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# **basic education**

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Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

## **SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS**

**LIFE SCIENCES P2**

**2019**

**MARKS: 150**

**TIME: 2½ hours**

**This question paper consists of 16 pages.**

**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answers to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. Do ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams, tables or flow charts only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You must use a non-programmable calculator, protractor and a compass, where necessary.
11. Write neatly and legibly.

**SECTION A****QUESTION 1**

- 1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A to D) next to the question numbers (1.1.1 to 1.1.8) in the ANSWER BOOK, e.g. 1.1.9 D.

1.1.1 Which ONE of the following characteristics applies to bipedal organisms?

- A A more backwards position of the foramen magnum
- B A short, narrow pelvis
- C A long, wide pelvis
- D An S-shaped spine

1.1.2 Which ONE of the following statements about biodiversity is CORRECT?

- A Speciation increases biodiversity.
- B Biodiversity is the number of organisms in a population.
- C Extinction increases biodiversity.
- D Speciation and extinction have no effect on biodiversity.

1.1.3 Which ONE of the following compounds contains amino acids?

- A RNA
- B Protein
- C Glucose
- D DNA

1.1.4 Thando and Mary gave the four characteristics below about themselves.

	THANDO	MARY
P	I am a boy.	I am a girl.
Q	I am 150 cm tall.	I am 153 cm tall.
R	I have attached earlobes.	I have attached earlobes.
S	My blood group is A.	My blood group is AB.

Which statements describe the characteristics of discontinuous variation?

- A P, Q and S only
- B P, R and S only
- C Q, R and S only
- D P, Q, R, and S

1.1.5 Which ONE of the following is the genotype of a person with haemophilia?

- A  $X^H X^h$
- B  $X^H Y$
- C  $X^H X^H$
- D  $X^h Y$

1.1.6 A child has blood group AB and her mother's blood group is A.

We can reasonably conclude that the ...

- A mother's genotype is  $I^A i$ .
- B child's genotype is  $I^A I^B$  and the mother's genotype is  $ii$ .
- C father's genotype is  $I^A I^B$  or  $I^B I^B$  or  $I^B i$ .
- D father's genotype is  $I^A I^B$  and the mother's genotype is  $ii$ .

1.1.7 Refer to a list of Mendel's laws below:

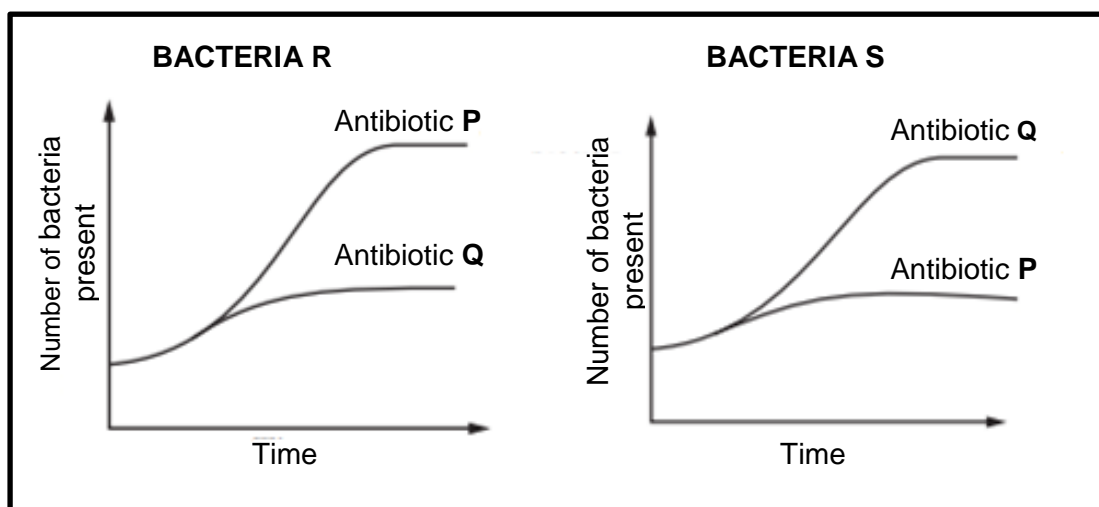
- (i) Law of dominance
- (ii) Principle of independent assortment
- (iii) Principle of segregation

A scientist crossed a red-eyed fruit fly with a white-eyed fruit fly and all the  $F_1$  offspring were red-eyed.

Which of the laws of Mendel can be used to explain this result?

- A (i), (ii) and (iii)
- B (iii) only
- C (i) and (iii) only
- D (ii) and (iii) only

- 1.1.8 The graphs below show the effect of two antibiotics, **P** and **Q**, on two different species of bacteria, **R** and **S**.



What conclusion can be drawn from the graphs?

- A Bacteria **R** is less resistant to antibiotic **P** than **Q**.
- B Bacteria **R** is more resistant to antibiotic **P** than **Q**.
- C Antibiotic **Q** is equally effective on bacteria **R** and **S**.
- D Antibiotic **P** is equally effective on bacteria **R** and **S**. (8 x 2) (16)

- 1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question numbers (1.2.1 to 1.2.6) in the ANSWER BOOK.

- 1.2.1 The analysis of DNA samples to identify individuals that may be related
- 1.2.2 The sugar found in RNA
- 1.2.3 The structure in an animal cell that forms spindle fibres
- 1.2.4 Undifferentiated animal cells that can give rise to specialised cell types
- 1.2.5 The division of the cytoplasm after a cell nucleus has divided
- 1.2.6 A diagram representing possible evolutionary relationships between species (6 x 1) (6)

- 1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Jaw of African apes	A: No spaces between teeth B: Large canines
1.3.2 Increases genetic variation	A: Cloning B: Crossing over
1.3.3 All the genes in a species	A: Genome B: Genotype

(3 x 2) **(6)**

- 1.4 A section of a DNA molecule has the following base sequence:

**CTT ACA**

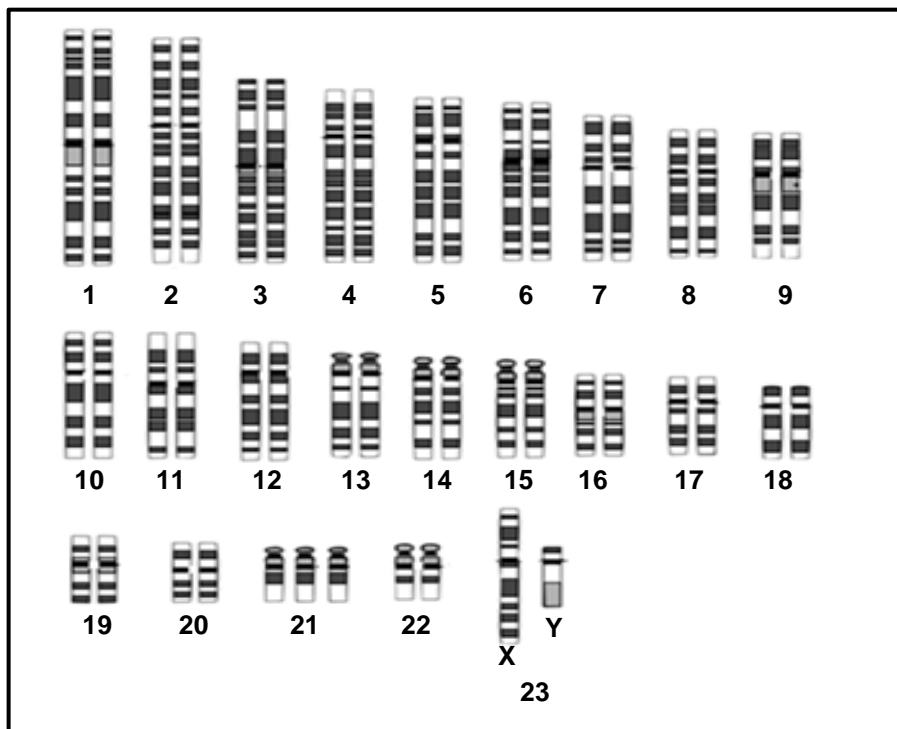
- 1.4.1 Name the nitrogenous base represented by **C** in the DNA molecule. (1)
- 1.4.2 The percentage of guanine in this DNA molecule is 30%.  
Give the percentage of thymine in the same molecule. (2)
- 1.4.3 Give the mRNA sequence, from left to right, for this segment of DNA. (2)
- 1.4.4 The table below shows the DNA triplets that code for some amino acids.

DNA TRIPLET	AMINO ACID
ACA	Cysteine
CTT	Glutamic acid
TGT	Threonine
TTA	Asparagine
GAA	Leucine
TAC	Methionine

Give the sequence of amino acids that would be coded for by the section of DNA above. (2)

- 1.4.5 Give the anticodon for the amino acid methionine. (1)  
**(8)**

- 1.5 The diagram below shows the karyotype of an individual with a disorder caused by non-disjunction.



1.5.1 Name:

- (a) This disorder (1)
- (b) The phase in meiosis when non-disjunction occurs (1)
- (c) The type of mutation that is a result of non-disjunction (1)

1.5.2 Identify the type of chromosomes numbered **1** to **22**. (1)  
(4)



1.6 The table shows the evolution of cranial capacity in some species.

SPECIES	PERIOD OF EXISTENCE (MILLION YEARS AGO)	AVERAGE CRANIAL CAPACITY (cm <sup>3</sup> )
<i>Sahelanthropus</i>	7,0–6,0	450
<i>Australopithecus africanus</i>	3,0–2,0	480
<i>Homo habilis</i>	2,2–1,6	650
<i>Homo erectus</i>	2,0–0,4	900
<i>Homo neanderthalensis</i>	0,4–0,04	1 500
<i>Homo sapiens</i>	0,2–0	1 450

1.6.1 Name:

- (a) TWO hominid genera in the table above (2)
- (b) TWO fossils of *A. africanus* that were found in South Africa (2)
- (c) The genus that appeared first on Earth as shown in the table (1)

1.6.2 Which hominid had a cranial capacity closest to that of *Homo sapiens*? (1)

1.6.3 Give the smallest cranial capacity (in cm<sup>3</sup>) of a *Homo* species. (1)

1.6.4 When did *Australopithecus africanus* become extinct? (1)

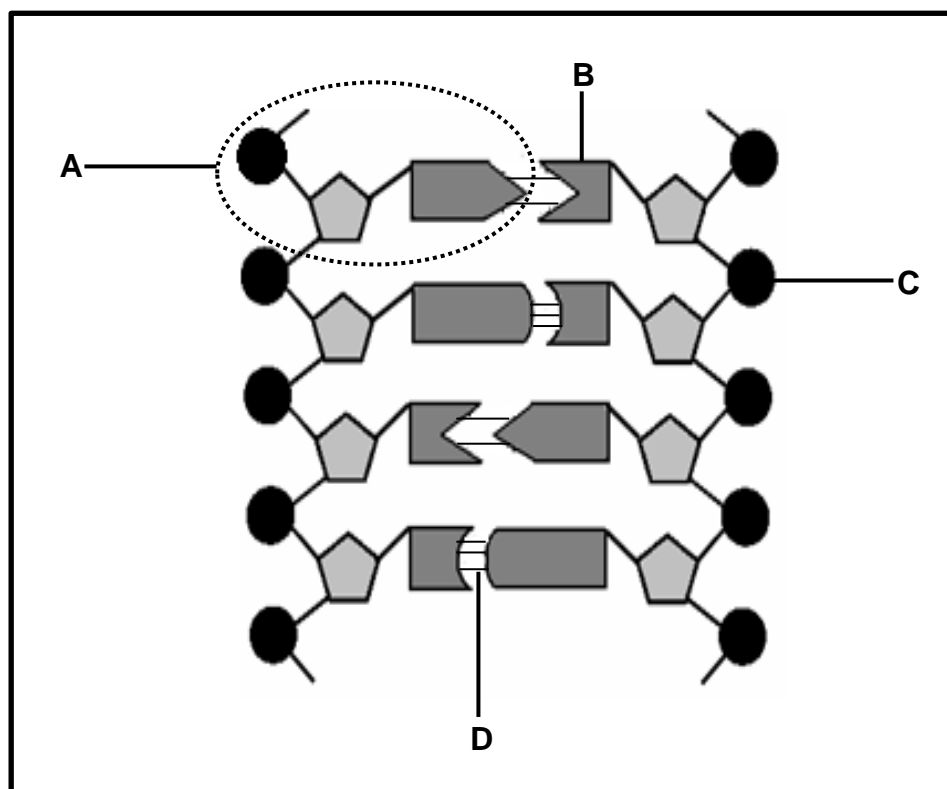
1.6.5 Fossils are used as evidence of hominid evolution.

Name TWO other lines of evidence. (2)  
**(10)**

**TOTAL SECTION A: 50**

**SECTION B****QUESTION 2**

2.1 The diagram below represents a portion of a DNA molecule.



2.1.1 Identify **B** and **C**. (2)

2.1.2 Name:

(a) Monomer **A** (1)

(b) TWO scientists who received a Nobel prize for discovering the DNA molecule (2)

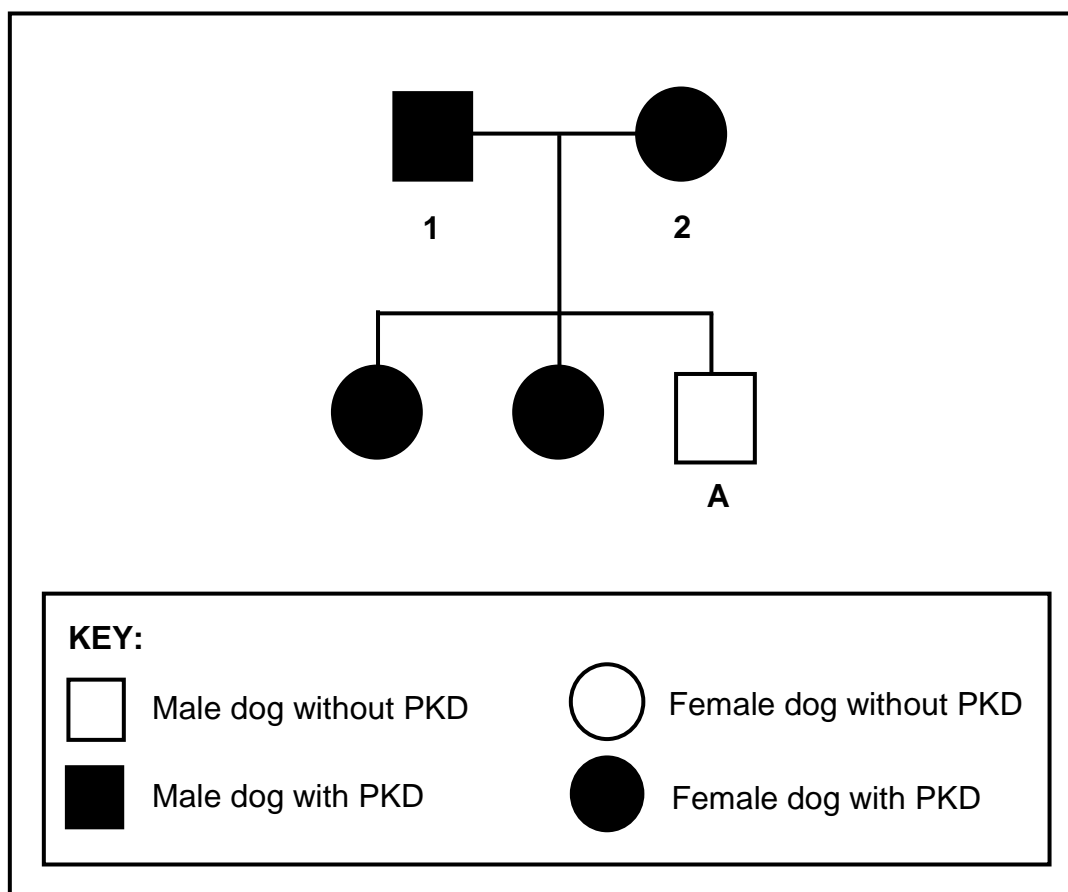
(c) ONE organelle in a cell where DNA is located (1)

2.1.3 Describe how a mutation on DNA may change the structure of a protein. (4)

2.1.4 Tabulate TWO structural differences between a monomer of RNA and a monomer of DNA. (5)  
**(15)**

2.2 Polycystic kidney disease (PKD) in dogs is caused by a dominant allele (**H**).

The pedigree diagram below shows the offspring produced by two dogs, 1 and 2.



2.2.1 How many offspring are affected by PKD? (1)

2.2.2 Explain how the genotype of offspring **A** shows that both parents are heterozygous. (4)  
(5)

## 2.3 Read the following extract on artificial selection.

Broccoli, brussel sprouts and cauliflower are edible plants in the cabbage family. They are different varieties of the same species (*Brassica oleracea*). They produce a cluster of yellow or white flowers. Each flower has four petals, four sepals, six anthers and a single stigma, style and ovary.

The somatic cells of these plants have a diploid chromosome number of 18. The chromosome number is reduced from diploid to haploid during gamete production, specifically during anaphase I of meiosis.

The size of the cabbage head was always important in artificial selection projects, but now the focus is on increasing resistance to various insects and diseases and on improving the nutritional content of cabbage.

- 2.3.1 Define a *species*. (2)
- 2.3.2 Name TWO structures in a flower where meiosis takes place. (2)
- 2.3.3 How many of each of the following structures is present in each cell of *Brassica oleracea* in the process of meiosis:
- (a) Chromosomes at the end of telophase II (1)
  - (b) Chromatids during metaphase I (1)
- 2.3.4 Describe the events of anaphase II. (3)
- 2.3.5 Explain why the focus is now on increasing resistance to insects and diseases. (2)
- (11)**

## 2.4 A species of fish has three phenotypes for fin length: elongated, short and medium. Heterozygous fish have medium fins.

The characteristic is under the control of one gene with two alleles: elongated (**E**) and short (**S**).

- 2.4.1 Name and describe the type of dominance shown here. (3)
- 2.4.2 Use a genetic cross to show the percentage chance of two fish with medium fins having offspring with short fins. (6)
- (9)**  
**[40]**

**QUESTION 3**

- 3.1 A group of students observed that the mating calls of a population of frogs at the local dam had recently become much louder. The dam is close to a highway, where traffic noise has increased over the years.

They wanted to investigate if the increase in traffic noise from the highway had an evolutionary effect on the loudness of the frogs' mating calls in the mating season.

They recorded the following:

- Average level of traffic noise over a period of 6 years
- Average loudness of the frogs' mating calls during the same period

The results are shown in the table below:

YEAR	AVERAGE LOUDNESS OF TRAFFIC NOISE (dB)	AVERAGE LOUDNESS OF MATING CALLS (dB)
2006	30	36
2007	32	38
2008	36	40
2009	40	48
2010	55	68
2011	62	74

- 3.1.1 Explain the advantage of a louder mating call. (2)
- 3.1.2 State why these results may be considered to be reliable. (1)
- 3.1.3 State a conclusion for this investigation. (2)
- 3.1.4 Give TWO variables that should be kept constant in this investigation. (2)
- 3.1.5 Draw line graphs on the same set of axes to show the change in average loudness of traffic noise and mating calls for the period 2006 to 2009. (7)
- (14)**

- 3.2 In holly trees, red fruit (**R**) is dominant over white fruit (**r**) and spiny leaves (**L**) are dominant over smooth leaves (**l**).

The Punnett square below shows the possible results of a cross between two individual plants. The genotype at **X** is not given.

GAMETES	RL	RI	rL	rl
RL	<b>X</b>	RRLI	RrLL	RrLI
RI	RRLI	RRII	RrLI	RrII
rL	RrLL	RrLI	rrLL	rrLI
rl	RrLI	RrII	rrLI	rrII

- 3.2.1 Give the:

- (a) Genotype of **X** (1)
- (b) Phenotype of the parents (2)

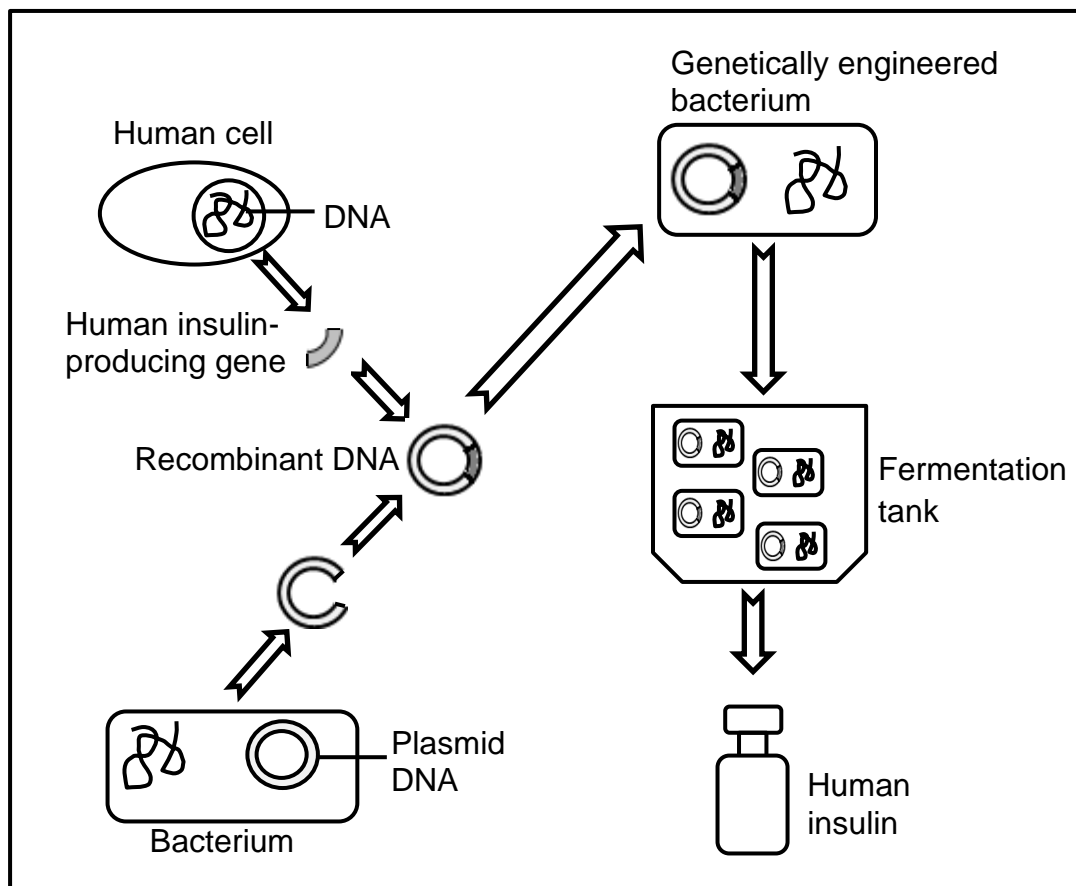
- 3.2.2 In a population of 128 plants, how many plants with red fruit and smooth leaves are expected from the Punnett square above? Show ALL working. (3)

- 3.2.3 A farmer wanted to produce plants with only white fruit and spiny leaves.

- Give the genotype of the plants that he should use in the cross. (2)
- (8)**

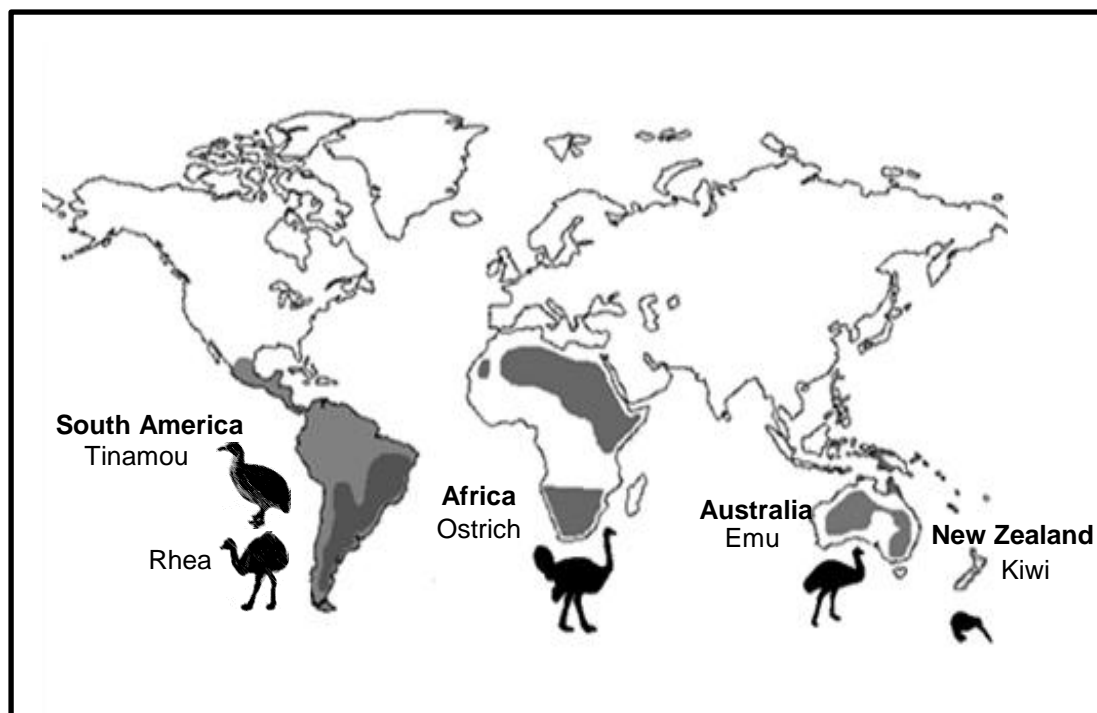
- 3.3 Synthetic insulin is used to treat diabetes and is produced by genetic engineering technology.

The diagram below represents the process.



- 3.3.1 Define *genetic engineering*. (2)
- 3.3.2 Describe the steps involved in producing the recombinant DNA. (4)
- 3.3.3 Explain why bacteria are most suitable for genetic engineering. (2)
- 3.3.4 Suggest THREE objections that some people might have to genetic engineering. (3)
- (11)**

- 3.4 Flightless bird species that are currently distributed across different continents are shown in the picture below.



Scientists hypothesise that these species of flightless birds arose from a single common ancestor that was able to fly.

- 3.4.1 Describe how Lamarck would have explained the evolution of flightless birds. (4)
- 3.4.2 Name THREE reproductive isolation mechanisms that keep species separate. (3)

(7)  
[40]

**TOTAL SECTION B: 80**



**SECTION C****QUESTION 4**

Describe natural selection and punctuated equilibrium. Also state THREE ways in which natural selection differs from artificial selection.

Content: (17)  
Synthesis: (3)  
**(20)**

**NOTE:** NO marks will be awarded for answers in the form of a table, flow charts or diagrams.

**TOTAL SECTION C: 20**  
**GRAND TOTAL: 150**