

A-Level Edexcel

BIOLOGY

UNIT 1(IAL)
2020 — 2025

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1 - ((WBI11)/1(IAL)_Summer_2020_Q1) - *Molecules, Transport And Health*

The primary structure of a protein determines its secondary structure and its three-dimensional structure.

(a) Read through the following account of the primary structure of a protein.

(5)

Complete the account by writing the most appropriate word or words on the dotted lines.

The primary structure of a protein is the specific sequence of amino acids joined together by bonds.

These bonds are formed between the group of one amino acid and the group of an adjacent amino acid by a reaction.

These bonds are formed during the stage of protein synthesis called

(b) The table describes the types of bond that hold the secondary and the three-dimensional structures together.

Which type of bonding is true for each structure?

(2)

Structure	Hydrogen bonds only	Ionic bonds only	Both hydrogen and ionic bonds	Neither of these bonds
secondary structure	☐	☐	☐	☐
three-dimensional structure	☐	☐	☐	☐

2 - ((WBI11)/1(IAL)_Summer_2020_Q2) - Molecules, Transport And Health

Most Bengal tigers are orange with black stripes but there is a very small number of Bengal tigers that are white with black stripes.

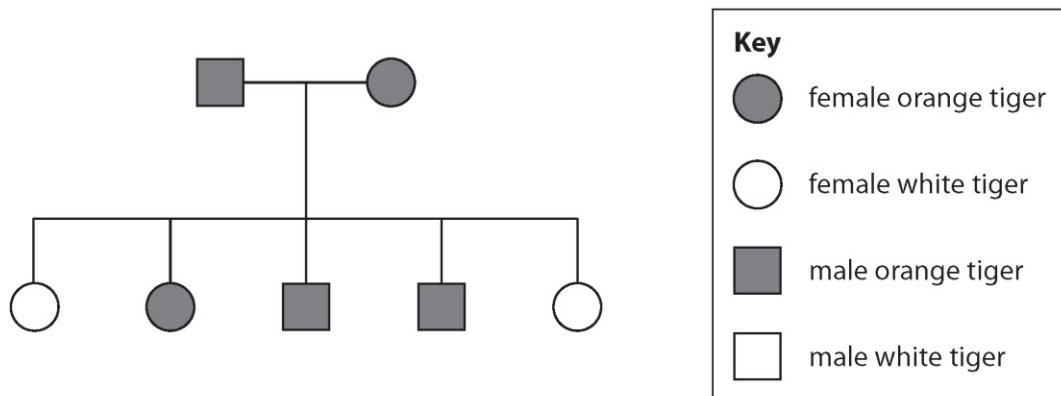
The photograph shows a white Bengal tiger with black stripes.



(Source: Caroline Wilcox)

White tiger offspring are produced by two Bengal tigers that each carry at least one recessive allele for a gene affecting coat colour.

The pedigree diagram shows the phenotypes in one family of tigers, bred in captivity.



(a) The phenotype is affected by the genotype.

State what is meant by the term **genotype**.

(1)

(b) State the probability that the next tiger born to these two parents will be female.

(1)

(c) Determine the expected phenotypic ratio of orange tigers to white tigers born to the parents shown in this pedigree diagram.

Use a genetic diagram to support your answer.

(3)

Answer

(d) The incidence of white tigers in the wild is 1 in 10 000 Bengal tigers.

There are approximately 6000 Bengal tigers in captivity, 200 of which are white.

Calculate the incidence of white tigers in captivity.

(1)

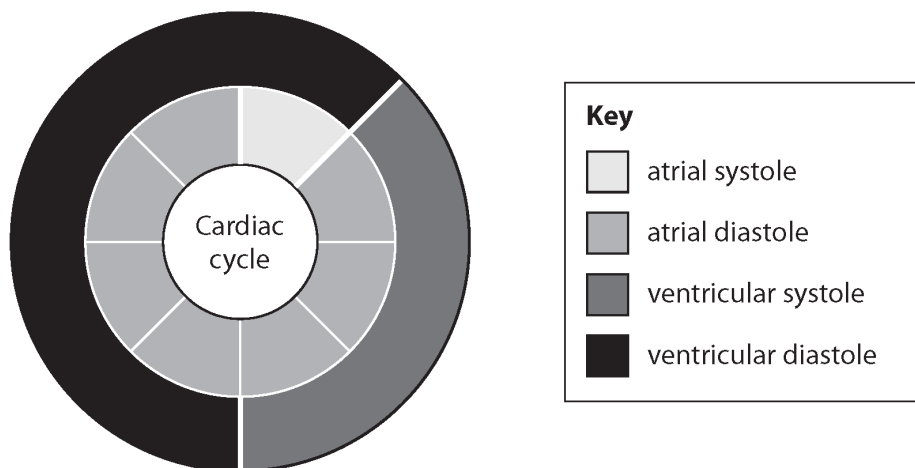
Answer

3 - ((WBI11)/1(IAL)_Summer_2020_Q3) - Molecules, Transport And Health

The cardiac cycle is the sequence of events that occurs when the heart beats.

A typical cardiac cycle takes 0.86 seconds.

(a) The diagram illustrates the cardiac cycle.



(i) Which row of the table describes the atria and ventricles during atrial systole?

(1)

	Atria	Ventricles
☐ A	contracted	contracted
☐ B	contracted	relaxed
☐ C	relaxed	contracted
☐ D	relaxed	relaxed

(ii) Explain why there is a delay of 0.01 seconds between atrial systole and ventricular systole.

(2)

- (iii) Using the information in the diagram, calculate the duration of ventricular systole in milliseconds.

Express your answer in standard form.

(2)

Answer ms

- (iv) State what proportion of the cardiac cycle is spent in ventricular diastole.

(1)

- (b) A typical cardiac cycle takes 0.86 seconds.

During exercise, the heart rate increases and the duration of the cardiac cycle decreases.

Calculate the increase in heart rate if the cardiac cycle decreases by 0.4 seconds.

(3)

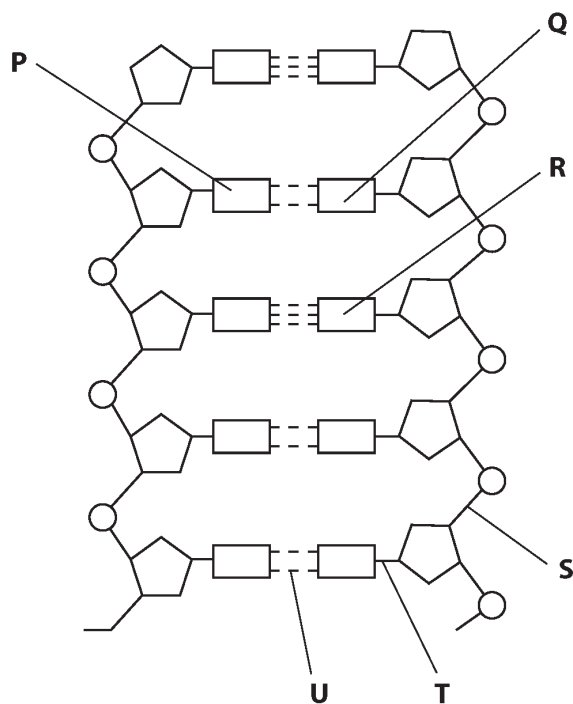
Answer beats per minute

4 - ((WBI11)/1(IAL)_Summer_2020_Q4) - Molecules, Transport And Health

The polynucleotide DNA is composed of mononucleotides linked together.

Two polynucleotides form a DNA molecule.

(a) The diagram shows part of a DNA molecule.



(i) Draw a circle around **one** mononucleotide that includes the base labelled **R**.

(1)

(ii) Which row of the table identifies the bonds labelled **S**, **T** and **U**?

(1)

	S	T	U
☐ A	hydrogen	phosphodiester	covalent
☐ B	hydrogen	covalent	phosphodiester
☐ C	phosphodiester	hydrogen	covalent
☐ D	phosphodiester	covalent	hydrogen

(iii) The base labelled **P** is adenine.

Which is the base labelled **Q**?

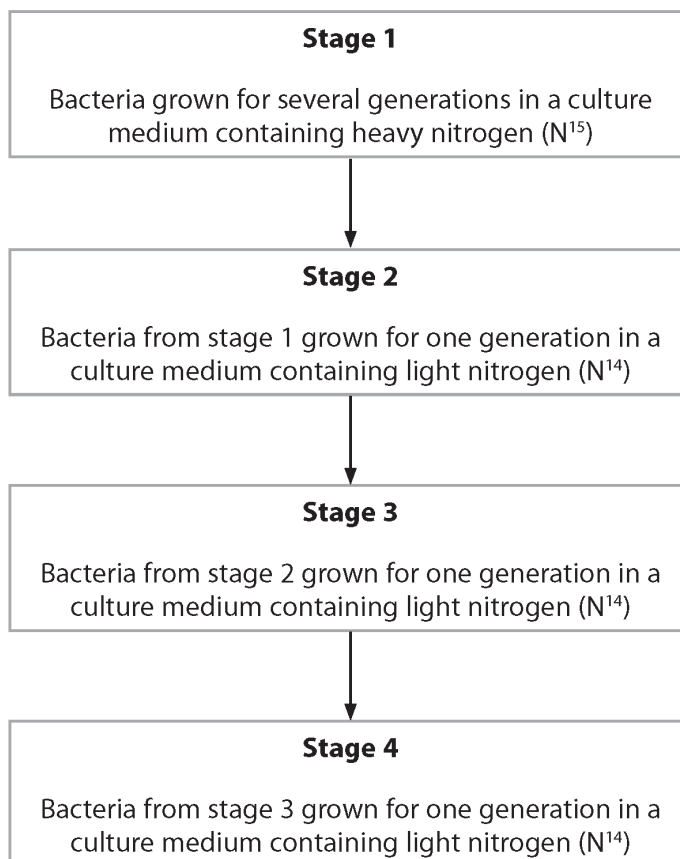
(1)

- ☐ **A** cytosine
- ☐ **B** guanine
- ☐ **C** thymine
- ☐ **D** uracil

- (b) Meselson and Stahl carried out experiments that provided evidence for the semi-conservative replication of DNA.

Heavy nitrogen (N^{15}) and light nitrogen (N^{14}) were used in these experiments.

The flow chart summarises part of one experiment performed by Meselson and Stahl.



After each stage, a sample of DNA was taken from the bacteria and the DNA molecules separated using a density gradient in a tube.

The heavier DNA molecules form bands lower down the gradient than the lighter DNA molecules.

The height of each band is proportional to the percentage of DNA molecules in the sample.

(i) Complete the diagram to show the results of this experiment.

Use the dotted lines to help you to position the bands on the diagram.

The first one has been done for you.

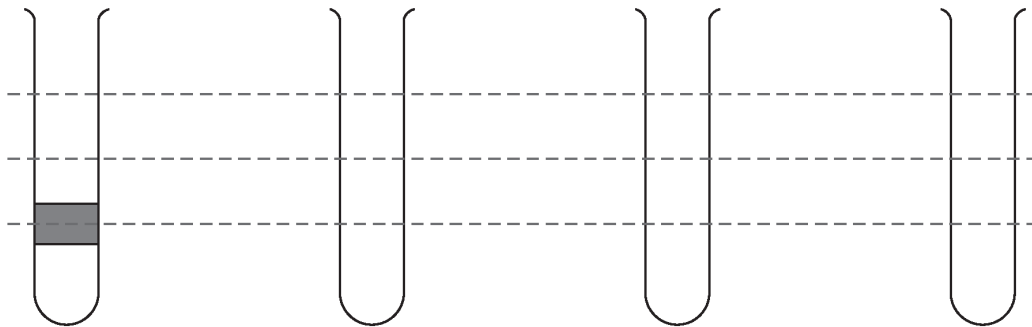
(5)

DNA sample taken
after stage 1

DNA sample taken
after stage 2

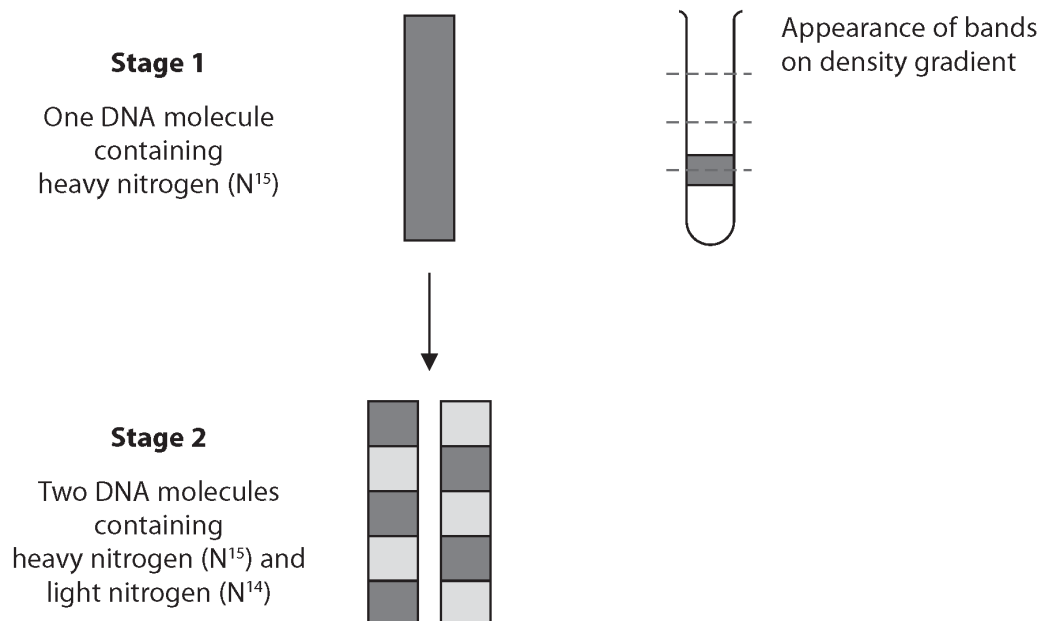
DNA sample taken
after stage 3

DNA sample taken
after stage 4



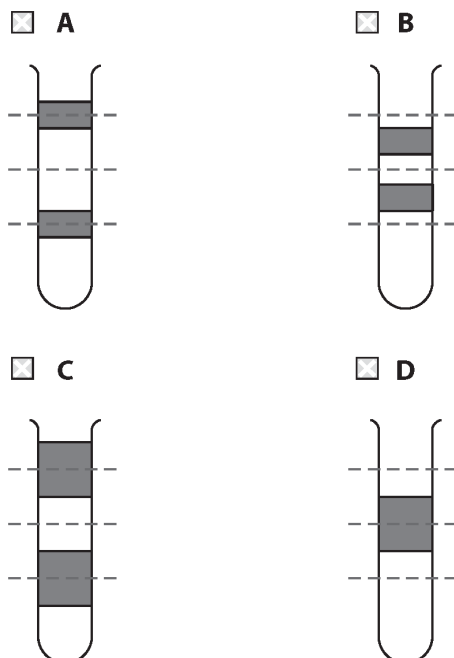
- (ii) The experiments of Meselson and Stahl disproved the dispersive theory of DNA replication.

The diagram shows the expected results if the dispersive theory was correct.



Which diagram would show the bands of DNA molecules on the density gradient at stage 2, if the dispersive theory was correct?

(1)



5 - ((WBI11)/1(IAL)_Summer_2020_Q5) - Molecules, Transport And Health

Obesity increases the risk of cardiovascular disease (CVD).

One way to reduce obesity is to lose weight by changing eating habits.

(a) Name **two** obesity indicators used by scientists.

(1)

1

2

(b) Glucomannan is a dietary supplement claimed to aid weight loss.

Glucomannan is a branched polysaccharide similar in structure to amylopectin.

(i) Which glycosidic bonds are responsible for the branching in glucomannan?

(1)

☐ **A** 1-4 only

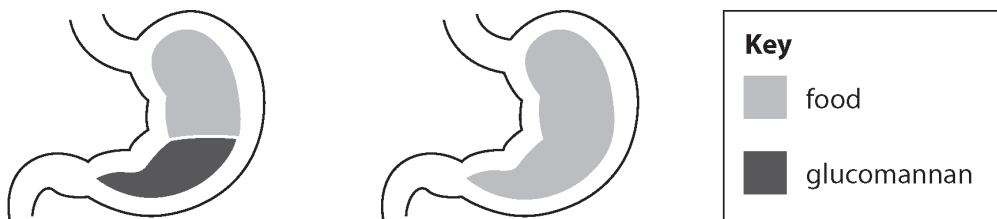
☐ **B** 1-6 only

☐ **C** both 1-4 and 1-6

☐ **D** neither 1-4 nor 1-6

(ii) In the presence of water, glucomannan swells to form a semi-solid gel.

The diagram shows a stomach with glucomannan present and a stomach without glucomannan.



Suggest how glucomannan aids weight loss.

(1)

(iii) If glucomannan could be digested it would cause a gain in weight.

Explain why glucomannan could cause a gain in weight.

(2)

(c) A study compared weight loss in two groups of women.

One group of women had a low-fat diet and the other group of women had a very low-carbohydrate diet.

(i) The table shows the results of this study.

Number of weeks on the diet	Mean body mass of the group of women / kg	
	Group on the low-fat diet	Group on the very low-carbohydrate diet
0	92.5	91.1
2	90.6	88.3
4	89.9	87.5
6	89.0	85.6
8	88.8	84.5
10	88.3	84.1
12	88.2	83.0

Many studies claim that a low-carbohydrate diet can result in two to three times as much weight loss as a low-fat diet.

Determine the extent to which this study supports this claim.

(3)

(ii) Very low-carbohydrate diets may increase cardiovascular risk factors.

Give **two** factors, other than weight loss, that should have been monitored in this study.

(2)

- 1
- 2

6 - ((WBI11)/1(IAL)_Summer_2020_Q6) - Molecules, Transport And Health

A gene contains the genetic code for the sequence of amino acids in a polypeptide chain.

The table shows the genetic codes found in DNA.

Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid
AAA AAG	Lysine	CAA CAG	Glutamine	GAA GAG	Glutamic acid	TAC TAT	Tyrosine
AAC AAT	Asparagine	CAT CAC	Histidine	GAC GAT	Aspartate	TCA TCC TCG TCT	Serine
ACA ACC ACG ACT	Threonine	CCA CCC CCG CCT	Proline	GCA GCC GCG GCT	Alanine	TGG	Tryptophan
AGA AGG	Arginine	CGA CGC CGG CGT	Arginine	GGA GGC GGG GGT	Glycine	TGC TGT	Cysteine
AGC AGT	Serine	CTA CTC CTG CTT	Leucine	GTA GTC GTG GTT	Valine	TTA TTG	Leucine
ATA ATC ATT	Isoleucine					TTC TTT	Phenylalanine
ATG	Methionine						

The genetic codes TAA, TAG and TGA are stop codons, that do not code for amino acids.

*(a) Explain the nature of the genetic code.

Use information in the table to support your answer.

(6)

- (b) The diagram shows the sequence of nucleotide bases in part of a DNA template (antisense) strand.

Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Base	A	T	G	G	C	T	T	G	C	C	C	G	A	T	C	C	T	A

- (i) Give the sequence of amino acids that is coded for by these bases.

(1)

- (ii) Explain the possible effects on a protein if there is a substitution mutation in the 9th base in this DNA strand.

Use information in the table to support your answer.

(5)

ANSWERS

1 - ((WBI11)/1(IAL)_Summer_2020_Q1) - Molecules, Transport And Health

Question number	Answer	Additional guidance	Mark
(a)	peptide (1) amino / NH_2 / NH_3^+ / amine (1) carboxyl / COOH / CO_2H / COO^- / carboxylic (acid) (1) condensation (1) translation (1)	DO NOT ACCEPT dipeptide / polypeptide / amide ACCEPT second and third point either way round ACCEPT polymerisation / addition elimination	(5)

Question number	Answer					Mark
(b)						(2)
	Structure	Hydrogen bonds only	Ionic bonds only	Both hydrogen and ionic bonds	Neither of these bond	
	secondary structure	X	☒	☒	☒	
	three-dimensional structure	☒	☒	X	☒	

2 - ((WBI11)/1(IAL)_Summer_2020_Q2) - Molecules, Transport And Health

Question number	Answer	Additional guidance	Mark
(a)	combination of alleles (1)	IGNORE genetic composition / combination of information carried in the genes / all genetic (information / make up) DO NOT ACCEPT genes	(1)

Question number	Answer	Additional guidance	Mark
(b)	1 in 2 / 50:50 / 50% / 0.5 / $\frac{1}{2}$	ACCEPT 2 in 4 / 1:1 / 2:2	(1)

Question number	Answer	Additional guidance	Mark
(c)	An answer that makes reference to the following points: - parents shown as heterozygotes (1) - genotypes of offspring shown (1) 3 (orange) : 1 (white) (1)	CEs throughout ACCEPT any pair of letters chosen to represent alleles from Punnet square ACCEPT 1 white : 3 orange	(3)

Question number	Answer	Additional guidance	Mark
(d)	1 in 30 / 0.03 / 3.3% / $\frac{1}{30}$	ACCEPT 0.03 recurring / 3.3% recurring	(1)

3 - ((WBI11)/1(IAL)_Summer_2020_Q3) - Molecules, Transport And Health

Question number	Answer	Mark		
(a)(i)	The only correct answer is B <table><tr><td>contracted</td><td>relaxed</td></tr></table> <i>A is incorrect because the ventricles are relaxed</i> <i>C is incorrect because the atria are contracted and the ventricles are relaxed</i> <i>D is incorrect because the atria are contracted</i>	contracted	relaxed	(1)
contracted	relaxed			

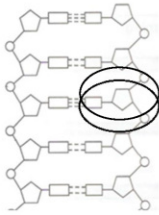
Question number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that includes the following points: - because the atrioventricular valves have to close (before the ventricles contract) (1) - to prevent backflow of blood into the atria (1)	ACCEPT {bicuspid / mitral} valve and tricuspid valve DO NOT ACCEPT valves close during ventricular systole	(2)

Question number	Answer	Additional guidance	Mark
(a)(iii)	- cardiac cycle time multiplied by proportion of cycle spent in ventricular systole (1) $3.2 \times 10^2 / 3.23 \times 10^2$ (1)	Example of calculation: $0.86 \times \frac{3}{8} / 0.3225 / 0.32 / 0.323$ Correct answer with no working gains 2 marks	(2)

Question number	Answer	Additional guidance	Mark
(a)(iv)	63% / 5/8 / 0.63	ACCEPT 0.625 / 62.5% / 5 out of 8	(1)

Question number	Answer	Additional guidance	Mark
(b)	- heart rate if cardiac cycle lasts 0.86 seconds (1) - heart rate if cardiac cycle last 0.46 seconds (1) - increase in heart rate = 60 / 61 beats per minute (1)	Example of calculation: $60 \div 0.86 = 69.76744186046512$ $60 \div 0.46 = 130.4347826$ Answer in range of 60.2 to 60.7 gains 2 marks CE from calculations of heart rate Correct answer alone gains 3 marks	(3)

4 - ((WBI11)/1(IAL)_Summer_2020_Q4) - Molecules, Transport And Health

Question number	Answer	Additional guidance	Mark
(a)(i)	circle drawn around R, the attached sugar and a phosphate group	 ACCEPT the phosphate group on either C3 or C5	(1)

Question number	Answer	Mark			
(a)(ii)	The only correct answer is D <table border="1" data-bbox="464 781 1133 857"> <tr> <td>phosphodiester</td><td>covalent</td><td>hydrogen</td></tr> </table> <i>A is incorrect because S is a phosphodiester bond, T is a covalent bond and U is a hydrogen bond</i> <i>B is incorrect because S is a phosphodiester bond and U is a hydrogen bond</i> <i>C is incorrect because T is a covalent bond and U is a hydrogen bond</i>	phosphodiester	covalent	hydrogen	(1)
phosphodiester	covalent	hydrogen			

Question number	Answer	Mark
(a)(iii)	The only correct answer is C Thymine <i>A is incorrect because adenine is complementary to thymine</i> <i>B is incorrect because adenine is complementary to thymine</i> <i>D is incorrect because adenine is complementary to thymine</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)(i)	A diagram that shows the following points: - a band the same width as stage 1 in the middle of the tube (1) - bands drawn at the top and middle of tube (1) - both bands narrower than stage 1 (1) - bands drawn at the top and middle of tube (1) - top band drawn narrower than stage 1 but wider than stage 3 and lower band drawn narrower than stage 3 (1)	DNA taken after stage 2 DNA taken after stage 3 DNA taken after stage 4	(5)

Question number	Answer	Mark
(b)(ii)	The only correct answer is B A is incorrect because neither DNA molecule is made of all heavy nitrogen or light nitrogen C is incorrect because neither DNA molecule is made of all heavy nitrogen or light nitrogen + bands are too wide D is incorrect because it has only one band	(1)

5 - ((WBI11)/1(IAL)_Summer_2020_Q5) - Molecules, Transport And Health

Question number	Answer	Additional guidance	Mark
(a)	ACCEPT any two from : - BMI / body mass index - waist to hip ratio / hip to waist ratio - waist to height ratio / height to waist ratio - waist circumference - skin fold (thickness)	IGNORE risk factors ACCEPT mass ÷ height² / weight ÷ height²	(1)

Question number	Answer	Mark
(b)(i)	The only correct answer is B B 1-6 only <i>A is incorrect because 1-4 bonds are present in straight chains only</i> <i>C is incorrect because 1-4 bonds are present in straight chains only</i> <i>D is incorrect because 1-6 bonds form the branches</i>	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	makes the person feel full / prevents so much food from being in the stomach / fills up the stomach so less food needed to satisfy hunger / glucomannan takes the space of the food (1)	IGNORE: reduces food intake decreases volume of stomach	(1)

Question number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that includes the following points: - because it contains lots of {monosaccharides / glucose / energy} (1) - therefore {energy input could be greater than energy output / (excess) glucose converted to fat} (1) - glucomannan would no longer be filling up the stomach so more food could be eaten (1)	ACCEPT sugar for glucose polymer of glucose lots of mannose broken down into lots of {glucose / monosaccharides / mannose} ACCEPT excess energy stored as fat	(2)

Question number	Answer	Additional guidance	Mark
(c)(i)	An answer that includes the following points: - group on low fat diet lost 4.3 (kg) and group on very low-carbohydrate diet lost 8.1 (kg) (1) (overall) loss of 8.1 (kg) is {1.88 / 1.9} times more weight (1) - which is slightly lower than the other studies are claiming (1) - claims are referring to low-carbohydrate diet but this one is a very low-carbohydrate diet (1)	ACCEPT group on low fat diet lost 3.8 (kg) more ACCEPT about twice as much / for low-fat diet this is 4.6% of starting weight and for very low-carbohydrate 8.9% starting weight ACCEPT results are at the lower end of the claim	(3)

Question number	Answer	Additional guidance	Mark
(c)(ii)	An answer that includes two of the following points: (blood) {cholesterol / LDL} levels (1) - blood pressure (1) - heart rate (1)	IGNORE other named risk factors ACCEPT LDL : HDL	(2)

6 - ((WBI11)/1(IAL)_Summer_2020_Q6) - Molecules, Transport And Health

Question number	Answer	Additional guidance	Mark
* (a)	Indicative content: - triplet codon system (D) - because (at least) 20 codes needed for the amino acids (E) - e.g. AAC is code for asparagine (x) - degenerate code (D) - therefore some amino acids have more than one code (E) - e.g. threonine can be coded for by ACA, ACC, ACG or ACT (x) - non-overlapping code (D) - so each base on DNA is used in only one triplet codon (E) - e.g. AAC AGA codes for two amino acids (x)	ACCEPT three bases code for one amino acid ACCEPT each amino acid has its own code ACCEPT there are more codes than necessary ACCEPT discrete	(6)

Question number	Answer	Additional guidance	Mark
(b)(i)	methionine alanine cysteine proline isoleucine leucine	ACCEPT phonetic spelling / reasonable abbreviations / M A C P I L	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that includes the following points: - it will have no effect (on the polypeptide) if the ninth base becomes a T as this still codes for {cysteine / same amino acid} (1) - will code for a stop codon if the ninth base becomes an A (1) - therefore the {protein / polypeptide} will be {shorter / not formed} (1) - will code for tryptophan if the ninth base becomes G (1) - this could change the bonding in the protein (1) - changing the {structure / activity} of the protein (1)	ACCEPT only two amino acids will join together ACCEPT even if tryptophan not given / given wrongly ACCEPT even if tryptophan not given / given wrongly	(5)