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**TOTAL
MARKS**

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NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2022

LIFE SCIENCES: PAPER I

EXAMINATION NUMBER

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Time: 3 hours

200 marks

ANSWER BOOKLET

There are 15 pages (i–xv) pages in this Answer Booklet. Please write your examination number in the blocks above.

QUESTION 1

- 1.1 Select the term in Column B that best matches the description in Column A. Write the letter of the term in the space provided between the brackets. Each letter may be used only once.

COLUMN A

COLUMN B

- | | |
|----------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| [] The person who proposed the hypothesis of the inheritance of acquired characteristics. | A Transitional fossil |
| [] The preserved remains of an organism that shows traits of both the ancestral and the descendent group. | B Vestigial |
| [] The study of the distribution of plants and animals across the world. | C Adaptive radiation |
| [] A structure or organ that is reduced and has no function in an organism. | D Galapagos |
| [] The islands where Darwin spent time observing various species that led him to develop his theory of evolution. | E Darwin |
| [] A hypothesis that states there is little change in species for long periods of time, followed by a period of rapid change. | F Gradualism |
| [] The independent evolution of similar traits in organisms that are not closely related. | G Founder effect |
| [] The process whereby organisms diversify rapidly into many different forms from an ancestral species. | H Biogeography |
| [] The loss of genetic variation that occurs when a new population is established from a small, isolated number of individuals. | I Convergent |
| [] A hypothesis that states that species evolve at a steady rate over long periods of time. | J Punctuated equilibrium |
| | K Lamarck |

(10)

- 1.2 Eight multiple-choice questions are given below. Choose the most correct answer to each question and write the letter of your choice in the table below.

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7	1.2.8
Answer								

- 1.2.1 The Knysna Lagoon is known for its unique seahorse species. Three different populations exist in the lagoon and only one of the populations has low levels of genetic diversity.

Which of the following is the most valid reason for the low levels of genetic diversity in one of the populations?

- A Inbreeding has taken place in the population.
- B Gene flow between the populations has increased.
- C Fewer mutations have resulted in harmful recessive alleles.
- D The fitness and adaptability of individuals have improved. (1)

- 1.2.2 What is the scientific name of the fossil, 'Lucy'?

- A *Homo habilis*
- B *Homo erectus*
- C *Australopithecus afarensis*
- D *Australopithecus africanus* (1)

- 1.2.3 Which of the following statements are correct regarding the function of oestrogen?

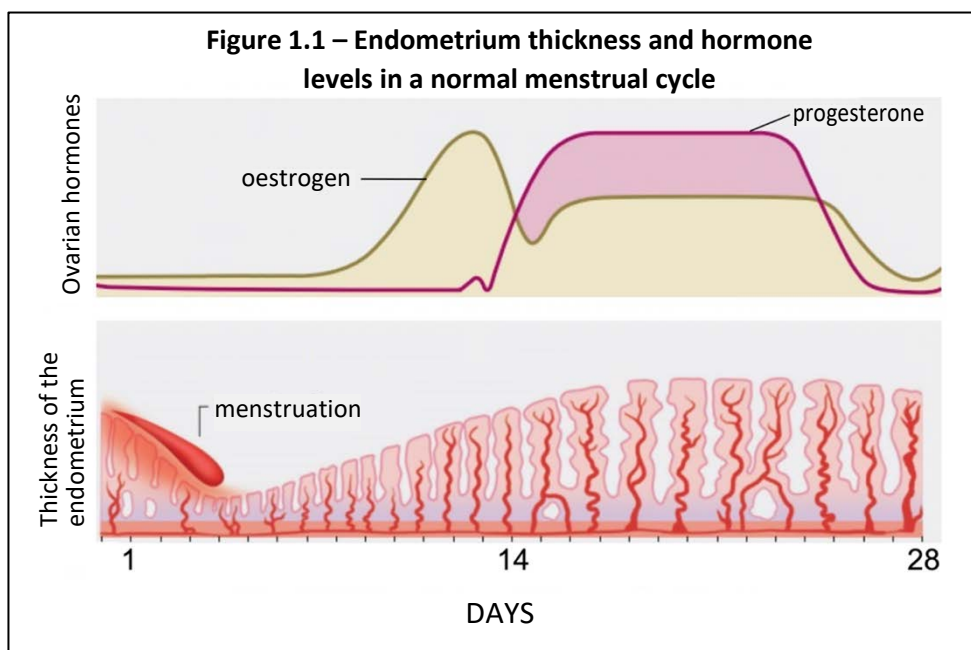
- 1 It stimulates the development of the Graafian follicle.
- 2 It repairs the lining of the endometrium.
- 3 It promotes the growth and development of secondary sexual characteristics.

- A 1 and 2 only
- B 2 and 3 only
- C 1 and 3 only
- D 1, 2 and 3 (1)

- 1.2.4 Which contraceptive method prevents the ova entering the uterus?

- A Rhythm method
- B Condom
- C Copper IUD
- D Contraceptive patch (1)

- 1.2.5 Figure 1.1 shows the ovarian hormones levels and the corresponding endometrium thickness during a normal menstrual cycle. Studies have shown that increased stress levels decrease the production and the release of progesterone.

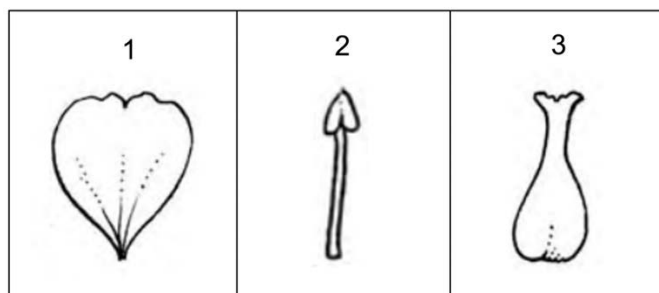


[Adapted: <<https://img.brainkart.com>>]

A logical deduction on the effect of high stress levels on a woman's menstrual cycle is that ...

- A ovulation will occur earlier than normal.
- B menstruation will start in a shorter time after ovulation.
- C the endometrium will have a greater thickness.
- D the menstrual cycle will not be affected. (2)

- 1.2.6 A student dissected a flower. Three structures from the dissected flower are shown below.



[Adapted: <<https://www.saps.org.uk>>]

Which of the following shows the correct sequence of the flower parts from the centre of the flower outwards?

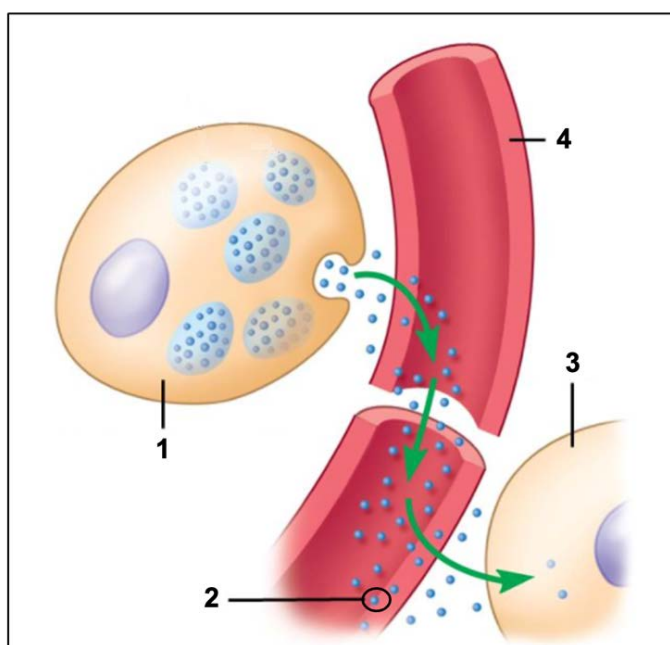
- A 1 → 2 → 3
- B 2 → 3 → 1
- C 3 → 1 → 2
- D 3 → 2 → 1 (2)

1.2.7 Which of the following statements are true regarding a person's response to a stressful situation?

- (i) Adrenalin is released.
 - (ii) Insulin is released.
 - (iii) Blood glucose increases.
 - (iv) Heartbeat increases.
 - (v) Eye pupils constrict.
- A (i), (ii) and (iii) are correct.
 B (i), (ii) and (iv) are correct.
 C (i), (iii) and (iv) are correct.
 D (i), (iii) and (v) are correct.

(2)

1.2.8 The image below illustrates components of the endocrine system.



[Adapted: <<https://slideplayer.com>>]

Which row identifies the numbered parts correctly?

	1	2	3	4
A	Hormone	Endocrine cell	Target cell	Blood vessel
B	Target cell	Blood vessel	Endocrine cell	Hormone
C	Endocrine cell	Hormone	Target cell	Blood vessel
D	Endocrine cell	Hormone	Blood vessel	Target cell

(2)

- 1.3 Study the following table that consists of two items (numbered 1 and 2) in the first column and a term in the second column. Decide which item(s) relate to the term.

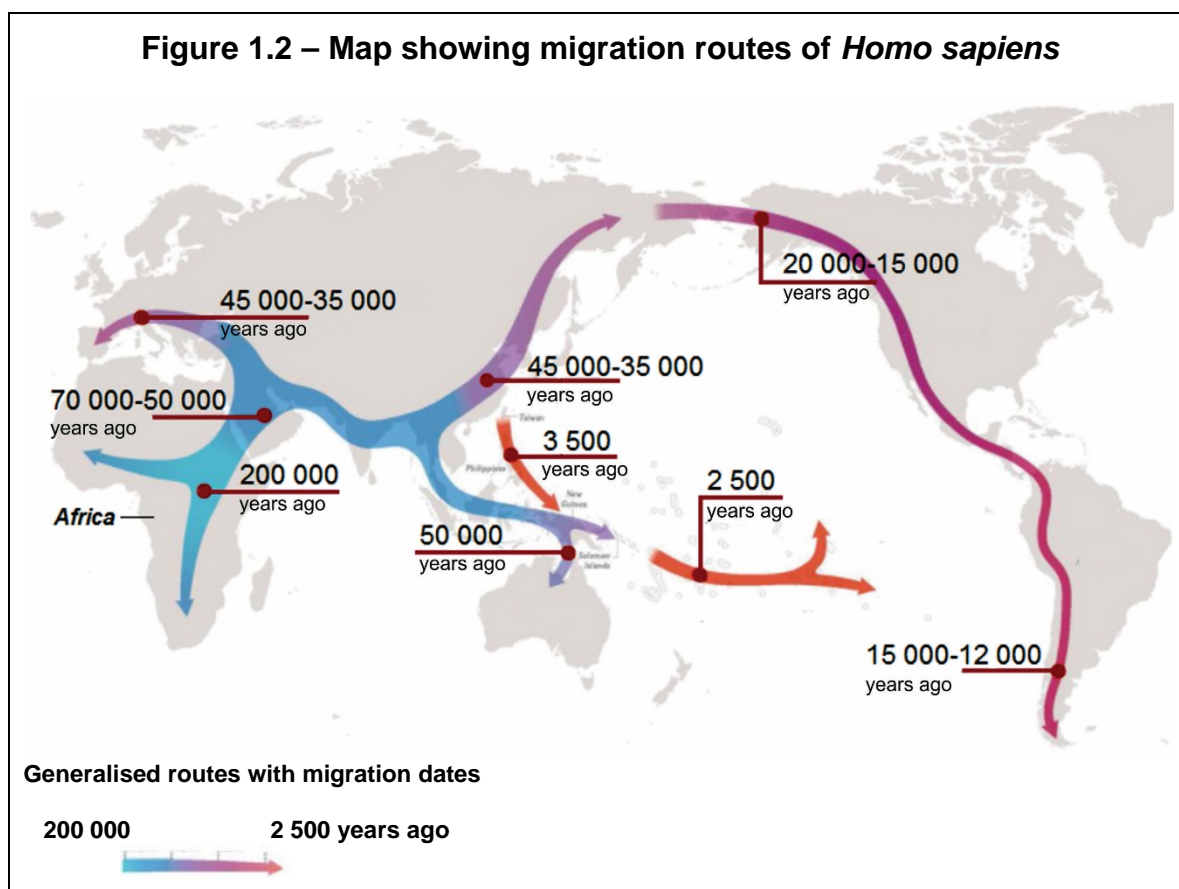
Write down your choice in the Answer column, making use of the following codes:

- A only item 1 relates to the term
 B only item 2 relates to the term
 C both items 1 and 2 relate to the term
 D neither item 1 nor item 2 relates to the term

Item	Term	Answer
1. Fertilisation usually requires an aquatic environment. 2. Large number of ova are produced.	External fertilisation	
1. Many offspring are produced. 2. Low survivorship of offspring.	K-strategy species	
1. Male birds may display elaborate dances to attract females. 2. Little energy expenditure to produce offspring.	Courtship	
1. Offspring receive nutrients through a placenta. 2. Eggs develop outside the body of the female.	Ovipary	
1. High parental care. 2. r-strategy animals.	Mammals	

(5)

1.4 Study the information shown in the map below and answer the questions that follow.



[Adapted: <<https://blog.education.nationalgeographic.org>>]

1.4.1 Which hominid species was the first to migrate out of Africa according to the 'Out-of-Africa' hypothesis?

(1)

1.4.2 According to the map, when did the first *Homo sapiens* migrate out of Africa?

(2)

1.4.3 Suggest a reason why *Homo sapiens* migrated out of Africa.

(1)

1.4.4 Mitochondrial DNA analysis of human populations supports the Out-of-Africa hypothesis.

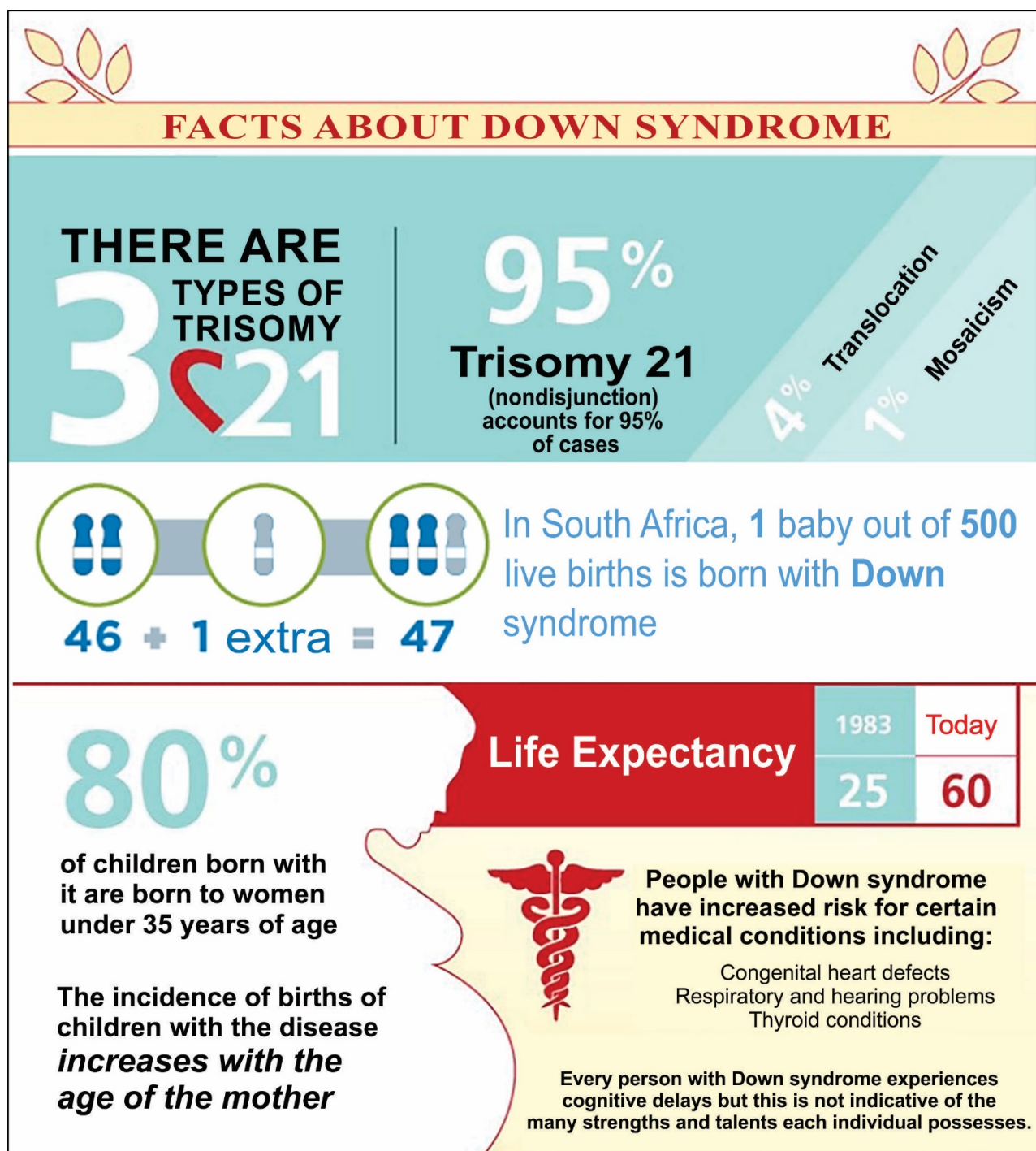
- (a) Explain how mitochondrial DNA can provide evidence in determining relatedness between populations.

(2)

- (b) Name **and** explain how ONE other line of evidence supports the hypothesis that modern humans evolved in Africa.

(2)

1.5 Study the infographic below on Down syndrome.



[Adapted: <<https://i.pinimg.com>> ; <<https://www.westerncape.gov.za>>]

The seven statements in the table below refer to the infographic on page viii. For each statement decide whether:

A: The statement is supported by the information in the infographic.

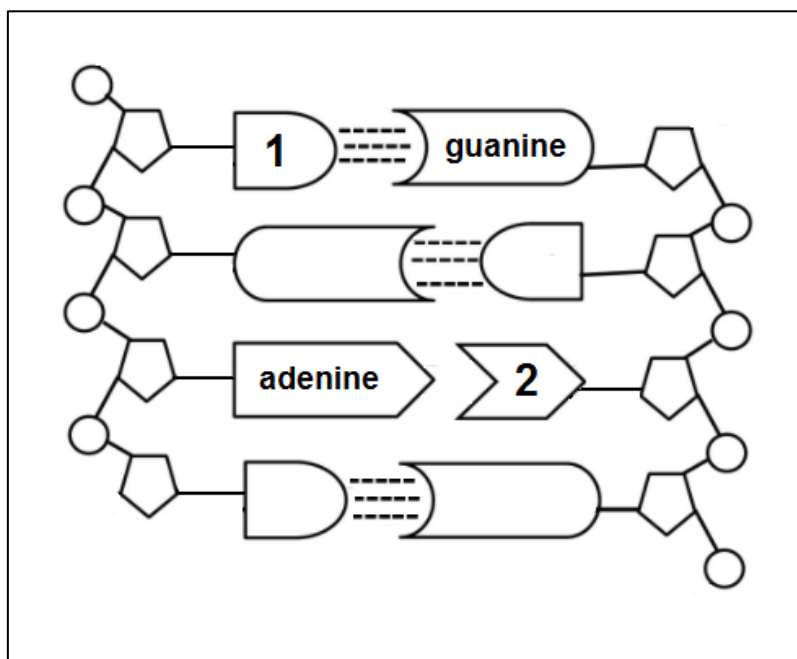
B: The statement is contradicted by the information in the infographic.

C: The statement is neither supported nor contradicted by the information in the infographic.

	Statement	A, B or C
1.5.1	Down syndrome is also known as trisomy 21.	
1.5.2	In South Africa, 0,5% of children born have Down syndrome.	
1.5.3	There are 46 chromosomes in the nucleus of the somatic cells of a Down syndrome person.	
1.5.4	The life expectancy of people with Down syndrome has increased.	
1.5.5	All people with Down syndrome experience cognitive delays and cannot be schooled.	
1.5.6	People with Down syndrome are at increased risk for heart conditions.	
1.5.7	Nondisjunction during meiosis causes all cases of trisomy 21.	

(7)

- 1.6 Study the diagram below that shows a section of a DNA molecule and answer the questions that follow.



[Adapted: <<https://www.biologycorner.com>>]

- 1.6.1 Name the nitrogen bases numbered:

1: _____

2: _____

(2)

- 1.6.2 On the diagram above:

(a) Draw a circle around a single basic unit/building block of DNA and name this single unit.

(2)

(b) Draw in the missing hydrogen bonds.

(2)

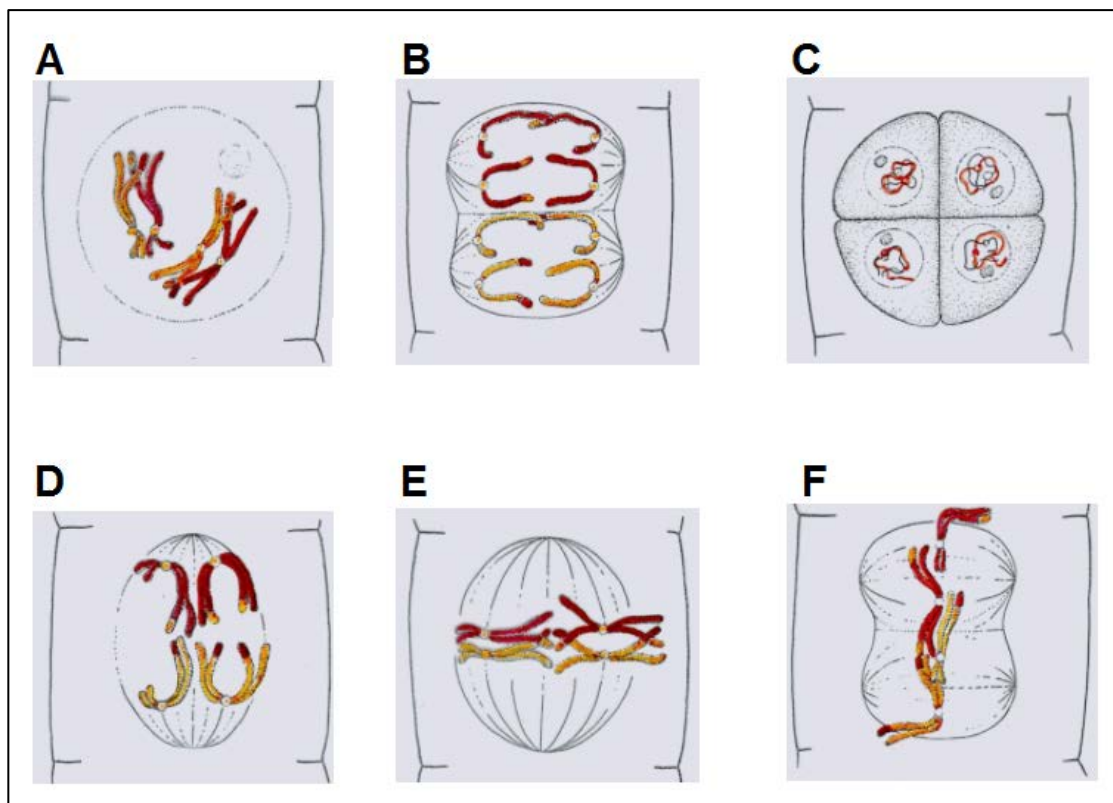
- 1.6.3 Name the scientists who discovered the structure of the DNA molecule.

(2)

- 1.6.4 Another section of a DNA molecule consists of 1 460 bases. How many guanine bases will be in this section of a DNA molecule if adenine makes up 20% of the bases in this section? Show all working.

(2)

- 1.7 The diagrams below (A to F) show the various phases of meiosis in a generalised animal cell. The diagrams are placed in a random order and do not show the correct order of the phases.



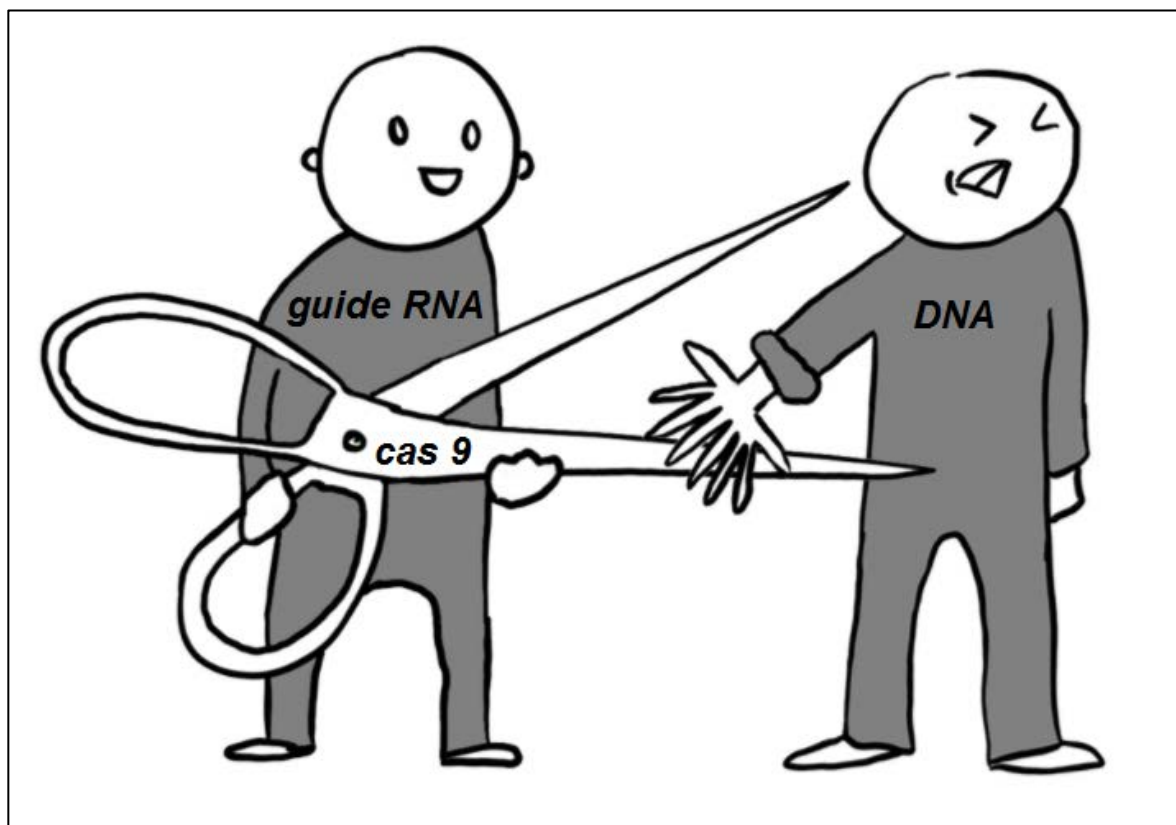
[Adapted: <<https://www.ndsu.edu>>]

Select the letter (A, B, C, D, E or F) that best matches the description of the phases in the table below. Letters may be used more than once.

	Description	Letter
1.7.1	Phase in which homologous chromosomes move to opposite poles of the cell.	
1.7.2	Phase in which the homologous chromosome pairs line up at the equator.	
1.7.3	Phase in which the centromeres split to separate the chromatids.	
1.7.4	Phase in which crossing over occurs.	
1.7.5	The final phase of meiosis that will result in the formation of gametes.	
1.7.6	The first phase of meiosis 1.	

(6)

1.8 Study the cartoon below and answer the questions that follow.



[Adapted: <<https://www.insearchoftomorrow.com>>]

1.8.1 What message does this cartoon convey about the process and purpose of CRISPR technology?

(3)

- 1.8.2 Read the headline below taken from an article published on the website *Scientific American*.

**SCIENTIFIC
AMERICAN.**

MEDICAL & BIOTECH

**Mail-Order CRISPR Kits Allow
Absolutely Anyone to Hack DNA**

Experts debate what amateur scientists could accomplish with the powerful DNA editing tool – and whether its ready availability is cause for concern

By Annie Sneed on 2 November 2017

Discuss why experts in gene editing should be concerned about readily available CRISPR kits.

(4)

1.9 Read the following information and answer the questions that follow.

Hermann Muller, a geneticist, conducted experiments in the 1920s to demonstrate that exposure to X-ray radiation can cause genetic mutations. In his experiments, Muller exposed *Drosophila* fruit flies to varying dosages of X-rays, measured in röntgens (R). After exposure, he allowed the flies to mate and produce offspring. He then observed the mutations in the offspring. Many different mutations occurred such as point and frameshift mutations. His results are shown in Table 1.1 below.

Table 1.1 – Radiation dosage and mutation frequency in *Drosophila* fruit flies

X-ray dosage (R)	Percentage of mutations
0	0
1 000	3
2 000	6
3 000	9
4 000	12
5 000	14

[Adapted: Snustad and Simmons. 2000. *Principles of Genetics*. 2nd edition. Page 379]

1.9.1 Define the term *mutation*.

(2)

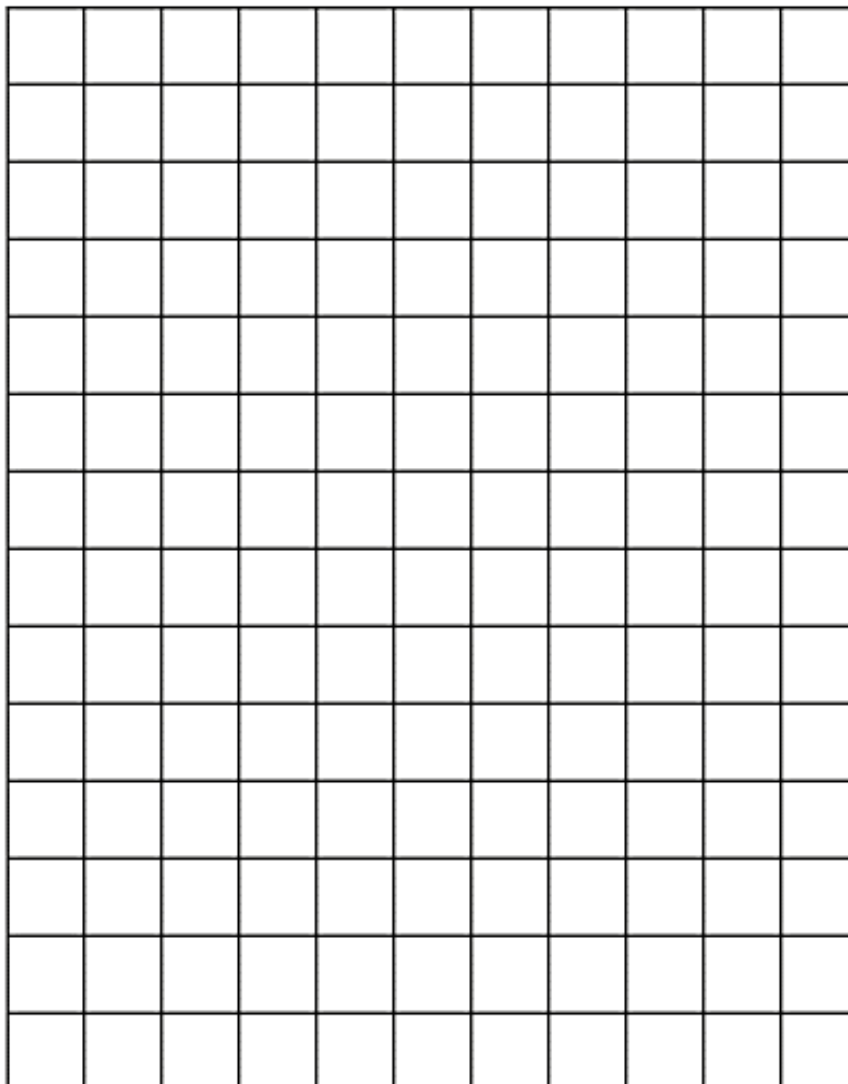
1.9.2 Explain clearly how a point mutation differs from a frameshift mutation.

(4)

1.9.3 Identify the independent variable in Muller's experiment.

(1)

- 1.9.4 Plot an appropriate graph of Muller's results in Table 1.1 on the graph paper below. Provide a suitable heading.



(8)
[80]