

4-60

**ENTRANCE EXAMINATION, 2020
Integrated MSc-Ph.D. in Biotechnology**

Time: 2 hours

Maximum Marks: 70

HALL TICKET NUMBER:

INSTRUCTIONS

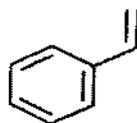
Please read the instructions carefully before answering the questions

1. Write your Hall Ticket Number in the OMR Answer sheet given to you. Also write the Hall Ticket Number in the space provided above.
2. There is no negative marking for wrong answer.
3. Answers are to be marked on the OMR answer sheet following the instructions provided there upon.
4. Hand over the OMR answer sheet at the end of the examination to the invigilator.
5. The question paper contains 70 questions of multiple choices, printed in 18 pages including this page. No additional sheets will be provided. Rough work can be done in the question paper itself /space provided at the end of the booklet.
6. All questions carry one mark each.
7. In case the candidates have equal marks, preference will be given towards the candidate who has obtained higher marks in Part-A.
8. Non-programmable scientific calculators are permitted.
9. Cell/Mobile Phones are strictly prohibited in the examination hall.

PART A

- 1) The point at a equidistance from the points $(-5, 10)$ and $(12, 3)$ that lies on Y-axis is
- $(2, 0)$
 - $(-2, 0)$
 - $(0, 2)$
 - $(0, -2)$
- 2) Minor $(M_{1,2})$ for the matrix $\begin{pmatrix} -1 & 0 & 1 \\ 2 & -1 & 2 \\ -1 & 2 & 1 \end{pmatrix}$ is
- 0
 - 4
 - 4
 - 2
- 3) The cost, in rupees, of manufacturing x masks is $570 + 0.5x$. The mask is sold for 10 rupees each. What is the minimum number of masks that need to be sold so that the revenue received recoups the manufacturing cost ?
- 50
 - 57
 - 60
 - 95
- 4) A bag contains 6 apples, 9 oranges and 5 mangoes. If one fruit is taken at random then what is the probability that the fruit drawn is mango ?
- $1/5$
 - $1/4$
 - $4/5$
 - $1/3$
- 5) A, B, C, D, E, F and G are sitting around a table in circle. Consider the following statements
- E is neighbor of A and D.
 - G is not between F and C.
 - B is second to the left of G.
 - F is to the immediate right of A.
- What is the correct order of sitting if you start with C ?
- C, B, F, A, E, D, G
 - C, B, F, E, A, G, D
 - C, D, B, F, E, A, G
 - C, B, E, F, A, G, D

- 6) What is the total number of sigma bonds found in the following compound?



- A. 16
B. 15
C. 14
D. 17
- 7) The identity of an element is determined by
- A. The number of its protons
B. The number of its neutrons
C. Density of the element
D. Its atomic mass
- 8)
$$\text{C}_2\text{H}_5\text{Br} + 2 \text{Na} \xrightarrow{\text{dry ether}} \text{C}_4\text{H}_{10} + 2 \text{NaBr}$$

The name of the reaction is
- A. Friedel-Crafts
B. Wurtz
C. Fittig
D. Reimer-Tiemann
- 9) Select a non-metal, which exists in liquid state at room temperature
- A. Mercury
B. Caesium
C. Bromine
D. Helium
- 10) Which one of the following statement(s) regarding alkane is/are false?
- I. Alkanes are non polar molecules
II. Alkanes are soluble in water
III. Alkanes experience dispersion forces
IV. Alkanes have low boiling points
- A. III and II
B. I and II
C. IV and II
D. II

11) Considering Sodium, Neon, Water and Ammonia, which of the following statement(s) is/are true?

- I. One mole of sodium atoms is the heaviest among all
- II. One mole of neon atoms is the heaviest among all
- III. One mole of water molecules is the heaviest and one mole of ammonia molecules is the lightest among all
- IV. One mole of sodium atoms is the lightest among all
- V. One mole of water atoms is the lightest among all

- A. II and IV
- B. I
- C. III
- D. II and V

12) Match the shapes of the following ions.

- | | |
|----------------------|------------------|
| I. BeF_3^- | 1. Linear |
| II. BF_4^- | 2. Triangular |
| III. IF_4^- | 3. Tetrahedral |
| IV. IBr_2^- | 4. Square Planar |

Which of the pairs given above are correctly matched ?

- | | I | II | III | IV |
|----|---|----|-----|----|
| A. | 2 | 3 | 4 | 1 |
| B. | 1 | 3 | 2 | 4 |
| C. | 3 | 2 | 4 | 1 |
| D. | 4 | 3 | 2 | 1 |

13) Find the hybridization of orbitals of N atom in NH_4^+ , NO_3^- and NO_2^+ in correct order

- A. sp , sp^2 , sp^3
- B. sp^3 , sp , sp^2
- C. sp^3 , sp^2 , sp
- D. sp^2 , sp , sp^3

14) Arrange the following elements in the increasing order of their atomic weight

- I. K
 - II. Zn
 - III. Ca
 - IV. Cl
 - V. Mn
- A. V, II, I, III, IV
 - B. IV, I, III, V, II
 - C. II, V, I, IV, III
 - D. I, II, V, IV, III

15) The isomerism between the molecules $\text{CH}_3\text{-CH}_2\text{-CHO}$ and $\text{CH}_3\text{-CO-CH}_3$ is known as

- A. Positional isomerism
- B. Chain isomerism
- C. Metamerism
- D. Functional isomerism

16) _____ of sound is not changed while sound travels from air to water

- A. Frequency
- B. Wavelength
- C. Amplitude
- D. Velocity

17) The ratio of density of a liquid to the density of water is known as

- A. Specific gravity
- B. Molecular density
- C. Molecular compressibility
- D. Buoyancy

18) Which one of the following is a scalar quantity ?

- A. Current
- B. Current density
- C. Dipole moment
- D. Force

19) At isoelectric pH, the amino acids and proteins

- A. Show high net charge
- B. Precipitate maximally
- C. Do not show buffering action
- D. Show maximum mobility in electric field

20) A short peptide composed of the sequence of amino acids as NPRSTG. Identify the correct statement regarding this peptide.

- I. The approximate molecular weight of the peptide is 660 Da
- II. The peptide has at least one positively charged residue
- III. The peptide has two positively charged residues and one aromatic residue
- IV. The peptide has at least one negatively charged residue

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

21) Match the following amino acids with their respective group.

- | | |
|----------|----------------------|
| I. Asp | 1. Polar, Uncharged |
| II. Phe | 2. Nonpolar |
| III. Asn | 3. Negatively charge |
| IV. Gly | 4. Aromatic |

Find the correct pairs:

- | | I | II | III | IV |
|----|---|----|-----|----|
| A. | 3 | 4 | 1 | 2 |
| B. | 1 | 3 | 2 | 4 |
| C. | 2 | 3 | 1 | 4 |
| D. | 3 | 4 | 2 | 1 |

22) Reducing sugars form a silver mirror when added to colorless Ag^+ solution. This test is known as

- A. Fehling's Test
- B. Benedict's Test
- C. Tollen's Test
- D. Barfoed's Test

23) Match the following items in left hand side column with their correct corresponding item

- | | |
|--------------------|-------------------------------------|
| I. Phosphorylation | 1. Processing of secretory proteins |
| II. Methylation | 2. Rust formation on iron |
| III. Oxidation | 3. Epigenetic modification of genes |
| IV. Glycosylation | 4. Conversion of ADP to ATP |

Identify the correctly matched pairs as given below

- A. I-4, II-3, III-2, IV-1
- B. I-4, II-3, III-1, IV-2
- C. I-2, II-3, III-4, IV-1
- D. I-3, II-4, III-2, IV-1

24) Which of the following compounds serve as the precursors of hormones ?

- I. Tyrosine and tryptophan
- II. Vitamin C
- III. Phosphatidyl choline
- IV. Cholesterol

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

25) Match the following items in left hand side column with their correct corresponding item

- | | |
|--------------------|-------------------------------------|
| I. Phosphorylation | 1) Processing of secretory proteins |
| II. Methylation | 2) Rust formation on iron |
| III. Oxidation | 3) Epigenetic modification of genes |
| IV. Glycosylation | 4) Conversion of ADP to ATP |

Identify the correctly matched pairs as given below:

- A. I-4, II-3, III-2, IV-1
- B. I-4, II-3, III-1, IV-2
- C. I-2, II-3, III-4, IV-1
- D. I-3, II-4, III-2, IV-1

26) Different steps of DNA replication can be summarized as below. Identify the correct sequence of steps out of the following:

- A. Origin – formation of a replication fork – initiation – elongation – termination
- B. Formation of a replication fork – leading and lagging strands – termination
- C. Formation of a replication fork – unwinding – initiation – elongation – termination
- D. Ligation – priming – elongation – termination

27) Which of the following statements are true?

- I. Identifying the relative positions of genes on the genome is called Genome mapping.
- II. Genome walking is the procedure of aligning sequence reads to the reference genome.
- III. Contigs are overlapping sequence reads.
- IV. Gene tracing is a method to predict novel genes in the genome.

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

28) Arrange the step involved in PCR in proper order.

- I. Annealing
- II. Extension
- III. Denaturation

- A. I, III, II
- B. I, II, III
- C. II, I, III
- D. III, I, II

29) Match the following pairs

- | | |
|------------------|--------------------------------|
| I. Auxin | 1. Ent-Kaurene |
| II. Ethylene | 2. Tryptophan |
| III. Gibberellin | 3. Dimethylallyl pyrophosphate |
| IV. Cytokinin | 4. S-adenosylmethionine |

Which of the pairs given above are correctly matched

- | | I | II | III | IV |
|----|---|----|-----|----|
| A. | 3 | 1 | 2 | 4 |
| B. | 2 | 4 | 1 | 3 |
| C. | 2 | 3 | 4 | 1 |
| D. | 4 | 3 | 1 | 2 |

30) Which of the following systems are indicative of community behavior in bacteria?

- I. Quorum quenching
- II. Quorum sensing
- III. Quorum glow
- IV. Biofilm formation

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

31) Which two of the following processes constitute mechanisms of genetic recombination?

- I. Conjugation
- II. Transduction
- III. Pseudogenization
- IV. Sumoylation

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

32) The following is the correct chronology of the stages of mammalian embryonic development:

- A. Zygote – morula – blastocyst – implantation - gastrula – notochord - somites
- B. Zygote – blastula – morula – gastrula – notochord – somites – fistula
- C. Oogonium - zygote – morula – blastocyst – implantation – gastrula- somites
- D. Zygote – germinal layers – blastocyst – gastrula – implantation – notochord

33) Match the following items in left hand side column with their correct corresponding item.

- | | |
|-----------------|--|
| I. Ornithology | 1) Study of the medicine of old people |
| II. Geriatrics | 2) Study of mites, midges and ticks |
| III. Acarology | 3) Study of birds |
| IV. Herpetology | 4) Study of amphibians and reptiles |

Identify the correctly matched pairs as given below:

- A. I-3, II-1, III-4, IV-2
- B. I-4, II-3, III-1, IV-2
- C. I-2, II-3, III-4, IV-1
- D. I-3, II-1, III-2, IV-4

34) Match the following items in left hand side column with their correct corresponding item

- | | |
|------------------|---------------------------------|
| I. Cholera | 1) Disease with severe debility |
| II. Tuberculosis | 2) Lifestyle disorder |
| III. Obesity | 3) Disease with social stigma |
| IV. Polio | 4) A serious waterborne disease |

Identify the correctly matched pairs as given below:

- A. I-4, II-3, III-2, IV-1
- B. I-4, II-3, III-1, IV-2
- C. I-2, II-3, III-4, IV-1
- D. I-3, II-4, III-2, IV-1

35) Consider the following data and the types of variables.

- | | |
|---------------------------|--------------------------------------|
| I. Continuous variable | 1. The age of a individuals in years |
| II. Qualitative variable | 2. The height of a person |
| III. Categorical variable | 3. Color of eyes |
| IV. Discrete variable | 4. Gender of a person |

Find the correct pairs:

- | | I | II | III | IV |
|----|---|----|-----|----|
| A. | 1 | 3 | 4 | 2 |
| B. | 4 | 2 | 3 | 1 |
| C. | 3 | 2 | 1 | 4 |
| D. | 2 | 3 | 4 | 1 |

PART B

- 36) C-value of any organism represents the total amount of
- DNA
 - RNA
 - Protein
 - DNA and RNA
- 37) Which are true for DNA structure?
- The length of one turn of DNA is 3.4 \AA
 - A-DNA is the left handed DNA
 - Denaturation of DNA results from the destabilization of hydrogen bond
 - It can hybridize with other DNA molecules but not with RNA
 - Has fewer hydroxyl groups than RNA
- I, III
 - III
 - I, II
 - I, II, III, IV and V
- 38) When present in small amounts in sequencing reactions, dideoxynucleoside triphosphates (ddNTPs) terminate the sequencing reaction at different positions in the growing DNA strands. ddNTPs stop a sequencing reaction because they
- Lack a 5' phosphate group
 - Have a hydroxyl group at their 5' end
 - Lack a hydroxyl ($-\text{OH}$) group at their 3' end
 - Permanently bind to the active site of DNA polymerase
- 39) Indicate the order in which the proteins below are added during formation of the replication-initiation complex in prokaryotes from earliest to latest.
- DnaB
 - Primase
 - Pol III
 - SSB protein
 - Dna A protein
- I, V, IV, II and III
 - I, II, V, IV and III
 - V, IV, I, II and III
 - V, I, IV, II and III

- 40) A tall, purple flower plant with genotype $Tt Pp$ is crossed with a tall, white flower plant of genotype $Tt pp$. What is the probability of obtaining progeny with genotype $TTpp$?
- A. $1/8$
 - B. $1/4$
 - C. $1/2$
 - D. $2/3$
- 41) What is the most likely result from mutating a prokaryotic Shine-Dalgarno sequence?
- A. The first amino acid of the translated protein would be changed
 - B. The mRNA would be less stable
 - C. The ribosome would not be able to bind to the mRNA
 - D. None of the above is true as the prokaryotes do not have a Shine-Dalgarno sequence
- 42) What would the result be if a specific sigma subunit of bacterial RNA polymerase was mutated?
- A. Nothing would result; sigma is not essential
 - B. RNA polymerase would still bind DNA at specific sites, but will fall off after joining together only a few RNA nucleotides
 - C. RNA polymerase would initiate transcription at random on the DNA
 - D. The core enzyme would not be as stable as usual
- 43) What is histone octamer, in DNA structure?
- A. A complex consisting of eight positively charged histone proteins (two of each H2A, H2B, H3 and H4) that aid in the packaging of DNA
 - B. A complex consisting of eight negatively charged histone proteins (two of each H2A, H2B, H3 and H4) that aid in the packaging of DNA
 - C. A complex consisting of nine positively charged histone proteins (H1 and two of each H2A, H2B, H3 and H4) that aid in the packaging of DNA
 - D. A complex consisting of nine negatively charged histone proteins (H1 and two of each H2A, H2B, H3 and H4) that aid in the packaging of DNA
- 44) Choose the correct order of eukaryotic chromatin organization
- I. Nucleosome
 - II. Chromatin fiber
 - III. Double stranded DNA
 - IV. Chromosome
- A. I, IV, II, III
 - B. III, I, II, IV
 - C. I, II, III, IV
 - D. III, IV, I, II

45) The genes of the lac operon will be expressed if

- I. Lactose binds to the operator
- II. Lactose binds to the repressor
- III. Repressor binds to the operator
- IV. Repressor cannot bind to the operator

Choose the right answer

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

46) The nucleotide sequences of replication origins

- I. Are conserved across bacteria
- II. Contain repeated elements
- III. Are conserved among bacteria, yeast and mammals
- IV. Contain flanking regions rich in A and T residues
- V. Can be functional when cloned into plasmids

Which of the statement(s) is (are) correct?

- A. I, II, III and V
- B. I, II and V
- C. I, II, III, IV and V
- D. I, II

47) Which of the following statement (s) is/are true about the peptide bond?

- I. The peptide C-N bond is unable to rotate freely because of the partial double bond character.
- II. By convention the bond angle resulting from N-C_α is labelled as *phi*.
- III. The alpha carbons of adjacent amino acids are arranged as C_α - C - N - C_α.
- IV. The *psi* angle in peptide bond formation can range from 0 to 180°.

- A. Only I
- B. I and IV
- C. I and III
- D. I and IV

48) In the proteasomal degradation system, ubiquitin specially bind to which residue on the protein substrate?

- A. Valine
- B. Lysine
- C. Alanine
- D. Glycine

49) Match the type of damage in the left panel with the correct repair system in the right panel

- | | |
|---|-------------------------------|
| I) Post replication repair which correct mis-incorporated nucleotides | 1. Non homologous end joining |
| II) Remove modified bases | 2. Mismatch Repair |
| III) Repair double strand break in DNA | 3. Nucleotide excision Repair |
| IV) Human disorder Xeroderma pigmentosum | 4. Base excision Repair |

	I	II	III	IV
A.	1	2	3	4
B.	1	3	2	4
C.	2	1	4	3
D.	2	4	1	3

50) In ion-exchange chromatography, which of the following conditions are increased to displace the proteins bound to the resin?

- A. Column length
- B. Size of sample
- C. Column volume
- D. Strength of ionic buffer

51) Allosteric enzymes show all the following characteristics, except

- A. sigmoid kinetics
- B. co-operative binding of the substrate
- C. substrate binding site and regulatory site are different
- D. same binding site for substrate and regulator

52) Which of the following statements about the competitive inhibition of an enzyme-catalyzed reaction is correct?

- A. Competitive inhibitor and substrate can bind simultaneously to the enzyme.
- B. The V_{max} and K_m (Michaelis constant) for a reaction are unchanged in the presence of a competitive inhibitor.
- C. The V_{max} for a reaction remains unchanged in the presence of a competitive inhibitor.
- D. The K_m for a reaction remains unchanged in the presence of a competitive inhibitor.

53) Protein-protein interaction can be studied by

- I. Molecular Modelling
 - II. Yeast two hybrid system
 - III. Fluorescence Resonance Energy Transfer (FRET)
 - IV. Dot Matrix Method
- A. I and IV
 - B. II and IV
 - C. I and III
 - D. II and III

54) Match the item in group I with correct options in Group II

Group I	Group II
a. SDS	1. Reducing agent
b. DTT	2. Anionic detergent
c. CHAPS	3. Cationic detergent
d. 16-BAC	4. Zwitterionic detergent

- A. a-1, b-2, c-3, d-4
- B. a-2, b-1, c-4, d-3
- C. a-3, b-4, c-1, d-2
- D. a-4, b-3, c-2, d-1

55) Match the following

- | | |
|-----------|---|
| I. SAGE | 1. To separate biological macromolecules |
| II. FISH | 2. Snapshot of the mRNA population |
| III. PAGE | 3. Technique that exploits variations in homologous DNA sequences |
| IV. RFLP | 4. Technique that uses fluorescent probes |

- | | | | | |
|----|---|----|-----|----|
| | I | II | III | IV |
| A. | 1 | 2 | 3 | 4 |
| B. | 2 | 4 | 1 | 3 |
| C. | 4 | 3 | 2 | 1 |
| D. | 3 | 4 | 1 | 2 |

56) Choose the correct sequence of the methods applied in a typical proteomic analysis;

- I) MALDI - TOF
 - II) Isoelectric focusing (IEF)
 - III) SDS-PAGE
 - IV) Isolation of proteins
- A. I, III, IV, II
 - B. II, III, IV, I
 - C. III, II, I, IV
 - D. IV, II, III, I

57) Arrange the following terms in a specified order.

- I. Family
 - II. Class
 - III. Genus
 - IV. Species
 - V. Order
- A. II, V, I, III, IV
 - B. II, V, I, IV, III
 - C. I, II, V, IV, III
 - D. V, II, I, III, IV

- 58) The growth of a 'facultative anaerobe' will be
- At the surface of the culture medium
 - At the bottom of the culture medium
 - At the middle of the culture medium
 - Throughout the culture medium
- 59) The plant molecule which acts as detoxification agent of pollutants
- Fructan
 - ROS
 - Glutathione
 - Peptidoglycan
- 60) The organ with maximum O_2 consumption per minute is
- Liver
 - Heart
 - Brain
 - Skeletal muscle
- 61) 'Rice tungro' disease is caused by
- Fungus
 - Bacteria
 - Virus
 - Zinc deficiency
- 62) Two of the following viruses are strongly associated with the development of cancer:
- HPV
 - Epstein Barr virus
 - Novel corona virus
 - Hepatitis E virus
 - Rabies virus
- I and II
 - II and III
 - I and IV
 - IV and V

63) Which of the following statements are correct?

- I. The inner-leaflet of the plasma membrane contains phosphatidyl serine
- II. Carbohydrates are located on the inner surface of the plasma membrane
- III. Flippases transport the negatively charged phospholipids from the inner-leaflet to the outer -leaflet
- IV. The outer leaflet is rich in Sphingomyelin

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

64) Match the following

- | | |
|-------------|---|
| I. CLUSTAL | 1. Comprehensive database of nucleotide sequences |
| II. BLAST | 2. A substitution matrix |
| III. PAM | 3. Sequence search tool |
| IV. GenBank | 4. Multiple sequence alignment |

- | | I | II | III | IV |
|----|---|----|-----|----|
| A. | 1 | 2 | 3 | 4 |
| B. | 2 | 4 | 1 | 3 |
| C. | 4 | 3 | 2 | 1 |
| D. | 2 | 4 | 3 | 1 |

65) Consider below the types of popular tests and assays and their applications.

- | | |
|------------------------|---|
| I. Widal test | 1) To assess DNA damage |
| II. Ames test | 2) To assess bleeding in the stomach or gut |
| III. Fecal Occult test | 3) Test for chemical induced mutation in bacteria |
| IV. Comet assay | 4) Test for typhoid fever |

Identify the correctly matched pairs as given below:

- A. I-4, II-3, III-2, IV-1
- B. I-4, II-3, III-1, IV-2
- C. I-2, II-3, III-4, IV-1
- D. I-3, II-4, III-2, IV-1

66) Match the following pairs

- | | |
|-------------------------|---------------------------|
| I. PEP to OAA | 1. NADP |
| II. OAA to Malate | 2. ATP |
| III. Malate to Pyruvate | 3. NADPH + H ⁺ |
| IV. Pyruvate to PEP | 4. HCO ₃ |

Which of the pairs given above are correctly matched?

	I	II	III	IV
A.	4	3	1	2
B.	3	4	1	2
C.	2	1	4	3
D.	4	1	2	3

67) Match the following

List I

- I. Cu²⁺
- II. K⁺
- III. Mn²⁺
- IV. Mo²⁺

List II

- 1. Pyruvate kinase
- 2. Cytochrome oxidase
- 3. Nitrate reductase
- 4. IAA oxidase
- 5. Carbonic anhydrase

	I	II	III	IV
A.	1	2	3	4
B.	2	1	4	3
C.	2	1	3	5
D.	3	2	4	5

68) The following compounds are intermediates in the pathway of photorespiration

- I. Phosphoglycolate
- II. Serine
- III. Glyoxylate
- IV. Glycine

The correct sequence of their appearance in the pathway is

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

69. Identify the sequence of intermediate formed during the biosynthesis of Indole-3-Acetic acid
- I. Tryptamine
 - II. Tryptophan
 - III. Indole-3-acetaldehyde
 - IV. Auxin
- A. I, II, III and IV
 - B. II, I, IV and III
 - C. I, IV, II and III
 - D. IV, III, I and II
70. Identify the correct order of the enzymes that are active in TCA cycle in a step by step manner :
- A. Citrate synthase, Aconitase, Isocitrate dehydrogenase, α -Ketoglutarate dehydrogenase, Succinyl- CoA synthetase, Succinate dehydrogenase, Fumarase, Malate dehydrogenase
 - B. Aconitase, Citrate synthase, Isocitrate dehydrogenase, α -Ketoglutarate dehydrogenase, Succinyl-CoA synthetase, Succinate dehydrogenase, Fumarase, Malate dehydrogenase
 - C. α -Ketoglutarate dehydrogenase, Citrate synthase, Aconitase, Isocitrate dehydrogenase, Malate dehydrogenase, Succinyl-CoA synthetase, Succinate dehydrogenase, Fumarase
 - D. Malate dehydrogenase, Citrate synthase, Aconitase, Isocitrate dehydrogenase, α -Ketoglutarate dehydrogenase, Succinyl-CoA synthetase, Succinate dehydrogenase, Fumarase

* * *