sequence among four species of *Drosophila*. The results are presented in the table below.

Species	Percentage similarity with species 1
1	-
2	95
3	90
4	80

Use these data to construct a phylogenetic tree showing the evolutionary relationships among these species. Draw your tree in the space below. Include a title with your drawing. (4 marks)

(b) Explain how fossils, comparative anatomy, comparative embryology and comparative genomics can each provide evidence for the theory of evolution. (10 marks)

Biotechnology

Science as a Human Endeavour

- transgenic organisms have been engineered for desirable traits, including resistance, faster growth rate, greater product quality and yield, and tolerance to adverse environmental conditions
- using transgenic organisms may have adverse effects on genetic diversity and the environment, including
  - the effects on non-target organisms
  - more rapid evolution of pesticide-resistant species
  - the possibility of gene flow from crop species to weed species resulting in the emergence of 'super weeds'
- biotechnology can be used in environmental conservation for
  - monitoring endangered species
  - assessing gene pools for breeding programs
  - quarantine
- technological developments in the fields of comparative genomics, comparative biochemistry and bioinformatics have enabled identification of further evidence for evolutionary relationships
- conservation planning to maintain viable gene pools includes consideration of
  - biogeography
  - reproductive behaviour
  - population dynamics

a) The process of DNA replication requires enzymes. Identify the main **two (2)** enzymes that attach to the DNA molecule and describe their function.

i. Enzyme 1: _____

Function: _____

ii. Enzyme 2: _____

Function: _____

b) Summarise the difference between DNA sequencing and DNA profiling

_____

_____

_____

_____

c) Draw a labelled diagram to show the difference between a sticky end and blunt end strand of recombinant DNA

d) Describe the technique of recombinant technology in producing transgenic organisms, using the production of human insulin as an example.

e) Name **two (2)** areas where animal geneticists are using biotechnology to improve agricultural and horticultural practices in Australia.

Among Australia's key cotton pests is the global insect nemesis of agriculture; *Helicoverpa armigera*, better known as the bollworm. Since the mid-1990s, Australia's cotton breeders have begun creating transgenic, or genetically modified, organisms by incorporating genes from a common soil bacterium, *Bacillus thuringiensis* (Bt). These genes encode for the production of toxic insecticidal proteins.

(a) Explain the desirable traits that Bt cotton has been engineered for.

(b) Outline the sequence of events most likely undertaken to produce the Bt cotton.

(c) As with many technological advances, concerns have been raised in regards to recombinant technology. Discuss the adverse effects that genetically modified crops may have on genetic diversity and the environment.

DNA sequencing is being applied to agriculture and environmental conservation and is often achieved by using the Sanger method, which utilises dideoxynucleotides (ddNTPs).

(d) State what DNA sequencing is.

(e) Describe why ddNTPs are used in the Sanger method of DNA sequencing.

Homeostasis

Homeostasis

- What is homeostasis (definition)
- Tolerance levels (pH, CO_2, oxygen, temperature)
- Thermoregulation
- Negative feedback loops
- Osmoregulation (salt and water balance, nitrogenous waste)
- Xerophytes (arid) and Halophytes (salt)

Animals are generally described as being endothermic (homeothermic) or ectothermic (poikilothermic).

(a) Differentiate between endothermic and ectothermic animals. (2 marks)

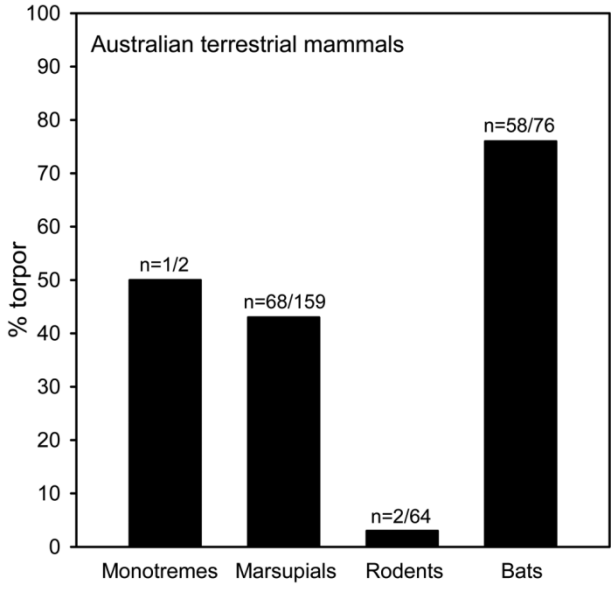
_____

_____

_____

Daily and prolonged torpor (temporary hibernation) in many Australian mammals appear to be opportunistic and not only important for survival of adverse seasonal conditions, but apparently also for dealing with unpredictable events such as droughts and perhaps fires and floods. During torpor these animals are able to decrease their body temperatures by up to 10^{o}C. These animals are therefore said to be 'heterothermic'.

The graph below shows the known or estimated number of heterothermic species/all species of Australian terrestrial mammals



(b) Calculate the percentage of marsupials that are heterothermic. (2 marks)

(c) Which group of Australian mammals has the highest percentage of heterotherms? (1 mark)

_____

(d) Explain how torpor helps to reduce the energy needs of the animals. (2 mark)

_____

_____

_____

(e) Scientific studies have shown that none of the heterothermic Australian species has gone extinct. In contrast many of the similar-sized homeothermic species, such as rodents and bandicoots, have suffered high rates of extinction. Discuss how torpor helps to improve the survival rate of Australian animals. (3 marks)

_____

_____

_____

_____

_____

Mallee is an Aboriginal name for a type of vegetation community in which the eucalypts grow. The Mallee Shrublands grow in semi-arid regions. Winter in these areas is short, cool and at times quite wet, whereas the summer is long, hot and dry.

(a) Describe the adaptations that the leaves of the vegetation in Mallee Shrublands would have to help the plants survive the hot, dry summers. (10 marks)

The barramundi is an iconic fish of Western Australia's Kimberley region. The barramundi's lifecycle includes freshwater, estuarine and marine phases. Their eggs hatch in the estuary, the juvenile fish then migrate into rivers and freshwater billabongs and when the fish become sexually mature (at three to five years of age) they migrate back to the saltwater.

(b) Barramundi have well developed physiological mechanisms for the regulation of salt to allow them to survive in salt and freshwater. Discuss how these mechanisms adapt as the Barramundi move from fresh water into salt water. (10 marks)

Infectious Disease

- infectious disease differs from other disease in that it is caused by invasion by a pathogen and can be transmitted from one host to another
- zoonoses, such as influenza, can be transmitted between vertebrate species
- the major groups of organisms that cause disease are bacteria, fungi, protists and viruses; each group can be distinguished by its structural characteristics
- diseases caused by these major pathogen groups include
  - tuberculosis, tetanus, crown gall of plants
  - chytridiomycosis (amphibian chytrid fungus disease)
  - malaria, Phytophthora dieback (jarrah dieback)*
  - influenza, Ross River virus, viral diseases of honeybees, Australian bat lyssavirus
- the life cycle of a pathogen and its associated diseases, including the method of invading the host, the impact on the host, and the mode of transmission (direct or indirect), determines its success for survival
- the spread of a specific disease involves a range of interrelated factors, including
  - growth of the pathogen population
  - density of the host population
  - mode of transmission
- transmission and spread of disease is facilitated by regional and global movement of organisms
- the distribution of mosquito-borne diseases may be affected by global climatic changes
- many pathogens evolve rapidly in a changing environment
- management strategies are used to control the spread of infectious diseases, including
  - quarantine
  - immunisation – herd immunity
  - disruption of pathogen life cycle
  - medications – antibiotics and antivirals
  - physical preventative measures

*The Phylum Oomycota containing *Phytophthora* dieback has been removed from the Fungi Kingdom and placed in the Protista Kingdom

Question 36 **(20 marks)**

The way in which pathogens are transmitted from one host to another can significantly impact how easily it can spread.

(a) Identify two human behaviours that can reduce the risk of contracting or spreading a contagious disease. (2 marks)

_____

_____

_____

(b) Explain why a pathogen, showing latent infection, can have a high degree of infectivity.(2 marks)

(c) Differentiate between the terms endemic, epidemic and pandemic. (3 marks)

The development of vaccines has enabled highly contagious diseases to be eradicated from the global population.

(d) Describe how immunisation programs have been successful in stopping the spread of virulent pathogens. (2 marks)

(e) Explain the concept of 'herd immunity'. (2 marks)

(f) Explain why herd immunity has been compromised in some communities around Australia. (2 marks)

Bacteria are the most abundant and diverse group of organisms on the planet. Much of their success can be attributed to adaptations and transmission.

(g) Identify two adaptive characteristics of bacteria and explain how these characteristics increase a bacteria's chance of survival. (4 marks)

(h) Outline three different ways in which bacteria cause disease. (3 marks)

_____

_____

_____

Australian Bat lyssavirus (ABLV) is one of twelve types of lyssavirus found worldwide. ABVL is the only type of lyssavirus found in Australia. Infection causes serious illness and death in humans.

(b) Explain how Australian Bat lyssavirus is transmitted from bat to human. Outline the signs of infection, possible treatments and preventative measures currently used in Australia. (10 marks)

For thousands of years, viral infections have caused the death of billions of people worldwide. The nature of viruses has made the development of effective treatments both difficult and time consuming.

(a) Describe the structure of a virus and its method of reproduction. Including a simple, labelled diagram to show the reproductive process. (10 marks)

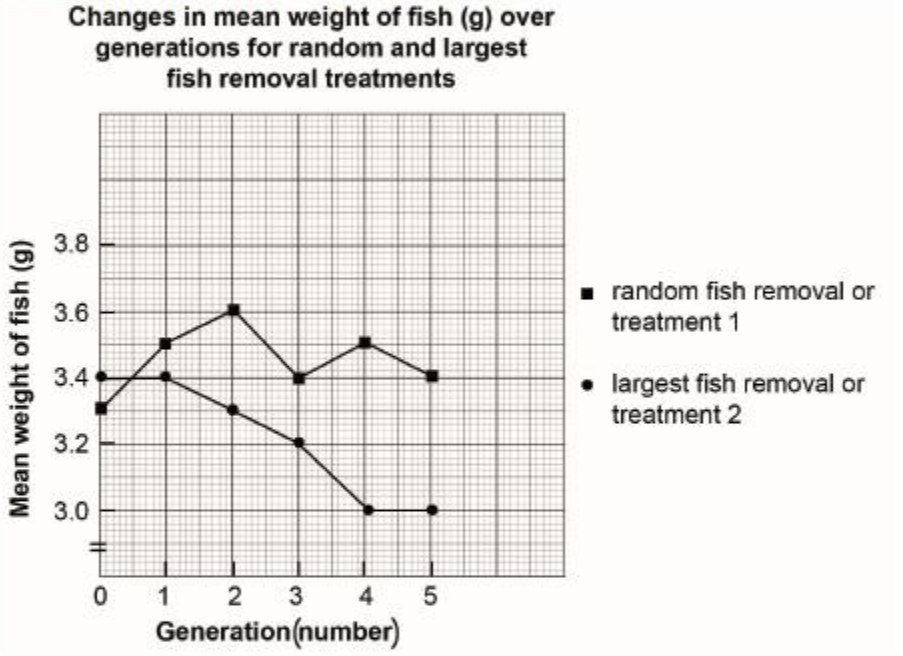
Solutions Start Next Page

Scientific Method

Question 32 **(20 marks)**

(a) Graph the mean weight of fish for both the random fish removal treatment and the large fish removal treatment against generation. (6 marks)

Description	Marks
title must include both variables	1
data plotted separately for treatments 1 and 2 including key	1
correct axes (X and Y)	1
appropriate scale	1
labelling – accurate labelling on both axes including units	1
plotting – data plotted accurately and joined (line graph)	1
Total	6
Note: 'mean' is required in Y axis label	



(b) (i) Identify the dependent variable in the experiment. Give a reason for your answer. (2 marks)

Description	Marks
mean weight/size of fish left in tank	1
this is the variable that was measured/depends on the independent variable	1
Total	2

(ii) Would conducting the experiment for more generations improve the reliability or validity of the experiment? Give a reason for your answer. (2 marks)

Description	Marks
validity	1
this would improve accuracy of experiment or the ability to determine whether removing largest fish had an effect	1
Total	2

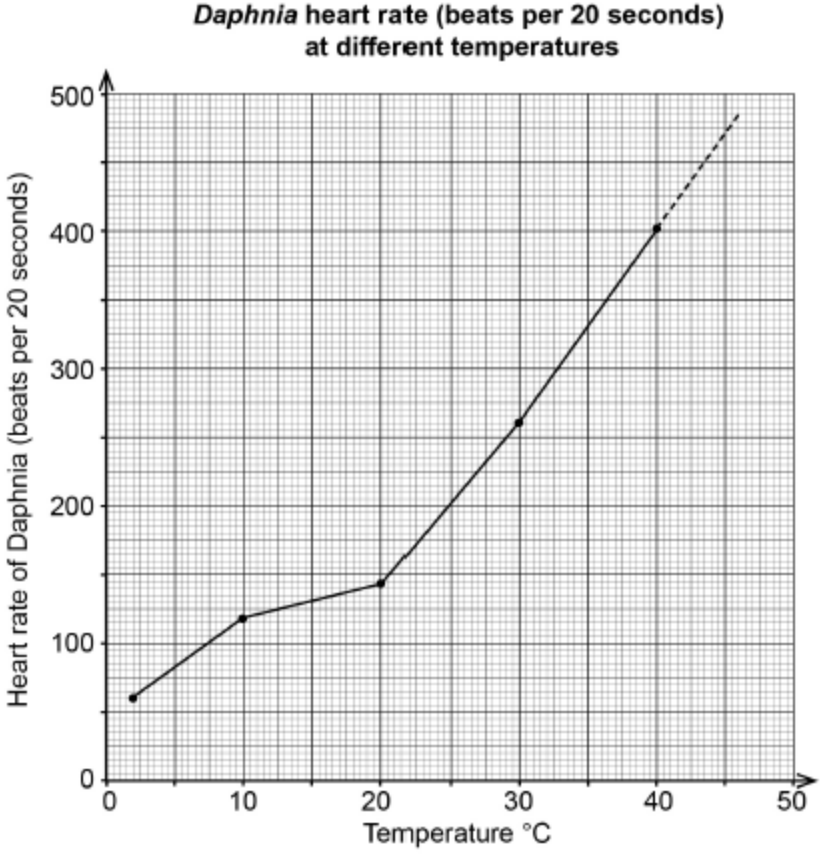
Question 32(b) (continued)

(b) (iii) Why did the biologists remove fish at random from the two tanks in Treatment 1. (2 marks)

Description	Marks
control	1
so the only difference between treatments was the size of the fish that were removed or to determine what would happen if fish were removed from tank regardless of weight/size	1
Total	2

Question 32 **(21 marks)**

(a) Graph the mean heart rate of the *Daphnia* against temperature. (6 marks)



Description	Marks
accurate title that includes both variables	1
choose appropriate graph/line graph	1
correctly allocates independent/dependent variables to X and Y axes respectively	1
scale uses correct intervals and graph size is appropriate for grid size	1
correct labelling of both axes including units	1
data points are accurate and accurately joined	1
Total	6

Question 32 (continued)

(b) (i) Estimate the heart rate for *Daphnia* at 15 °C. (1 mark)

Description	Marks
135 beats/20 seconds (accept 130–140, must have units)	1
Total	**1**

(ii) Estimate the heart rate for *Daphnia* at 45 °C. (1 mark)

Description	Marks
470 beats/20 seconds (accept 460–480, must have units)	1
Total	**1**

(iii) In which estimate do you have the greater confidence? Give a reason for your answer. (2 marks)

Description	Marks
heart rate at 15 °C or first estimate or (i)	1
this is an interpolation/within the range of the data or heart rate at 45 °C is an extrapolation/outside of range of data	1
Total	**2**

(c) (i) What is the independent variable in this study? Give a reason for your answer. (2 marks)

Description	Marks
temperature	1
it is the variable that the investigator controls/changes	1
Total	**2**

(ii) State one way of improving the reliability of the study. (1 mark)

Description	Marks
increase the sample size or use more *Daphnia* or repeating experiment	1
Total	**1**
Note to markers: Must have only one statement to improve reliability.	

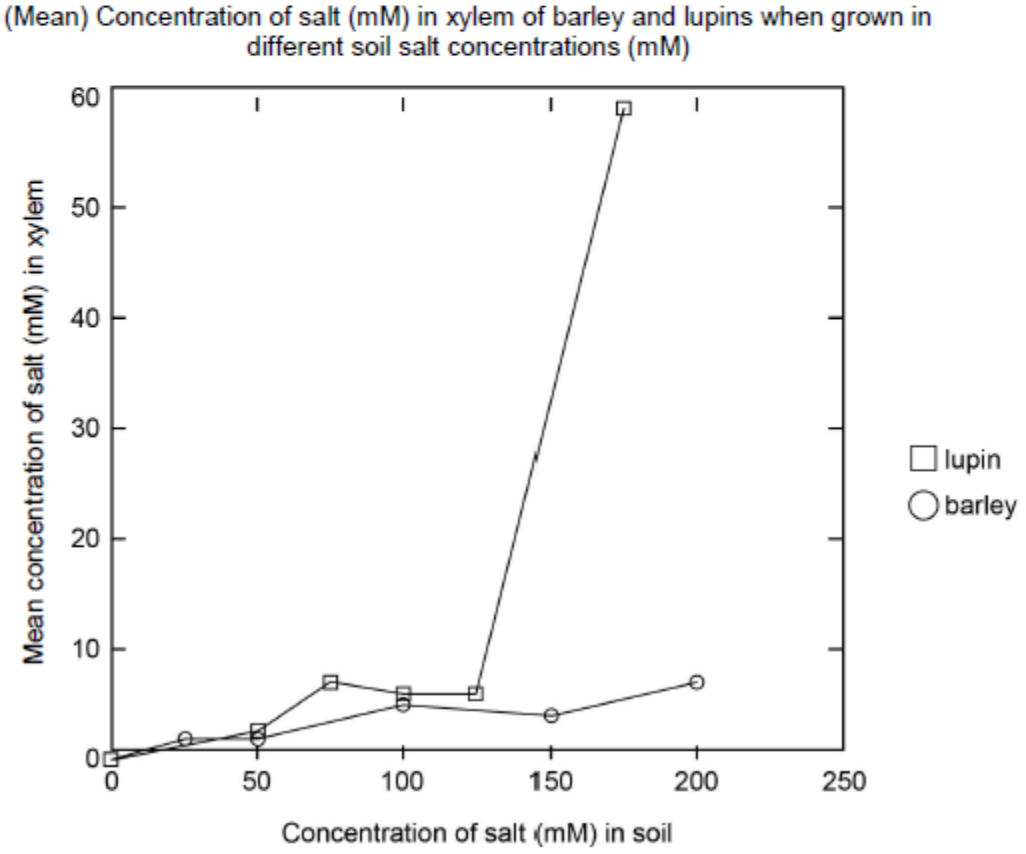
(iii) Propose an hypothesis for the study. (1 mark)

Description	Marks
heart rate in *Daphnia* is affected by temperature or heart rate in *Daphnia* is not affected by temperature or *Daphnia* heart rate increases with increasing temperature or increasing water temperature increases heart rate in *Daphnia*	1
Total	**1**

Question 34 **(20 marks)**

(a) Graph the mean salt concentration found in the xylem for both barley and lupins against the salt concentration in the soil. (6 marks)

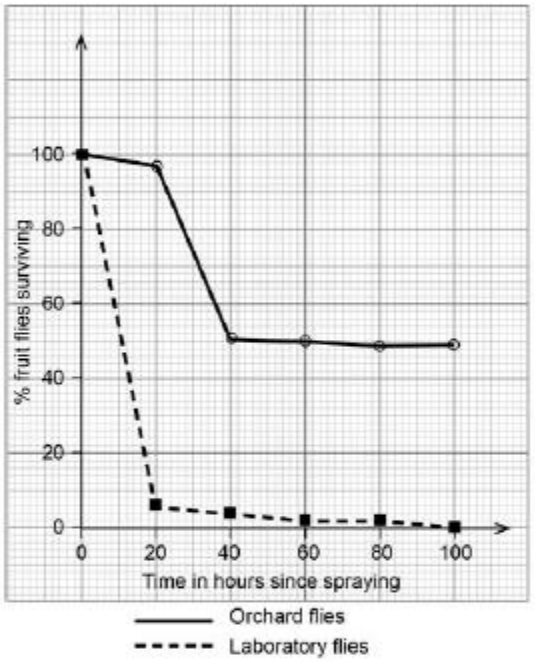
Description	Marks
Title must include both variables	1
Line graph; data plotted separately for barley and lupins with key	1
Correct axes (X and Y)	1
Correct scale	1
Labelling – accurate labelling on both axes including units	1
Plotting – data points accurate and accurately joined	1
Total	**6**
Note: 'mean' is required in Y axis label	



Question 33 **(20 marks)**

(a) On the grid below, graph the percentage of fruit flies surviving over time for both the fruit flies from the orchard and those from the laboratory. (6 marks)

Survival rates of fruit flies from an orchard and a laboratory when sprayed with an insecticide



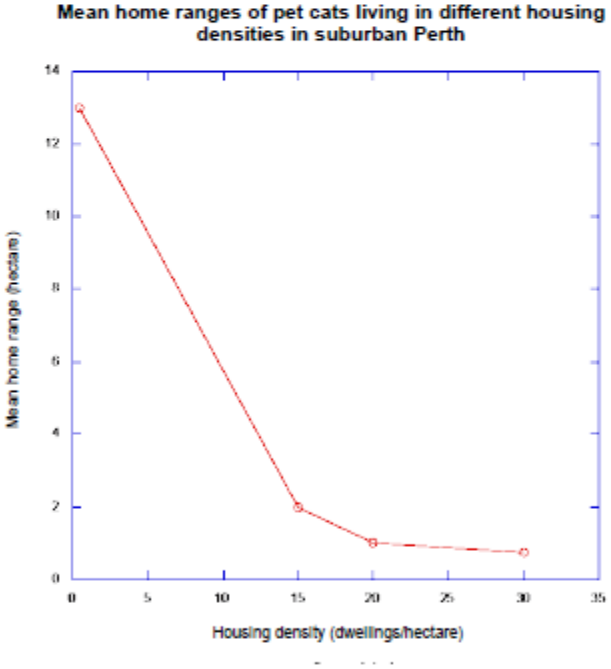
Description	Marks
Title, must include both variables	1
Line graph, data plotted separately for each group of flies with key	1
Correct axes (X and Y)	1
Correct scale	1
Labelling – accurate labelling on both axes including units	1
Plotting – data points accurate and accurately joined	1
Total	6

Question 33 **(20 marks)**

(a) The table below was constructed to summarise the data. Some cells are filled in as examples. Complete the summary table by placing the requested data in the empty cells. (3 marks)

Housing density (dwellings/ hectare)	Number of cats	Mean home range (hectare)	Median home range (hectare)	Range of home range (hectare)
0.5	4	13.0	13.5 (1 mark)	6.0-19.0
15.0	6 (1 mark)	2.0	2.0	1–3 (1 mark)
20.0	6	1.0	1.0	1.0-1.0
30.0	4	0.75	0.75	0.5-1.0

(b) Graph the relationship between the mean home range (hectare) of cats and housing density (dwellings/hectare). (6 marks)



Description	Marks
Title - must include both variables	1
Line graph	1
Correct axes	1
Correct scale	1
Labelling - accurate labelling on both axes, including units	1
Plotting - data points accurate and accurately joined	1
Total	6

(c) (i) Using your graph, estimate the mean home range (hectare) of cats at the housing densities (dwellings/hectare) below. (2 marks)

Description	Marks
8 dwellings/hectare = 7.2 hectares (accept 7.0 to 7.4), must include units	1
22 dwellings/hectare = 1 hectare (accept 0.8 to 1.2), must include units	1
Total	2

(ii) In which of the above estimates should you have the greater confidence? Give a reason for your answer. (2 marks)

Description	Marks
22 dwellings/hectare	1
Because there are more data points around 22 hectares or Because there are few data points around 8 hectares	1
Total	2

(d) Does the study on home range in cats have an independent variable? Explain your answer. (3 marks)

Description	Marks
Any three of:	
• Yes/There is an independent variable • Housing density was the independent variable • Effect of housing density on cat home range was investigated • An independent variable is one that is changed to determine its effect on the dependent variable	1–3
Total	3

(e) (i) Explain an advantage of using more cats in the study. (2 marks)

Description	Marks
Increase reliability	1
Reduces the chance of random errors or that the cats used were not representative or limits the effects of outliers	1
Total	2

(ii) Explain a disadvantage of using more cats in the study. (2 marks)

Description	Marks
Any one of the following answer sets, one mark per point	
increase costs will require more labour and equipment	1–2
ethical considerations should minimise/reduce numbers of animals used in studies	1–2
Total	2

DNA, Cell Reproduction, Protein Synthesis

(a) Explain the relationship between DNA, genes and chromosomes. (3 marks)

Chromosomes are made up of DNA that is coiled tightly around histones (1).
DNA is made up of four nucleotides (ATGC) (1)
Genes are sequences of DNA that code for a certain protein (1)

(b) Name the enzyme that would transcribe the gene shown above. (1 mark)

RNA Polymerase

(c) State whether the top or bottom strand would serve as a template if the enzyme from question (a) above were to transcribe the gene from left to right. (1 mark)

Top strand (3' – 5' direction)

(d) Write the sequence of mRNA that will be produced.Include the position of the 3' and 5' ends. (2 marks)

5' – CCGUAUACGCUAUCAGCU – 3'

(e) Describe the three events that occur allowing the mRNA strand to be translated. (6 marks)

Initiation
Ribosome attaches to the mRNA (1)
Begins at the START (AUG) codon (1)
Elongation
tRNA brings corresponding amino acid to each codon (1)
via the anticodon (1)
Termination
Reading of the STOP codon (1)
Ends synthesis and releases protein (1)

(f) Asides from the change of Thymine to Uracil, describe two (2) other differences between DNA and mRNA in regards to protein synthesis (4 marks)

Any two (2) differences with suitable reason for two marks each:
Differences:
mRNA is single stranded, whilst DNA is double stranded (1)
DNA forms a double helix, whilst RNA does not (1)
mRNA is shorter / smaller than DNA (1)
ribose sugar in RNA, and deoxyribose in DNA (1)
Reasons:
double stranded/double helix mRNA would inhibit/delay protein synthesis (1)
ribose has –OH group leaving mRNA single stranded (1)
this is because it is required to leave the nucleus to be translated (1)

(g) State the type of mutation shown above. (1 mark)

Addition

(h) Define the term mutagen. (1 mark)

A physical or chemical agent that causes mutations.

(i) Explain the possible effects of this mutation on the GFI protein. (5 marks)

No effect (1) - silent mutation / protein is not affected (1)
Protein is altered (1) and resultant protein may confer either a negative (1) or positive (1) effect

i) Draw a diagram of a labelled nucleotide (1 mark)

Phosphate – deoxyribose sugar - nitrogenous base (1)

ii) The two DNA strands run in a counter current direction. In which direction are new nucleotides added? (1 mark)

iii) 5' to 3' (can only be added to the sugar end)

iv) Write the correct name for DNA. (1 mark)

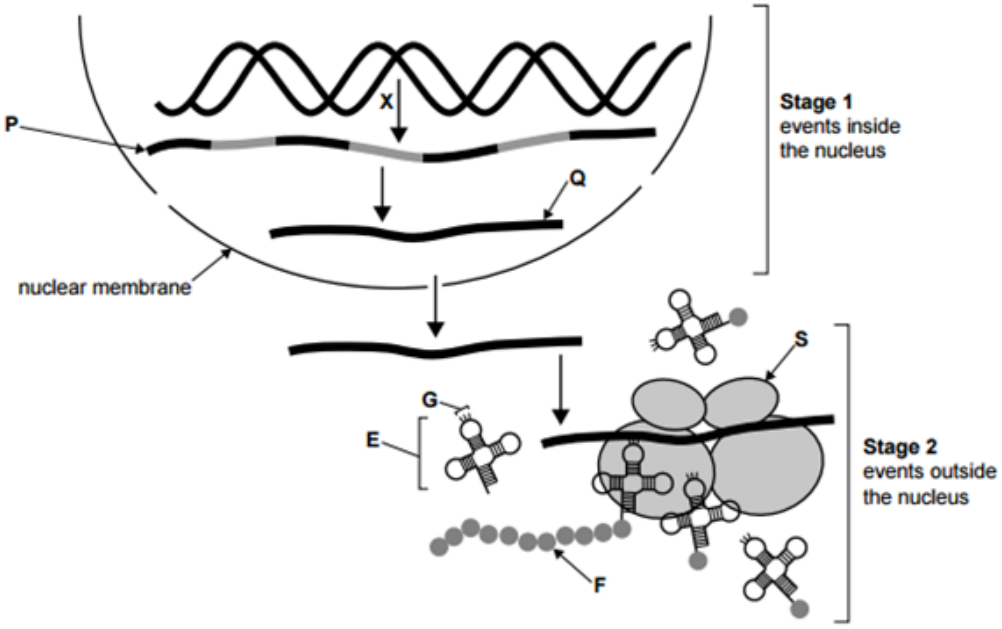
Deoxyribose Nucleic Acid

i) Write the corresponding tRNA code for the following DNA strand: (1 mark)

DNA	T A T C G G C T A C A A T T
tRNA	U A U C G G C U A C A A U U

ii) At which anticodon is translation initiated? (1 mark)

UAC



Label:

i) Process X: **Transcription**
ii) Structure Q: **mRNA**
iii) Structure E: **tRNA** (3 marks)

d) Describe the events occurring in stage 2, including the role of each of the structures S, F, E and G. (4 marks)

- **mRNA binds with ribosome**
- **tRNA anticodon matches mRNA codon and carries corresponding amino acid**
- **Next tRNA moves into place**
- **Peptide bond**

d) Describe the events occurring in stage 2, including the role of each of the structures S, F, E and G. (4 marks)

- **mRNA binds with ribosome**
- **tRNA anticodon matches mRNA codon and carries corresponding amino acid**
- **Next tRNA moves into place**
- **Peptide bond**

e) Describe codon degeneracy and its biological importance. (4 marks)

- 20 amino acids and 4 nucleotide bases A, T, C, G.
- unique code for each amino acid requires three bases to code for each (a triplet code);
- Two bases only give 16 combinations. **However,** three bases give 64 combinations.
- **Therefore because** there are more possible codes than amino acids the system is degenerate.
- **Biological significance: Point mutation does not always result in a phenotype change**

f) The complimentary DNA (cDNA) strand can be synthesised using the analysis of the amino acids. However, if scientists use this analysis of the protein to form cDNA, it may not have the same code sequence as cDNA formed using mRNA.

Discuss why this situation occurs. (4 marks)

- **Due to** degeneracy of the code / more codes than amino acids, there is more than one code for each amino acid
- **So** if you know the amino acid sequence of the protein produced there will be a variety of different sequences of DNA that may have produced it.
- **However,** when cDNA is produced from an mRNA sequence there can only be one sequence the cDNA can have.
- This sequence may or may not be the same as the cDNA sequence produced from the protein.

- Explain the process of budding and both the advantages and disadvantages of asexual reproduction.

Budding – maximum 2 marks:

Bud forms on the body of the parent cell (1)
Genetic material of the parent cell undergoes mitosis and new nucleus fills bud (1)
Each new cell receives the same genetic information as parent cell (1)

Advantages – maximum 4 marks:

Rapid increase in offspring (1) increasing the frequency of their genes (1)
Do not require a mate (1) meaning it does not have to spend time or energy finding a suitable mate before reproducing (1)
Does not require mobility (1) meaning that reproductive success is greater (1)
Prevailing conditions suit phenotype of parent so will suit offspring (1)

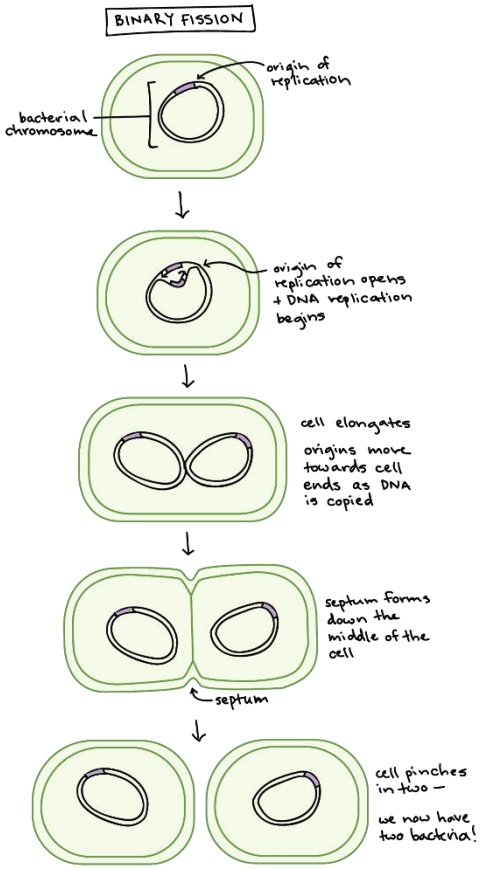
Disadvantages – maximum 4 marks:

Inheritance of mutations/defects (1) due to exact copy of genes (1)
Less ability to adapt (1) due to decreased genetic variety (1)
Changes in the environment can have major consequences (1) owing to the lack of diversity (1)

Describe the differences between meiosis and mitosis.

Mitosis	Meiosis
In all body cells, including germline	In germline cells only
Crossing over does not occur	Crossing over occurs
Two daughter nuclei same as parent	Four daughter nuclei different to parent
One division	Two divisions
Individually line up at equator	Homologous pairs line up at equator
Diploid daughter cell	Haploid sex cells
For repair, growth and replacement	To create gametes (egg/sperm)

Draw a diagram detailing how bacteria reproduce

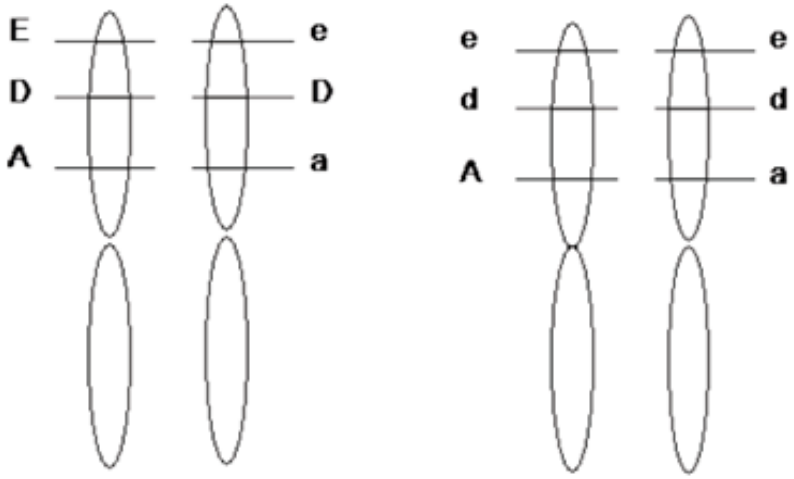


Inheritance

26. A species of mammal has 20 chromosomes in its cells, including 18 autosomal chromosomes plus a pair of sex chromosomes (XX or XY, as in humans). Some of the genes on autosomal chromosome number 1 are shown in the table below.

Characteristic controlled	Alleles
Ear shape	E – ear rounded e – ear pointed
Coat colour	D – coat dark grey d – coat light grey
Eye size	A – eye large a – eye small

The number 1 autosomal chromosomes of a mating pair of this species are shown below.



Male parent Female parent

(a) (i) List the **characteristics** for which the male parent is heterozygous. (2 marks)

Ear shape (1), Eye size (1), pay only (1) mark for phenotype

(ii) List the **characteristics** for which the female parent is homozygous. (2 marks)

Ear shape (1), Coat colour (1), pay only (1) mark for phenotype

(b) Give the probability of an offspring of this pair having pointed ears. Explain your answer, showing your working. (4 marks)

Genotypes (2), Offspring (1), Probability ½ or 50% (1)

	E	e
e	Ee	ee
e	Ee	ee

(c) (i) Describe the phenotype of the male parent for all characteristics. (2 marks)

Round ears, Dark grey coat, Large eyes (must have all correct)

(ii) Describe the phenotype of the female parent for all characteristics. (2 marks)

Pointed ears, Light grey coat, Large eyes (must have all correct)

(d) Is it possible that the male parent's mother had a light-grey coat? Explain your answer, showing your working. (4 marks)

No (1)
Male genotype DD (1)
Must have received a D from father, D from mother (2)
Or
Would have to be dd to have light grey coat, mother could not as she passed on D allele (2)
Or
Equivalent punnet squares as evidence

(e) What is the probability that the first offspring of this pair is a female with rounded ears and a dark coat? Show your working. (4 marks)

Female = ½ (1)

Round ears = ½ (1)

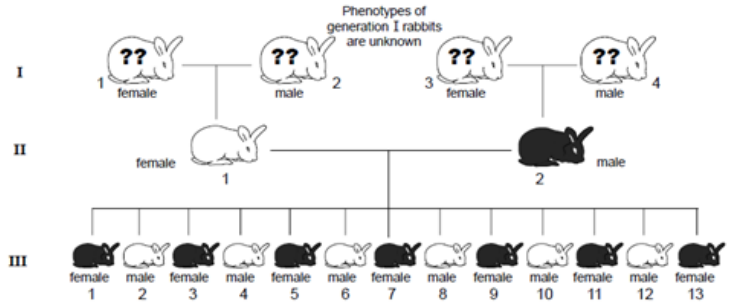
	E	e
e	Ee	ee
e	Ee	ee

Dark coat = 1/1 or 100% (1)

	D	D
d	Dd	Dd
d	Dd	Dd

Overall probability = ½ x ½ x 1 = ¼ (1)

6. The pedigree below represents a family of rabbits. The shaded rabbits have inherited a disease. The phenotypes of rabbits I-1, I-2, I-3 and I-4 are not known.



On the basis of the offspring from generations II-1 and II-2 it has been suggested that the disease is an **X-linked dominant** characteristic.

a) What evidence from generations II and III support this suggestion? (1 mark)

Affected male (II2) has passed on to all daughters in generation III (1)

b) If the mode of inheritance suggested is correct, complete the table below to show the possible phenotypes and genotypes of rabbits I-1, I-2, I-3 and I-4. For each rabbits phenotype, select from (4 marks)

- Has the disease
- Does not have the disease
- Impossible to tell from the information given

	Phenotype	Possible genotypes
Rabbit I 1	Impossible to tell	X^dX^d, X^DX^d
Rabbit I 2	Does not have	X^dY
Rabbit I 3	Has disease	X^DX^D/X^DX^d
Rabbit I 4	Impossible to tell	X^dY, X^DY

(1/2 mark each)

Natural selection and evolution

The Western Ground Parrot is a critically endangered species. Small populations have been found in Fitzgerald National Park and Cape Arid National Park. Reduced home ranges, predation and competition from introduced species have greatly affected their numbers. The selection pressures that they have been exposed over the past 200 years are very different to those that they were exposed to previously. With the small numbers of parrots remaining, wildlife officers are not sure if they still have a viable gene pool.

a) Natural selection occurs when selection pressures in the environment confer a selective advantage on a specific phenotype to enhance its survival and reproduction. State the outcome of natural selection to a population. (1 mark)

The advantageous genotype/phenotype increases in frequency

b) What is a gene pool? (1 mark)

The total of all genes in a population

c) Explain what is meant by "a viable gene pool" (2 marks)

enough variation to ensure survival

d) What is meant by the term "extinction"? (1 mark)

no descendants of species remains

c) Name the **three (3)** areas that conservation planners consider important to maintain viable gene pools of a specific species. (3 marks)

- Biogeography
- Reproductive behaviour
- Poplation dynamics

d) Establishing small breeding populations of Western Ground Parrots, exposes them to fluctuations in allele frequencies.

Explain the meaning of random genetic drift and bottleneck effect with relation to allele frequencies (2 marks)

Term	Explanation
Genetic drift	Change in allele frequency due to random fluctuations in small populations
Bottleneck effect	Catastrophic event resulting a population who's gene pool is not representative of the parent population

Artificial, or selective breeding, is a term utilised by Charles Darwin to help explain the concept of natural selection. It is currently used in the Australian agricultural industry in Australia and allows for the rapid development of individuals with certain desirable traits.

State the main difference between artificial selection and natural selection.

Describe how the rapid changes in phenotypes of organisms occur due to artificial selection.

Question 35 **(20 marks)**

(a) (i) Define the term 'fossil'. (1 mark)

Description	Marks
preserved remains/impression/traces of an old/ancient/extinct organism	1
Total	**1**

(ii) Outline how fossils can provide evidence for evolution. (3 marks)

Description	Marks
show past life/extinct organisms	1
show that life has changed over time or that life on earth has a long history	1
show how one type of organism/structure has transitioned to another	1
Total	3

(b) List **four** reasons why the fossil record is incomplete. (4 marks)

Description	Marks
Any **four** of:	
• only hard parts are likely to form fossils or soft parts are unlikely to form fossils • only organisms that avoid decomposition/scavengers/predators form fossils or fossils only form in areas with no oxygen/bacteria • only organisms that are buried in sediment/mineral rich water form fossils or rapid burial • not all fossils have been found yet • some fossils have been destroyed (by volcanic eruptions/human activities/earthquakes)	1–4
Total	**4**

(c) (i) Approximately when did life first evolve on Earth? (1 mark)

Description	Marks
3.5 billion years ago (accept any answer between 3 and 4 billion) or Archaean or Palaeozoic	1
Total	**1**

(ii) Describe the first life forms on Earth. (3 marks)

Description	Marks
Any **three** of:	
• microbes/single cell • simple cells/prokaryotes • bacteria/bacteria-like/archaea • aquatic/anaerobes/marine	1–3
Total	3

(d) Use these data to describe the evolutionary relationships of these monkeys. (4 marks)

Description	Marks
saki and woolly are closely related/most closely related	1
colobus and macaque are closely related/next most closely related	1
squirrel, saki and woolly form a related group or colobus and macaque are distantly related to others or form a distinctive group	1
any accurate quote of data (must give names of monkeys and number of amino acid substitutions)	1
Total	**4**

(e) Explain how differences in the amino acid sequence of a protein can provide evidence of evolutionary relationships between organisms. (4 marks)

Description	Marks
Any **four** of:	
Either • sequence of amino acids in a protein is determined by a DNA sequence • the more similar the amino acids, the more similar the DNA sequence • organisms with similar DNA/amino acid sequences are closely related • because they diverged more recently • less time to accumulate mutations/differences **or** • sequence of amino acids in a protein is determined by a DNA sequence • the more different the amino acids, the more different the DNA sequence • organisms with different DNA/amino acid sequences are not closely related • because they diverge a long time ago • more time to accumulate mutations/differences	1–4
Total	**4**

(e) Explain how a phylogenetic tree can represent the evolutionary relationships among different species. (4 marks)

Description	Marks
Explains how a phylogenetic tree can represent the evolutionary relationships (any **four** of):	
• branching of the tree represents the relationships • recent/descendent species are at the tips of branches • shared/common ancestors are at base/trunk of the tree • nodes/branching point represent a common ancestor • branch length represents divergence time/similarities/differences • closely related species will be grouped in same part of tree or unrelated species will be grouped in different parts of tree • tree constructed from DNA/morphological/biochemical data (which reflect relationships)	1–4
Total	**4**

(c) Describe the main features of the evolution of the forefeet in horses over the past 50 million years. (4 marks)

Description	Marks
Any **four** of:	
• (progressively) reduced the number of digits • started with four digits • digit five was lost early on • digits two and four have also been reduced • forefeet of modern horse comprises only one (main) digit/digit three • accurate quote from the figure that gives time, taxon name and details of forefeet • forefoot elongates/widens/more robust over time (as horse height increases)	1–4
Total	**4**
Note: can use fingers or phalanges instead of digits but maximum of three marks if candidate refers to toes in answer	

(d) Explain how biologists know about the evolution of the forefeet in horses over the past 50 million years. (4 marks)

Description	Marks
Any **four** of:	
• fossils/fossil record • preserved bones (from forefeet) • bones are likely to be preserved/common in the fossil record • compare fossil evidence with forefoot in modern horse/comparative anatomy • can age fossils using index fossils/date bones/date rock (in which the fossil was found)	1–4
Total	**4**

(e) Is the evolution of horse forefeet an example of microevolution or macroevolution? Explain your answer. (4 marks)

Description	Marks
Macroevolution	1
Any **three** of:	
• evolution above the level of the species • major or large-scale changes • over a long period of time/millions of years • trend within a large group/taxon • accumulation of many small/microevolutionary changes	1–3
Total	**4**
Note: if states microevolution then zero marks for explanation	

Question 35 **(20 marks)**

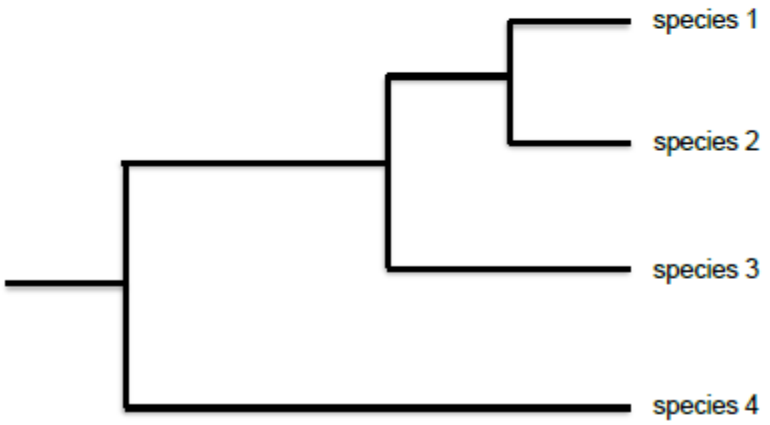
(a) A biologist calculated the percentage similarity in DNA sequence among four species of *Drosophila*. The results are presented in the table below.

Species	Percentage similarity with species 1
1	-
2	95
3	90
4	80

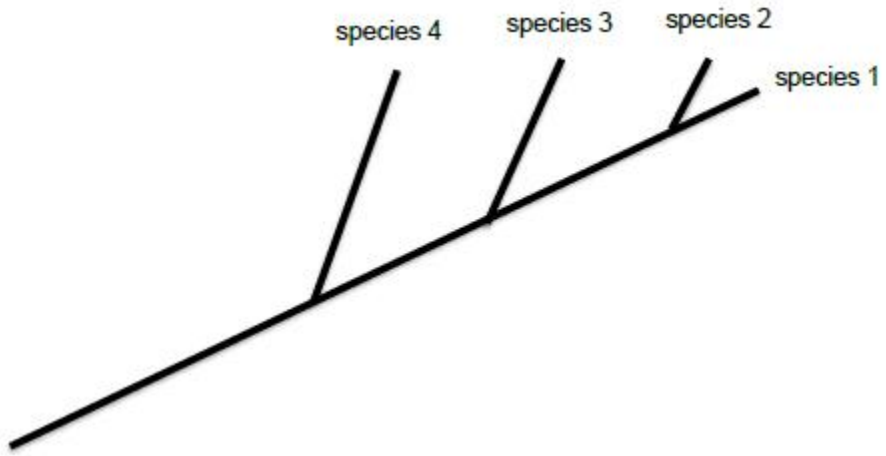
Use these data to construct a phylogenetic tree showing the evolutionary relationships among these species. Draw your tree in the space below. Include a title with your drawing. (4 marks)

Description	Marks
See Tree below	
Branches placing species 1 and 2 together (must have species labels)	1
Branch/section placing species 3 on the outside of species 1 and 2 (must have species label)	1
Branch/section placing species 4 on the outside of species 3 (must have species label)	1
Title	1
Total	**4**

Phylogenetic tree showing the evolutionary relationships among four *Drosophila* species



or



(b) Explain how fossils, comparative anatomy, comparative embryology and comparative genomics can each provide evidence for the theory of evolution. (10 marks)

Description	Marks
Fossils	
Any **three** of:	
• Show past life/extinct species or show traces of past life/extinct species • Can be dated or assigned to a time period • Can follow changes in a trait/organisms/species over time • Show transitional/intermediate/ancestral forms (which show how one group evolved from another) • Specific example, Archaeopteryx/forms that show features of both birds and dinosaurs	1–3
Comparative anatomy	
Any **three** of:	
Either • Homologous structures • Structures developed from the same plan • Different functions • Shows the relationships among organisms (despite modification for different functions) • Specific example, e.g. pentadactyl limb of vertebrates **or** • Convergent evolution or analogous structures • Different structures • Same function • Evolved independently • Specific example, e.g. wing of bat and insects **or** • Vestigial structures • Structure that is no longer functional/reduced in size • Can be traced to functional structure in other organisms • Shows evidence of relationships among organisms • Specific example, e.g. appendix in humans	1–3
Comparative embryology	
Any **two** of:	
• (Embryos) show features that are not present/obvious in adults • These features can show relationships among organisms or ancestry of organisms • Specific example, e.g. embryo of whales have limb buds	1–2
Comparative genomics	
Any **two** of:	
Either • Large amounts of genetic/sequence data are compared • The closer the sequence (DNA/RNA/Amino acid) the more closely related the organisms. • Build phylogenetic trees • Determine evolutionary relationships (from phylogenetic trees) **or** • Genetic code is (almost) universal • Implies that all organisms have descended from a common ancestor	1–2
Total	**10**

Biotechnology

c) The process of DNA replication requires enzymes. Identify the main **two (2)** enzymes that attach to the DNA molecule and describe their function. (4 marks)

i. Enzyme 1: DNA helicase (1)

Function: unwinds the DNA molecule so other molecules can attach to it(1)

ii. Enzyme 2: DNA polymerase (1)

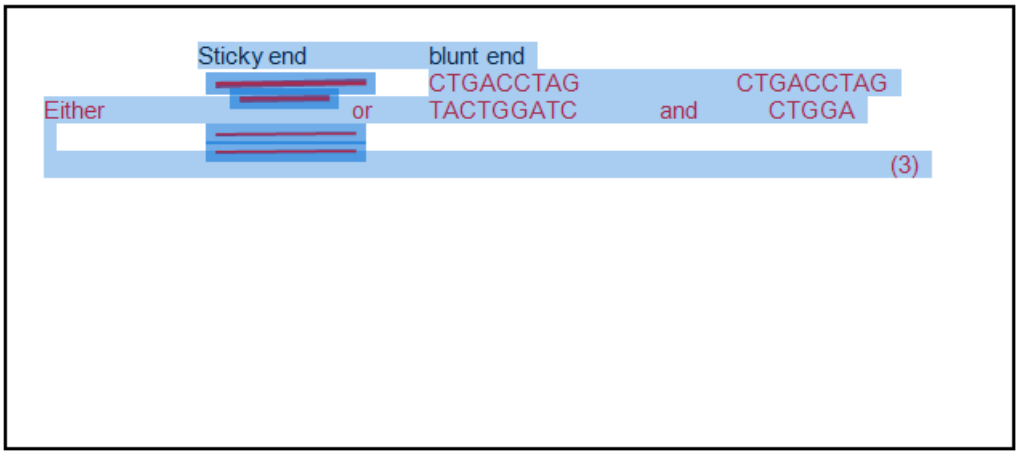
iii. Function: binds to the DNA and synthesises a new complimentary strand of DNA (1) from the 5' to 3' end.

iv. Or ligase….

d) Summarise the difference between DNA sequencing and DNA profiling (2 marks)

DNA sequencing enables mapping of species genomes; DNA profiling used compare unique samples

e) Draw a labelled diagram to show the difference between a sticky end and blunt end strand of recombinant DNA (2 marks)



f) Describe the technique of recombinant technology in producing transgenic organisms, using the production of human insulin as an example. (7 marks)

4 Isolate the Gene of Interest using Restriction Enzymes
- Matches the sequence of nucleotides in the DNA
- Cuts at the specific location
- Creates Sticky/Blunt ends

1 Cut/Digest vector DNA with same Restriction Enzyme

1 Ligation
- Ligase enzymes form hydrogen bonds between nucleotides
- DNA-ase helps form bonds forming side strand

2. Introduce plasmid to bacterium/production vat/Antibiotics

(6)

g) Name **two (2)** areas where animal geneticists are using biotechnology to improve agricultural and horticultural practices in Australia. (2 Marks)

h) produce blowfly-resistant sheep
i) produce cattle that can withstand greater temperature and water stresses
j) increase wool production
k) reduce diseases in aquaculture
l) improve defences against stock animal disease
m) improve pig welfare
n) protect cattle against tick-borne diseases
o) any other relevant area

Among Australia's key cotton pests is the global insect nemesis of agriculture; *Helicoverpa armigera*, better known as the bollworm. Since the mid-1990s, Australia's cotton breeders have begun creating transgenic, or genetically modified, organisms by incorporating genes from a common soil bacterium, *Bacillus thuringiensis* (Bt). These genes encode for the production of toxic insecticidal proteins.

(a) Explain the desirable traits that Bt cotton has been engineered for. (3 marks)

Contains the Bt gene that produces a toxin that kills/harms the bollworm (1). This improves the yield (1) and reduces the need to spray insecticide (1).

(b) Outline the sequence of events most likely undertaken to produce the Bt cotton. (5 marks)

Identify and isolate the Bt gene that kills/harms bollworms (1)
Extract / cut Bt gene out of DNA along with plasmid / agrobacterium (1)
Splice / ligate Bt gene into a plasmid / agrobacterium (1)
Transfer / transform / introduce recombinant plasmid / agrobacterium into tissue culture of cotton (1)
Culture / Grow Bt cotton plants (1)

(c) As with many technological advances, concerns have been raised in regards to recombinant technology. Discuss the adverse effects that genetically modified crops may have on genetic diversity and the environment. (4 marks)

Any two of the following three, with appropriate reasoning:

Gene Flow	- reduced genetic diversity / lack of variation - increased risk of extinction / weak adaptation to change
Effects on non-target species	- other organisms may ingest the toxins and die
Pesticide-resistant species	- Rapid evolution of resistant insect pests and weeds

DNA sequencing can be achieved by using the Sanger method, which utilises dideoxynucleotides (ddNTPs).

(d) State what DNA sequencing is. (1 mark)

Process of determining the precise order of nucleotides within a DNA mocelcule.

(e) Describe why ddNTPs are used in the Sanger method of DNA sequencing. (2 marks)

Inhibit the elongation of DNA / terminates the DNA chain (1), and allows different lengths and the sequence of the DNA to be found (1).

(a) Differentiate between endothermic and ectothermic animals. (2 marks)

Description	Marks
Endotherm: an animal that generates heat by metabolic activity within its body; for example mammals, birds, tuna.	1
Ectotherm: an animal that depends on absorbing heat from external heat sources; For example, fish, reptiles.	1
Total	2

(b) Calculate the percentage of marsupials that are heterothermic. (2 marks)

Description	Marks
Percentage of heterothermic marsupials = $\frac{68}{159} \times \frac{100}{1} = 42.8\%$	1 - 2
Total	2

(c) Which group of Australian mammals has the highest percentage of heterotherms? (1 mark)

Description	Marks
bats	
Total	2

(d) Explain how torpor helps to reduce the energy needs of the animals. (2 mark)

Description	Marks
Lower body temperature during torpor means the animals will need less food energy for respiration.	1
It the animal does not need to maintain a high body temperature then they do not need to maintain a high metabolic rate.	1
Total	2

(e) Discuss how torpor helps to improve the survival rate of Australian animals. (3 marks)

Description	Marks
• Animals who do not have torpor must forage long and frequently to meet large energetic demands and thus are more vulnerable to predation by introduced foxes and cats. • Animals who have torpor can avoid adverse environmental conditions such as drought (water limitation) and a lack of food after fire	1 - 3
Total	3

Mallee is an Aboriginal name for a type of vegetation community in which the eucalypts grow. The Mallee Shrublands grow in semi-arid regions. Winter in these areas is short, cool and at times quite wet, whereas the summer is long, hot and dry.

(c) Describe the adaptations that the leaves of the vegetation in Mallee Shrublands would have to help the plants survive the hot, dry summers. (10 marks)

Description	Marks
Mallee plants show many adaptations to survive dry climates such as; **Reducing the surface area of their leaves to minimise water loss;** • Leaf adaptation includes tiny leaves, long narrow leaves, needle-shaped leaves or rolling their leaves during the hottest part of the day. When the leaf is rolled fewer stomatal grooves are exposed to the drying **Leaves which reflect heat and light** • Some plants have shiny leaves, with waxy cuticles that reflect heat; • Light coloured leaves, especially if they are hairy, reflect significantly more radiant heat energy; • Fine hairs also decrease the air movement close to the surface of the plant, thus reducing water loss by evaporation. • More stomata located on the under surfaces of leaves and it is on this surface that most hairs are found **Leaves which hang vertically and edge-on to the sun;** • This reduces the total surface area exposed to the sun **Sclerophyllous leaves;** • Plants have hard, leathery leaves which reduce wilting and thick waxy cuticles which reduce water loss **Succulents** • Plants store water in fleshy stems or leaves.	1-10
Total	**10**

(d) Barramundi have well developed physiological mechanisms for the regulation of salt to allow them to survive in salt and freshwater. Discuss how these mechanisms adapt as the Barramundi move from fresh water into salt water. (10 marks)

Description	Marks
When the Barramundi live in salt water, they will be osmoconformers and match their osmolarity to the surrounding salt water: • Gain of water and salts from drinking sea water. • They lose water by osmosis though gills and other parts of the body surface. • Small volume of urine produced. Urine is slightly less concentrated then body fluids. • Excretion of ions in urine and through the gill surface. • They balance water loss by drinking seawater and excreting salts.	1-5
When the Barramundi live in fresh water, they will be osmoregulators and regulates their body osmolarity so it remains constant regardless of the external environment. • Actively control salt concentrations despite the salt concentrations in the environment. • Constantly take in water by osmosis from their hypoosmotic environment. • Water is gained by drinking, food and osmosis through the surface of the gills and other body parts. • They lose salts by diffusion. • Maintain water balance by excreting large amounts of dilute urine. Urine is less concentrate than the body fluids. • Salts lost by diffusion are replaced by uptake of salts across the gills.	1-5
Total	**10**

Infectious Disease

Question 36 **(20 marks)**

(a) Identify **two** human behaviours that can decrease the risk of contracting or spreading a contagious disease. (2 marks)

Description	Marks
***Two** points from the following* • Not sharing needles when using illicit drugs. • Using appropriate protection during sexual intercourse. • Washing hands after using the toilet and before food preparation. • Staying quarantined when ill.	 1 1 1 1
TOTAL	**2**

(b) Why can a pathogen, showing latent infection, have a high degree of infectivity(2 marks)

Description	Marks
The pathogen lives within the host for a long period with causing symptoms so the person does not know they are sick/contagious.	1
This allows the pathogen to reach other hosts over a longer period of time and infect a greater number of people.	1
TOTAL	**2**

(c) Differentiate between the terms endemic, epidemic and pandemic. (3 marks)

Description	Marks
An endemic is when a disease occurs within a population at a steady rate.	1
An epidemic occurs when the disease begins to increase in the population above what is considered normal.	1
A pandemic occurs when an epidemic spreads across many countries or continents throughout the world.	1
TOTAL	**3**

(d)Describe how immunisation programs have been successful in stopping the spread of virulent pathogens

Description	Marks
Reducing the rate of infection of virulent pathogens.	1
Eradicating some diseases by completely stopping spread through mass immunisation programs.	1
TOTAL	**2**

(e) Explain the concept of 'herd immunity'. (2 marks)

Description	Marks
When a large proportion of the population are immunised so the few left unimmunised cannot sustain the disease.	1
The chance of coming into contact with an infected person is very low and the disease cannot spread.	1
TOTAL	**2**

(f)

Explain why herd immunity has been compromised in some communities around Australia.

Description	Marks
More people are choosing NOT to have their infants/children immunised due to fear of serious illness from side effects and misinformation.	1
The growing number of non-immunised individuals weakens the 'herd immunity' and certain diseases can be reintroduced into a population.	1
TOTAL	**2**

(g) Identify **two** adaptive characteristics of bacteria and explain how these characteristics increase their chance of survival. (4 marks)

Description	Marks
Two *adaptations from the following* • **Flagellum** – helps to move around increasing spread. • **Slimy bacterial capsule** – helps bacteria stick to surfaces like cells OR can also increase virulence by impeding immune response. • **Endospore formation** – make bacteria resistant to extreme conditions allowing increased rate of dispersal.	1 – 2 1 – 2 1 – 2
TOTAL	**4**

(h) Outline **three** different ways in which bacteria cause disease. (3 marks)

Description	Marks
Three *points from the following* • Divide rapidly, damaging tissues directly. • Production of toxins that disrupt cell function. • Pathogenic parts of bacteria stimulate an overly strong and damaging immune response. • Interfering with the host's immune system, increasing the susceptibility to infection by other pathogens.	1 1 1 1
TOTAL	**3**

(b) Explain how Australian Bat lyssavirus is transmitted from bat to human. Outline the signs of infection, possible treatments and preventative measures currently used in Australia.

- Lyssavirus is usually transmitted via a bite or scratch from an infected bat or mammal. (1)
- Infection can also occur through contact with body fluids or waste. (1)
- Lyssavirus has a variable/long incubation period from weeks to months so symptoms of infection may not be obvious for some time. (1)
- First signs of disease/infection include fever, headache and fatigue. (1)
- The virus then infects the nervous system and causes paralysis, delirium, convulsions and eventually death (within a few weeks). (1)
- If a person is scratched or bitten the wound should be washed/cleaned and applied with antiseptic or antiviral medication (like ethanol or iodine). (1)
- Directly after exposure to a bite or body fluids, the vaccine can be administered due to the long incubation period of lyssavirus. Must be vaccinated before illness begins. (1)
- The vaccine/s are the same as those used for Rabies. Injected at the site of injury and other soft tissue. (Follow up injections required.) (1)
- Preventative measures are (at least **two**); no contact with bats or touching injured bats, being trained to handle bats and wearing protective garments, vaccination for lyssavirus prior to contact/handling bats. (1 – 2)

For thousands of years, viral infections have caused the death of billions of people worldwide. The nature of viruses has made the development of effective treatments both difficult and time consuming.

(a) Describe the structure of a virus and its method of reproduction. Including a simple, labelled diagram to show the reproductive process. (10 marks)

- Viruses are very simple and not classed as true living cells. They are non-cellular agents, sometimes referred to as obligate parasites. (1)
- They are comprised only of a protein coat and nucleic acid. (1)
- Viruses cannot reproduce or function outside a living cell. They need a host cell to carry out normal cell functions. (1)
- Viruses are very specific to the host cell or organism it can infect. (1)
- Some viruses only infect and reproduce in one type of species (variants of malaria) while others can successfully infect multiple species (swine flu). (1)
- When virus infects its preferred host, it 'seeks out' the specific cell it affects. The virus recognises the protein receptors on the cell membrane and bind to them. (1)
- It injects the cell with its nucleic acid, which takes over cell function. (1)
- **Simple diagram (eg., below)** of how a virus reproduces in a host cell. (1 - 3)