Question ONE: (50×1.5=75 Marks, 60 min)

Choose only ONE correct answer and mark in the answer sheet:

1) **Two examples of substrate level phosphorylation in glucose metabolism involve the following substrates:**
   a) 1,3 bisphosphoglycerate and phosphoenol pyruvate
   b) Glucose-6 phosphate and Fructo-6-phosphate
   c) 3 phosphoglyceraldehyde and phosphoenolpyruvate
   d) 1,3 diphosphoglycerate and 2-phosphoglycerate
2) **Conversion of glucose to glucose-6- phosphate is by:**
   a) Hexokinase
   b) PFK-1
   c) Phosphatase
   d) Glucose-6-phosphate dehydrogenase
3) **Dihydroxyacetone phosphate and glyceraldehyde-3-phosphate are intercoverted by:**
   a) Fructose isomerase
   b) Triose phosphate isomerase
   c) Triose reductase
   d) Dihydroxyacetone oxidase
4) **Lactic acid formation from glucose is termed as:**
   a) Aerobic glycolysis
   b) Oxidative phosphorylation
   c) Oxidation in brain
   d) Anaerobic glycolysis
5) **The reaction catalyzed by phosphofructokinase-1 uses the following substrate:**
   a) Fructose-6-phosphate
   b) Fructose-1-phosphate
   c) Fructose-1,6-biphosphate
   d) Fructose-2,6-biphosphate

6) ATP is 'wasted' in glycolysis in RBCs as the reaction catalyzed by phosphoglycerate kinase is bypassed by:

a) Phosphoglucomutase
b) Phosphohexoisomerase
c) Phosphofructokinase
d) Phosphoenol pyruvate carboxykinase

7) A specific inhibitor for pyruvate dehydrogenase complex is:

a) Arsenite
b) Citrate
c) Ca^{+2}
d) Cyanide

8) In glycogenolysis, the enzyme required is:

a) Phosphorylase
b) Synthase
c) Branching enzyme
d)Thiokinase

9) For glycogenesis, Glucose should be activated into:

a) Glucuronic acid
b) UDP- glucose
c) Pyruvic acid
d) Sorbitol

10) Fluoride inhibits _____ and arrests glycolysis.

a) Glyceraldehyde-3-phosphate dehydrogenase
b) Aconitase
c) Enolose
d) Succinate dehydrogenase

11) Glycogenin is:

a) Uncoupler of oxidative phosphorylation
b) Polymer of glycogen molecules
c) Protein primer for glycogen synthesis
d) Intermediate in glycogen breakdown

12) Conversion of alanine to carbohydrate is termed:

a) Glycogenesis
b) Glycogenolysis
c) Gluconeogenesis
d) Photosynthesis

13) Reduced glutathione functions in RBCs to:

a) Produce NADPH
b) Reduce myoglobin to hemoglobin
c) Produce NADH
d) Reduce oxidizing agents such as H_2O_2

14) In glycolysis, 2-phosphoglycerate is converted by enolase to:

a) Phospho enol pyruvate
b) Enol pyruvate
c) Di hydroxy acetone phosphate (DHAP)
d) 1,3 bisphosphoglycerate

15) Human body can get pentoses from:

a) Glycolytic pathway
b) TCA cycle
c) Glycogenolysis pathway
d) HMP shunt

16) Dehydrogenase enzymes of the pentose phosphate pathway are dependent on

a) NAD+ b) NADP+ c)FAD d) FMN

17) Glycogen synthase catalyzes the formation of:

a) α−1, 4-Glycosidic bonds
b) α−1, 6-Glycosidic bonds
c) β−1, 4-Glycosidic bonds
d) β−1, 6-Glycosidic bonds

18) An aneplerotic reaction which sustains the availability of oxaloacetate is the carboxylation of:

a) Glutamate
b) Citrate
c) Pyruvate
d) Succinate

19) *De novo* synthesis of fatty acids occurs in:

a) Mitochondria
b) Cytosol
c) Nucleus
d) Lysosomes

20) Excessive intake of ethanol increases the ratio:

a) NADH / NAD^+
b) $FADH_2$ / FAD
c) NAD^+/ NADH
d) FAD / $FADH_2$

21) Adipose tissue lacks:

a) Hormone-sensitive lipase
b) Glycerol kinase
c) cAMP-dependent protein kinase
d) Glycerol-3-phosphate dehydrogenase

22) Carnitine is required for the transport of:

a) Triglycerides out of liver
b) Triglycerides into mitochondria
c) Short chain fatty acids into mitochondria
d) Long chain fatty acids into mitochondria

23) Net ATP generation on complete oxidation of palmitic acid is:

a) 129 c) 131
b) 146 d) 148

24) Human desaturase enzyme system cannot introduce a double bond in a fatty acid beyond:

a) Carbon 9 c) Carbon 6
b) Carbon 5 d) Carbon 3

25) The release of free fatty acids from adipose tissue is increased by all of the following <u>EXCEPT</u>:

a) Glucagon c) Epinephrine
b) ACTH d) Insulin

26) β-oxidation of odd-chain fatty acids results in final cleavage products propionyl CoA+ Acetyl CoAl, propionyl CoA is then converted into:

a) Pyruvate b) Fumarate c) Succinyl CoA d) L-malate

27) Malonyl CoA is a direct inhibitor of which enzyme?

a) Carnitine palmitoyl transferase-I
b) Carnitine palmitoyl transferase-II
c) Translocase
d) Thiokinase

28) Reactions of fatty acid synthesis include:

a) Condensation→ hydrogenation→ Hydration→ Oxidation
b) Condensation→ Reduction→ Dehydration→ Reduction
c) Oxidation→ Reduction→ Dehydration→ Reduction
d) Condensation→ Reduction→ Dehydration→ Oxidation

29) Pyruvate dehydrogenase complex and α-ketoglutarate dehydrogenase complex require the following coenzymes for their oxidative decarboxylation:

a) CoASH and Lipoic acid
b) CoASH and TPP
c) NAD^+ and FAD
d) CoASH, TPP,NAD^+,FAD, Lipoate

30) During starvation, ketone bodies are used as a fuel by which of the following?

a) Erythrocytes
b) Liver
c) Brain
d) All of these

31) An enzyme required for the synthesis of ketone bodies as well as cholesterol is:

a) Acetyl CoA carboxylase
b) HMG CoA reductase
c) HMG CoA synthetase
d) HMG CoA lyase

32) Regarding fatty acid synthesis, the transfer of acetyl portion of mitochondrial acetyl CoA to the cytosol is mediated by:

a) Carnitine shuttle
b) Citrate-malate-pyruvate shuttle
c) Malate aspartate shuttle
d) Glycerol phosphate shuttle

33) Bioynthesis of arachidonic acid in human is from:

a) Palmitic acid b) Stearic acid c) Oleic acid d) Linoleic acid

34) The conversion of stearic acid to oleic acid is catalyzed by:

a) Fatty acid synthase
b) Elongase
c)Desaturase
d)Thiophorase

35) All long chain fatty acids with even number of carbon atoms are oxidized to _____ by β-oxidation.

a) CO2
b) Acetic acid
c) Propionic acid
d) Acetyl CoA

36) All of the following are correct regarding HMG-CoA reductase <u>EXCEPT:</u>

a) The enzyme is active in the dephosphorylated form
b) Inhibited by cholesterol
c) Its activity increased by glucagon
d) Its activity is stimulated by thyroid hormone

37) Which of the following enzymes is used for malonyl CoA biosynthesis?

a) Malic enzyme
b) Acetyl CoA carboxylase
c) CoASH and ATPase
d) CPT-1

38) Which of the following enzymes is controlling cholesterol biosynthesis?

a) HMG-CoA lyase
b) HMG-CoA reductase
c) HMG-CoA synthase
d) Both b & c

39) Acyl carrier protein is involved in the biosynthesis of:

a) Protein b) Glycogen c) Fatty acids d) Cholesterol

40) Which of the following compounds is directly inhibiting HMG CoA reductase?

a) Statins
b) Tyrosine
c) Aspirin
d) Acetoacetyl CoA

41) The amino acids whose skeletons generate pyruvate or oxaloacetate or other intermediate of TCA cycle are termed ……

a) Glucogenic
b) Ketogenic
c) Both ketogenic and glucogenic
d) Lipogenic

42) The enzyme which combines NH_3 with glutamate (glu) to form glutamine is called:

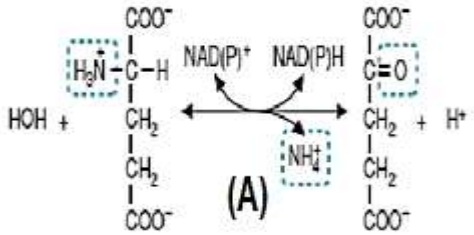
a) Glutamine synthetase
b) Glutamate dehydrogenase
c) Glutaminase
d) Glutamate oxidase

43) Serine is metabolized to pyruvate by:

a) Serine dehydratase
b) Serine oxidase
c) Serine dehydrogenase
d) Serine hydroxylase

44) The enzyme that catalyzes reaction (A) is called……

a) Glutamate dehydrogenase
b) L-aminoacid oxidase
c) Transaminase
d) Glutamate synthase



45) Methionine synthase catalyzes formation of methionine from…….

a) Cysteine
b) Cystathionine
c) Homocysteine
b) S-adenosylmethionine

46) Elevated plasma level of homocysteine is correlated with the severity of ……

a) Coronary artery disease
b) Kidney disease
c) Liver disease
d) GIT disease

47) All of the following statements about phenylketonuria are correct <u>EXCEPT</u>:

a) It is treated by the addition of Tyr and restriction of Phe from diet
b) It could lead to mental retardation if untreated.
c) It is characterized by low urinary excretion of phenylpyruvate
d) It is characterized by deficiency of pigmentation

48) All of the following are correct about signals that enter the cell <u>EXCEPT</u>:

a) They bind to intracellular receptors
b) They activate the transcription of regulated genes
c) They activate a phosphorylation cascade and release second messengers
d) They are small lipophilic molecules

49) Which of the following is type of Insulin receptor:

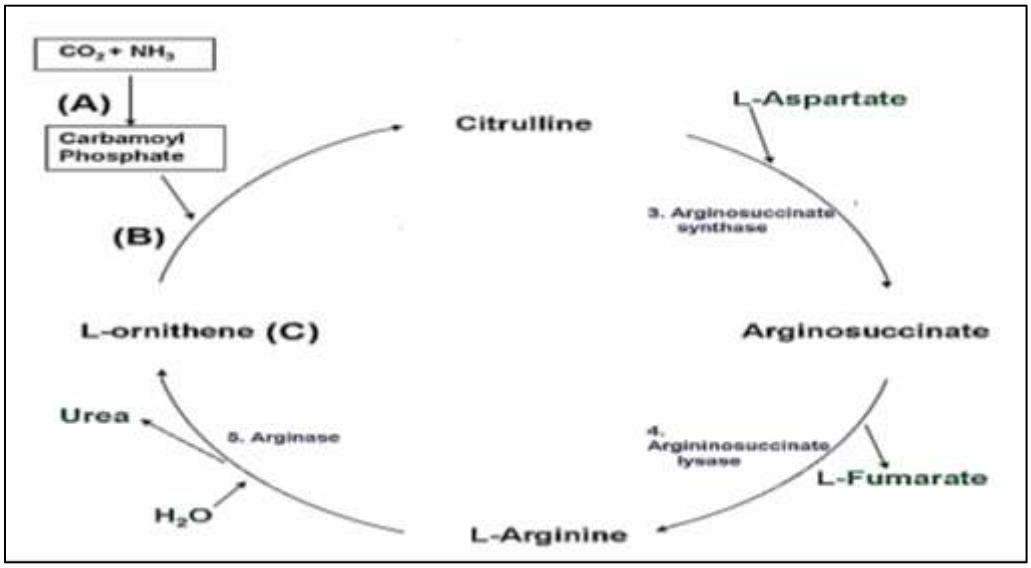
a) Tyrosine kinases receptor
b) Ion channel coupled receptor
c) G-proteins coupled receptor
b) Intracellular receptor

50) Which of the following signals binds to G-proteins coupled receptors:

a) Steroids b) Vitamin D c) Retinoic acid d) Glucagon

Question TWO:

I. Based on the following illustrated diagram answer the related questions? (11x2=22 Marks, 15 min)



1. **This cycle is called:** ……..
2. **This cycle takes place in** ……
   a) Liver b) Kidney c) Muscle d) Heart
3. **The enzyme that catalyzes reaction (A) is called:** ……
4. **The reaction (A) is the rate limiting step in this cycle?** a) Yes b) No
5. **The reaction (B) take place in mitochondria?** a)Yes b) No
6. **Identify the compound which links this cycle to TCA?** ……
7. **Illustrate the role of aspartate in this cycle?**

   ……
8. **Draw the chemical structure of compound (C)?**

9. **What is the consequences of genetic defects of any of the enzymes of this cycle?**

   ……
10. **Name two mechanisms that transport ammonia from tissues to the organ where this cycle occurs?**

    (A) ……

    (B) ……

II. Match each of the following metabolic diseases in column (A) with the corresponding enzyme deficiency/defect in column (B)?

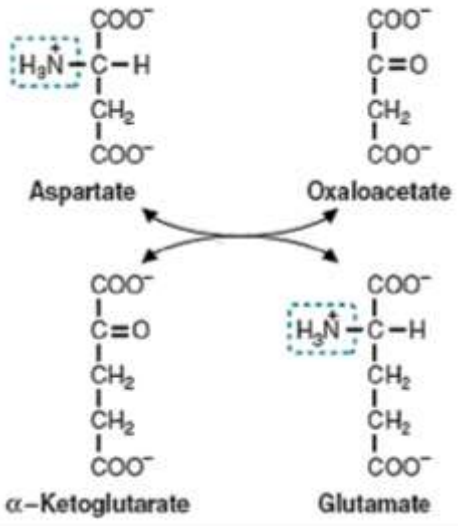
(8x2=16 Marks, 10 min)

#	(A)		#	(B)
1	Phenylketonuria	( )	**A**	Homogentisic acid oxidase
2	Alkaptonuria	( )	**B**	Tyrosinase
3	Albinism	( )	**C**	Ornithine transcarbamylase
4	Homocystinuria	( )	**D**	Branched-chain alpha-keto acid dehydrogenase complex
5	von Gierke's	( )	**E**	Phenylalanine hydroxylase
6	Maple syrup urine disease	( )	**F**	Phosphofructokinase
			G	Cystathionine β-synthase
7	Hereditary hyperammonemia	( )	**H**	Glucose-6-phosphate dehydrogenase
			I	Glucose-6-phosphatase
8	Galactosemia	( )	**J**	Galactose-1-phosphate uridyl transferase

Question THREE:

I- Answer the questions about the following biochemical reaction:

(7 Marks, 10 min)

Biochemical reaction	Questions
	**1. What is the enzyme that catalyzes this reaction?** …….. **2. Illustrate the diagnostic value of this enzyme?** …….. **3. This reaction takes place in the cytosol?** a) Yes b) No **4. This reaction requires a cofactor called** …….. **5. Aspartate is considered:** a) Only glucogenic amino acid b) Only ketogenic amino acid c) Both ketogenic and glucogenic amino acid

II- Write full chemical equations or sketches for each of the following:

(3×10=30 Marks, 25 min)

1. Energy generation phase of glycolysis

2- Citric acid cycle (Sketch only)

3- Ketogenesis

Good luck