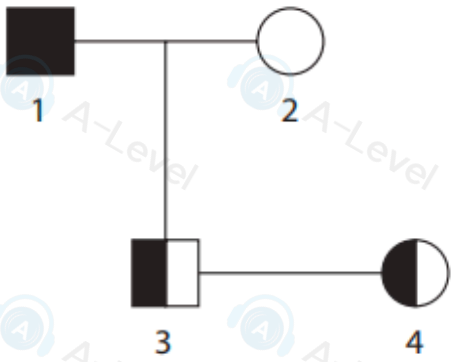
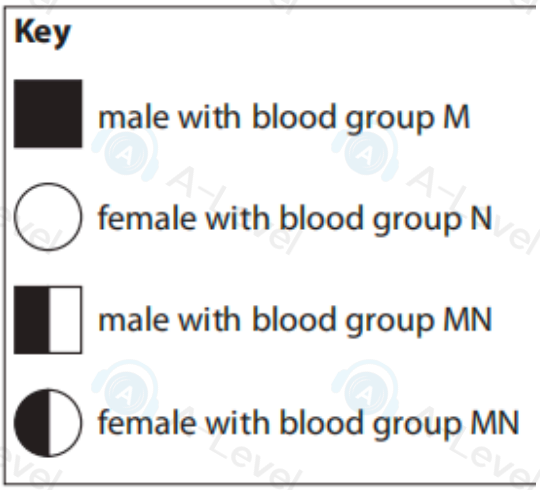
8 Red blood cells have a number of different groups of proteins on the cell surface membrane.

The inheritance of some of these groups of proteins is an example of codominance.

The pedigree diagram shows the blood type of individuals in part of one family. Individuals 1 and 2 are both homozygous for blood type.





(a) Explain why the inheritance of blood type, shown in this diagram, is an example of codominance.

(2)

(b) Determine the ratio of the possible blood type phenotypes of the children of individuals 3 and 4.

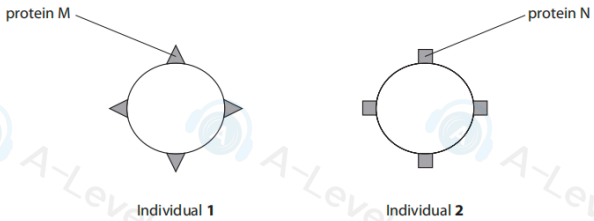
You must draw a genetic diagram. **(4)**

Genetic diagram:

Ratio .....

(c) The gene that determines this blood type codes for proteins present on the cell membranes of red blood cells.

The diagram shows red blood cells from two members of the family shown in the pedigree diagram.



Individual **1** Individual **2**

(i) Explain how the alleles present in individual **3** result in the proteins found on the surfaces of his red blood cells.

(3)

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*(ii) Discuss the possible effects that a mutation in one of the genes coding for this blood type could have on the phenotype of individual **3**.

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

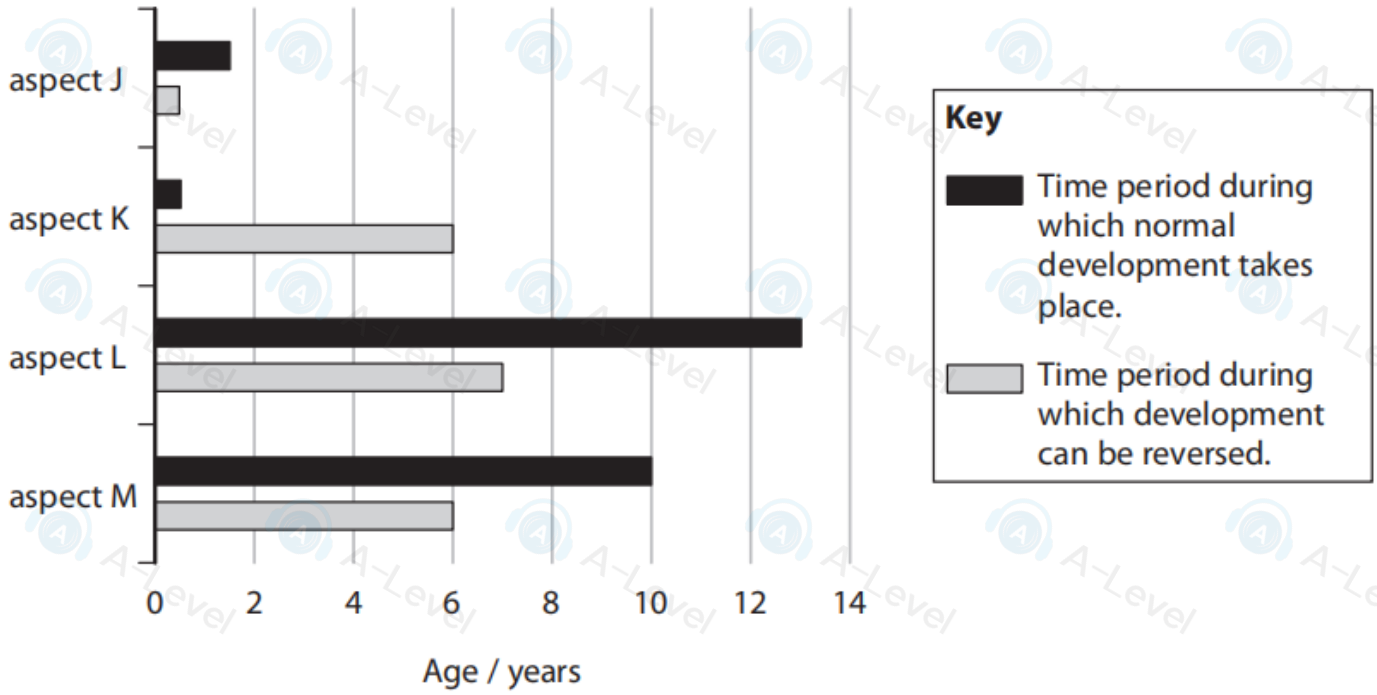
4 Development of the brain is affected by both genetic and environmental factors.

Critical windows have been identified during which the development of some aspects of the visual system take place.

The effect on visual development of the temporary loss of vision in children has been investigated.

Four aspects, J, K, L and M, were investigated.

The graph below shows the critical windows for these aspects.



(a) Put a cross ☒ in the box that completes each statement about the development of the visual system.

(i) During the critical window for the development of the visual system, exposure to light stimulates

(1)

☒ **A** division of optic nerve cells

☒ **B** formation of rhodopsin in rod cells

☒ **C** formation of synaptic connections in the cortex

☒ **D** growth of rod cells in the retina

(ii) Temporary loss of vision at two years of age would damage the development of

(1)

☒ **A** aspect J only

☒ **B** aspect J and aspect K

☒ **C** aspect K only

☒ **D** aspect K and aspect L

3 Collagen is a fibrous protein found in bones.

Brittle bone disease is a rare condition caused by a dominant allele. This allele is the result of a mutation in a gene coding for the production of collagen.

The photograph below shows an X-ray of an adult with brittle bone disease.

Magnification ×0.2

(a) Name the bond that joins amino acids together to form collagen.

(1)

(b) In the space below, draw a genetic pedigree diagram to show two parents, heterozygous for brittle bone disease, and all their possible offspring.

Use the symbols shown in the key.

(2)

Key

- affected female
- affected male
- unaffected female
- unaffected male

(c) Brittle bone disease can be caused by a mutation in the COL1A1 gene.

(i) Explain how prenatal testing can be used to identify this condition.

(4)

(ii) Suggest **two** reasons why prenatal testing for brittle bone disease is not offered to all pregnant women.

(2)

1 .....

.....

.....

2 .....

.....

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(Total for Question 3 = 9 marks)