



**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

**(a) (i)** State the set point for body temperature.

.....[6]



- (i) The BMI of the Nilotic male is 18.84.

Using the information in Table 1.1, calculate the BMI of the Inuit male.

**Show your working. Give your answer to two decimal places.**

Answer = ..... [2]

- (ii) The Nilotic man is adapted for life in the hot deserts of North Africa and the Inuit man for life in the frozen areas of the Arctic.

Using the information in Fig. 1.1 and Table 1.1, explain the differences in the BMI of the Nilotic and Inuit men **and** suggest how these differences adapt them for life in their environment.

Nilotic male .....

.....

.....

.....

.....

Inuit male .....

.....

.....

.....

.....[5]

[Total: 16]

- 2 (a) Abnormalities of the immune system are responsible for a large number of disease conditions.

It has been discovered that some people have antibodies in their blood which complement the cell surface antigens on beta cells in their pancreas.

Suggest what is unusual about these antibodies **and** describe their effects on the beta cells in the pancreas.

.....

.....

.....

.....

.....

.....

.....

.....[4]

- (b) The normal concentration of glucose in the blood is  $90 \pm 10 \text{ mg per } 100 \text{ cm}^3$  of blood.

Table 2.1 shows the results of glucose tolerance tests on two individuals, **A** and **B**.

- i The blood glucose concentration was measured at the start of the test.
- ii They were then given 50 g of glucose.
- iii The blood glucose concentration was then measured at fifteen-minute intervals for two hours.

**Table 2.1**

time/min	blood glucose concentration /mg per $100 \text{ cm}^3$ blood	
	<b>A</b>	<b>B</b>
0	90	100
15	110	125
30	140	172
45	100	190
60	80	208
75	91	205
90	84	200
105	87	197
120	89	195

- (i) Explain why the blood glucose concentration of individual **A** did not return immediately to  $90 \text{ mg per } 100 \text{ cm}^3 \text{ blood}$ .

.....

.....

.....

- (ii) Explain the data for individual **B** given in Table 2.1.

.....

.....

.....

.....

.....

.....

.....

.....[3]

- (c) Individuals with Type 2 diabetes are recommended to make the following changes to their diet:

- i ~~avoid~~ foods high in refined sugar (a high glycaemic index)
- ii ~~eat~~ carbohydrate in the form of more starch (a low glycaemic index)
- iii ~~reduce~~ the intake of saturated fat.

- (i) Explain why it is important to avoid foods high in refined sugar but to eat more starch.

.....

.....

.....

.....

.....

.....[3]

(ii) Suggest why diabetics should eat less saturated fat.

.....

.....

.....

.....

.....

.....[3]

(d) Diabetics may also be prescribed statins. These are drugs that lower blood cholesterol.

In a clinical study, patients with Type 2 diabetes were divided into three groups:

- i group X was treated by changes in the diet only
- i group Y was treated by statin only
- i group Z was treated by both diet and statin.

The following measurements were taken from each group:

- i blood LDL concentration
- i blood insulin concentration
- i resistance to the effect of insulin.

After 12 weeks, the three measurements were repeated and the **mean percentage change** calculated for each group.

The results of this investigation are shown in Fig. 2.1.

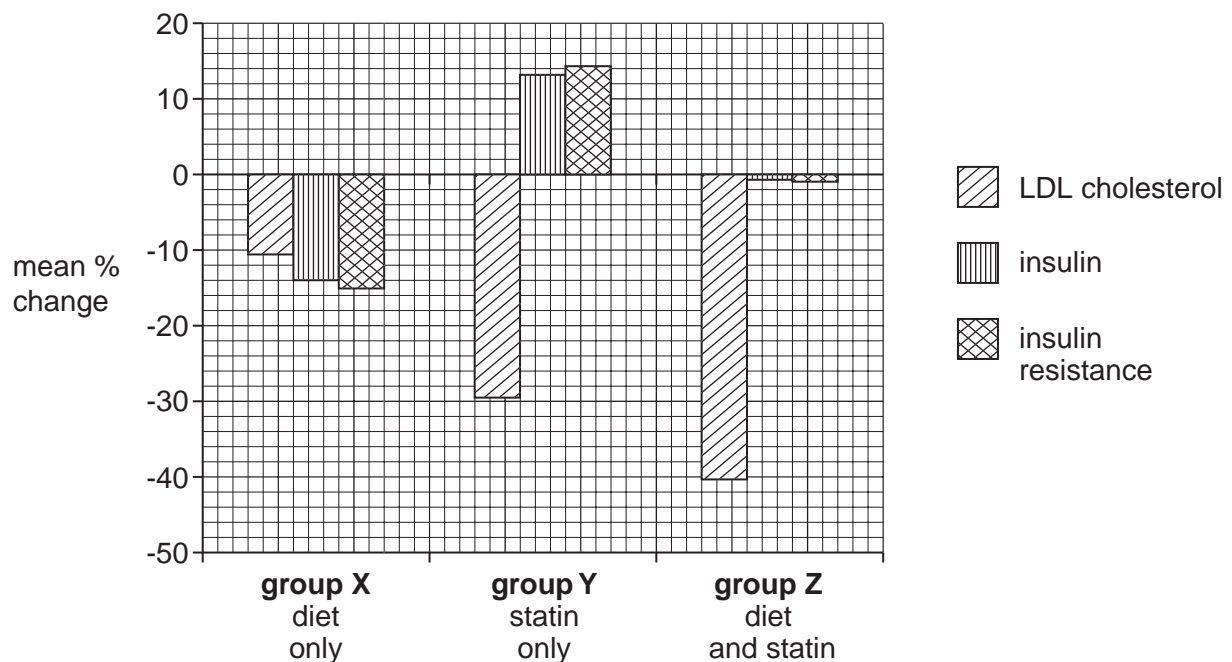


Fig. 2.1

Using the information in Fig. 2.1, explain why diabetics are encouraged to use a combination of diet and statin, rather than diet or statin alone, to treat their condition.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 19]

**3** In this question, one mark is available for the quality of use and organisation of scientific terms.

An elderly gentleman asks his daughter if she will take him to a nearby department store to buy a new telephone, as he is experiencing difficulty with the telephone he has at present.

- He cannot easily hear the caller when he answers the phone.
- When he makes a call he frequently dials the wrong number.
- He also has difficulty finding the right buttons to press.

(a) Describe the changes that may have occurred in the **brain** and **sense organs** as the gentleman ages, which could account for his difficulty with the telephone.

[7]

Quality of Written Communication [1]

(b) The daughter is worried that this is not the first time that her father has asked her for help with routine tasks. She suspects that he may be developing a degree of dementia.

(i) Describe **one** suitable diagnostic procedure which would help to assess her father's condition.

.....

.....

.....

.....

.....

.....[3]

(ii) Outline the **long term** difficulties that may be faced by the **daughter** if her father is found to have dementia.

.....

.....

.....

.....

.....

.....

.....[3]

(iii) Suggest **two** ways in which the daughter could seek extra help for her father.

1 .....

.....

.....

2 .....

.....

.....[2]

[Total: 16]



ethical issues ..... [7]

Quality of Written Communication [1]

- (b)** A patient was given a heart transplant for severe coronary heart disease (CHD).

Suggest the advice that might be given to this patient for his after-care.

[4]

- (c) A new technique has been developed in the United States that allows the transplant of a kidney from a living donor who does **not** have a matching blood group.

The technique involves washing the blood of the recipient three times a week for three months, to remove all the antibodies that would damage the transplanted kidney.

- (i) A patient who is blood group **O** has been offered a kidney transplant from a relative who is group **AB**.

State the **antibodies** from the **ABO** system that must be washed out of the blood if the transplant is to be successful.

.....[2]

- (ii) In addition to the blood groups, it is important that the tissue type should match as closely as possible.

Explain what is meant by the *tissue type* in this context.

.....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....[4]

[Total: 18]

- 5 The gene that causes nail patella syndrome is linked to the **ABO** blood group gene. This is one of the few examples of autosomal linkage in humans that is well understood.

- (a) The Human Genome Project has revealed other autosomal linkage groups. This has contributed greatly to the mapping of human chromosomes and has considerable potential for the diagnosis of human genetic diseases.

Suggest how linked genes may have the potential for the diagnosis of genetic diseases.

.....  
 .....  
 .....[1]

**As known examples of autosomal linkage in humans are very rare, an imaginary example has been used in the following questions.**

It has been proposed that individuals who have a long index finger (locus **D/d**) also have a short big toe (locus **T/t**).

An individual with a long index finger and a short big toe has five children with a partner who has a normal length index finger and a normal length big toe.

All their children have a normal length index finger and a normal length big toe.

- (b) State whether the allele for a long index finger is dominant or recessive. Give a reason for your answer.

allele .....  
 reason .....  
 .....  
 .....[2]

- (c) Using the symbols **D/d** for the index finger length locus and **T/t** for the toe length locus,

- (i) state the genotype of the children;

.....[2]

- (ii) state the possible genotypes of the parent with a normal length index finger and a normal length big toe.

.....[2]

- (d) Researchers investigated a large sample of people with the heterozygous genotype for both index finger and big toe length. Each person had children with a partner who had a long index finger and a short big toe.

The number of children with each phenotype is shown below.

$\frac{1}{2}$	long index finger and a short big toe	83
$\frac{1}{2}$	long index finger and a normal big toe	21
$\frac{1}{2}$	normal index finger and a short big toe	20
$\frac{1}{2}$	normal index finger and a normal big toe	80

The ratio of phenotypes for unlinked loci is predicted to be 1 : 1 : 1 : 1

The chi-squared ( $\chi^2$ ) test was conducted on these data, giving a value for  $\chi^2$  of 73.06.

**Table 5.1**

degrees of freedom	probability (p)				
	0.10	0.05	0.02	0.01	0.001
1	2.71	3.84	5.41	6.64	10.83
2	4.61	5.99	7.82	9.21	13.82
3	6.25	7.82	9.84	11.35	16.27
4	7.78	9.49	11.67	13.28	18.47

- (i) Use the value of  $\chi^2$  and Table 5.1 to find the probability of these results differing from the expected ratio by chance.

.....[1]

- (ii) State the conclusions that may be drawn from the probability found in (d)(i).

.....

.....

.....

.....[3]

- (iii) The difference between the observed and expected results in this investigation occurs because the loci for index finger length and big toe length are on the same chromosome (linked).

Explain **by means of a genetic diagram**, how the actual results of these crosses occurred.

<i>parental phenotypes</i>	normal index finger normal big toe	long index finger short big toe
<i>parental genotypes</i>	.....	.....
<i>gametes</i>	.....	.....

explanation .....

.....

.....

.....

.....

.....

.....[8]

[Total: 19]



- (b) It has been suggested that secondary oocytes could be used to regain fertility in menopausal women.

(i) Suggest how this might delay the menopause.

.....

.....

.....[2]

(ii) Discuss the **advantages** and **disadvantages** of delaying the menopause.

.....

.....

.....

.....

.....

.....

.....

.....[4]

- (c) Discuss methods, **other than the use of secondary oocytes**, that may be used to delay the menopause or to reduce its symptoms.

.....

.....

.....

.....

.....[3]

- (d) Secondary oocytes produced from germinal epithelium could become a valuable resource for IVF.

Explain how IVF could change the frequency in the population of alleles that cause disease.

.....

.....

.....[2]

[Total: 17]

[Turn over

- 7 As the diagnosis of genetic disease improves, there is an increased need for counselling individuals who are involved.

(a) Turner's syndrome is caused by a chromosomal mutation.

(i) Suggest why this condition is called a *syndrome*.

.....

.....

.....[2]

(ii) Describe how Turner's syndrome occurs.

You may use a labelled diagram if it helps you to answer the question.

.....

.....

.....

.....

.....

.....

.....

- (b) Turner's syndrome may be diagnosed while the foetus is still in the uterus, by obtaining cells from the amniotic fluid.

- (i) Outline how these cells are treated to diagnose Turner's syndrome.

.....

.....

.....

.....

.....

.....[3]

- (ii) Why are chromosomal mutations easier to diagnose than gene mutations?

.....

.....

.....

.....[2]

- (c) The improved diagnosis of genetic disease involves some important ethical issues.

Describe two **ethical issues** that may be involved.

1 .....

.....

.....

.....

2 .....

.....

.....

.....[4]

[Total: 15]

**END OF QUESTION PAPER**

**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

---

*Copyright Acknowledgements:*

Fig. 6.1 photo       $\frac{1}{2}$  Biophoto Associates / Science Photo Library

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

OCR is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.