SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) – SEMESTER TWO
END OF SEMESTER EXAMINATION

COURSE CODE	:	**BIO119**
COURSE TITLE	:	**Biochemistry**
LECTURER(S)	:	**Christal Jean**
DATE	:	**22 April 2025**
TIME	:	**9:00am – 11:00am**
DURATION	:	**2 hours**
STUDENT ID #	:	_____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- This paper consists of TWO (2) sections. Section ONE (1) consists of forty (40) multiple choice questions and Section TWO (2) consists of forty (40) fill in the blanks questions.
- Answer ALL questions on the question paper.
- Specific instructions are given at the beginning of each section.
- Ensure that your College Identification Number is on every sheet of paper that you submit.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION 1

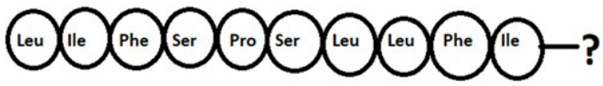
***Specific Instructions**: Read each question carefully and circle the best answer for each of the following questions on this answer sheet provided.*

1. All of the following are good measures to ensure your centrifuge is balanced **except**?
   a) Place tubes opposing one another
   b) Make sure the tubes are same size
   c) Make sure the volumes are identical
   d) Place tubes next to each other

2. If the basic formula of an α-amino acid is R-CH(NH_2)-COOH, where R is the side chain. What is the primary point of distinction between any two proteins?
   a) The side chain R
   b) Number of carboxyl groups
   c) Number of amino groups
   d) Relative positions of amino, carboxyl groups and R

3. RNA is_____ from DNA and then _____ into protein.
   a) transformed; transfigured
   b) transcribed; translated
   c) transfigured; transformed
   d) translated; transcribed

4. Identify the labelled **"?"** portion of the peptide to the below.



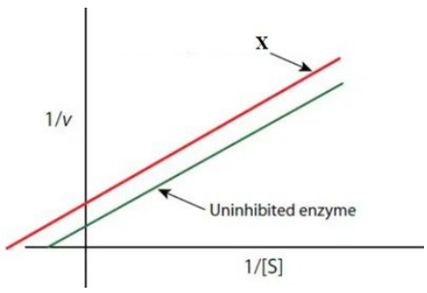
   a) L-terminal amino acid
   b) I-terminal amino acid
   c) C-terminal amino acid
   d) N-terminal amino acid

5. In which of these structures of proteins can disulfide bonds be found?
   a) Tertiary structure
   b) Primary structure
   c) Beta sheet
   d) Alpha helix

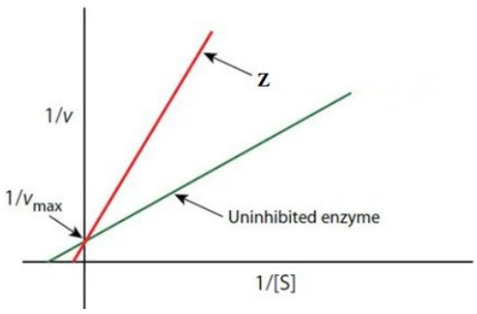
6. What is the bond between amino acids called?
   a) Acidic bond
   b) Hydrogen bond
   c) Peptide bond
   d) Ionic bond

7. Which of these structures have more than one polypeptide chain?
   a) Quaternary
   b) Primary
   c) Tertiary
   d) Secondary

8. A sample can be tested for the presence of proteins using the biuret test. What will a positive result show?
   a) A brick-red precipitate
   b) A blue-black solution
   c) A purple solution
   d) A cloudy-white layer



9. Assessment of enzyme activity under standard condition and plotted as a linear Lineweaver-Burk plot gives the line labelled uninhibited enzyme. What scenario best represents the line labelled X in the Lineweaver-Burke plot above?
   a) Non competitive Inhibitor present
   b) Competitive Inhibitor present
   c) Allosteric Activator present
   d) Uncompetitive Inhibitor present

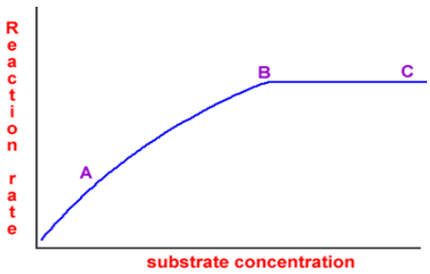


10. Assessment of enzyme activity under standard condition and plotted as a linear Lineweaver-Burk plot gives the line labelleduninhibited enzyme. What scenario best represents the line labelled Z in the Lineweaver-Burke plot above?
    a) Insufficient substrate present
    b) Uncompetitive Inhibitor present
    c) Competitive Inhibitor present
    d) Non competitive Inhibitor present

11. In feedback inhibition, an enzyme in a metabolic pathway is inhibited by:
    a) A substrate that initiates the pathway
    b) The final product of the pathway
    c) A product formed earlier in the pathway
    d) The enzyme itself

12. Drugs that inhibit enzymes in an uncompetitive manner will have which of the following effects on the Michaelis-Mentenequation derived parameters: V_{max} and/or K_m?
    a) decrease V_{max} but no change on K_m
    b) decrease both V_{max} and K_m
    c) decrease K_m but no effect on V_{max}
    d) increase K_m but no change in V_{max}

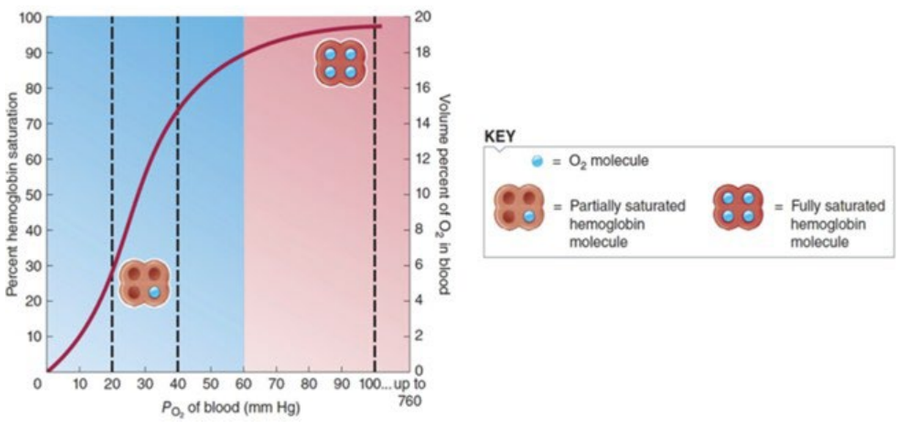
13. Based on the graph below, which of the following could increase the reaction rate beyond point C?
    a) decrease enzyme concentration
    b) increase the temperature
    c) increase the amount of substrate
    d) add more water



14. Chemical reactions that occur spontaneously are called
    a) exergonic and require energy
    b) exergonic and release energy
    c) endergonic and require energy
    d) endogonic and release energy

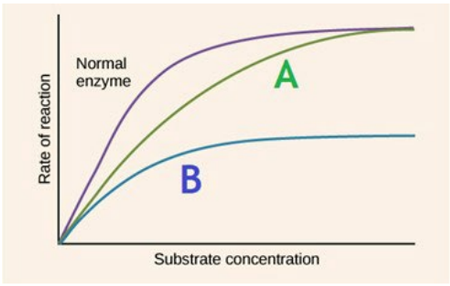
15. In competitive inhibition
    a) two different substrates compete for the same binding site on the enzyme.
    b) an inhibitor molecule competes with the substrate for the same binding site on the enzyme.
    c) an enzyme molecule has to compete with other enzyme molecules for the necessary energy.
    d) an enzyme molecule has to compete with other enzyme molecules for the necessary substrate.

16. The electron transport chain
    a) prepares a proton gradient which makes ATP production possible.
    b) establishes an electron gradient, making ATP production possible.
    c) generates 5 ATP molecules.
    d) utilizes large amounts of oxygen, so is damaging to the cells.

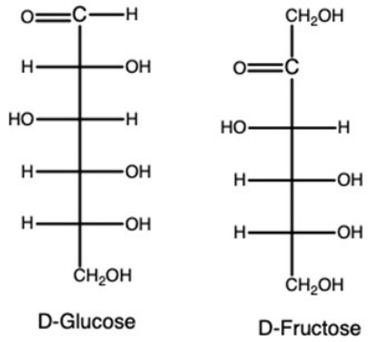


17. The sigmoid shape of the oxyhemoglobin dissociation curve as featured above is due to:
    a) the moping up of released oxygen by myoglobin.
    b) drop of oxygen pressure as oxygen is taken up.
    c) decreased pH at increasing oxygen tension.
    d) cooperative effect of binding one oxygen molecule on the binding of subsequent oxygen molecules.

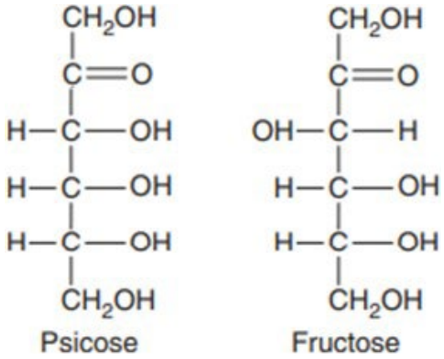
18. What scenario best represent A?
    a) No Enzyme present
    b) Non competitive Inhibitor present
    c) Competitive Inhibitor present
    d) Allosteric Activator present



19. A liquidized sample of food is tested with Benedict s reagent. Which of the following indicates that a reducing sugar is presentin this sample?
    a) A brick-red precipitate forms
    b) The solution turns blue black
    c) The solution remains blue
    d) A purple precipitate forms

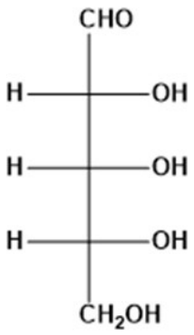


20. Based on the image above, it is clear that D-Glucose and D-Fructose:
    a) are isomers. D-Glucose is an aldehyde and D-Fructose is a ketone.
    b) are enantiomers. D-Glucose is an aldehyde and D-Fructose is a ketone.
    c) are diastereomers.
    d) are not related at all.



21. Consider the molecules of two isomers, psicose and fructose shown above. These molecules are:
    a) Both D-isomers. Psicose and fructose are enantiomers.
    b) Psicose is the L-isomer conkguration of fructose.
    c) Both D-isomers. Psicose is an epimer of fructose.
    d) Psicose and fructose are not stereoisomers.

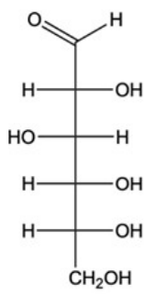
22. For D-Ribose, how many stereoisomers are possible?
    a) 32
    b) 16
    c) 6
    d) 8



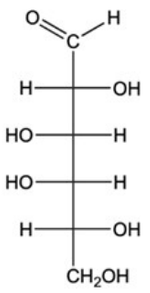
D-Ribose

23. What does the position of the OH group on the anomeric carbon determine in a Haworth projection?
    a) The orientation of the entire molecule
    b) The ring size
    c) The alpha or beta configuration
    d) The D or L configuration

24. D-galactose and D-glucose differ in configuration as seen in the image below. Which type of stereoisomers most specifically describes them?
    a) Enantiomers
    b) Epimers
    c) Anomers
    d) Diastereomer

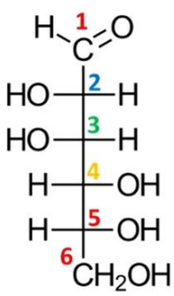


D-Glucose



D-Galactose

25. How many stereoisomers exist for the sugar featured below?
    a) 32
    b) 16
    c) 64
    d) 8

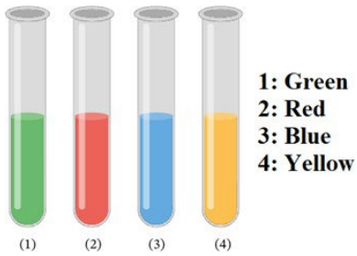


26. To obtain the D-isomer of a L molecule,
    a) Change the anomeric hydroxyl group so that it is above the plane of the molecule.
    b) Interchange the position of hydroxyl group and hydrogen connected to the penultimate carbon.
    c) Interchange the position of hydroxyl group and hydrogen connected to the penultimate chiral carbon.
    d) Change all groups connected to the anomeric carbon.

27. The compounds which have same chemical reactivity but structures which are mirror images of each other are known as:
    a) isomers
    b) allotropes
    c) isoforms
    d) enantiomers

28. Benedict s reagent can be used to test a sample of food for the presence of reducing sugars. What is a reducing sugar?
    a) A monosaccharide or disaccharide that can dissolve into an aqueous solution
    b) A monosaccharide or disaccharide that reduces the size of its carbon chain when mixed into a solution
    c) A monosaccharide or disaccharide that can receive protons from another molecule
    d) A monosaccharide or disaccharide that can donate electrons to another molecule

29. Samples of **four (4) different foods** were liquidized and then **mixed with Benedict's reagent** before being **heated** in a boiling-water bath. The diagram provided below shows the results:



Which food sample has a high level of reducing sugars?
    a) Sample 3
    b) Sample 4
    c) Sample 2
    d) Sample 1

30. Sucrose and lactose are _____
    a) disaccharides
    b) polyssaccharides
    c) pentoses
    d) monosaccharides

31. A DNA strand with the sequence AACGTAACG is transcribed. What is the sequence of the mRNA molecule synthesized?
    a) TTGCATTGC
    b) AACGUAACG
    c) AACGTAACG
    d) UUGCAUUGC

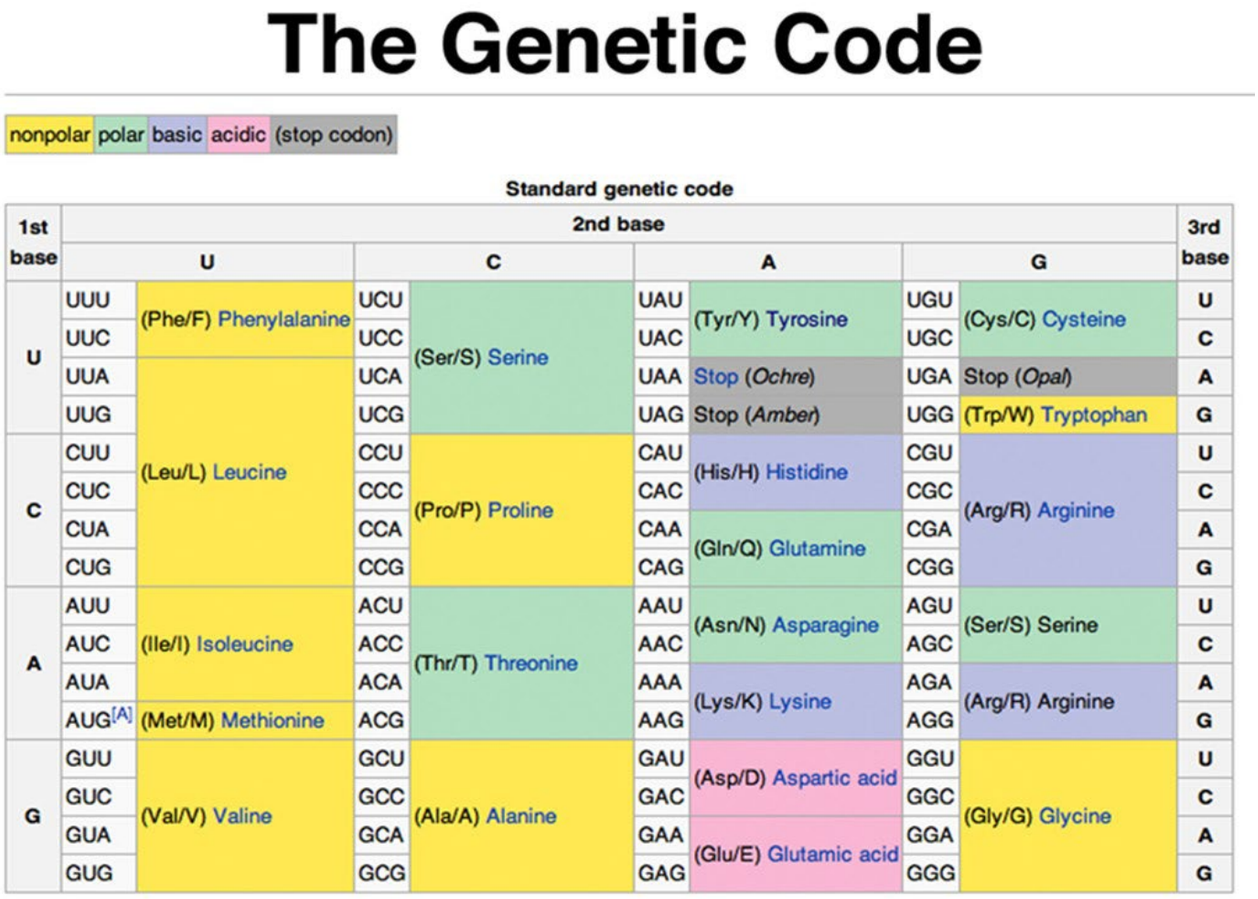
32. How many bases are there in per turn of the A form of DNA?
    a) 8 bp
    b) 12 bp
    c) 10 bp
    d) 11 bp

33. How many DNA duplexes are obtained from one DNA duplex after 4 cycles of PCR?
    a) 4
    b) 16
    c) 8
    d) 32

34. UV light damages DNA by
    a) allowing an aromatic ring to insert itself in between two base pairs.
    b) causing the double helix to split apart.
    c) causing two purine rings to bind together.
    d) causing the formation of thymine dimers.

35. Which of the following is a **MISMATCH**?
    a) Primer - oligonucleotide
    b) Polymerase - Taq polymerase
    c) Template - double stranded DNA
    d) Synthesis – 5' to 3' direction

Refer to the following image for questions 36-38:



The Genetic Code

nonpolar polar basic acidic (stop codon)

Standard genetic code

1st base	2nd base U		2nd base C		2nd base A		2nd base G		3rd base
U	UUU	(Phe/F) Phenylalanine	UCU	(Ser/S) Serine	UAU	(Tyr/Y) Tyrosine	UGU	(Cys/C) Cysteine	U
	UUC		UCC		UAC		UGC		C
	UUA	(Leu/L) Leucine	UCA		UAA	Stop (*Ochre*)	UGA	Stop (*Opal*)	A
	UUG		UCG		UAG	Stop (*Amber*)	UGG	(Trp/W) Tryptophan	G
C	CUU		CCU	(Pro/P) Proline	CAU	(His/H) Histidine	CGU	(Arg/R) Arginine	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	(Gln/Q) Glutamine	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	(Ile/I) Isoleucine	ACU	(Thr/T) Threonine	AAU	(Asn/N) Asparagine	AGU	(Ser/S) Serine	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	(Lys/K) Lysine	AGA	(Arg/R) Arginine	A
	AUG[A]	(Met/M) Methionine	ACG		AAG		AGG		G
G	GUU	(Val/V) Valine	GCU	(Ala/A) Alanine	GAU	(Asp/D) Aspartic acid	GGU	(Gly/G) Glycine	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	(Glu/E) Glutamic acid	GGA		A
	GUG		GCG		GAG		GGG		G

36. The Anticodon AGA and AGG codes for ___
    a) Termination
    b) Arginine
    c) Tryptophan
    d) Serine

37. The Codon AGA and AGG codes for _____
    a) Arginine
    b) Serine
    c) Termination
    d) Tryptophan

38. With reference to the genetic code reading frame, which of the following is **INCORRECT**?
    a) No gaps present
    b) The code is non overlapping
    c) Flexible reading frame
    d) 5 → 3 direction reading frame

39. A lipase breaks a triacylglycerol molecule down into
    a) 2-monoacylglycerol plus two fatty acids.
    b) acetyl-glycerol plus two fatty acids.
    c) 2-monoacylglycerol plus one fatty acid.
    d) 2-monoacylglycerol plus three fatty acids.

40. Micelles of fatty acids in water are organized such that the _____face the solvent and the _____ are directed toward the interior.
    a) hydrophilic heads; hydrophilic tails
    b) carboxylic acid groups; hydrocarbon chains
    c) hydrophobic tails; hydrophilic heads
    d) hydrocarbon chains; carboxylic acid groups

Section One (1) Total: 40 Marks

SECTION 2

Specific Instructions: *Read each statement carefully and fill in the blank(s) with the* ***most*** *appropriate word(s) or phrase(s) to complete the sentences accurately.*

A. Outline the method used for fractionation and separation of cell components

1. The process of breaking open cells to study organelles is called:_____ .
   (1 mark)

2. The technique used to separate cellular components based on size and density as well as exploits differences in the sedimentation rate of biological particles of varying size and density. is called:
   _____
   _____ . (1 mark)

3. The lightest fractions, such as ribosomes, require _____ to be effectively separated. (1mark)

Total: 3 Marks

B. Explain the physical and chemical properties of water

1. The ability of water molecules to stick to each other due to hydrogen bonding is called: _____. (1 mark)

2. Water has a high _____, meaning it can absorb large amounts of heat with minimal temperature change. This property makes it ideal for regulating temperature in living organisms. (1 mark)

Total: 2 Marks

C. Describe the structure of amino acids

1. The basic structure of an amino acid consists of a central _____ atom bonded to an amino group, a carboxyl group, a hydrogen atom, and an R group. (1 mark)

2. The variable group in an amino acid, also known as the _____, determines its chemical properties. (1 mark)

3. Amino acids exist as _____ in solution, meaning they have both a positive and negative charge. (1 mark)

Relate the structure of proteins to its function

4. _____ bonds between cysteine residues help stabilize tertiary and quaternary protein structures. (1 mark)

Describe the process of protein synthesis

5. The molecule that carries amino acids to the ribosome during translation is _____. (1 mark)

Total: 5 Marks

D. Define terms associated with enzymes and explain enzyme specificity

1. The _____ model suggests that the active site of an enzyme has a specific shape that fits the substrate exactly. (1 mark)

2. The _____ model suggests that an enzyme changes shape to better accommodate the substrate. (1 mark)

3. Lipase demonstrates _____ specificity by acting on various triglycerides with ester bonds. (1 mark)

4. Glucose oxidase acts only on β-D-glucose and not α-D-glucose, showing _____ specificity. (1 mark)

5. Glucokinase acts only on glucose and not other sugars, which is an example of _____ specificity.
(1 mark)

Interpret graphs involving Km, Vmax, Michaelis Constant, and Lineweaver-Burke plot

6. The Michaelis constant (Km) is defined as the substrate concentration at which the reaction rate is _____ of Vmax. (1 mark)

7. A lower Km indicates a _____ affinity of the enzyme for its substrate. (1 mark)

Describe the role of components assisting enzyme interactions

8. Non-protein molecules that assist enzyme function are called _____. (1 mark)

9. Organic cofactors, often derived from vitamins, are called_____. (1 mark)

10. An enzyme with its cofactor attached is called a/an _____, whereas without its cofactor, it is called a/an _____ . (2 marks)

11. Tightly bound organic cofactors are referred to as _____. (1 mark)

Explain enzyme inhibitions

12. In uncompetitive inhibition, the inhibitor binds only to the _____ complex, preventing product formation. (1 mark)

Total: 13 Marks

E. Describe the structure of carbohydrates

1. Carbohydrates are composed of carbon, hydrogen, and oxygen in a ratio of _____ respectively. (1 mark)

2. A bond formed between two monosaccharides is called a _____bond. (1 mark)

Outline the metabolic processes of carbohydrates

3. Glycolysis produces two molecules of _____, ATP, and NADH per glucose molecule. (1 mark)

4. Under anaerobic conditions in humans, pyruvate is converted into _____ to regenerate NAD^+. (1 mark)

Explain the role of carbohydrates in the regulation of blood glucose levels by naming the PROCESS involved:

5. Glucagon stimulates _____ in the liver to increase blood glucose levels. (1 mark)

Total: 5 Marks

F. Describe nucleosides, nucleotides, and their role in the formation of nucleic acids

1. The sugar found in both DNA and RNA is _____. (1 mark)

2. The backbone of nucleic acids is formed by _____ bonds linking adjacent nucleotides. (1 mark)

Differentiate between purines and pyrimidines

3. Two (2) pyrimidine bases found in RNA are:
   i) _____
   ii) _____
   (cytosine /uracil)

(2 marks)

4. Purines have a _____-ring structure, while pyrimidines have a _____ -ring structure. (2 marks)

Discuss the importance of ATP in energy production

5. The energy stored in ATP is released when a _____ group is removed by hydrolysis. (1 mark)

Explain the biological roles of DNA and RNA

6. The process of copying DNA to RNA is called _____, while the process of making proteins from RNA is called _____. (2 marks)

7. During translation, mRNA codons are matched with _____ on tRNA molecules to ensure proper protein synthesis. (1 mark)

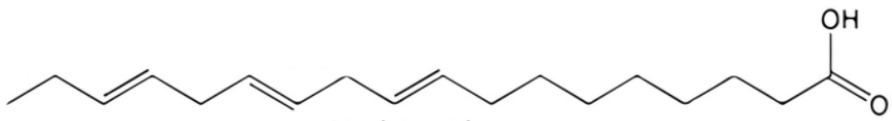
Explain formation of triplet code through base pairing and its role in protein synthesis

8. The start codon in mRNA is _____, which codes for the amino acid _____. (2 marks)

Total: 12 Marks

G. Describe the structure and properties of various types of lipids

1. Phospholipids have a hydrophilic _____ head and hydrophobic _____ tails. (2 marks)



Linoleic acid

2. The **CORRECT** name for the above fatty acid (Linoleic acid) using the **omega (ω)** nomenclature system is:

_____

(2 marks)

3. The **CORRECT** name for the above fatty acid (Linoleic acid) using the **delta (Δ)** nomenclature system is:

_____

(2 marks)

Arachidonic acid

4. The **CORRECT** name for the above fatty acid (Arachidonic acid) using the **omega (ω)** nomenclature system is:

_____

(2 marks)

5. The **CORRECT** name for the above fatty acid (Arachidonic acid) using the **delta (Δ)** nomenclature system is:

_____

(2 marks)

Total: 10 Marks

Section Two (2) Total: 50 Marks

END OF EXAMINATION