

Bio303 Past papers for mid term

Subject: Bio303(Past Papers)

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1) Give types of Noteworthy chemical transformation during glycolysis?

1. Degradation of the carbon skeleton of glucose to yield pyruvate
2. Phosphorylation of ADP to ATP by compounds with high phosphoryl group transfer potential, formed during glycolysis
3. Transfer of a hydride ion to NAD⁺ forming NADH

2) Importance of gluconeogenesis?

Glucose by gluconeogenesis in the liver or kidney or ingested in the diet is delivered to those other tissues, including brain and muscle, through the bloodstream.

3) Write Components of fermenter?

- 1) **Formulation of media** to be used in culturing the organism during development of inoculums and in the production fermenter.
- 2) **Sterilization** of the medium, fermenter and ancillary equipment
- 3) **Production** of an active **pure culture** in sufficient quantity to inoculate the production vessel
- 4) **The growth of organism** in the production fermenter under optimum conditions for product formation.
- 5) **The extraction of the product** and its purification.
- 6) **Disposal of effluents** produced by the process.

4) How ATP synthase do the chemical work in the inner mitochondrial membrane?

ATP synthase in the inner mitochondrial membrane, uses the proton-motive force to do chemical work: synthesis of ATP from ADP and Pi as protons flow spontaneously across the membrane.

5) What are Thioalcohals? 2

Thioalcohols (thiols) the oxygen atom of an alcohol is replaced with a sulfur atom.

6) How ribonucleotides held together? 2

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The ribonucleotides are held together by 3, - 5 phosphodiester bonds. 3'-OH group of one nucleotide is bound to 5'-PO₄ of the other nucleotide and form a linear strand.

7) What is the net yield of ATP per molecule of glucose and How?

The net yield is two molecules of ATP per molecule of glucose used, because two molecules of ATP were invested in the preparatory phase of glycolysis to phosphorylate the two ends of the hexose molecule

8) Write equation of gluconeogenesis?

Glucose 6 phosphate + H₂O --- Glucose + Pi

9) Write steps of synthesis of Phosphoenolpyruvate from pyruvate?

- The first step of the bypass reactions in gluconeogenesis is the conversion of pyruvate to phosphoenolpyruvate (PEP)
- The reaction cannot occur by simple reversal of the pyruvate kinase reaction of glycolysis which has three large, negative free energy change and is irreversible (Table 14-2, step 10)
- Instead the phosphorylation of pyruvate is achieved by a roundabout sequence of reaction that in eukaryotes requires enzymes in both the **cytosol and mitochondria**.
- Pyruvate is first transported from the cytosol into mitochondria by **transmission** in which the alpha amino group is transferred from alanine (leaving pyruvate) to an alpha keto carboxylic acid.
- In mitochondria, pyruvate is converted to oxaloacetate in a biotin (**coenzyme**) requiring reaction catalyzed by **pyruvate carboxylase a mitochondrial enzyme**.

10) Give names of some industrial products fermentation and how the products they form in industry.

Yogurt

Cheese

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Yogurt is produced when the bacterium *Lactobacillus bulgaricus* ferments the carbohydrates in milk producing lactic acid; the resulting **drop in pH causes the milk proteins to precipitate**, producing the thick texture and sour taste of unsweetened yoghurt. **Cheese** is produced *propionic acid and CO₂* the propionic acid precipitates milk proteins and bubbles of CO₂ cause holes characteristic of **Swiss cheese**

Name 2 phases of pentose phosphate pathway.

11) There are two phases of the pentose phosphate pathway:

- I. The oxidative phase
- II. The non oxidative phase

12) **What is Standard reduction potential.**

When two conjugate redox pairs are together in solution, electron transfer from the electron donor of one pair to the electron acceptor of the other may proceed spontaneously. The tendency for such a reaction depends on the relative affinity of the electron acceptor for each redox pair for electrons, measure of the affinity (in volts) is called the **standard reduction potential, E^o**

13) **Which form of pyruvate can immediately tautomerize? What does it form?**

The enol form of pyruvate can immediately tautomerize to the more stable keto form of pyruvate. Because phosphoenolpyruvate has only one form (enol) and the product, pyruvate, has two possible forms, the product is more stabilized relative to the reactant.

14) **What is glycolysis?**

In **glycolysis** (from the Greek *glykys*, “sweet” or “sugar,” and *lysis*, “splitting”), a molecule of glucose $C_6H_{12}O_6$ is degraded in a series of enzyme-catalyzed reactions to yield two molecules of the three-carbon compound **pyruvate** $CH_3C(=O)COO^- + H^+$

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During glycolysis, the free energy released is used to form the high-energy compounds **ATP** (adenosine triphosphate) and **NADH** (reduced nicotinamide adenine dinucleotide).

15) What is hyperchromicity?

Concomitant with this denaturation of DNA molecules is an increase in the optical absorbance of the purine and pyrimidine bases—a phenomenon referred to as hyperchromicity of denaturation.

The absorbance of double-stranded DNA (dsDNA) at 260 nm is less than that of either single-stranded DNA (ssDNA) or the free bases. This is called —hyperchromism.¶

16) Difference b/w DNA and RNA 5.

DNA stands for Deoxyribo Nucleic Acid and RNA for Ribo Nucleic Acid **Definition:** A nucleic acid that contains the genetic instruction used in development and functioning of all modern living organisms. DNA's genes are expressed, or manifested through the proteins that its nucleotides produce with the help of RNA. The information found in DNA determines which traits are to be created, activated, or deactivated, while the various forms of RNA do the work.

Function: The blueprint of biological guidelines that living organism must follow the exist and remain functional, Medium of long-term stable storage and transmission of genetic information. Helps carry out DNA's blueprint guidelines. Transfers genetic code needed for the creation of proteins from the nucleus to the ribosome.

Structure: DNA double-standard structure and RNA is a single strand. It has two nucleotide stands which consist of its phosphate group, five-carbon sugar (the less stable ribose) and four nitrogen-containing nucleobases; adenine, uracil (not thymine), guanine and cytosine.

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Base Pairing Adenine links to thymine (A-T) and cytosine links to guanine (C-G) Adenine links to uracil (A-U) and cytosine links to guanine (C-G).

Location DNA is found in the nucleus of a cell and in mitochondria.

Depending on the type of RNA, this molecule is found in a cell's nucleus, its cytoplasm, and its ribosome.

Stability: Deoxyribose sugar in DNA is less reactive because of C-H bonds. Stable in alkaline conditions. DNA has smaller grooves, which makes it harder for enzymes to "attack". Ribose sugar is more reactive because of C-OH (hydroxyl) bonds. Not stable in alkaline conditions. RNA has larger grooves, which makes it easier to be "attacked" by enzymes.

Propagation: DNA is self replicating. RNA is synthesized from DNA when needed.

Unique Features The helix geometry of DNA is of B-Form. DNA is protected in the nucleus, as it is tightly packed. DNA can be damaged by exposure to ultra-violet rays. The helix geometry of RNA is of A-Form. RNA strands are continually made, broken down and reused. RNA is more resistance to damage by Ultra-violet rays.

17) What you know about snRNA.5

An other types of RNA are Small nuclear RNA (snRNA)

Small nuclear RNA (snRNA) are large number of small stable RNA species found in eukaryotic cells.

Most of them are complexed with proteins to form ribonucleoproteins.

They are distributed in the nucleus, in the cytoplasm or in both.

They are significantly involved in rRNA and mRNA processing and gene regulation.

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Small nuclear RNA (snRNA)- play pivotal roles in RNA processing, particularly mRNA processing

18) **Pyruvate three metabolism pathway**

Pyruvate is the end product of the second phase of glycolysis.

For each glycolysis molecules, two ATP are consumed in the preparatory phase and four ATP are produced in the payoff phase

This gives a net yield of two ATP per molecule of glucose converted to pyruvate

Each phosphoryl group represented here as P, has two negative charges

19) **Write down the laws of thermodynamics?**

First law:

The first law is the principle of the conservation of energy; it states that for any physical or chemical change, the total amount of energy in the universe remains constant; energy may change form or it may be transported from one region to another, but it cannot be created or destroyed.

Second law

The second law of thermodynamics says that the universe always tends toward increasing disorder; in all natural process, the entropy of the universe increases.

20) **Three major fates of animals and vascular plant**

In animals and vascular plants, glucose has three major fates:

- I. It may be stored (as a polysaccharide or as sucrose).
- II. Oxidized to a three-carbon compound (pyruvate) via glycolysis to provide ATP and metabolic intermediates.
- III. Oxidized via the pentose phosphate (phosphogluconate) pathway to yield ribose 5-phosphate for nucleic acid synthesis and NADPH for reductive biosynthesis process.

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21) The acceptor arm of tRNA?

All tRNA molecules contain 4 main arms or loops.

The Acceptor (1-Acceptor) arm: This is made up unpaired sequence of cytosine-cytosine-adenine (CCA) at the 3' end. The 3' OH group of adenine binds with the carboxylic group of a specific amino acid and carries it to ribosomes for protein synthesis.

22) Why sterilization is essential in fermentation?

Sterilization is essential for preventing the contamination with any undesired microorganisms. Air is sterilized by membrane filtration while the medium is usually heat sterilized. Any nutrient component which is heat labile is filter-sterilized and later added to the sterilized medium. The fermenter may be sterilized together with the medium or separately. Sterilizing the feed solution is essential because the media cannot contain foreign microbes because this could severely hinder the growth of the production microbe. Most popular method is heat sterilization of the feed solution.

23) In which conditions renaturation of DNA takes place? (2)

Under appropriate conditions (*temp. & salt concentration*), separated strands of DNA will renature or reassociate and form the double helix by the process called renaturation (or reannealing).

This reannealing process is also referred to as hybridization

24) Define gluconeogenesis?

The process of synthesis of glucose from non-carbohydrate sources is known as gluconeogenesis new formation of sugar OR

Gluconeogenesis is the pathway, which converts pyruvate and related three and four carbon compounds to glucose.

25) Write 6 types of fermenters?

Simple fermenters (batch and continuous) are:

- Fed batch fermenter

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- Air-lift or double fermenter
- Cyclone column fermenter
- Tower fermenter
- Fluidized bed bioreactors
- Packed bed bioreactor
- Photo bioreactor

26) Define Gibbs free energy?

Gibbs free energy:

Gibbs free energy, G expresses the amount of energy capable of doing work during a reaction at constant temperature and pressure. When a reaction proceeds with the release of free energy (that is, when the system changes so as to possess less free energy), the free-energy change, G , has a negative value and the reaction is said to be exergonic. In endergonic reactions, the system gains free energy and G is positive.

27) Name of the enzyme required for third bypass of gluconeogenesis?

Glucose 6 phosphate

28) What is the 1st step of non oxidative pathway of pentose phosphate pathway?

Transketolase catalyzes the transfer of a two carbon fragment from a ketose donor to an aldose acceptor. In its first appearance in the pentose phosphate pathway, transketolase transfers C-1 and C-2 of xylulose 5-phosphate to ribose 5-phosphate, forming the seven-carbon product sedoheptulose 7-phosphate. The remaining three carbon fragment from xylulose is glyceraldehyde 3-phosphate.

29) What is the cori cycle and its substrate?

The pathway through which lactate produced by anaerobic glycolysis in skeletal muscle returns to the liver and is converted to

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glucose, which moves back to muscle and is converted to glycogen is called the Cori cycle.

Substrate: Lactate

Occurs due to absence of glucose-6-phosphate in liver.

30) What is continuous fermentation process?

A Continuous fermentation is a process in which fresh medium (substrate) is continuously added in the bioreactor, and biomass or products containing left over nutrients and microorganisms are continuously removed at the same rate to keep the culture volume constant. Under these conditions the cells remain in the logarithmic phase of growth.

31) Ping pong mechanism?

Ping-pong mechanism of nucleoside diphosphate kinase: The enzyme binds its first substrate (ATP in our example), and a phosphoryl group is transferred to the side chain of a His residue. ADP departs, and another nucleoside (or deoxynucleoside) diphosphate replaces it, and this is converted to the corresponding triphosphate by transfer of the phosphoryl group from the phosphohistidine residue.

32) What is ncRNAs?

One of the most exciting discoveries in the last decade of eukaryotic regulatory biology has been the identification and characterization of regulatory nonprotein coding RNAs (ncRNAs).

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33) ncRNAs exist in two general size classes, small consisting of microRNA (miRNAs) and silencing (siRNAs) and Large consisting of long noncoding RNAs (lncRNAs). The small ncRNAs termed microRNA (miRNAs) and silencing (siRNAs) typically inhibit gene expression at the level of specific protein production by targeting mRNAs through one of several distinct mechanisms. Both siRNAs and miRNAs typically hybridize, via the formation of RNA–RNA hybridization to their targeted mRNAs

34) Write the name of two molecules which can be formed after energy donate from ATP?

The donation of energy from ATP can occur in the two form

- A) ATP ADP+ Pi
- B) ATP AMP+ 2 Pi

35) What is hydrolase?

Hydrolases (enzyme)

These enzymes catalyze hydrolysis, i.e. add water molecule to the substrate which is simultaneously decomposed; the functional group of substrate is transferred to water. Common example of hydrolases is:

Protein hydrolyzing Enzymes (peptidases).

36) Write the three main operations of fermentation?

1. Batch fermentation
2. Continuous Fermentation
3. Fed-batch Fermentation

37) What is transaldolase, write its function?

Transaldolase is an enzyme catalyzes a reaction similar to the aldolase reaction of glycolysis, that is, a three-carbon fragment is removed from sedoheptulose 7-phosphate and condensed with glyceraldehydes 3-phosphate, forming fructose 6-phosphate and the tetrose erythrose 4-phosphate.

38) Write the fates of pyruvate under anaerobic condition.

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Under aerobic conditions, the pyruvate formed in the final step of glycolysis is oxidized to **acetate (acetyl- CoA), which enters the citric acid cycle** and is oxidized to CO₂ and H₂O.

The NADH formed by dehydrogenation of glyceraldehyde 3-phosphate is ultimately reoxidized to NAD⁺ by passage of its electrons to O₂ in mitochondrial respiration. Under hypoxic (low-oxygen) conditions, as in very active skeletal muscle, in submerged plant tissues, in solid tumors, or in lactic acid bacteria—NADH generated by glycolysis cannot be reoxidized by O₂.

Failure to regenerate NAD⁺ can leave the cell with no electron acceptor for the oxidation of glyceraldehyde 3-phosphate, and the energy-yielding reactions of glycolysis would stop. There must be another way to regenerate NAD⁺. Modern organisms continually regenerate NAD⁺ during anaerobic glycolysis by transferring electrons from NADH to form a reduced end product such as lactate or ethanol.

39) Write the advantages of fermentation?

1. Preserves and enriches food, improves digestibility, and enhances the taste and flavour of foods.
2. Potential of enhancing food safety by controlling the growth and multiplication of a number of pathogens in foods.
3. Important contribution to human nutrition, particularly in developing countries, where economic problems pose a major barrier to ensuring food safety.

40) What is isozyme?

Two or more enzymes that catalyze the same reaction but are encoded by different genes are called isozymes.

41) What is binding site of ligand?

A ligand binds at a site on the protein called the binding site, binding site is complementary to the ligand in size, shape, charge, and Hydrophobic or Hydrophilic character.

Furthermore, the interaction is specific: the protein can discriminate among the thousands of different molecules in its environment and selectively bind only one or a few. The binding of

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a protein and ligand is often coupled to a conformational change in the protein that makes the binding site more complementary to the ligand, permitting tighter binding called induced fit. A given protein may have separate binding sites for several different ligands.

42) Define bioenergetics?

Bioenergetics is the quantitative study of the energy transductions changes of one form of energy into another that occur in living cells and of the nature and function of the chemical processes underlying these transductions.

43) Write full name of NAD and NADP?

NAD: nicotinamide adenine dinucleotide

NADP: nicotinamide dinucleotide phosphate

44) Differentiate between standard free energy and actual free energy?

Standard free:

The standard free-energy change of a chemical reaction is simply an alternative mathematical way of expressing its equilibrium constant.

If the equilibrium constant for a given chemical reaction is 1.0, the standard free-energy change of that reaction is 0.0 (the natural logarithm of 1.0 is zero).

If K_{eq} of a reaction is greater than 1.0, ΔG° is negative. If K_{eq} is less than 1.0, ΔG° is positive. Because the relationship between ΔG° and K_{eq} is exponential, relatively small changes in ΔG° correspond to large changes in K_{eq} .

Actual free-energy change

The actual free-energy change, ΔG , is a variable that depends on ΔG° and on the concentrations of reactants and products:

$$\Delta G = \Delta G^{\circ} - RT \ln ([\text{products}]/[\text{reactants}])$$

When ΔG is large and negative, the reaction tends to go in the forward direction; when ΔG° is large and positive, the reaction tends to go in the reverse direction; and when $\Delta G = 0$, the system is at equilibrium.

EXPLANATION

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Just as K_{eq} is a physical constant characteristic for a reaction, the standard transformed free-energy change, ΔG° , is also a physical constant.

there is a simple relationship between K_{eq} and ΔG° :

$$\Delta G^\circ = -RT \ln K_{eq}$$

45) What is tRNA Write its function?

Transfer RNAs (tRNAs)- adapter molecules that carry specific amino acids for protein synthesis

46) Name three main steps in which an operation of fermenter broken down at industrial scale?

1. Upstream processing,
2. The fermentation process and
3. Downstream processing.

47) Write down experiment of Arthur and William Young in 1906 o yeast Extract?

In the preparatory phase of glycolysis, two molecules of ATP are invested and the hexose chain is cleaved into two triose phosphates. In 1906, Arthur Harden and William Young tested their hypothesis that inhibitors of proteolytic enzymes would stabilize the glucose fermenting enzymes in yeast extract.

They added blood serum (known to contain inhibitors of proteolytic enzymes) to yeast extracts and observed the predicted stimulation of glucose metabolism.

- However, in a control experiment with the boiling serum, they discovered that boiled serum was just as effective at stimulating glycolysis! Careful examination revealed that inorganic phosphate was responsible for the stimulation.

- Harden and Young soon discovered that glucose added to their yeast extract was converted to a hexose bisphosphate (the —Harden- Young ester, eventually identified as **fructose 1,6-bisphosphate**).

- This was the beginning of investigations on the role of organic esters and anhydrides of phosphate in biochemistry, which has led to our current understanding of the central role of **phosphoryl group transfer in biology**.

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48) What is the Denaturation of DNA?

Separation of the two strands of the double helix when hydrogen bonds between the paired bases are disrupted. Disruption can occur in the laboratory if the pH or the salt concentration of the DNA solution is altered if the solution is heated above 80°C. Disruption of the hydrogen bonds between paired bases and of base stacking causes unwinding of the double helix to form two single strands complete separation of DNA stands along the entire length.

No covalent bonds in the DNA are broken.

49) What is transketolase?

Two enzymes unique to the pentose phosphate pathway act in these interconversions of sugars: transketolase and transaldolase. Transketolase catalyzes the transfer of a two carbon fragment from a ketose donor to an aldose acceptor. In its first appearance in the pentose phosphate pathway, transketolase transfers C-1 and C-2 of xylulose 5-phosphate to ribose 5-phosphate, forming the seven-carbon product sedoheptulose 7-phosphate. The remaining three carbon fragment from xylulose is glyceraldehyde 3-phosphate.

50) Name three electron carrier of ETC cycle?

NADH, NADPH, and FADH

51) Name organ in which glucose transporters are found and name of 3 transporters

Glucose uptake from the blood is mediated by the GLUT family of glucose transporters

The transporters are:

GLUT1, GLUT2) and GLUT3

52) Write 5 steps of glycolysis?

Step 1: The first step in glycolysis is phosphorylation of glucose at the hydroxyl group on C-6 by a family of enzymes called hexokinases to form glucose-6-phosphate (G6P).

Step 2: The D-glucose 6-phosphate thus formed is converted to D-fructose 6-phosphate, which is again phosphorylated, this time at C-1, to yield D-fructose 1, 6-bisphosphate

Step 3

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For both phosphorylations, ATP is the phosphoryl group donor. Fructose 1,6-bisphosphate is split to yield two three-carbon molecules, dihydroxyacetone Phosphate and glyceraldehyde 3-phosphate

Step 4); this is the —lysis step that gives the pathway its name. The dihydroxyacetone phosphate is isomerized to a second molecule of glyceraldehyde 3-phosphate

Step 5, ending the first phase of glycolysis may be either ATP or GTP, depending on which succinyl-CoA synthetase isozyme is the catalyst.

53) What is Primary Structure of RNA

It is defined as the number and sequence of ribonucleotides in the RNA chain. The sequence is complementary to the template strand of the gene from which it was transcribed.

Primary Structure of RNA

It is defined as the number and sequence of ribonucleotides in the RNA chain. The sequence is complementary to the template strand of the gene from which it was transcribed. The ribonucleotides are held together by 3' - 5' phosphodiester bonds. 3'-OH group of one nucleotide is bound to 5'-PO₄ of the other nucleotide and form a linear strand. The ribosyl moieties are attached to the nucleobases by *N*-glycosidic bonds. Similar to DNA RNA polymer also has polarity.

54) Write down the effect of cAMP cascade of liver

Summary of effects of glucagon-cAMP cascade in liver:

- Gluconeogenesis is stimulated.
- Glycolysis is inhibited.
- Glycogen breakdown is stimulated.
- Glycogen synthesis is inhibited.

- Free glucose is formed for release to the blood.

55) Define Nucleophiles and electrophiles?

Nucleophiles: functional groups rich in and capable of donating electrons

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Electrophiles: electron-deficient functional groups that seek electrons

56) What is hyperchromicity in denaturation of dna?

Concomitant with this denaturation of the DNA molecule is an increase in the optical absorbance of the purine and pyrimidine bases—a phenomenon referred to as hyperchromicity of denaturation.

The absorbance of double-stranded DNA (dsDNA) at 260 nm is less than that of either single-stranded DNA (ssDNA) or the free bases. This is called —hyperchromism. ||

57) Write types of RNA and what is snRNA?

There are main types RNA. These are:

Transfer RNA (tRNA):

Transfer RNAs (tRNAs)- adapter molecules that carry specific amino acids for protein synthesis

Messenger RNA (mRNA):

Messenger RNAs (mRNAs)- transfer genetic information from DNA to the protein-synthesizing machinery.

Ribosomal RNA (rRNA):

Ribosomal RNAs (rRNAs)- contribute to the formation and function of ribosomes

snRNA

Another types of RNA are snRNA. Small nuclear RNA (snRNA) are large number of small stable RNA species found in eukaryotic cells. Most of them are complexed with proteins to form ribonucleoproteins. They are distributed in the nucleus, in the cytoplasm or in both. They are significantly involved in rRNA and mRNA processing and gene regulation.

58) Name of the enzyme require for third bypass of

gluconeogenesis?

Glucose 6 phosphate

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