

Gene Expression

Question Paper

Level	International A Level
Subject	Biology
Exam Board	Edexcel
Topic	Cell Structure, Reproduction and Development
Sub-Topic	Gene Expression
Booklet	Question paper

Time Allowed: 76 minutes

Score: /63

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 Hens lay a variety of sizes of eggs. Certain breeds lay larger eggs than other breeds.

In India, two native breeds of hen were evaluated for egg production. The breeds were Aseel and Kadaknath.



Aseel hen
Magnification $\times 0.05$



Kadaknath hen
Magnification $\times 0.1$

(a) Egg size is affected by polygenic inheritance.

(i) Explain what is meant by **polygenic inheritance**.

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(ii) State the type of variation expected in the size of eggs produced by one breed as a result of polygenic inheritance.

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(iii) Young hens lay smaller eggs than older hens.

Environmental factors may also affect the size of eggs produced.

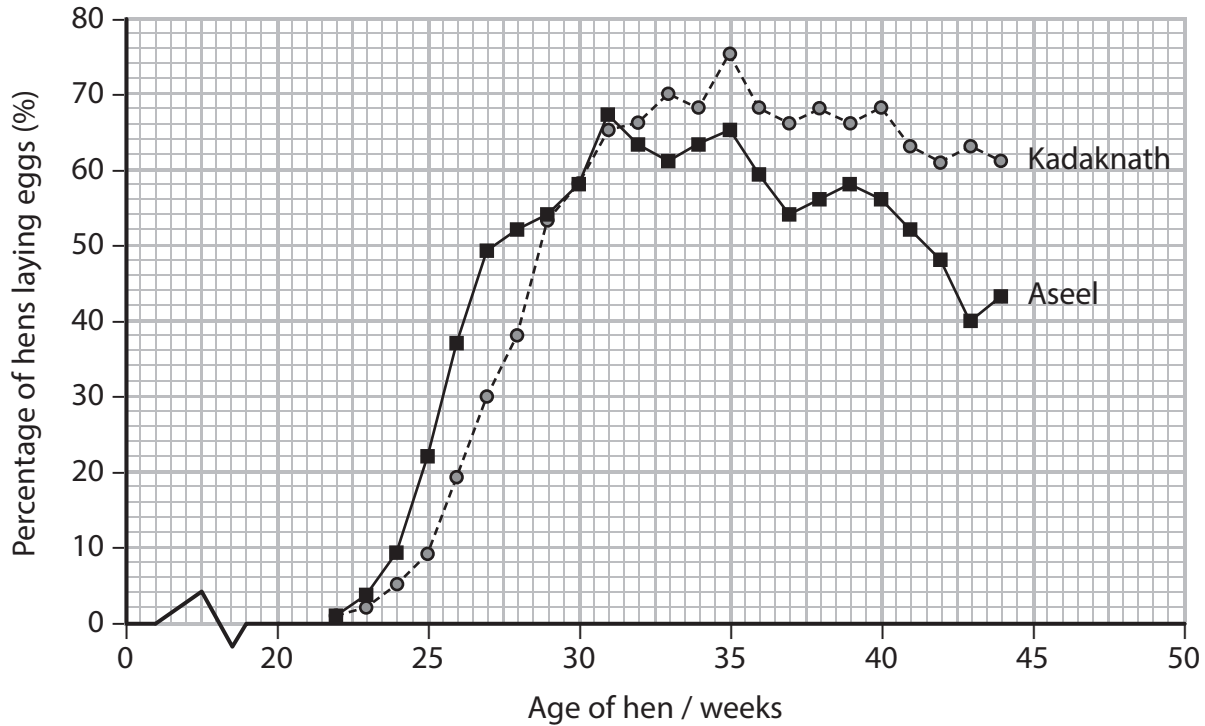
Suggest **one** environmental factor that may affect the size of eggs produced by hens.

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(iii) The scientists also calculated the percentage of hens of different ages that were laying eggs.

The results are shown in the graph below.



Using the information in the graph, compare the effect of the age of the hens on egg laying in these two breeds.

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(Total for Question 1 = 12 marks)

- (b) It has been reported that the relative risk of developing lung cancer is doubled if a person has a close family member who has developed lung cancer.

Explain what this suggests about the causes of lung cancer.

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- (c) Identical twins can provide evidence for the relative effects of the factors that affect a phenotype.

Identical twins develop from one fertilised egg.

- (i) Explain why studies of identical twins can provide evidence for the relative effects of the factors that affect a phenotype.

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(ii) Non-identical twins are produced from the fertilisation of two eggs.

Concordance is the probability that each twin will have the same characteristic if it is present in one of the twins.

The table below shows the concordance of lung cancer in identical and non-identical twins.

Type of twin	Concordance of lung cancer (%)
Identical	20
Non-identical	11

Using information in the table, comment on the relative contributions of genotype and the environment to the probability of developing lung cancer.

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(Total for Question 2 = 9 marks)

(b) Tyrosinase is an enzyme involved in the production of melanin in melanocytes.

Tyrosinase is synthesised on ribosomes and is then modified before being transferred to the melanosomes.

*(i) Suggest what happens to the tyrosinase from when it is released from the ribosomes until it enters the melanosomes.

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(ii) In some forms of albinism, melanin is not produced. This can be due to tyrosinase being secreted from the cell instead of entering the melanosomes.

Suggest how tyrosinase is secreted from the cell.

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4 One gene can give rise to more than one protein.

(a) Explain the importance of the sequence of bases in a gene.

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* (b) The cochlea in a chicken's inner ear is lined with hair cells that can detect different frequencies of sound. The frequency detected depends on the type of BK channel protein present in the cell membrane.

One report suggests that there are 48 different BK channel proteins in these hair cells.

The *cSlo* gene codes for all of these BK channel proteins.

Explain how one *cSlo* gene can give rise to different BK channel proteins in these hair cells.

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(Total for Question 4 = 9 marks)

5 Bacteria are involved in the decomposition of organic matter.

(a) Place a cross ☒ in the box next to the type of chemical reaction that takes place in decomposition.

(1)

- A condensation
- B esterification
- C hydrolysis
- D polymerisation

(b) An investigation was carried out to study the rate of decomposition of leaves from ash trees and beech trees.

Five piles of each type of leaf were placed outside on the ground and each pile was covered with a heavy bucket. Each pile of leaves had a mass of 10 grams.

Every few weeks, one pile of each type of leaf was removed and weighed.

The table below shows the results of this investigation.

Time after falling from the tree / weeks	Mass of pile of ash leaves / g	Mass of pile of beech leaves / g
0	10.0	10.0
4	4.9	9.1
8	2.0	8.4
16	1.1	6.0
32	1.2	2.8
64	0.8	2.4

(iv) Suggest what effect an increase in temperature would have on the rate of decomposition of these leaves. Give an explanation for your answer.

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(Total for Question 5 = 11 marks)

6 Genetic diversity accounts for up to 80% of the variation in human height.

(a) (i) Using height in humans as an example, explain what is meant by the term **genetic diversity**.

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(ii) Genes have been identified that affect height. Some of these genes affect the growth of the bones in the arms and legs.

Place a cross in the box next to the correct words to complete the following statement.

During puberty, hormones are produced that may stimulate an increase in height by

(1)

- A activating these genes that are then transcribed to produce mRNA
- B activating these genes that are then translated to produce mRNA
- C switching off these genes and transcribing mRNA
- D switching off these genes and translating mRNA

(iii) Explain why differential gene expression determines the structure and function of cells.

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(iii) Suggest why any conclusions from this study may not be valid.

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(Total for Question 6 = 12 marks)