Biology 12 **Name:** _____

Cell Biology **Per:** _____ **Date:** _____

Chapter 5 – Metabolism: Energy and Enzymes

Complete using BC Biology 12, pages 154 - 175

5.1 Energy Transformations & Metabolism page 158

1. **Metabolism**: _____

   _____

2. _____(a) refers to the breaking down of molecules while _____(b) refers to the building up, or synthesis, of molecules.
3. In a chemical reaction, _____(a) are the substances that participate in a reaction (_____(b) in the reaction below), while the _____(c) are the substances that form as the result of a reaction (_____(d) in the reaction below).

   A + B → C + D
4. **Free energy** (ΔG): _____
5. **Exergonic reactions**: _____
   a. Examples: _____
6. **Endergonic reactions**: _____
   a. Examples: _____

ATP: Energy for Cells

7. ATP is the common _____(a). When cells require energy they "spend" ATP. The more _____(b) the organism the _____(c) the demand for ATP. However, the amount on hand at any one moment is _____(d) because ATP is constantly being generated from _____(e) and a molecule of _____(f).
8. Place the appropriate letters next to each statement (use Figure 5.1 on page 158 to help)

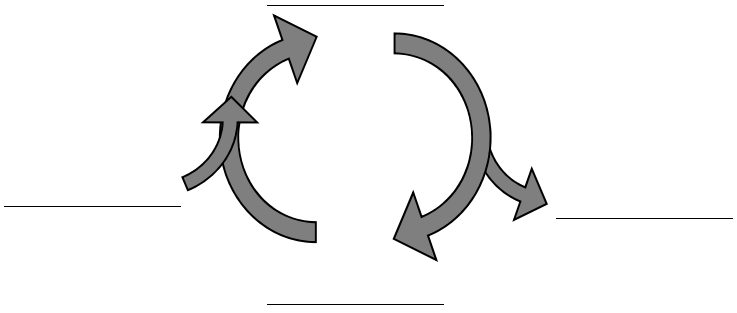
   En = endergonic Ex = exergonic
   a. _____ Energy is released as the reaction occurs.
   b. _____ Energy is required to make the reaction go.
   c. _____ Reaction used by the body for muscle contraction and nerve conduction.
   d. _____ ATP → ADP + (P).
   e. _____ ADP + (P) → ATP
9. Label this diagram, using these terms:

   ATP

   ADP

   -P (release of phosphate)

   +P (additional of phosphate)



10. Explain whether an anabolic reaction is more likely to be exergonic or endergonic. _____

_____

5.2 Enzymes & Metabolic Pathways pages 159 - 164

11. **Metabolic pathway**: _____

_____

12. While it is possible to write an _____(a) equation for a pathway as if the beginning _____(b) went to the end _____(c) in one step, actually many specific steps occur in between.
13. Consider the following diagram of a metabolic pathway:

$$A \xrightarrow{E_1} B \xrightarrow{E_2} C \xrightarrow{E_3} D \xrightarrow{E_4} E \xrightarrow{E_5} F \xrightarrow{E_6} G$$

    a. A – F are _____
    b. B – G are _____
    c. E_1 – E_6 are _____
    d. A is a _____ for the first enzyme and B is the product
14. **Enzyme**: _____
15. **Substrate**: _____

Energy of Activation

16. **Energy of activation**: _____

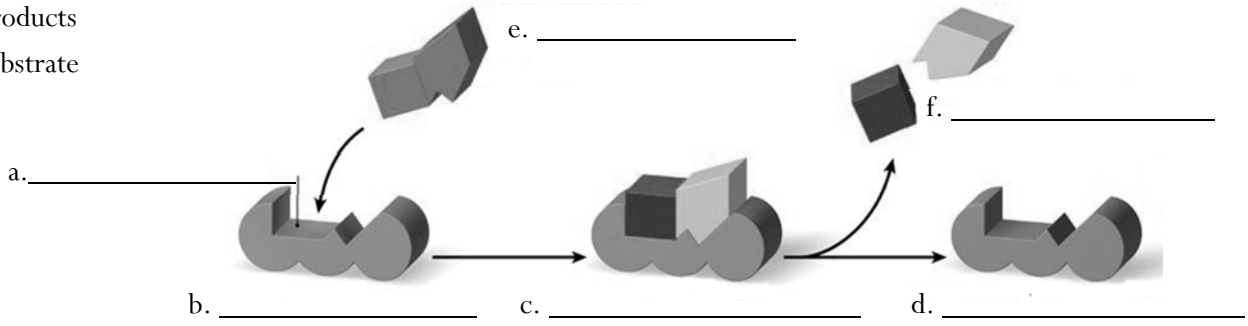
_____

17. Enzymes lower the amount of energy required for _____(a) to occur. Nevertheless, the addition of the enzyme does not change the _____(b) of the reaction. Without the enzyme, the reaction rate will be _____(c). By lowering the energy of activation, the enzyme _____(d) of the reaction.
18. Draw and label a diagram of the energy of activation using the following terms:
    - energy of activation (with enzyme)
    - energy of activation (without enzyme)
    - energy of reactants
    - energy of products
    - free energy
    - progress of the reaction

How Enzymes Function

19. Write the equation used to indicate than an enzyme forms a complex with its substrate (include all labels).

20. Label this diagram, using the following terms
    - active site
    - enzyme (twice)
    - enzyme-substrate complex
    - products
    - substrate



21. Is the reaction above a synthetic reaction or a degradative reaction? _____
    How do you know? _____

22. What is the **induced fit model** and how does it differ from the model cell biologists used previously?

23. If enzymes are so important for chemical reactions, then why is only a small amount of enzyme needed in a cell?

24. Why are enzymes named after their substrate (e.g. maltase speeds breakdown of maltose)? _____

Factors Affecting Enzymatic Speed

25. Complete each statement with the term *increases* or *decreases*.
    a. Enzyme activity _____ as substrate concentration increases.
    b. Raising the temperature generally _____ the rate of an enzymatic reaction.
    c. Boiling an enzyme drastically _____ the rate of the reaction.
    d. Changing the pH toward the optimum pH for an enzyme _____ the rate of the reaction.
    e. Introducing a competitive inhibitor _____ the availability of an enzyme for its normal substrate.
    f. Due to feedback inhibition, the affinity of the active site for the substrate _____

26. **Denatured**: _____

_____

27. Describe how the concentration of a specific product is always kept within a certain range (hint: read section on enzyme activation). _____

_____

_____

28. Enzyme inhibition occurs when the substrate is unable to bind to the active site of an enzyme.
    There are two types of enzyme inhibitors *(not in your textbook, will be completed with teacher)*
    a. _____: _____

    _____

        i. Examples: _____
    b. _____: _____

    _____

        i. Examples: _____
29. Many enzymes require an _____[(a)] ion or an organic, but _____[(b)], helper to function properly. The inorganic ions are metals such as _____[(c)]; these helpers are called _____[(d)]. The organic, non-protein molecules are called _____[(e)] and _____[(f)] are often components of these, becoming part of the coenzyme's molecular structure.
30. A deficiency of any one of these _____[(a)] results in a lack of the coenzyme and therefore a lack of certain _____[(b)]. Niacin deficiency results in a skin disease called _____[(c)] and a riboflavin deficiency results in _____[(d)].

5.3 Metabolic Rate & the Thyroid and Parathyroid Glands pages 164 - 165

31. The **thyroid gland** is located in the _____ and the **parathyroid glands** are embedded behind the thyroid gland.
32. Explain the difference the two hormones produced by the thyroid gland.
    a. **triiodothyronine** ($\mathbf{T_3}$) : _____
    b. **thyroxine** ($\mathbf{T_4}$) : _____
33. Where do we get the iodine necessary to produce these hormones? _____
34. How do the thyroid hormones increase metabolic rate? _____

_____

_____

35. Describe the functional relationship between **calcitonin** and **parathyroid hormone**. _____

_____

_____

Chapter 5 Review Questions

pages 172 - 175

1. _____
2. _____
3. _____
4. _____
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6. _____
7. _____
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11. _____
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22. _____
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24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____

31. Don't draw a graph, just explain. _____

32. _____

33. _____

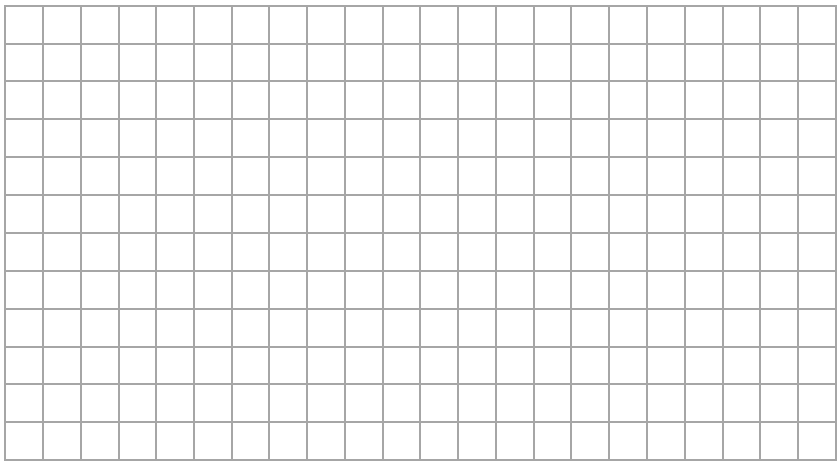
34. _____

35. _____

37. Think of the processes discussed in Chapter 3. _____

38. _____

39. Create a graph below.



40. _____
41. _____
42. _____
43. _____
44. _____
45. _____
46. _____
47. _____

Mark the review questions using the answer key on pages 533 - 534