PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 1: BIOLOGICAL MOLECULES

DNA AND PROTEIN SYNTHESIS

SCORE	PERCENTAGE
/183	%

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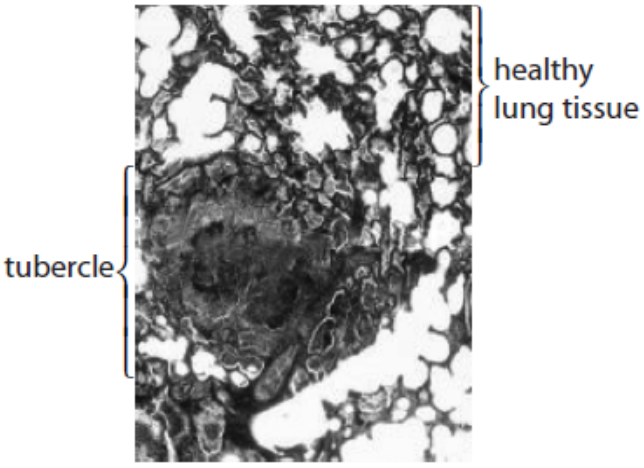
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Q1.

Infection of the lungs with *Mycobacterium tuberculosis* can result in a range of symptoms. These symptoms can include severe breathing problems, a persistent cough and coughing up blood.

The photograph below shows a tubercle in part of a lung infected with *Mycobacterium tuberculosis*, as seen using a light microscope.

A tubercle is a solid mass of dead tissue, macrophages and bacteria.



©John Burbidge/Science Photo Library

Magnification ×50

Using the information in the photograph and your knowledge of gas exchange surfaces, suggest why this infection can result in these symptoms.

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Q2. The sequence of bases in DNA determines the sequence of amino acids in a polypeptide.

The table below shows the genetic code for each amino acid.

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

(a) The diagram below shows the DNA base sequence coding for part of a polypeptide.

A	T	G	G	G	C	A	T	T

(i) Using the information in the table, state the order of amino acids for this part of the polypeptide.

(1)

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(ii) Explain what is meant by the term **non-overlapping genetic code**.

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(b) (i) Explain why there are **three** bases in each of the codes shown in the table.

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(ii) Suggest an advantage for most amino acids having more than one code. Give an explanation for your answer.

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(c) Explain the role of the base sequences TAA, TAG and TGA.

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(d) Explain how the amino acids are joined together in a polypeptide.

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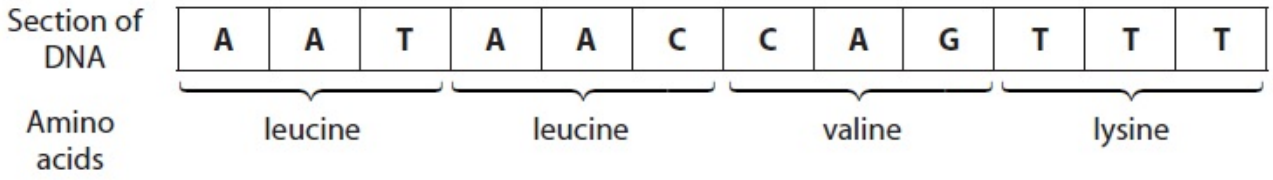
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(Total for Question = 13 marks)

Q3. 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

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(ii) Non-overlapping

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(iii) Degenerate

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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.

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(Total for Question = 13 marks)

Q4.

Mitochondrial disorders may be caused by mutations in the genes coding for mitochondrial components. Some of these genes are found in mitochondrial DNA (mtDNA) and some are found in nuclear DNA.

Leigh syndrome is an example of a mitochondrial disorder. In this syndrome, a number of different proteins involved in respiration are affected.

These mutations may be inherited or may occur when DNA replicates.

Leigh syndrome can also be due to a mutation in the SURF1 gene.

This mutation results in a shortened protein.

Explain how a mutation can result in a shortened protein being produced.

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(Total for question = 2 marks)

Q5.

Many of the chemicals found in living organisms are polymers.

Which of the following molecules are all polymers?

(1)

☒ **A** polypeptides, nucleotides, starch

☒ **B** polypeptides, starch, lipids

☒ **C** proteins, carbohydrates, lipids

☒ **D** proteins, nucleic acids, starch

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 ☒.

Transpiration moves water and mineral ions from the roots to the leaves of plants.

Which box in the table shows the mineral ions needed to make an amino acid and which box shows those needed to make DNA?

(2)

Molecule	Mineral ions needed to make the molecule			
	nitrate ions only	phosphate ions only	both nitrate and phosphate ions	neither nitrate nor phosphate ions
amino acid	☒	☒	☒	☒
DNA	☒	☒	☒	☒

(Total for question = 2 marks)

Q7.

During the development of active immunity, macrophages present antigens to T helper cells.

In an investigation into clonal selection, macrophages and T cells were isolated from two strains of guinea pig, strain 2 and strain 13.

The macrophages from each strain of guinea pig were exposed to an antigen and treated with mitomycin.

Mitomycin forms cross links between complementary strands of DNA.

These macrophages were then cultured with T cells from each of the strains of guinea pig for 72 hours.

Radioactive thymidine was included in the culture. This molecule will become incorporated into DNA during DNA replication instead of thymine.

The table shows the results of this investigation.

Source of macrophages	Level of radioactive thymidine incorporated into T cells / a.u.	
	T cells from strain 2 guinea pigs	T cells from strain 13 guinea pigs
strain 2	180	13
strain 13	17	59

(i) Explain why the macrophages were treated with mitomycin.

(3)

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(ii) Explain how radioactive thymidine becomes incorporated into the DNA.

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(iii) Analyse the data to explain the results of this investigation.

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(Total for question = 9 marks)

Q8.

Mitochondrial disorders may be caused by mutations in the genes coding for mitochondrial components. Some of these genes are found in mitochondrial DNA (mtDNA) and some are found in nuclear DNA.

Leigh syndrome is an example of a mitochondrial disorder. In this syndrome, a number of different proteins involved in respiration are affected.

These mutations may be inherited or may occur when DNA replicates.

Some people with Leigh syndrome have a mutation in the MT-ATP6 gene.
This gene codes for ATP synthase.

This is a point mutation at nucleotide 8993 that changes thymine to guanine.

(i) What type of mutation is this?

(1)

☒ **A** insertion

☒ **B** monosomy

☒ **C** substitution

☒ **D** translocation

(ii) Explain how this mutation could affect oxidative phosphorylation.

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(Total for question = 4 marks)

Q9.

A mutation of the *F*2 gene causes thrombophilia, a condition that results in the production of excess prothrombin.

In this gene mutation, guanine is replaced with adenine.

(i) Name this type of mutation.

(1)

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(ii) People without this mutation have a 1 in 1000 risk of producing a blood clot in an artery.

The mutation increases this risk by 20 times.

State the probability of producing a blood clot for people with this mutation.

(1)

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(iii) Explain why thrombophilia increases the risk of producing a blood clot in an artery.

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(Total for question = 5 marks)

Q10.

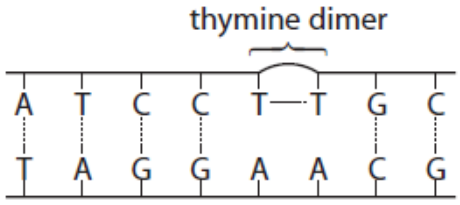
Ultraviolet (UV) radiation damages DNA and is used in microbiology to produce aseptic conditions.

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.



Name the bonds that are lost when thymine dimers are formed.

(1)

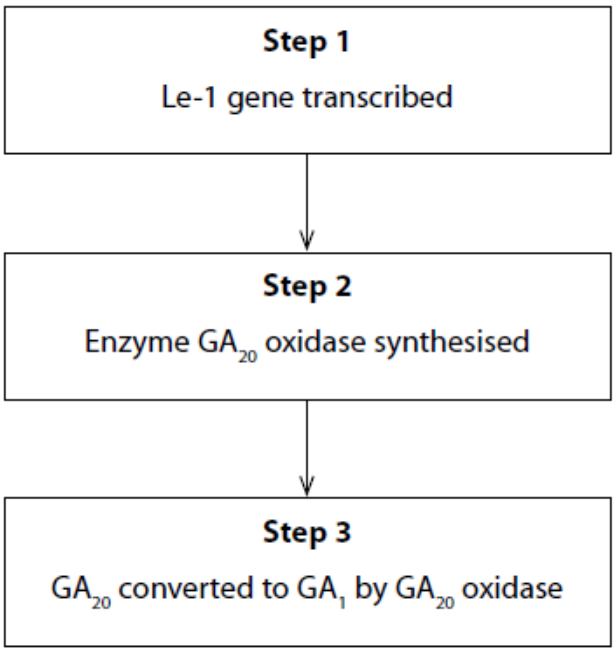
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(Total for question = 1 mark)

Q11.

'DELLA' proteins normally prevent transcription factors from binding to important growth-stimulating genes in the cells of plant stems.

The diagram below shows part of the biochemical pathway leading to the synthesis of an active plant growth substance called gibberellin (GA_1). GA_1 reduces the effect of 'DELLA' proteins.



(a) The Le-1 gene codes for the enzyme GA_{20} oxidase. A mutation of this gene forms a recessive allele which, when translated, leads to a single amino acid change in this enzyme. This change significantly reduces the activity of GA_{20} oxidase.

Explain how a single amino acid change can bring about a change in the structure and activity of GA_{20} oxidase.

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(b) (i) Explain why homozygous recessive plants will have short stems.

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(ii) An ecological survey of a stable population of one species of plant found that 36% had short stems.

Calculate the percentage of heterozygous individuals in this population.
Assume that there are only two alleles for this gene.

(4)

Answer .....

(Total for question = 12 marks)

Q12.

Antibiotics can affect bacteria.

The table describes the mode of action of four antibiotics.

Antibiotic	Mode of action
benzylpenicillin	disrupts peptidoglycan structure
streptomycin	binds to 70S ribosomes
ciprofloxacin	inhibits enzymes involved in prokaryotic DNA replication
rifamycin	inhibits prokaryotic RNA polymerase

Mutations in the DNA of bacteria can enable them to be resistant to antibiotics.

(i) A single bacterium can produce 2×10^{10} new cells per day by cell division.

The mean mutation rate in one day is 1 in 10 million new cells produced.

Calculate the mean number of bacteria with mutations that could be produced in one day from a single bacterium.

(2)

Answer .....

(ii) Explain how bacteria may become resistant to streptomycin if a mutation changes the primary structure of a protein.

(3)

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(Total for question = 5 marks)

Q13.

Antibiotics can affect bacteria.

The table describes the mode of action of four antibiotics.

Antibiotic	Mode of action
benzylpenicillin	disrupts peptidoglycan structure
streptomycin	binds to 70S ribosomes
ciprofloxacin	inhibits enzymes involved in prokaryotic DNA replication
rifamycin	inhibits prokaryotic RNA polymerase

Explain how rifamycin prevents the growth of bacteria.

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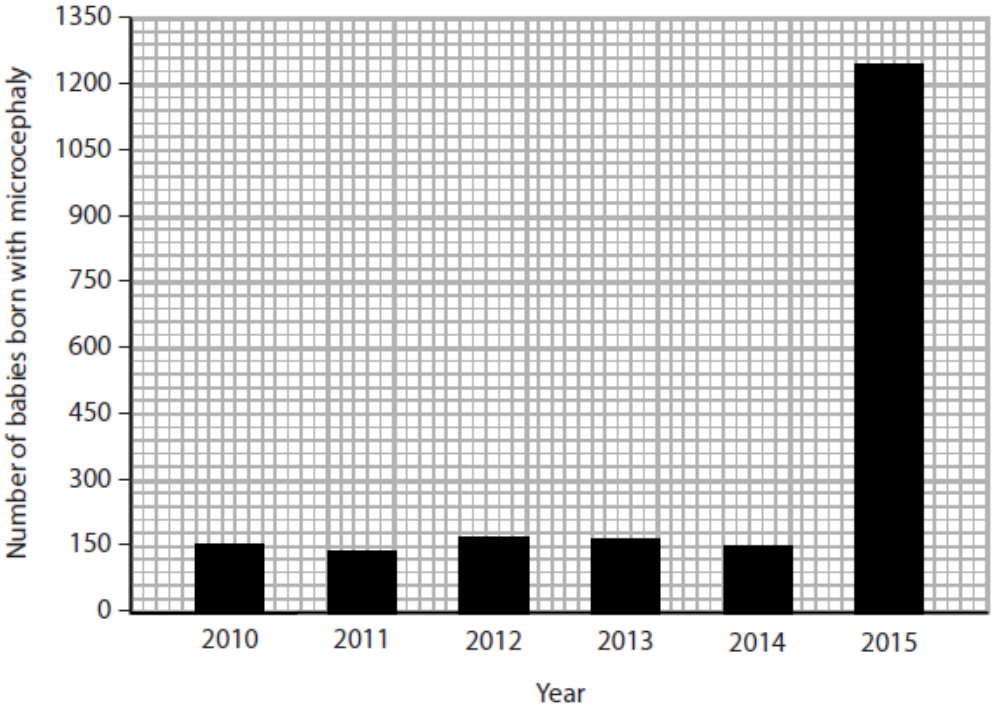
(Total for question = 3 marks)

Q14.

In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



Scientists have discovered that the Zika virus genome is made of RNA.

This RNA codes for:

- capsid protein with 105 amino acids
- pre-membrane protein with 187 amino acids
- envelope protein with 505 amino acids
- seven nonstructural proteins

(i) State how many bases are needed to code for the capsid protein.

(1)

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(ii) Unlike human immunodeficiency virus (HIV), Zika is not a retrovirus.

Describe what happens to the Zika RNA once it is in the cell.

(2)

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(Total for question = 3 marks)

Q15.

The Ebola virus contains RNA that cannot be translated into protein directly.

First, RNA polymerase must produce a strand of RNA complementary to the viral RNA.

The diagram shows a section of the RNA contained in the Zaire Ebola virus.

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

(i) Give the RNA strand that the RNA polymerase would make from this section of RNA.

(1)

The table shows part of the genetic code.

RNA triplet	**Amino acid**	**RNA triplet**	**Amino acid**
AAA	Lysine	ACA	Threonine
AAG	Lysine	GGU	Glycine
CAU	Histidine	GGC	Glycine
CAC	Histidine	GUG	Valine
CCA	Proline	UGU	Cysteine
UUU	Phenylalanine	GGG	Glycine
UGG	Tryptophan	GUU	Valine

(ii) The genetic code was worked out by using radioactive synthetic RNA molecules and analysing the polypeptide produced.

The table shows some of the results obtained.

Synthetic RNA molecule	**Amino acids incorporated into the polypeptide**
contains only U	phenylalanine
contains only A	lysine
contains U and G in a 5:1 ratio	20% cysteine, 20% valine, 4% glycine, 5% tryptophan

Explain how these results give evidence for the genetic code.

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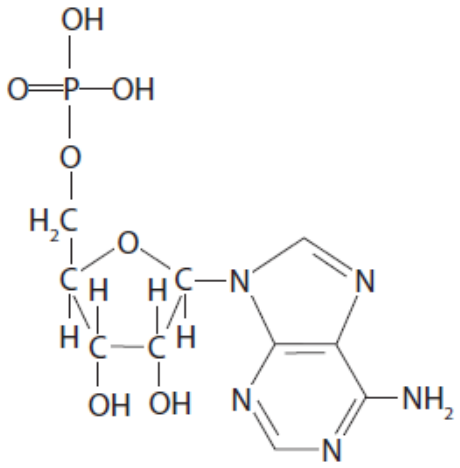
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Q16.

Many of the chemicals found in living organisms are polymers.

The diagram shows the structure of a monomer.

(1)



This monomer is found in

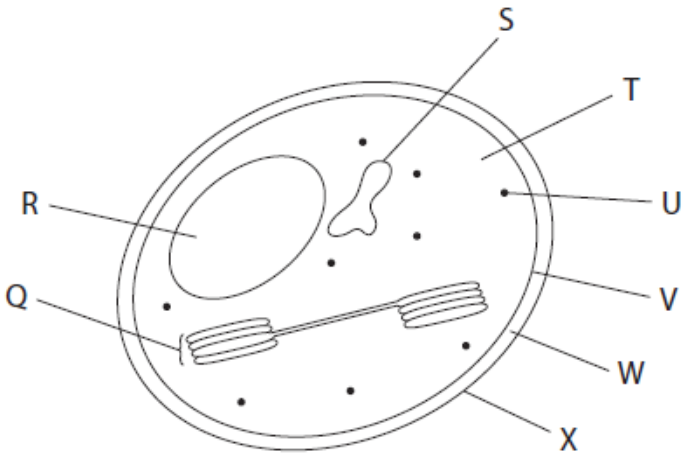
- ☒ **A** DNA
- ☒ **B** DNA polymerase
- ☒ **C** haemoglobin
- ☒ **D** mRNA

Q17.

The light-dependent stage and the light-independent stage of photosynthesis both take place in the chloroplast.

The rate of photosynthesis is affected by a number of different factors, including carbon dioxide concentration and temperature.

The diagram shows a chloroplast.



(i) Where does the light-dependent stage take place?

(1)

☒ **A** Q

☒ **B** T

☒ **C** V

☒ **D** X

(ii) The light-dependent stage produces hydrogen ions.

Where do these hydrogen ions accumulate?

(1)

☒ **A** Q

☒ **B** R

☒ **C** S

☒ **D** W

(iii) Where does translation take place?

(1)

☒ **A** Q

☒ **B** R

☒ **C** S

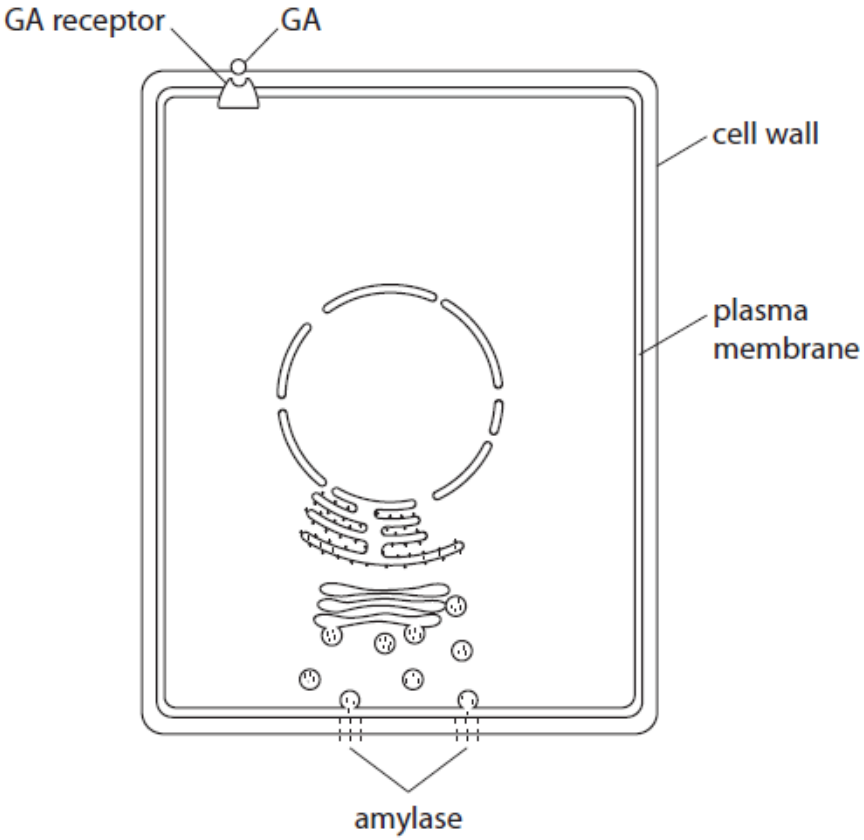
☒ **D** U

(Total for question = 3 marks)

Q18.

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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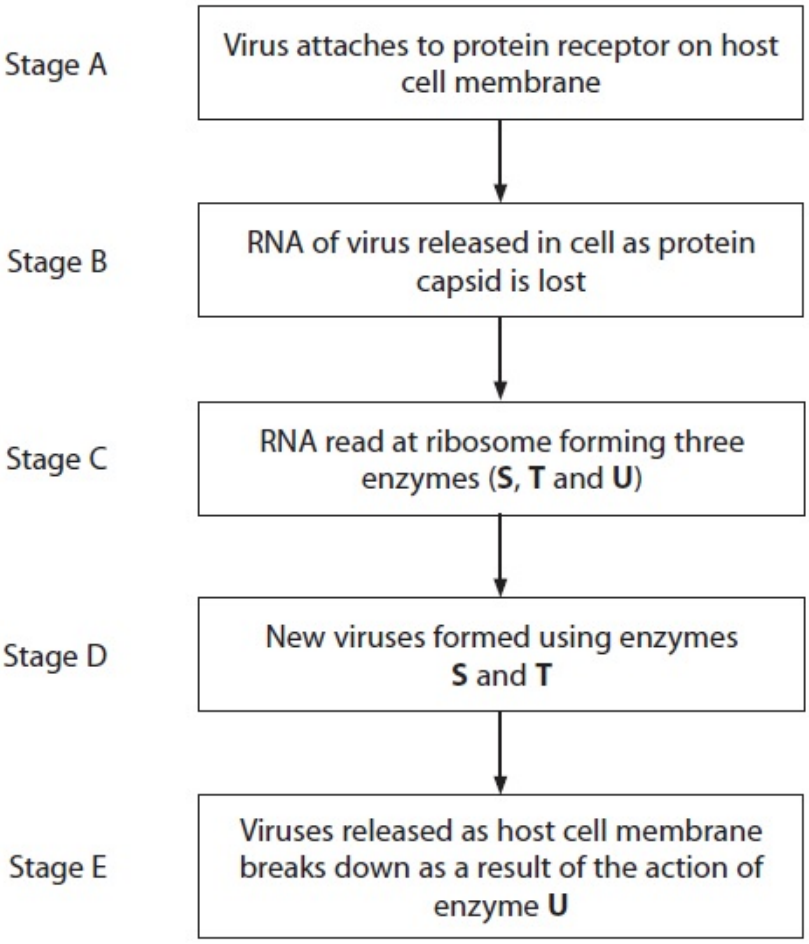
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(Total for question = 7 marks)

Q19. The common cold is a disease caused by a variety of viruses.

The flow diagram below describes how common cold viruses attack the cells on the inside of the nose.



(a) Common cold viruses infect only the cells inside the nose.

(i) Suggest why common cold viruses cannot infect cells if they land on unbroken skin.

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(ii) Suggest why common cold viruses cannot infect cells if they enter the blood through a cut in the skin.

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(b) Compare the action of the RNA in the common cold virus with that found in HIV.

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(c) At Stage C, three enzymes are formed.

(i) Suggest why two of these enzymes, **S** and **T**, are needed at Stage D.

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(ii) Suggest how enzyme **U** might catalyse the breakdown of the host cell membrane at Stage E.

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(Total for Question = 11 marks)

Q20.

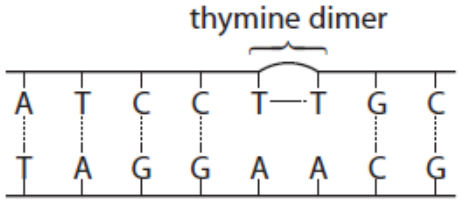
Ultraviolet (UV) radiation damages DNA and is used in microbiology to produce aseptic conditions.

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.

(2)

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(Total for question = 2 marks)

Q1.

In 2014, the British nurse Will Pooley contracted Ebola. He was given the experimental drug Zmapp and he recovered.

Zmapp contains three monoclonal antibodies that bind to Ebola glycoprotein.

Changes to viral proteins are essential for fusion of the virus with the host cell membrane.

This process delivers the viral RNA into the cell cytoplasm.

The model shows how the three monoclonal antibodies bind to the Ebola glycoprotein.



(i) Analyse the information to explain the success of Zmapp in treating patients with Ebola.

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(ii) The rate of mutation in the Ebola virus is as fast as that of the influenza virus.

The Ebola genome codes for seven proteins, one of which is the glycoprotein.

Explain what effect a mutation may have on the effectiveness of Zmapp.

(2)

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Q2.

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.

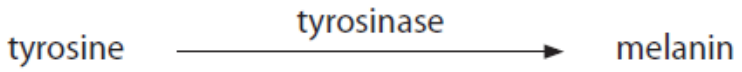


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The pigment melanin causes the fur to turn black.
This pigment is produced by tyrosinase, an enzyme coded by the TYR gene.



(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

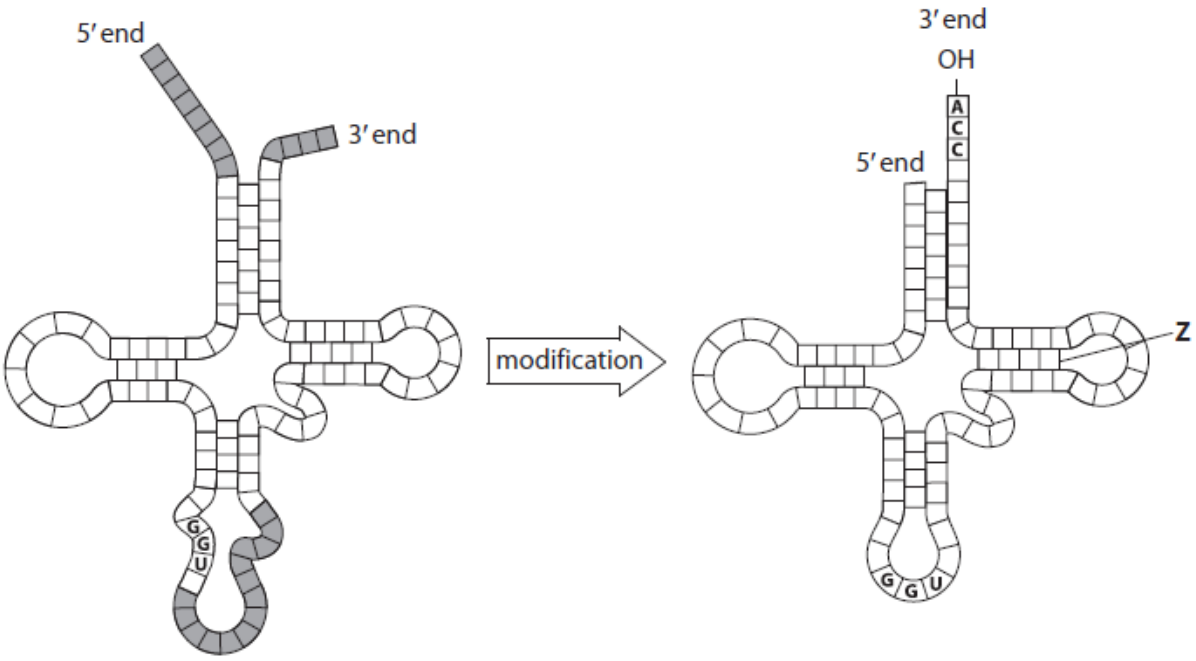
☒ **D** universal

(Total for question = 2 marks)

Q3.

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

(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

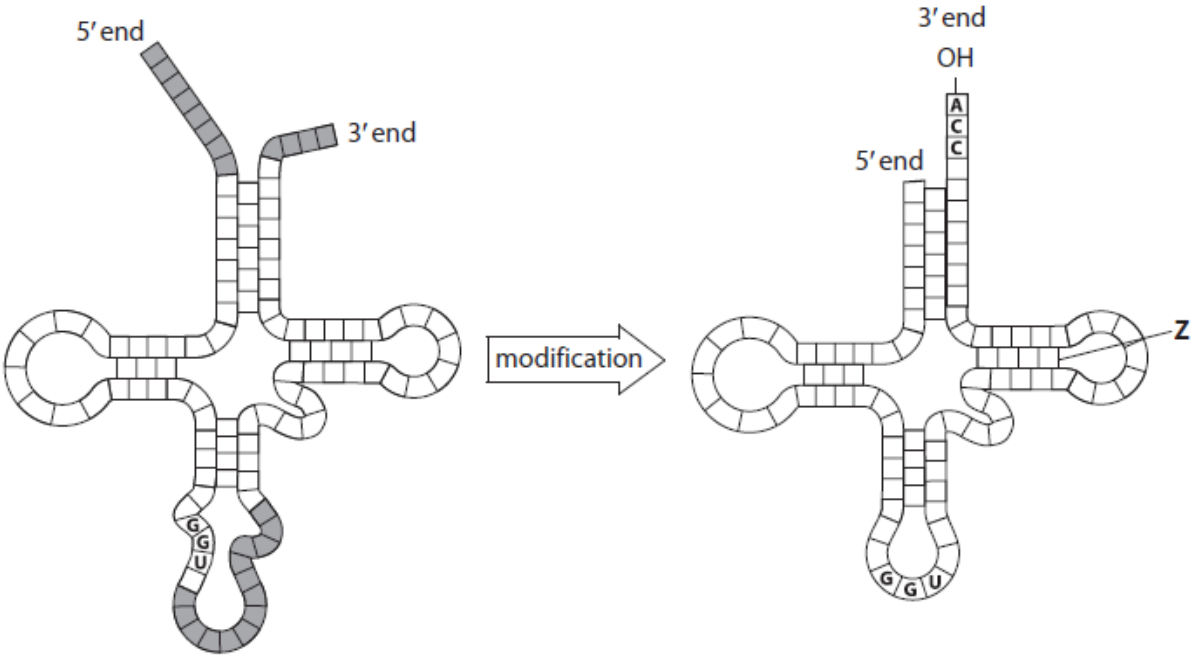
☒ **D** U G G

(Total for question = 2 marks)

Q4.

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)

Q5.

Sickle cell anaemia is caused by a mutation in the β-globin gene which codes for part of haemoglobin.

The diagram shows the first 10 amino acids in this part of haemoglobin, in a healthy person and in a person with sickle cell anaemia.

Healthy person:	val – his – leu – thr – pro – glu – glu – lys – ser - ala
Person with sickle cell anaemia:	val – his – leu – thr – pro – val – glu – lys – ser – ala

Explain why the haemoglobin in a person with sickle cell anaemia will fold differently from the haemoglobin of a healthy person.

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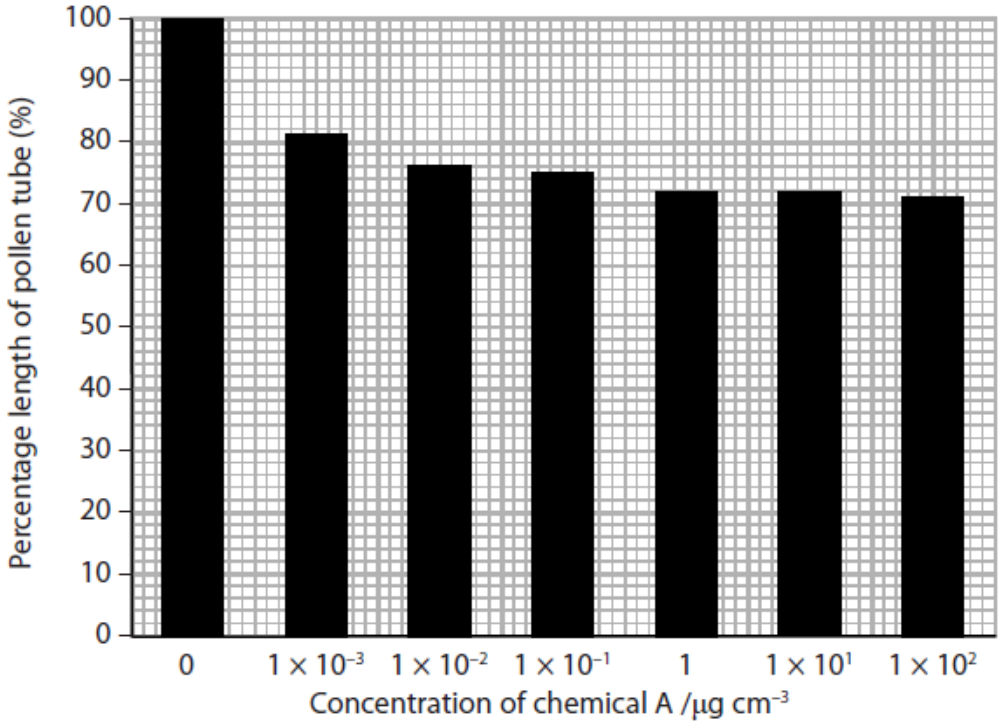
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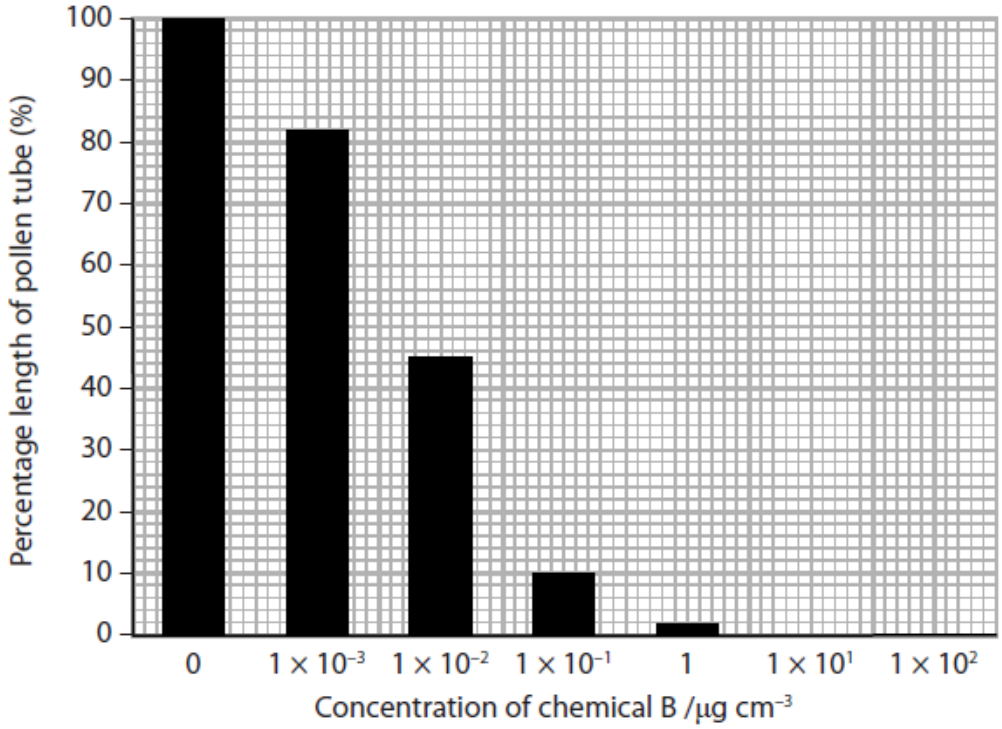
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Q6.

In flowering plants, pollen grains grow pollen tubes that are involved in fertilisation, producing a zygote and endosperm.

A scientist investigated the effects of chemical A and chemical B on pollen tube growth.
Chemical A prevents transcription.
Chemical B prevents translation.
Pollen grains were treated with different concentrations of these two chemicals.
The lengths of the pollen tubes they produced were compared with a control group of pollen grains.
The lengths of the pollen tubes were measured and expressed as a percentage of the control group.
The results are shown in the graphs.





(i) The mean length of the pollen tubes in the control group was 7.5 mm.

Calculate the mean length of the pollen tubes after adding 0.010 μg cm^{-3} of chemical A.

(2)

Answer .....

(ii) Analyse the data to comment on the effects of chemical A and chemical B on the roles of transcription and translation in pollen tube growth.

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(Total for question = 6 marks)

Q7.

Leukaemia is a type of cancer involving abnormal white blood cells.

In 2015, scientists announced that 1 in 5 people aged 90 or over had mutations linked to leukaemia.

The current UK population is about 64 million, of which 0.8% are aged 90 or over.

(i) Calculate how many people aged 90 or over could have these mutations.

(2)

Answer .....

(ii) Patients with leukaemia were given injections of radioactive thymidine so that the growth rate of the leukaemia cells could be measured.

Thymidine is a molecule containing thymine and deoxyribose.

Analyse this information to explain how the radioactive thymidine could give an indication of the growth rate of the leukaemia cells.

(2)

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Q8.

Prothrombin is involved in the blood clotting process.

The *F2* 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)

Q9.

The HIV virus contains an enzyme called reverse transcriptase. This enzyme uses the viral RNA as a template to synthesise a single strand of complementary DNA in the host cell.

(i) A sequence of bases in a section of RNA from HIV is UCCCCAGCG.

Which of the following shows the correct sequence of bases in the single strand of complementary DNA made using reverse transcriptase?

(1)

☒ **A** UCCCCAGCG

☒ **B** AGGGGTCGC

☒ **C** AGGGGUCGC

☒ **D** TCCCCTCGC

(ii) Describe how other enzymes convert the complementary single strand of DNA into a double strand of DNA in the host cell.

(2)

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(Total for question = 3 marks)

Q10.

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)

Q11.

As a result of the destruction of many habitats, the numbers of some species of animals are now so low that they may not be able to survive.

The white rhinoceros, *Ceratotherium simum*, is an example of a mammal that is threatened with extinction.



White rhino
Magnification ×0.02

In southern Africa, many reserves have been set up to protect habitats and animals. These areas are governed by special legislation and monitored by wardens.

(a) Suggest why many scientists consider that the use of protected reserves is likely to be more successful for the conservation of some animals than captive breeding programmes in zoos.

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*(b) The illegal killing of white rhinoceros (poaching), to obtain their horns, is a serious problem in many of the reserves in southern Africa. When the body of a white rhinoceros is discovered, determination of the time of death is an important part of the police investigation to catch the poachers.

After several days, body temperature and rigor mortis cannot be used to determine the time of death.

Suggest how the time of death of a white rhinoceros could be determined if it is discovered several days after being killed.

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(Total for question = 8 marks)

Q12.

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.

(4)

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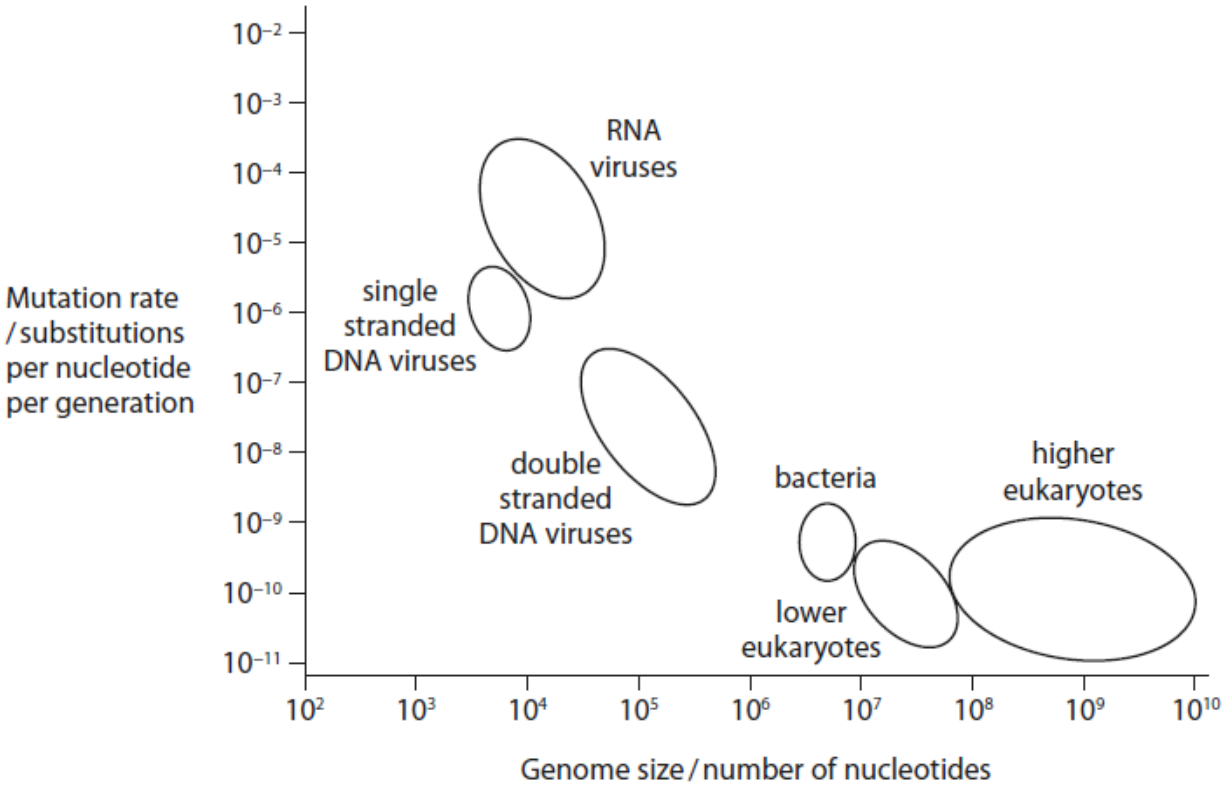
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(Total for question = 5 marks)

Q13.

The graph shows the relationship between genome size and mutation rates of organisms.



(i) Analyse the graph to determine the approximate mutation rate for tobacco mosaic virus (TMV).

(2)

Answer .....

(ii) Comment on the relationship between genome size and mutation rate of the organisms shown in the graph.

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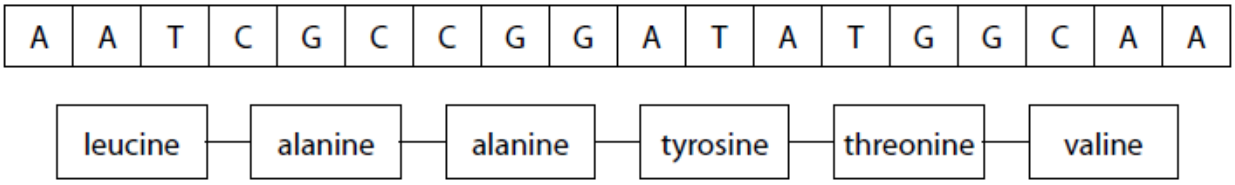
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(Total for question = 5 marks)

Q14.

The diagram below shows the order of bases in a section of DNA that codes for part of a polypeptide chain.



(i) Give the sequence of bases in the mRNA that codes for the amino acid leucine.

(1)

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(ii) Explain how this length of DNA will code for this sequence of amino acids.

(3)

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*(iii) Discuss the possible consequences for this sequence of amino acids if a point mutation occurred in this section of DNA.

(6)

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(Total for question = 10 marks)

Q15.

Enzymes are polymers. A mutation in DNA can lead to a change in the primary structure of an enzyme.

Explain why a mutation might lead to a change in the activity of an enzyme.

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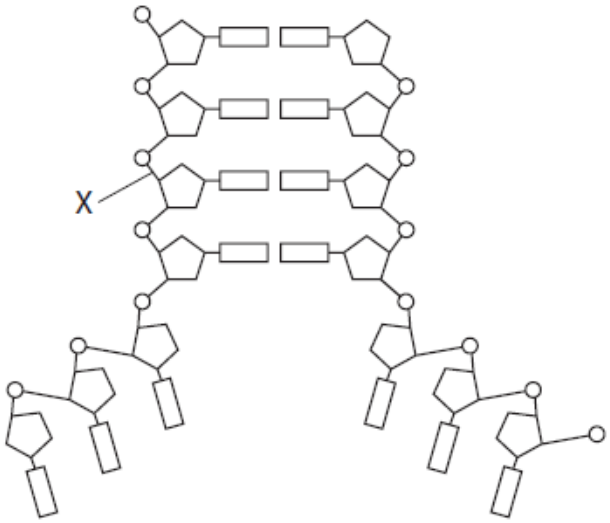
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Q16.

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

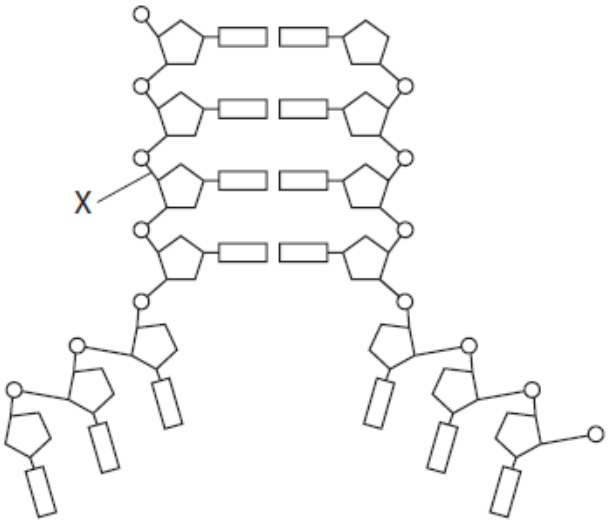
☒ **C** hydrogen

☒ **D** phosphodiester

(Total for question = 1 mark)

Q17.

The diagram shows DNA replication.



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

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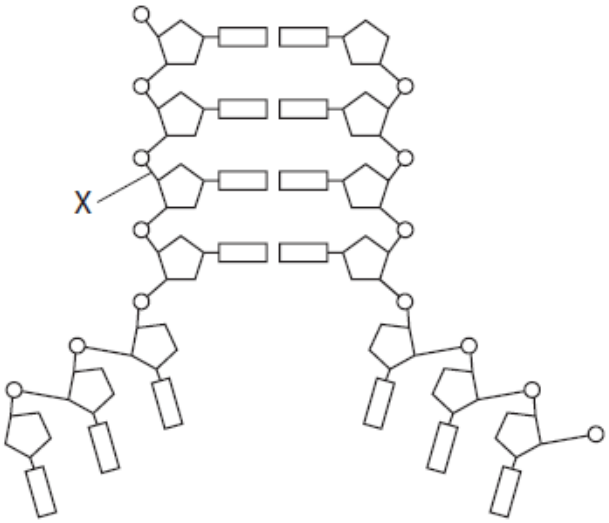
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(Total for question = 3 marks)

Q18.

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)

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.

(2)

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

(2)

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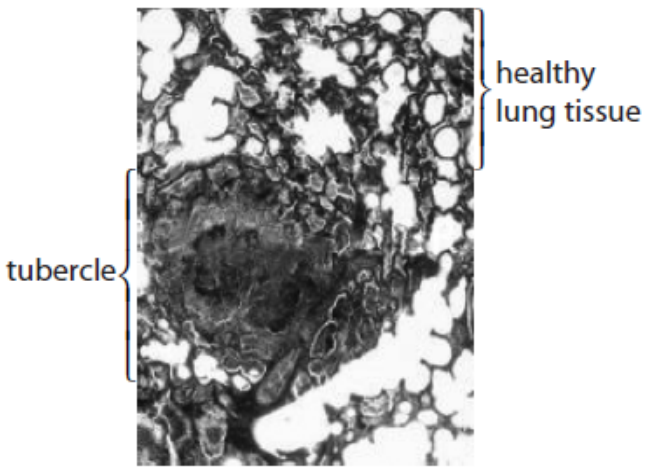
(Total for question = 4 marks)

Q20.

Infection of the lungs with *Mycobacterium tuberculosis* can result in a range of symptoms. These symptoms can include severe breathing problems, a persistent cough and coughing up blood.

The photograph below shows a tubercle in part of a lung infected with *Mycobacterium tuberculosis*, as seen using a light microscope.

A tubercle is a solid mass of dead tissue, macrophages and bacteria.



©John Burbidge/Science Photo Library

Magnification ×50

Using the information in the photograph and your knowledge of gas exchange surfaces, suggest why this infection can result in these symptoms.

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