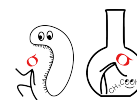


Sigma Tournament

Day 2: Biology & Chemistry



Tour 1

1) A Sigma camper found an old manuscript in Wesley hall left by Omega campers. The Sigma camper found that some reactions written on this manuscript are just not chemically possible, while the others are either totally correct or can be corrected by changing some of the coefficients (one cannot change chemical formulas). Please correct the equations that can be corrected and specify which chemical reactions are not possible.

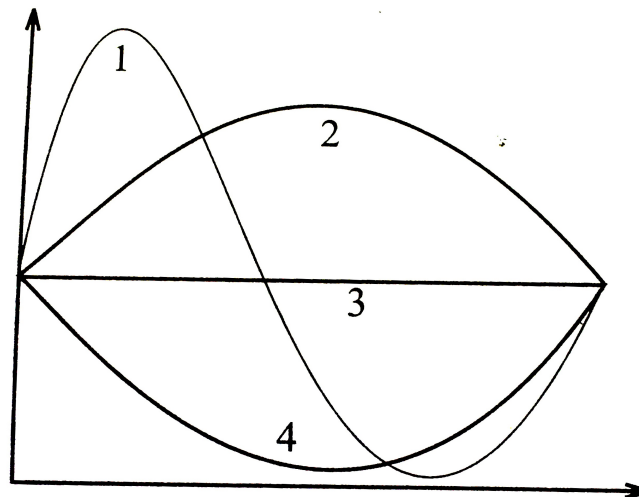
- 1) $\text{H}_2 + \text{O}_2 = \text{H}_2\text{O}$
- 2) $\text{Na}_2\text{CO}_3 + 2\text{HCl} = 2\text{NaCl} + \text{CO}_2 + \text{H}_2\text{O}$
- 3) $4\text{Al} + 3\text{Cl}_2 = 2\text{Al}_2\text{Cl}_3$
- 4) $2\text{Fe}(\text{OH})_3 = \text{Fe}_2\text{O}_3 + 3\text{H}_2\text{O}$
- 5) $\text{Zn}(\text{OH})_2 + \text{NaOH} = \text{Na}_2[\text{Zn}(\text{OH})_4]$
- 6) $\text{Al} + \text{Cu} = \text{Au} + \text{Cl}_2$

2) The littoral (intertidal) zone is the area where land and sea meet. This habitat is covered with water at high tide and exposed to air at low tide. What are the specific challenges faced by the animals living there and what adaptations have they evolved to survive in this challenging, ever-changing environment?

3) About two centuries ago aluminum was very expensive, even more expensive than gold. This was because aluminum was obtained using a rather complex and expensive procedure. It was purified by an anodizing process, which uses an electric current to transfer a thin layer of metal from a mixture of elements onto an anode plate.

One rich man decided to make a statement about his wealth and ordered a custom built yacht with a hull made out of aluminum sheets held together by copper rivets. Unfortunately for this man, his brand new vessel's maiden journey was only long enough to take him out of port and into deeper waters before the ship began to sink. Why did this man's yacht not get very far?

4) Saliva is a watery substance located in the mouths of organisms. It is secreted by the salivary glands. The enzymes found in saliva are essential in beginning the process of digesting dietary starches and fats. Which graph correctly describes saliva secretion following consumption of lemon juice?

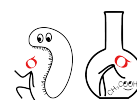


5) Usually tropical butterflies can not synthesize pigments. Nevertheless their wings look brightly colored. Why?



Sigma Tournament

Day 2: Biology & Chemistry



Tour 2

Experimental problem!

(4 points for a complete solution)

You are given five tubes with water solutions of NH_4HCO_3 , Na_2CO_3 , NaOH , HCl and phenolphthalein, as well as ten empty and clean tubes. Identify which one of the solution-containing tubes contains NH_4HCO_3 . You may use the empty tubes you were provided with in order to do so. You may also request additional empty tubes for your efforts, however, each extra tube requested will take half of a point off your final score awarded for the solution.