

84284 Signaling Pathways in Health and Disease

14 CFU

Exam Questions

Academic Year 2023/2024

Exam method:

Students enrolled in the course of Signaling Pathways in Health and Disease will be assessed through three written exam modules: Physiology, Cell Signaling and Metabolic Biochemistry. ALL the three modules must be taken as an integrated exam in the same session date (cf. Almaesami).

Cell Signaling will be assessed through a 1-hour online written test including both multiple-choice and open-ended response questions published on EOL.

Mark Fractions: Cell Signaling, 9/32 pts; Metabolic Biochemistry 14/32 pts; Physiology, 9/32 pts. MAX total grade: 30 cum laude.

However, please also note that exam outcomes will not be disclosed to students as partial grades of each module, but as integrated final marks. Consequently, the passing value (18) can be reached with any possible mathematical combination of the hidden partial results from the three individual exam modules.

Students will have to make their decision whether or not to accept the Signaling Pathways in Health and Disease exam outcome based on the integrated final mark.

● **EXAM QUESTIONS OF 17/06/2024**

84285 Cell Signal 4 CFU

Maria Luisa Genova

Exam questions:

Same questions as on the drive

84286 Metabolic Biochemistry 6 CFU

Giorgio Lenaz and Michele Di Foggia

Exam questions:

Multiple Choice

1. Which is incorrect?
 - a. Glycolipids contain sphingosine
 - b. ?
 - c. ?
 - d. ?
 - e. ?
2. Caffeine inhibits (something about cAMP). What is the effect?
 - a. Decreased lipolysis
 - b. ?
 - c. ?
 - d. ?
 - e. ?
- 3.
- 4.

- 5.
- 6.
- 7.
- 8.
- 9.

Open Questions

10. Fill in the blanks (complete the reactions)
11. Name the coenzymes and prosthetic groups, if any. Write the name of the vitamin it's derived from
12. Write the complete set of reactions for synthesis of (?) from (?)

76149 Physiology 4 CFU

Daive Martelli

Exam questions:

1. Haldane Effect
 - a. Glucose uptake in intestine
 - b. Increase in osmotic pressure due to impermeable molecules
 - c. affinity of hemoglobin to CO2 changes when there is oxygen bond to it**
 - d. ?
2. Which neurotransmitter do parasympathetic ganglions use?
 - a. GABA
 - b. ACTH
 - c. ACh**
 - d. ?
3. Electrochemical gradient equation
 - a. $\Delta\mu_x = RT \ln([x_i]/[x_o]) - zxFVm$
 - b. $\Delta\mu_x = RT \ln([x_i]/[x_o]) + zxFVm$**
 - c. $\Delta\mu_x = RT \log([x_i]/[x_o]) + zxF$
 - d. $\Delta\mu_x = RT \ln([x_i]/[x_o]) + Vm$
4. CRH induces the release of
 - a. ACTH**
 - b. FSH
 - c. GH
 - d. TSH
5. What is phosphate concentration in the bloodstream?
 - a. 1 mg/dL
 - b. 4 mg/dL**
 - c. 10 mg/dL
 - d. 20 mg/dL
6. How much plasma in adult who weighs 70 kg
 - a. 10.5 L
 - b. 14 L
 - c. 3.5 L**
 - d. 28 L
7. What is the effect of innervation of sympathetic nerves in airways/bronchi idk
 - a. Secretion of mucous
 - b. Bronchodilation**
 - c. Bronchoconstriction
 - d. No effect since no sympathetic nerves in bronchi
8. What has the biggest effect on membrane potential?
 - a. Na⁺/K⁺ pump

- b. **The unequal distribution of ions among the two sides of the lipid bilayer**
 - c. ?
 - d. ?
9. What triggers action potential
- a. **increase in conductance of Na⁺ channels then in K⁺ channels**
 - b. increase in conductance of K⁺ channels then in Na⁺ channels
 - c. Increase in conductance of Cl⁻ channels then (?) channels
 - d. Increase in conductance of K⁺ channels then Ca⁺⁺ channels
10. What is the intensity of a stimulus
- a. **Frequency of action potential**
 - b. Amplitude of the sensory receptor
 - c. How many neurons fire
 - d. All of the above
11. Type of proton pump in lysosomes
- a. F-type
 - b. **V-type**
 - c. ABC
 - d. P-type
12. What are the Nociceptor fibers?
- a. A delta mechanosensitive
 - b. A delta mechanothermal
 - c. **C fibers**
 - d. All of the above
13. In which muscles does 2nd messenger IP3 work?
- a. Skeletal muscle
 - b. Cardiac muscle
 - c. Smooth muscle
 - d. ?
14. In which process are clathrin used
- a. Pinocytosis
 - b. **Endocytosis**
 - c. Constitutive exocytosis
 - d. (Something else) exocytosis
15. From where is calcium released?
- a. Dihydropyridine receptors
 - b. **Ryanodine receptors**
 - c. SERCA
 - d. Extracellular Matrix?
16. How are neuro agents lethal?
- a. Inhibit acetylcholinesterase
 - b. Block calcium channels
 - c. Block sodium channels
17. What is released by pre-ganglionic neurons?
- a. **Acetylcholine**
 - b. Adrenaline
 - c. Noradrenaline

● **EXAM QUESTIONS OF 12/07/2024**

[84285 Cell Signal 4 CFU](#)

Maria Luisa Genova

Exam questions:

Section A1 - Multiple Choice

1. ...

- a. ...
 - b. ...
 - c. ...
2. ...

Section A2 - Graphical Problem

Section A3 - Fill in the Blanks

84286 Metabolic Biochemistry 6 CFU

Giorgio Lenaz and Michele Di Foggia

Exam questions:

Multiple choice:

1. One answer is wrong. Pyruvate carboxylase
 - a. **Is in cytoplasm and mitochondria**
 - b. Has biotin as coenzyme
 - c. Activated (I think) by acetyl CoA
 - d. Catalyzes an aneupleurotic reaction
 - e. ?

2. Which of the following would cause Hyperglycemia
 - a. Phosphorylation of PKB
 - b.

Open Questions:

1. Fill in the blanks
 - a. Glycogen (n) + ___ → Glycogen (n-1) + ___
 - b. Fructose-1,6-bisphosphate + ___ → fructose-6-P + ___
 - c. Erythrose-4-P + ___ → glyceraldehyde-3-P
 - d. ___ + GTP → PEP + ___ + ___
 - e. Arginine + ___ → ___ + Urea
 - f. HMG-CoA → acetyl CoA + ___
 - g. ___ + CO₂ + ___ → malonyl CoA + ___ + ___
 - h. ? (β acyl something)
 - i. ?

2. Write the coenzymes and prosthetic groups, the vitamins they derive from and the reactions
 - a. Transaldolase
 - b. Transketolase
 - c. HMG-CoA
 - d. Alpha-ketoglutarate dehydrogenase complex
 - e. Pyruvate dehydrogenase
 - f. Acetyl CoA carboxylase
 - g. Serine hydroxymethyl transferase
 - h. ?
 - i. ?

3. Write the reactions for synthesis of **glucose** from **glutamate**. Show ATP balance and compartmentalisation

76149 Physiology 4 CFU

Davide Martelli

Exam questions:

1. What is the physiological level of calcium in the blood?
 - a. 1 mg/dL
 - b. 4 mg/dL
 - c. 10 mg/dL**
 - d. 20 mg/dL

2. The (?) of Miesnner's plexus controls
 - a. Gastrointestinal motility**
 - b. ?
 - c. ?
 - d. ?

3. What protein for retrograde transport?
 - a. Dynein**
 - b. Kinesin
 - c. ?
 - d. ?

4. (I don't remember)
 - a. Larger acuity with smaller receptive fields**
 - b. Larger acuity with larger receptive fields
 - c. ?
 - d. ?

5. Something about EPSP

6. What is a rapidly adapting neuron?
 - a. Always active
 - b. Stops responding to constant stimulus**
 - c. ?
 - d. ?

7. Electromechanical coupling (something about DHPR and T-tubules) is predominantly found in
 - a. Smooth muscle cell
 - b. Cardiac muscle cell
 - c. Skeletal muscle cell**

8. Ca⁺⁺ concentration in ECF and ICF of neuron
 - a. 145, 15**
 - b. ?
 - c. ?
 - d. ?

9. Something about baroreceptor reflex
 - a. ?
 - b. ?
 - c. ?
 - d. ?

10. What type of pump is the Na⁺/K⁺ ATPase
 - a. V-type
 - b. P-type**
 - c. F-type
 - d. ABC

11. How much plasma in an adult who weighs 70 kg?
 - a. 28 L
 - b. 10.5 L
 - c. 3.5 L**
 - d. 14 L

12. Which organ has the most permeable endothelium
 - a. Liver**
 - b. ?

- c. ?
 - d. ?
13. Starling equation
- a. $J_v = K_f (P_c - P_{is}) - \sigma (P_c - P_{is})$
 - b. $J_v = \beta D/x$
 - c. $J_v = K_f (P_{is} - P_c) - \sigma (P_{is} - P_c)$
 - d. ?
14. ?
15. ?pto
16. ?

- **EXAM QUESTIONS OF 16/09/2024**

84285 Cell Signal 4 CFU

Maria Luisa Genova

Exam questions:

Which of the following is a secondary messenger
 Which of the following is a ligand binding receptors
 Something about primary bile acids
 Properties of trimerc g proteins
 Image about insulin pathway
 Text about TFS and proteins acting on
 Filling in the blanks about steroid hormones and receptors

84286 Metabolic Biochemistry 6 CFU

Giorgio Lenaz and Michele Di Foggia

Exam questions:

76149 Physiology 4 CFU

Davide Martelli

Exam questions:

- Electrochemical gradient formula
- Sharp, persistent pain. ANSWER: alpha, delta and C fibers
- ATP in Muscle contraction. ATP and myosin, ATP hydrolysis
- K⁺ concentration in and out of the cell
- Micturition reflex (Sympathetic nerves). Options: contraction/relaxation of detrusor muscle; contraction/relaxation sphincter
- Passive flow of ions. Options: K⁺ goes outwards, K⁺ goes inwards, Na⁺ goes outwards, Na⁺ doesnt go inwards or outwards
- Permeability coefficient formula
- Plasma osmolarity
- Which hormone acts on preganglionic sympathetic neurons (acetylcholine gaba adrenaline noradrenaline)
- TRH which hormone it stimulates
- Where does Ca²⁺ come from after signal travels down T tubules. Options: RYR receptor, etc.

- Haldene effect
- What does clathrin mediate

- **EXAM QUESTIONS OF 30/09/2024**

84286 Metabolic Biochemistry 6 CFU

Giorgio Lenaz and Michele Di Foggia

MC questions:

In a well fed individual

- The activity of liver glucose-6-phosphatase is high
- The blood levels of acetoacetate are low
- The activity of fructose-1,6-bisphosphate phosphatase is high
- Fatty acid biosynthesis is decreased
- The secretion of cortisol is increased

Concerning gluconeogenesis (not sure if it was this question)

- An intermediate is oxaloacetate
- Among precursors we have β -hydroxybutyrate
- It is decreased by cortisol
- It is stimulated by fructose-2,6-bisphosphate
- A key regulatory enzyme is aldolase

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 inhibit

Which of these effects would you expect by a genetic defect of acyl CoA dehydrogenase?

- The patient improves with fasting
- The patient improves by forcing with a high fat diet
- The patient develops acidosis due to high ketone bodies generation
- The patient develops liver steatosis (fatty liver)
- The level of acylcarnitines in blood is decreased

In a well-fed individual after a meal

- The levels of non-esterified fatty acids in plasma are increased
- Oxaloacetate is reduced to malate in the mitochondrion
- Protein degradation in skeletal muscles is enhanced
- Pyruvate dehydrogenase is activated
- Phosphoenolpyruvate carboxykinase is activated

Which of the following is NOT involved in purine synthesis?

- a. Glycine
- b. Aspartate
- c. CO₂
- d. Methionine
- e. Glutamine

Deficiency in B₂, what is not affected:

- a. Complex I
- b. Complex II
- c. Complex III
- d. PDH
- e. Fatty acyl coa dehydrogenase

About ACP:

- A) connects to FA via thioester bond
- b) has 2 sulfhydryl groups
- c) has prosthetic group
- d) involved in FA oxidation
- e) is an individual protein in humans

Concerning glycolysis

- a. Pyruvate cannot be produced under anaerobic conditions
- b. Four NAD⁺ are reduced per glucose molecule oxidized
- c. Glycolytic NADH can be reoxidized by oxaloacetate
- d. Phosphofructokinase is inhibited by AMP
- e. The key regulatory enzyme is glyceraldehyde phosphate dehydrogenase

Open questions:

Write the pathway from aspartate to glucose. Pay attention to the compartmentalization and write the ATP count

List all the coenzymes or prosthetic groups deriving from the following vitamins and describe their functions. (he will pick some of these)

- a. Thiamine (Vit B₁)
- b. Riboflavin (Vit B₂)
- d. Panthothenic acid (Vit B₅)
- e. Pyridoxine (Vit B₆)
- f. Cobalamine (Vit B₁₂)
- g. Folic acid (B₉)
- h. Niacin (B₃) / Nicotinamide (Vit PP)
- i. Biotin (B₇)

11. Complete the following reactions

- a. Glycogen (n) + \rightarrow Glucose-1-P +
- b. Glyceraldehyde-3-P + + \rightarrow + NADH + H⁺
- c. + NADP⁺ \rightarrow Ribulose-5-P + +
- d. + NADH + H⁺ \rightarrow β -hydroxybutyrate +
- e. Citrate + + \rightarrow Acetyl CoA + + +
- f. Ornithine + \rightarrow + Pi
- g. + FH₄ \rightarrow Glycine +
- h. Homocysteine + \rightarrow + FH₄

Coenzyme Q + ... \rightarrow Fumarate + ...

76149 Physiology 4 CFU

Daive Martelli

Exam questions:

1. Interstitial fluid in 70 kg adult = 10.5L
2. Starling equation = $J_v = K_f [(P_c - P_{is}) - \sigma (\Pi_c - \Pi_{is})]$
3. Does PTH:
 - a. lower Ca in plasma
 - b. Elevate Ca in plasma
 - c. Lower Ca in cytosol
 - d. Elevate Ca in cytosol
4. Something about C fibers = ..
5. What is a rapidly adapting neuron? = Something about it stopping responding to constant stimulus
6. What type of pump is the H⁺ ATPase
7. Something about itching conduction velocity (0.5 m/s)
8. Something about the receptive field
9. What measures the intensity of the stimulus? (frequency)

84285 Cell Signal 4 CFU

Maria Luisa Genova

A1: Multiple choice:

1. What's targeted by cAMP
 - a. PKA
 - b. PLA
 - c. PKC
 - d. PDK1

2. What works on 7TMRS
 - a. NO
 - b. Glucagon
 - c. Insulin
 - d. Testosteron

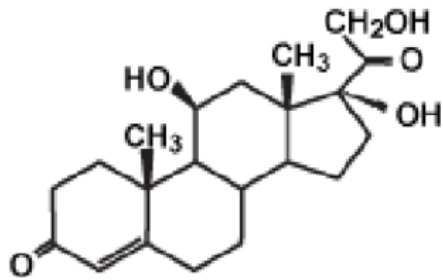
3. Insulin
 - a. Does it form a zinc hexamer with glutamate residues
 - b. Is It secreted from pancreatic beta cells when glucose is very low
 - c. Formed by two peptide chains linked with disulfied bridges
 - d. Excreted through GLUT4 to the blood

4. Which one is not an abbreviation for an intracellular second messenger
 - a. DAG
 - b. PIP3
 - c. HRE
 - d. cGMP

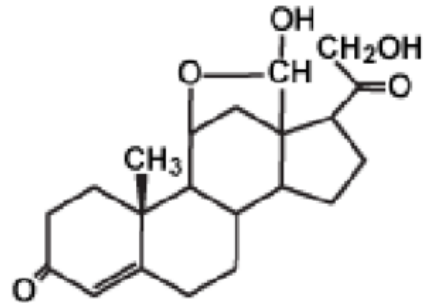
5. Steroid vs peptide hormone characteristic
 - a. Steroids are hydrophilic while peptides not
 - b. Steroids control gene expression while peptides not
 - c. Hormones are water soluble and peptide are not water soluble
 - d. Peptide hormones link to membrane receptors and steroids to intracellular

A2: Fill in the blanks is about Guanylyl Cyclase / NO hormone

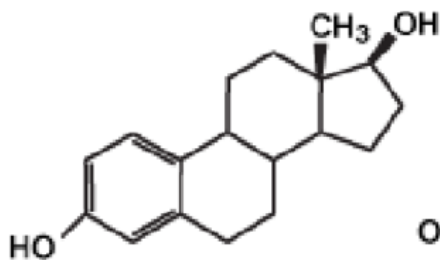
A3: Image on the steroid hormone pathway (structures and C#)



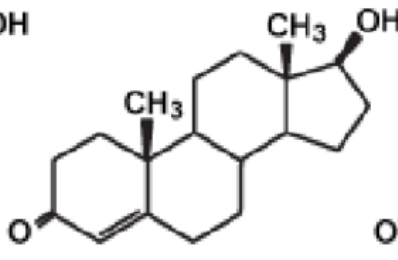
Cortisol
Glucocorticoid



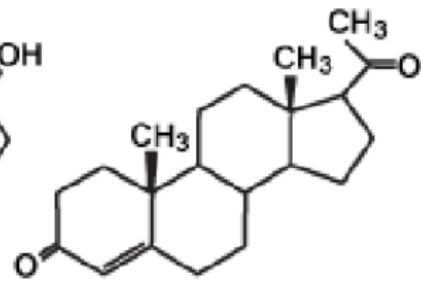
Aldosterone
Mineralocorticoid



Estradiol
Sex Steroid



Testosterone
Sex Steroid



Progesterone
Sex Steroid

You had to match the top half and bottom half of the molecule to each other, as well as mention the carbon numbers of estradiol, aldosterone and cortisol.

- **EXAM QUESTIONS OF 14/01/2025**

[84286 Metabolic Biochemistry 6 CFU](#)

[76149 Physiology 4 CFU](#)

[84285 Cell Signal 4 CFU](#)

- **EXAM QUESTIONS OF 28/02/2025**

[84286 Metabolic Biochemistry 6 CFU](#)

[76149 Physiology 4 CFU](#)

[84285 Cell Signal 4 CFU](#)

