1 A healthy kidney controls the excretion of urea and other waste products of metabolism from the blood.

After kidney failure there are two possible treatments: dialysis or a kidney transplant.

Fig. 4.1 shows how blood and dialysis fluid move through a dialysis machine.

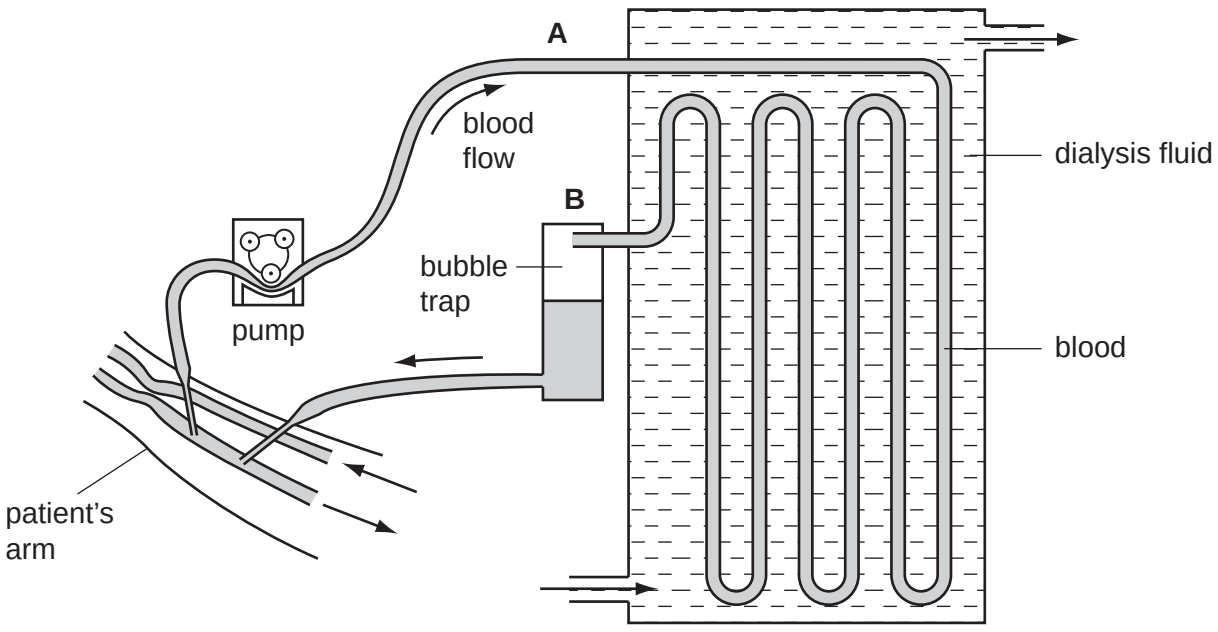

Fig. 4.1

(a) Describe the changes that occur to the blood as it flows through the dialysis machine from **A** to **B**.

.....

.....

.....

.....

..... [2]

(b) Discuss the advantages of kidney transplants compared with dialysis.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(c) Two brothers have to make a difficult decision.

One brother, with blood group AB, has kidney failure and is on dialysis.

The healthy brother has agreed to donate one of his kidneys to his brother. He has to have a blood test.

Their father has blood group A and their mother has blood group B.

The brothers have a sister who has blood group O.

(i) Explain how this girl has blood group O when her parents have different blood groups. You **must** use the space below for a genetic diagram to help your answer.

Use the symbols I^A, I^B and I^O to represent the alleles involved in the inheritance of blood groups.

parental phenotypes	blood group A		×	blood group B	
parental genotypes	.....		×	.....	
gametes	.....	.....	+	.....	.....
girl's genotype	.....				
girl's phenotype	.....				

.....

.....

.....

.....

..... [4]

(ii) The healthy brother can only donate the kidney to his brother if they both have the same blood group.

What is the probability that the healthy brother also has blood group AB?

..... [1]

[Total: 10]

2 Fig. 1.1 shows a vertical section through a flower of soybean, *Glycine max*, following self-pollination. Fig. 1.2 shows part of the section at a higher magnification.

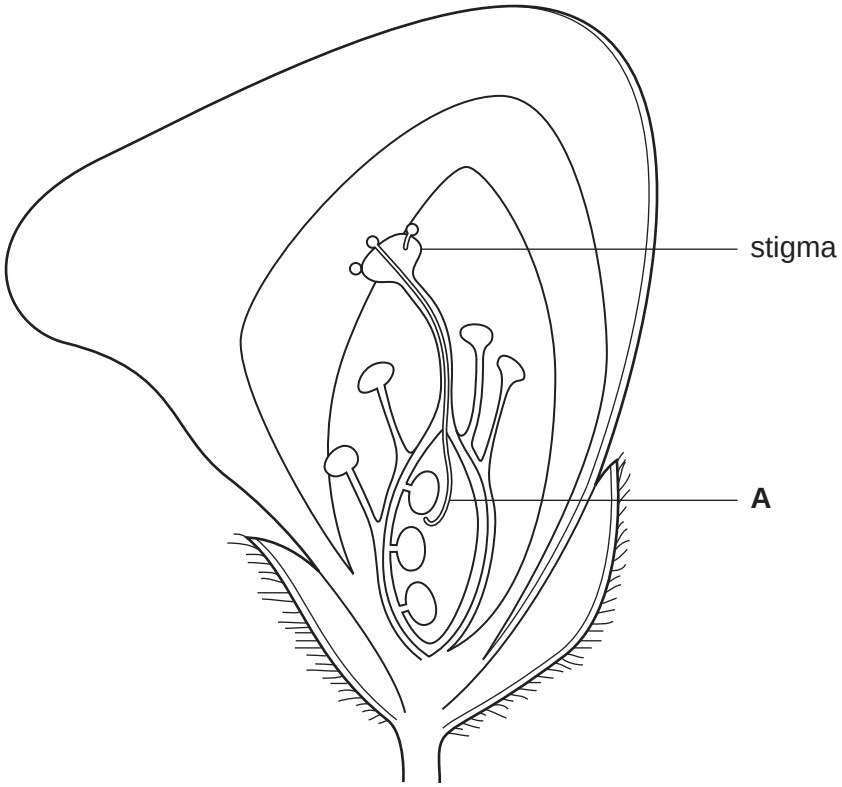

Fig. 1.1

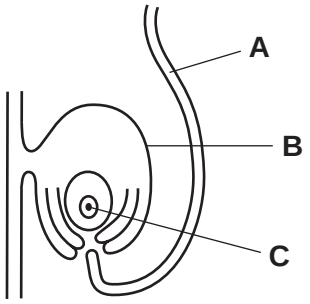

Fig. 1.2

(a) Name the parts labelled **A** to **C** shown in Figs. 1.1 and 1.2.

A .....

B .....

C ..... [3]

(ii) Describe what happens to the structures shown in Figs. 1.1 and 1.2 to bring about fertilisation. You may refer to the structures labelled **A** to **C** by their letters if you wish.

.....

.....

.....

.....

.....

..... [3]

(iii) Explain the advantages **and** disadvantages of self-pollination for flowering plants, such as soybean.

advantages .....

.....

.....

.....

disadvantages .....

.....

.....

.....

..... [4]

(b) Soybean is a dicotyledonous plant.

(i) Name the genus to which the soybean belongs.

..... [1]

(ii) State two features which are **only** found in dicotyledonous plants.

1. .....

2. ..... [2]

[Total: 13]

3 Fig. 4.1 is a photograph of a root of radish covered in many root hairs.

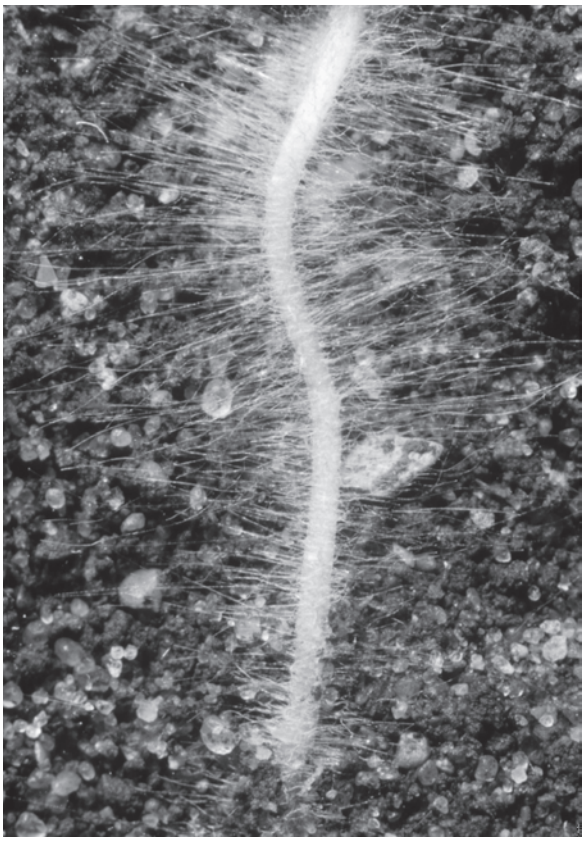

Fig. 4.1

(a) Using the term *water potential*, explain how water is absorbed into root hairs from the soil.

.....

.....

.....

.....

.....

..... [3]

A potometer is a piece of apparatus that is used to measure water uptake by plants.

Most of the water taken up by plants replaces water lost in transpiration.

A student used a potometer to investigate the effect of wind speed on the rate of water uptake by a leafy shoot. As the shoot absorbs water the air bubble moves upwards.

The student's apparatus is shown in Fig. 4.2.

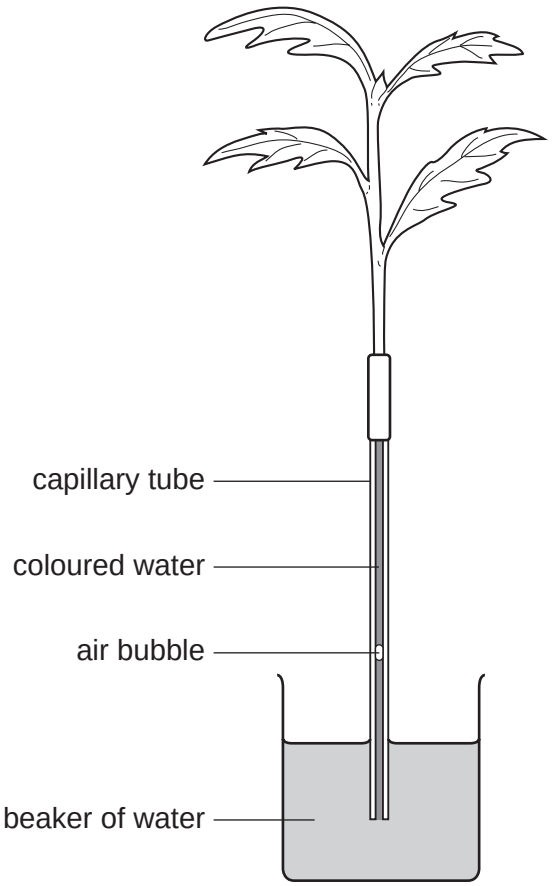

Fig. 4.2

The student used a fan with five different settings and measured the wind speed. The results are shown in Table 4.1.

Table 4.1

wind speed / metres per second	distance travelled by the air bubble / mm	time / minutes	rate of water uptake / mm per minute
0	4	10	0.4
2	12	5	2.4
4	20	5	4.0
6	35	5	7.0
8	40	2	……

(b) Calculate the rate of water uptake at the highest wind speed and write your answer in the table.

[1]

(c) Describe the effect of increasing wind speed on the rate of water uptake. You may use figures from Table 4.1 to support your answer.

.....

.....

.....

..... [2]

(d) State two environmental factors, **other than wind speed**, that the student should keep constant during the investigation.

1. .....

2. ..... [2]

(e) Some of the water absorbed by the plants is **not** lost in transpiration.

State two **other** ways in which water is used.

1. .....

2. ..... [2]

(f) Water moves through the xylem to the tops of very tall trees, such as giant redwoods of North America. The movement of water in the xylem is caused by transpiration.

Explain how transpiration is responsible for the movement of water in the xylem.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(g) Plants that live in hot, dry environments show adaptations for survival.

State three **structural** adaptations of these plants.

1. .....

2. .....

3. ..... [3]

[Total: 17]

4 **(a** Four definitions of terms used in genetics are shown in Table 5.1.

Table 5.1

definitions	
the outward appearance of an organism	……..
a length of DNA that codes for a protein	……..
having one set of chromosomes	……..
type of nuclear division which gives daughter nuclei that are genetically identical	…….

For each of the definitions, select an appropriate term from the list and write it in the box provided.

chromosome	genotype	mitosis
diploid	haploid	mutation
dominant	heterozygous	phenotype
gene	homozygous	recessive

[4]

(b) A couple who have blood groups **A** and **B** have four children. Each child has a different blood group.

Use the space below to draw a genetic diagram to show how this is possible. Use the symbols, $\mathbf{I^A}$, $\mathbf{I^B}$ and $\mathbf{I^o}$, for the alleles.

parental blood groups		**A** ×	**B**	
parental genotypes		..... ×	.....	
gamete genotypes		.....	.....	
children's genotypes	.....	.....	.....	.....
children's blood groups	.....	.....	.....	.....

[4]

(c) Explain what is meant by *codominance*. You may refer to the genetic diagram in **(b)** to help you with your answer.

.....

.....

.....

.....

.....

.....

[3]

(d) Insulin produced by genetically engineered bacteria first became available in 1982. Before 1982, insulin had been prepared from dead animal tissues.

Explain the **advantages** of using insulin produced by genetically engineered bacteria rather than insulin from dead animal tissues.

.....

.....

.....

.....

.....

.....

[3]

(e) Fig. 5.1 shows some of the steps involved in the genetic engineering of bacteria.

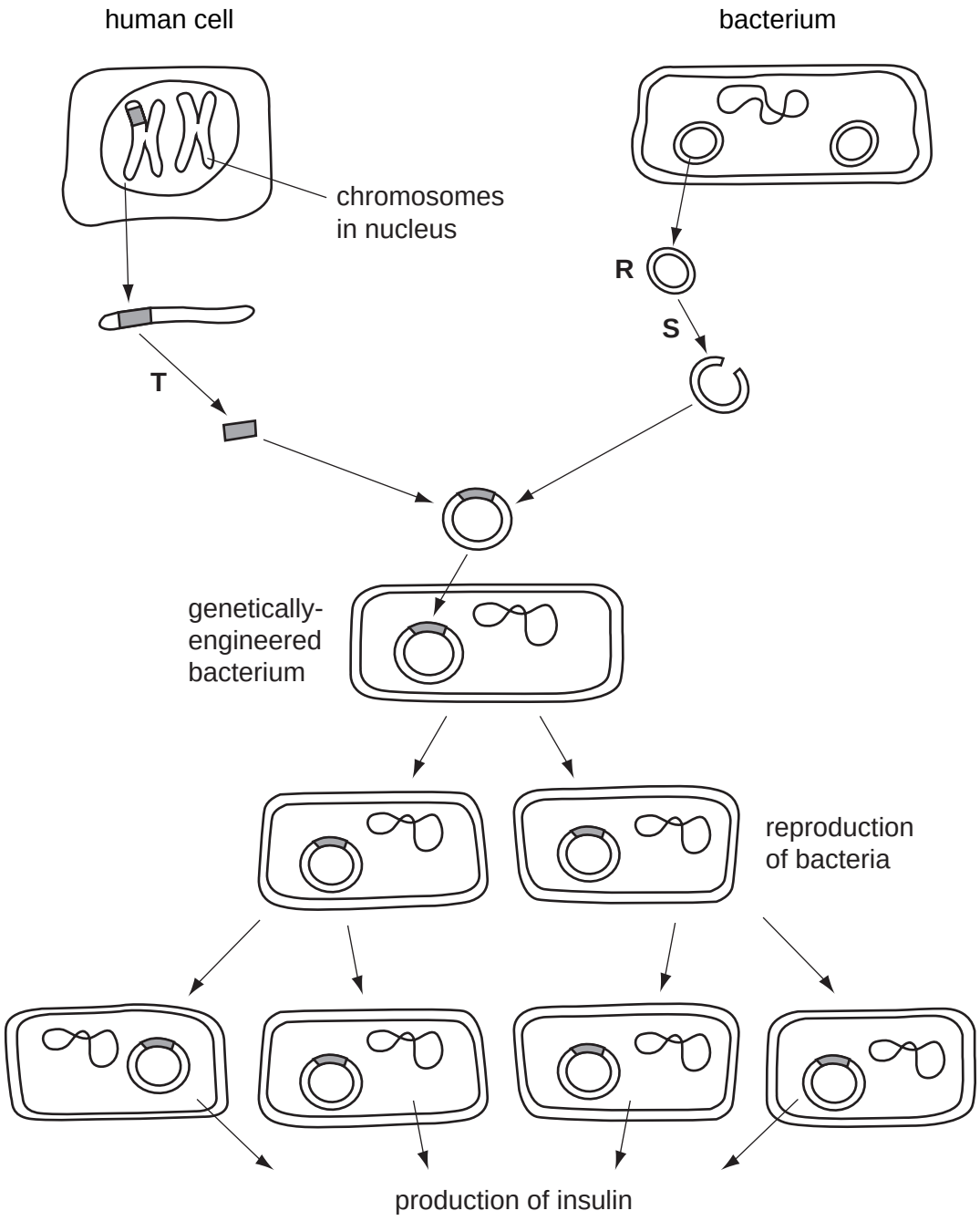

Fig. 5.1

(i) Name structure **R** and state what it is made from.

.....

[2]

(ii) State what is added at stages **S** and **T**.

.....

[1]

[Total: 17]