84284 Signaling Pathways in Health and Disease 14 CFU

Exam Questions

Academic Year 2022/2023

- Physiology 9/32 pts.

→ MAX GRADE: 30 cum laude.

The final exam for the module of **Physiology** will be an open-ended question written test. **Starting from September 2022 it will be multiple choice based, with 16 questions (4 choices) and 0.25 penalties for each mistake. We don't know how it will be in June 2023.**

84285 Cell Signaling 4 CFU

Maria Luisa Genova

Exam method

Students who regularly attended the course of Cell Signaling will be evaluated through a **four-hour FINAL EXAM**, a cumulative **written test** with both **multiple-choice and open-ended** response formats that include topics from all the teaching modules of the integrated course of Signaling Pathways in Health and Disease.

Final Grade Fractions:

- Cell Signaling 9/32 pts;
- Metabolic Biochemistry 14/32 pts;

Exam Questions

29/09/2022

- Image on cholesterol destiny (fill it part)

30/01/2023

- The exam was the one that appeared on 25/06/2021, already in the folder.

27/02/2023

- Insulin tkr pathways, primary bile acids, receptors in nucleus and cytosol, hormones as ligands, intracellular second messengers, GPCRs

21/07/23

- Image on T3, T4 pathways; text to fill in about AKT, the exam was the same as 25/06/2021 already in the folder except for the change in one of the multiple choice questions.

76149 Physiology 4 CFU

Davide Martelli

Exam Questions

30/01/2023

- Questions about: hyperalbuminemia, rimonabant (placebo effect), GABA kinds of receptors, CNS laminae, Starling equation, ANS influences, micturition reflex, physiological Pi/Ca++ levels, ATPase kinds of pumps (P, V, F, ABC cassette), passive and active transport features, Haldane effect, the intensity of the stimulus depends on … (the right answer should be: "type of receptor

activated"). **We still don't know if he reuses them, but we are sure that during the exam there are at least two different sets of questions to prevent cheating. So far, mc questions have been specific and sometimes tricky.**

27/02/2023

- Questions about: hyperalbuminemia, Nernst equation recognition, action potentials (Na+ channels then K+ channels), GABA receptors, , primary sensory neurons, CNS laminae, lymphatic system, neurotransmitter released from pre ganglionic neurons, skeletal muscle RYR receptor, smooth muscle IP3, how many different cone types (3) in retina

21/07/2023

- Questions about: nociceptor type (C fiber), number of different cone types in retina (3), interstitial fluid, nernst equation recognition, CO2 in erythrocyte is majorly carried as …, GABA B receptor type (metabotropic), opiates in dorsal horn neurons regulation, IPSPs open which channel, endothelium with the most permeability, membrane is a capacitor because of which channels, pituitary stalk lesions (PRL), DHPR in cardiac muscle

84286 - Metabolic Biochemistry 6 CFU

Giorgio Lenaz

Exam Questions 09/2022

1. Which of the following do you expect if you observe an increase of fructose-2,6-bis-phosphate?

a. An increase of cyclic AMP
b. Increased glycemia
c. Enhanced formation of ATP by glycolysis
d. Enhanced gluconeogenesis
e. The tandem enzyme works as a phosphatase

2. Concerning pyruvate dehydrogenase

a. it is a multienzyme complex
b. it is located in the inner mitochondrial membrane
c. it is inhibited by CoA
d. It is activated by phosphorylation
e. FAD reduced in E3 donates electrons to CoQ bypassing Complex I

3 Which of these treatments may induce hyperglycemia?

a. Activation of cAMP phosphodiesterase
b. Inhibition of adrenaline B-receptors
c. phosphorylation of glycogen phosphorylase
d. dephosphorylation of phosphorylase b kinase
e. phosphorylation of GSK3

4. Chylomicron triacylglycerols are hydrolyzed by

a. Pancreatic lipase
b. Phospholipase C
c. **Lipoprotein lipase**
d. Hormone-sensitive lipase
e. Phospholipase A2

5. Only one answer is wrong. HMGCoA reductase

a. **in mitochondria is involved in ketone body synthesis**
b. may be inhibited by phosphorylation
c. is involved in the synthesis of Coenzyme Q
d. catalyzes two consecutive reductions
e. is a cytosolic enzyme

6. One of these statements is false.

a. The reducing power for fatty acid biosynthesis is obtained by glucose o
b. All carbon atoms of glucose will be found in palmitic acid
c. Fatty acid biosynthesis is stimulated by insulin ·
d. Acetyl CoA carboxylase may be phosphorylated
e. Acetyl CoA carboxylase is activated by citrate

Concerning methylmalonyl CoAQ

a. It is involved in cholesterol biosynthesis
b. It is formed from propionyl CoA
c. **It is converted into succinyl CoA**
d. It is an intermediate of fatty acid biosynthesis
e. It is ketogenic

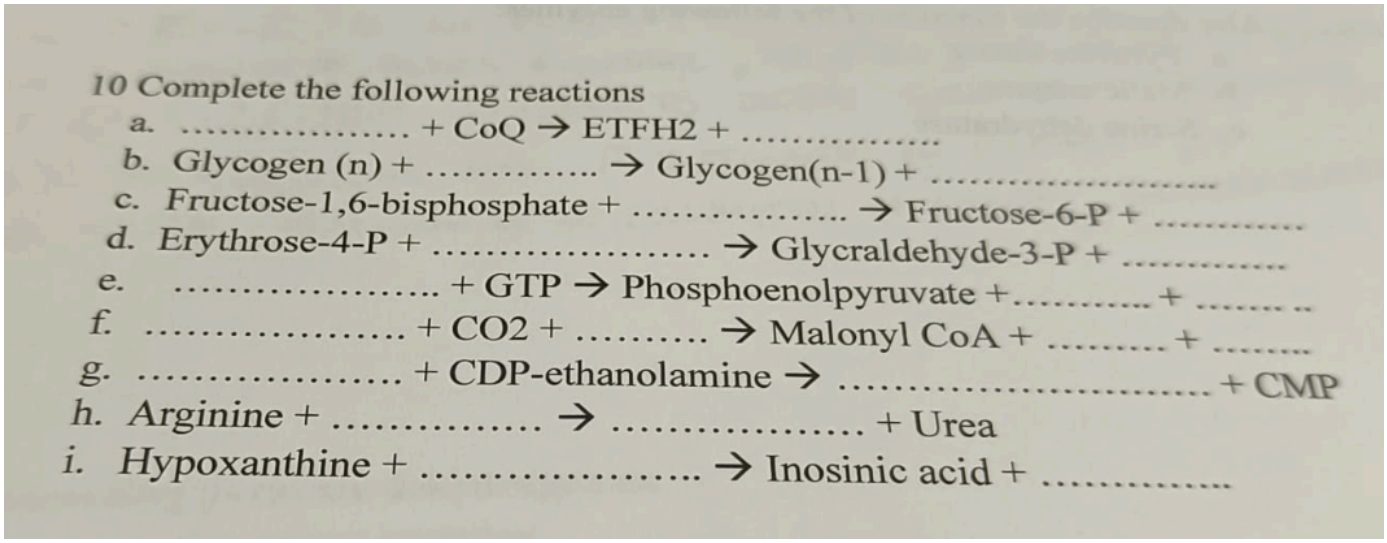
8. Concerning amino acids

a. Deamination of serine occurs via transamination
b. Isoleucine is an only ketogenic amino acid
c. Valine enters the Krebs cycle at the level of oxaloacetate
d. Glutamate dehydrogenase catalyzes an irreversible reaction
e. The most abundant amino acids in blood are glutamine and alanine

9. Which of these is a substrate for ribonucleotide reductase?

a. AMP
b. ADP
c. ATP
d. dADP
e. dAMP

10.



10 Complete the following reactions

a. ..... + CoQ → ETFH2 + ...

b. Glycogen (n) + ... → Glycogen(n-1) + ...

c. Fructose-1,6-bisphosphate + ... → Fructose-6-P + ...

d. Erythrose-4-P + ... → Glycraldehyde-3-P + ...

e. ..... + GTP → Phosphoenolpyruvate + ... + ...

f. ..... + CO2 + ... → Malonyl CoA + ... + ...

g. ..... + CDP-ethanolamine → ..... + CMP

h. Arginine + ... → ..... + Urea

i. Hypoxanthine + ... → Inosinic acid + ...

11.) List the coenzymes or prosthetic groups deriving from the following vitamins and describe their functions.

a. Thiamine (Vit B1)
b. Riboflavin (Vit B2)
c. Nicotinamide (Vit PP)
d. Pantothenic acid (Vit B5)
e. Pyridoxine (Vit B6)
f. Cobalamine (Vit B12)

12. Write the following reactions involving pyruvate and comment on their functional role in metabolism

a. Reduction
b. Oxidative decarboxylation
c. Carboxylation
d. Transamination

Also describe the function of the following enzymes:

a. Pyruvate kinase
b. Malic enzyme
c. Serine dehydratase

30/01/2023

All the questions, reactions and exercises were taken from his Virtuale (I strongly suggest doing all of them). In particular the **ATP** yield, cell localization and passages to obtain **palmitate** from **alanine**. An exercise about prosthetic groups, vitamin derivatives and coenzymes of some molecules.

27/02/2023

Repetition of questions in previous past papers (like fill in the gaps, **glutamate** to **glucose** + **atp** balance, vitamins of coenzymes and prosthetic groups, hyperglycemia, pyruvate dehydrogenase, type-1 diabetes…)

26/06/2023

Physiology: (there were 2 forms)
16 multiple choice questions:
1. Given a person weighs 70kg, calculate his plasma fluid? ***(3.5L roughly)***
2. What is the blood concentration of Pi? ***(0.8 to 1.5 mmol/L (or 2.5 to 4.5 mg/dL)***
3. What is the formula for electrochemical gradient? ***(Nernst equation here)***
4. What is the main reason that establishes membrane potential? ***(Question seems incomplete?)***
5. Recognise the Sterling equation (very specific, is it [in the capillary - interstitium] or the opposite)
6. What channels are involved in the release of neurotransmitters (He gave as options both N-type and L-type Ca++, need to know specific type) ***(N-type Ca++ channel)***
7. What protein is involved in anterograde transport in the axon ***(Kinesin)***
8. What hormone concentration will increase due to a lesion in the pituitary stalk ***(prolactin)***
9. What is the Haldane Effect?

Metabolic biochemistry:

Open Question:
1)Construct a scheme containing the following terms: 1,3-bisphosphoglycerate, Coenzyme Q, dihydroxyacetone phosphate, glyceraldehyde-3-P, glyceraldehyde-3-P dehydrogenase, glycerol-3-P, glycerol-3-P dehydrogenase, inner mitochondrial membrane, NAD+, NADH, outer mitochondrial membrane. Some terms may be repeated more than once.

2) fill in the blanks
Ornithine + …….. → …… + Pi
Citrate +..... + CoASH -› Oxaloacetate + ...+…….+……
Glycogen (n) + …… → Glucose-1-P + …….
Glyceraldehyde-3-P + ……. + …….. → ……. + NADH + H+
…….. + NADP+ → Ribulose-5-P + …… + ……..
……. + NADH + H+ → β-hydroxybutyrate + ……
Citrate + …….. + …….. → Acetyl-CoA + …… + ……. + ……..
Ornithine + …… → ……. + Pi
…… + FH4 → Glycine + …….
Homocysteine + …… → …… + FH4

3) List all coenzymes you know that
derive from the following Vitamins
and briefly describe their function(s)
Riboflavin (Vitamin B2)
Pantothenic acid (b5)
Pyridoxine (Vitamin B6)
Thiamine (Vitamin B1)
Folic acid (b9)
Niacin (b3)
Biotin (B7)

Multiple choice questions:

1. During fasting or starvation
a. The level of nonesterified fatty acids (NEFA) in plasma is decreased
b. Oxaloacetate is reduced to malate in the cytosol
c. Protein degradation in skeletal muscles is enhanced
d. Pyruvate dehydrogenase is activated
e. Phosphoenolpyruvate carboxykinase is inhibited

2.Which of these effects would you expect by a
genetic defect of acyl CoA dehydrogenase?
a. The patient improves with fasting
b. The patient improves by forcing with a high fat diet
c. The patient develops acidosis due to high ketone bodies generation
d. The patient develops liver steatosis (fatty liver)
e. The level of acylcarnitines in blood is decreased

3. In a well-fed individual after a meal
a. The levels of non-esterified fatty acids in plasma are increased
b. Oxaloacetate is reduced to malate in the mitochondrion
c. Protein degradation in skeletal muscles is enhanced
d. Pyruvate dehydrogenase is activated
e. Phosphoenolpyruvate carboxykinase is activated

4. Which of the following is NOT glucogenic
   a. Beta HMG-CoA (or maybe it was beta hydroxybutyrate)

5. Which of the following is NOT involved in purine synthesis -
   a. Glycine
   b. Aspartate
   c. CO2
   d. Methionine

Cell Signaling:
Part 1: five multiple choice

1. Which of the following is not a ligand (hormone)?
a) Progesterone
b) cGMP
c) Adenylyl cyclase

Part 2: find error in a signaling pathway and fill in the blank text
And then elaborate on specific parts of it.

Fill in the gaps in a text about steroid hormone receptors

Exam of 15/09/2023

Physiology (16 multiple choice questions, Prof. Davide Martelli)

some of the questions are occasionally repeated and can be found in the “past exam’s questions”

- Haldane effect
- CO2 is primarily transported as (bicarbonate, CO2, protein complexes were the options) ***(Bicarbonate)***
- Plasma physiological level ***(290 osmL/kg)***
- How many cones in the retina? ***(3)***
- Clathrin mediated endocytosis
- Naloxone (was the answer of one question)
- Formula of permeability coefficient ***(P=(DxK)/d***
- Electrochemical gradient equation
- What does inhibin inhibit ***(Follicle stimulating hormone, FSH)***

Cell Signaling (Prof. Maria Luisa Genova)

- 5 multiple choices regarding enzymes, ligands, receptors, G-proteins.
- 1 text to fill in the gaps regarding cholesterol and steroid / nuclear receptors
- Figure to find out the mistakes: insulin slow and fast pathways, glucose transporters, glycogen synthase

Metabolic Biochemistry (Prof. Giorgio Lenaz)

- 9 multiple choice questions exactly the ones you find on his virtuale
- Reactions to fill in the gaps which are identical to the ones in his Refresher lectures or on this and previous files of past year’s “Exam questions”
- 1 open question asking to associate to each Vitamin its coenzyme and describe its function
- 1 open question regarding Pyruvate: oxidative decarboxylation, reduction, transamination, carboxylation. Also describe the function of serine dehydratase, malic enzyme, pyruvate dehydrogenase.

Exam of 22/01/2024

Physiology (16 multiple choice questions, Prof. Davide Martelli)

some of the questions are occasionally repeated and can be found in the “past exam’s questions”

The new questions were:

- ICF and ECF concentration of Ca++ ***(0.0001 mM (100 nM) for ICF, 1.1-1.3 mM (or 1,100-1,300 µM for ECF, basically ECF is much larger than ICF)***
- Baroreflex
- Meissner plexus function ***(gut motility)***
- What protein is involved in retrograde transport in the axon -> ***(dynein)***
- In which synapse EPSPs can you be sure it will evoke an action potential?
- Na/K ATPase - some question about type of pumps (V-type, P-type)?
- If a man weighs 70 kg how many L he has of plasma? ***(3.5L)***
- Which organ has the most permeable endothelium? ***(The Liver)***
- How is acuity influenced by receptive fields? E.g. higher acuity when receptive field is bigger/smaller etc.
- Something about location of ganglia of some neurons?
- Physiological levels of Pi ***(In an average adult: 0.8 to 1.5 mmol/L (or 2.5 to 4.5 mg/dL)***
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Cell signaling:

- The exam was the one that appeared on 25/06/2021, already in the folder. ->except for a question regarding thyroglobulin.

Met biochem:

The exam was this exact one:

1. Which of the following do you expect may contribute to elevated glycemia?

A. Glycolysis
B. glycogenolysis
C. Glucokinase reaction
D. Pentose phosphate shunt
E. GSK3 phosphorylation

2. Only one answer is wrong. Pyruvate carboxylase

A. Is present in both mitochondria and cytosol. (Only in mitochondria!)
B. Has covalently bound biotin as prosthetic group
C. Is activated by AcetylCoA

D. Requires ATP
E. Catalyzes an anaplerotic reaction

3. Concerning muscle glycogen

A. A.It is formed starting from blood glucose during exercise
B. When broken down it contributes significantly to blood glucose levels
C. Its breakdown occurs by reacting with inorganic phosphate
D. Glucagon stimulates its breakdown
E. The 1-6 glycosidic bond in its branches is broken by an isozyme of phosphorylase

4. One of the these statements is false

A. The reducing power of fatty acids biosynthesis is obtained by glucose oxidation
B. All carbon atoms of glucose will be found in palmitic acid
C. Fatty acid biosynthesis is stimulated by insulin
D. AcetylCoA carboxylase may be phosphorylated
E. AcetylCoA carboxylase is activated by citrate

5. Concerning fatty acid biosynthesis

A. Citrate activates fatty acid biosynthesis
B. Phosphorylation of fatty acid synthase is required for palmitate biosynthesis
C. Excess AcetylCoA inhibits FA biosynthesis
D. FA synthase may synthesize C16, C18, C20
E. The carbon atom of CO2 used for AcetylCoA carboxylase will be incorporated into palmitic acid

6. Chylomicrons

A. Are carried to the liver by portal circulation
B. Contain free fatty acids deriving from digestion
C. Undergo triglyceride hydrolysis by lipoprotein lipase
D. Release glycerol into adipocytes to be used for triacylglycerol re-synthesis
E. Are the only lipoproteins that do not contain phospholipids

7. Type-2 diabetics are often obese because

A. Lack of insulin stimulates transcription of fatty acid biosynthesis enzymes
B. Obesity and over feeding favor diabetes arousal
C. Lack of insulin inhibits lipolysis in adipose tissue
D. Lack of insulin enhances the transport of citrate in the cytosol
E. Glucocorticoids enhance lipogenesis

8. Which of these is a substrate for ribonucleotide reductase?

A. AMP
B. ADP
C. ATP
D. DADP
E. DAMP

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9. Which of these are substrates of thymidylate synthase?

A. DUMP and methylFH4
B. UMP and methylFH4
C. DUMP and methyleneFH4

D. DUDP and methyleneFH4
E. UDP and methyleneFH4

10. PPP all the pathway and write all the reactions involved

11. Associate the enzymatic defects with the pathologies

- LDL receptor - hypercholesterolemia
- Glutamate decarboxylation enzyme - altered GABA neurotransmission
- Lipoprotein lipase - hypertriglyceridemia
- AcylCoA DH - liver steatosis
- Citrate lyase - defect in FA and cholesterol biosynthesis
- Glucose-6-phosphatase - hypoglycemia
- Glucose-6-P DH - erythrocyte glutathione remains oxidized
- PFK2 - lack of response of glycolysis
- Phosphorylase b kinase - glycogen accumulation in liver
- Pyruvate DH - lactic acidosis
- SuccinylCoA acetoacetate transferase - ketonemia

12. Complete the following reactions

A. ……. + UTP -> UDP-glucose + …..
B. PEP + …….. -> …… + ATPy
C. Isocitrate + …….. -> …… + ……. + CO2
D. ……. + acetoacetate -> succinate + ……
E. HMG-CoA -> acetoacetate + ……
F. Citrate + ……. + …….. -> AcetylCoA + …… + …… + …….
G. …….+ ATP + …… -> argininosuccinate + ……. + ……
H. Serine + …… -> methyleneFH4 + ……
I. Guanine + ……. -> GMP + ……