

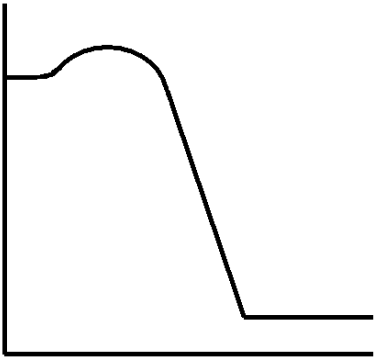
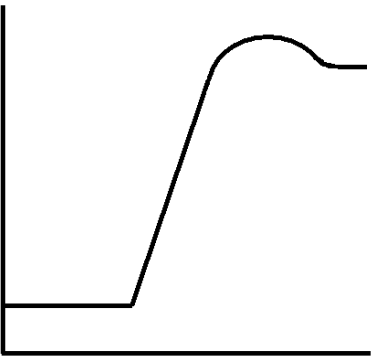
ENERGY EXCHANGES

LAWS OF THERMODYNAMICS

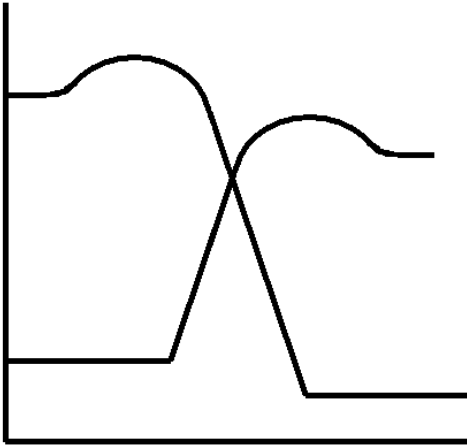
First Law	Second Law

ENERGY EXCHANGES

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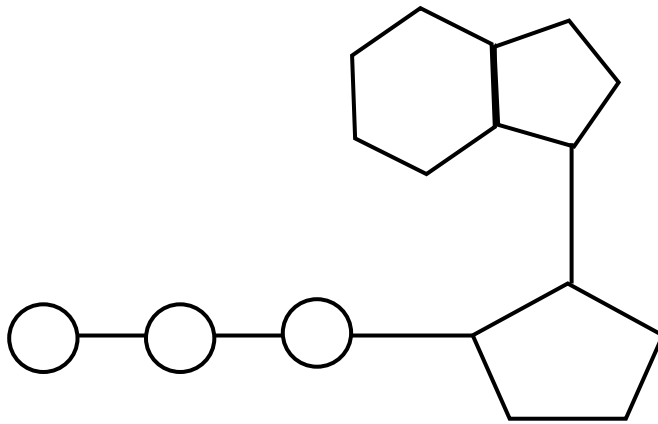
EXERGONIC REACTIONS	ENDERGONIC REACTIONS
	

COUPLED REACTIONS

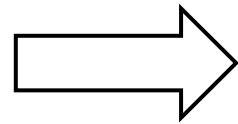
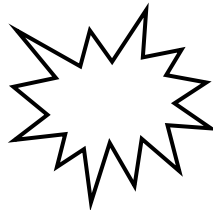
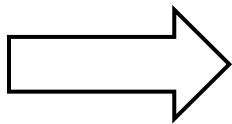


ATP

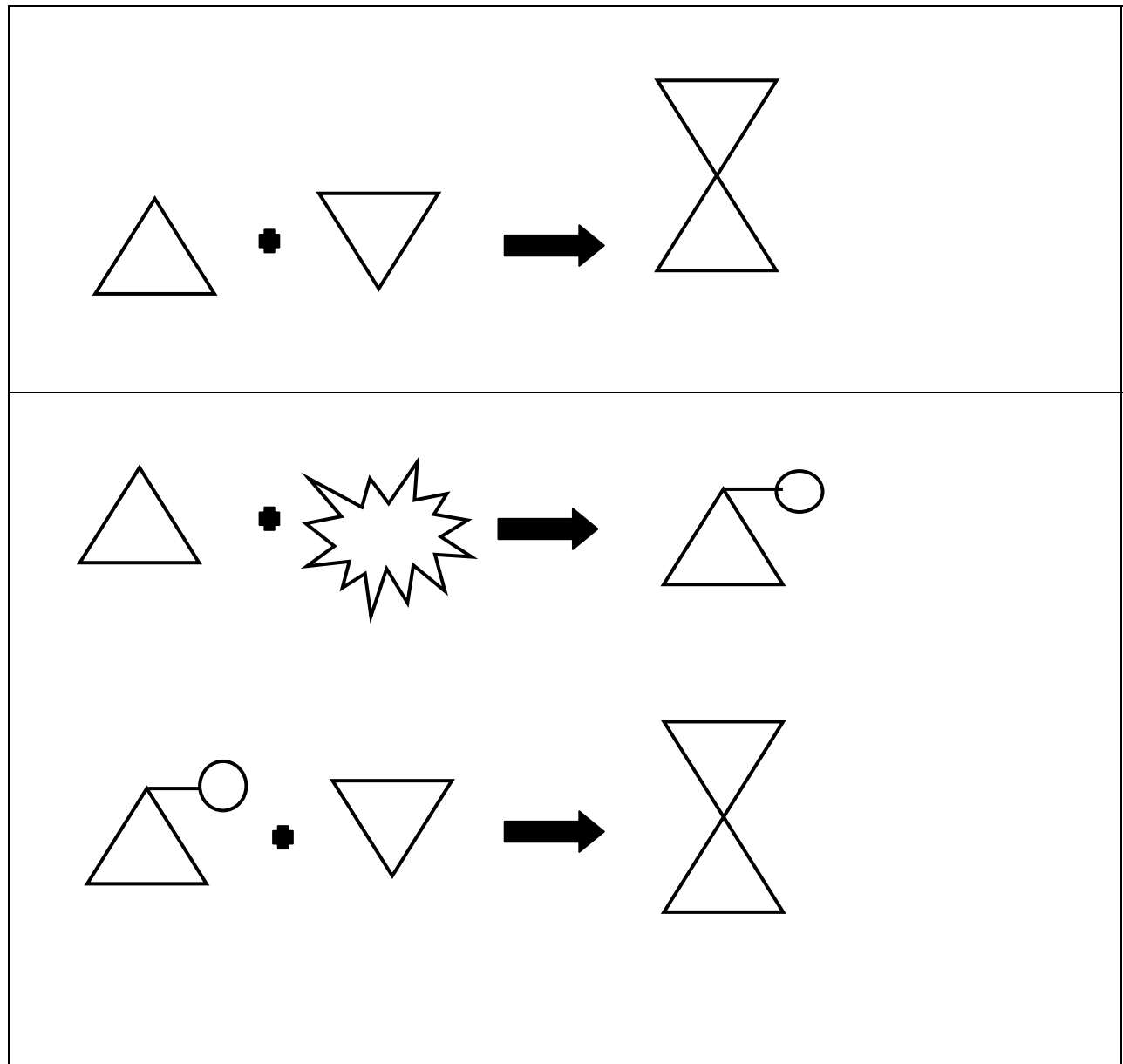
STRUCTURE



PRODUCTION



ATP & COUPLED REACTIONS



QUESTIONS:

1. Define each of the following terms:

Term	Definition
Metabolism	
Catabolism	
Anabolism	

2. Identify each of the following as true of **Catabolism** or **Anabolism**.

- | | |
|------------------------------------|----------------------------|
| _____ Release energy | _____ “Downhill” reaction |
| _____ Store/consume energy | _____ “Uphill” reaction |
| _____ Build complex molecules | _____ Photosynthesis |
| _____ Break down complex molecules | _____ Cellular respiration |

3. Define the following terms:

Term	Definition
Energy	
Kinetic Energy	
Potential Energy	

4. Identify each of the following as having kinetic energy (**KE**) or potential energy (**PE**).

- | | |
|--------------------------------|------------------------------|
| _____ Child at top of slide | _____ Water turning turbines |
| _____ Child sliding down slide | _____ Glucose |
| _____ Water behind dam | _____ Food molecules |

5. According to the First Law of Thermodynamics, if the total energy before a reaction is 500 kcal, then the total energy after the reaction must be:

6. According to the Second Law of Thermodynamics, if the total energy before an energy exchange is 500 kcal, then the amount of useful energy after the exchange is:

- a. Less than 500 kcal
- b. 500 kcal
- c. More than 500 kcal

7. Does the Second Law of Thermodynamics contradict the First Law? Explain.

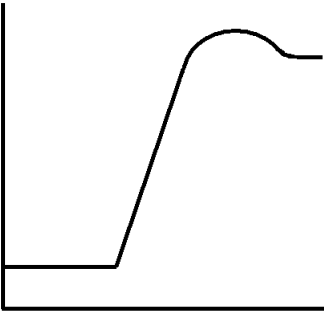
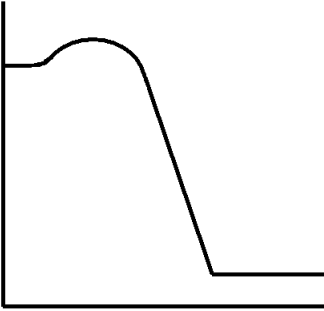
8. Do highly ordered living organisms violate the Second Law of Thermodynamics? Explain.

9. In the equation $\Delta H = \Delta G + T\Delta S$, which part of the equation represents:

Change in enthalpy?	
Change in total energy?	
Change in free energy?	
Energy lost to the system?	

Change in usable energy?	
Amount of energy available to do work?	
Change in entropy?	

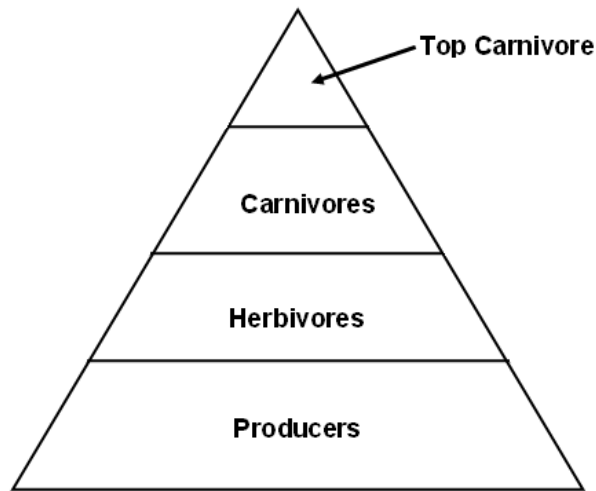
10. Complete the following chart:

	Graph A	Graph B
Is ΔG positive or negative		
Exergonic or Endergonic		
Spontaneous Yes or No		
Uphill or Downhill Reaction		
Products have more or less energy than reactants		

11. Of the light energy reaching the earth from the sun, the earth's plants are believed to convert less than 1% into the form of potential energy stored in the chemical bonds of food molecules. What happens to the rest of the energy?

12. Organisms cannot use heat energy to drive their energy-requiring processes. Does this mean that the heat released by metabolism is of no use to them? Why or why not?

13. Shown below is an energy pyramid for an ecosystem. Use this pyramid to answer the questions that follow.



- a. What happens to the amount of available energy at each trophic level?
-
- b. Use the laws of thermodynamics to explain why this happens.
-
-
-
14. What are the three main kinds of work performed by or in cells?
-
15. Explain how ATP performs work.
-
-
16. When ATP is produced, energy is required. What is the source of this energy?
-
17. When ATP is broken, energy is released. How is this energy used?
-

18. What is the ΔG of a system (reaction) that is in equilibrium?

Can a system at equilibrium do work?

Explain why or why not.

19. How is equilibrium avoided in living systems?
