KU LEUVEN

Basics of biological chemistry

Assignment

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1 Prof. J. Vanderleyden – dr. H. Steenackers

1.1 Chemical reaction equation

Consider the following reaction: $(NH_4)_2CO_3 + Zn(NO_3)_2 \rightarrow NH_4NO_3 + ZnCO_3$

a.) Balance the equation

$(NH_4)_2CO_3 + Zn(NO_3)_2 \rightarrow 2\ NH_4NO_3 + ZnCO_3$

b.) Reactants and products

Name all reactants and reaction products.

- $(NH_4)_2CO_3$: Ammonium carbonate
- $Zn(NO_3)_2$: Zinc nitrate
- NH_4NO_3 : Ammonium nitrate
- $ZnCO_3$: Zinc carbonate

c.) Lewis structure, VESPR

Construct the Lewis structures of the polyatomic ions you recognize and predict their molecular structure using the VSEPR theory.

d.) Oxidation states

Determine the oxidation state of all the atoms in all the compounds. Is this an oxidation-reduction reaction?

e.) Mass

How many grams of ZnCO3 can be prepared from 400g Zn(NO3)2 by using sufficient(NH4)2CO3?

1.2 DNA sequence analysis

The following diagram shows part of a template DNA strand, with sections X,Y and Z being the exons of a gene:

5' 3' GTA GGT TGT ATC GAT GGT CAT X Y Z

a) What is the corresponding sequence on the new daughter strand made from the given parent strand during replication?

b) What polypeptide sequence will be synthesized from the given template DNA? Give a short overview of the different processes (and enzymes) involved in the synthesis of polypeptides from template DNA. Where in the cell do these processes take place?

c) What polypeptide sequence will be synthesized if the ATC in exon Y is mutated to TTC? What polypeptide sequence will be synthesized if the ATC in exon Y is mutated to ATG? Which of those substitution mutations is likely to be more harmful? Why?

d) Which steps in polypeptide synthesis are affected by resp. the macrolide antibiotics and the tetracycline antibiotics?

e) The error rate in RNA synthesis is much higher than the error rate of DNA replication. What is the origin of this difference? Motivate why this is not a serious problem.

1.3 All tRNA molecules have a particular 3D-structure. Which functional

groups and which chemical bonds/interactions contribute to this particular structure? Why is this particular structure of importance for the biological function?

2 Prof. B. Sels

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