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Level 1 Science, 2016

90948 Demonstrate understanding of biological ideas relating to genetic variation

9.30 a.m. Monday 14 November 2016
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 2–8 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.

Merit

TOTAL

14

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Paper annotation

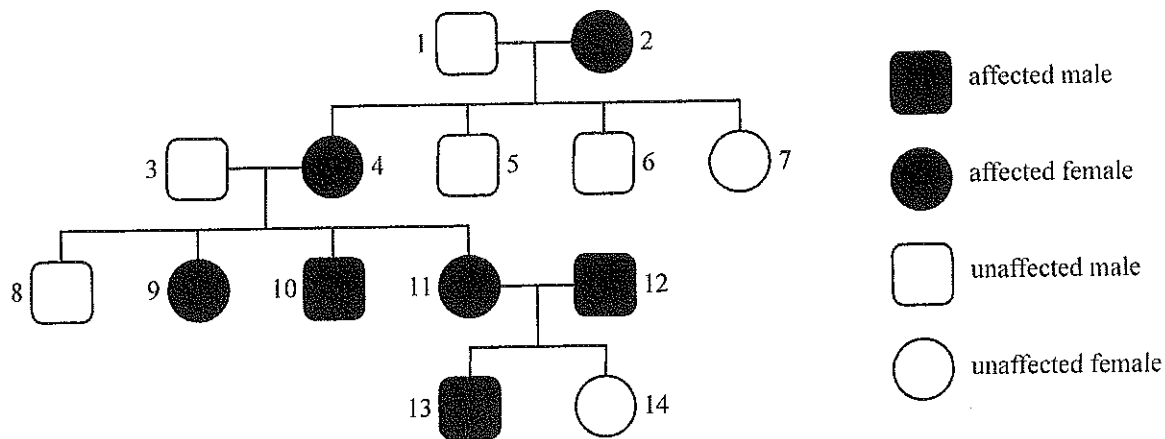
SCORE 14

MERIT

Question	Grade	Annotation
1	A3	<p>Candidate gave the correct genotypes for the individuals in the pedigree chart.</p> <p>They were unable to say why 13's genotype is AA or Aa. They were also unable to say why photic sneezing was dominant.</p> <p>They were correct in giving the punnet squares for expected ratios and giving the 1:1 ratio for phenotypes. They were unable to link the observed ratios to the expected ratio or give chance or sample size as reasons.</p>
2	E7	<p>The candidate was unable to link the change in DNA base code to different alleles and then to different phenotypes.</p> <p>They did however give a good link between combining alleles to different phenotypes for the 3 alleles. All linked to Rocket pocket mice</p> <p>They stated dark was dominant to light.</p>
3	A4	<p>The candidate described sexual reproduction but crossing over was not completed. Independent assortment was not sufficient for explanation of meiosis.</p> <p>The candidate defined inheritable and non-inheritable variation.</p>

QUESTION ONE

Photic sneezing is a condition which causes affected people to sneeze due to bright light. It can be traced through a family, as shown in the pedigree chart. Photic sneezing (A) is dominant to unaffected (a).



(a) Work out the genotypes of the following four individuals:

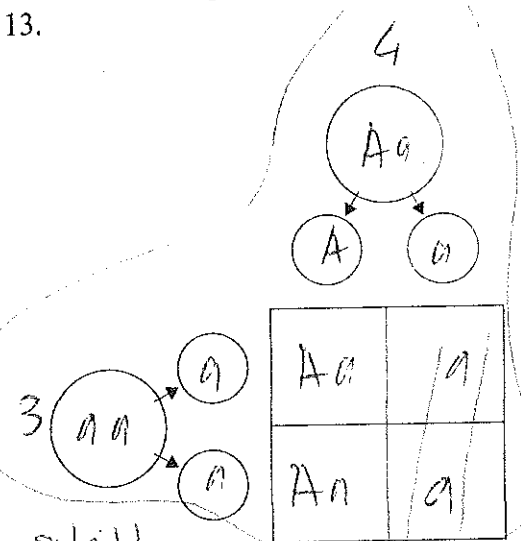
1 aa
11 Aa

2 AA
12 Aa

(b) Explain how the pedigree chart can be used to show that Photic sneezing is dominant, but it cannot be used to determine the genotype of individual 13.

You may use the Punnett square.

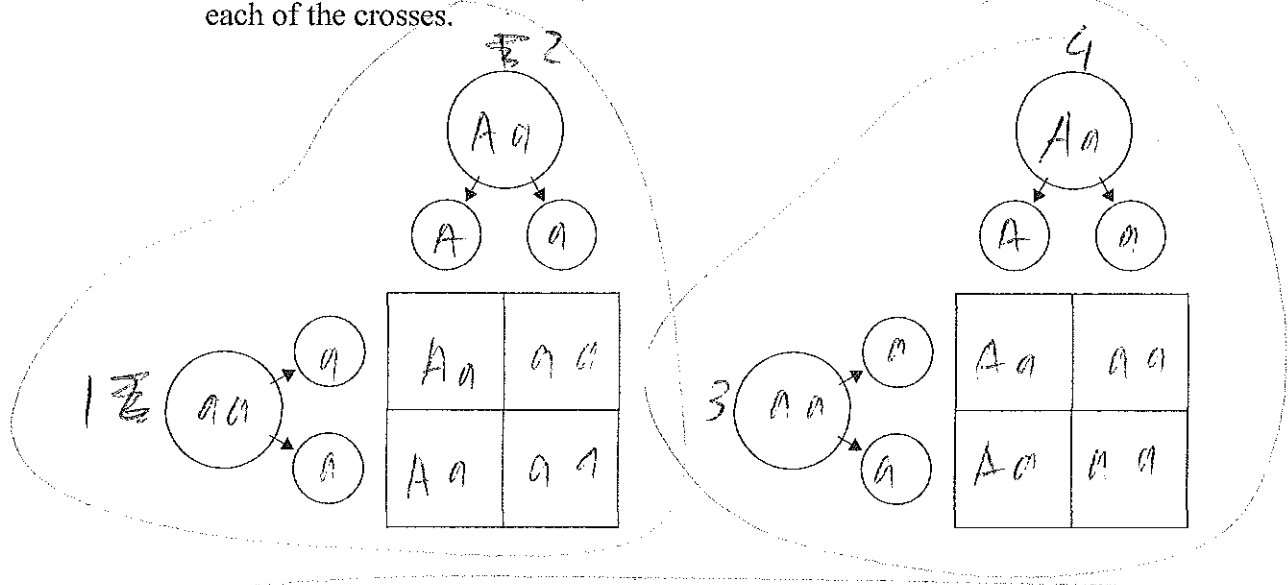
The pedigree chart shows that photic sneezing is dominant 75% of 4 and 5's offspring have the are affected. This shows that there is still a high chance that the offspring will be affected, despite having only one ~~an~~ allele carrying the trait → (Aa, aa, we cannot use the pedigree chart to figure out the genotype at 13 as its parent 12 has no history in the chart, so there is no way of figuring out a definite genotype - we can only speculate



(c) The cross between 1 and 2 in the pedigree chart has **one affected sneezing** offspring.
 The cross between 3 and 4 in the pedigree chart has **three affected sneezing** offspring.

Explain the difference in the number of affected offspring (photic sneezers) in these 2 crosses.
 In your answer you should:

- complete Punnett squares
- give the expected phenotype ratio for each cross
- account for any difference between the expected ratio and the actual phenotype ratio for each of the crosses.



Each of these two crosses actually are the same. Both have a 50% chance of having affected offspring and a 50% chance of ~~not having~~ being unaffected. This means that each time an offspring is produced there is always a 50/50 chance that it will be either affected or an affected. This is why there is such a difference in the two crosses. The number of offspring also does not affect the chances of being affected/unaffected. The phenotypic ratio is expected to be 2 affected : 2 unaffected

AS

an educated guess

but this is not always what happens

QUESTION TWO

Rock pocket mice can have dark fur or light fur, as shown below.



[www.discoverlife.org/mp/20q?search=Chaetodipus+intermedius&mobile=close&flags=glean:](http://www.discoverlife.org/mp/20q?search=Chaetodipus+intermedius&mobile=close&flags=glean)

www.flickrriver.com/photos/tags/broadcanyonbioblitz/interesting/

- (a) Using the example of rock pocket mouse fur colour, explain how information carried on the DNA controls the appearance.

In your answer you should refer to DNA base sequence, genes and alleles.

Each strand of DNA codes for a specific gene. The DNA base sequence uses triple-codes to code for specific amino-acids that code, in turn, for different proteins. Alleles are alternative forms of genes. ~~The~~ In this example, this gene is coding for hair colour, but there are two different alleles for ~~fur~~ hair colour; dark fur and light fur. There are dominant alleles ~~and~~ and recessive alleles. If the dominant allele is present it will be shown in the phenotype (observable characteristic). The recessive allele is only shown ~~if~~ ~~the~~ if both alleles are recessive.

(b) In rock pocket mice, dark fur colour (D) is dominant to light fur colour (d).

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Each mouse has two alleles for fur colour.

Explain how they inherit these two alleles, and explain how the two alleles interact to produce different phenotypes.

In your answer you should:

- define phenotype and genotype
- explain how the alleles are inherited from the parents
- state the three possible fur colour genotypes for rock pocket mice.

A genotype is alleles that the organism inherits from its parents, ^{eg. ~~DD, dd or Dd~~} the phenotype is the observable characteristic of the organism so, dark fur or light fur. You inherit ~~one~~ allele from each parent, therefore you get 2 alleles in total. There are 3 different types of genotypes: homozygous dominant, heterozygous, and homozygous recessive. In this example dark fur is the dominant allele and light fur is the recessive allele. For rock pocket mice homozygous dom. is DD and homozygous recess. is dd. Heterozygous is Dd. The dominant gene is always the one that is shown in the phenotype, if it is present. The recessive allele is only shown in the phenotype if BOTH alleles are recessive. ✓

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QUESTION THREE

Venus flytraps (*Dionaea muscipula*) are plants that live in poor quality soils. They have specially adapted leaves that snap shut to catch insects.

The plants reproduce sexually, involving the production of flowers.

(a) Discuss the advantages of sexual reproduction.

In your answer you should:

- define sexual reproduction
- explain how ONE important process in sexual reproduction helps to produce variation in offspring
- explain how variation as a result of sexual reproduction can benefit the Venus flytrap plant population over generations.

www.flickr.com/photos/david_jones/5256437760

Sexual reproduction is the process in which two organisms 'mate' to produce ^{unique} offspring which inherit genes from BOTH parents. This type of reproduction results in variation within the population.

The important process in sexual reproduction that helps produce variation is the process of meiosis. In this process there are two stages: crossing over and individual assortment. In this process (crossing over) two chromosomes (one from each parent) cross-over and swap one side.

This is called a semi-conservative process as one side of the original chromosome stays intact. After this process is complete the individual assortment ~~also~~ happens the chromosomes line up randomly ready to be split into cells. Meiosis Science 90948, 2016 creates 4 daughter cells.

(b) The Venus flytrap plants come in a number of different types, such as the "B-52" with a red leaf.

A teacher brought two identical plants to class and put them in different parts of the classroom. The Venus flytrap put near a window grew short leaves and the Venus flytrap in the shade grew long leaves.

Colour variation in the leaves of the Venus flytraps can be passed on to a plant's offspring, but the different leaf length cannot. **Explain why.**

In your answer you should:

- define inheritable and non-inheritable variation
- explain what causes inheritable and non-inheritable variations.

Inheritable variation ~~directly~~ directly linked to genes that are passed on from parents to offspring. non-inheritable variation is usually caused by change in the environment and, to some extent, mutations. So colour is a genetically inheritable trait as it is passed down through generations. However the leaf length is non-inheritable as it is caused by the environment. The plant in the sunny area grew short leaves because that is all it needed to gain enough energy from the sunlight (photosynthesis). The plant in the dark area however didn't have the same amount of sunlight available, so it adapted and grew longer leaves to be able to collect enough energy from the sunlight.

https://commons.wikimedia.org/wiki/File:Venus_Flytrap_-_B-52.jpg

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A4

**Extra paper if required.
Write the question number(s) if applicable.**

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QUESTION
NUMBER

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