Online Resource 3

Pop-up questions with corresponding test questions for study 2 (translated from Dutch)

Chapter 2 - Atoms and Molecules

ITEM 1 – LEARNING GOAL 1

Test question

How many valence electrons does the atom N (nitrogen) contain?

A. 2
B. 4
C. 5
D. 8

Pop-up question

The half-life of isotope ^{33}P is 25 days. The atomic number of phosphor is 15 (see periodic system). How many neutrons and valence electrons does isotope ^{33}P contain?

A. 18 neutrons and 15 valence electrons
B. 18 neutrons and 5 valence electrons
C. 17 neutrons and 15 valence electrons
D. 17 neutrons and 5 valence electrons

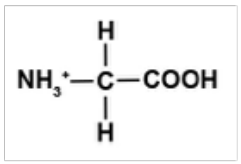
Feedback per answer: Phosphor contains 15 electrons, but not all of them are valence electrons / *Phosphor contains (33-15=) 18 neutrons. Phosphor contains 15 electrons within three electron shells (2, 8, 5). Five electrons are present in the outer electron shell. /*Phosphor contains 15 electrons, but not all of them are valence electrons / The number of neutrons is equal to the mass number minus the atomic number

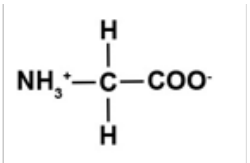
Chapter 3 Chemistry of Water

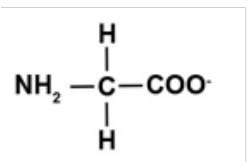
ITEM 2 – LEARNING GOAL 11

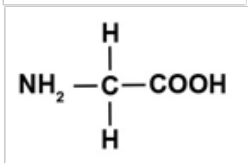
Test question

The amino acid glycine contains a carboxyl group with pKa value 2.3 and an amino group with pKa value 9.6. What is the structural formula for glycine at pH=2, pH=7 and pH=12?
Match the pH levels with the following structural formulas.









Pop-up question

What is the molecular formula for the N-terminus of an amino acid with pKa value 10 at pH=2,

pH=7 and pH=12?

- **A. pH=2: NH_3^+**
- B. pH=2: NH_2
- **C. pH=7: NH_3^+**
- D. pH=7: NH_2
- E. pH=12: NH_3^+
- **F. pH=12: NH_2**

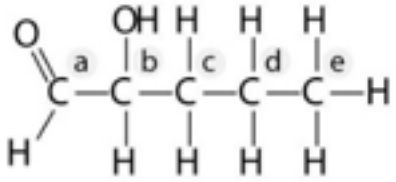
Feedback: No feedback provided

Chapter 4 Carbon: The Basis of Molecular Diversity

ITEM 3 – LEARNING GOAL 14

Test question

Which of the carbon atoms within the structural formula below is asymmetric?



- *A. a*
- ***B. b***
- *C. c*
- *D. d*
- *E. e*

Pop-up question

Which of the following amino acids does not contain asymmetric carbon atoms (See Figure 5.14, Campbell & Reece, Biology 11th global edition)?

- A. Proline
- B. Alanine
- **C. Glycine**
- D. None

Feedback: *All amino acids contain one asymmetric carbon atom except for glycine. The side chain of glycine is H.*

Chapter 5 Biological Macromolecules and Lipids

ITEM 4 – LEARNING GOAL 25

Test question

Why are human sex hormones considered to be lipids?

- **A. Sex hormones mix poorly with water**
- B. Sex hormones are made of fatty acids
- C. Sex hormones are hydrophilic components
- D. Sex hormones contribute to atherosclerosis

E. Sex hormones are essential components of cell membranes

Pop-up question
Which of the following statements account for all lipids?

A. Lipids mix poorly with water
B. Lipids are made of glycerol and fatty acids
C. Lipids contain nitrogen
D. Lipids possess low energy

Feedback per answer: *All lipids are hydrophobic / Steroids are a certain group of lipids / All lipids do contain carbon and hydrogen / Most lipids possess high energy*

ITEM 5 – LEARNING GOAL 26

Test question
Which of the following molecules will be labeled when cultured in a medium with radioactive ^{35}S?

A. Phospholipids
B. Nucleic acids
C. Carbohydrates
D. Proteins
E. Proteins and Nucleic acids

Pop-up question
You add radioactive sulfur (^{35}S) to a cell culture. Which macromolecule will become radioactively labeled?

A. Lipids
B. Proteins
C. Nucleic acids
D. Sugars

No feedback provided

Chapter 6 Energy and Life

ITEM 6 – LEARNING GOAL 37 & 38

Test question
How does the free energy, total energy and entropy change when glucose monomers form a cellulose polymer? – is decrease; + increase

A. +ΔG, +ΔH, +ΔS
B. +ΔG, +ΔH, -ΔS
C. -ΔG, +ΔH, +ΔS
D. +ΔG, -ΔH, -ΔS
E. +ΔG, -ΔH, +ΔS

Feedback: The production of glucose from a cellulose polymer is anabolic and costs energy. Therefore, the total energy (ΔH) increases. The order increases, thus entropy (ΔS) decreases. Together with the function $\Delta G=\Delta H-T\Delta S$, it can be concluded that free energy (ΔG) increases.

Pop-up question
A chemical reaction can proceed when entropy increases. In which of the following reactions does entropy increase?

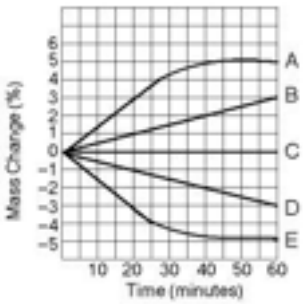
A. A+B → C+D
B. A+B+C → D
C. A → B+C
D. A+B+C → D+E+F

Feedback per answer: *The entropy does not change / The entropy decreases / The entropy increases / The entropy does not change*

Chapter 8 Cell Membranes

ITEM 7 – LEARNING GOAL 60

Test question



The figure above depicts the mass change of five dialysis bags filled with different concentrations of sucrose. The membranes of the bags are semipermeable and impermeable for sucrose. The five bags are placed in different beakers with a concentration of 0.6 M sucrose. After each 10 minutes, the weight of the bags is measured. The percentage in weight difference for every bag is presented in the graph above.
Which bag contained the highest start concentration of sucrose?

A. **A**
B. B
C. C
D. D
E. E

Pop-up question
An artificial liposome without membrane proteins is cultured in a 0,03 M sucrose solution and placed in pure water. Which of the following answer best describes what happens?

A. Sucrose diffuses from the liposome
B. Nothing will happen because no membrane proteins are present
C. Water will diffuse in the liposome and the liposome will burst out at a certain moment.
D. Water will be pushed out of the liposome and hence the liposome will shrink.

Feedback: *See textbook. Proteins are needed for transport of sucrose.*

Chapter 9 Cell Signaling

ITEM 8 – LEARNING GOAL 71

Test question

A cell sends of a signal molecule to its environment and a few cells within the environment respond. How do we call this type of signaling?

A. autocrine signaling
B. synaptic signaling
C. **paracrine signaling**
D. endocrine signaling
E. signaling through Gap-Junctions

Pop-up question

We just discussed endocrine, paracrine and synaptic signaling. Which of these three systems has the most specific interaction between receptor and ligand?

A. Endocrine
B. Paracrine
C. Synaptic signaling

No feedback provided

ITEM 9 – LEARNING GOAL 86

Test question

Which of the following associations is incorrect?

A. Kinase activity and the addition of phosphate groups
B. Phosphodiesterase activity and the removal of phosphate groups
C. GTPase activity and hydrolysis of GTP to GDP
D. Guanine Exchange Factor and the exchange of GDP to GTP
E. Adenylyl Cylcase activity and the conversion of AMP to cAMP

Pop-up question

The enzyme adenylyl cyclase has the opposite effect of the enzyme..

A. Protein Phosphatase
B. Kinase
C. Phosphodiesterase

No Feedback provided

Chapter 10 Cell Respiration

ITEM 10 – LEARNING GOAL 93

Test question

During the transfer of NAD^+ to NADH, NAD^+ is …

A. Hydrolysed
B. Oxidized
C. Reduced
D. I don't know

Pop-up question

In a short time, we will discuss the following fermentation reaction: pyruvate + NADH → lactate + NAD^+. What is the name of the enzyme in this reaction?

- **A. Lactate dehydrogenase**
- B. Pyruvate dehydrogenase

Feedback: *Pyruvate is reduced.*

ITEM 11 – LEARNING GOAL 97

Test question

What happens with the citric acid cycle when no oxygen is present?

- **A. It stops because NAD^+ and FAD become depleted.**
- B. It stops because ADP increases in the absence of oxygen.
- C. It continues because no oxygen is needed within any of the reactions in the citric acid cycle.
- D. It continues because ATP concentration is lowered which thereby activates enzymes of the citric acid cycle

Pop-up question

What is the purpose of fermentation?

- A. Production of alcohol and lactate to provide energy in cells without oxygen.
- B. Production of extra ATP when respiration does not produce enough ATP.
- **C. Conversion of NADH to NAD^+, which can then be used for glycolysis.**

No feedback provided

Chapter 11 Photosynthetic Processes

ITEM 12 – LEARNING GOAL 93

Test question

The reducing agent of the Calvin cycle is…

- **A. NADPH**
- B. ATP
- C. Oxygen
- D. NADH

Pop-up question

What is the electron acceptor during the electron transport in chloroplasts?

- A. O_2
- B. H_2O
- C. Ferredoxine (Fd)
- D. NAD^+
- E. **$NADP^+$**

No feedback provided

Chapter 12 Mitosis

ITEM 13 – LEARNING GOAL 121

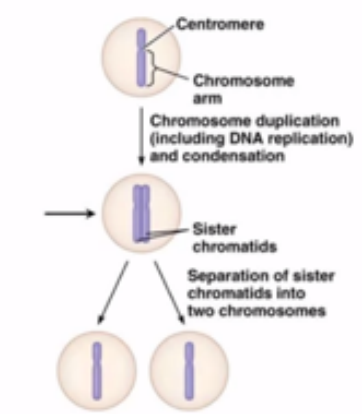
Test question

If a cell in anaphase contains 20 centromeres, how many chromosomes does every daughter cell contain after cytokinesis?

A. ***10***
B. *20*
C. *40*
D. *80*

Pop-up question

How many chromosomes does the central cell contain in the figure below?



A. 1
B. 2
C. 4

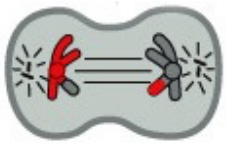
Feedback: *The central cell contains only one chromosome but two chromatids.*

Chapter 13 Sexual Life Cycle and Meiosis

ITEM 14 – LEARNING GOAL 123

Test question

Look at the figure below. In which phase does this process takes place?



A. Mitosis – metaphase
B. Mitosis – anaphase
C. Meiosis I – metaphase
D. Meiosis I – anaphase
E. Meiosis II – metaphase
F. Meiosis II - anaphase

Pop-up question

Which phase is presented in the figure above?

A. Meiosis 1 metaphase
B. Meiosis 1 prophase
C. Meiosis 2 metaphase
D. Mitotic metaphase
E. Meiosis 2 prophase

No feedback provided