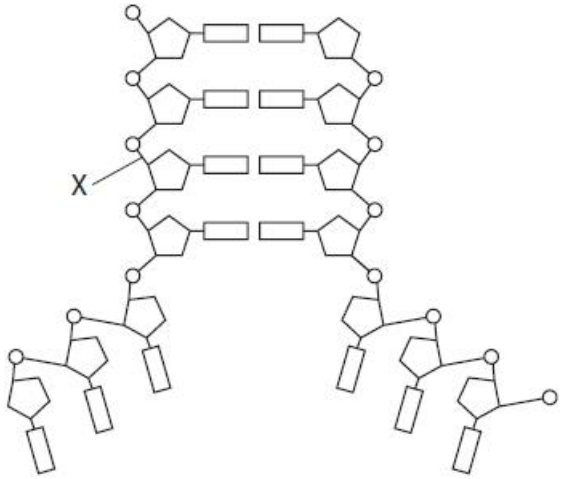
Questions

Q1.

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 ☒.

The diagram shows DNA replication.



Which of the following is the name of the bond labelled X on the diagram?

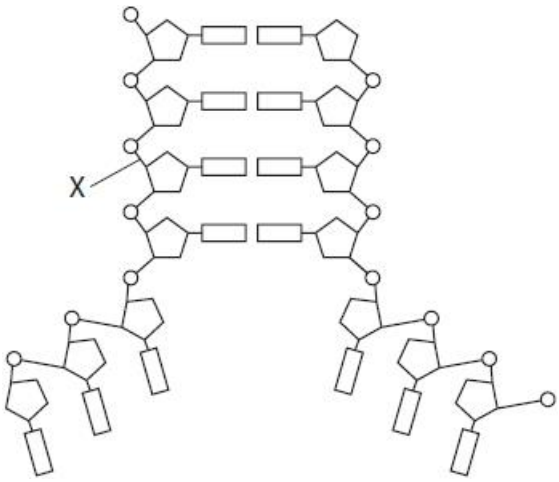
(1)

- ☒ **A** ester
- ☒ **B** glycosidic
- ☒ **C** hydrogen
- ☒ **D** phosphodiester

(Total for question = 1 mark)

Q2.

The diagram shows DNA replication.



Describe the roles of three named enzymes involved in DNA replication.

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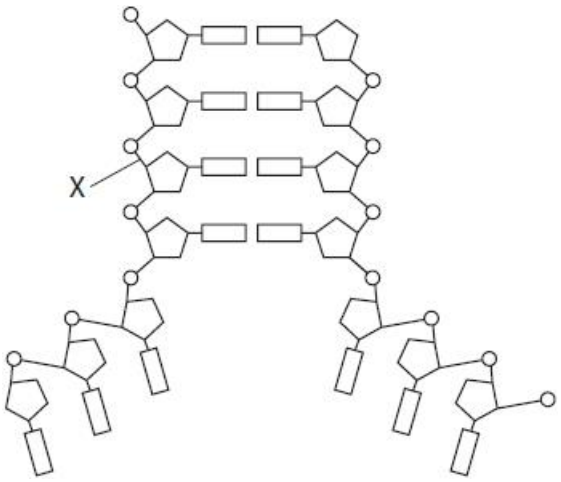
(Total for question = 3 marks)

Q3.

The diagram shows DNA replication.



A section of double-stranded DNA has a total number of 10 000 nucleotides.

Adenine makes up 35% of the nucleotides in this section of double-stranded DNA.

Calculate the total number of cytosine nucleotides found in this section of DNA.

(2)

Answer .....

(Total for question = 2 marks)

Q4.

Peptide hormones and steroid hormones are synthesised by endocrine glands.

Peptide hormones are transported dissolved in blood plasma. They bind to specific receptor molecules on the cell surface membranes of their target organs.

Some peptide hormones are nonapeptides.

The table shows the amino acid sequences of three types of nonapeptide: A, B and C.

Type	Position of amino acid in the nonapeptide								
	1	2	3	4	5	6	7	8	9
A	cys	tyr	ile	gln	asn	cys	pro	arg	gly
B	cys	tyr	phe	gln	asn	cys	pro	arg	gly
C	cys	tyr	phe	gln	asn	cys	pro	lys	gly

(i) Compare and contrast the amino acid sequence of these three nonapeptides.

(3)

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(ii) Explain why the DNA base sequences coding for these three nonapeptides are more variable than their amino acid sequences.

(3)

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(Total for question = 6 marks)

Q5.

There are three different types of haemoglobin in the blood of an adult human. Each haemoglobin molecule is composed of four polypeptide chains.

The *β*, *δ* and *γ* polypeptide chains have similar amino acid sequences.

The table shows the sequence of nine amino acids in a part of each of these polypeptide chains.

Type of polypeptide chain	Sequence of amino acids
β	- phe - ala - thr - leu - ser - glu - leu - his - cys -
δ	- phe - ser - gln - leu - ser - glu - leu - his - cys -
γ	- phe - ala - gln - leu - ser - glu - leu - his - cys -

The *β*, *δ* and *γ* polypeptide chains are coded for by three different genes.

Compare and contrast the sequence of bases in the DNA coding for each of these parts of the three polypeptide chains.

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(Total for question = 4 marks)

Q6.

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 ☒.

The photographs show a black cat and a Siamese cat.

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The pigment melanin causes the fur to turn black.
This pigment is produced by tyrosinase, an enzyme coded by the TYR gene.

tyrosine $\xrightarrow{\text{tyrosinase}}$ melanin

(i) The diagram shows part of the DNA for the TYR gene.

A	C	C	C	C	A	A	G	G	C	T	C

Complete the diagram to show the messenger RNA produced by the transcription of this DNA.

(1)

(ii) Some amino acids have more than one codon.

Which term describes this property of the genetic code?

(1)

- ☒ **A** degenerate
- ☒ **B** non-overlapping
- ☒ **C** triplet code
- ☒ **D** universal

(Total for question = 2 marks)

Q7.

The table shows the sequence of bases in part of an mRNA molecule.

Complete the table to show the base sequence of **each** of the following:

(i) the corresponding coding strand of DNA that produced this mRNA sequence

(1)

(ii) the base sequence of an antisense drug that will bind to this mRNA.

(1)

Base sequence on the DNA coding strand												
Base sequence on mRNA	C	A	U	G	C	A	U	A	U	C	G	G
Base sequence of antisense drug												

(iii) State the number of amino acids that would be coded for by the part of mRNA shown in this table.

(1)

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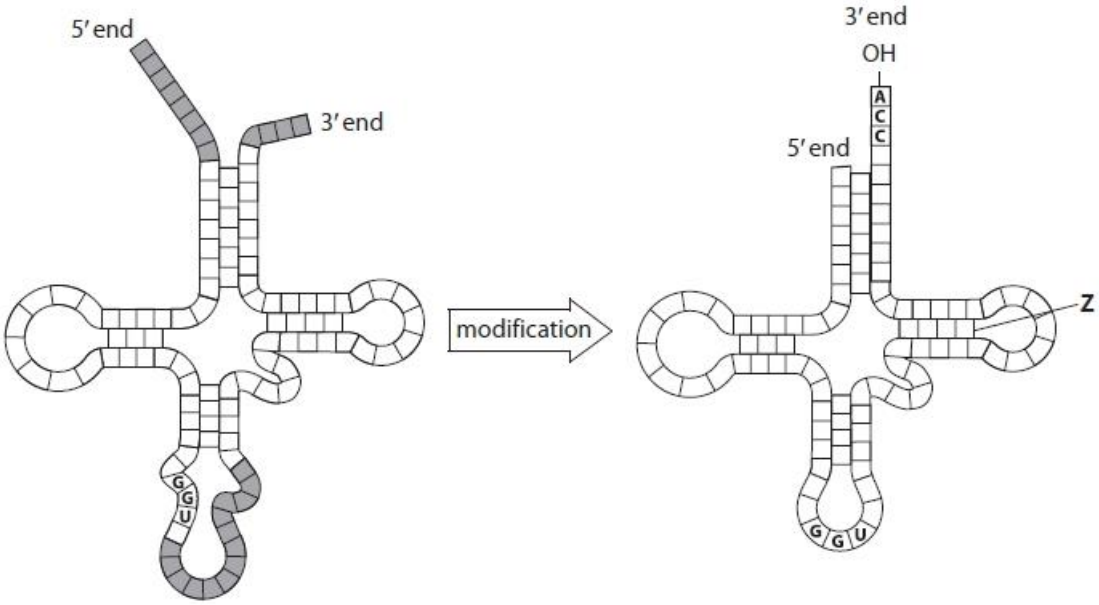
(Total for question = 3 marks)

Q8.

A molecule of tRNA is made from a precursor molecule that is modified. Modification includes splicing, trimming and attachment of new nucleotides.

The diagram shows a precursor molecule for a tRNA specific for the amino acid proline, and a tRNA molecule specific for the amino acid proline. Some of the bases are shown in each diagram.



(i) Which of the following base sequences is the mRNA code for proline?

(1)

- ☒ **A** A A T
- ☒ **B** C C A
- ☒ **C** C C T
- ☒ **D** C C U

(ii) Which of the following base sequences is the DNA code for proline?

(1)

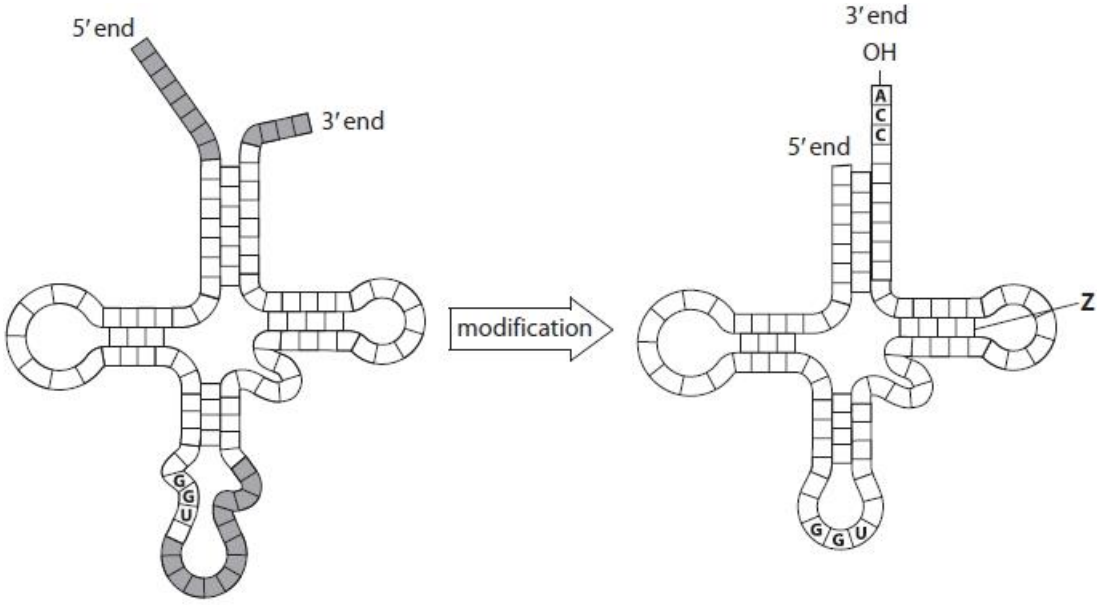
- ☒ **A** A C C
- ☒ **B** C C A
- ☒ **C** G G T
- ☒ **D** U G G

(Total for question = 2 marks)

Q9.

A molecule of tRNA is made from a precursor molecule that is modified. Modification includes splicing, trimming and attachment of new nucleotides.

The diagram shows a precursor molecule for a tRNA specific for the amino acid proline, and a tRNA molecule specific for the amino acid proline. Some of the bases are shown in each diagram.



precursor molecule

tRNA molecule specific for the amino acid proline

Which bond is labelled **Z**?

(1)

- ☒ **A** glycosidic
- ☒ **B** hydrogen
- ☒ **C** peptide
- ☒ **D** phosphodiester

(Total for question = 1 mark)

Q10.

Prothrombin is involved in the blood clotting process.

The *F*2 gene codes for the synthesis of prothrombin.

This gene is located from base pair 46 719 191 to base pair 46 739 504 on chromosome 11.

Determine the number of codons in this gene.

(1)

Answer .....

(Total for question = 1 mark)

Q11.

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 ☒.

The nucleic acids, DNA and mRNA, are polymers.

The table shows some components that may be found in a molecule of these nucleic acids.

For each component, put **one** ☒ cross in the appropriate box, in each row, to show where these components can be found.

(4)

Component	Component found in a molecule of			
	both DNA and mRNA	DNA but **not** mRNA	mRNA but **not** DNA	neither DNA nor mRNA
Adenine	☐	☐	☐	☐
Hydrogen bonds	☐	☐	☐	☐
Pentose sugar	☐	☐	☐	☐
Uracil	☐	☐	☐	☐

(Total for question = 4 marks)

Q12.

The table shows the number of bases in the DNA strand used in the synthesis of mRNA.

Complete the table to show the percentage of bases in the mRNA synthesised.

(3)

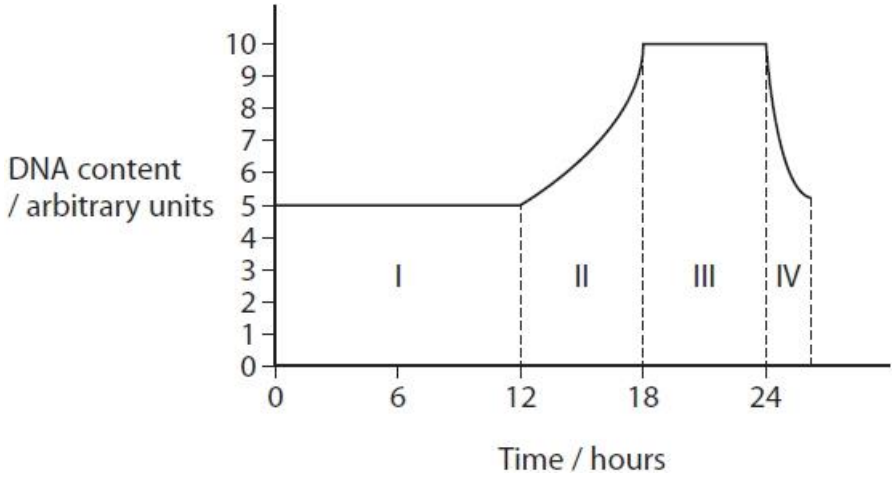
Bases	Number of bases in the DNA strand	Percentage of bases in the mRNA (%)
Adenine	31 000	23.3
Cytosine	22 000	
Guanine	26 000	
Thymine	24 000	

(Total for question = 3 marks)

Q13.

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 ☒.

The graph shows the DNA content of a cell during four stages, I, II, III and IV, of one cell cycle.



(i) In which stage does DNA replication take place?

(1)

- ☒ **A** stage I
- ☒ **B** stage II
- ☒ **C** stage III
- ☒ **D** stage IV

(ii) Explain the role of the enzyme ligase in DNA replication.

(3)

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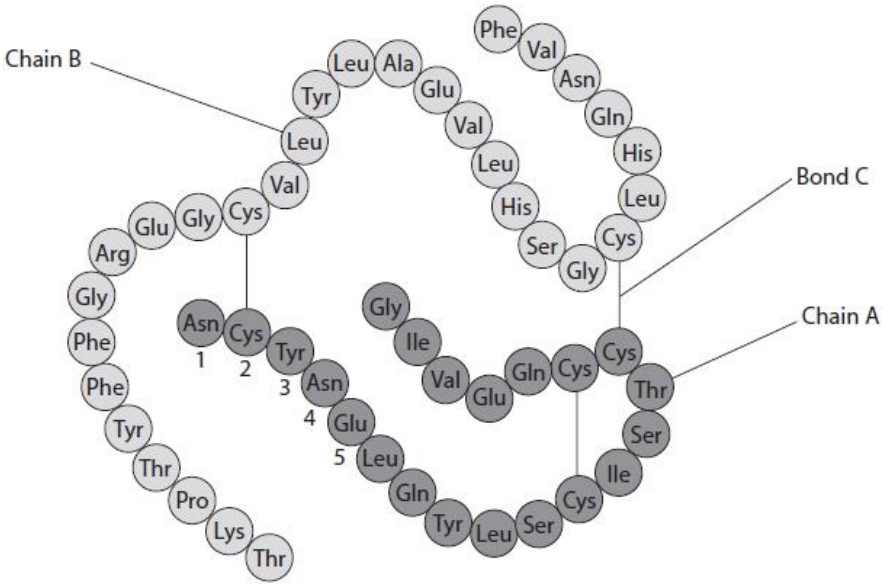
(Total for question = 4 marks)

Q14.

Insulin is a protein that is composed of two polypeptide chains, chain A and chain B.

The diagram shows the amino acid sequence of these two polypeptide chains and some of the bonds involved in the folding of this protein.



The table shows the DNA genetic codes on the anti-sense DNA strand (template strand) for amino acids.

Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid	Genetic code	Amino acid
AAA AAG	Lys	CAA CAG	Gln	GAA GAG	Glu	TAC TAT	Tyr
AAC AAT	Asn	CAT CAC	His	GAC GAT	Asn	TCA TCC TCG TCT	Ser
ACA ACC ACG ACT	Thr	CCA CCC CCG CCT	Pro	GCA GCC GCG GCT	Ala	TGG	Try
AGA AGG	Arg	CGA CGC CGG CGT	Arg	GGA GGC GGG GGT	Gly	TGC TGT	Cys
AGC AGT	Ser	CTA CTC CTG CTT	Leu	GTA GTC GTG GTT	Val	TTA TTG	Leu
ATA ATC ATT	Ile					TTC TTT	Phe
ATG	Met						

The genetic codes TAA, TAG and TGA are stop codons.

(i) Complete the diagram to show one base sequence in the antisense DNA strand (template strand) coding for the five amino acids numbered in the diagram of insulin.

(1)

Amino acid number	1	2	3	4	5
Amino acid abbreviation	Asn	Cys	Tyr	Asn	Glu
Base sequence on the antisense DNA strand		TGT			

*(ii) Analyse the information to deduce how gene mutations in the DNA base sequence for Cys (amino acid number 2) could affect the structure of insulin.

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(Total for question = 7 marks)

Q15.

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) Which bonds join the nucleotides in a single strand of DNA?

(1)

- ☒ **A** peptide
- ☒ **B** disulfide
- ☒ **C** glycosidic
- ☒ **D** phosphodiester

(ii) Describe how the process of DNA replication produces two identical DNA molecules.

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(Total for question = 5 marks)

Q16.

Eukaryotic cells and prokaryotic cells have similarities and differences in their ultrastructure.

Some antibiotics inhibit RNA synthesis and protein synthesis in cells.

Actinomycin D, Rifamycin and *α*-Amanitin are antibiotics that work by binding to molecules in a cell. This inhibits protein synthesis.

The scientists who developed these antibiotics had to find out which types of cell were affected and which molecule they were binding to.

The table shows the types of cell that these antibiotics affect and the molecule that they bind to.

Antibiotic	Type of cell affected	Molecule that the antibiotic binds to
Actinomycin D	Prokaryotic and eukaryotic	DNA
Rifamycin	Prokaryotic only	RNA polymerase
α-Amanitin	Eukaryotic only	RNA polymerase

(i) Describe the structure of a DNA molecule.

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(ii) Explain the effect of Actinomycin D on protein synthesis.

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(iii) Explain the effect of Rifamycin and *α*-Amanitin on protein synthesis.

(3)

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(Total for question = 9 marks)

Q17.

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 ☒.

Short sequences of nucleotides are being developed as potential drugs.

They act by binding to selected sites on DNA or RNA molecules and prevent the synthesis of a specific protein associated with a disease.

Two types of drug to treat genetic disorders are:

- antisense drugs, which are RNA nucleotides that bind to mRNA
- triplex drugs, which are DNA nucleotides that bind to DNA forming a three-stranded helix.

(i) The type of bonds that hold the two strands of a DNA molecule together in a double helix are

(1)

- ☐ **A** glycosidic bonds
- ☐ **B** hydrogen bonds
- ☐ **C** phosphodiester bonds
- ☐ **D** peptide bonds

(ii) Antisense drugs inhibit protein synthesis by interfering with

(1)

- ☐ **A** protein folding
- ☐ **B** replication
- ☐ **C** transcription
- ☐ **D** translation

(iii) Triplex drugs inhibit protein synthesis by interfering with

(1)

- ☐ **A** protein folding
- ☐ **B** replication
- ☐ **C** transcription
- ☐ **D** translation

(Total for question = 3 marks)

Q18.

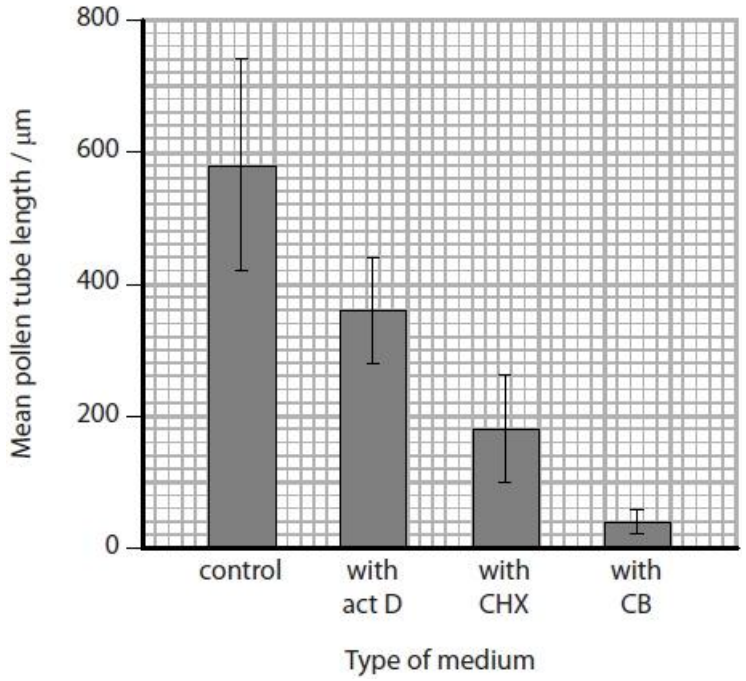
A student investigated the effect of three inhibitors on the growth of pollen tubes.

Pollen grains were incubated in a control medium.

In addition, some pollen grains were also incubated in three media, each containing one inhibitor.

The inhibitors used were actinomycin D (act D), cycloheximide (CHX) and cytochalasin B (CB).

The results of this investigation are shown in the graph.



The student made the following conclusions from these results:

Conclusion 1: all three inhibitors affected pollen tube growth

Conclusion 2: pollen grown in CB grew the slowest

Conclusion 3: the control result was the least repeatable

Conclusion 4: more pollen grains germinated in the control group

(i) Actinomycin D (act D) inhibits transcription.

Explain why pollen tubes could still grow in the presence of act D.

(2)

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(ii) Cycloheximide inhibits translation.
Describe the process of translation.

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(iii) Cytochalasin B prevents the addition of monomers in the synthesis of the protein actin.
Describe how monomers are bonded to a polypeptide chain during the synthesis of actin.

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(Total for question = 8 marks)

Q19.

Some antibiotics work by inhibiting the production of ribosomes in bacteria.

The structure of ribosomes in bacteria is similar to the structure of ribosomes in mitochondria.

(i) Describe the structure of a ribosome.

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(ii) Describe the role of ribosomes in protein synthesis.

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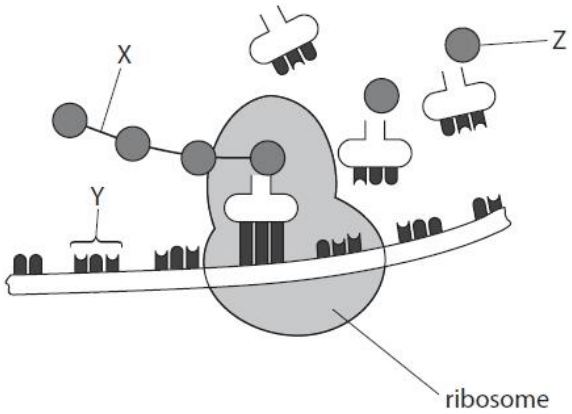
(Total for question = 4 marks)

Q20.

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 ☒.

The diagram represents part of protein synthesis.



(i) Name the stage of protein synthesis shown in the diagram.

(1)

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(ii) The stage shown in the diagram takes place in the

(1)

- ☒ **A** cytoplasm
- ☒ **B** Golgi apparatus
- ☒ **C** nucleus
- ☒ **D** smooth endoplasmic reticulum

(iii) The part labelled X on the diagram represents

(1)

- ☒ **A** an ester bond
- ☒ **B** a glycosidic bond
- ☒ **C** a hydrogen bond
- ☒ **D** a peptide bond

(iv) The part labelled Y on the diagram represents

(1)

- ☒ **A** an anticodon
- ☒ **B** a base pair
- ☒ **C** a codon
- ☒ **D** a DNA triplet

(v) Name the molecule represented by the part labelled Z on the diagram.

(1)

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(Total for question = 5 marks)

Q21.

Which of the following statements is true for the total number of bases in a double-stranded DNA molecule?

(1)

☒ **A** $\frac{A+T}{C+G}=1$

☒ **B** $\frac{A}{T}=\frac{C}{G}$

☒ **C** $A \times T = C \times G$

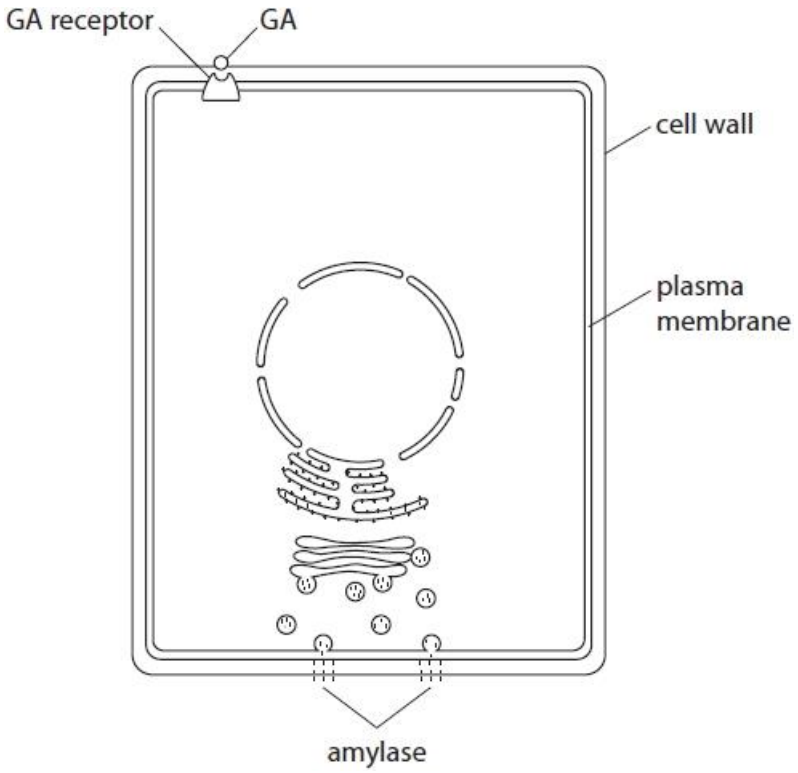
☒ **D** $\frac{A}{C}=\frac{G}{T}$

(Total for question = 1 mark)

Q22.

Gibberellin stimulates cells in the aleurone layer of cereal grains, such as barley, to produce the enzyme amylase.

The diagram shows a cell from the aleurone layer with some of the structures involved in the production of amylase.



Gibberellin binds to a protein receptor in the cell surface membrane and this stimulates transcription in the nucleus.

(i) Describe the process of transcription in the nucleus of this cell.

(2)

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(ii) Describe the processes occurring after transcription that result in the release of amylase from the cell shown in the diagram.

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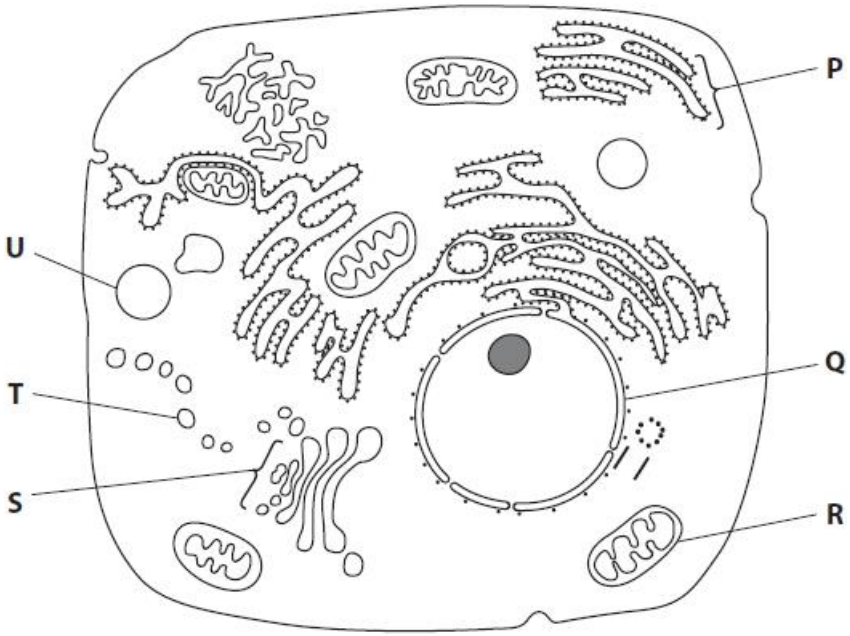
(Total for question = 7 marks)

Q23.

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 ☒.

The diagram shows the ultrastructure of an animal cell.



Magnification ×9000

(i) The structure labelled **R** on the diagram represents a

(1)

- ☒ **A** chloroplast
- ☒ **B** lysosome
- ☒ **C** mitochondrion
- ☒ **D** ribosome

(ii) The structure labelled **Q** on the diagram represents the

(1)

- ☒ **A** cell surface membrane
- ☒ **B** nuclear envelope
- ☒ **C** rough endoplasmic reticulum
- ☒ **D** smooth endoplasmic reticulum

(iii) Calculate the actual diameter of the structure labelled **U**.

(2)

Answer .....

(iv) Describe how the structures labelled **P**, **S** and **T** are involved in the production and secretion of molecules from this cell.

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(Total for question = 7 marks)

Q24.

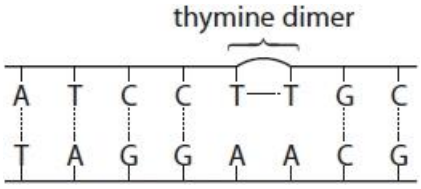
Ultraviolet (UV) radiation damages DNA and is used in microbiology to produce aseptic conditions.

The UV radiation changes the bonding found in DNA.

This change in bonding creates thymine dimers in which covalent bonds form between adjacent thymine nucleotides.

Thymine dimers bend the DNA backbone. This prevents replication of DNA.

The diagram shows the change in bonding caused by UV radiation.



Explain why preventing the replication of DNA produces aseptic conditions.

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(Total for question = 2 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	The only correct answer is: **D** phosphodiester *A is incorrect as this bond is found in lipids* *B is incorrect as this bond is found in carbohydrates* *C is incorrect as this bond pair bonds nucleotides*		**1 comp**

Q2.

Question Number	Answer	Additional Guidance	Mark
1(b)	A description that makes reference to the following points: • {DNA polymerase} {joins the sugar phosphate backbone (between nucleotides) / forms phosphodiester bonds / joins adjacent nucleotides} (1) • DNA {ligase} {joins fragments of DNA / short pieces of DNA / Okazaki fragments} (1) • DNA {helicase} {breaks hydrogen bonds / unzips double helix / separates strands} (1)	**Accept** {RNA primase} makes {RNA to start replication of DNA}	**3 expert**

Q3.

Question Number	Answer	Additional Guidance	Mark
	A calculation that makes reference to the following points: • correct calculation of percentage cytosine (1) • correct calculation of number of nucleotides (1)	15 % cytosine 15 % of 10 000 = **1500** Correct answer with no working gains full marks **One mark** for 15 %	**2 grad**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: Similarities: • all three types have the same amino acids in positions 1, 2, 4, 5, 6, 7 and 9 (1) Differences: • type A has ile in position 3 whereas types B and C have phe (1) • type C has lys in position 7 whereas types A and B have arg (1)	**ACCEPT** they all have cys, tyr, gln, asn, (cys), pro, gly they all have one amino acid different **ACCEPT** instead of phe **ACCEPT** instead of arg	(3) EXP

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • there are more (triplet) codes than there are amino acids (1) • so the code is degenerate (1) • therefore the same amino acids may have a different code (1) • this helps to maintain the same {structure / function} of the {nonapeptide / protein} (1)	**ACCEPT** this helps to prevent a mutation from changing the {structure / function}	(3) EXP

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	A response that makes reference to the following: **Similarities** • there will be {27 bases / 9 triplet codons } in the sequence **(1)** • all three will have the code for { phe / amino acid 1 / amino acids 4-9 / leu, ser, glu, leu, his, cys } **(1)** • β and γ will both code for the same amino acid 2 / δ and γ will both code for the same amino acid 3 **(1)** **Differences** • the sequence of bases in the code for the same amino acid might be different **(1)** • {β and δ will have different sequences for amino acids 2 and 3 / β and γ different for amino acid 3 / δ and γ different for amino acid 2 } **(1)**	**ACCEPT** they have the same number of (DNA) bases **ACCEPT** triplet sequence is the same for ... / same codon **ACCEPT** if clear context of bases coding for ... in the whole response **ACCEPT** if clear context of bases coding for ... in the whole response	**(4)**

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	UGG GGU UCC GAG		1

Question Number	Answer	Mark
(ii)	The only correct answer is A degenerate *B is incorrect because non-overlapping refers to discrete reading frames* *C is incorrect because it simply refers to three bases* *D is incorrect because it refers to the same code in all organisms*	1

Q7.

Question Number	Answer	Mark
(i)	GTACGTATAGCC	(1)

Question Number	Answer	Mark
(ii)	GUACGUAUAGCC	(1)

Question Number	Answer	Mark
(iii)	4	(1)

Q8.

Question Number	Answer	Mark
(i)	**The only correct answer is B** ***A*** *is not correct because G binds to C and U to A* ***C*** *is not correct because G binds to C and U to A* ***D*** *is not correct because G binds to C and U to A*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is C** ***A*** *is not correct because C binds to G and A binds to T on DNA* ***B*** *is not correct because C binds to G and A binds to T on DNA* ***D*** *is not correct because C binds to G and A binds to T on DNA*	**(1)**

Q9.

Question Number	Answer	Mark
	The only correct answer is B ***A*** *is not correct because glycosidic bonds join monosaccharides together* ***C*** *is not correct because peptide bonds join amino acids together* ***D*** *is not correct because phosphodiester bonds join adjacent mononucleotides together*	**(1)**

Q10.

Question Number	Answer	Additional Guidance	Mark
	6771		**(1)**

Q11.

Question Number	Answer	Additional Guidance	Mark

Component	Component found in a molecule of			
	both DNA and mRNA	DNA but not mRNA	mRNA but not DNA	neither DNA nor mRNA
Adenine	X	□	□	□
Hydrogen bonds	□	X	□	□
Pentose sugar	X	□	□	□
Uracil	□	□	X	□

Q12.

Question Number	Answer	Additional Guidance	Mark
(b)	• 25.2 (1) • 21.4 (1) • 0.0 (1)	[NB. penalise just once for inappropriate decimal places] ACCEPT 25 ACCEPT 21 ACCEPT 0	(3)

Q13.

Question Number	Answer	Mark
(i)	**The only correct answer is B** ***A*** *is not correct because in stage I the DNA remains at 5 a.u.* ***C*** *is not correct because in stage III the DNA remains at 10 a.u.* ***D*** *is not correct because in stage IV the DNA content reduces not increases*	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • joins sections of DNA together / repairs breaks in the phosphodiester backbone (1) • by forming phosphodiester bonds (1) • (forms bonds) between phosphate and {deoxyribose / sugar / pentose } (1)	ACCEPT join Okazaki fragments / joins fragments produced from copying the lagging strand / needed for working in 3' to 5' direction ACCEPT between (mono) nucleotides	(3)

Q14.

Question Number	Answer					Additional Guidance	Mark
(i)							(1) GRAD
	AAC / AAT/ GAC/ GAT	TGT	TAC / TAT	AAC / AAT/ GAC/ GAT	GAA / GAG		

Question Number	Indicative content
* (ii)	**Indicative content:** • substitution mutation may result in no change of amino acid • TGT to TCC • so no effect on structure • substitution may change amino acid • e.g. TGT to TGG • inserting a try instead of Cys • no disulphide bond joining chain A and B together at that point • insertion / deletion will result in {frame shift mutation / change in amino acid sequence} • Cys no longer present in that position • no disulphide bond joining chain A and B together at that point • Cys may be inserted further down the chain so disulfide bond forming elsewhere • chain A will be shorter • change in bonding will affect {tertiary / quaternary} structure of insulin Level 1 : different types of mutation described but no link to insulin amino acids Level 2 : different types of mutation described with a link to insulin amino acids Level 3 : effects of mutations linked to possible changes in structure of insulin

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	D phosphodiester *A is incorrect because peptide bonds are found in proteinsB is incorrect because disulfide bonds are found in proteins* *C is incorrect because glycosidic bonds are found incarbohydrates*		1
(ii)	A description that makes reference to four of: • hydrogen bonds between nucleotides broken byDNA helicase (1) • complementary nucleotides bind (1) • because {hydrogen bonds} will only form betweencytosine and guanine and adenine and thymine (1) • phosphodiester bonds are formed by DNApolymerase (1) • (the leading strand is synthesised continuously butlagging strand required) DNA ligase to join fragments (on lagging strand) (1)	**Allow** unzipped by helicase	4

Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to three of the following: • composed of nucleotides / nucleotides described **(1)** • nucleotides held together by phosphodiester bonds **(1)** • complementary base pairs held together by hydrogen bonds **(1)** • two {sugar phosphate backbones / polynucleotide chains / DNA strands} that form a double helix **(1)**	**ACCEPT** description e.g. between named base pairs	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • the DNA strands will not be able to separate / no template strand will be available **(1)** • leading to inhibition of {transcription / mRNA synthesis / RNA polymerase binding to DNA} **(1)** • DNA of both cell types are the same (structure) so both cell types affected **(1)**	**ACCEPT** DNA can't be unzipped	**(3)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • will inhibit {transcription / mRNA synthesis} **(1)** • because the RNA polymerase {will be inhibited / will not be able to bind to the DNA} **(1)** • each antibiotic affects different cell types because the (structure of) RNA polymerases are different **(1)**	**ACCEPT** cannot catalyse the reaction, prevent enzyme-substrate complex formation	**(3)**

Q17.

Question Number	Answer	Mark
i	**The only correct answer is B** ***A*** *is not correct because glycosidic bonds are in carbohydrates* ***C*** *is not correct because phosphodiester bonds are between the phosphate and base forming the backbone of the DNA molecule* ***D*** *is not correct because peptide bonds are in proteins*	**(1)**

Question Number	Answer	Mark
ii	**The only correct answer is D** ***A*** *is not correct because proteins fold with bonds between amino acids and not with mRNA* ***B*** *is not correct because replication does not involve mRNA* ***C*** *is not correct because transcription forms mRNA from a DNA template*	**(1)**

Question Number	Answer	Mark
iii	**The only correct answer is C** ***A*** *is not correct because proteins fold with bonds between amino acids and not with DNA* ***B*** *is not correct because replication is not involved in protein synthesis* ***D*** *is not correct because translation does not involve DNA*	**(1)**

Q18.

Question Number	Acceptable Answers	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • because there was some mRNA in the pollen grain (1) • so some {translation / protein synthesis} can take place (1)	Allow some mRNA can still be made e.g. if act D was a competitive inhibitor or transcription not completely inhibited Allow pollen tubes may already have the proteins they need for growth	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	A description that makes reference to four of the following: • mRNA attached to the ribosome (1) • tRNA is attached to a (specific) amino acid (1) • tRNA anticodon binds to mRNA codon (1) • peptide bonds form between amino acids (1) • process involves {start / stop} codons (1)	Reject amino acids Allow {complementary base pairing / hydrogen bonds} between tRNA and mRNA	(4)

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	A description that makes reference to two of the following: • formation of a peptide bond (1) • between an amino group and carboxyl group (1) • by a condensation reaction (1)	Allow amine and carboxylic acid and formulae Allow release of a water molecule	(2)

Q19.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • composed of protein and RNA (1) • (arranged in) two {(sub) units / parts} (1)	**ACCEPT** large and small subunit / 60S and 40Ssubunit / 50S and 30S subunit	(2)
(ii)	An answer that makes reference to two of the following: • translation (1) • to hold the tRNA on the mRNA (1) • whilst peptide bonds form to join (adjacent) amino acids together(1)		(2)

Q20.

Question Number	Answer	Additional Guidance	Mark
(i)	translation		(1)

Question Number	Answer	Mark
(ii)	**The only correct answer is A** ***B*** *is not correct because translation does not occur in the Golgi apparatus* ***C*** *is not correct because transcription not translation takes place in the nucleus* ***D*** *is not correct because the smooth endoplasmic reticulum does not have any ribosomes for translation*	(1)

Question Number	Answer	Mark
(iii)	**The only correct answer is D** ***A*** *is not correct because ester bonds are in lipids* ***B*** *is not correct because glycosidic bonds are in carbohydrates* ***C*** *is not correct because hydrogen bonds are bonds in the secondary not primary structure of the protein*	(1)

Question Number	Answer	Mark
(iv)	**The only correct answer is C** ***A*** *is not correct because an anticodon is on the tRNA* ***B*** *is not correct because a base pair is two complementary bases joined by hydrogen bonds* ***D*** *is not correct because the a DNA triplet would be found on a DNA molecule in the nucleus*	(1)

Question Number	Answer	Additional Guidance	Mark
(v)	amino acid		(1)

Q21.

Question Number	Answer	Mark
	The only correct answer is B ***A*** *is not correct because A + T will not equal C +G* ***C*** *is not correct because* A × T will not equal C × G ***D*** *is not correct because A/C will not equal T/G*	**(1)**

Q22.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to two the following: • DNA strands separate (1) • antisense strand used as template (for mRNA) (1) • RNA polymerase synthesises mRNA (1)		**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	A description that makes reference to five of the following: • mRNA leaves through nuclear pores (1) • {translation occurs at / mRNA travels to} ribosomes / rough endoplasmic reticulum (1) • codons (on mRNA) pair with anticodons on tRNA / tRNA brings amino acid (to the ribosome) (1) • peptide bonds form between amino acids (1) • amylase enters Golgi and is {modified / processed} / amylase {is packaged into vesicles / travels in vesicles} (1) • exocytosis releases {amylase / protein} (1)	Accept protein for amylase Accept description for exocytosis	**(5)**

Q23.

Question Number	Answer	Mark
(i)	**The only correct answer is C** ***A*** *is not correct because there are no chloroplasts in an animal cell* ***B*** *is not correct because lysosomes do not have a folded inner membrane* ***D*** *is not correct because ribosomes are much smaller and do not have a membrane*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is B** ***A*** *is not correct because it is not at the cell surface* ***C*** *is not correct because the rough endoplasmic reticulum is irregular in shape and is labelled P in the diagram* ***D*** *is not correct because the structure has ribosomes on the surface*	**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	A calculation that shows: • image size measured correctly (1) • image size / 9000 with suitable units (1)	<u>Example of calculation</u> 8mm 8/9000 = 0.00089mm / / 0.0009mm / 0.89µm / 0.9µm / 889nm / 8.9 x10^{-7} Allow ECF from image size +/- 1mm for one mark correct answer gets both marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
(iv)	A description that makes reference to the following: • P is (rough endoplasmic reticulum) where {translation / protein synthesis} takes place (1) • S is (Golgi apparatus) where protein is {packaged / sorted / quaternary structure produced} (1) • T are (vesicles) in which {proteins / enzymes} are transported to the cell membrane (1)	**Allow** exocytosis	**(3)**

Q24.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • {bacteria / microbes} cannot {reproduce / undergo binary fission} (1) • (because) complementary base pairing cannot occur (1) • (because) mRNA synthesis prevented (1)	Accept bacteria cannot replicate / multiply Accept T cannot pair with A Accept no transcription occurs	**(2)**