

Questions

Q1.

A student wanted to extract the DNA from fresh peas.

The student crushed the peas and added washing up liquid and water.

The enzyme protease was then added to this mixture.

(i) Explain why the enzyme protease was added to the mixture.

(2)

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.....  
.....  
.....  
.....  
.....

(ii) The mixture was then heated and filtered.

Finally, the student poured the filtrate into a test tube and ice-cold ethanol was poured down the side of the test tube into the filtrate.

State why ice-cold ethanol was poured into the filtrate.

(1)

.....  
.....  
.....

(iii) The student wanted to compare the mass of DNA found in fresh peas with the mass of DNA found in fresh beans.

Give two variables the student would need to control to make this a valid comparison.

(2)

1 .....

.....

2 .....

.....

(Total for question = 5 marks)

Q2.

Cell division processes are used to produce body cells and gametes.

The nucleus of a daffodil cell has 46 chromosomes.

(i) State the number of chromosomes in each pollen grain from this daffodil.

(1)

.....  
.....

(ii) Humans share 35% of their DNA with a daffodil.

The human genome contains 6600 million bases. Calculate the number of bases that are the same as a daffodil.

(2)

number of bases = ..... million

(Total for question = 3 marks)

Q3.

Figure 1 shows a model of a DNA molecule coiled into a double helix. A double helix has two strands of DNA.



Figure 1

(i) Use a word from the box to complete the sentence.

(1)

phosphate	sugar	hydrogen	strong
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The two strands of DNA are held together with ..... bonds.

(ii) A section of a gene from one person was sequenced.

Give the sequence of the complementary strand of DNA.

(1)



(iii) When the same gene was sequenced in a different person, the sequence was ATTTAGCC.

Explain why this shows that the gene has more than one allele.

(2)

.....  
.....  
.....  
.....

(Total for question = 4 marks)

Q4.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

(i) What is the correct definition of a genome?

(1)

- A all the cells of an organism
- B all the enzymes of an organism
- C all the genetic material of an organism
- D all the cytoplasm of an organism

(ii) A new project called the Earth BioGenome Project aims to discover the sequence of bases in the DNA for all plants and animals.

State two benefits of discovering the sequence of bases for all plants and animals.

(2)

1 .....

.....

.....

2 .....

.....

.....

(Total for question = 3 marks)

Q5.

Figure 2 shows part of a DNA molecule.

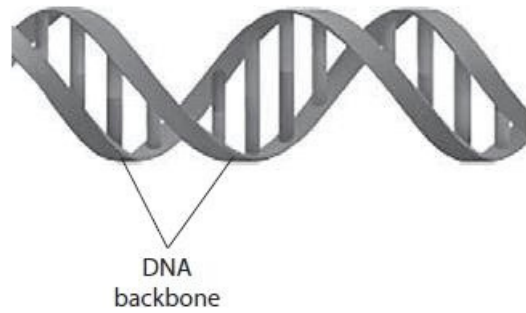


Figure 2

DNA can be extracted from fruit.

Describe how cells are broken down to release DNA.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q6.

DNA molecules contain base pairs.

Describe how the base pairs are bonded together in a DNA molecule.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)



Q8.

Figure 3 outlines a method that can be used to extract DNA from fruit.

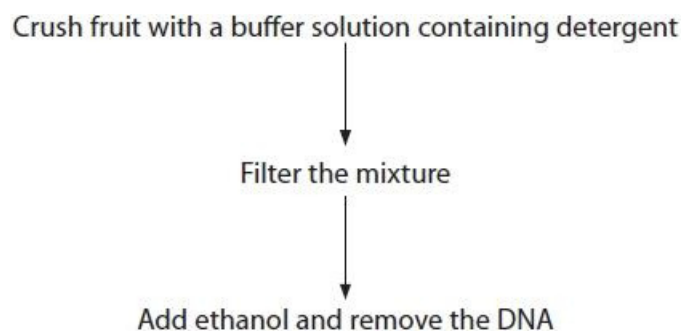


Figure 3

(i) Give a reason for filtering the mixture.

(1)

.....

.....

(ii) What is the role of the ethanol?

(1)

- A denature the enzymes
- B disrupt cell membranes
- C supercoil the DNA
- D to precipitate the DNA

(Total for question = 2 marks)

Q9.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

James Watson and Francis Crick built a model that showed that DNA has a double helix structure.

(i) Which statement about DNA is correct?

- A each pair of bases is joined by hydrogen bonds
- B phosphate groups are joined by hydrogen bonds
- C nucleotides consist of a sugar and a phosphate group only
- D bases are joined to phosphate molecules

(1)

(ii) Figure 6 shows the percentage of each base in human DNA.

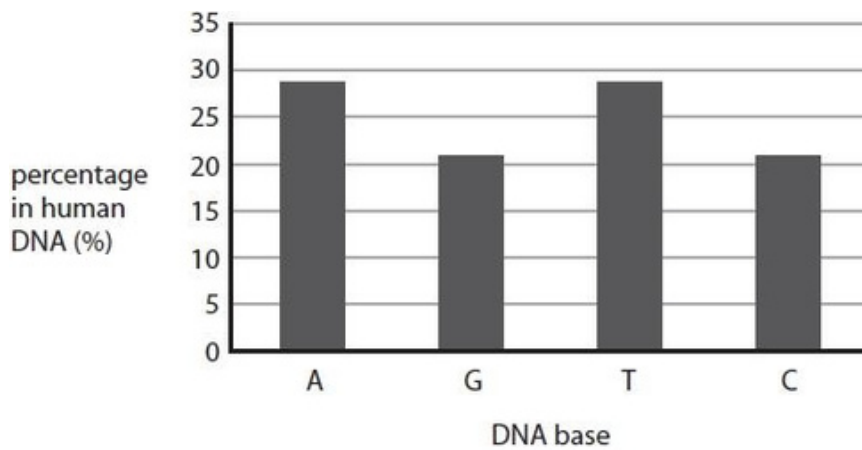


Figure 6

Describe how this data provides evidence for base pairing in DNA.

(2)

.....

.....

.....

.....

.....

(Total for question = 3 marks)



Q10.

A section of one allele for eye colour has the following DNA sequence:

ATGGCTAAGTA

(i) Which sequence is the complementary DNA strand?

(1)

- A ATGGCTAAGTA
- B CGTTAGCCTGC
- C TACCGATTCAT
- D GCAATGGACG

(ii) Give one way in which a second allele for eye colour might be different.

(1)

.....

.....

(Total for question = 2 marks)

Q11.

Figure 2 shows part of a DNA molecule.

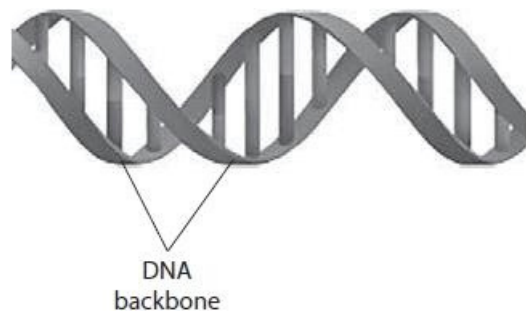


Figure 2

(a) (i) What is the shape of a DNA molecule?

- A single helix
- B double helix
- C complementary helix
- D triple helix

(1)

(ii) Which molecules are present in the DNA backbone?

- A sugars and phosphates
- B amino acids and bases
- C sugars and bases
- D amino acids and phosphates

(1)

(iii) State the type of bond that joins the bases together in the DNA molecule.

(1)

.....

(Total for question = 3 marks)

Q12.

A student used the method shown in Figure 14 to compare the mass of DNA extracted from strawberry fruit cells and from kiwi fruit cells.

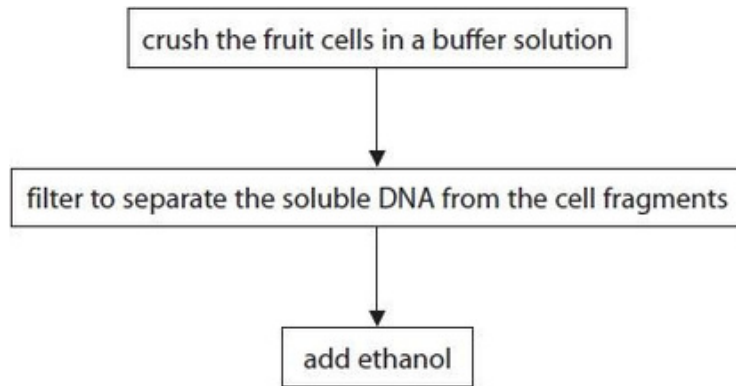


Figure 14

(i) State why ethanol is used.

(1)

.....  
.....

(ii) State two variables the student needs to control when using this method to compare the mass of DNA from these two fruits.

(2)

1 .....

.....

2 .....

.....

(iii) The student repeated the experiment.

Give one reason why.

(1)

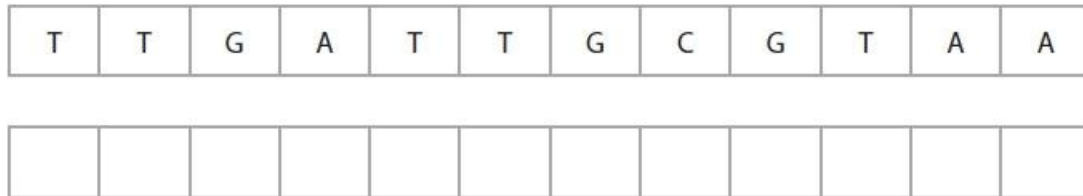
.....  
.....  
.....

(Total for question = 4 marks)

Q13.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Figure 9 shows part of a DNA molecule.



**Figure 9**

(i) Write the code for the complementary DNA strand in Figure 9.

(2)

(ii) Three bases code for each amino acid.

Which is the maximum number of amino acids coded for by this strand of DNA?

(1)

- A 3
- B 4
- C 6
- D 12

(iii) What is the shape of a DNA molecule?

(1)

- A triple stranded
- B single stranded
- C single helix
- D double helix

(Total for question = 4 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking <b>two</b> from: <ul style="list-style-type: none"> <li>• (protease) breaks down proteins (1)</li> <li>• in the {cell/nuclear} membrane (1)</li> <li>• destroys enzymes that may break down the DNA (1)</li> </ul>	accept break down {the cell / nucleus/ cell wall}	(2) AO1 2
Question number	Answer	Additional guidance	Mark
(ii)	to precipitate the DNA / because DNA is insoluble in ethanol	accept to see the DNA	(1) AO1 2
Question number	Answer	Additional guidance	Mark
(iii)	Any <b>two</b> from: <ul style="list-style-type: none"> <li>• mass of peas and beans (1)</li> <li>• method of crushing (1)</li> <li>• volume of {washing up liquid / detergent} / water (1)</li> <li>• volume of protease (1)</li> <li>• temperature if qualified (1)</li> <li>• volume of ethanol (1)</li> <li>• time if qualified (1)</li> </ul>	accept weight  accept keep the temperature of the mixture the same  accept time the mixture was heated / time exposed to ethanol	(2) AO3 3a 3b

Q2.

Question number	Answer	Mark
(i)	23 (chromosomes)	(1)

Question number	Answer	Additional guidance	Mark
(ii)	6600 million $\div$ 100 (1) $\times$ 35 = 2310 million (1)	award full marks for correct numerical answer without working	(2)

Q3.

Question number	Answer	Additional guidance	Mark
(i)	hydrogen	accept if only hydrogen ringed or underlined in the box	(1)

Question number	Answer	Mark								
(ii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>T</td> <td>A</td> <td>C</td> <td>A</td> <td>T</td> <td>C</td> <td>G</td> <td>G</td> </tr> </table> <p>accept lower case letters</p>	T	A	C	A	T	C	G	G	(1)
T	A	C	A	T	C	G	G			

Question number	Answer	Additional guidance	Mark
(iii)	<p>An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark):</p> <ul style="list-style-type: none"> <li>the sequence is different/G has become T / there is a mutation (1)</li> <li>alleles are different versions of the same gene (1)</li> </ul>	accept there are 3 T's	(2)

Q4.

Question number	Answer	Mark
(i)	<p>C all the genetic material of an organism</p> <p><b>The only correct answer is C</b></p> <p><i>A is not correct because a genome is not all the cells of an organism</i></p> <p><i>B is not correct because a genome is not all the enzymes of an organism</i></p> <p><i>D is not correct because a genome is not all the cytoplasm of an organism</i></p>	<p><b>(1)</b></p> <p>AO1 1</p>

Question number	Answer	Mark
(ii)	<p>Any two from:</p> <ul style="list-style-type: none"> <li>• identify useful genes (1)</li> <li>• track evolution/ identify new species to show which species are more closely related (1)</li> <li>• understand diseases (of crop plants and animals) (1)</li> <li>• discover new medicines / find a cure for diseases (1)</li> <li>• identify the sequences that allow some plants and animals to cope with environmental change (1)</li> </ul>	<p><b>(2)</b></p> <p>AO2 1</p>

Q5.

Question Number	Answer	Additional guidance	Mark
	<ul style="list-style-type: none"> <li>• homogenise cells(1)</li> <li>• mix cells with a salt/detergent (solution)(1)</li> </ul>	<p>allow grind /crush/squash cells (using pestle and mortar)(1)</p> <p>accept use alcohol/ethanol(1)</p>	<p><b>(2)</b></p> <p>AO 1 2</p>

Q6.

Question number	Answer	Additional guidance	Mark
	A description linking <b>two</b> from: weak (1) hydrogen bonds (1) complementary bases (1) A - T / C - G (1)	accept H bonds reject hydro bonds  accept the names of the base pair	<b>(2)</b> <b>AO1 2</b>

Q7.

Question number	Indicative content	Mark
	<p><b>Structure of DNA</b></p> <ul style="list-style-type: none"> <li>• polymer</li> <li>• four bases (A, T, C, G)</li> <li>• (complementary) base pairs</li> <li>• A-T and C-G</li> <li>• (weak) hydrogen bonds join bases</li> <li>• two strands</li> <li>• double helix</li> <li>• nucleotides</li> </ul> <p><b>DNA extraction</b></p> <ul style="list-style-type: none"> <li>• crush up / grind / squash cells</li> <li>• add detergent / salt solution / protease</li> <li>• heat in a water bath / heat to 60°C</li> <li>• add to (ice cold) ethanol</li> <li>• DNA forms as a precipitate /white strands</li> </ul>	<b>(6)</b> <b>AO1</b> <b>AO2</b>



Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> <li>No rewardable material.</li> </ul>
Level 1	1-2	<ul style="list-style-type: none"> <li>Demonstrates elements of biological understanding, some of which is accurate. Understanding of scientific, enquiry, techniques and procedures lacks detail.</li> <li>Presents a description which is not logically ordered and with significant gaps.</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed.</li> <li>Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing.</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed.</li> <li>Presents a description that has a well-developed structure which is clear, coherent and logical.</li> </ul>

Level	Mark	Additional Guidance	General additional guidance
	0	No rewardable material	The level is determined by the areas of indicative content covered within the response. The mark within the level is determined by the detail within each description.
Level 1	1-2	<ul style="list-style-type: none"> <li>A simple description of DNA structure.</li> <li>A brief description of how to extract DNA from plants</li> </ul>	<u>Possible candidate responses</u> <ul style="list-style-type: none"> <li>DNA contains four bases</li> <li>DNA can be extracted by crushing up fruit</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>A description of DNA structure.</li> <li>A description of how to extract DNA from plants</li> </ul>	<u>Possible candidate responses</u> <ul style="list-style-type: none"> <li>DNA contains four bases A, T, C and G and DNA is a double helix.</li> <li>DNA can be extracted by crushing up fruit and adding detergent.</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>A detailed description of DNA structure.</li> <li>A detailed description of how to extract DNA from plants.</li> </ul>	<u>Possible candidate responses</u> <ul style="list-style-type: none"> <li>The DNA molecule is a double helix. DNA contains four bases which pair A-T and C-G. The bases are held together by hydrogen bonds.</li> <li>DNA can be extracted by crushing up fruit with detergent and pouring the mixture into (ice-cold) ethanol. DNA appears as a precipitate.</li> </ul>

Q8.

Question number	Answer	Mark
(i)	To remove insoluble material	(1)

Question number	Answer	Mark
(ii)	D	(1)

Q9.

Question	Answer	Mark
(i)	<p>A each pair of bases is joined by hydrogen bonds</p> <p><b>The only correct answer is A</b></p> <p><i>B is not correct because phosphate groups are not joined by hydrogen bonds</i></p> <p><i>C is not correct because nucleotides consist of a sugar, a phosphor group and a base</i></p> <p><i>D is not correct because bases are not joined to phosphate molecules</i></p>	(1) AO1(1)

Question	Answer	Additional Guidance	Mark
(ii)	<p>An answer that combines points of interpretation/evaluation to provide a logical description:</p> <ul style="list-style-type: none"> <li>amount of C and G is equal/amount of A and T is equal</li> <li>A pairs with T and C pairs with G</li> </ul>		(2) AO3(1a+1b)

Q10.

Question number	Answer	Mark
(i)	C	(1)

Question number	Answer	Additional guidance	Mark
(ii)	Any one from: <ul style="list-style-type: none"> <li>• mutation in the base sequence (1)</li> <li>• different base sequence (1)</li> <li>• different sequence length (1)</li> </ul>	different amino acid sequence	(1)

Q11.

Question Number	Answer	Mark
(i)	B double helix  <b>1. The only correct answer is B</b>  <i>A is not correct because the shape of a DNA molecule is not a single helix</i>  <i>C is not correct because the shape of a DNA molecule is not a complementary helix</i>  <i>D is not correct because the shape of a DNA molecule is not a triple helix</i>	(1)  AO 1 1

Question Number	Answer	Mark
(ii)	A sugars and phosphates  <b>1. The only correct answer is A</b>  <i>B is not correct because amino acids and bases are not present in the DNA backbone</i>  <i>C is not correct because bases are not present in the DNA backbone</i>  <i>D is not correct because amino acids are not present in the DNA backbone</i>	(1)  AO 1 1

Question Number	Answer	Mark
(iii)	(weak) hydrogen (bonds)	(1) AO 1 1

Q12.

Question number	Answer	Additional Guidance	Mark
(i)	to precipitate the DNA	accept so the DNA is visible / so the DNA is not soluble (in ethanol)	AO1 (2) <b>(1)</b>

Question number	Answer	Additional Guidance	Mark
(ii)	Any two from: <ul style="list-style-type: none"> <li>• mass of fruit (1)</li> <li>• volume of buffer (1)</li> <li>• crushing method /crushing time / crushed evenly (1)</li> <li>• volume of ethanol (1)</li> <li>• temperature (1)</li> <li>• pH /same buffer solution (1)</li> </ul>	accept amount of fruit / number of fruit cells /size of fruit  ignore amount of buffer  accept idea of incubation time  ignore amount of ethanol  accept fully filtered (1)  accept same concentration of ethanol (1)	<b>(2)</b> A02 (2)

Question number	Answer	Additional Guidance	Mark
(iii)	<p>Any one from:</p> <ul style="list-style-type: none"> <li>to obtain more data (1)</li> <li>to identify anomalies (1)</li> <li>see if the results are {the same / reliable/correct} (1)</li> <li>to calculate a {mean/average} (1)</li> </ul>	<p>accept to be sure their {results are valid / conclusion is valid} (1)</p> <p>ignore accuracy/precision</p>	<p>(1)</p> <p>AO2(2)</p>

Q13.

Question number	Answer	Additional guidance	Mark																								
(i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>T</td><td>T</td><td>G</td><td>A</td><td>T</td><td>T</td><td>G</td><td>C</td><td>G</td><td>T</td><td>A</td><td>A</td> </tr> <tr> <td>A</td><td>A</td><td>C</td><td>T</td><td>A</td><td>A</td><td>C</td><td>G</td><td>C</td><td>A</td><td>T</td><td>T</td> </tr> </table> <p>award 1 mark for all the As and Ts in the top line correctly paired (1)</p> <p>award 1 mark for all the Cs and Gs in the top line correctly paired (1)</p>	T	T	G	A	T	T	G	C	G	T	A	A	A	A	C	T	A	A	C	G	C	A	T	T	<p>accept lower case letters</p>	<p>(2)</p> <p>AO2 1</p>
T	T	G	A	T	T	G	C	G	T	A	A																
A	A	C	T	A	A	C	G	C	A	T	T																

Question number	Answer	Mark
(ii)	<p>B 4</p> <p><b>The only correct answer is B</b></p> <p><i>A is incorrect because 3 amino acids would need 9 bases to be present</i></p> <p><i>C is incorrect because 6 amino acids would need 18 bases</i></p> <p><i>D is incorrect because 12 amino acids would need 36 bases</i></p>	<p><b>(1)</b></p> <p><b>A02 1</b></p>

Question number	Answer	Mark
(iii)	<p>D double helix</p> <p><b>The only correct answer is D</b></p> <p><i>A is incorrect because a DNA molecule is not three separate strands</i></p> <p><i>B is incorrect because the DNA molecule consists of two strands</i></p> <p><i>C is incorrect because a DNA molecule is a double helix not a single helix</i></p>	<p><b>(1)</b></p> <p><b>A01 2</b></p>