Name: "KEY"

1. Which of the following is found in the **least abundance** in the human body? (Choose one correct answer) (2 pts)
   A. Sodium.
   B. Iron.
   C. Nitrogen.
   D. Calcium.
   E. Potassium.

   2

2. List the **four classes of molecules** found in the human body and give at least one **role** for each. (4 pts)

   only need one role

   (+1) Proteins ° enzymes, membranes, fuel
   (+1) Lipids ° membranes, fuel
   (+1) CHO's ° cell-cell recognition, fuel
   (+1) Nucleic Acids ° storage/transfer genetic information

   4

3. A patient is admitted to the ER with the following test results: (2 pts)
   pH 7.10 (nl:7.35-7.45) ↓
   pCO_2 32 mmHg (nl:35-45 mmHg) ↓
   HCO_3^- 24 mM (nl: 24-28 mM)

   Your diagnosis is? Explain your answer based on the clinical findings.

   pH ↓ acidosis
   pCO_2 ↓
   } same direction (both lower)
   ⇩
   "Metabolic Acidosis"

   2

4. Both **glyco**proteins and **glyco**lipids are important components of membranes. **Why**?? (3 pts)

   Cell-cell communication + recognition

   (either communication OR recognition is fine)

   3

5. What are the **ABO blood group antigens** and where are they found? (3 pts)

   Distinct polysaccharides (glycoproteins) on the surface of RBC's

   3

5

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6. There are three types (classes) of **integral membrane proteins**, name them. (3 pts)

(+1) Antigens
(+1) Receptors
(+1) Translocators (Transporters)

(3)

7. What is the primary biological role for **myoglobin** (Mb)? (2 pts)

only need one { store O_2 for release during crisis; times of O_2 depletion

(2)

8. What is the primary biological role for **hemoglobin** (Hb)? (2 pts)

Oxygenate the tissues

(2)

9. Explain, **using biochemistry**, how **Fetal Hb** (HbF) is oxygenated by **Adult Hb** (HbA). (3 pts)

No Biochem (-2)

Lack of His in HbF disrupts salt bridges making it "relax", i.e. it has ↑ affinity for O_2 causing HbA $\xrightarrow{O_2}$ HbF
[$\alpha\gamma$ vs. $\alpha\beta$] this is ok for biochem

(3)

10. Explain why the structure of ***myoglobin*** makes it function well as an oxygen-storage protein whereas the structure of ***hemoglobin*** makes it function well as an oxygen-transport protein. (3 pts)

Mb has a high affinity for O_2 even at low pO_2, it is released during CRISIS involving O_2

Must Have

Hb's cooperative (-1) binding of O_2 gives it ↑ affinity for O_2 in lungs and ↓ affinity for O_2 in the tissues

(3)

11. What is the effect of **pH** (the Bohr effect) on the binding of oxygen to Hb? (3 pts)

As H^+ ↑, pH ↓, the affinity of Hb for O_2 decreases in the tissues

(3)

Briefly **describe** the mechanism of this effect.

High [H^+] causes protonation of His leading to salt bridge formation and stabilization of the T-state
[R ⟶ T] this is ok for mechanism

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(6)

12. Describe, ***briefly***, the basic structure of an IgG protein molecule (antibody). (3 pts)

4 proteins, 2 Heavy + 2 Light
Proteins form a "Y" shape
Must have + 2 others → [Arms contain two identical antigen binding sites]
Structure stabilized by

3

13. Briefly describe how a **vaccine** works. (3 pts)

Injection of a non-virulent (dead) form of the virus causes Ab production, then when exposed to the "virulent" form the immune system is prepared

3

14. Briefly describe the **immune system** and what causes an **autoimmune disorder**. (4 pts)

The immune system is the bodies way to fight/destroy antigens, this is based on recognition of "self" (+2)
An autoimmune disorder occurs when the recognition of "self" fails (+2)

4

15. Enzyme cofactors **ALWAYS**: (Choose one correct answer) (3 pts)

A. are inorganic molecules.
B. form a complex with the substrate to make it more accessible to the enzyme.
(C.) provide a reactive group not found in the enzyme but necessary for it's activity.
D. maintain the native conformation of the enzyme.
E. are covalently bound to enzymes.

3

16. K_m of an enzyme is a measure of the: (3 pts)

Enzymes affinity for substrate
OR
Affinity for substrate
OR
[S] needed to give ½ V_{max}

3

17. **Trypsin** features a proton shuttle (catalytic triad) between which three amino acids? (3 pts)

Ser, His, Asp
(+1) (+1) (+1)

3

Elastase is specific for what type of amino acid residues? (3 pts)

small uncharged amino acid residues
(List Ala, Gly, Val also ok)

3

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18. What is a **zymogen**? (3 pts) An enzyme synthesized as a large inactive protein that must undergo proteolysis to become active OR poised for action OR trypsinogen → trypsin (3)

19. ***Briefly*** define the following: (8 pts)

Available Carbohydrate:

(+2) starch in plants, glycogen in animals

Micronutrient:

(+2) A nutrient required in very small quantities, i.e. vitamins, minerals

Macronutrient:

(+2) A nutrient that provides ENERGY i.e. CHO, Lipid, Protein (8)

Trans Fatty Acid:

(+2) An unsaturated fat with one or more "trans" double bonds OR An unsaturated fat that has been saturated

20. The study of replication and expression of genetic information involves a unidirectional flow from DNA (+1) to RNA (+1) to Protein (+1). (3 pts) (3)

21. Describe two primary biochemical causes of **Gout** and the primary treatment. (3 pts)

(+1) ① Overproduction of Uric Acid
(+1) ② Decreased excretion of Uric Acid OR ↓HGPRT (3)
(+1) Treatment: Allopurinol

22. Name the **enzyme** which converts Ribose-5-phosphate into 5-Phosphoribosyl-1 pyrophosphate (PRPP) in the synthesis of Purines. (3 pts)

PRPP Synthase (3)

23. What compound activates Carbamoyl Phosphate Synthetase II (**CPS-II**) in the synthesis of Pyrimidines? (3 pts)

PRPP (3)

23

24. What enzyme does the chemotherapeutic drug **Methotrexate** (MTX) inhibit in the pyrimidine synthetic pathway? (3 pts)

Dihydrofolate Reductase (3)

25. How does **5-Fluorouracil** work as a chemotherapeutic drug? (3 pts)

Competitive inhibitor of Thymidylate Synthase (3)

26. What is the biochemical cause of **Lesch-Nyhan Syndrome**? (3 pts)

Complete absence of HGPRT (3)

27. **Lactate dehydrogenase**, under anaerobic conditions, reduces pyruvate to lactate. This step also regenerates NAD(+) to keep glycolysis going. (2 pts) (2)

28. The two **enzymes** which catalyze the substrate-level phosphorylation of **ADP** to **ATP** in glycolysis are: (2 pts)

(+1) PGK
(+1) PK (2)

29. **How many** of each of the following molecules, **GTP**, **NADH** and **$FADH_2$** are formed as one molecule of acetyl CoA moves through one turn of the citric acid cycle? (3 pts)

(+1) GTP: 1
(+1) NADH: 3
(+1) $FADH_2$: 1 (3)

30. A **deficiency** of the citric acid cycle at **α-ketoglutarate dehydrogenase** will lead to decreased activity of the **pyruvate dehydrogenase complex** because of feedback inhibition by: (3 pts)

Acetyl CoA OR NADH (3)

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31. Label each of the following statements regarding **substrate-level phosphorylation** and **oxidative phosphorylation** as True (**T**) or False (**F**). (4 pts)

(+1) F A. Substrate-level phosphorylation is linked to oxidation-reduction reactions while oxidative phosphorylation is not.

(+1) T B. Oxidative phosphorylation is sensitive to uncoupling but substrate-level phosphorylation is not.

(+1) F C. Substrate-level phosphorylation is exclusively a cytosolic process and oxidative phosphorylation is exclusively mitochondrial.

(+1) T D. In red blood cells, substrate-level phosphorylation is quantitatively more important than is oxidative phosphorylation as a source of ATP.

4

32. A marked increase in the concentration of **AMP** is what kind of signal to a cell? (2 pts)

Low Energy

2

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