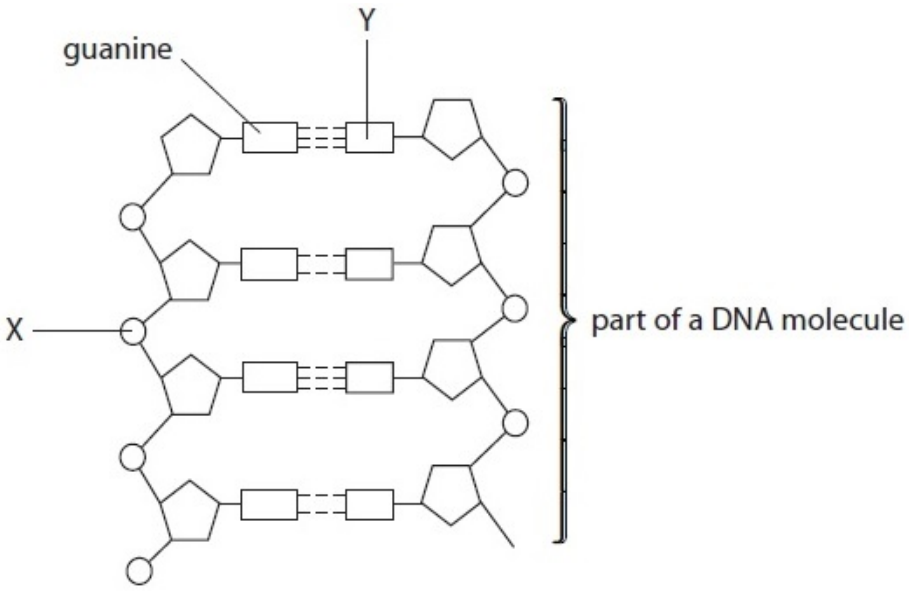
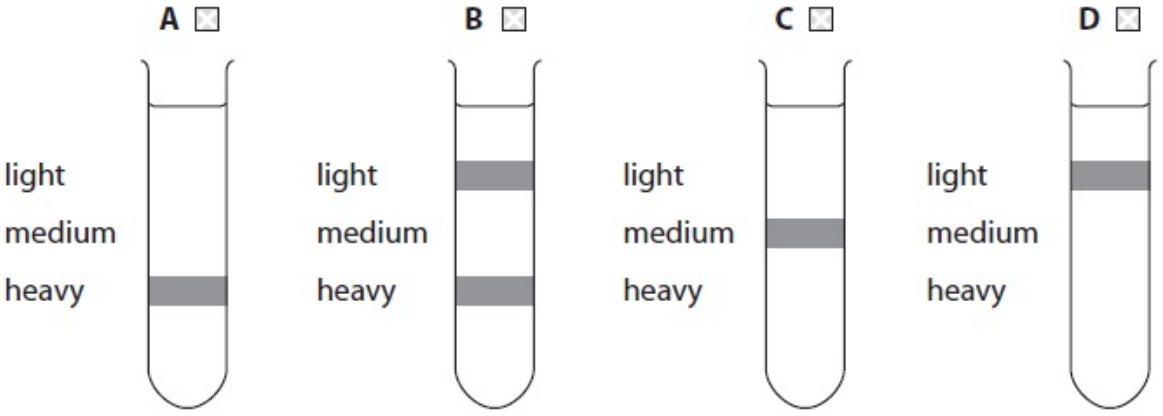
Q1. (a) The diagram below shows part of a DNA molecule.



(i) Place a cross in the box next to the molecule represented by the letter X



(1)

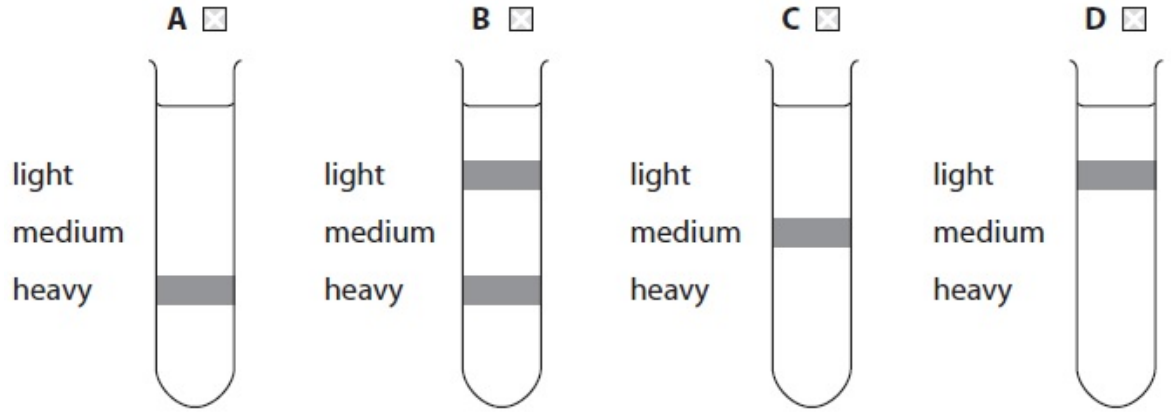
☒ **A** Deoxyribose

☒ **B** Phosphate

☒ **C** Ribose

☒ **D** Uracil

(ii) Place a cross in the box next to the molecule represented by the letter Y



(1)

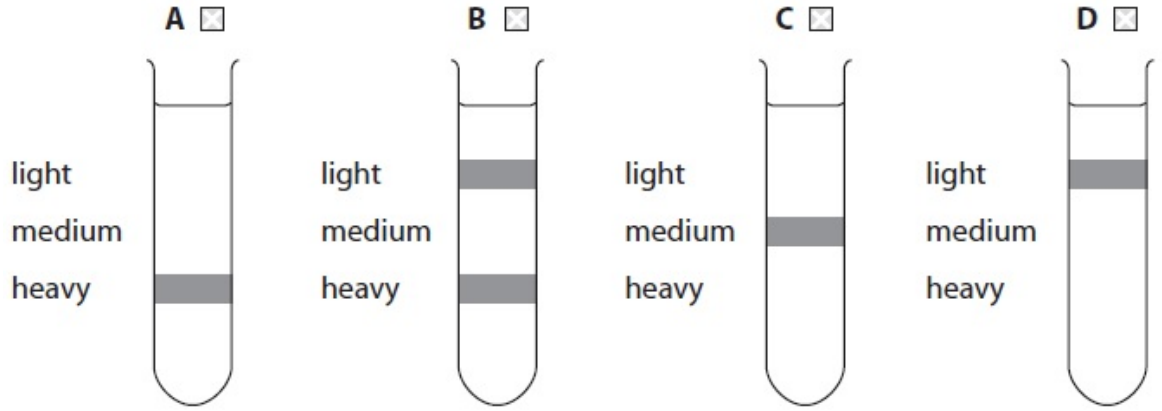
☒ **A** Adenine

☒ **B** Cytosine

☒ **C** Thymine

☒ **D** Uracil

(iii) Place a cross in the box next to the name of the bonds holding the two strands of DNA together.



(1)

☒ **A** Ester bonds

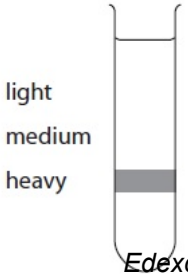
☒ **B** Glycosidic bonds

☒ **C** Hydrogen bonds

☒ **D** Peptide bonds

(b) A culture of bacteria had its DNA labelled with the heavy isotope of nitrogen (^{15}N).

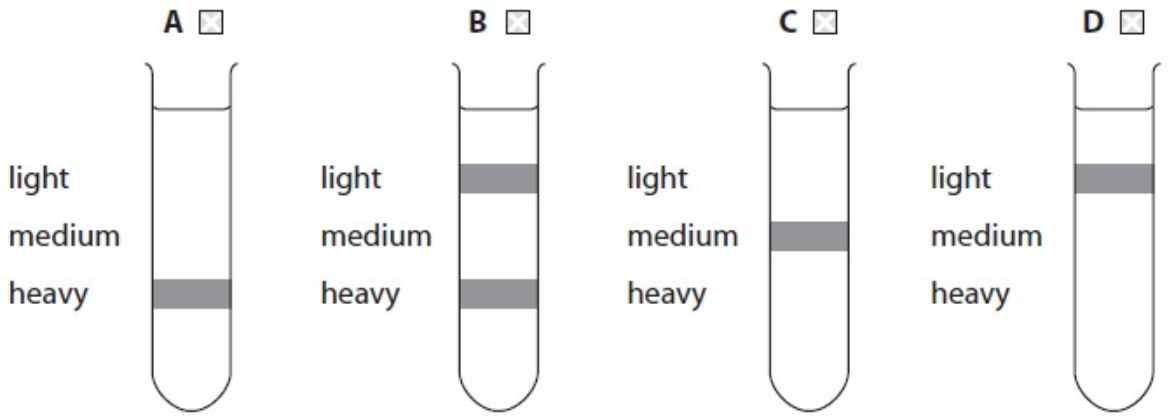
The diagram below shows the position of the DNA band in the centrifuge tube when the DNA was labelled with the heavy isotope of nitrogen, ^{15}N.



The bacterial culture was then allowed to reproduce using nucleotides containing the normal isotope of nitrogen (^{14}N).

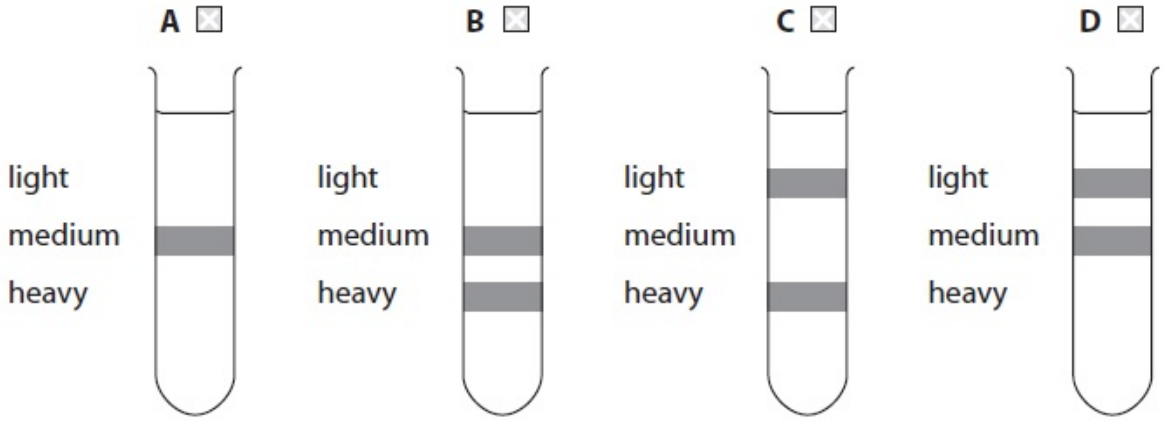
(i) Place a cross

in the box below next to the tube showing the correct pattern of DNA after the bacteria have divided once.



(1)

(ii) Place a cross in the box below next to the tube showing the correct pattern of DNA after the bacteria have divided twice.



(1)

(c) Name the place in a eukaryotic cell where messenger RNA will be synthesised.

(1)

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(d) Achondroplasia is an inherited condition that results in restricted growth in humans. This condition is caused by a dominant allele (A).

Fetuses which are homozygous for the allele for achondroplasia are rarely born alive.

Two parents who both have achondroplasia would like to have children. They are concerned about the risk of their child inheriting two dominant alleles and dying before birth.

(i) Describe **one** advantage and **one** disadvantage to these parents of genetic screening of their fetus.

(2)

Advantage:

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Disadvantage:

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(ii) In the space below, draw a suitable genetic diagram to show the probability of a child these parents growing up without achondroplasia.

(4)

probability .....

(Total for Question = 12 marks)

Q2.

The diagram below shows the sequence of bases in a short length of mRNA.

A	U	G	G	C	C	U	C	G	A	U	A	A	C	G	G	C	C	A	C	C	A	U	C

(a) (i) Place a cross ☒ in the box next to the letter that shows the DNA sequence which is complementary to the **first four** of these bases.

(1)

☒ **A**

T	A	C	C

☒ **B**

T	U	C	C

☒ **C**

U	A	C	C

☒ **D**

U	T	C	C

(ii) State the maximum number of amino acids coded for by this length of mRNA.

(1)

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(b) Name the process by which mRNA is formed in the nucleus.

(1)

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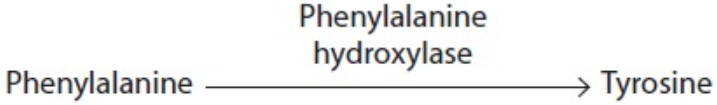
(c) Phenylalanine is an amino acid found in many proteins in the human diet.

In most people it is converted to the amino acid tyrosine by an enzyme, as shown in the diagram below.



Phenylketonuria is the result of a gene mutation.

People with phenylketonuria cannot convert phenylalanine to tyrosine.

Explain why people with this gene mutation cannot convert phenylalanine to tyrosine.

(4)

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(d) Explain why a gene mutation involving the replacement of one base with another has less effect than the loss of a base.

(2)

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(Total for question = 9 marks)

Q3.

One function of DNA is to act as a template for the synthesis of messenger RNA.

State what is meant by the term **template** for the synthesis of messenger RNA.

(1)

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Q4.

Describe how transcription is involved in the synthesis of an enzyme.

(4)

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(Total for question = 4 marks)

Q5.

DNA is a double-stranded molecule. During transcription, the antisense and sense strands are separated.

Part of the antisense strand, with base sequence TACGCTGAC, is transcribed.

(i) State where transcription occurs in an animal cell.

(1)

.....

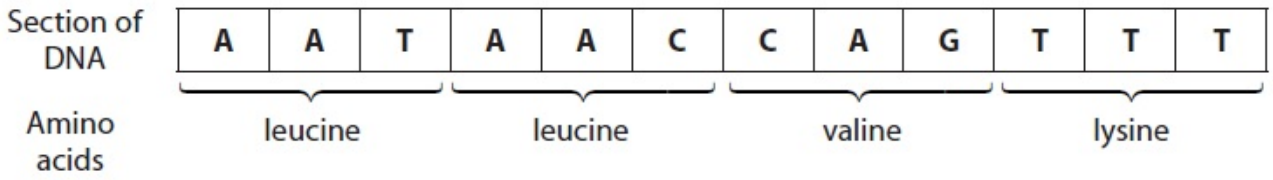
(ii) Which row shows the correct sequence for the complementary sense strand and the mRNA produced in transcription?

(1)

		Sense strand	mRNA
☒	**A**	ATGCGACTG	ATGCGACTG
☒	**B**	TACGCTGAC	AUGCGACUG
☒	**C**	TACGCTGAC	ATGCGACTG
☒	**D**	ATGCGACTG	AUGCGACUG

(Total for question = 2 marks)

Q6. The diagram below shows the base sequence on a short section of DNA consisting of 12 mononucleotides. This base sequence contains the genetic code for a short section in the primary structure of a polypeptide.



(a) Name each of the bases represented by the letters, **A**, **C**, **G** and **T** in the diagram.

(1)

A.....

C.....

G.....

T.....

(b) Using the sequence shown in the diagram, explain the meaning of each of the following terms.

(i) Triplet code

(2)

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(ii) Non-overlapping

(2)

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(iii) Degenerate

(2)

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(c) Place a cross ☒ in the box next to the names of the two components, other than the bases, that form part of each mononucleotide in this sequence.

(1)

☒ **A** deoxyribose and nitrate

☒ **B** deoxyribose and phosphate

☒ **C** ribose and nitrate

☒ **D** ribose and phosphate

*(d) Transcription of this section of DNA forms a complementary strand of mRNA.

Describe how translation of this mRNA synthesises part of a polypeptide molecule.

(5)

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(Total for Question = 13 marks)

Q7. DNA is a very important molecule in living organisms as it carries the genetic code. Before a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

(a) Explain the nature of the genetic code.

(2)

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*(b) Describe the process of DNA replication.

(5)

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(Total for Question = 7 marks)

Q8.

The phenotype of organisms is affected by genotype.

Achondroplasia is a genetic condition that causes dwarfism in humans.

Genetic screening can be used to identify achondroplasia in embryos.

Individuals that are heterozygous for achondroplasia have shortened limbs.

Individuals homozygous for achondroplasia will not usually survive for more than one year.

(i) Deduce if achondroplasia is caused by a dominant or recessive allele.

(1)

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(ii) Use a genetic diagram to determine the probability that a child of parents with achondroplasia will be homozygous for this condition.

(3)

Answer .....

(iii) An embryo, created by IVF, can be screened before it is placed in the mother's uterus.

Name this type of genetic screening.

(1)

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(iv) Explain **one** ethical issue relating to the use of prenatal genetic screening.

(2)

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(Total for question = 7 marks)