

1. Which one is equal to 1.5×10^3 mL?

- a. 1.5×10^{-1} L
b. 150×10^0 mL

- c. 1.5×10^3 cm³
d. a, b, and c

e. b and c only

$$1.5 \times 10^3 \text{ mL} = 1500 \text{ mL}$$

is it a? $1.5 \times 10^{-1} \cancel{\text{L}} \times \frac{10^3 \text{ mL}}{1 \cancel{\text{L}}} = 1.5 \times 10^2 \text{ mL} \therefore$

is it b? $150 \times 10^0 \text{ mL} = 1.5 \times 10^2 \text{ mL} \therefore$

is it c? $1.5 \times 10^3 \cancel{\text{cm}^3} \times \frac{1 \text{ mL}}{1 \cancel{\text{cm}^3}} = 1.5 \times 10^3 \text{ mL} \therefore$

2. Which one is NOT equal to 2.74×10^2 milligrams?

- a. 2.74×10^{-4} kg
b. 2.74×10^7 μ g

- c. 2.74×10^8 ng
d. 2.74×10^{-1} g

e. 27.4×10^0 cg

Is it a? $2.74 \times 10^{-4} \cancel{\text{kg}} \times \frac{10^3 \cancel{\text{g}}}{1 \cancel{\text{kg}}} \times \frac{10^3 \text{ mg}}{1 \cancel{\text{g}}} = 2.74 \times 10^2 \text{ mg} \therefore$

Is it b? $2.74 \times 10^7 \cancel{\mu\text{g}} \times \frac{1 \text{ mg}}{10^3 \cancel{\mu\text{g}}} = 2.74 \times 10^4 \text{ mg} \therefore$ shall we go through each one to be sure?

Is it c? $2.74 \times 10^8 \text{ ng} \times \frac{1 \text{ mg}}{10^3 \text{ ng}} \times \frac{1 \text{ mg}}{10^3 \mu\text{g}} = 2.74 \times 10^2 \text{ mg} \therefore$

Is it d? $2.74 \times 10^{-1} \text{ g} \times \frac{10^3 \text{ mg}}{1 \text{ g}} = 2.74 \times 10^2 \text{ mg} \therefore$

Is it e? $27.4 \times 10^0 \text{ cg} \times \frac{10 \text{ mg}}{1 \text{ cg}} = 274 \text{ mg} = 2.74 \times 10^2 \text{ mg} \therefore$

3. Which statement correctly compares a scientific theory to a scientific law?

- Scientific theories are a kind of deductive reasoning and try to explain natural events, while scientific laws are a kind of inductive reasoning and predict future observations.
- Scientific theories are not yet proven, but as more evidence accumulates in favor of a theory it can become a scientific law. **Theories never become laws.**
- Scientific theories are a kind of inductive reasoning and can be tested with experiments, while scientific laws are a kind of deductive reasoning and cannot be tested with experiments. **Laws can be tested with experiments.**
- Scientific theories can never be proven and are not widely accepted by scientists, while scientific laws have been proven and are accepted by both scientists and non-scientists as true. **Theories are widely accepted by scientists.**

4. Collecting observations is an example of ___; analyzing specific observations to reach a conclusion is an example of ___ reasoning.

- hypothesis-based science; inductive
- the process of science; deductive
- discovery science; inductive
- descriptive science; deductive**
- hypothesis-based science; deductive

5. A controlled experiment is one in which
- the experiment tests more than one possible hypothesis.
 - the experiment proceeds at a slow pace to guarantee that the scientist can carefully observe all reactions and process all experimental data.
 - there are at least two groups, one differing from the other by one variable.**
 - there are at least two groups, one differing from the other by two or more variables.
 - there are three groups for which the scientist controls all variables.
6. What is the primary reason for including a control in the design of an experiment?
- To demonstrate in what way the experiment was performed incorrectly.
 - To ensure that the results obtained are due to only one variable.**
 - To provide more data so one can perform a more sophisticated statistical analysis.
 - To test the effect of more than one variable.
 - To make sure you don't kill your test organisms
7. Maria and Bill go to a new restaurant and do not like the food they are served. Their hypothesis is that if they go to the restaurant again, they will not like the food. If they continue to follow the scientific method, what should they do next?
- never go near the restaurant again and tell all their friends not to try it
 - go back to the restaurant several times and order different items**
 - try some nearby restaurants instead
 - get some friends to go to the restaurant and order what Maria and Bill didn't like.
8. A structured procedure for collecting information to test a hypothesis is a(n)
- principle.
 - experiment.**
 - control.
 - theory.
 - observation
9. As today's scientists use the term, a theory is
- equivalent to a scientific law, such as the law of gravity.
 - a hypothesis that has been supported by repeated testing.**
 - a synonym for a hypothesis.
 - a proven fact or series of fact.
10. All of the following are features of the scientific method except
- forming hypotheses
 - experimentation
 - inference from individual observations**
 - deductive reasoning
 - forming conclusions
11. One ml of an experimental drug is injected into 20 pregnant mice to determine possible side effects. Which of the following is a suitable "control" for this experiment?
- 20 male mice injected with 1 ml of saline (harmless salt solution)
 - 20 male mice injected with 1 ml of the drug
 - 20 pregnant mice injected with 2 ml of the drug
 - 20 non-pregnant mice injected with 1 ml of the drug
 - 20 pregnant mice injected with 1 ml of saline**
12. Micrograms are a measure of
- length
 - area
 - volume
 - temperature
 - mass**

Sugar dissolves in, or mixes completely with, water. The solubility of a substance in water is determined by measuring the maximum amount of the substance that dissolves in a given amount of water at a given temperature. HYPOTHESIS: The solubility of sugar in water increases as the temperature of the water decreases.

13. What should NOT be a constant in this experiment?
- the type of sugar used
 - amount of water used
 - the amount of stirring
 - volume of the container
 - temperature of the water**

14. What is the dependent variable?
a. amount of sugar used
b. amount of water used
c. amount of sugar that will dissolve
d. size of the container
e. temperature of the water
15. The English physician Ronald Ross wanted to find the cause of malaria. Based on his observations, Dr. Ross suggested that the *Anopheles* mosquito might spread malaria from person to person. This idea was a
a. prediction b. hypothesis c. theory d. scientific "truth" e. conclusion
16. He did an experiment to determine if the number of mosquitoes people were bitten by affected their chance of having malaria. The number of mosquitoes that a person was bitten by was the
a. hypothesis b. conclusion c. constant
d. independent variable
e. dependent variable
17. A pH neutral solution
a. has no H⁺
b. has no OH⁻
c. has equal amounts of H⁺ and OH⁻
d. is hydrophobic
e. has a pH of 0
18. A buffer
a. is an acid that is used to offset overly basic conditions in the body
b. is a base that is used to offset overly acidic conditions in the body
c. is a base that is used to increase acidic conditions in the body
d. releases H⁺ ions when conditions become too basic and binds to H⁺ ions when conditions become too acidic.
e. releases H⁺ ions when conditions become too acidic and binds to H⁺ ions when conditions become too basic.
19. Household ammonia has a pH of 12; household bleach has a pH of 13. Which of the following statements is true?
a. both of these substances are strong acid.
b. the ammonia has 10 times as many H⁺ ions as the bleach
c. the ammonia has 10 times as many OH⁻ ions as the bleach
d. a solution that could buffer the ammonia and the bleach would remove excess OH⁻ ions
e. both b and d are correct
20. What would be the pH of a solution with a hydroxide ion [OH⁻] concentration of 10⁻¹² M
a. pH 2 b. pH 4 c. pH 10 d. pH 12 e. pH 14
21. Which bonds must be broken for water to vaporize?
a. ionic bonds
b. nonpolar covalent bonds
c. polar covalent bonds
d. hydrogen bonds
e. both c and d are correct
22. Magnesium has 12 protons. How many electrons are in its third energy level?
a. 2 b. 4 c. 6 d. 8 e. 10
23. How do hydrophobic molecules react with water?
a. Attracted to
b. Mixed with
c. Absorbed by
d. Polarized by
e. Repelled by
24. A hydrogen bond is
a. a sharing of a pair of electrons between a hydrogen and an oxygen nucleus.
b. a sharing of a pair of electrons between a hydrogen nucleus and an oxygen nucleus.
c. an attractive force that involves a hydrogen atom and a negatively charged oxygen atom that are either in two different molecules or within the same molecule.
d. none of the above
e. all of the above
25. A solution with pH 8 has how many times fewer hydrogen ions than a solution with pH 6?
a. 2 b. 4 c. 10 d. 100 e. 1,000

26. The atomic number refers to the
 a. mass of an atom.
 b. number of protons in an atom.
 c. number of protons and neutrons in an atom.
 d. number of neutrons in an atom.
 e. number of electrons in an atom.

27. Hydrophilic molecules
 a. Form hydrogen bonds among themselves
 b. Are neutral and nonpolar
 c. Readily dissolve in water
 d. a and c
 e. a, b, and c

28. The nucleus of an atom contains
 a. neutrons and protons.
 b. protons and electrons.
 c. neutrons only.
 d. neutrons and electrons.
 e. protons only.

29. What is the atomic mass of an atom that has 6 protons, 6 neutrons, and 6 electrons?
 a. 6 b. 8 c. 1 d. 12 e. 18

30. Briefly describe an experiment to test the effect of pH on yeast respiration (yeast produce CO₂ gas). Include a hypothesis, independent variable, dependent variable, and constants.

Hypothesis: yeast prefer pH 7 because acidic or basic conditions might harm them, so they will produce more gas at pH 7 than at pH 2 or pH 12.

Independent variable: pH Dependent variable: volume of CO₂ gas

Constants: water temperature, mass of yeast, source of yeast, same amount of sugar for food, etc.

31. What are two objects in cells that are too small to see with a light microscope? Which property of visible light makes a light microscope unsuitable for viewing them?

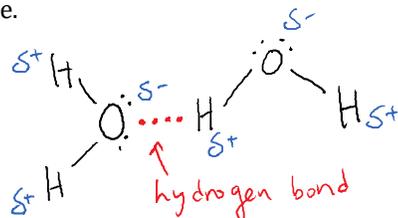
atoms, ribosomes, mitochondria, lysosomes, peroxisomes, DNA, RNA

the wavelength of visible light. If an object is smaller than the wavelength of visible light then you cannot see it (too blurry)

32. Describe the process that leads to a chemical bond between a Sodium atom and a Chlorine atom. Be sure to use the correct terminology and explain which force it is that holds the atoms together.

The sodium atom transfers its single valence electron to the chlorine atom. The sodium atom becomes a positively charged ion, and the chlorine is a negative ion. By the law of charges the ions are held together in an ionic bond.

33. Draw two water molecules with a hydrogen bond and label the parts of the molecules that are partially negative and partially positive.



34. A small proportion of hydrogen atoms have a mass number of 2 instead of 1. These isotopes of hydrogen are known as deuterium. What would be a simple test to distinguish an ice cube made with deuterium from an ice cube made with a typical sample of hydrogen atoms and oxygen?

Put both of them in water. The heavy-water ice cube will sink.

35. Water in a graduated cylinder forms a meniscus (it curves up on the edges). Why? Explain which exerts a greater force in forming the meniscus, cohesion or adhesion.

Water's polarity makes it stick to other surfaces, which is what we call adhesion. The force of adhesion exerts greater force in forming the meniscus, otherwise the meniscus would be upside-down, like mercury in a graduated cylinder.



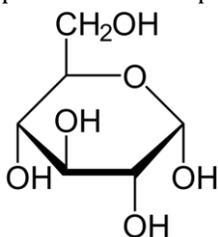
36. Describe three properties of water and why they result from the structure of the water molecule.

Cohesion is when water molecules stick to each other. They do this because of the polar covalent bond between oxygen and hydrogen in an individual water molecule, which makes the oxygen side δ^- and the hydrogen side δ^+ . So the opposite charges attract other water molecules and they stick together.

Water has a high specific heat. This means that it takes a lot of energy to increase water's temperature, and likewise that water releases a lot of energy as it cools. High specific heat is also due to the water molecule's polar covalent bonds between oxygen and hydrogen. Heat = molecular motion. The hydrogen bonds between water molecules oppose free movement, so more energy is required to get the molecules moving.

Water is a universal solvent. Water is great at dissolving polar and ionic compounds because of the water molecule's polar covalent bonds between oxygen and hydrogen. For example, if you put sodium chloride in water the δ^+ side of the water molecules stick to the negatively charged chloride ions, and the δ^- side of the water molecules stick to the positively charged sodium ions.

37. **A.** Circle a polar covalent bond in the carbohydrate. **B.** Benedict's reagent turns from blue to orange when heated in the presence of a simple sugar. Would this carbohydrate test blue or orange with Benedict's reagent?



Orange, because this is a simple sugar (monosaccharide)

38. What are the products and reactants? $C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2$

Provide at least one reason for why you think the reaction is endothermic or exothermic.

Reactants: glucose and oxygen

Products: water and carbon dioxide

This looks like an exothermic reaction because the carbon atoms are oxidized in the reaction.

39. A protease is a stomach enzyme that digests proteins. Predict how the enzyme would function at pH 3 and pH 8.

This enzyme has high activity at pH 3, and is inactive at pH 8. Because the stomach is an acidic environment, we expect this enzyme to have its best function in an acidic environment.

40. Fill in the table. No hints! No word bank!

| | | | | |
|--------------------------|--|---|---|---------------------|
| macromolecule | Carbohydrates | Lipids | Proteins | Nucleic Acids |
| polymer | Polysaccharide | Not applicable | Polypeptide | DNA or RNA |
| monomer | Monosaccharide | Not applicable | Amino acids | nucleotides |
| How is it used by cells? | energy storage, quick energy in the bloodstream, structural molecule in plant cell walls | In cell membranes, store energy, sex hormones | Enzymes! Muscle tissue Signaling molecules Protein channels and pumps | Genetic information |

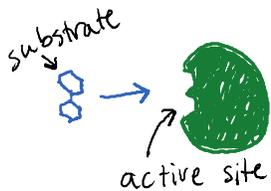
41. What is an enzyme? What effect do enzymes have on chemical reactions in cells, and how do they do it?

Enzymes are biological catalysts. They make reactions happen faster. They do that by decreasing the required activation energy of the reaction.

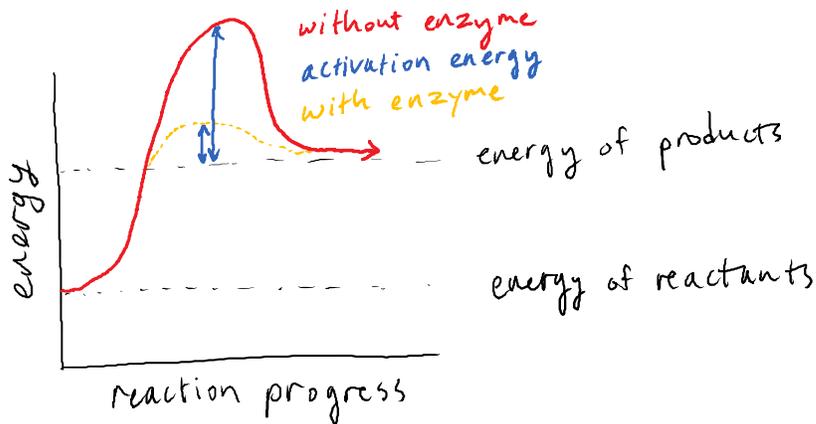
P.S. enzymes are not used up in chemical reactions!

42. Sketch a picture of an enzyme. Include the active site and the substrate. (3 points)

Not on your test, I promise. But you will probably see this on your EOC final exam:



43. Sketch a reaction diagram showing the difference between reactions with enzymes and reactions without enzymes. (3 points)



Is this reaction exothermic or endothermic?