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CONSOLIDATION EXERCISE B – GENETICS

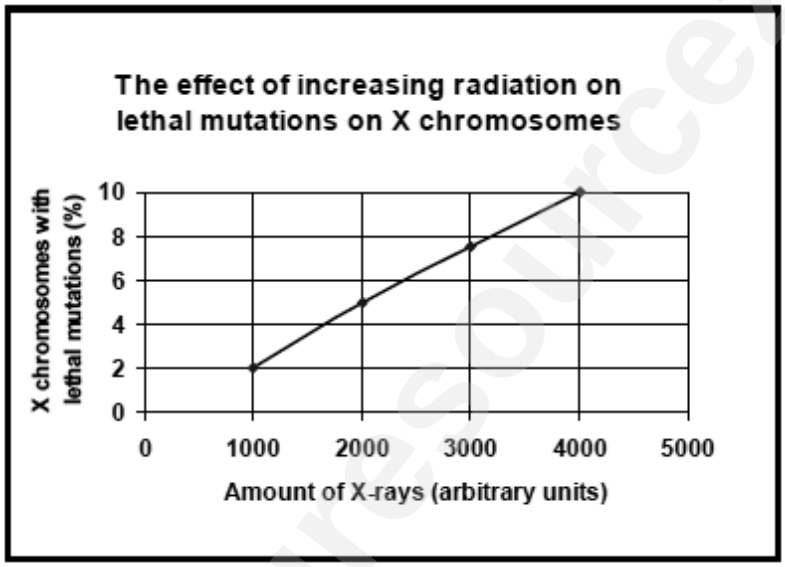
Learner Note: Please ensure that you adhere to the time allocation. An important examination skill is to adhere to the time based on the mark allocation. Should this not be the case you will not manage to complete their question paper timeously.

SECTION A: TYPICAL EXAM QUESTIONS

Question 1: 10 Minutes *(Taken from DoE Feb/March 2009 Paper 1)*

An investigation to determine the effect of increasing radiation on lethal (deadly) mutations on X chromosomes in fruit flies was undertaken by scientists.

The results are shown in the graph below.



1.1. Formulate a possible hypothesis for this investigation. (2)
1.2. Name ONE factor that was varied by the scientists in this investigation. (1)
1.3. How many different values of the factor named in QUESTION 1.2 above were used? (1)
1.4. Name TWO factors that would have to be kept constant during this investigation. (2)
1.5. What conclusion can be drawn from the results presented in the graph? (2)
1.6. If you were carrying out this investigation, describe ONE way in which you would ensure that the results obtained are reliable. (2)

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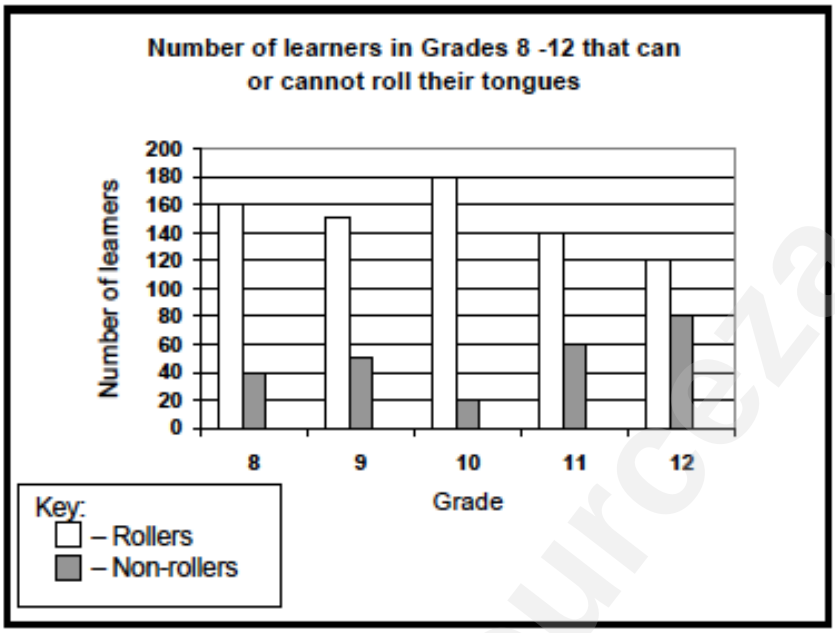
Question 2: **10 Minutes** *(Taken from DoE November 2008 Paper 1)*

Some people have the ability to roll their tongue (rollers) while other people cannot roll their tongues (non-rollers).

A Grade 12 learner wanted to determine the frequency of learners in the school that could roll their tongues. She went to each grade in the school and counted the number of rollers and non-rollers. She presented her results in the graph below.



2.1. State a hypothesis for this investigation. (2)

2.2. Which grade had the most learners that could roll their tongues? (1)

2.3. Use the data in the graph to draw a table that shows the results she obtained. (7)

2.4. Calculate the ratio of rollers to non-rollers. Show ALL working. (4)

[14]

Question 3: **12 Minutes** *(Taken from Bishops Life Sciences Grade 12 Prelim 2008 Paper 1)*

The pedigree for albinism is inherited as an autosomal recessive trait. The trait is not sex linked and is shown by both males and females. The affected female in the third generation has phenotypically normal parents. Refer to the diagrams on the following page and answer the questions that follow from the diagram and from your knowledge.

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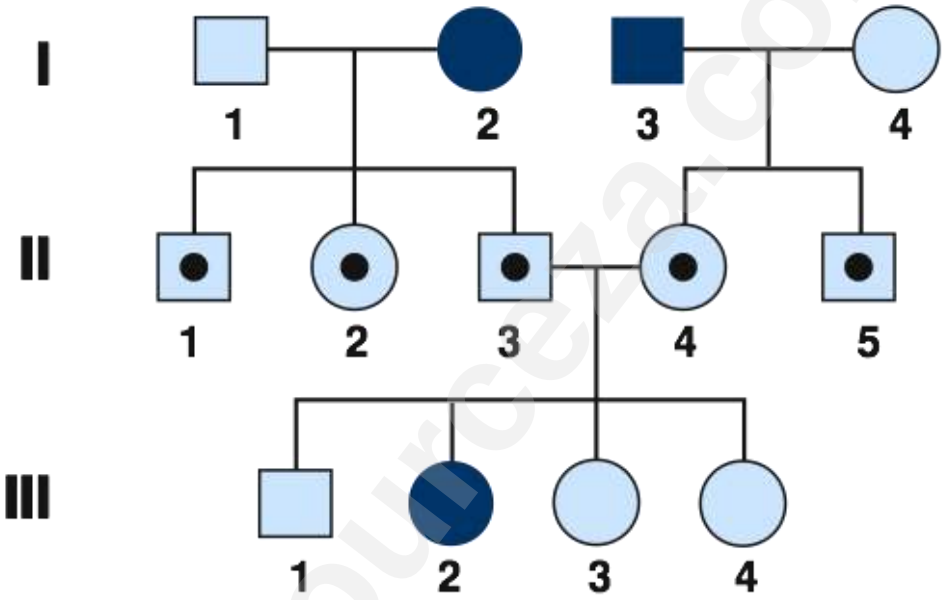
Use the following symbols to understand the pedigree



3.1 What change would occur in the genetic structure for albinism to arise? (1)

3.2 List 2 characteristics shown in the phenotype of a person with albinism. (2)

3.3 Explain what is meant by **autosomal recessive** trait**.** (2)

3.4 Distinguish between genotype and phenotype. (3)

3.5 Explain how:

(i) All generation II offspring are carriers for the albino allele.

(ii) III-2 is an albino girl whose paternal grandmother and maternal grandfather are also albinos.

(iii) All her other relatives in Generation III show normal phenotypes. (6)

[14)

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Question 4: **8 Minutes** *(Taken from Bishops Life Sciences Grade 12 Prelim 2008 Paper 1)*

Two newborn babies were accidentally mixed up at the hospital. In an effort to determine the correct parents of each baby, the blood types of the babies and the parents were determined as follows:

Baby 1 – type O	**Baby 2 – type A**
Mr Smith – type AB	**Mrs Smith – type B**
Mr Jones – type B	**Mrs Jones – type B**

4.1 Who are the parents of Baby 2? (2)

4.2 Provide evidence for your answer in 4.1 by showing your working in a Punnett square. (6)

[8]

SECTION B: SOLUTIONS AND HINTS

Question 1:

1.1 The percentage of X chromosomes with lethal mutations increases/ decreases ✓ when the dosage of X-rays increases/decreases ✓

OR

A change in the amount of X-rays ✓ has no effect on the percentage X chromosomes with lethal mutations ✓ (2)

1.2 Radiation ✓/Amount of X-rays (1)

(***Mark first ONE only)***

1.3 4 ✓

1.4 Use chromosomes from the same species ✓
Use X chromosomes only ✓
Time exposed to radiation ✓
Environmental conditions ✓e.g. temperature, CO_2, O_2 and humidity
Ensure that no lethal mutations present before the investigation ✓ (2)

(Mark first TWO only)

1.5 An increase in the amount of radiation of X-rays ✓ leads to an increase in the percentage of X chromosomes showing lethal mutations ✓

OR

A decrease in the amount of X-rays ✓ leads to a decrease in the percentage of X chromosomes with lethal mutations ✓ (2)

1.6 Take many readings ✓ at each X-ray amount and find the average ✓ reading (2)

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Question 2:

2.1 Most ✓ learners in the school can roll their tongue ✓
OR
Most ✓ learners cannot roll their tongue ✓
OR
Equal ✓ number of rollers and non-rollers ✓
OR
Difference ✓ in the number of rollers and non-rollers ✓
OR
Tongue rolling occurs ✓/does not occur among the learners ✓ (2)

2.2 Grade 10 ✓ (1)

2.3 The number of rollers and non-rollers in the different grades

Grade	Rollers	Non-rollers
8	160	40
9	150	50
10	180	20
11	140	60
12	120	80

OR

The number of rollers and non-rollers in the different grades

Grade	8	9	10	11	12
Rollers	160	150	180	140	120
Non-rollers	40	50	20	60	80

Caption ✓
Correct column headings ✓
Correct row headings ✓
Data in table: 5 rows correct ✓✓✓
3 to 4 rows correct ✓✓
1 to 2 rows correct ✓
Drawing of table as blocks with columns and rows ✓ (7)

2.4 160 + 150 + 180 + 140 + 120 = 750 ✓
40 + 50 + 20 + 60 + 80 = 250 ✓
750 ÷ ✓ 250 **OR** 750/250 ✓

3 : 1 ✓ **OR** 75% : 25% **OR** 1 non-roller: 3 rollers (4)
[14]

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3.1 a mutation (1)

3.2 lack of colour in hair/ skin/ no colour in iris/
rapid eye movements/ vision defects/ photophobia (2)

(Mark any two)

3.3. It is a trait shown on any body/somatic chromosome /not on a sex chromosome√ recessive because it only shows in phenotype/expressed √if its homozygous√ (3)

(or any other correctly worded definition of both)

3.4. Genotype is the genetic makeup of an organism√
Phenotype is the characteristics/appearance of an organism√ (2)

3.5. (i) the offspring in II are carry one gene for albinism √
and need 2 to exhibit the trait √

OR

they have only inherited 1 gene from the albino parent √
in Gen 1 therefore do not exhibit the trait/ are carriers √ (2)

(ii) She inherited a gene from each of her parents who were carriers √ who had inherited a gene each from the grandparents who are shown to have albinism. √ (2)

(iii) All other relatives in generation III are did not inherit the gene for albinism √ from either of their parents √who only carried one gene for albinism√ (2)

(answers to be correctly explained for the marks)

Question 4:

Baby 2 – type A

4.1. Parents are Mr and Mrs Smith√√ (2)

4.2. P^1 Mr Smith AB x Mrs Smith B
P^1 I^AI^B √ X I^BI^B OR I^Bi√

Punnett square:

	I^A	I^B
I^B	I^AI^B	I^BI^B
i	I^Ai	I^Bi

gametes √√
Punnett square correctly done√√√

F^1: blood type A √ or AB √ or B √

only Mr and Mrs Smith could have a baby with type A √ blood or I^Ai √ **(12 x half = 6)**