SL Paper 1

What is formed during transcription?

A. RNA strand complementary to DNA strand, formed by RNA polymerase
B. DNA strand complementary to DNA strand, formed by DNA polymerase
C. RNA strand complementary to RNA strand, formed by DNA polymerase
D. DNA strand complementary to RNA strand, formed by RNA polymerase

Markscheme

A

Examiners report

N/A

What is required to replicate DNA?

A. Temperature of 37 °C

B. Free nucleotides carrying A, C, G and T bases

C. Plasmids

D. Endonuclease

Markscheme

B

Examiners report

This question was too easy so did not discriminate well.

Research has shown that the genetic code is not entirely universal. Which research finding has shown this?

A. Some amino acids are coded for by more than one codon.
B. There are differences between the base sequences of genes in different species.
C. In some organisms the genetic code for mitochondria differs from the genetic code for the nucleus.
D. Some codons code for the addition of an amino acid and some code for the termination of translation.

Markscheme

C

Examiners report

Some teachers complained that this question was unfair, as only the universality of the genetic code was expected in the guide. This is true; nevertheless the answer can be deduced and in section 1.5 the guidance does mention that there are some minor changes that have accrued since the origin of species. Most candidates went for answer B, believing that there were differences between base sequences of genes in different species. Although this answer is a true statement, it does not explain why the genetic code is not universal in all cases. The same happens for answers A and D.

Which of the following chemical elements are part of biochemical molecules in living organisms?

A. nitrogen, sulfur, phosphorus and iron

B. lead, oxygen, carbon and phosphorus

C. helium, carbon, sulfur and nitrogen

D. silicon, helium, oxygen and iron

Markscheme

A

Examiners report

[N/A]

What property makes water an important coolant in the natural world?

A. It is cohesive.
B. It requires much energy to evaporate.
C. It has a lower temperature than blood.
D. It has a low specific heat.

Markscheme

B

Examiners report

N/A

For which discovery about DNA do Watson and Crick receive credit?

A. DNA is the molecule that genes are made of.

B. The amount of adenine equals the amount of thymine in an organism.

C. Phosphate–pentose bonding along the nucleotide backbone is covalent.

D. The shape of DNA is a double helix.

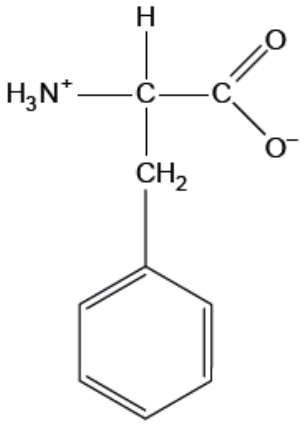
Markscheme

D

Examiners report

[N/A]

The image shows the structural formula of a molecule.



What is this molecule?
A. Amino acid
B. Ribose
C. Deoxyribose
D. Lactose

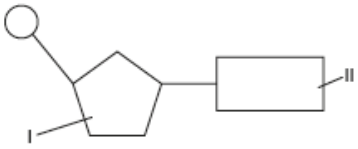
Markscheme

A

Examiners report

Although the question could have confused candidates by adding the charges in the amino and carboxyl termini, this was not an unfair question. The fact that the R group was fully shown should not have confused them.

The image shows a DNA nucleotide.



Which correctly identifies the parts labelled I and II?

	I	II
A.	base	phosphate
B.	ribose	uracil
C.	deoxyribose	base
D.	ribose	adenine

Markscheme

C

Examiners report

[N/A]

What is denaturation?

A. A structural change of a protein that results in the loss of its biological properties
B. A change in the genetic code of an organism
C. A change in the amino acid sequence of a protein causing a disruption of its 3D shape
D. The process by which amino acids are broken down and ammonia is released

Markscheme

A

Examiners report

N/A

How can the rate of photosynthesis be measured?

I. By the amount of oxygen produced
II. By the increase in biomass
III. By the amount of carbon dioxide produced

A. I only
B. I and II only
C. I and III only
D. I, II and III

Markscheme

B

Examiners report

The answers to the question do not reflect a measurement of a rate of reaction, as time is not included. As none of the answers include the time, it is implied in the question.

What is a role of sulfur in living organisms?

A. Formation of proteins
B. Formation of carbohydrates
C. Formation of teeth
D. Transmission of nerve impulses

Markscheme

A

Examiners report

This question turned out to be an excellent discriminator where most good candidates mentioned that sulfur is used in the synthesis of proteins and many of the weak candidates believed it took part in the transmission of nerve impulses.

Which process produces the most ATP per molecule of glucose?

A. Anaerobic respiration in a yeast cell
B. Aerobic respiration in a bacterial cell
C. Glycolysis in a human liver cell
D. The formation of lactic acid in a human muscle cell

Markscheme

B

Examiners report

There were a number of criticisms of this question as being confusing for candidates. Those at the grade award meeting considered these comments but felt that the question was appropriate, though candidates did find it challenging.

Which always contains carbon, hydrogen and oxygen?

I. Carbohydrate

II. Protein

III. Fat

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

D

Examiners report

Usually candidates do not answer multiple completion questions well, but in this case, more than 50% of the candidates were able to answer it well and the discrimination index was high.

What substance is produced from glucose during anaerobic respiration in all organisms?

A. Carbon dioxide
B. Ethanol
C. Lactate
D. Pyruvate

Markscheme

D

Examiners report

N/A

How does chlorophyll respond to the red, green and blue wavelengths in white light?

	Red	Green	Blue
A.	reflects	reflects	absorbs
B.	absorbs	reflects	reflects
C.	reflects	absorbs	reflects
D.	absorbs	reflects	absorbs

Markscheme

D

Examiners report

N/A

Which sequence shows increasing relative size?

	Smallest → Largest		
A.	membrane thickness	virus	bacterium
B.	molecule	virus	membrane thickness
C.	bacterium	virus	eukaryotic cell
D.	bacterium	organelle	virus

Markscheme

A

Examiners report

[N/A]

Which carbon compound produced by living organisms is inorganic?

A. DNA
B. Cellulose
C. Glucose
D. Carbon dioxide

Markscheme

D

Examiners report

N/A

A short sequence of nucleotides reads GGACAGAGCGCAGACGA. In which type of molecule could this sequence be found?

A. DNA molecule only

B. RNA molecule only

C. Both in a DNA and an RNA molecule

D. In double-stranded DNA only

Markscheme

C

Examiners report

[N/A]

How many molecules of water are required to completely hydrolyse a polypeptide made up of 23 amino acids?

A. 11
B. 22
C. 23
D. 44

Markscheme

B

Examiners report

This question turned out to be one of the most difficult for candidates, but tested candidate understanding of the process of hydrolysis and was a good discriminator.

Between which atoms do hydrogen bonds form in water?

A. Oxygen and hydrogen atoms in the same water molecule
B. Oxygen and hydrogen atoms in different water molecules
C. Hydrogen atoms in the same water molecule
D. Oxygen atoms of different water molecules

Markscheme

B

Examiners report

N/A

Which is an effect of protein denaturation?

A. The order of amino acids is changed when the protein overheats.
B. The bonds between amino acids are broken by condensation.
C. Parts of the protein become linked together by hydrolysis.
D. The three-dimensional structure of the protein is altered.

Markscheme

D

Examiners report

This question helped to discriminate well.

Which are necessary to make DNA replication semi-conservative?

I. Separation of the strands by RNA polymerase

II. Complementary base pairing

III. Use of a pre-existing strand as a template

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

C

Examiners report

[N/A]

What is a codon?

A. A sequence of nucleotides on rRNA that corresponds to an amino acid
B. A sequence of nucleotides on mRNA that corresponds to an amino acid
C. A sequence of nucleotides on tRNA that corresponds to an amino acid
D. A sequence of nucleotides on DNA that corresponds to an amino acid

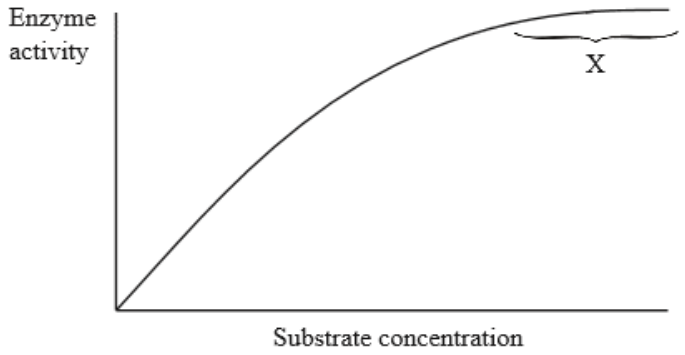
Markscheme

B

Examiners report

N/A

The graph below shows the effect of substrate concentration on enzyme activity. What conclusion can be drawn about section X of the graph?



A. The enzyme has started to denature and the reaction slows down.
B. The reaction has finished and the substrate has been used up.
C. The enzyme is saturated and is working at its maximum reaction rate.
D. Some of the enzyme has been consumed and the reaction has reached a plateau. .

Markscheme

C

Examiners report

N/A

What is the difference between galactose and lactose?

A. Lactose is a disaccharide and galactose is a monosaccharide.
B. Lactose is the product of anaerobic respiration in humans and galactose is the product of anaerobic respiration in yeast.
C. Lactose is an enzyme and galactose is a hormone.
D. Galactose is a sugar found in milk but lactose is not found in milk.

Markscheme

A

Examiners report

N/A

How is oxygen produced during photosynthesis?

A. Water molecules are split with energy from ATP.
B. Water molecules are split with energy from light.
C. Carbon dioxide molecules are split with energy from ATP.
D. Carbon dioxide molecules are split with energy from light.

Markscheme

B

Examiners report

N/A

Which of the following processes produces CO_2?

I. Glycolysis
II. Alcohol (ethanol) fermentation
III. Lactic acid production

A. I only
B. II only
C. I and II only
D. I, II and III

Markscheme

B

Examiners report

N/A

How does the proteome of a species contain a larger number of proteins than genes that code for these proteins?

A. Some proteins have more than one polypeptide chain.

B. There are genes that code for several proteins.

C. Not all proteins are coded for by the genome.

D. Some proteins are coded for by other proteins.

Markscheme

B

Examiners report

[N/A]

Water shows strong cohesive properties. Which of the following can occur because of the cohesive properties of water?

A. Water can be pulled up a plant through the xylem.
B. Enzymes can react with their substrates in cells.
C. Sweating cools the body on a hot day.
D. Salt can dissolve in sea water.

Markscheme

A

Examiners report

Question 5 included the term xylem, which is not specifically mentioned in the SL Biology programme, but Assessment Statement 3.1.6 indicates that candidates should understand the relationship between water's properties and its use as a transport medium. These include water's cohesive properties and thus its movement under tension in plant transport. Even if candidates were uncertain whether the answer including xylem was correct, they should have been able to eliminate the other three alternatives. More than 75% of candidates answered this question correctly and the discrimination index was high.

What are the most frequently occurring elements in living organisms?

A. calcium, phosphorus, iron and sodium

B. calcium, sodium, nitrogen and phosphorus

C. carbon, phosphorus, oxygen and nitrogen

D. nitrogen, carbon, oxygen and hydrogen

Markscheme

D

Examiners report

[N/A]

What is the source of the oxygen released into the air as a product of photosynthesis?

A. Chlorophyll
B. Carbon dioxide only
C. Water only
D. Both water and carbon dioxide

Markscheme

C

Examiners report

This question seemed to cause problems for many candidates, with many choosing option D rather than the correct answer C. There was a complaint in the G2 forms that asking students to identify the source of oxygen in the process of photosynthesis was beyond the scope of the SL syllabus. However, it is assessment statement 3.8.5 in the core syllabus.

A fever in a normally healthy adult during an illness is not usually a problem and can be regarded as a defence mechanism. However, a fever higher than 41°C might be dangerous. What is the cause of the possible damage due to a high fever?

A. Loss of body mass
B. Muscle damage due to shivering
C. Overactive metabolic enzymes
D. Spread of infection

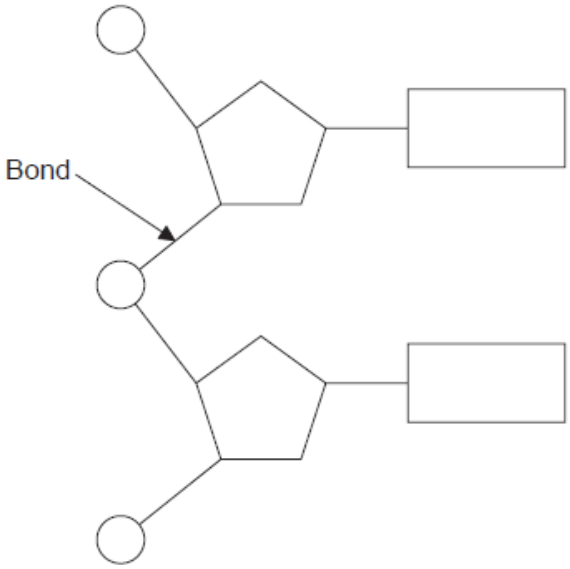
Markscheme

C

Examiners report

[N/A]

The diagram shows a dinucleotide.



Which type of bond is identified by the arrow?

A. Phosphate

B. Hydrogen

C. Covalent

D. Peptide

Markscheme

C

Examiners report

There was a mistake in the diagram that will be corrected for publication but did not affect the answer. The 3’ end should not have a phosphate group.

Which type of reaction is the breakdown of starch into sugars?

A. Denaturation
B. Reduction
C. Catabolic
D. Condensation

Markscheme

C

Examiners report

[N/A]

This is a sequence of nucleotides from a section of mRNA.

AUGAAACGCACGCAG

From which DNA sequence has it been transcribed?

A. ATGAAACGCACGCAG
B. UACUUUGCGUGCGAC
C. TACUUUGCGTGCGTC
D. TACTTTGCGTGCGTC

Markscheme

D

Examiners report

An easy question.

What will be the sequence on the mRNA molecule that is produced when the DNA base sequence ACTGATGCC is transcribed?

A. ACTGATGCC
B. ACUGAUGCC
C. TGACTACGG
D. UGACUACGG

Markscheme

D

Examiners report

N/A

Which of the following colours of light is absorbed the most by chlorophyll?

A. Blue
B. Green
C. Yellow

D. Orange

Markscheme

A

Examiners report

This question seemed to be quite easy for most candidates.

Which properties explain the ability of water to dissolve solutes?

I. Polarity of water molecules
II. High specific heat capacity of water
III. Hydrogen bonding

A. I and II only
B. I and III only
C. II and III only
D. I, II and III

Markscheme

B

Examiners report

[N/A]

Which of these molecules is a disaccharide?

A. Galactose
B. Sucrose
C. Cellulose
D. Ribose

Markscheme

B

Examiners report

N/A

What links the pairs of complementary bases in a DNA double helix?

A. Covalent bonds
B. Hydrogen bonds
C. Ionic bonds
D. Peptide bonds

Markscheme

B

Examiners report

N/A

Meselson and Stahl conducted experiments using the isotopes ^{14}N and ^{15}N which showed that DNA replication is semi-conservative. What would they have observed about the distribution of isotopes in the DNA after one round of replication if DNA replication was conservative rather than semi-conservative?

A. Only ^{14}N DNA

B. Only ^{15}N DNA

C. All DNA half ^{14}N and half ^{15}N

D. Half the DNA with only ^{14}N and half with only ^{15}N

Markscheme

D

Examiners report

[N/A]

Which molecule is a polysaccharide?

A. Cellulose

B. Fructose

C. Maltose

D. Sucrose

Markscheme

A

Examiners report

[N/A]

What process occurs when fatty acids combine with glycerol to make a triglyceride?

A. Condensation
B. Decarboxylation
C. Denaturation
D. Hydrolysis

Markscheme

A

Examiners report

N/A

What is a function of cellulose in plants?

A. To form a mesh of fibres in the cell wall
B. To prevent mineral ions from diffusing out of the cell
C. To prevent water loss
D. To capture blue and red light photons

Markscheme

A

Examiners report

The wording of this question seemed to be confusing to some candidates. Possibly not familiar with the term mesh, some candidates went for options

B and C as an answer instead of A.

In an experiment the effect of changing pH on an enzymatic reaction is tested. Which could be a dependent variable in this kind of experiment?

A. Changing substrate concentration

B. Rate of formation of product

C. Variation in temperature

D. Change in pH

Markscheme

B

Examiners report

[N/A]

What is the source of the oxygen released into the atmosphere in photosynthesis?

A. Glucose
B. Carbon dioxide
C. Chlorophyll
D. Water

Markscheme

D

Examiners report

N/A

How do cells capture the energy released by cell respiration?

A. They store it in molecules of carbon dioxide.
B. They produce glucose.
C. The energy is released as pyruvate.
D. They produce ATP.

Markscheme

D

Examiners report

N/A

Which are functions of lipids?

A. Hydrophilic solvent and energy storage

B. Hydrophobic solvent and membrane potential

C. Thermal insulation and energy storage

D. Thermal insulation and hydrophilic solvent

Markscheme

C

Examiners report

For some reason, this straightforward question on the function of lipids was left blank more frequently than others. It was a good discriminator.

Which type of light is **least** useful for photosynthesis in terrestrial plants?

A. Blue
B. Green
C. White
D. Red

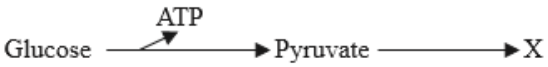
Markscheme

B

Examiners report

N/A

The diagram shows anaerobic respiration in yeast cells.



What would be produced at X?

A. ATP
B. Lactate
C. Ethanol and CO_2
D. CO_2 and H_2O

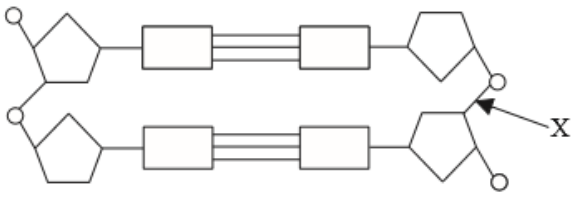
Markscheme

C

Examiners report

N/A

The diagram shows part of a DNA molecule.



What type of bond does X represent?

A. Covalent bond
B. Hydrogen bond
C. Peptide bond
D. Semi-conservative bond

Markscheme

A

Examiners report

N/A

How is the information in the genetic code used?

A. To predict the genotype of gametes

B. To distinguish prokaryotic genomes from eukaryotic genomes

C. To deduce phenotypes in pedigree charts

D. To translate mRNA into polypeptides

Markscheme

D

Examiners report

[N/A]

A polymer of alpha-D-glucose found in plants has mostly 1,4 linkages and some 1,6 linkages. Which molecule fits this description?

A. Glycogen

B. Cellulose

C. Amylose

D. Amylopectin

Markscheme

D

Examiners report

[N/A]

What describes anaerobic cell respiration?

A. Glucose break down to pyruvate

B. Carbon dioxide fixation

C. No ATP formation

D. Occurs in the mitochondrion

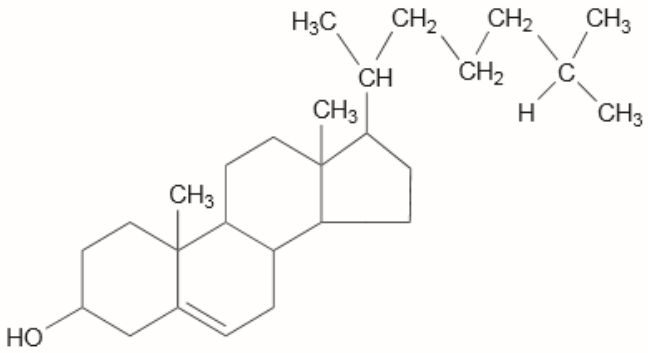
Markscheme

A

Examiners report

Many candidates (including good ones) wrongly believe that anaerobic respiration does not produce ATP.

The diagram shows a molecular structure.



Which type of molecule is shown?

A. Amino acid
B. Lipid
C. Carbohydrate
D. Nucleotide

Markscheme

B

Examiners report

[N/A]

Which pair of molecules are products of aerobic and anaerobic cell respiration in some organisms?

	Aerobic cell respiration	Anaerobic cell respiration
A.	oxygen	pyruvate
B.	lactate	adenosine triphosphate
C.	carbon dioxide	glucose
D.	adenosine triphosphate	carbon dioxide

Markscheme

D

Examiners report

[N/A]

Which molecule can be hydrolyzed?

A. Glycerol

B. Maltose

C. Fructose

D. Galactose

Markscheme

B

Examiners report

[N/A]

The most abundant structural protein in the human body is found in ligaments and skin. What is the name of this protein?

A. Collagen

B. Hemoglobin

C. Myoglobin

D. Immunoglobulin

Markscheme

A

Examiners report

[N/A]

Which of the following is an organic compound made by all plants?

A. Carbon dioxide

B. DNA

C. Lactose

D. Oxygen

Markscheme

B

Examiners report

Surprisingly this was the hardest question on the paper. Most considered oxygen an organic compound. Many also considered carbon dioxide as organic, when assessment statement 3.2.1 clearly states it is not.

Which property of water accounts for its moderating effects on the Earth's atmosphere?

A. Cohesive

B. Thermal

C. Transparency

D. Adhesive

Markscheme

B

Examiners report

[N/A]

Which of the following are connected by hydrogen bonds?

A. Hydrogen to oxygen within a molecule of water
B. Phosphate to sugar in a DNA molecule
C. Base to sugar in a DNA molecule
D. Hydrogen to oxygen between two different molecules of water

Markscheme

D

Examiners report

N/A

The percentage of thymine in the DNA of an organism is approximately 30 %. What is the percentage of guanine?

A. 70 %
B. 30 %
C. 40 %
D. 20 %

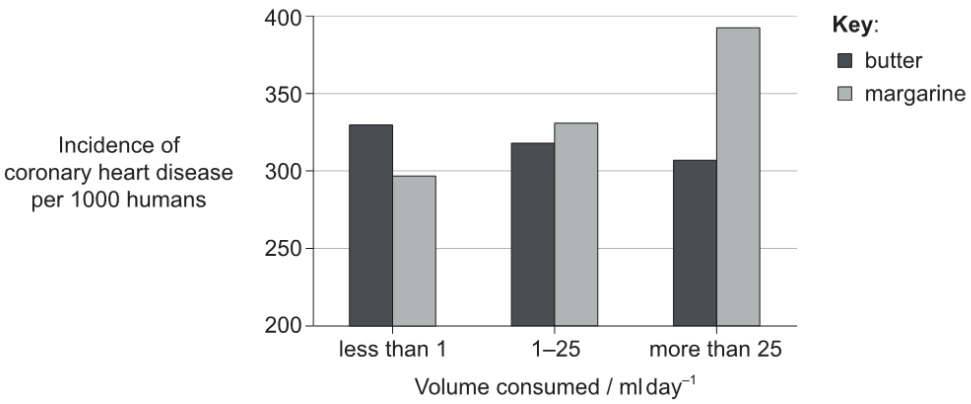
Markscheme

D

Examiners report

N/A

The Framingham heart study was an observational study that went on for 20 years. The following data were produced.



[Source: adapted from Gillman et al., Margarine intake and subsequent coronary heart disease in men. Epidemiology, 1997 Mar; 8(2): 144–9]

Which conclusion can be drawn, based on these data?

A. It is better to eat margarine than to eat butter.

B. The more margarine consumed, the greater the incidence of coronary heart disease.

C. Butter is a natural product whereas margarine is hydrogenated vegetable oil that leads to coronary heart disease.

D. Margarine causes more heart related deaths than butter.

Markscheme

B

Examiners report

[N/A]

What is replicated by a semi-conservative process?

A. Messenger RNA (mRNA) only
B. Messenger RNA (mRNA) and transfer RNA (tRNA) only
C. Messenger RNA (mRNA), transfer RNA (tRNA) and DNA only
D. DNA only

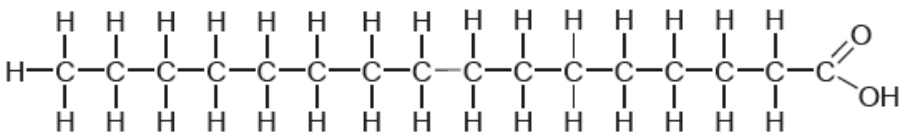
Markscheme

D

Examiners report

N/A

The diagram shows the structure of palmitic acid.



What type of fatty acid is palmitic acid?

A. It is monounsaturated.

B. It is polyunsaturated.

C. It is saturated.

D. It is a trans-fatty acid.

Markscheme

C

Examiners report

[N/A]

What enables bacteria to produce human growth hormone?

A. DNA replication is semi-conservative.
B. The polymerase chain reaction can be used.
C. They need the hormone for growth.
D. The genetic code is universal.

Markscheme

D

Examiners report

[N/A]

Which variable has the **least** effect on enzyme activity?

A. Temperature
B. Light intensity
C. pH
D. Substrate concentration

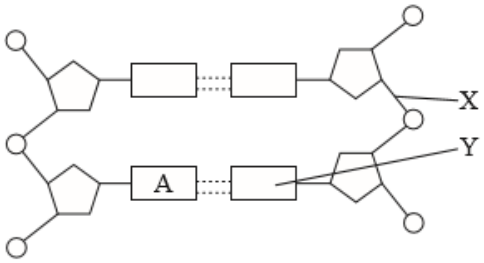
Markscheme

B

Examiners report

Most candidates answered this question correctly, making it the second easiest question in the exam.

This question refers to the following diagram of DNA.



What does the structure labelled Y represent?

A. Ribose
B. Thymine
C. Guanine
D. Deoxyribose

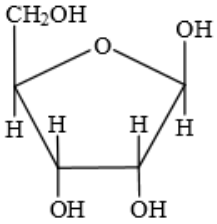
Markscheme

B

Examiners report

N/A

Which molecule is shown below?



A. Glucose
B. Galactose
C. Ribose
D. Sucrose

Markscheme

C

Examiners report

N/A

Which of the following is a function of cellulose in plants?

A. Storage of fat
B. Formation of mitochondria
C. Storage of energy
D. Formation of cell walls

Markscheme

D

Examiners report

N/A

A plant is exposed to increasing light intensity from very dim to bright light, while the carbon dioxide concentration and temperature are kept at an optimum level. What will happen to the rate of oxygen production?

A. It will increase exponentially.
B. It will remain constant.
C. It will decrease to a minimum level.
D. It will increase to a maximum level.

Markscheme

D

Examiners report

N/A

What happens as an enzyme becomes denatured?

A. The enzyme works faster.
B. The enzyme works slower.
C. The enzyme can perform a new role.
D. The enzyme can make the reverse reaction proceed faster.

Markscheme

B

Examiners report

Most candidates realized that as enzymes become denatured they work more slowly.

What is light energy used for in photolysis?

A. Formation of hydrogen and oxygen

B. Formation of carbon dioxide only

C. Formation of ATP and glucose

D. Formation of oxygen only

Markscheme

A

Examiners report

This question had the highest discrimination index on the paper with the better candidates correctly choosing A and almost all other candidates incorrectly selecting C. The top candidates realized that light is used in the light dependent reactions so looked for the products of this stage, while the weaker candidates were considering the final products of photosynthesis.

Which of the following is the best definition of cell respiration?

A. A process needed to use energy, in the form of ATP, to produce organic compounds
B. A process used to provide oxygen to the atmosphere
C. A controlled release of energy, in the form of ATP, from organic compounds in cells
D. A controlled release of energy in the production of food from organic compounds

Markscheme

C

Examiners report

N/A

What is a similarity between DNA and RNA?

A. Both are polymers of nucleotides.
B. Both are composed of antiparallel strands.
C. Both contain adenine, cytosine and thymine.
D. Both contain ribose sugar.

Markscheme

A

Examiners report

[N/A]

How can the activity of a human amylase enzyme be increased during a laboratory experiment?

A. Adding sugar to the mixture

B. Decreasing the pH from 7 to 3

C. Increasing the temperature from 20 °C to 37 °C

D. Adding water to the mixture

Markscheme

C

Examiners report

The activity of an enzyme is reflected in its rate of reaction.

Which substance in prokaryotes contains sulfur?

A. DNA
B. Phospholipids
C. Proteins
D. Antibiotics

Markscheme

C

Examiners report

Although very few candidates did go for option D, some teachers commented on G2s that some antibiotics contain sulfur. This is true, but generally antibiotics are not found in prokaryotes. The most correct answer was then proteins. Surprisingly many candidates answered phospholipids, showing that they did not know the structure of these chemicals.

What property of water makes it a good evaporative coolant?

A. High latent heat of evaporation
B. Relatively low boiling point
C. Volatility
D. Transparency

Markscheme

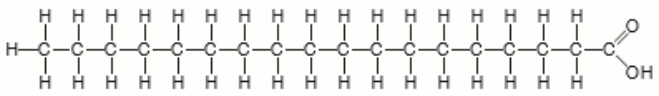
A

Examiners report

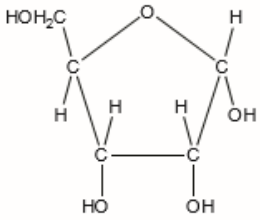
Some teachers felt that the language of this question may prove difficult but the candidates performed well.

What are these molecules?

I



II



	I	II
A.	amino acid	glucose
B.	amino acid	ribose
C.	fatty acid	glucose
D.	fatty acid	ribose

Markscheme

D

Examiners report

N/A

What is a feature of shorter wavelength visible radiation?

A. It includes violet light.
B. It has less energy per photon than longer wavelengths.
C. It is absorbed by greenhouse gases.
D. It is reflected by chlorophyll.

Markscheme

A

Examiners report

Although this question was asking for a detail of the photosynthetic process, the answer is stated as an understanding in section 2.9.

How does an increase in temperature affect enzyme activity?

	Movement of molecules	Chance of collision between enzyme and substrate
A.	increases	increases
B.	decreases	decreases
C.	increases	decreases
D.	decreases	increases

Markscheme

A

Examiners report

N/A

In enzyme experiments, the rate of enzyme activity often gradually decreases. What is most likely to cause this decrease?

A. The temperature decreasing

B. The enzyme concentration decreasing

C. The pH decreasing

D. The substrate concentration decreasing

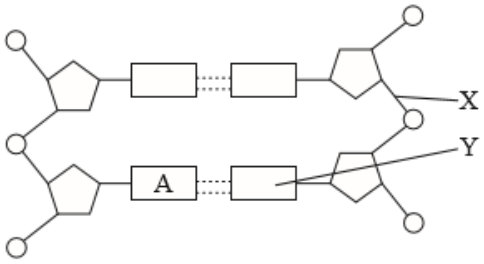
Markscheme

D

Examiners report

There were comments on the G2s that there was more than one possible answer to this question. While it may be true that in some specific cases the various distracters may be correct, the most correct answer is D as the substrate will decrease in all enzyme reactions, causing the enzyme activity to gradually decrease.

This question refers to the following diagram of DNA.



What does the structure labelled X represent?

A. Hydrogen bond
B. Phosphate
C. Covalent bond
D. Base

Markscheme

C

Examiners report

N/A

Where in the cell do condensation reactions involving amino acids occur?

A. Nucleus
B. Golgi apparatus
C. Ribosomes
D. Lysosome

Markscheme

C

Examiners report

This question was a good discriminator, which was testing two elements of understanding, those of the condensation process and where in the cell amino acids are assembled into polypeptides. Just over half of candidates gave the correct answer of C, with many being drawn to B, the Golgi apparatus.

Although this question discriminated well, a large proportion of candidates chose option B instead of the correct response of A (endocytosis). It was thought that perhaps students had been drawn by the connection of osmosis and the word “fluidity” in the question.

Which of the following is part of the process of cellular respiration?

A. Changes in the volume of the thoracic cavity
B. Exchange of gases across the surface of the alveoli
C. Exchange of gases across the surface of capillaries
D. Glycolysis

Markscheme

D

Examiners report

N/A

What contributes to the structure of an enzyme?

A. Sequence of bases linked by hydrogen bonds
B. Sequence of substrates linked by condensation reactions
C. Sequence of amino acids linked by peptide bonds
D. Sequence of polypeptides linked by hydrolysis reactions

Markscheme

C

Examiners report

N/A

What occurs during DNA replication?

A. DNA polymerase separates the two DNA strands.
B. DNA molecules containing nucleotides from the original molecule are produced.
C. Adenine forms a base pair with either thymine or uracil.
D. New bases attach to the original sugar-phosphate backbone.

Markscheme

B

Examiners report

Although this question was only an average discriminator, almost as many candidates picked option A as those who chose the correct answer, B. Also a large number picked D. There was a concern expressed by some teachers that C was a correct answer because RNA primers formed during DNA replication have uracil paired with adenine in the template DNA strand. In fact this was the least popular answer and candidates can reasonably have been expected to choose answer B as the best response. Substantial numbers of candidates chose A and D, showing weak understanding of replication. It is felt that students need to understand and be able to apply the concepts of semi-conservative replication, rather than simply committing the points to memory.

Which process causes ADP to change to ATP?

A. Hydrolysis

B. Protein synthesis

C. DNA replication

D. Anaerobic cell respiration

Markscheme

D

Examiners report

[N/A]

Oxygen is produced during photosynthesis. What is the source of this oxygen inside the plant?

A. Air spaces in the leaf

B. Carbon dioxide

C. Glucose

D. Water

Markscheme

D

Examiners report

[N/A]

What is the relative wavelength in the visible spectrum of red light and blue light and are these colours absorbed or reflected by chlorophyll?

	Red light		Blue light	
A.	longest wavelength	absorbed	shortest wavelength	absorbed
B.	shortest wavelength	reflected	longest wavelength	reflected
C.	longest wavelength	absorbed	shortest wavelength	reflected
D.	shortest wavelength	absorbed	longest wavelength	absorbed

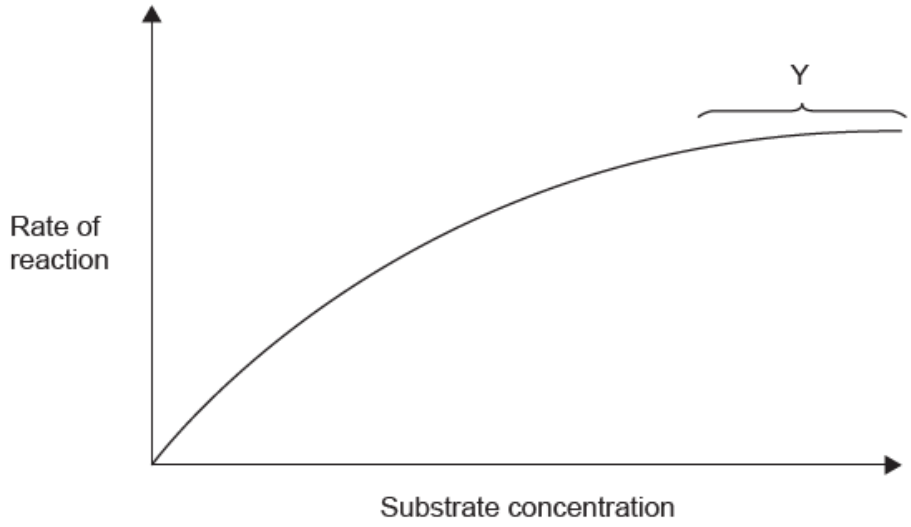
Markscheme

A

Examiners report

[N/A]

The graph shows the effect of increasing the substrate concentration on the rate of an enzyme-catalysed reaction. What is occurring during the phase indicated by section Y of the graph?



A. The active site of the enzyme is saturated.

B. The enzyme becomes denatured.

C. The substrate concentration has risen too high.

D. The optimum rate is reached.

Markscheme

A

Examiners report

[N/A]

What are the effects of changing carbon dioxide concentration on the rate of photosynthesis?

I. At low and moderate carbon dioxide concentrations, decreases cause the rate of photosynthesis to fall.
II. At high carbon dioxide concentrations, increases do not alter the rate of photosynthesis.
III. At high carbon dioxide concentrations, increases cause the rate of photosynthesis to fall.

A. I only
B. I and II only
C. I and III only
D. III only

Markscheme

B

Examiners report

Feedback on the G2 forms suggested that there was too much information given in the question, and that candidates may have been disadvantaged by this. It was accepted that this type of question was difficult for some candidates, and many were distracted by option A, but the majority did choose the correct response of B, and the question gave good discrimination

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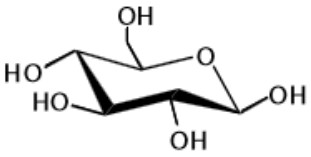
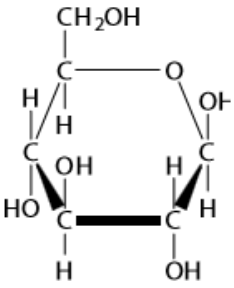
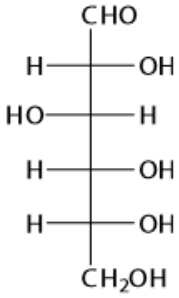
The diagrams show three representations of the structure of the same chemical substance.







What chemical substance is shown?

A. Ribose
B. Glucose
C. Fatty acid
D. Amino acid

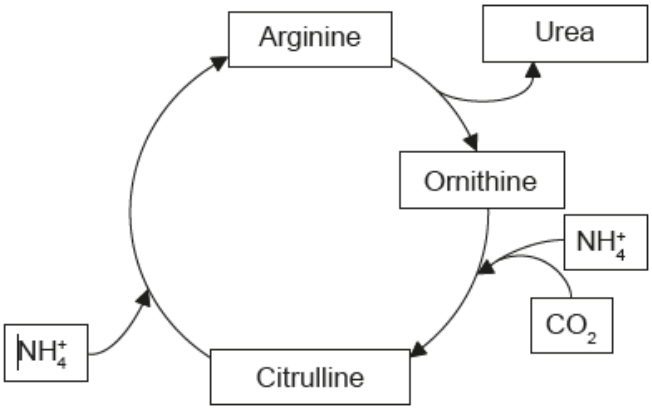
Markscheme

B

Examiners report

The majority of candidates did pick the correct answer of B, but comments on the G2 feedback forms suggested that the question was too hard for a Biology paper. However, it was felt that students should be able to recognise the different ways of representing the molecules of important compounds such as glucose.

The diagram shows a cycle of reactions that occurs in human liver cells.



Which term describes the overall reactions of this cycle?

A. Oxidation

B. Catabolism

C. Condensation

D. Metabolism

Markscheme

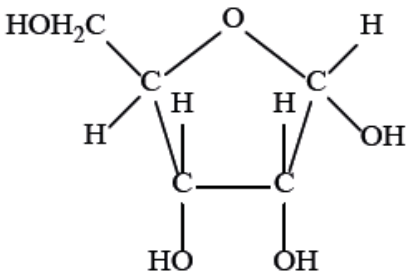
D

Examiners report

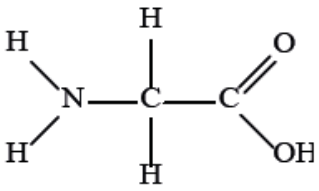
[N/A]

Which types of molecule are shown in the diagrams?

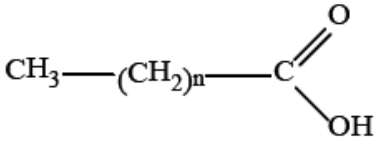
Molecule I



Molecule II



Molecule III



	Molecule I	Molecule II	Molecule III
A.	amino acid	fatty acid	ribose
B.	glucose	amino acid	fatty acid
C.	ribose	amino acid	fatty acid
D.	fatty acid	glucose	amino acid

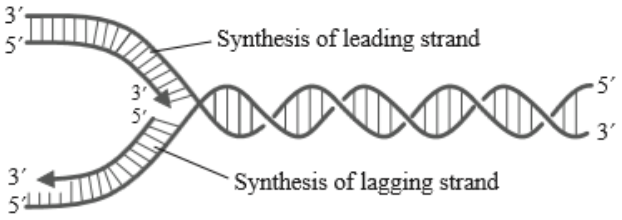
Markscheme

C

Examiners report

Although this question was one that was common to HL, the SL candidates found it to be much more difficult. Perhaps this has to do with the fact that more HL candidates also do Chemistry than SL candidates. It was a very good discriminator with almost all of those getting it incorrect choosing B, showing confusion between the structures of glucose and ribose.

Which enzyme catalyzes the elongation of the leading strand?



[Source: image from WK Purves, *et al.*, (2003) *Life: The Science of Biology*, **4**, Sinauer Associates (www.sinauer.com) and WH Freeman (www.whfreeman.com)]

A. RNA polymerase
B. Helicase
C. DNA polymerase
D. Ligase

Markscheme

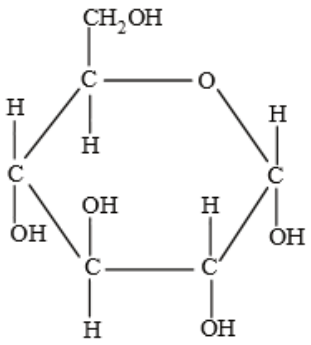
C

Examiners report

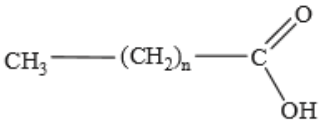
There were many complaints about this question, and as a matter of fact it turned out to be the second question in difficulty and not that good at discriminating between good and weak candidates. Many candidates believed helicase is in charge of elongation of DNA, the syllabus clearly states that helicase only unwinds DNA for DNA polymerase to act. It was agreed that this question was more appropriate for HL than for SL, but it could still be answered with the knowledge acquired in SL.

Which describes these molecules correctly?

I.



II.



	I	II
A.	ribose	amino acid
B.	glucose	amino acid
C.	ribose	fatty acid
D.	glucose	fatty acid

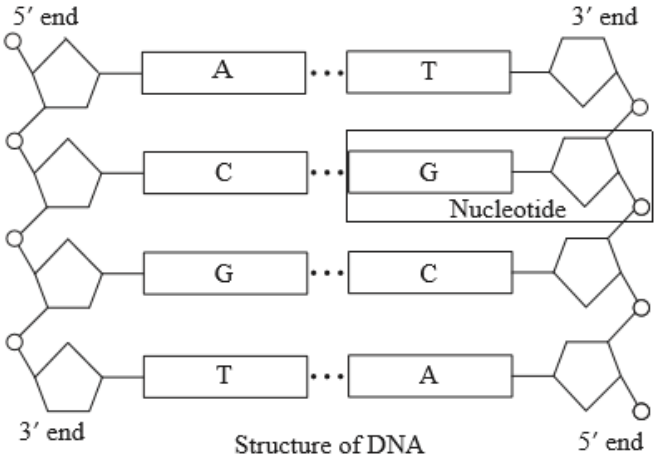
Markscheme

D

Examiners report

N/A

Which molecules form the nucleotide marked in the diagram?



Structure of DNA

A. phosphate, deoxyribose and nitrogenous base
B. phosphorus, ribose and nitrogenous base
C. phosphorus, deoxyribose and guanosine
D. phosphate, ribose and guanine

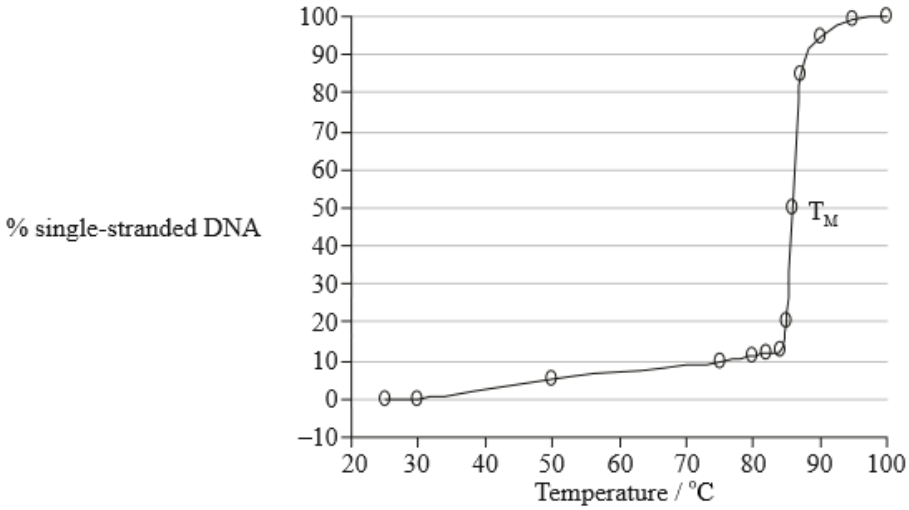
Markscheme

A

Examiners report

This question was a very good discriminator and was not a difficult question for most candidates. Most candidates knew the correct answer. Some weak candidates went for the answer with ribose as the sugar present in DNA.

The graph below shows the effect of temperature on the separation of the strands in DNA to form single strands. The temperature at which 50% of the DNA is single-stranded is called the melting temperature (T_M).



What do the results show?

A. When the temperature reaches 85°C there are no more double-stranded DNA molecules.
B. When the temperature reaches 85°C the DNA strands start separating rapidly.
C. A T_M of 85°C means that DNA is not stable at room temperature (25°C).
D. The separation of the DNA strands is directly proportional to the increase in temperature.

Markscheme

B

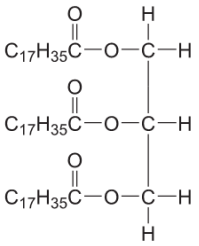
Examiners report

This question turned out to be an easy question. According to the teacher comments, this was due to the fact that candidates were able to rule all the incorrect answers out. There is however, a lot of interesting data in this question.

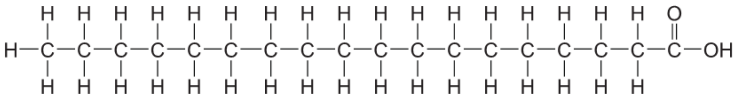
The T_M is extremely important in PCR and it is interesting to see that at a given temperature the DNA strands all of a sudden tend to separate. This is also a good question to use with candidates to explain the breaking of H bonds between complementary bases.

Which molecule could be hydrolysed into amino acids?

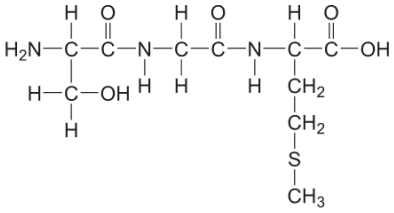
A.



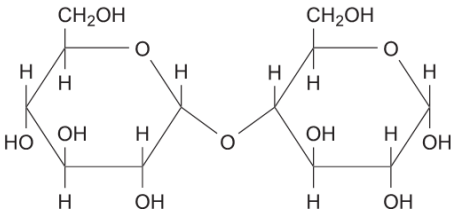
B.



C.



D.



Markscheme

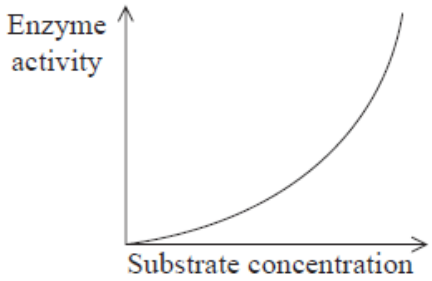
C

Examiners report

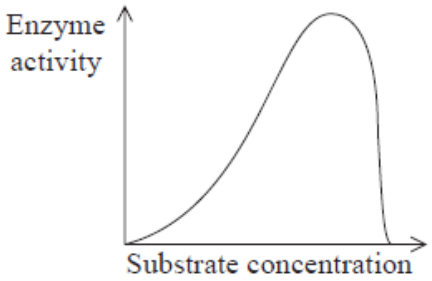
[N/A]

Which of the following graphs shows the relationship between substrate concentration and enzyme activity with a fixed concentration of enzyme?

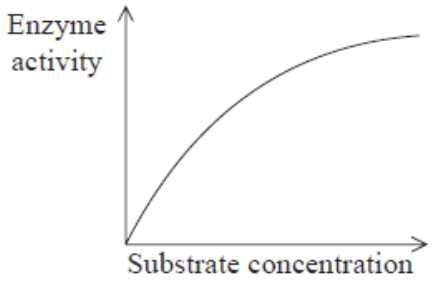
A.



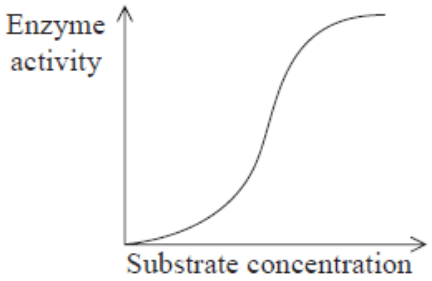
B.



C.



D.



Markscheme

C

Examiners report

[N/A]

The table shows the genetic code.

First letter	Second letter: U	Second letter: C	Second letter: A	Second letter: G	Third letter
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	**STOP**	**STOP**	A
	Leu	Ser	**STOP**	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

Which mRNA could code for the sequence Met-Ser-Leu-Arg-Phe?

A. AUG UCA UCG UGG UUU

B. AUG UCC ACC AGA UUC

C. AUG UCU CCC AGA UUU

D. AUG UCG CUG AGG UUC

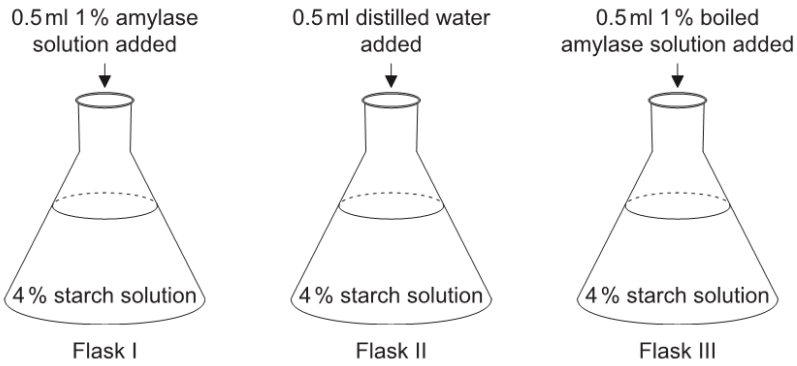
Markscheme

D

Examiners report

[N/A]

Three flasks were prepared for an analysis of the activity of amylase. At time zero, each of the substances indicated in the diagrams was added.



Which flask(s) could provide support for the hypothesis that heat denatures enzymes?

A. Flasks I and II after 15 minutes

B. Flasks II and III after 15 minutes

C. Flasks I and III after 15 minutes

D. Flask III at time zero and again after 15 minutes

Markscheme

C

Examiners report

[N/A]

Which chemical is produced during both aerobic and anaerobic respiration in humans?

A. Carbon dioxide
B. Pyruvate
C. Water
D. Lactate

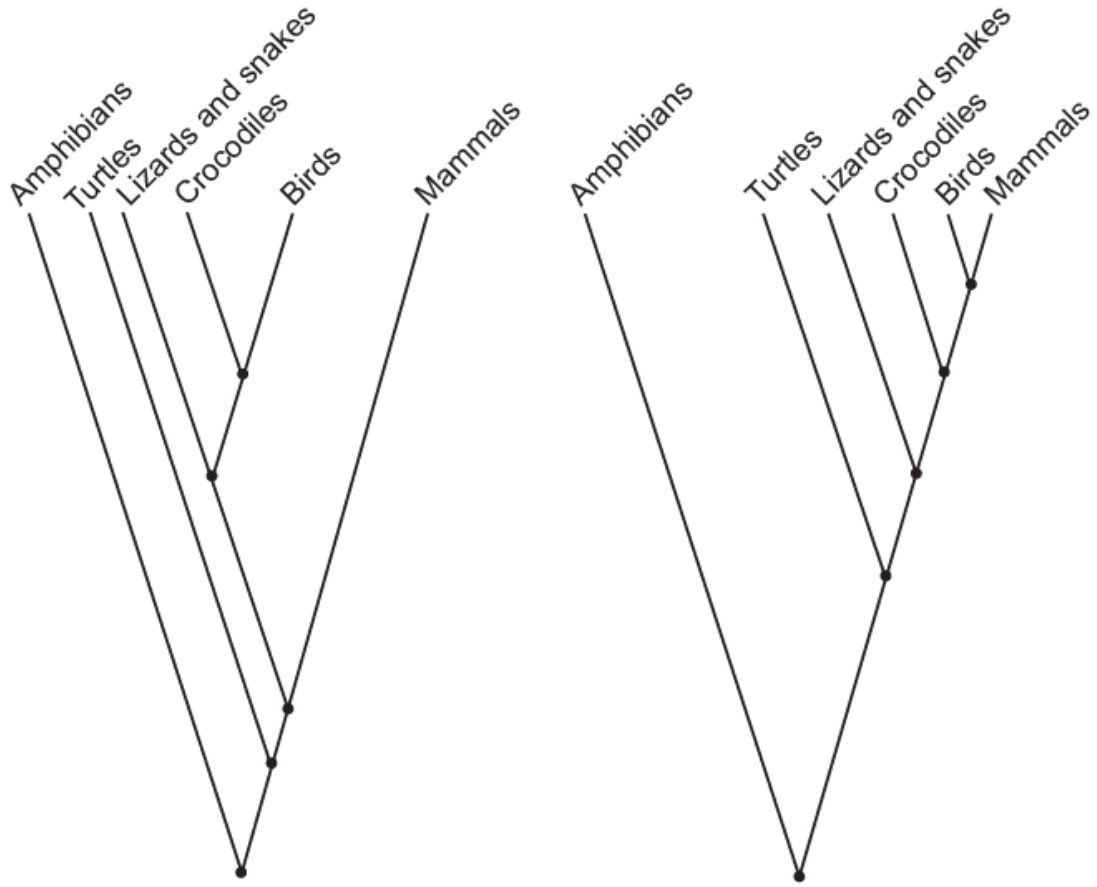
Markscheme

B

Examiners report

Some G2 feedback suggested that option A was the best answer to this question, and although many candidates chose this, it is wrong, as the wording of the question clearly states “during both aerobic and anaerobic respiration”. Furthermore, it was felt that the use of the word “produced” had not presented a problem to the candidates.

Cladograms can be created by comparing DNA or protein sequences. The cladogram on the left is based on DNA sequences and the cladogram on the right is based on comparing protein sequences.



What is the reason that cladograms based on DNA sequences are more reliable predictors of the phylogenetic relationship of species than cladograms based on protein sequences?

A. Amino acids are not as chemically stable as DNA nucleotides.

B. DNA mutates but amino acids do not.

C. Several different triplets of bases can code for the same amino acid.

D. There are 20 different amino acids but only 4 nucleotides.

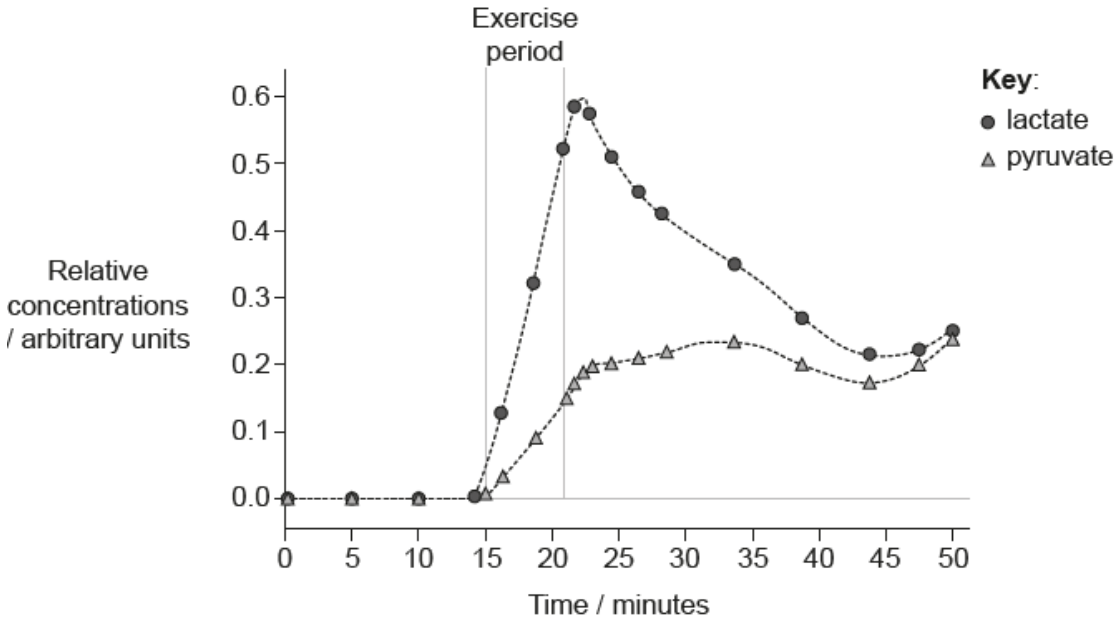
Markscheme

C

Examiners report

[N/A]

The graph shows the changes in lactate and pyruvate measured in an athlete's blood during and following a mild exercise period as compared to the period before the exercise.



[Source: W. E. Huckabee (1958) *The Journal of Clinical Investigation*, 37 (2), page 257.]

What do these curves suggest?

A. Before the exercise, there was no pyruvate produced because there was no cell respiration.

B. During the exercise, there was not enough oxygen available for cell respiration, so the process was partly anaerobic.

C. During the exercise, the level of lactate increased due to aerobic respiration.

D. After the exercise, the level of lactate decreased because there was enough pyruvate to be used for anaerobic cell respiration.

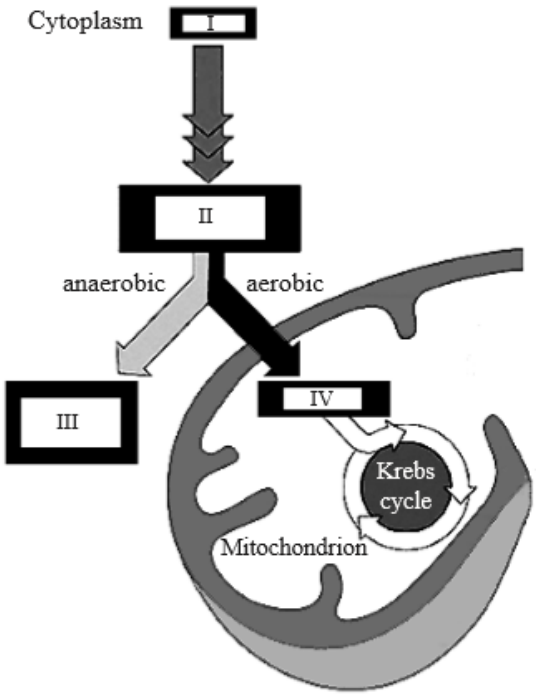
Markscheme

B

Examiners report

[N/A]

The diagram below shows a biochemical pathway in a yeast cell. Which of the following correctly identifies a compound in the diagram?



[Source: adapted from Addison Wesley Longman, Inc.]

A. I is fat.
B. II is pyruvate.
C. III is lactate.
D. IV is carbon dioxide.

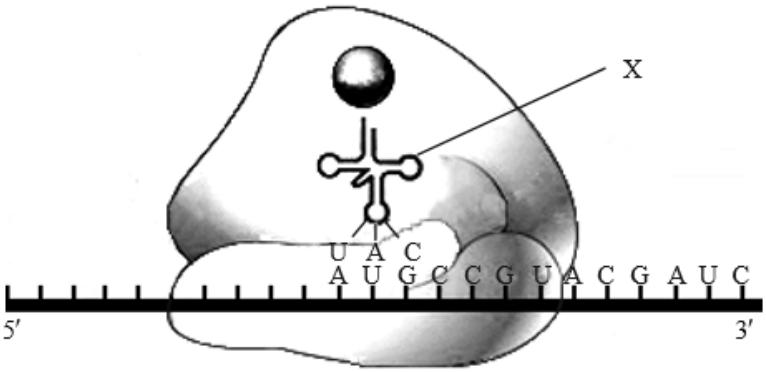
Markscheme

B

Examiners report

There were some comments on this question. The diagram is quite clear, but the fact that this is occurring in humans can be easily missed. This question was however, a very good discriminator.

What sequence of processes is carried out by the structure labelled X during translation?



A. Combining with an amino acid and then binding to an anticodon
B. Binding to an anticodon and then combining with an amino acid
C. Binding to a codon and then combining with an amino acid
D. Combining with an amino acid and then binding to a codon

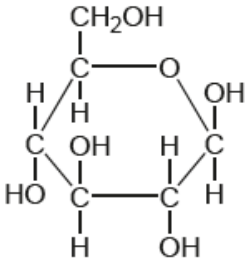
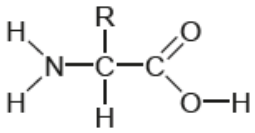
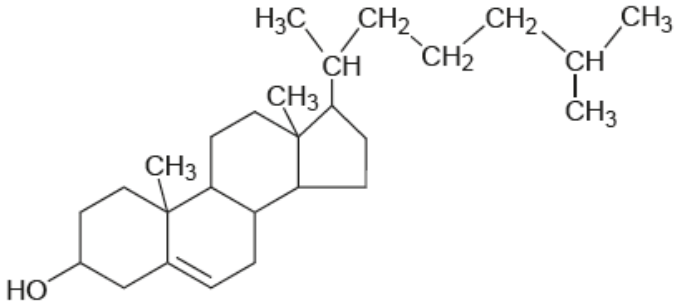
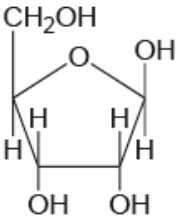
Markscheme

D

Examiners report

Some teachers argued that C could be a correct answer to this question. This is not true, as the transfer RNA joins the amino acid and then it joins to the codon. The drawing is a little unclear as it does not show the amino acid joined to the tRNA.

Which molecule diagram corresponds to the name?

	Name	Molecule diagram
A.	D-ribose	
B.	Amino acid	
C.	Phospholipid	
D.	Beta-D-glucose	

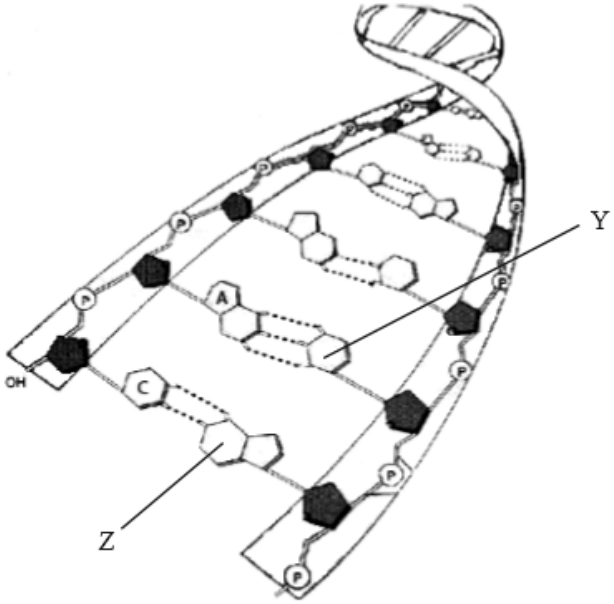
Markscheme

B

Examiners report

[N/A]

The following diagram shows a short stretch of DNA. What bases are indicated by labels Y and Z?



[Source: adapted from: http://ghs.gresham.k12.or.us/science/ps/sci/ibbio/chem/notes/chpt14/dna3.gif]

	Y	Z
A.	thymine	adenine
B.	thymine	guanine
C.	uracil	guanine
D.	uracil	adenine

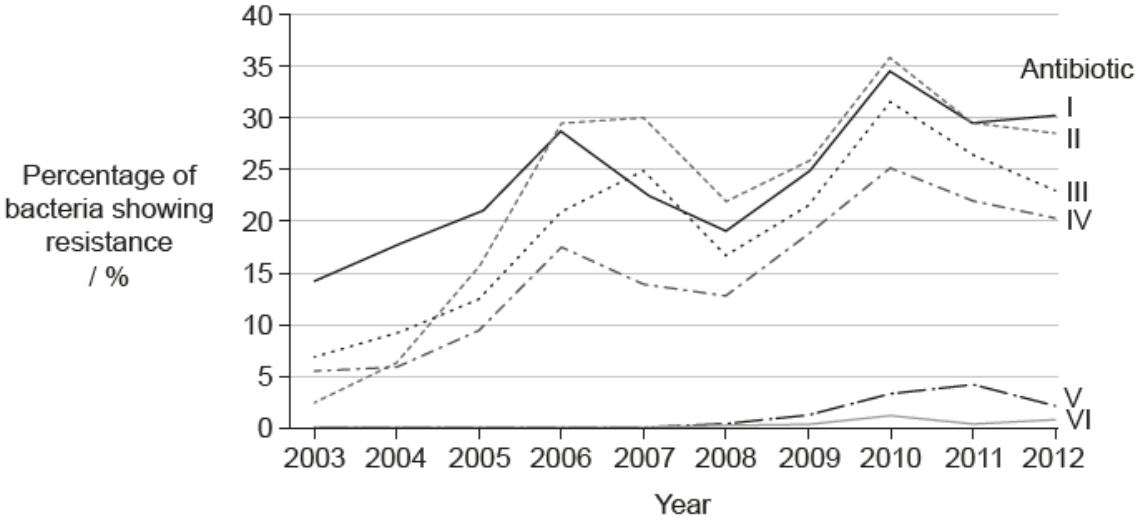
Markscheme

B

Examiners report

There was a mistake in the diagram, as adenine is shown joined by three hydrogen bonds to thymine and cytosine by two hydrogen bonds to guanine when it should have been the other way round. Nevertheless, the usefulness of the question was not affected, as most candidates answered this question correctly.

The bacterium *Neisseria gonorrhoeae* causes infections related to the human reproductive system. The graph shows the percentage of samples in which this bacterium showed resistance to six antibiotics over a period of ten years.



[Source: © All rights reserved. National Surveillance of Antimicrobial Susceptibilities of *Neisseria gonorrhoeae* Annual Summary 2012. Public Health Agency of Canada, 2012. Translated, adapted and reproduced with permission from the Minister of Health, 2017.]

What is a possible explanation for the total percentage resistance being larger than 100% in 2010?

A. People do not take the antibiotics as prescribed.

B. More people have been sampled in that year.

C. There was an epidemic of *Neisseria gonorrhoeae* in that year.

D. Some bacteria are resistant to more than one antibiotic.

Markscheme

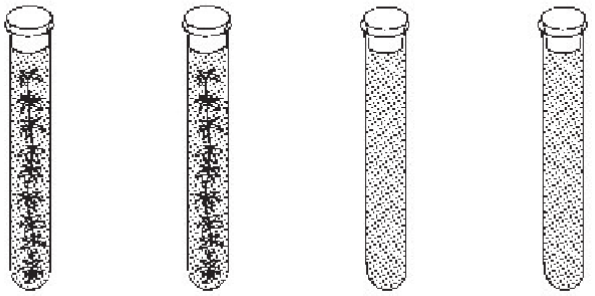
D

Examiners report

[N/A]

An experiment was set up so that each test tube contained water at a pH of 6.3 and a pH indicator. Test tubes 1 and 2 also contained a common pond autotroph. Carbon dioxide dissolves in water and forms carbonic acid. After three days the four test tubes were found to have these results.

Test tube 1	**Test tube 2**	**Test tube 3**	**Test tube 4**
kept in light pH = 7.0	kept in dark pH = 5.5	kept in light pH = 6.4	kept in dark pH = 6.2



What conclusion can be drawn from test tube 1 and test tube 2?

	Test tube 1	Test tube 2
A.	photosynthesis has used CO_2	respiration has produced CO_2
B.	photosynthesis has made the water more acidic	respiration has made the water less acidic
C.	photosynthesis occurred but not respiration	respiration occurred but not photosynthesis
D.	no conclusion can be drawn, since pH in the controls has changed	

Markscheme

A

Examiners report

[N/A]

Which sequence of bases and amino acids could be produced by transcription and translation

of the DNA molecule shown?

3′ ATGAAATGCTTTCGCGGG 5′
5′ TACTTTACGAAAGCGCCC 3′

2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	**STOP**	**STOP**	A
	Leu	Ser	**STOP**	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

	Sequence of bases	Sequence of amino acids
A.	UAC-UUU-ACG-AAA-GCG-CCC	Leu-Lys-Cys-Phe-Arg-Gly
B.	GGG-CGC-UUU-CGU-AAA-CAU	Gly-Arg-Phe-Arg-Lys-His
C.	AUC-AAA-UGC-UUU-CGC-GGG	Met-Lys-Cys-Phe-Arg-Gly
D.	UAC-UUU-ACG-AAA-GCG-CCC	Tyr-Phe-Thr-Lys-Ala-Pro

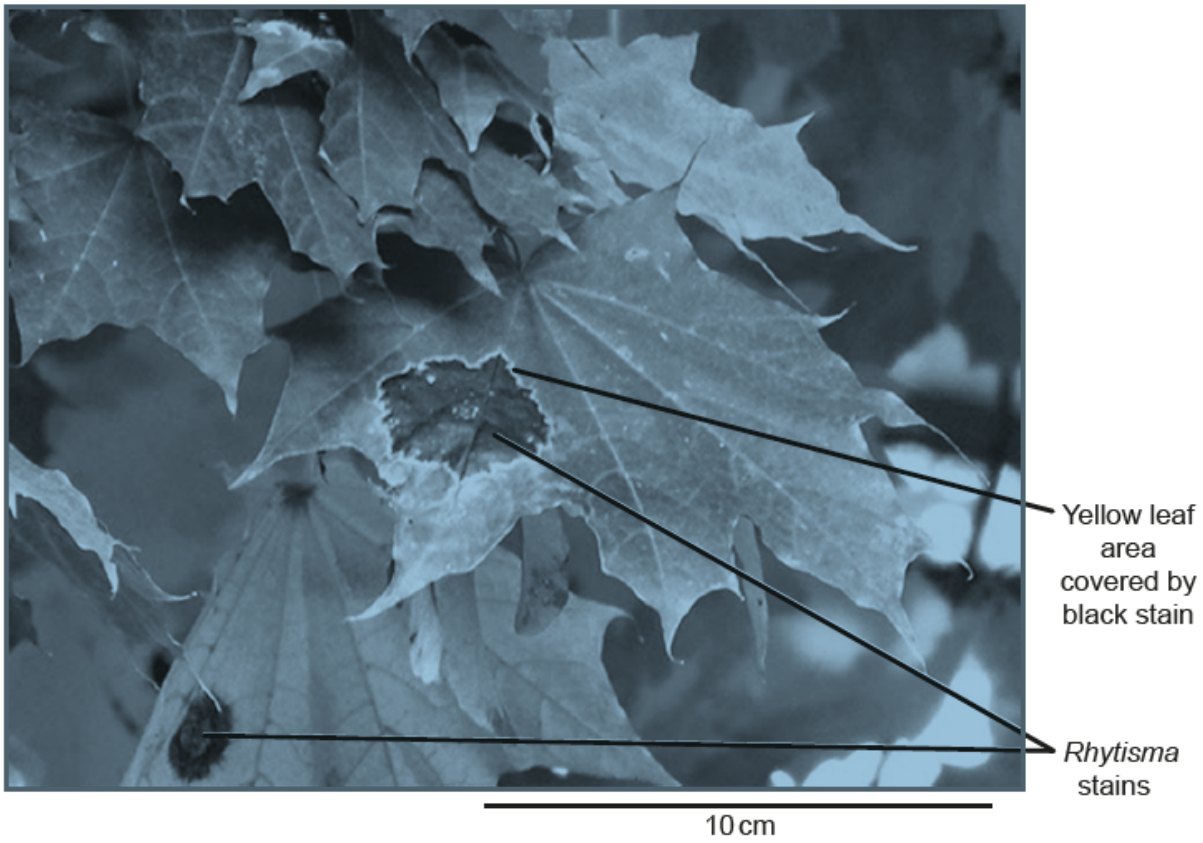
Markscheme

D

Examiners report

[N/A]

The fungus *Rhytisma* grows on the leaves of certain trees, causing a yellow leaf area in which chlorophyll is no longer present. A black, tar-like stain later spreads out.



[Source: © International Baccalaureate Organization 2017]

What happens in the leaf when Rhytisma is present?

I. An increase in the intake of carbon dioxide

II. A reduction in the production of oxygen

III. An increase in the loss of water

A. I only

B. II only

C. II and III only

D. I, II and III

Markscheme

B

Examiners report

[N/A]