Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCE (Biology A)

Resource Set Topic 2: Genes and Health.

Question Paper

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

3 Haemoglobin is a protein made of four polypeptide chains.

There are two identical chains each consisting of 141 amino acids. The other two identical chains each consist of 146 amino acids.

(a) Which of the following is the minimum number of nucleotides present in the mRNA coding for haemoglobin?

(1)

☒ **A** 287

☒ **B** 574

☒ **C** 861

☒ **D** 6862

(b) Sickle cell anaemia is a genetic disorder caused by a mutated allele for haemoglobin.

This causes one amino acid to be changed in one type of polypeptide chain in the haemoglobin protein. This affects the function of the red blood cells.

(i) An allele is a version of a gene.

State what is meant by the term gene.

(1)

.....

.....

(ii) Two parents who are both heterozygous for the mutated allele are expecting a child.

Use a genetic diagram to determine the probability of this child being homozygous for the mutated allele.

(2)

Answer .....

(iii) Explain how a change of one amino acid could lead to a change in the structure and properties of the haemoglobin protein.

(4)

(Total for Question 3 = 8 marks)

5

*(d) People with cystic fibrosis require a higher energy diet than people without cystic fibrosis. They are also more likely to develop problems in the pancreas.

Men with cystic fibrosis are less likely to be able to release sperm.

Discuss why a person with cystic fibrosis could have these symptoms.

(6)

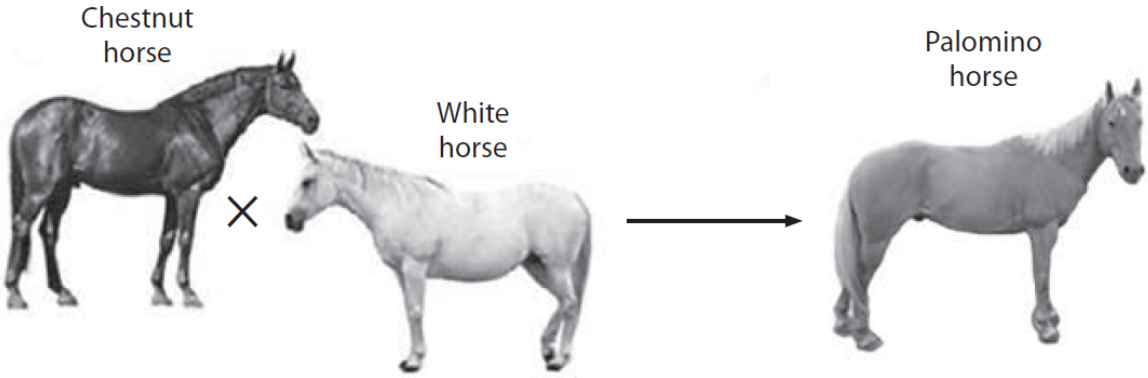
(Total for Question 5 = 6 marks)

4 The phenotype of organisms is affected by genotype.

(a) Chestnut horses are homozygous for the allele H^C. White horses are homozygous for the allele H^W.

If a chestnut horse is mated with a white horse, the offspring will be palomino.

Palomino horses have coats with a colour intermediate between chestnut and white.



(i) State what is meant by the term **allele**.

(2)

(ii) Explain why the offspring have the palomino coat colour.

(3)

(b) Achondroplasia is a genetic condition that causes dwarfism in humans.

Genetic screening can be used to identify achondroplasia in embryos.

Individuals that are heterozygous for achondroplasia have shortened limbs.

Individuals homozygous for achondroplasia will not usually survive for more than one year.

(i) Deduce if achondroplasia is caused by a dominant or recessive allele.

(1)

.....

(ii) Use a genetic diagram to determine the probability that a child of parents with achondroplasia will be homozygous for this condition.

(3)

Answer .....

(iii) An embryo, created by IVF, can be screened before it is placed in the mother's uterus.

Name this type of genetic screening.

(1)

.....

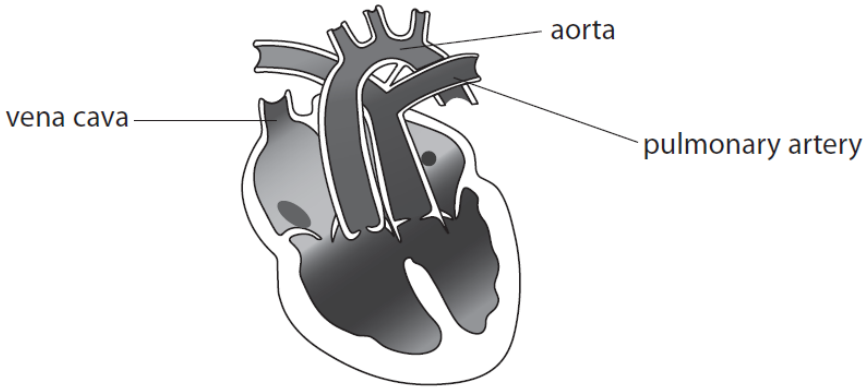
(iv) Explain **one** ethical issue relating to the use of prenatal genetic screening.

(2)

(Total for Question 4 = 12 marks)

8

(b) A baby was born with an abnormal heart. The diagram shows the heart of this baby. There is a hole in the septum between the two ventricles.



(i) Identify the problem with the blood vessels of this heart.

(1)

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(ii) The baby survived because of the hole in the septum of the heart.

Explain how the hole in the septum allowed this baby to survive.

(3)

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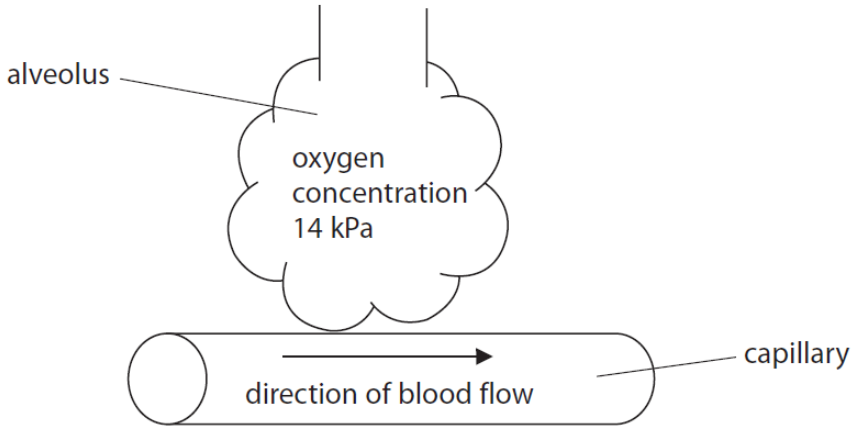
(iii) Oxygen diffuses between the alveoli of the lungs and the blood.

Fick's Law shows how three factors affect the rate of diffusion:

$$\text{Rate of diffusion} = \frac{\text{surface area} \times \text{concentration difference}}{\text{diffusion distance}}$$

The diagram and the table give information about the oxygen concentration in the alveoli and in the blood.



Heart	Oxygen concentration / kPa	
	Blood entering the lungs	**Blood leaving the lungs**
Normal	5	13
With hole in the septum between the ventricles	8	10

*Assess the effect of this heart defect on the rate of oxygen diffusion between the alveoli and the blood.

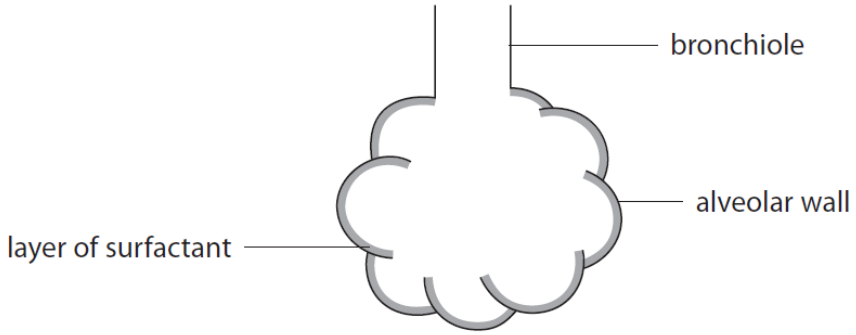
(6)

(Total for Question 8 = 10 marks)

6 Cells in the walls of the alveoli secrete a fluid.

This fluid, containing proteins and lipoproteins, acts as a surfactant.

The layer of surfactant, shown in the diagram, prevents the alveoli collapsing.



Alveolar cells undergoing protein synthesis were investigated.

Cells containing amino acids labelled with a fluorescent marker were monitored for 30 minutes.

The percentage of fluorescence inside and outside the cells was measured.

The results are shown in the table.

Time / min	Fluorescence (%)	
	Inside the cells	Outside the cells
0	100	0
5	87	13
10	80	20
15	68	32
20	56	44
25	47	53
30	38	62

(a) During which period of time did the fluorescence inside the cells decrease at the fastest rate?

(1)

☒ **A** 0 to 5 minutes

☒ **B** 0 to 10 minutes

☒ **C** 10 to 15 minutes

☒ **D** 10 to 20 minutes

(b) The percentage of fluorescence inside and outside these alveolar cells changed.

Explain why these changes occurred.

(4)

(c) Explain how these labelled amino acids would be incorporated into a surfactant protein.

(4)

(Total for Question 6 = 9 marks)

7 DNA is a polymer made from monomers called nucleotides.

(a) Describe how nucleotides join together to form DNA.

(2)

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(b) Different theories for DNA replication have been suggested. Figure 1 illustrates two of these theories.

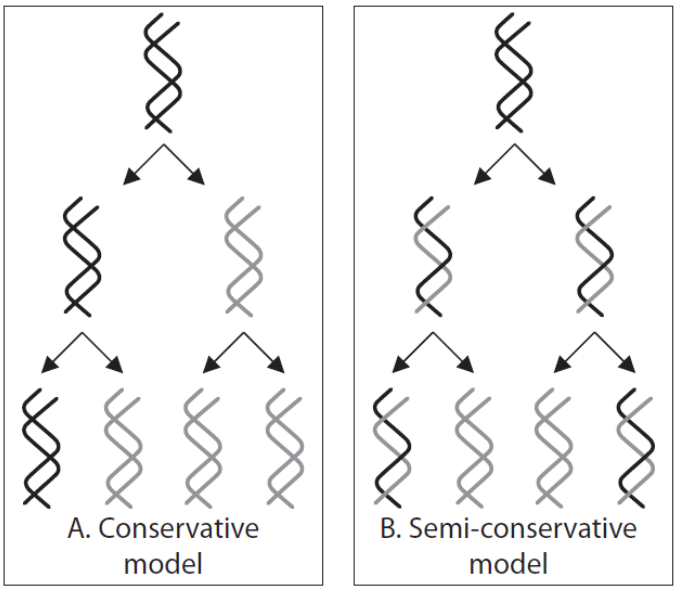


Figure 1

Meselson and Stahl carried out experiments to test these theories for DNA replication.

Figure 2 shows the results from one of their experiments.

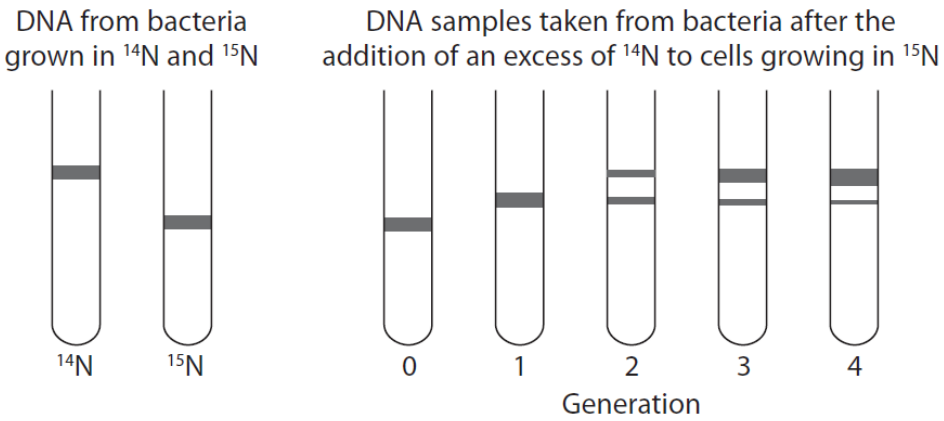
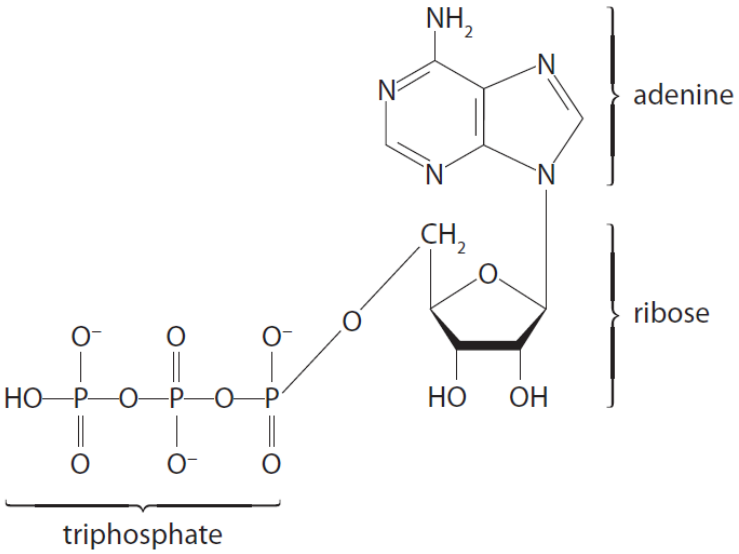


Figure 2

Analyse the data to explain why Meselson and Stahl accepted one of the models for DNA replication and rejected the other.

(4)

(c) The diagram shows the structure of ATP.



Compare and contrast the structure of ATP and a DNA nucleotide.

(3)

(Total for Question 7 = 9 marks)

TOTAL FOR TEST = 54 MARKS