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90948



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## Level 1 Science, 2015

### 90948 Demonstrate understanding of biological ideas relating to genetic variation

9.30 a.m. Tuesday 10 November 2015

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of biological ideas relating to genetic variation.	Demonstrate in-depth understanding of biological ideas relating to genetic variation.	Demonstrate comprehensive understanding of biological ideas relating to genetic variation.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

**You should attempt ALL the questions in this booklet.**

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–10 in the correct order and that none of these pages is blank.

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

**Achievement**

**TOTAL**

**10**

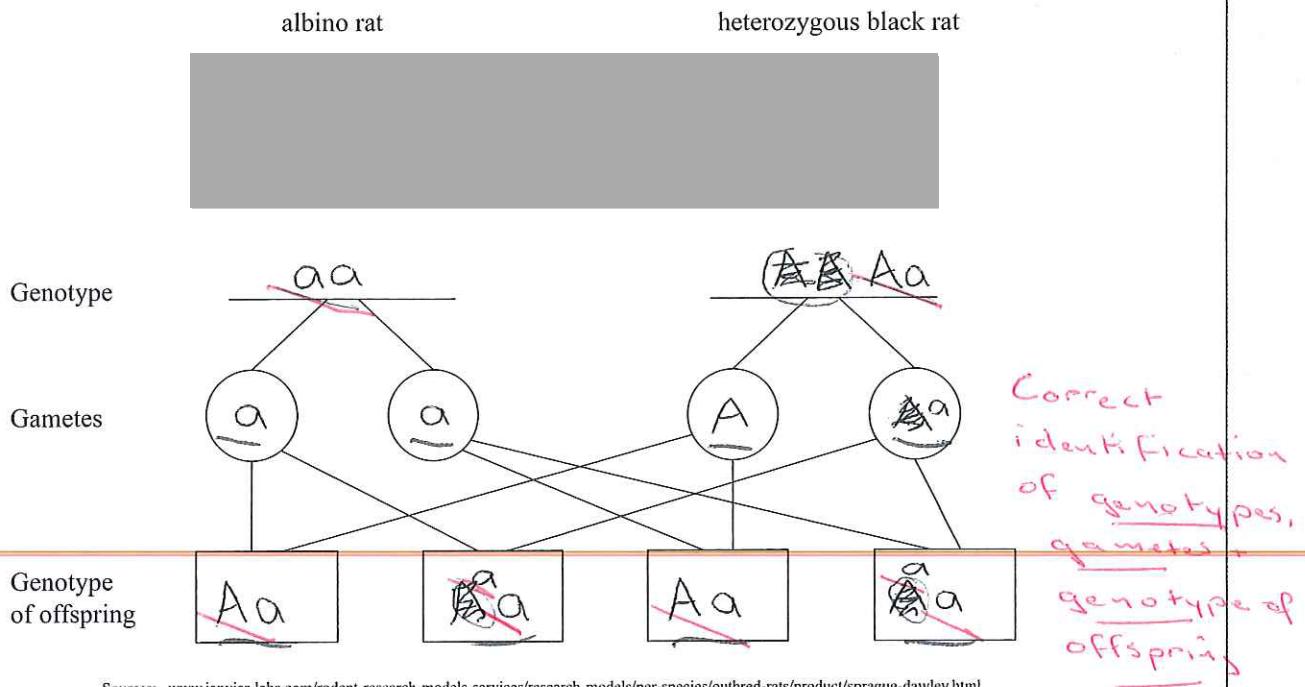
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## QUESTION ONE: FAMILY PEDIGREES

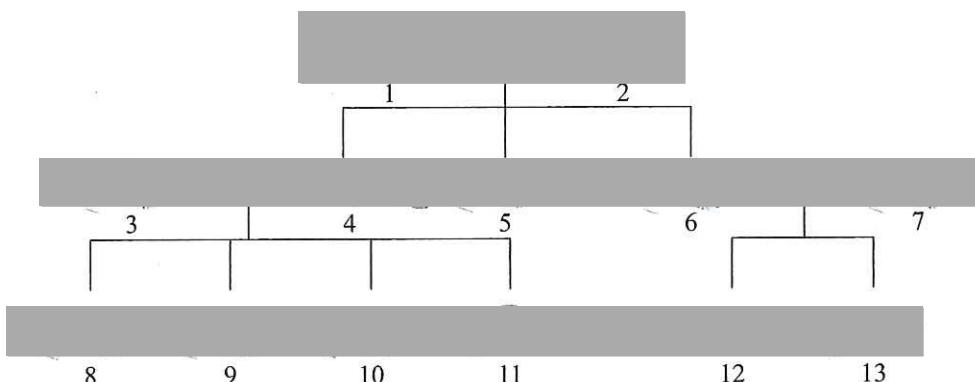
**ASSESSOR'S  
USE ONLY**

Albinism in rats results in white fur and pink eyes. Albinism is caused by a recessive allele **a**.

- (a) Complete the following diagram:



- (b) The albino rat and the heterozygous black rat produced the following two generations of offspring, as shown in the pedigree chart below.



What are the genotypes of the following rats?

Rat 4: aa ✓

Rat 6: Aa

Rat 10: Aall

Correct identification of all three genotypes

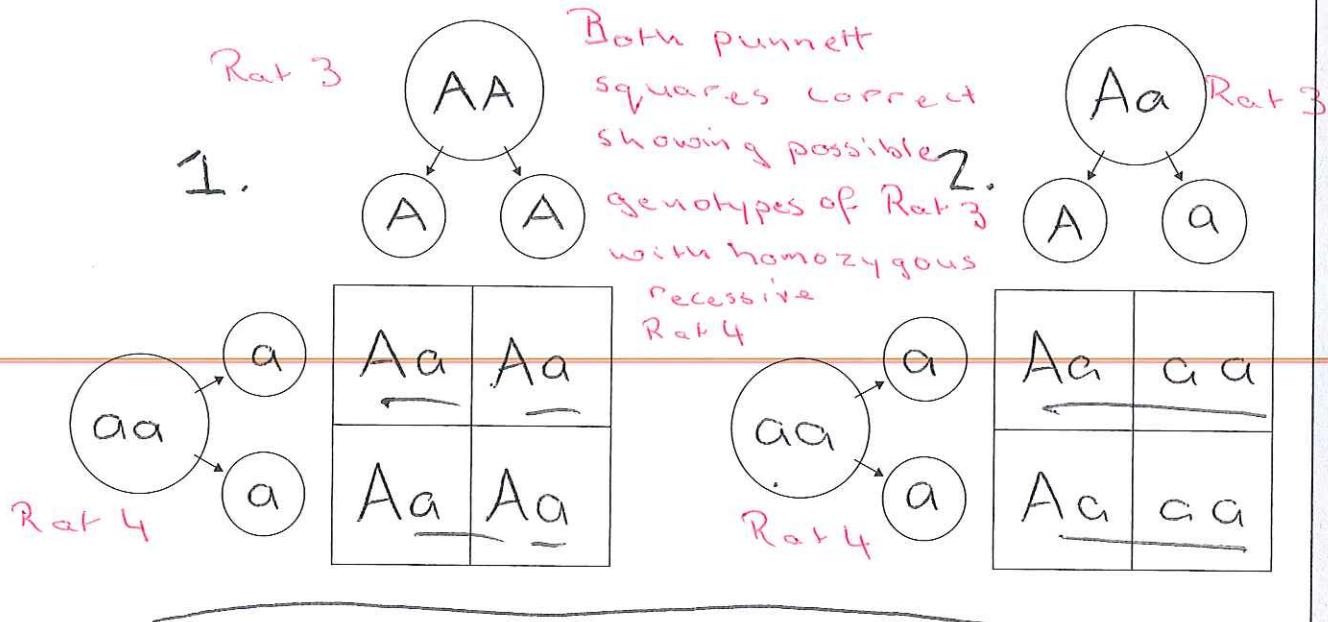
- (c) Rat 3 was **not** an offspring of Rat 1 and Rat 2 in the family tree.

Give the possible genotypes for Rat 3 and explain which is the most likely genotype for Rat 3.

In your answer you should:

- state the possible genotypes for Rat 3
- explain why both genotypes are possible but one is more likely
- explain what you could do to be more certain about the genotype of Rat 3.

*Punnett squares will be useful.*



These are the two possible genotypes for Rat 3. I think the first genotype shown in the punnet squares is the most plausible one because Rat 3 and Rat 4's offspring are all Black rats. Statement not explained in depth and it is impossible for a Albino rat to appear but if it was the other genotype

2 it would be a 50/50 chance of being Albino and we can see that no Albino rats were produced therefore making it highly likely to be genotype 1. If I wanted to be more certain I could test the offspring for Rat 3 and 4's to see who carries the gene.

*no explanation as*

*to now a test cross could be carried out.*

## QUESTION TWO: DNA, ALLELES, GENES, AND CHROMOSOMES

A snail known as *Cepaea nemoralis* can have either a plain shell or a banded shell.



Plain shell

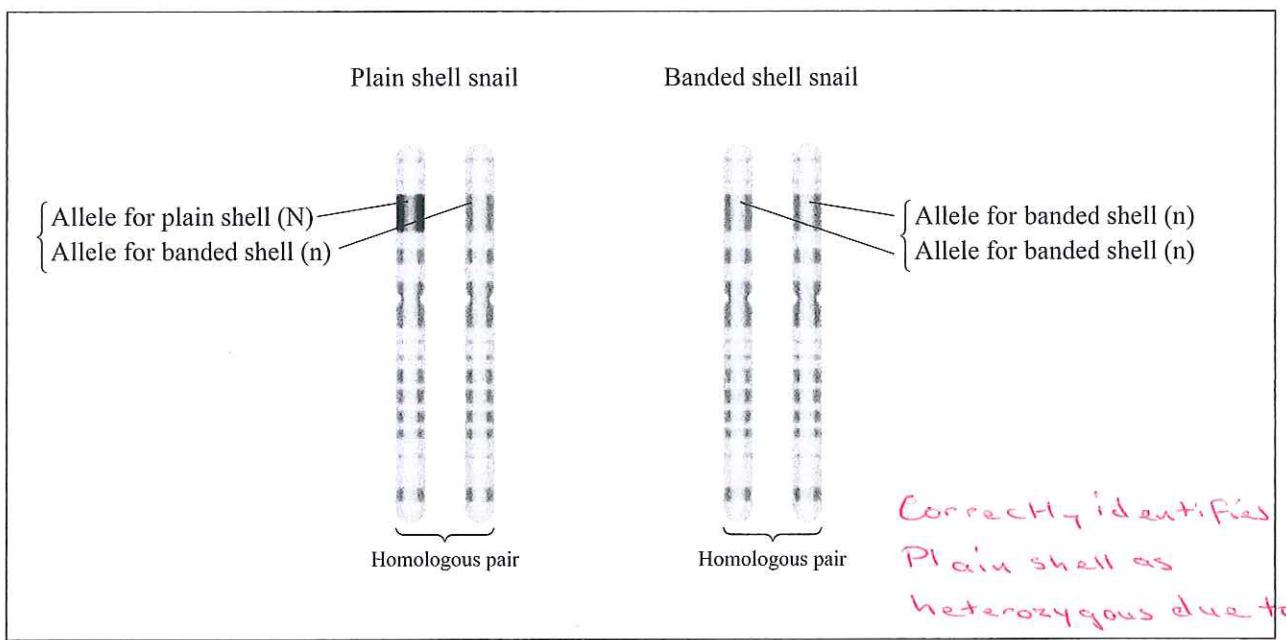
[http://en.wikipedia.org/wiki/List\\_of\\_non-marine\\_molluscs\\_of\\_Ireland](http://en.wikipedia.org/wiki/List_of_non-marine_molluscs_of_Ireland)

Banded shell

<http://de.wikipedia.org/wiki/Hain-B%C3%A4nderschnecke>

The diagrams below show the homologous chromosomes that contain the gene for shell pattern for each of the snails in the photographs above.

Assume the allele for plain shell (N) is dominant over the allele for banded shell (n).



- (a) In the diagram above, which snail is heterozygous for shell pattern?

// Plain shell ~~snail~~ snail //

Explain why you chose this snail.

// because heterozygous is when there is two different alleles (dominant, recessive) and homozygous is when there is two of the same allele (dominant, dominant) or (recessive, recessive) //

- (b) Referring to the examples shown previously for shell pattern, explain the difference between an allele and a gene.

//The gene is the coding for a genotype or phenotype in this case its the shell but the allele is and alternative to the gene in this case its the shells ~~banded~~ pattern or colour.//

*Gives correct definition of allele, but not gene. No indepth explanation relating to*

- (c) These two snails were produced by sexual reproduction from the same male and female. ~~snails~~.

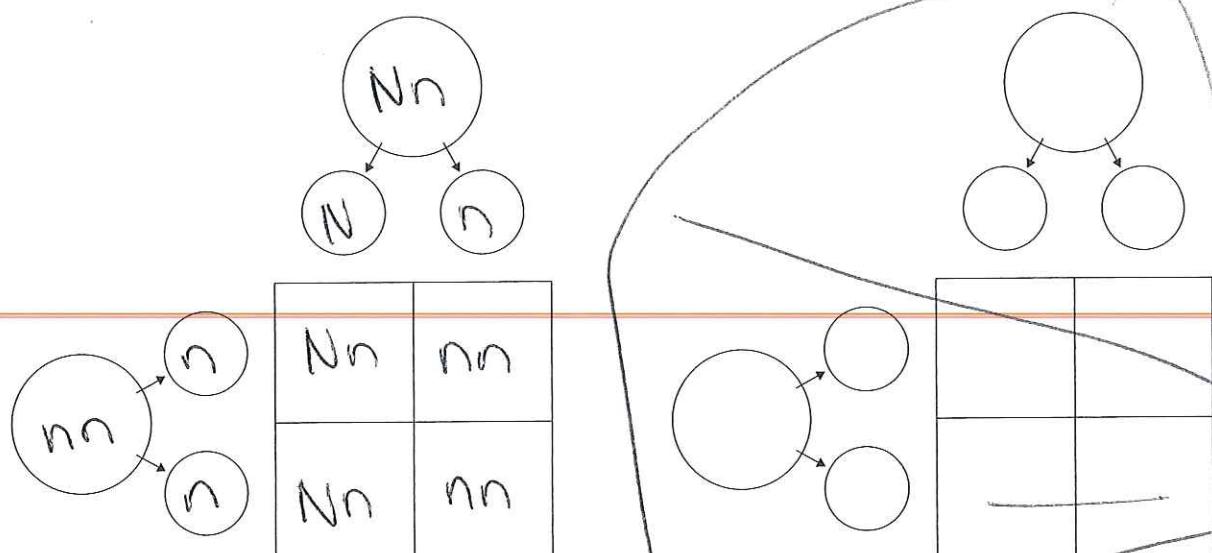
Discuss how they have inherited different alleles for shell pattern.

In your answer you should:

- explain where the homologous chromosomes have come from
- give the possible genotypes of both parents and explain how you determined these possible genotypes.

-The snails chance of having banded -or plain shells was 50/50 because -The parents both carried the recessive gene and only one carried the dominant therefore using the punnet square over the page you see that it is an equally likely chance to have ~~a~~ each different shell

There are more space and Punnett squares for your answer to this question on the following page.



One correct punnett given  
but 2<sup>nd</sup> option of  $Nn \times Nn$   
missed.

### QUESTION THREE: VARIATION IN PLANTS

The photograph below shows a large number of plants that are all the same species.



<http://blogs.ext.vt.edu/soybean-update/files/2013/08/Brown-Stem-Rot-IMAG0159.jpg>

- (a) The yellow-brown colour in some of the plants has been caused by a disease. The disease is present throughout the field, but affects only some plants. This is because of variation in the plants.

Explain why variation means not all the plants get the disease.

Because variation is where a gene varies for a specific reason in this case it is not to get the disease. This is when a gene varies for the population so only some plants get the disease. Identifies that some plants have inherited resistance to disease.

- (b) The plants in the photograph were grown from seeds. Seeds are the result of sexual reproduction.

(i) Name one process that occurs during sexual reproduction, and explain how it results in variation. Names one process, meiosis, that occurs during sexual reproduction.

Meiosis happens in sexual reproduction and helps in variation because genes combine through the female and male reproduction organs when they combine helping the process of variation.

- (ii) Discuss the advantages of sexual reproduction for a species when the environment changes.

In your answer you should:

- give examples of a changing environment
- explain the impact of changing environments on a population
- consider the importance of variation in a population in a changing environment.

// examples of changing environments  
 is summer and winter and how  
 some ~~other~~ animals / plants need  
 to survive during these seasons.  
 The impact on changing environments  
 for a population is that it  
 can disrupt breeding, hunting,  
 growth and key things the  
 organisms need to survive. and  
 Advantages of sexual reproduction  
 in helping the process of genetic  
 variation because it gives more  
 chances of the varried gene to  
 get passed onto offsprings and  
 the more offsprings the carried the  
 varried gene the more chance there  
 is of the gene being used in the  
 changing of environments. Genetic  
 variation for a population can  
 be very crucial in some cases  
 where it helps with the ~~an~~ organisms  
 to extinction reduction. //

Gives basic explanation of link between genetic variation + survival of offspring produced through sexual reproduction

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**Achievement**

**TOTAL**

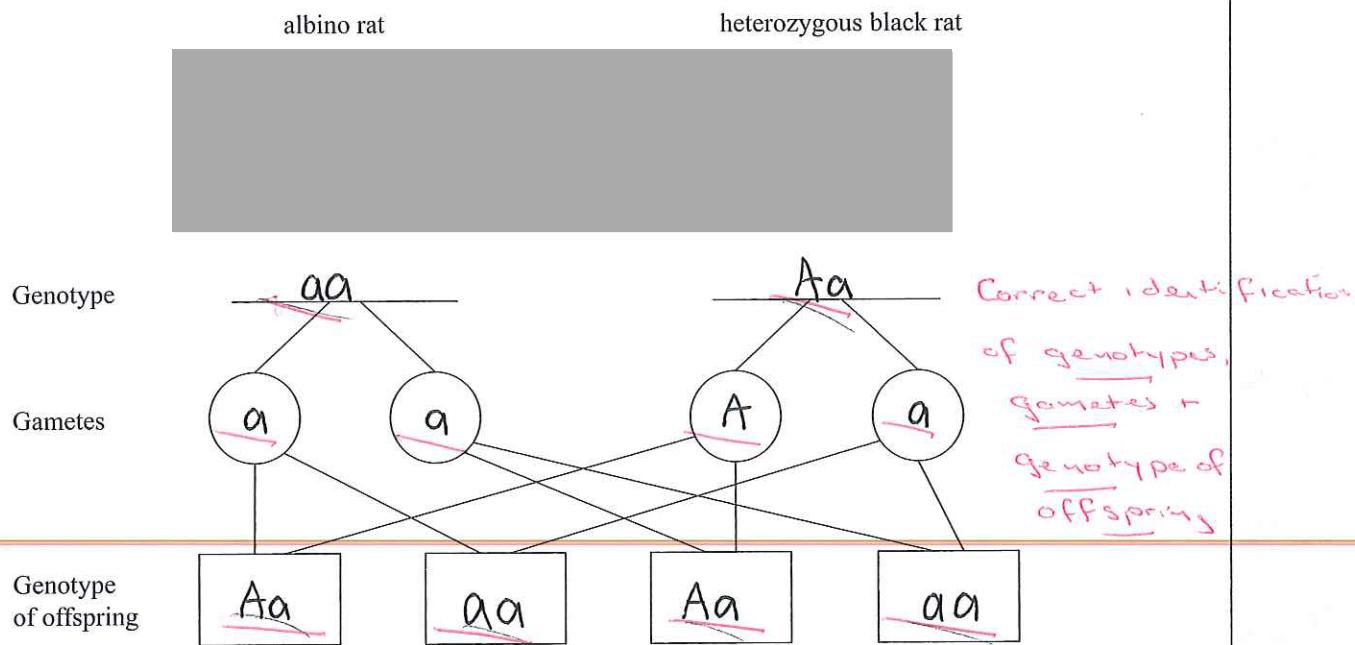
**11**

ASSESSOR'S USE ONLY

## QUESTION ONE: FAMILY PEDIGREES

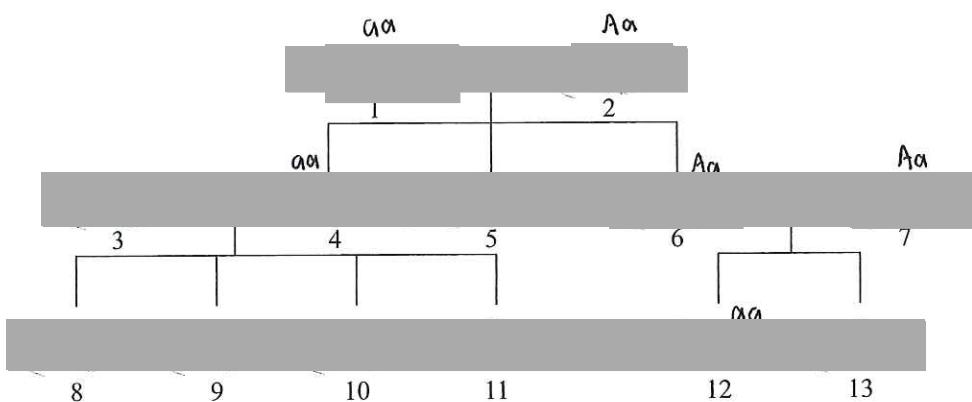
Albinism in rats results in white fur and pink eyes. Albinism is caused by a recessive allele  $a$ .

- (a) Complete the following diagram:



Sources: [www.janvier-labs.com/rodent-research-models-services/research-models/per-species/outbred-rats/product/sprague-dawley.html](http://www.janvier-labs.com/rodent-research-models-services/research-models/per-species/outbred-rats/product/sprague-dawley.html)  
[www.nobuggy.com/pest-wiki/rats](http://www.nobuggy.com/pest-wiki/rats)

- (b) The albino rat and the heterozygous black rat produced the following two generations of offspring, as shown in the pedigree chart below.



What are the genotypes of the following rats?

Rat 4:  $aa$

*Correct identification*

Rat 6:  $Aa$

*of all three*

Rat 10:  $Aa$

*rats*

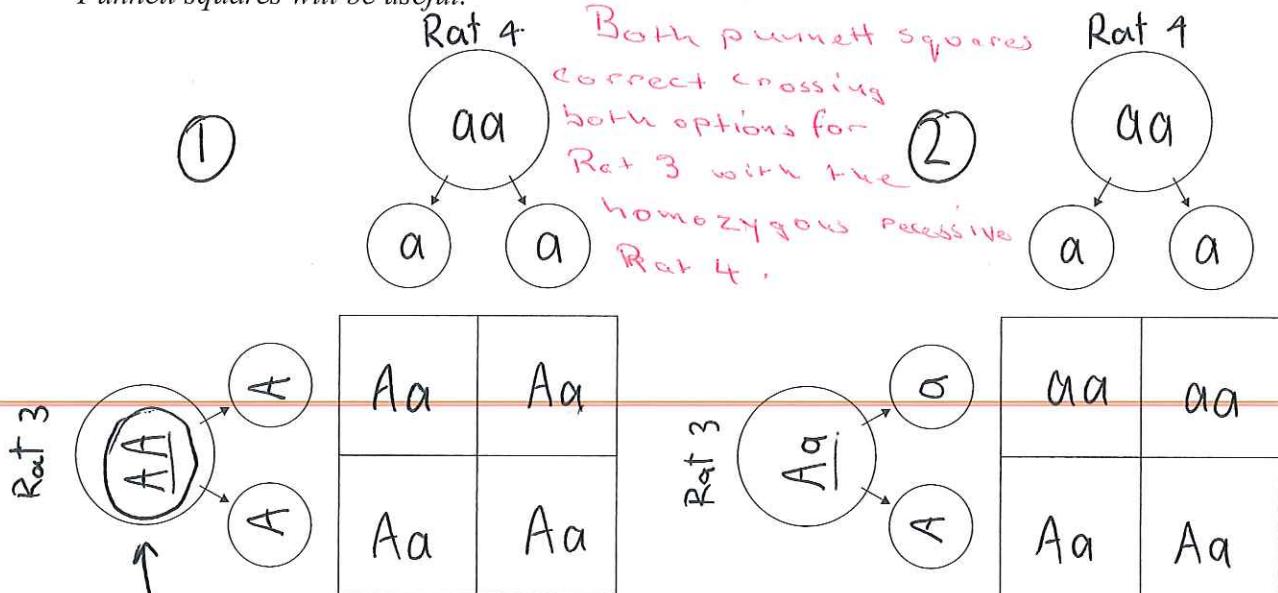
- (c) Rat 3 was **not** an offspring of Rat 1 and Rat 2 in the family tree.

Give the possible genotypes for Rat 3 and explain which is the most likely genotype for Rat 3.

In your answer you should:

- state the possible genotypes for Rat 3
- explain why both genotypes are possible but one is more likely
- explain what you could do to be more certain about the genotype of Rat 3.

Punnett squares will be useful.



It is most likely that Rat 3 has a Genotype of AA. This is because when mating with Rat 4, all the possible outcomes are heterozygous black rats, and all 4 of their offspring are black rats. (Rats 8, 9, 10, and 11) It is also possible for ~~Rat 3~~ Rat 3 to express the genotype in Punnet Square 2 as there is a 50% chance the rats could be black offspring, and 50% chance they could be albino. This is a more unlikely option, however, because none of their offspring are albino, which could just be a coincidence, or Rat 3 has the genotype that is more likely, AA.

correct explanation for offspring (1 merit mark)

linking observed (Pedigree) to theoretical Punnett

A4

Although 1 merit point covered well + in detail  
ms grade required 2 merit points  
Science 90948,

## QUESTION TWO: DNA, ALLELES, GENES, AND CHROMOSOMES

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A snail known as *Cepaea nemoralis* can have either a plain shell or a banded shell.



Plain shell

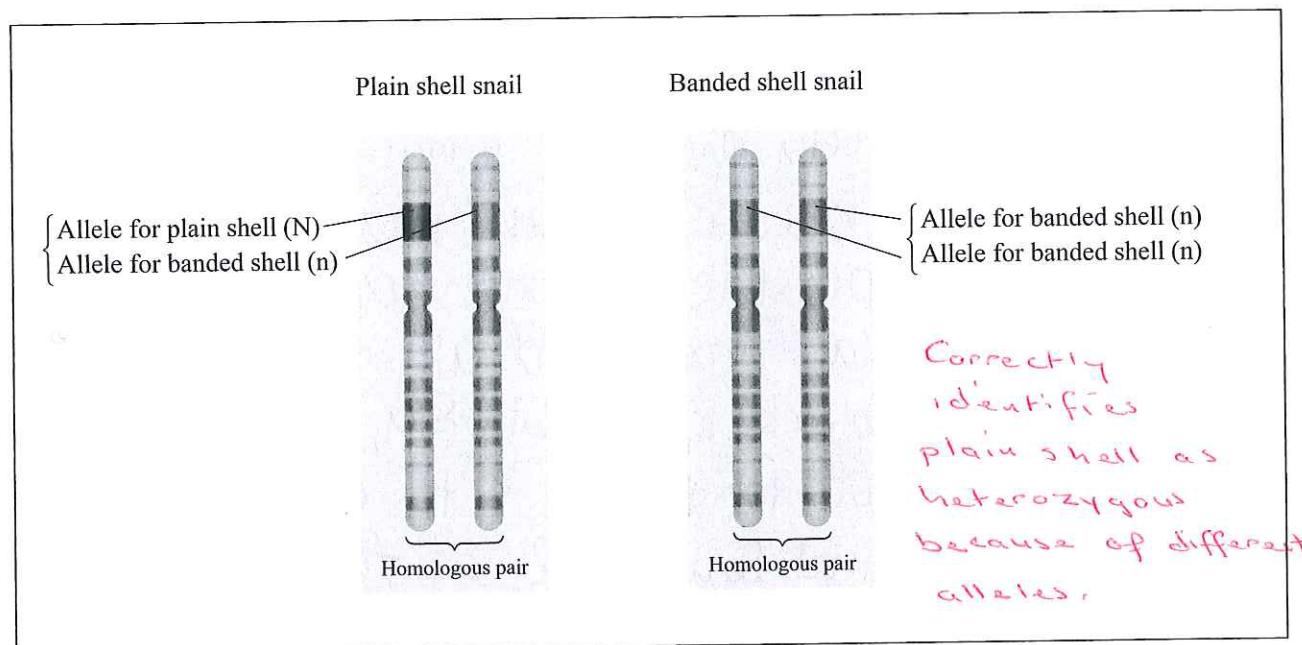
[http://en.wikipedia.org/wiki/List\\_of\\_non-marine\\_molluscs\\_of\\_Ireland](http://en.wikipedia.org/wiki/List_of_non-marine_molluscs_of_Ireland)

Banded shell

<http://de.wikipedia.org/wiki/Hain-B%C3%A4nderschnecke>

The diagrams below show the homologous chromosomes that contain the gene for shell pattern for each of the snails in the photographs above.

Assume the allele for plain shell (N) is dominant over the allele for banded shell (n).



- (a) In the diagram above, which snail is heterozygous for shell pattern?

Plain shell snail

Explain why you chose this snail.

↓In the chromosome's homologous pair, in one of them the plain shell allele (N) is present, and in the other the banded shell allele (n) is also present, but the dominant allele means this trait is expressed.↓

- (b) Referring to the examples shown previously for shell pattern, explain the difference between an allele and a gene.

A gene is a section of DNA that codes for a particular trait/characteristic. An allele, however, is the variation of each certain gene, and can be expressed as dominant or recessive.

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- (c) These two snails were produced by sexual reproduction from the same male and female. Example

Discuss how they have inherited different alleles for shell pattern.

In your answer you should:

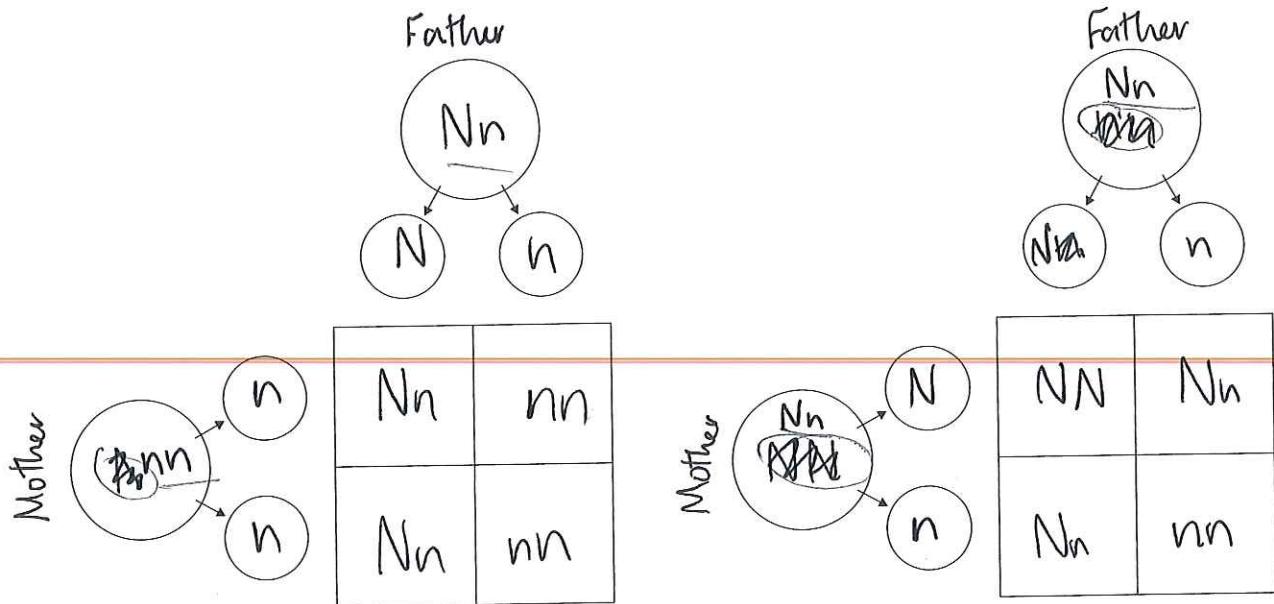
- explain where the homologous chromosomes have come from
- give the possible genotypes of both parents and explain how you determined these possible genotypes.

Correctly identifies that homologous chromosomes inherit as one from each parent

The homologous chromosomes in these two snails have come from their parents. Since these chromosomes come in pairs, one has come from the mother, and the other from the father.

The genotypes of the parents could possibly be either (nn) homozygous recessive with (Nn) heterozygous, or both parents being (Nn) heterozygous. Both of these sets of genotypes would produce both plain shell snails (Nn or NN) as well as banded shell snails (nn), which is necessary considering these two different type of shell snails come from the same parents.

There are more space and Punnett squares for your answer to this question on the following page.



Identifies in words + Punnett Squares  
that both plain + banded offspring  
can be produced from crossing

$Nn \times nn$  and  $Nn \times Nn$ ,

with an explanation required for merit

A4

### QUESTION THREE: VARIATION IN PLANTS

The photograph below shows a large number of plants that are all the same species.



<http://blogs.ext.vt.edu/soybean-update/files/2013/08/Brown-Stem-Rot-IMAG0159.jpg>

- (a) The yellow-brown colour in some of the plants has been caused by a disease. The disease is present throughout the field, but affects only some plants. This is because of variation in the plants.

Explain why variation means not all the plants get the disease.

Variation is due to having two different parents (male and female) that go through processes of reproduction which vary the genes that the offspring obtain. This variation occurs during Meiosis when Independent Assortment and Crossing over occur.

Identifies meiosis as a process of sexual reproduction + how this leads to genetic variation.

- (b) The plants in the photograph were grown from seeds. Seeds are the result of sexual reproduction.

- (i) Name one process that occurs during sexual reproduction, and explain how it results in variation.

A vital step that occurs during sexual reproduction (Meiosis) is Crossing over. This is when the chromosomes line up in pairs at the nucleus equator and exchange genetic information before being separated into two cells, and then four daughter cells with half the number of original chromosomes.

- (ii) Discuss the advantages of sexual reproduction for a species when the environment changes.

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In your answer you should:

- give examples of a changing environment
- explain the impact of changing environments on a population
- consider the importance of variation in a population in a changing environment.

Sexual reproduction is important to the survival of a species as this is how the offspring has different genes and can adapt to a changing environment. Examples of a changing environment include flooding, droughts, food sources becoming scarce, etc.

Significant changes in the environment can mean a population can be greatly affected, in some cases finding it hard to sustain life and survive. Variation is an important aspect needed to sustain a population while the environment may be going through changes. If a change, like disease effected a population that was asexually produced, it would be very unlikely that they would survive it considering they are all genetically identical.

I identifies that changing environments can affect survival.

A3