HL Paper 1

Which statement about water is correct?

A. The atoms within a molecule of water are held together by hydrogen bonds.
B. Water has a low heat capacity allowing enzymatic reactions to happen at a wide range of temperatures.
C. Water molecules are polar, therefore fatty acids do not dissolve.
D. Ice has a higher density than liquid water, therefore some organisms can live under the ice.

Which statements correctly explain properties of water?

I. Water is a useful medium for metabolic reactions as many substances dissolve in water.
II. Water is useful as a coolant as it takes a small amount of heat energy to change its temperature.
III. Water molecules are cohesive which helps water transport in the roots and stems of plants.

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

What is involved during oxidation?

A. The loss of electrons
B. The gain of electrons
C. The gain of hydrogen
D. The loss of oxygen

What property of water makes it suitable as a coolant?

A. It takes a lot of energy to increase the temperature of water.

B. It takes a lot of energy for water to evaporate.

C. Water molecules are cohesive and stick to the skin.

D. Water is a good solvent so it can transport heat from the body.

What is formed from glucose during anaerobic cell respiration?

A. Lactate and ATP in cytoplasm
B. Carbon dioxide and water in mitochondria
C. Lactate and carbon dioxide in mitochondria
D. Carbon dioxide and water in cytoplasm

Why is light important in photosynthesis?

A. To produce ATP and split water molecules
B. To produce ADP needed to fix carbon dioxide
C. To activate the enzymes that fix carbon dioxide
D. To activate carbon dioxide molecules

Which molecules are monosaccharides?

A. starch, glycogen, cellulose
B. sucrose, maltose, lactose
C. fructose, glucose, galactose
D. glucose, lactose, cellulose

What is light energy used for during photosynthesis?

A. To produce carbon dioxide
B. To produce water molecules
C. To produce ATP
D. To break down sugar molecules

Which sugars are examples of a monosaccharide and disaccharide?

	Monosaccharide	Disaccharide
A.	fructose	galactose
B.	lactose	maltose
C.	sucrose	fructose
D.	galactose	lactose

Which of the following statements is/are correct for DNA replication?

I. It occurs during interphase.
II. It is semi-conservative.
III. It is a stage in protein synthesis.

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

What happens during the pathway of glycolysis?

A. Glucose is broken down into pyruvate.
B. Carbon dioxide is produced.
C. More ATP is consumed than is produced.
D. Lactic acid is produced.

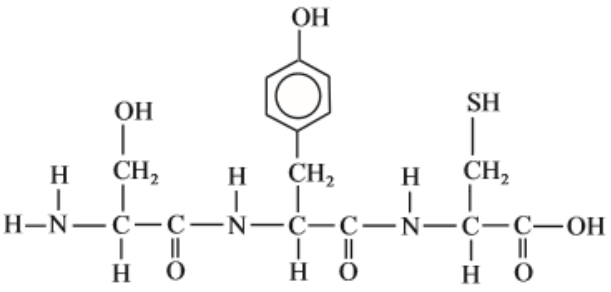
If 15 % of a sample of DNA is thymine, what percentage of the DNA is guanine?

A. 15 %
B. 30 %
C. 35 %
D. It cannot be determined from the information given.

Which of the following processes uses DNA ligase?

A. Unwinding DNA
B. Gene transfer using plasmids
C. Adding primers
D. Complementary base pairing

Which type of molecule is shown in the diagram below?



A. Peptide
B. Carbohydrate
C. Lipid
D. Nucleic acid

What is the energy absorbed by chlorophyll used directly for in plants?

I. To produce ATP
II. To split water
III. To fix CO_2

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

What happens during translation?

A. Copying of DNA to produce DNA

B. Copying of DNA to produce mRNA

C. Copying of DNA to produce tRNA

D. Polypeptide synthesis

Which molecule is a polysaccharide?

A. Glucagon
B. Glucose
C. Glycerol
D. Glycogen

Why does exposure to high temperatures cause an enzyme to lose its biological properties?

A. The substrate blocks the active site at high temperatures.

B. The three dimensional structure of the enzyme becomes changed.

C. Chemical reactions cannot take place at high temperatures.

D. High temperatures increase the activation energy of reactions.

On which molecule is a codon found?

A. DNA
B. mRNA
C. tRNA
D. rRNA

Blood is a water-based transport medium. Which property of water makes it a good transport medium?

A. High specific heat
B. Transparency
C. Versatility as a solvent
D. It has its greatest density at 4°C

Glucose is absorbed through protein channels in the plasma membrane of epithelium cells in the small intestine. Which characteristics of glucose prevent its diffusion through the phospholipid bilayer?

A. It is non-polar and therefore hydrophobic.

B. Its hydrogen bonds link with amino acids in the protein channel.

C. It is polar and therefore hydrophilic.

D. Its covalent bonds interact with the phospholipids.

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.

Which carbohydrates are used to provide energy storage in plants and animals?

	Plants	Animals
A.	starch	glucose
B.	cellulose	glycogen
C.	starch	glycogen
D.	maltose	glucose

Which of the following statements is **true** about enzymes?

A. They are used up in the reactions they catalyse.
B. Allosteric inhibitors bind to the active site.
C. They lower the energy of activation for a reaction.
D. They supply the energy of activation for a reaction.

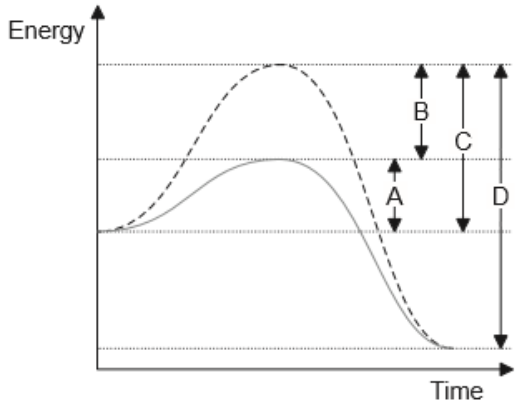
What are the **most** frequently occurring elements in living organisms?

A. calcium, phosphorus, iron and sodium
B. calcium, sodium, nitrogen and phosphorus
C. carbon, phosphorus, oxygen and nitrogen
D. nitrogen, carbon, oxygen and hydrogen

Which sugars are both disaccharides?

A. maltose and lactose
B. lactose and fructose
C. fructose and galactose
D. galactose and maltose

Which is the activation energy of a reaction when it is catalysed by an enzyme?



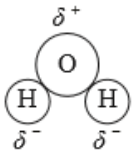
The base sequence of a fragment of DNA is:

ACC GTG CAG GAT

What is the base sequence on the messenger RNA (mRNA) molecule transcribed from it?

A. TGG CAC GTC CTA
B. TGG CUC GTC CTU
C. UGG CTC GUC CUT
D. UGG CAC GUC CUA

Which diagram represents the polarity of a water molecule?

A.


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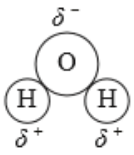

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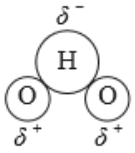

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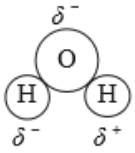
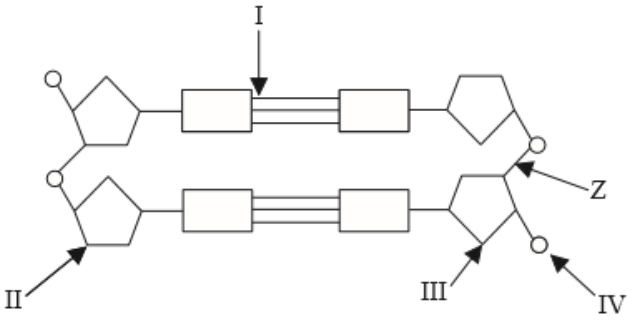


This question refers to the following DNA diagram.



Which points to the 3′ end of a strand of DNA?

A. I
B. II
C. III
D. IV

Why is sweat a good coolant for the body?

A. The arterioles that transfer water to sweat move closer to the skin surface when it is hot.
B. Breaking H bonds between water molecules in sweat requires energy from body heat.
C. Sweat contains minerals such as sodium chloride.
D. Sweat is non-polar.

A channel protein is used to transport ions across a membrane. What would you expect to find lining the inside of the channel?

A. Phospholipids
B. Non-polar amino acids
C. Fatty acids
D. Polar amino acids

What is phosphorus used for in plant cells?

A. Structure of hemoglobin
B. Composition of long-term energy storage
C. Positive charge of membranes
D. Composition of nucleic acids

Organisms can be genetically modified to produce the human blood clotting factor IX. What characteristic of the genetic code makes this possible?

A. It is conservative.
B. It is degenerate.
C. It is complementary.
D. It is universal

Which of the following is **true** about a polar amino acid and cellulose?

A. Both are polysaccharides.
B. Both contain nitrogen.
C. Both are hydrophobic.
D. Both contain hydrogen atoms.

Which can be explained by the solvent properties of water?

A. Sodium chloride is transported as Na^+ and Cl^- in blood.

B. Movement of water occurs under tension in the xylem.

C. Water is the coolant in sweat.

D. Ice floats on liquid water.

What principle is necessary to prevent mutation of DNA during replication?

A. Base pairing is complementary.

B. One gene codes for one polypeptide.

C. Substrates are specific to enzymes.

D. The genetic code is universal.

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.

What is decreased when lactase is added to milk?

A. Sweetness

B. Disaccharides

C. Calcium

D. Monosaccharides

In cell respiration, what is the name of the process where glucose is broken down into pyruvate?

A. Electron transport chain
B. Krebs cycle
C. Link reaction
D. Glycolysis

A base substitution in a gene has changed a codon. Which of these consequences could result from a base substitution in a codon?

I. Another amino acid will be incorporated in the protein
II. A stop codon is generated
III. The same protein will be synthesized

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

What is produced when the enzyme lactase is added to milk?

A. Glucose and galactose
B. Lactose
C. Glucose and fructose
D. Lactic acid

It is possible to attach β-galactosidase to alginate beads for use in the production of lactose-free milk. What are enzymes that have been attached in this way called?

A. Inhibited
B. Immobilized
C. Catalysed
D. Activated

What happens in both respiration and photosynthesis?

A. Triose phosphates are decarboxylated.
B. NADPH is produced.
C. ATP is produced.

D. Electrons pass through ATP synthase.

For what purpose is the enzyme lactase useful?

A. Production of lactose-free milk so that more people can consume dairy products
B. As a dietary supplement to aid in protein digestion of milk
C. For use in coagulating milk protein to make cheese
D. To improve protein consumption in developing countries that lack milk

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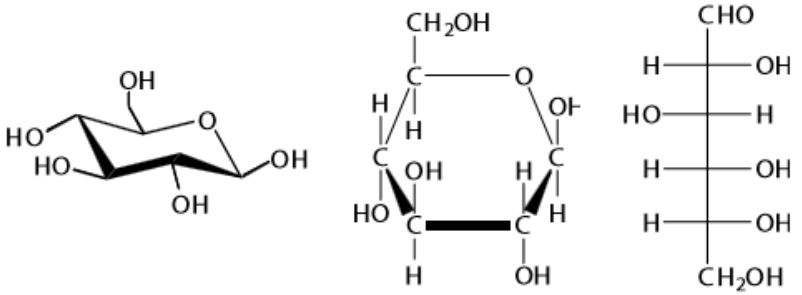
Which of the following are involved in **both** replication and transcription?

A. DNA only
B. DNA and RNA
C. DNA and ribosomes
D. DNA, RNA and ribosomes

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 %

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



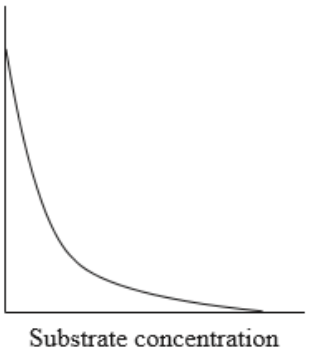
What chemical substance is shown?

A. Ribose
B. Glucose
C. Fatty acid

D. Amino acid

Which graph shows the effect of increasing the substrate concentration on enzyme activity?

A.



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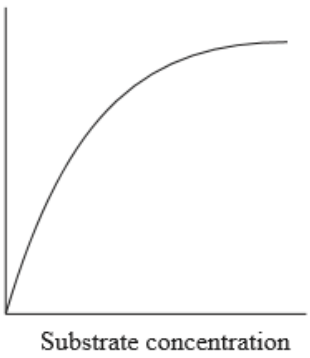
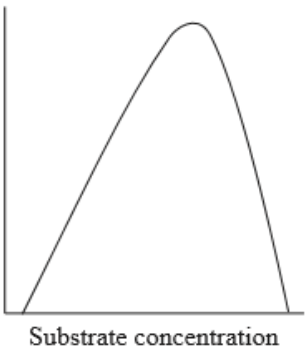


C.



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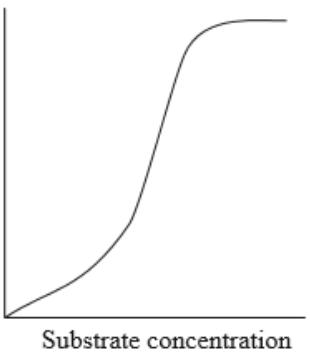


What is required to replicate DNA?

A. Temperature of 37 °C

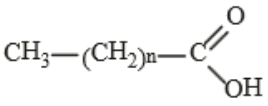
B. Free nucleotides carrying A, C, G and T bases

C. Plasmids

D. Endonuclease

Which structure represents a fatty acid?

A.



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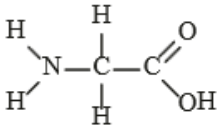

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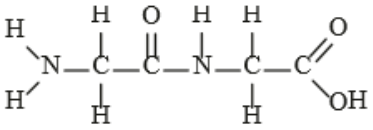
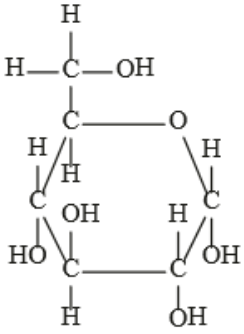


D.



Where are proteins synthesized by free ribosomes used?

A. Outside the cell after secretion
B. Within the nucleus
C. Within the lysosomes
D. Within the cytoplasm

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

Which gas produces most of the bubbles in bread dough?

A. Oxygen
B. Methane
C. Carbon dioxide
D. Water vapour

This reaction is a step in anaerobic cell respiration in a yeast cell.

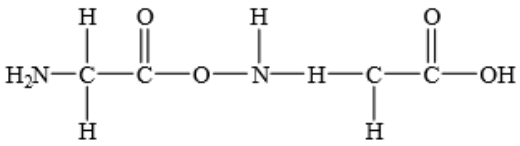
$$\text{Pyruvate} \longrightarrow \text{I} + \text{II}$$

What are the products of this reaction?

	I	II
A.	oxygen	methanol
B.	carbon dioxide	ethanol
C.	hydrogen	glucose
D.	ADP	phosphate

Which molecular structure correctly illustrates two amino acids linked by a peptide bond?

A.



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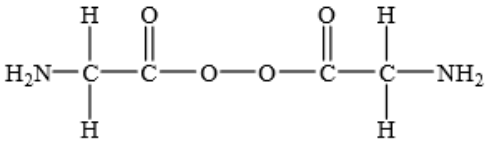

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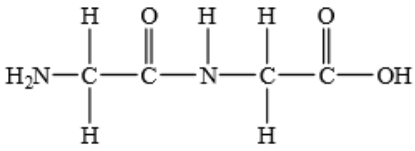
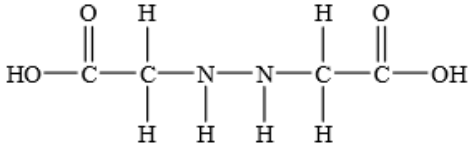


D.



Olive oil may reduce the risk of coronary heart disease. What is/are the compound(s) responsible for the health benefits of olive oil?

I. Cis unsaturated fatty acids
II. Trans unsaturated fatty acids
III. Saturated fatty acids

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

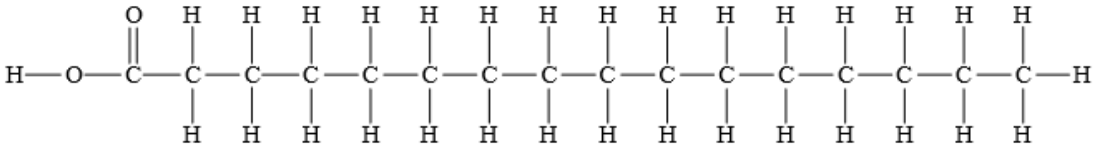
What is the relationship between enzymes and DNA?

A. Enzymes contain the code for DNA.
B. Enzymes act on DNA during translation.
C. Both enzymes and DNA have similar shapes.
D. The structure of enzymes is determined by DNA.

Which statement describes glycogen?

A. It is a hormone involved in the control of blood glucose.
B. It is a component of the cell wall in plants.
C. It is a monosaccharide converted to pyruvate during cell respiration.
D. It is a polysaccharide found in animals.

What substance is represented by this structure?



A. Glycerol
B. Fatty acid
C. Cellulose
D. Glycogen

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

What usually distinguishes DNA from RNA?

	DNA	RNA
A.	strands are symmetrical	strands are antiparallel
B.	contains adenine	contains cytosine
C.	pentoses linked to phosphates	pentoses linked to bases
D.	double stranded	single stranded

Which always contains carbon, hydrogen and oxygen?

I. Carbohydrate

II. Protein

III. Fat

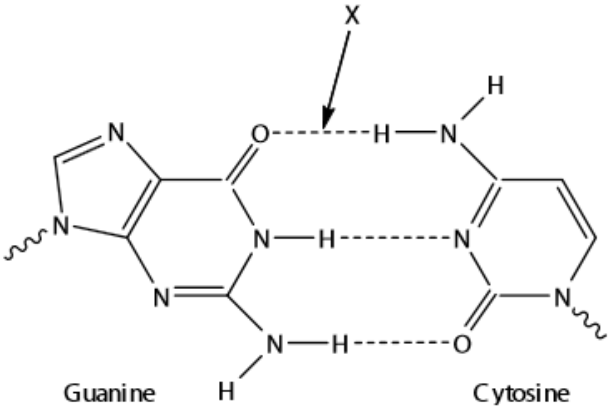
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

What type of bond is labelled X?

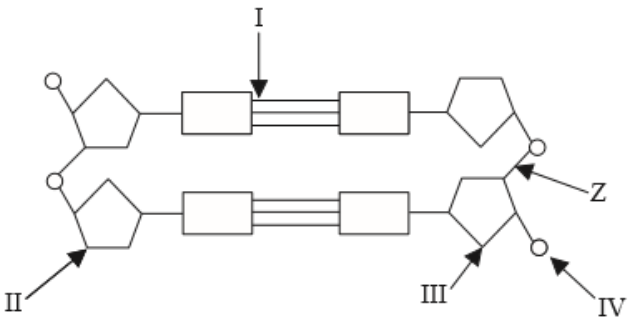


A. Ionic
B. Peptide
C. Covalent
D. Hydrogen

What happens during glycolysis for one molecule of glucose?

A. Two pyruvates are formed.
B. There is a net gain of two NADPH + H^+.
C. There is a net loss of two ATP.
D. Two acetyl CoA are formed.

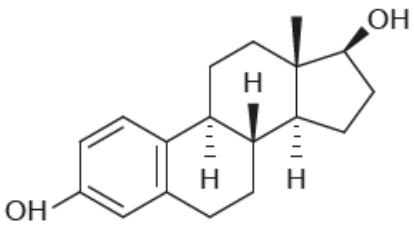
This question refers to the following DNA diagram.



What type of bond does Z represent?

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

What characteristic shows that this steroid molecule is a lipid?



A. It is made of carbon rings.

B. It has a very low proportion of oxygen to carbon.

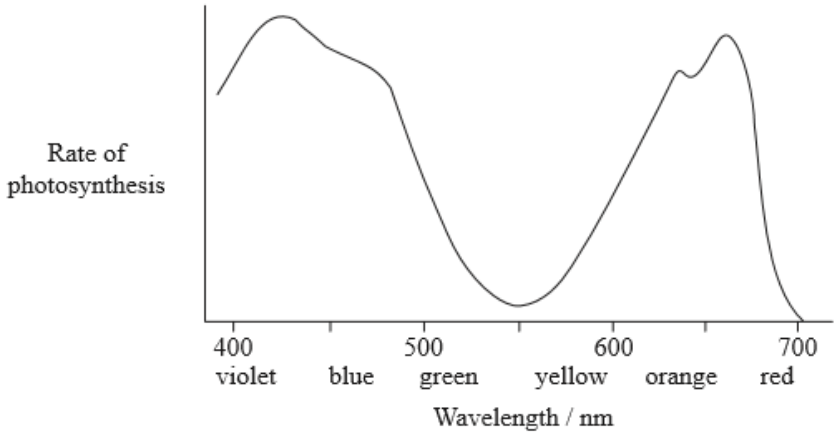
C. It contains OH groups as do fatty acids.

D. It is made only of nitrogen, oxygen and hydrogen.

Which sequence represents the order of events in protein synthesis?

	Earlier → Later		
A.	small and large subunits of a ribosome are joined	a first tRNA with the amino acid methionine joins the ribosome	the ribosome reaches a stop codon
B.	an amino acid binds to tRNA	the tRNA moves from a binding site to another binding site on the ribosome	the ribosome reaches a stop codon
C.	an amino acid binds to mRNA	a peptide bond is made between the amino acids	the tRNA moves from a binding site to another binding site on the ribosome
D.	the tRNA moves from a binding site to another binding site on the ribosome	a peptide bond is made between the amino acids	the anticodon of a mRNA pairs with the tRNA

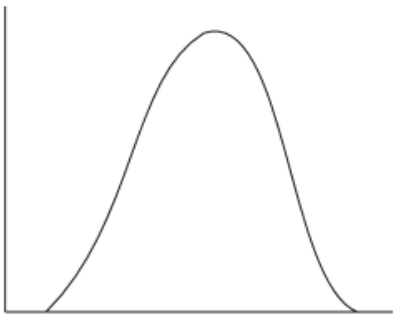
What conclusion can be drawn from examining the action spectrum for a green plant shown below?



A. Yellow light is the most effective at promoting photosynthesis.
B. Every colour of light is equally effective at promoting photosynthesis.
C. Light of wavelength 550 nm is least effective at promoting photosynthesis.
D. Light in the green range is the most effective at promoting photosynthesis.

Which graph shows the effect of increasing substrate concentration on enzyme activity?

A.



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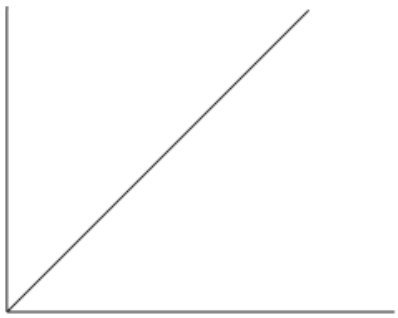
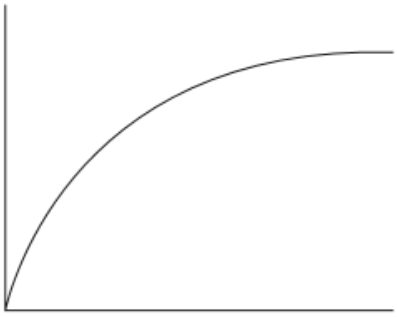
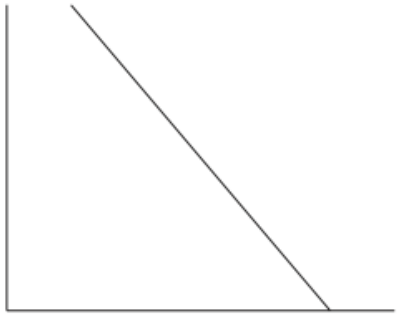


C.



D.

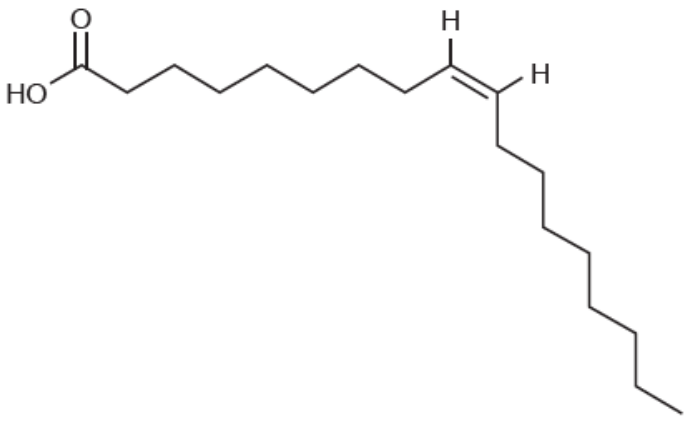


What is a consequence of the specific heat capacity for liquid water, ice and water vapour?

State	Specific heat capacity / $kJ\,kg^{-1}\,K^{-1}$
liquid water	4.187
ice	2.108
water vapour	1.996

A. Less energy is needed to warm water vapour than liquid water.
B. Salt dissolves more readily in liquid water than in ice.
C. Small insects can walk on liquid water.
D. Ice floats on liquid water.

What type of molecule is shown in this diagram?



A. Trans saturated fatty acid

B. Cis unsaturated fatty acid

C. Cis saturated fatty acid

D. Trans unsaturated fatty acid

The table below shows the codons that determine different amino acids in protein translation.

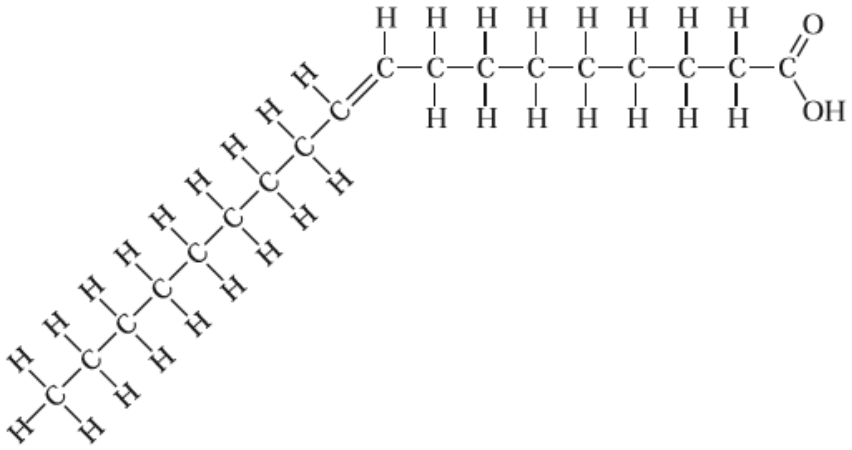
First base in codon	Second base in codon				Third base in codon
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	—	—	A
	Leu	Ser	—	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

What is the sequence of the amino acids that is being translated from the following mRNA sequence?

5' AUGGGUGCUUAUUGGUAA 3'

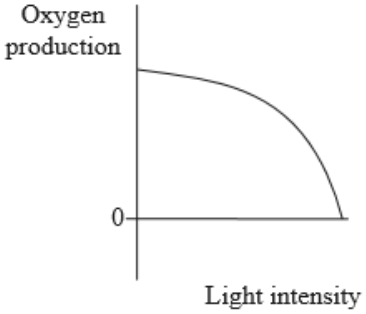
A. Met-Pro-Arg-Ile-Thr
B. Met-Cys-Ser-Tyr-Trp
C. Met-Gly-Ala-Tyr-Trp
D. Met-Gly-Tyr-Ala-Thr

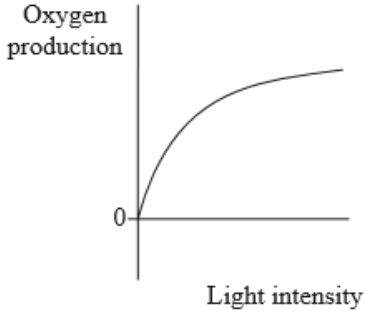
Which chemical is shown in the diagram below?

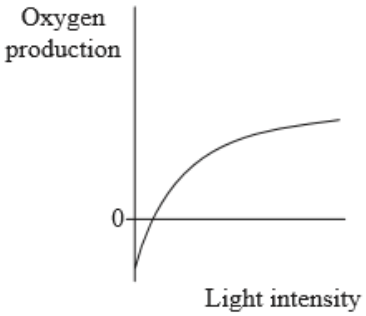


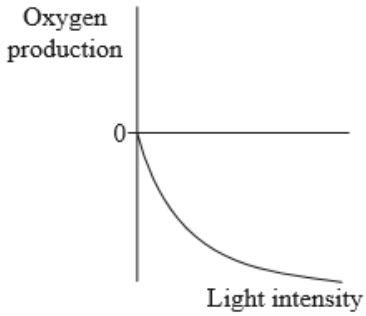
A. Monosaccharide
B. Triglyceride
C. Fatty acid
D. Amino acid

Which of the following graphs represents the effect of changing light intensity on the rate of oxygen production by a green plant?

A.


B.


C.


D.


Which model represents transcription?

A. – A A T C G G A C T T A C –
– U U A G C C U ↑ ↑ ↑ ↑ ↑ –
→ G A A U G –

B. – A A T C G G A C T T A C –
– aa aa aa
→ ↑
aa

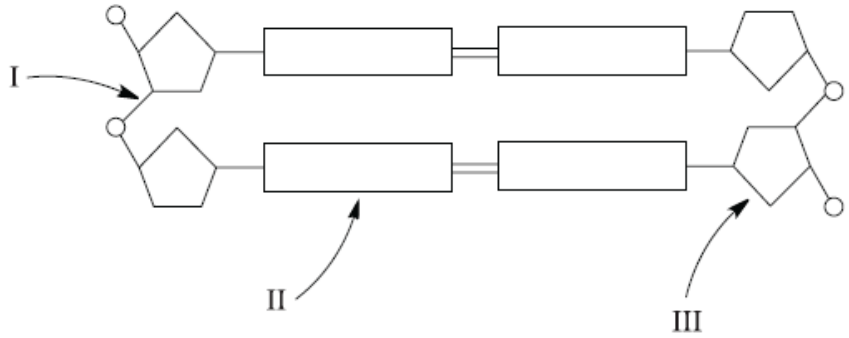
C. – A A U C G G A C U U A C –
– aa aa aa
→ ↑
aa

D. – A A T C G G A C T T A C –
– T T A G C C T ↑ ↑ ↑ ↑ ↑ –
→ G A A T G –

Key:
A, C, G, T, U = nucleotides
aa = amino acids
= enzyme
= ribosome

[Source: © International Baccalaureate Organization 2015]

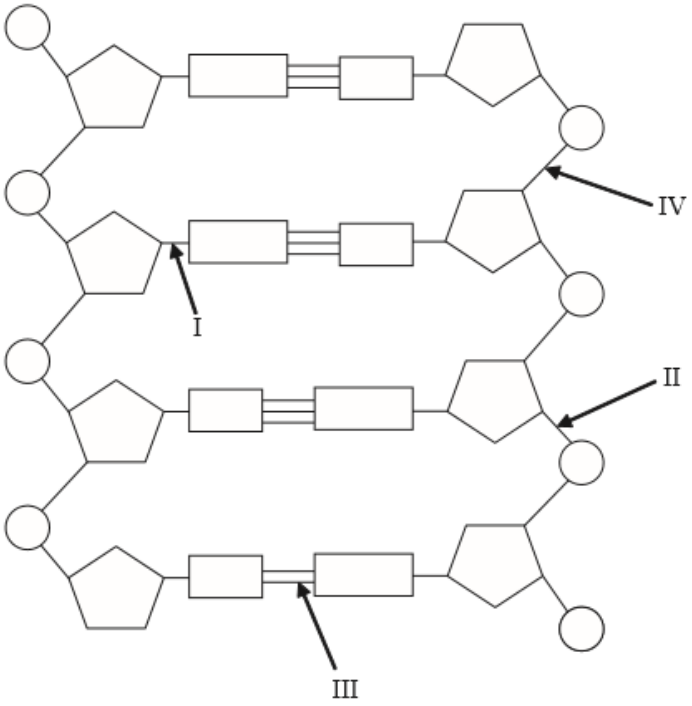
The diagram below represents part of the DNA molecule.



What are the parts labelled I, II and III?

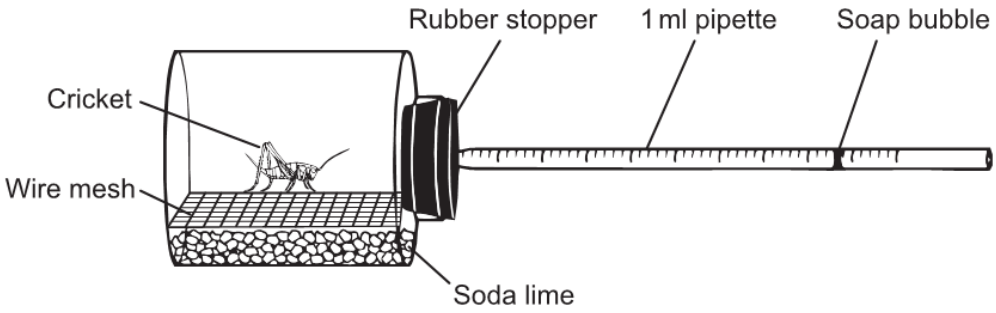
	I	II	III
A.	hydrogen bond	base	deoxyribose
B.	hydrogen bond	deoxyribose	phosphate group
C.	covalent bond	base	deoxyribose
D.	covalent bond	deoxyribose	phosphate group

In the model of the DNA molecule shown below, which arrows point to covalent bonds?



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

A cricket was placed in a respirometer at constant temperature for ten minutes. The soap bubble moved along the pipette.



[Source: © International Baccalaureate Organization 2017]

What was measured by the movement of the soap bubble?

A. Production of carbon dioxide

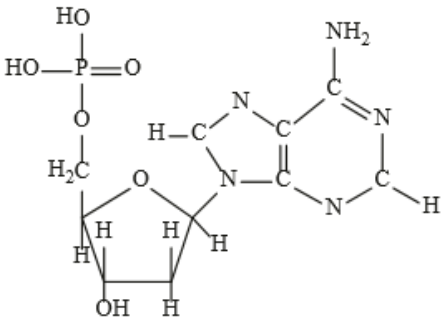
B. Volume of excretory products

C. Oxygen consumption

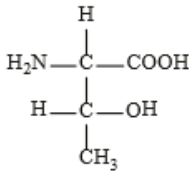
D. Release of heat

Which molecules show a monosaccharide and a fatty acid?

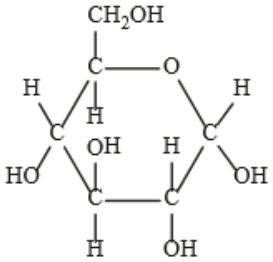
Molecule 1



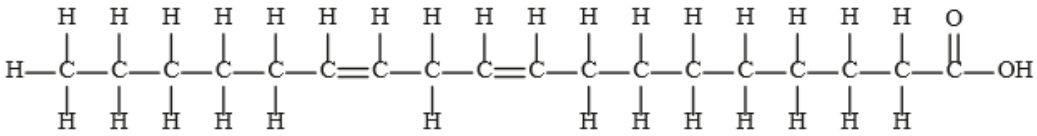
Molecule 2



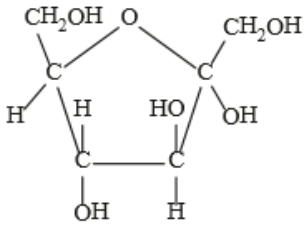
Molecule 3



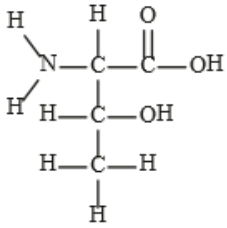
Molecule 4



Molecule 5

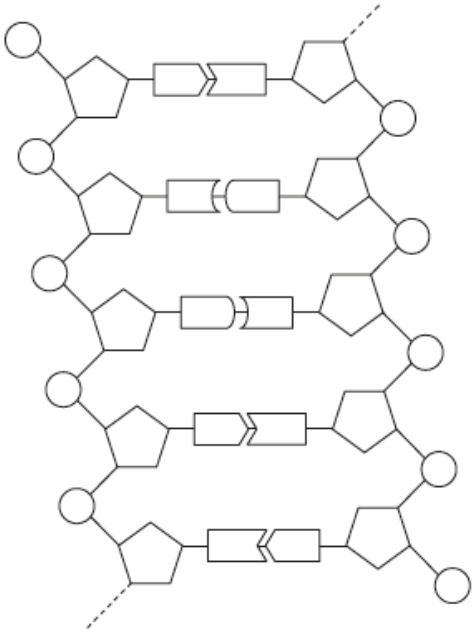


Molecule 6



	Monosaccharide	Fatty acid
A.	1, 3 and 5 only	2, 4 and 6 only
B.	1 only	2 and 6 only
C.	3 only	2 and 6 only
D.	3 and 5 only	4 only

What is correct for the DNA double helix?



	Deoxyribose bonds to a …	Hydrogen bonds form the bond between the …	Complementary base pairing between …
A.	phosphate and a base	phosphates and the bases	adenine and uracil
B.	deoxyribose and a phosphate	deoxyribose molecules	thymine and guanine
C.	base and a deoxyribose	phosphate and the deoxyribose	adenine and thymine
D.	base and a phosphate	bases	cytosine and guanine

A strand of mRNA consists of the following nucleotides:

AUUCUGGCUA

Which of the following represents the non-transcribed (sense) strand of the DNA?

A. TAAGACCGAT

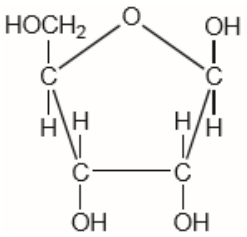
B. ATTCTGGCTA

C. UAAGACCAU

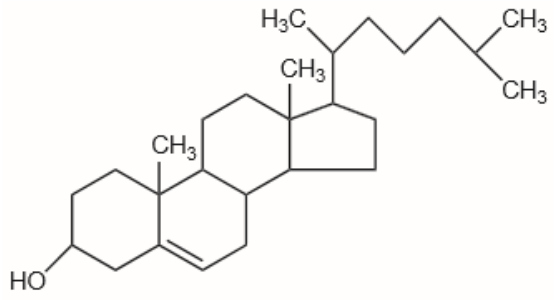
D. AUUCUGGCUA

Which molecule is a sugar?

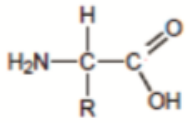
A.



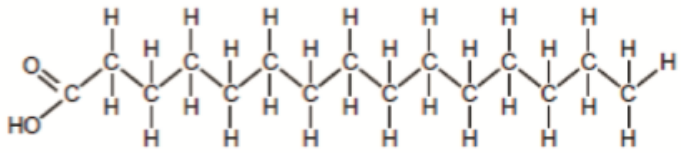
B.



C.

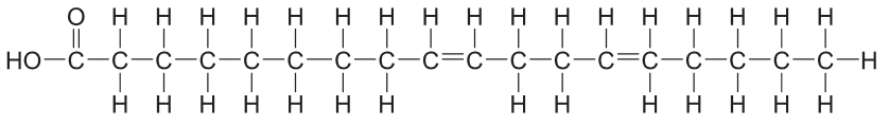


D.

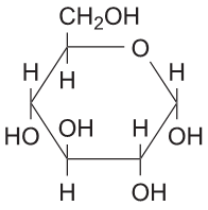


Which of the molecules contain peptide bonds or are sugar molecules?

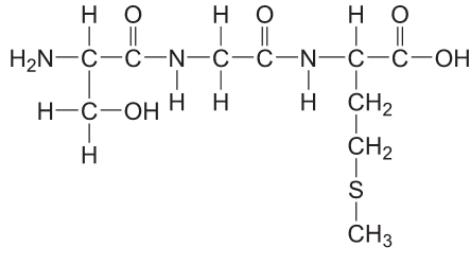
I.



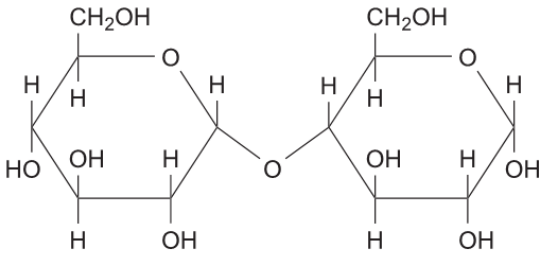
II.



III.

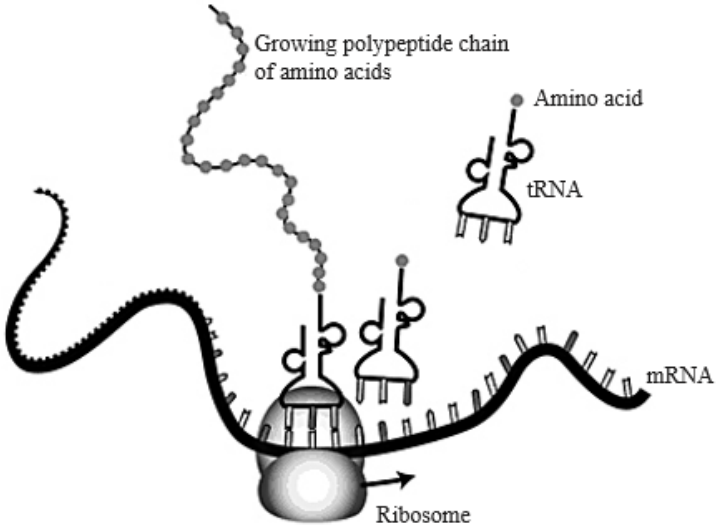


IV.



	Contain peptide bonds	Are sugar molecules
A.	I, III	II
B.	III	II, IV
C.	I, III, IV	II
D.	I	III, IV

The diagram shows the translation of a mRNA molecule.



[Source: National Human Genome Research Institute]

A tRNA molecule with anticodon CAG carries the amino acid phenylalanine. Which codon of mRNA will the tRNA join?

A. CTG
B. CAG
C. GTC
D. GUC

Which equation shows a chemical reaction that occurs during anaerobic cell respiration?

A. pyruvate → lactate

B. pyruvate → lactate (ADP → ATP)

C. pyruvate → lactate + CO_2

D. pyruvate → ethanol + ATP
