(Pages : 3) J – 1328

Reg. No. : 2471813a008...

Name : Begum Nazsin...

Fourth Semester B.Sc. Degree Examination, March 2020

Career Related First Degree Programme Under CBCSS

2(a) – Botany and Biotechnology

Complementary Course

BB 1431 : METABOLISM

(2014 Admission onwards)

Time : 3 Hours Max. Marks : 80

SECTION – I

(Very Short Answer Type- maximum two sentences)

Answer **all** questions.

1. What is meant by 'energy investment phase' of glycolytic pathway?
2. Name a hormone that acts as an activator of glycogen phosphorylase.
3. Name an ω 3 fatty acid which is essential to humans.
4. How many ATP molecules are produced by the complete oxidation of one molecule of palmitic acid?
5. Name a protein digesting enzyme found in the stomach of infants and children, but absent in adults.
6. Which is the reaction catalysed by alanine amino transferase?

P.T.O.

7. Define P/O ratio.

8. What are uncouplers of oxidative phosphorylation?

9. What is the wobble position of a codon?

10. What is meant by a primary transcript?

(10 × 1 = 10 Marks)

SECTION – II

(Short Answer Questions- not to exceed one paragraph)

Answer any **eight** questions.

11. Describe the extend up to which carbohydrates are digested in the mouth.

12. List out the irreversible reactions of glycolysis.

13. Compare mitochondrial and peroxisomal β oxidation of fatty acids.

14. What are micelles? Describe the role of micelle formation in the digestion of lipids.

15. Name the proteolytic enzymes of the GI tract. Why they do not cause any proteolytic damage to the cells of their formation?

16. Compare the absorption of D and L amino acids in the small intestine.

17. Differentiate between oxidative and substrate level phosphorylations.

18. Why ATP is considered as a high energy compound? Explain with the help of its structure.

19. Give two examples for inhibitors of electron transport chain. How do they act?

20. How do you explain degeneracy of genetic code?

21. Define start and stop codons.

22. What are promoters? Where are they located?

(8 × 2 = 16 Marks)

SECTION – III

(Short Essay - not to exceed 120 words)

Answer any **six** questions.

23. Describe cori cycle and explain its significance.
24. How glycogen metabolism is allosterically regulated?
25. What is meant by emulsification? How emulsifiers play a major role in the digestion and absorption of lipids?
26. Describe the physiological functions of phospholipids.
27. Give an account of urea cycle.
28. Explain why the process of ATP production by electron transport in mitochondrial membrane is called oxidative phosphorylation.
29. Explain the role of high energy phosphate groups in bioenergetics.
30. Give an account of the arrangement of DNA in chromosomes.
31. Give an account of the structure and functions of tRNA.

(6 × 4 = 24 Marks)

SECTION –IV

(Long Essay)

Answer any **two** questions.

32. Give an account of the digestion and absorption of carbohydrates.
33. Explain the biosynthesis of cholesterol and bile acids. Describe their functions.
34. Explain the process of mitochondrial electron transport and ATP production.
35. Describe the major events involved in prokaryotic transcription.

(2 × 15 = 30 Marks)

(Pages : 3) **G – 4200**

Reg. No. : .....

Name : .....

Fourth Semester B.Sc.Degree Examination, July 2019

Career Related First Degree Programme under CBCSS

Group 2(a) : Botany and Biotechnology

Complementary Course : BB 1431: METABOLISM

(2014 Admn onwards)

Time : 3 Hours, Maximum Marks : 80

SECTION – A

Answer **all** questions in one or two sentences. Each question carries 1 mark

1. Comment on zymogen activation of proteolytic enzymes.
2. What is transamination?
3. Name the coenzymes involved in transamination.
4. What is oxidative phosphorylation?
5. What are essential fatty acids?
6. What is the role of salivary amylase?
7. Write the functions of bile.
8. Name two inhibitors of electron transport chain.
9. What is the role of pyrophosphate bond?
10. What are okazaki fragments?

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

Answer any **eight** questions. Each question carries 2 marks. Answer not to exceed **one** paragraph.

11. What are phospholipids? Give an example.

12. Explain redox reactions.

13. Comment on chemiosmotic hypothesis.

14. Write the structure of ATP.

15. What are DNA polymerases?

16. What are nucleosomes?

17. What is gluconeogenesis?

18. What are lipases?

19. Comment on creatine phosphate as a high energy compound.

20. Explain Shine Dalgarno sequence.

21. Explain peptide bond formation.

22. Enumerate the properties of genetic code.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Explain urea cycle.

24. What are the different types of RNA? Add a note on their functions.

25. Write the structure of DNA.

26. Outline the reactions of glycolysis.

27. Briefly explain control of glycogen metabolism.

28. Give description on pentose phosphate pathway.

29. Outline Cori cycle.

30. How are bile acids syntheszed in liver?

31. What are the physiological functions of phospholipids?

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions (Not more than three pages). Each question carries 15 marks

32. Explain mitochondrial electron transport chain? Draw Diagram.

33. Write an essay on protein synthesis in prokaryotes.

34. Explain glycogen metabolism.

35. Outline the biosynthesis of cholesterol.

(2 × 15 = 30 Marks)

Section A

Answer all questions. Each bunch of four questions carries weightage 1

Section A: Answer all questions: (10x 1= 10 marks)

1. **Comment on zymogen activation of proteolytic enzyme.**
   - The key enzyme for activation of zymogen is enteropeptidase (formerly enterokinase) produced by intestinal (mostly duodenal) mucosal epithelial cells. Enteropeptidase cleaves off a hexapeptide (6 amino acid fragment)from the N- termina end of trypsinogen to produce trypsin, the active enzyme. Trypsin, in turn, activates other trypsinogen molecules (autocatalysis) Further, trypsin is the common activator of all other pancreatic zymogens to produce the active proteases, namely chymotrypsin, elastase and carboxypeptidase(sA and B).

2. **What is Transamination?**
   - Transfer of an amino group from an amino acid to a keto acid to form a new amino acid.

3. **Name the coenzyme involved in transamination.**
   PLP

4. **What is oxidative phosphorylation.?**
   - The transport of electrons through the ETC is linked with the release of free energy. The process of synthesizing ATP from ADP and Pi coupled with the electron transport chain is known as oxidative phosphorylation

5. **What are essential fatty acids.**
   - The unsaturated fatty acids which the body cannot synthesize and, therefore, must be consumed in the diet are referred to as essential fatty acids (EFA).
   - The fatty acids-linoleic , linolenic acid and arachidonic acid are essential fatty acids.

6. **What is the role of salivary amylase?**

   Salivary amylase (also known as ptyalin) breaks down starches into smaller, simpler sugars.

7. **Write the functions of bile.**
   1. Digestion Bile is essential for the complete digestion of fats and to some extent of proteins and carbohydrates
   2. Absorption:Bile helps in the absorption of Fats, Iron, Calcium, vitamins
   3. Excretion: Certain substances are excreted through bile, for instance:
      i. Some metals like copper, zinc, mercury, etc.
      ii. Toxins, bacteria, etc.
      iii. Bile pigments.

8. **Name two inhibitors of electron transport chain.**
   - Carbon monoxide, cyanide, hydrogen sulphide, azide Fish polson rotenone, barbituate drug amytal , antibiotic piercidin A, and Antimycin A

9. **What is the role of pyrophosphate bond?**
   - A **pyrophosphate bond** is a high potential energy **bond** between two phosphate groups.

10. **What are okazaki fragments?**
    - The small fragments of the discontinuously synthesized DNA are called okazaki fragments.

Section B: Answer any eight of the following questions: (8x 2= 16 marks)

11. What are phospholipids? Give one Example.

- These are complex or compound lipids containing phosphoric acid, in addition to fatty acids, nitrogenous base and alcohol. E.g Lecithin, Cephalin, plasmalogens, Cardiolipin,sphingomyelin etc

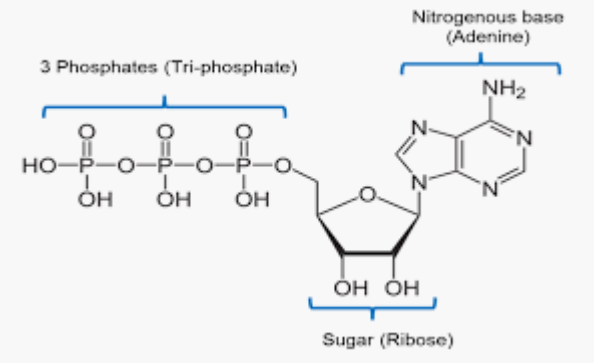
12. Explain redox reaction.

- An oxidation-reduction (redox) reaction is a type of chemical reaction that involves a transfer of electrons between two species. An oxidation-reduction reaction is any chemical reaction in which the oxidation number of a molecule, atom, or ion changes by gaining or losing an electron

13. Comment on chemiosmotic hypothesis.

- Chemiosmosis is the movement of ions across a selectively permeable membrane, down their electrochemical gradient. More specifically, it relates to the generation of ATP by the movement of hydrogen ions across a membrane during cellular respiration.
- Peter D. Mitchell proposed the chemiosmotic hypothesis in 1961.[1] The theory suggests essentially that most ATP synthesis in respiring cells comes from the electrochemical gradient across the inner membranes of mitochondria by using the energy of NADH and FADH2 formed from the breaking down of energy-rich molecules such as glucose.
- Hydrogen ions (protons) will diffuse from an area of high proton concentration to an area of lower proton concentration. Peter Mitchell proposed that an electrochemical concentration gradient of protons across a membrane could be harnessed to make ATP. He linked this process to osmosis, the diffusion of water across a membrane, which is why it is called chemiosmosis.
- ATP synthase is the enzyme that makes ATP by chemiosmosis. It allows protons to pass through the membrane and uses the kinetic energy to phosphorylate ADP, making ATP. The generation of ATP by chemiosmosis occurs in chloroplasts and mitochondria as well as in most bacteria

14. Write the structure of ATP.



15. What are DNA polymerases.

- DNA polymerase is an enzyme that synthesizes DNA molecules from deoxyribonucleotides, the building blocks of DNA.
- These enzymes are essential for DNA replication and usually work in pairs to create two identical DNA strands from a single original DNA molecule. In eukaryotic cells
- , DNA polymerases can be found in the nucleus, mitochondria and chloroplasts. In prokaryotic cells, the DNA polymerases are located in the cytoplasm
- The function of DNA polymerase is to replicate, proofread and repair DNA. Several DNA polymerases exist, but DNA polymerase I, or Pol I, and DNA polymerase III, or Pol III, are the main ones involved in DNA replication.

16. What are nucleosomes?

- Nucleosomes are structural unit of a eukaryotic chromosome, consisting of a length of DNA coiled around a core of histones. Inside the nucleus, DNA forms a complex with proteins called chromatin, which allows the DNA to be condensed into a smaller volume.

17. What is gluconeogenesis?

- Gluconeogenesis is a metabolic pathway that results in the generation of glucose from certain non-carbohydrate carbon substrates like lactate, pyruvate, Alanine, glutamine, (glucogenic amino acids) fatty acids, glycerol etc . It is an an important pathway that allows the body to store needed energy for the brain in the form of glucose

18. What are lipases.

- Lipase is an enzyme that breaks down triglycerides into free fatty acids and glycerol. Lipases are found in the blood, gastric juices, pancreatic secretions, intestinal juices, and adipose tissues..

19. Comment on creatine phosphate as a high energy compound.

- Creatine phosphate is a phosphorylated creatine molecule that serves as a rapidly mobilizable reserve of high-energy phosphates in skeletal muscle and the brain to recycle ATP.
- In the process of regeneration of ATP, creatine phosphate transfers a high-energy phosphate to ADP. The products of this reaction are ATP and creatine.

20. Explain shine dalgarno sequence.

- The Shine-Dalgarno sequence, proposed by Australian scientists John Shine and Lynn Dalgarno, is a ribosomal binding site in the mRNA, generally located 8 bases upstream of the start codon AUG.
- This sequence helps recruit the ribosome to the mRNA to initiate protein synthesis by aligning it with the start codon

21. Explain peptide bond formation.

- A peptide bond is a chemical bond formed between two molecules when the carboxyl group of one molecule reacts with the amino group of the other molecule, releasing a molecule of water . The enzyme peptidyltransferase catalyses the formation of peptide bond

22. Enumerate the properties of Genetic Code.

- The important properties of genetic code are: (1) Code is a Triplet (2) The Code is Degenerate (3) The Code is Non-overlapping (4) The Code is Comma Less (5) The Code is Unambiguous (6) The Code is Universal

Section C: Answer any Six of the following questions: (6x 4= 24 marks)

23. Explain urea cycle.

- Urea is the end product of protein metabolism (amino acid metabolism). The nitrogen of amino acids, converted to ammonia is toxic to the body. It is converted to urea and detoxified.
- rea is synthesized in liver and transported to kidneys for excretion in urine
- Urea has two amino (-NH_2) groups, one derived from NH_3 and the other from aspartate. Carbon atom is supplied by CO_2. Urea synthesis is a five-step cyclic process, with five distinct enzymes. The first two enzymes are present in mitochondria while the rest are localized in cytosol
    - Synthesis of carbamoyl phosphate
    - Formation of citrulline
    - Synthesis of arginosuccinate
    - Cleavage of arginosuccinate :
    - Formation of urea :
    - Overall reactions and energetic
    - Diagram

24. What are the different types of RNA?Add a note on their functions.

The three major types of are

. Messenger RNA (mRNA) : Transfers genetic information from genes to tibosomesto synthesize proteins

2. Transfer RNA (IRNA) : Transfers amino acids to mRNA for protein biosynthesis.

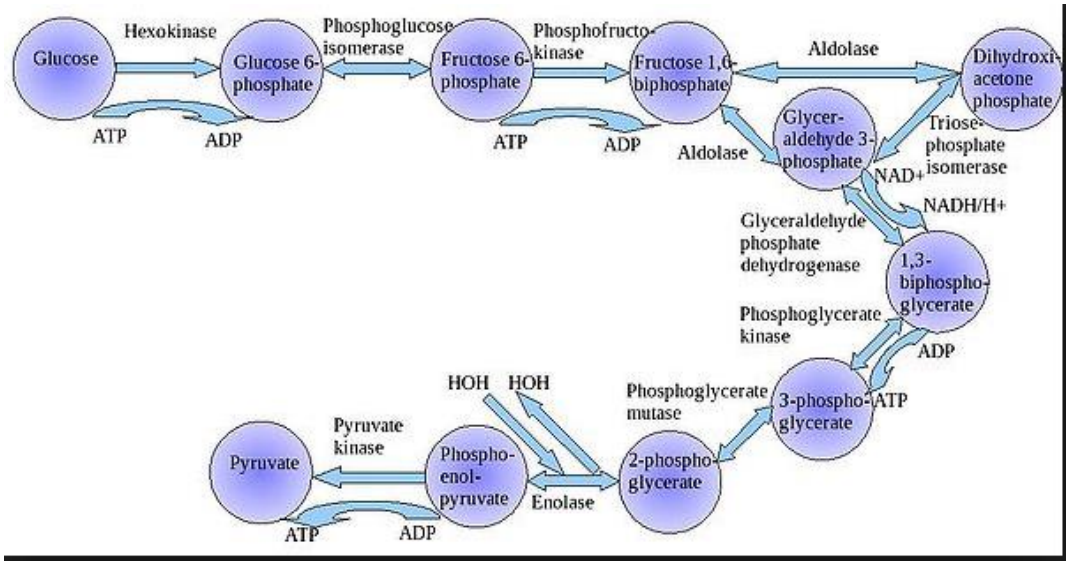
3. Ribosomal RNA (rRNA) : provides structural framework for ribosomes.

25. Write the structure of DNA.

- The DNA is a right handed double helix. It consists of two polydeoxyribonucleotide chains (strands) twisted around each other on a common axis.
- The two strands are antiparallel, i.e., one strand runs in the 5' to 3' direction while the other in 3' to 5'direction.
- The width (or diameter) of a double helix is 20 A° (2 nm).
- . Each turn (pitch) of the helix is 34 A° (3.4 nm) with 10 pairs of nucleotides, each pair placed at a distance of about 3.4 A°.
- Each strand of DNA has a hydrophilic deoxyribose phosphate backbone(3'-5' phosphodiesterbonds) on the outside (periphery)o f the molecule while the hydrophobic bases are stacked inside (core).
- The two polynucleotide chains are not identical but complementary to each other due to base pairing
- The two strands are held together by hydrogen bonds formed by complementary base pairs .The A-T pair has 2 hydrogen bonds while G-C pair has 3 hydrogen bonds.
- The hydrogen bonds are formed between a purine and a pyrimidine only. A-T, T-A, G-C and C-C.
- The complementary base pairing in DNA helix proves Chargaffs rule. The content of adenine equals to that of thymine (A = T) and guanine equals to that of cytosine (G = C).
- The genetic information resides on one of the two strands known as template strand or

26. Outline the reactions of glycolysis.

- Glycolysis is defined as the sequence of reactions converting glucose (or glycogen) to pyruvate or lactate, with the production of ATP.
- The pathway can be divided into three distinct phases
  - A. Energy investment phase or priming stage
  - B. Splitting phase
  - C. Energy generation phase



27. Briefly explain the control of glycogen metabolism.

Hormonal regulation:

1) Glucagon and epinephrine – Glucagon and epinephrine stimulate glycogenolysis by stimulating Glycogen phosphorylase enzyme activity.
2) Insulin – Insulin inhibits glycogenolysis by inhibiting Glycogen phosphorylase enzyme activity.

Coordinate and reciprocal regulation of glycolysis and gluconeogenesis by hormonal regulation of cAMP-dependent kinase and phosphorylation of enzymes that regulate the turnover of a key allosteric regulator F2,6-BP:

1. High blood glucose → drop in glucagon → decrease in protein phosphorylation → rise in F2,6-BP → glycolysis stimulated and gluconeogenesis inhibited
2. Low blood glucose → rise in glucagon →increase in protein phosphorylation →drop in F2,6-BP → glycolysis inhibited and gluconeogenesis stimulated

Changes in protein phosphorylation regulate glycogen synthesis and breakdown:
1. High blood glucose → drop in glucagon and rise in insulin → decrease in protein phosphorylation → glycogen synthase active and glycogen phosphorylase inactive →glycogen synthesis
2. Low blood glucose → rise in glucagon and drop in insulin →increase in protein phosphorylation →glycogen synthase inactive and glycogen phosphorylase active →glycogen breakdown

28. Give description on pentose phosphate pathway.

The sequence of reactions of HMP shunt is divided into two phases-oxidative and non-oxidative.

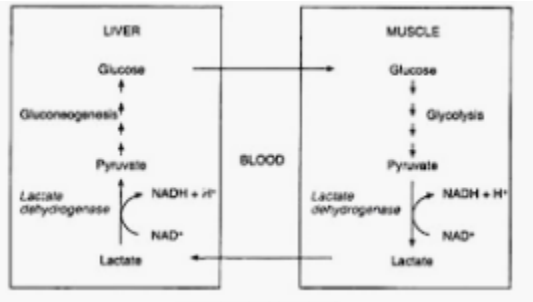
1. **Oxidative phase** : Glucose 6-phosphate dehydrogenase is an NADP-dependent enzyme that converts glucose 6-phosphate to 6-phosphogluconolactone. The latter is then hydrolysed by the gluconolactone hydrolase to 6-phosphogluconate. The next reaction involving the synthesis of NADPH is catalysed by 6-phosphogluconate dehydrogenase to produce 3 keto 6-phosphogluconate which then undergoes decarboxylation to give ribulose5 -phosphate.
2. **Non-oxidative phase** : The non-oxidative reactions are concerned with the interconversion of three, four, five and seven carbon monosaccharides. Ribulose 5 –phosphate is acted upon by an epimerase to produce xylulose 5-phosphate while ribose5 -phosphatek etoisomerase converts ribulose5 -phosphateto ribose 5-phosphate

Significance:- HMP shunt is unique in generating two important products-pentoses and NADPH needed for the biosynthetic reactions and other functions.

Diagram

29. Outline Cori cycle.

- Lactate produced by active skeletal muscle is a major precursor for gluconeogenesis. Under anaerobic conditions, pyruvate is reduced to lactate by lactate dehydrogenase L DH)
- The plasma membrane is freely permeable to lactate. Lactate is carried from the skeletal muscle through blood and handed over to liver, where it is oxidized to pyruvate. Pyruvate, so produced, is converted to glucose by Gluconeogenesis, which is then transported to the skeletal muscle.
- The cycle involving the synthesis of glucose in liver from the skeletal muscle lactate and the reuse of glucose thus synthesized by the muscle for energy purpose is known as Cori cycle



30. How are bile acids synthesized in liver?

- The synthesis of primary bile acids takes place in the liver and involves a series of reactions. The step catalysed by 7 a-hydroxylase is inhibited by bile acids and this is the rate Limiting reaction. Cholic acid and chenodeoxycholic acid are the primary bile acids.
- On conjugation with glycine or taurine, conjugated bile acids (glycocholic acid, taurocholic acid etc.) are formed which are more efficient in their function as surfactants. In the bile, the conjugated bile acids exist as sodium and potassium salts which are known as bile salts.

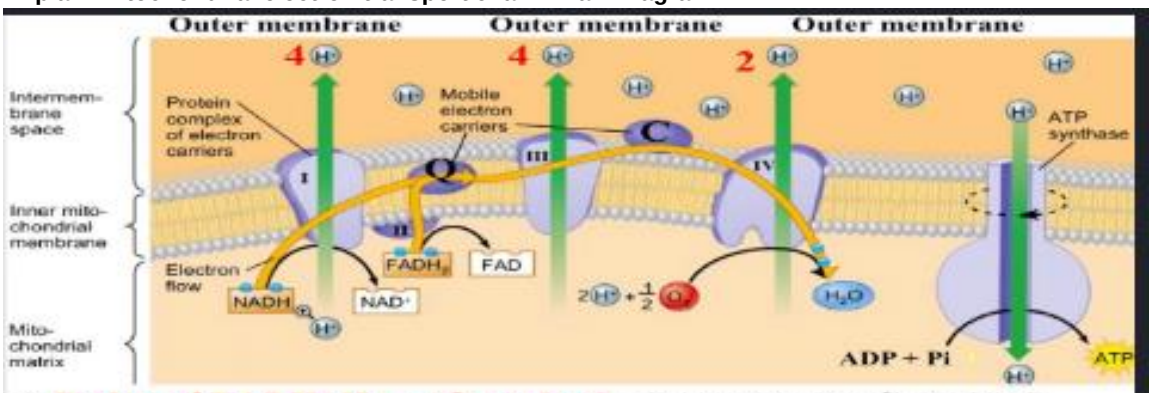
- In the intestine a, portiono f primary bile acids undergoes deconjugation and dehydroxylation to form secondary bile acids (deoxycholic acid and lithocholic acid). These reactions are catalysed by bacterial enzymes in the intestine
-

31. What tare the physiological functions of phospholipids?

1. In association with proteins, phospholipids form the structural components of membranes and regulate membrane permeability.
2. Phospholipids (lecithin, cephalin and cardiolipin) in the mitochondria are responsible for maintaining the conformation of electron transport chain components, and thus cellular respiration.
3. Phospholipids participate in the absorption of fat from the intestine.
4. Phospholipids are essential for the synthesis of different lipoproteins, and thus participate in the transport of lipids.
5. Accumulation of fat in liver (fatty liver) can be prevented by phospholipids, hence they are regarded as lipotropic factors.
6. Arachidonica cid, an unsaturated fatty acid liberated from phospholipids, serves as a precursor for the synthesis of eicosanoids .
7. Phospholipids participate in the reverse cholesterol transport and thus help in the removal of cholesterol from the body.

Section D: Answer any Two of the following questions: (2x 15= 30 marks)

32. Explain mitochondrial electron transport chain. Draw Diagram.



1. **Redox of NADH+H+ at Complex I**, electrons go to Complex I, four protons pumped from matrix to intermembrane space
2. **Redox of $FADH_2$ at Complex II**, Coenzyme Q picks up electrons (from Complex I and II) and transports to Complex III
3. **Redox of Complex III**, four protons pumped from matrix to intermembrane space, carrier C transports electrons to Complex IV
4. **Redox of Complex IV**, two protons pumped from matrix to intermembrane space, formation of H_20 (20% of water in body)
5. **ATP Synthase action**, pumps protons from intermembrane space to matrix, produces ATP from ADP + Pi + energy

33. Write an essay on protein synthesis in prokaryotes.

- Initiation of translation : - In prokaryotes The formation of translation initiation complex in prokaryotes is less complicated compared to eukaryotes. The 30S ribosomal subunit is bound to initiation factor 3 (IF-3) and attached to ternary complex of IF-2, formyl met- IRNA and CTP. Another initiation factor namely IF-I also participates in the formation of preinitiation complex. The recognition of initiation codon AUG is done

through Shine- Dalgarno sequence.A 50S ribosome unit is now bound with the 30S unit to produce 70S initiation complex in prokaryotes.

- Elongation of Translation : Ribosomes elongate the polypeptide chain by a sequential addition of amino acids. The amino acid sequence is determined by the order of the codons in the specific mRNA. Elongation, a cyclic process involving certain elongation factors (EFs) m ay be divided into three steps
    1. Binding of aminoacyl I-RNA to A-site.
    2. Peptide bond formation.
    3. Translocation.
    - The termination codons which act as stop signals do not have specific tRNAs to bind. As the termination codon occupies the ribosomal .A-site, the release factor namely eRF recognizes the stop signal. eRF-CTP complex, in association with the enzyme peptidyltransferase cleaves the peptide bond between the polypeptide and the tRNA occupying P-site. ln this reaction, a water molecule, instead of an amino acid is added. This hydrolysis releases the protein and tRNA from the P-site.

34. Explain glycogen metabolism.

Write in detail about

Glycogenesis: The formation of glycogen from glucose.

1. Synthesis of UDP-glucose
2. Requirement of primer to initiate glycogenesis
3. Glycogen synthesis by glycogen synthase
4. Formation of branches in glycogen

Glycogenolysis : The breakdown ofglycogen to glucose.

1. Action of glycogen phosphorylase
2. Action of debranching enzyme
3. Formation of glucose 6-phosphate and glucose

35. Outline the Biosynthesis of cholesterol.

1. Synthesis of HMG CoA
2. Formation of mevalonate (6C)
3. Production of isoprenoid units (5C)
4. Synthesis of squalene(30C)
5. Conversion of squalene to cholesterol (27C).
6. Diagram

(Pages : 2)

C – 3919

Reg. No. : 24732014

Name : Varsha

Fourth Semester B.Sc. Degree Examination, July 2017
Career Related First Degree Programme Under CBCSS
GROUP 2(A) : BOTANY AND BIOTECHNOLOGY
Complementary Course
BB 1431 : METABOLISM
(2014 Admission)

Time : 3 Hours

Max. Marks : 80

SECTION – I

Very short answer type-maximum **two** sentences. (Answer **all** questions). **(10×1=10 Marks)**

1. Which is the coenzyme of aspartate transaminase ?
2. List any two functions of phospholipids.
3. Which is the key enzyme of cholesterol biosynthesis ?
4. Name any two hormones involved in the regulation of carbohydrate metabolism.
5. Name the site of synthesis and degradation of fatty acids.
6. What is substrate level phosphorylaton.
7. How is glucose absorbed from intestinal lumen to cells ?
8. Name the key enzymes of gluconeogenesis.
9. What is omega oxidation ?
10. Write down the structure of 1, 3 bisphosphoglycerate.

SECTION – II

Short answer type-**not** to exceed **one** paragraph. (Answer **any eight** questions).
(8×2=16 Marks)

11. Describe Cori cycle.
12. What are ketone bodies ? How are they formed ?
13. Write a note on the formation and functions of bile acids.
14. Explain the formation of amino acyl tRNA.

P.T.O.

15. What are the functions of mRNA, tRNA and rRNA ?
16. Describe the formation of peptide bond during the synthesis of proteins.
17. Describe the properties of genetic code.
18. What is α oxidation ?
19. What do you mean by P/O ratio ?
20. What is the importance of Urea Cycle ?
21. What is the fate of pyruvate formed during glycolysis ?
22. What are zymogens ? How are they activated ?

SECTION – III

Short essay **not** to exceed **120** words. (Answer **any six** questions). **(6×4=24 Marks)**

23. Briefly explain the reactions of pentose phosphate pathway.
24. Describe the degradation of glycogen.
25. Describe the structure of tRNA.
26. Explain the chemiosmotic coupling hypothesis.
27. Describe the structure of nucleosome.
28. Discuss the process of transcription.
29. Explain with one example deamination and transamination.
30. Discuss the action of the various enzymes involved in the digestion of proteins in the gastro intestinal tract.
31. Outline the steps of the biosynthesis of ethanolamine.

SECTION – IV

Long Essay. (Answer **any two** questions). **(15×2=30 Marks)**

32. Give a detailed account of the glycolytic pathway. Add a note on the regulation of glycolysis.
33. Explain the digestion and absorption of lipids.
34. Describe the biosynthesis of fatty acids and the regulation of the pathway.
35. Explain the role of enzymes and other proteins that participate in the replication of DNA.

(Pages : 3) **A – 3480**

Reg. No. : 24711413 2002

Name : AMAL RAJ

Fourth Semester B.Sc. Degree Examination, June 2016
Career Related First Degree Programme under CBCSS
Group 2(a) BOTANY AND BIOTECHNOLOGY
Complementary Course
BB 1431 : Metabolism
(2014 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – I

Very Short Answer Type – Maximum **two** sentences.

Answer **all** questions. **(10×1=10 Marks)**

1. Name the essential fatty acids.
2. Which compound is the precursor of steroid hormones ?
3. State the functions of bile salts.
4. What happens if any of the enzymes of urea cycle are defective ?
5. What is wobble hypothesis ?
6. What is the fate of pyruvated formed during glycolysis ?
7. State the most important rate limiting step of glycolysis.
8. What is glycogenesis ?
9. What is the normal fasting blood glucose level ?
10. Write down the structure of creatine phosphate.

P.T.O.

SECTION – II

Short Answer Type – **Not** to exceed **one** paragraph. Answer **any eight** questions. **(8×2=16 Marks)**

11. What is the significance of pentose phosphate pathway ?
12. Distinguish with examples – uncouplers and inhibitors of electron transport.
13. What is shine dalgarno sequence ?
14. Describe the initiation of transcription.
15. Explain the structure of mRNA.
16. Name any two coenzymes involved in one carbon transfer reactions. State the nature of the group transferred.
17. How is glycogen metabolism regulated ?
18. Name the enzymes of fatty acid synthetase complex.
19. Describe the functions of DNA polymerase.
20. Write down the functions of topoisomerase and helicases.
21. What are histones ? What are the functions of various types of histones ?
22. Explain the synthesis of triglycerides ?

SECTION – III

Short Essay – **Not** to exceed **120** words. Answer **any six** questions. **(6×4=24 Marks)**

23. Discuss the steps of glycogen synthesis.
24. How are amino acids absorbed from the intestinal human ?
25. Describe the biosynthesis of cholesterol.
26. Explain the reactions of urea cycle.

27. Describe the structure of tRNA.

28. Differentiate with examples – oxidative phosphorylation and substrate level phosphorylation.

29. Write down the structures of any two high energy compounds. Why are they called so ?

30. Outline the steps in the synthesis of phosphatidyl choline.

31. Discuss the absorption of lipids in the gastro intestinal tract.

SECTION – IV

Long Essay. Answer **any two** questions. **(15×2=30 Marks)**

32. Describe the reactions of gluconeogenesis. How are glycolysis and gluconeogenesis coordinately regulated ?

33. Discuss the β oxidation of fatty acids. How many ATP molecules are produced by the β-oxidation of one molecule of palmitic acid ?

34. Discuss the various steps of translation.

35. Explain the pathway of electron transport in the inner mitochondrial membrane. Add a note on ATP synthesis.

Fourth Semester B.Sc Degree Examination, June 2016 SET – II

(Career related First Degree Programme under CBCSS)

Group 2 (a) Botany and Biotechnology

Complementary course - IV

BB 1431 :METABOLISM

(2013 admission)

Max.Marks: 80

Time: 3 hrs

Answer key

SECTION – A

I. Answer all questions in one word to two sentences. Each question carries 1 mark

1. FAD (flavin adenine dinucleotide): The coenzyme of some oxidation-reduction enzymes; it contains riboflavin
2. Translation: The process in which the genetic information present in an mRNA molecule specifies the sequence of amino acids during protein synthesis.
3. Name the product of glycolysis-pyruvic acid
4. Unsaturated fatty acid: A fatty acid containing one or more double bonds
5. Oxidative phosphorylation: The enzymatic phosphorylation of ADP to ATP coupled to electron transfer from a substrate to molecular oxygen
6. Glycogenesis-definition
7. Nonsense codon: A codon that does not specify an amino acid, but signals the termination of a polypeptide chain.
8. α-oxidation-oxidation of the fatty acid at the α carbon-any relevant point
9. Nucleoside- A compound consisting of a purine or pyrimidine base covalently linked to a pentose.
10. Polypeptide: A long chain of amino acids linked by peptide bonds

(10x1=10 marks)

SECTION -B

II. Answer any eight questions; not to exceed a paragraph. Each question carries two marks.

11. Pyrimidine: A nitrogenous heterocyclic base found in nucleotides and nucleic acids. Eg.Cytosine, uracil - 2 marks

12. Termination codons: UAA, UAG, and UGA; in protein synthesis, signal the termination of a polypeptide chain. Also known as stop codons - 2 marks
13. Deamination: The enzymatic removal of amino groups from biomolecules such as amino acids or nucleotides-explanation with example - 2 marks
14. Essential fatty acids: The group of polyunsaturated fatty acids produced by plants, but not by humans; required in the human diet-explanation with example - 2 marks
15. Malonyl coA Is Formed from Acetyl-CoA and Bicarbonate.The irreversible formation of malonyl-CoA from acetyl-CoA is catalyzed by acetyl-CoA carboxylase . Acetyl-CoA carboxylase contains biotin as its prosthetic group, covalently bound in amide linkage to the ε-amino group of a Lys residue on one of the three subunits of the enzyme molecule. The two-step reaction is very similar to other biotin-dependent carboxylation reactions, such as those catalyzed by pyruvate carboxylase and propionyl-CoA carboxylase . The carboxyl group, derived from bicarbonate (HCO_3), is first transferred to biotin in an ATP-dependent reaction. The biotinyl group serves as a temporary carrier of CO_2, transferring it to acetyl-CoA in the second step to yield malonyl-CoA. - 2 marks
16. Shine-Dalgarno sequence: A sequence in an mRNA required for binding prokaryotic ribosomes The initiation of protein synthesis in bacteria starts with the formation of a complex between the smaller 30S subunit, the starting aminoacyl tRNA complex and the messenger RNA molecule. This complex formation is aided by the initiation factors IF present in the 30S sub unit in presence of IF_3. Each specific mRNA chain contains one to several ribosome binding regions having nucleotide sequence (Shine–Dalgarno sequence) whose sole function is correct lining up of mRNA molecules on ribosome surfaces. Virtually all-binding sites on mRNA have an AGGA sequence or a close derivative which base pair with a pyrimidine rich section at the 3' end of the 16S rRNA. This pairing brings the AUG codon, upon which the protein synthesis has to be initiated in to a position so that it can bind to the anticodon of the first aminoacyl tRNA complex - 2 marks
17. Replication forks - replicating DNA molecule must spin 300 revolutions per minute to facilitate the unwinding of the parental DNA strands. This furious process of unwinding raises the possibility of positive super coils developing ahead of the replication fork. Such super coils are relaxed by the DNA topoisomeres. The topoisomerases catalyze transient breaks in DNA molecules but use covalent linkages to hold on to the cleaved molecules. These transient breaks provide an axis of rotation that allows the segments of DNA on opposite sides of the break to spin independently. Thus during DNA replication, only a short segment of DNA in front of the replication fork need to spin – the segment up to the closest transient nick by topoisomerase. The replication begins at a specific initiation site in a double helix at which a nick is produced in one of the

two strands of the double helix. The nick produced by an endonuclease enzyme enables the cut strands to unwind there by forming two single stranded templates. The opposing chain directions of (5'-3' and 3'-5') of the two strands of a double helix mean that the two daughter strands being synthesized in each replication fork must also run in opposite directions. But the DNA polymerases are strictly direction oriented and can synthesize DNA only in the 5'-3' direction - 2 marks.

18. Free energy (G): The component of the total energy of a system that can do work at constant temperature and pressure. free-energy change (ΔG): The amount of free energy released (negative ΔG) or absorbed (positive ΔG) in a reaction at constant temperature and pressure - 2 marks

19. Chemiosmotic coupling:Coupling of ATP synthesis to electron transfer via an electrochemical H^+ gradient across a membrane. Chemiosmotic theory provides the intellectual framework for understanding many biological energy transductions, including the processes of oxidative phosphorylation in mitochondria and photophosphorylation in chloroplasts. The mechanism of energy coupling is similar in both cases. The conservation of free energy involves the passage of electrons through a chain of membrane-bound oxidation-reduction (redox) carriers and the concomitant pumping of protons across the membrane, producing an electrochemical gradient, the protonmotive force. This force drives the synthesis of ATP by membrane-bound enzyme complexes through which protons flow back across the membrane, down their electrochemical gradient. Proton motive force also drives other energy-requiring processes of cells. - 2 marks

20. Nucleosomes- Structural unit for packaging chromatin; consists of a DNA strand wound around a histone core-explanation - 2 marks

21. Inhibitors of electron transport chain-cyanides-explanation - 2 marks

22. Structure of tRNA-explanation - 2 marks.

(8x2 = 16 marks)

SECTION -C

III. Answer any six questions, not to exceed 120 words. Each question carries four marks

23. Explain the Fate of pyruvate in alcoholic fermentation-Three alternative catabolic routes are taken by the pyruvate formed by glycolysis. In aerobic organisms or tissues, under aerobic conditions, glycolysis constitutes only the first stage in the complete degradation of glucose . Pyruvate is oxidized, with loss of its carboxyl group as CO_2, to yield the acetyl group of acetylcoenzyme A, which is then oxidized completely to CO_2 by the citric acid cycle. The electrons from these oxidations are passed to O_2 through a chain of carriers in

mitochondrion, forming H_2O. The energy from the electron transfer reactions drives the synthesis of ATP in the mitochondrion.

The second route for pyruvate metabolism is its reduction to lactate via lactic acid fermentation. When a tissue such as vigorously contracting skeletal muscle must function anaerobically, the pyruvate cannot be oxidized further for lack of oxygen. Under these conditions pyruvate is reduced to lactate. Certain tissues and cell types (retina, brain, erythrocytes) convert glucose to lactate even under aerobic conditions. Lactate (the dissociated form of lactic acid) is also the product of glycolysis under anaerobic conditions in microorganisms that carry out the lactic acid fermentation . The third major route for catabolism of pyruvate leads to ethanol. In some plant tissues and in certain invertebrates, protists, and microorganisms such as brewer's yeast, pyruvate is converted anaerobically into ethanol and CO_2, a process called alcohol (or ethanol) fermentation – 4 marks

24. In the overall reaction catalyzed by the mitochondrial respiratory chain, electrons move from NADH, succinate, or some other primary electron donor through flavoproteins, ubiquinone, iron-sulfur proteins, and cytochromes (nearly all of which are embedded in the inner membrane), and finally to O_2. The sequence in which the carriers act has been deduced in several ways.The carriers function in order of increasing reduction potential, because electrons tend to flow spontaneously from carriers of lower E'_0 to carriers of higher E_0. The order of carriers deduced by this method is NADH, UQ, cytochrome b, cytochrome cl, cytochrome c, cytochrome a + a_3. - 4 marks
25. Glycogenolysis-explanation - 4 marks
26. Decarboxylation of amino acids-explanation with example - 4 marks.
27. **β oxidation:** Oxidative degradation of fatty acids into acetyl-CoA by successive oxidations at the β-carbon atom – 4 marks
28. Physiological functions of phospholipids - 4 marks
29. Okazaki **fragments** - At the molecular level the synthesis of the complementary strands of DNA is occurring in opposite physical directions. The synthesis of the strand being extended in the overall 5'-3' direction, called the leading strand is continuous. T he strand being extended in overall 3'-5' direction, called the lagging strand grows by the synthesis of short fragments (synthesized 5'-3') and the subsequent covalent joining. Thus the synthesis of the lagging strand occurs by a discontinuous mechanism. These short fragments of DNA synthesized on the discontinuous strands are called Okazaki fragments after Reiji and Tuneko Okazaki who discovered them in the late 1960's. The Okazaki fragments of *E.coli* are found to be 1000 to 2000 nucleotides long whereas in eukaryotes they are found to be only 100 to 200 nucleotides long. RNA primers and Okazaki fragments are shorter in eukaryotes than in prokaryotes. – 4 marks.

30. **Formation of ketone bodies:** Acetoacetate, D-βhydroxybutyrate, and acetone; watersoluble fuels normally exported by the liver but overproduced during fasting or in untreated diabetes mellitus. The ketone bodies acetoacetate, D-β-hydroxybutyrate, and acetone are formed in the liver and are carried to other tissues, where they serve as fuel molecules, being oxidized to acetyl-CoA and thus entering the citric acid cycle. The overproduction of ketone bodies in uncontrolled diabetes or severe starvation can lead to acidosis or ketosis.The first step in formation of acetoacetate in the liver is the enzymatic condensation of two molecules of acetyl-CoA, catalyzed by thiolase; this is simply the reversal of the last step of β oxidation. The acetoacetyl-CoA then condenses with acetyl-CoA to form **β-hydroxy-β-methylglutaryl-CoA** (HMG-CoA), which is cleaved to free acetoacetate and acetyl-CoA. The free acetoacetate so produced is reversibly reduced by **D-β-hydroxybutyrate dehydrogenase**, a mitochondrial enzyme, to D-β-hydroxybutyrate . This enzyme is specific for the D stereoisomer; it does not act on L-β-hydroxyacyl-CoAs and is not to be confused with L-β-hydroxyacyl-CoA dehydrogenase, which acts in the β-oxidation pathway. In healthy people, acetone is formed in very small amounts from acetoacetate by the loss of a carboxyl group. Acetoacetate is easily decarboxylated; the carboxyl group may be lost spontaneously or by the action of acetoacetate decarboxylase (Fig. 1616). Because untreated diabetics produce large quantities of acetoacetate, their blood contains significant amounts of acetone, which is toxic. Acetone is volatile and imparts a characteristic odor to the breath, which is sometimes useful in diagnosing the severity of the disease. – 4 marks

31. Gluconeogenesis-explanation - 4 marks

(6x4=24 marks)

SECTION - D

IV. Write essay on any two of the following, not more than three pages. Each question carries 15 marks

32. High energy phosphate compounds with structures, Mention their role. – 5 marks 10 marks
33. **Pentose phosphate pathway:** A pathway that serves to interconvert hexoses and pentoses and is a source of reducing equivalents and pentoses for biosynthetic processes; present in most organisms. Also called the phosphogluconate pathway. Explanation – 6 marks. Schematic diagram - 6 marks, Sig... – 3 ma...
34. Properties of genetic code-
35. Diagrams-Base, sugar-ribose- deoxy ribose, phosphate, purines, pyridimines, double helix -8marks.Description of the structure of double-helical model of DNA-7marks.

(2x15=30 marks)