Key

Unit 1 Test Study Guide

Polio and the Scientific Method

Background Info: What is Polio?

Polio is a contagious, historically devastating disease that is caused by a virus, which causes muscles not to work and attacks the nervous system of the human body. If left untreated, polio can eventually lead to death. People who have abortive polio or non-paralytic polio usually make a full recovery. However, paralytic polio, as its name implies, causes muscle paralysis - and can even result in death. In paralytic polio, the virus leaves the intestinal tract and enters the bloodstream, attacking the nerves (in abortive or asymptomatic polio, the virus usually doesn't get past the intestinal tract). The virus may affect the nerves governing the muscles in the limbs and the muscles necessary for breathing, causing respiratory difficulty and paralysis of the arms and legs.

Although polio has plagued humans since ancient times, its most extensive outbreak occurred in the first half of the 1900s before the vaccination, created by Jonas Salk, became widely available in 1955. At the height of the polio epidemic in 1952, nearly 60,000 cases with more than 3,000 deaths were reported in the United States alone. However, with widespread vaccination, wild-type polio, or polio occurring through natural infection, was eliminated from the United States by 1979 and the Western hemisphere by 1991.

Scenario:

In the early 1950's, nearly 60,000 people were stricken with Polio. Hundreds of medical researchers were trying to find an effective way to prevent this dreaded disease. Among them was Dr. Jonas Salk. Salk investigated various methods on how to eliminate this virus and decided to produce a vaccine. He developed several different types of vaccines and tested them in experiments on monkeys. As a result of his experiments he developed a working vaccine that contained the "inactive" polio virus. After perfecting this vaccine in the laboratory, Salk tested it on several hundred people and found it to be safe. The next step was to test this new vaccine on a larger scale. In a nationwide field test in 1954, over 440,000 children were vaccinated with Salk's vaccine. Like any good test, half the children were unknowingly given the real vaccine while the other half unknowingly received a "fake" vaccine called a placebo. A placebo acts like a control in an experiment. These tests, and additional tests in Canada and Denmark, showed the vaccine to be nearly 100% effective.

Background Questions:

1. What is Polio? contagious disease that causes muscles to stop working & attacks the nervous system
2. When was polio eliminated from the United States? 1979
3. When was Polio eliminated form the Western hemisphere? 1991

Scenario Questions:

4. What was the problem in the scenario above? many people were stricken w/ Polio
5. What were the test subjects in the beginning stages of the various experimental vaccines? Salk tested first on monkeys.
6. What was in the final working vaccine that Salk chose to try? an "inactive" polio virus
7. How did he first test his new working vaccine? on several hundred people
8. How did he verify the results of his first test? test on a larger scale
9. What is a placebo? a "fake" vaccine
10. Why was a control used in the experiment? the placebo was used a point of comparison

Math Skills

Directions: Solve each problem. All answers should be written with the correct significant figures and have units. Use scientific notation when asked.

11. Determine the number of significant figures in each measurement.
    a. 102.10g 5 sf
    b. 0.046020 cm 5sf
    c. 5.78×10^4 mg 3 sf
    d. 100 km/hr 1 sf
    e. 100. Km/hr 3 sf.

12. Solve the problems and write the answers in scientific notation and significant figures.
    a. $(2.23 \times 10^2\ g) + (8.3 \times 10^3 g) =$ 8523g = 8.5×10^3 g
    b. $(1.0005 \times 10^{-4}\ m) + (3.56 \times 10^{-5}\ m) =$ .00013565m = 1.36×10^{-4}m
    c. $(6.120 \times 10^7$ miles) - $(4.17854 \times 10^7$ miles) = 19414600 miles = 1.941×10^7 miles
    d. $(3.2222 \times 10^{-5}$ cm) × $(1.111 \times 10^{-3}$ cm) = 3.5798642×10^{-8} cm² = 3.580×10^{-8} cm²
    e. $(6.626 \times 10^{-34}$ J·s) × $(5.34 \times 10^{16}$ 1/s) = 3.538284×10^{-17} J = 3.54×10^{-17} J
    f. $\frac{(3.00 \times 10^8\ m/s)}{(1.50 \times 10^{-7}\ m)} =$ 2×10^{15} 1/s = 2.00×10^{15} 1/s

Atomic Theory – see last page

13. Atomic Theory History: know the following people and what they accomplished.
    a. Democritus
    b. John Dalton – Dalton's Atomic Theory
    c. JJ Thomson – Cathode ray experiment, discovered what subatomic particle?, plum pudding model)
    d. Ernst Rutherford – Gold foil experiment, discovered what particles?, Rutherford's atomic model)
    e. Neils Bohr – Planetary model
    f. Quantum Mechanical Model –(including what an electron cloud is)

Atomic Structure

14a. proton - nucleus
neutron - nucleus
electron - electron cloud
14b. atomic # - # protons
mass # - # protons + # neutrons

14. Atomic Structure
    a. What are the 3 subatomic particles and where are they located in an atom?
    b. Define atomic number. Define mass number.
    c. What is an isotope? - atoms w/same atomic # but different #n°
    d. ~~How is an ion different from an atom~~
    e. Complete the chart.

Name	Chemical Symbol	Atomic # (Z)	Mass # (A)	$\#p^+$	$\#e^-$	$\#n^0$	Isotopic symbol
beryllium	Be	4	9	4	4	5	$^{9}_{4}Be$
manganese	Mn	25	56	25	25	31	$^{56}_{25}Mn$
cadmium	Cd	48	110	48	48	62	$^{110}_{48}Cd$
arsenic	As	33	33	75	33	42	$^{75}_{33}As$

see last page

f. Magnesium has 3 naturally occurring isotopes. ^{24}Mg has a mass of 23.98504 amu with an abundance of 78.70%, ^{25}Mg has a mass of 24.98584 amu with an abundance of 10.13%, and ^{26}Mg has a mass of 25. 98259 amu with an abundance of 11.17%. Calculate the average atomic mass of magnesium.

15. Electron Configurations: Write electron configurations for the following elements:
   a. O $1s^2 2s^2 2p^4$ or $[He] 2s^2 2p^4$
   b. K $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ or $[Ar] 4s^1$
   c. As $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^3$ or $[Ar] 4s^2 3d^{10} 4p^3$
   d. Tc $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^5$ or $[Kr] 5s^2 4d^5$

16. Electrons and Light
   a. Why do elements give off colored light when heated, like in the flame test lab we did in class? When heated, the e- absorb energy & jump to a higher orbital. e- releases photons of colored light to return to their original state
   b. Use the equations below to help you answer the questions.

$c = \lambda \times \nu$ $c = 3.00 \times 10^8$ m/s

$E = h \times \nu$ $h = 6.626 \times 10^{-34}$ J·s

see last page

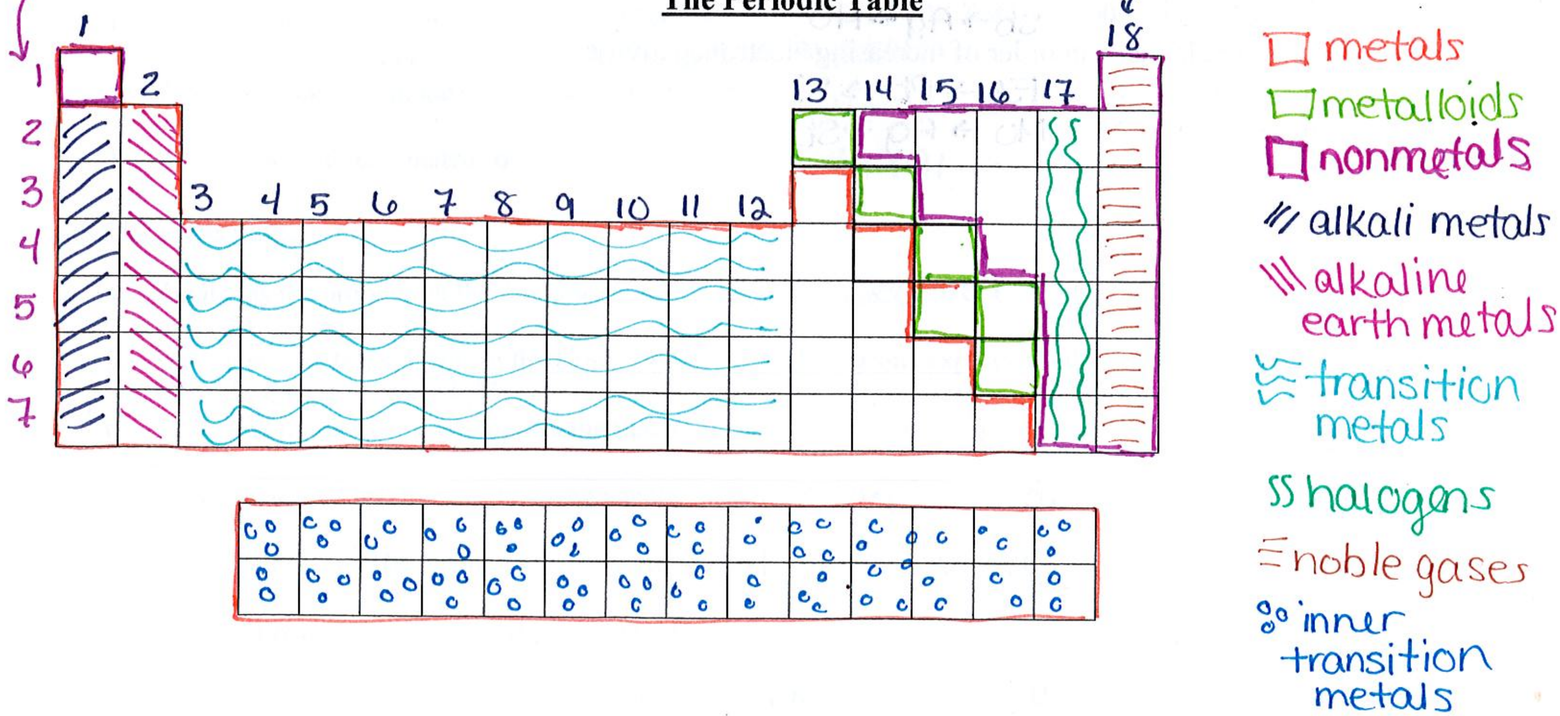
   i. Lithium emits red light with a wavelength of 6.80×10^{-7}m. Calculate the frequency and then the energy of the photons emitted.
   ii. Sodium gives off yellow light with a frequency of 5.25×10^{14} 1/s, find the wavelength.
   iii. Copper emits a green light with a wavelength of 4.85×10^{-7} m. Find the frequency and the energy of the photon of green light.
   iv. Potassium gives off a violet light with a frequency of 7.00×10^{14} 1/s. Find the wavelength. How much energy does a photon of violet light have?

17. Nuclear Chemistry see last page
   a. Define fission. Fusion.
   b. How have all the elements heavier than hydrogen formed? How about the elements heavier than iron?
   c. Which produces the most energy: fission or fusion?
   d. Which can only occur at extremely high temperatures: fission or fusion?

periods - horizontal rows

groups - vertical columns

The Periodic Table



18. Number the groups on the Periodic Table above. Define a group.

19. Number the periods on the Periodic Table above. Define a period.

20. Outline and label the following: metals, metalloids, and nonmetals.
21. Color in and label these groups:
   a. Transition metals
   b. Noble gases
   c. Inner transition metals
   d. Halogens
   e. Alkaline earth metals
   f. Alkali metals

22. How is the modern Periodic Table arranged? in order of increasing atomic #

23. Determine the trends below for the elements.

	atomic radius	ionic radius	ionization energy	electronegativity
down a group	increases	XXXXXXX	decreases	decreases
across a period	decreases	XXXXXXX	increases	increases

24. Use your knowledge of the periodic trends to answer these questions.
   a. Which element has a larger atomic radius: (Cr) or Cu?
   b. Which element has a larger ionization energy: (Cr) or W?
   c. Order these elements from smallest to largest atomic radius:
      i. Si Fl Pb Si → Pb → Fl
      ii. Ag Mo Sb Sb → Ag → Mo
   d. Order these elements in order of decreasing ionization energy:
      i. Si Fl Pb Si → Pb → Fl
      ii. Ag Mo Sb Sb → Ag → Mo
   e. Order these elements in order of increasing electronegativity:
      i. Si Fl Pb Fl → Pb → Si
      ii. Ag Mo Sb Mo → Ag → Sb

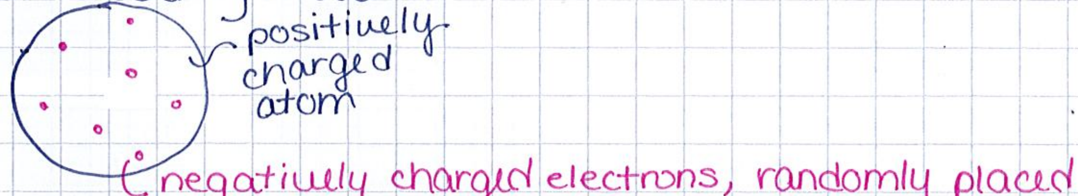
13 (A) Democritus - 1st person to say that everything is made of atoms

(B) John Dalton / Dalton's Atomic Theory

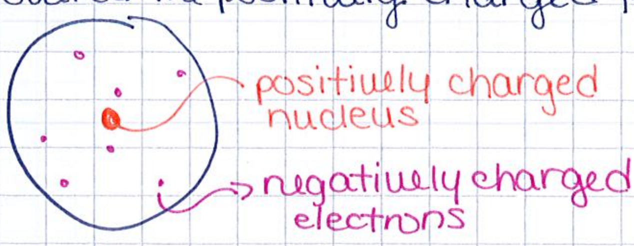
(1) elements are made of particles called atoms
(2) all atoms of an element are identical
(3) atoms of 1 element are different from atoms of another atom
(4) atoms of an element combine with other elements in simple, whole # ratios
(5) atoms cannot be created or destroyed, only rearranged in a chemical reaction

(C) JJ Thompson - completed the cathode ray experiment & discovered electrons.

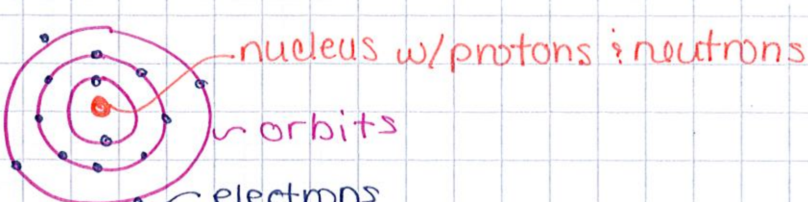
Plum Pudding model



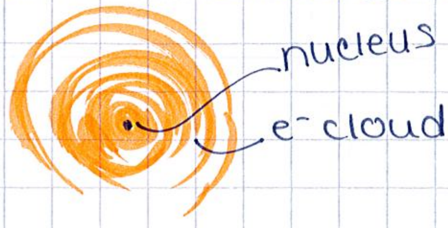
(D) Ernest Rutherford - completed the gold foil experiment, discovered the positively charged nucleus. He later discovered the positively charged protons in the nucleus



(E) Niels Bohr / Planetary model



(F) Quantum Mechanical Model



14 f. $A.M = (\text{mass}_{\text{isotope }1} \times \%\text{isotope }1) + (\text{mass}_{\text{isotope }2} \times \%\text{isotope }2) + (\text{mass}_{\text{isotope }3} \times \%\text{isotope }3) + \ldots$

$A.M. = (23.98504\text{amu} \times .7870) + (24.98584\text{amu} \times .1013) + (25.98259\text{amu} \times .1117)$

$A.M. = 24.30954738\text{amu} = 24.31\text{amu}$

16 b. i frequency $c = \lambda \cdot \nu$ $c = 3.00 \times 10^{8}\ \text{m/s}$

$\frac{3.00 \times 10^{8}\ \text{m/s}}{6.80 \times 10^{-7}\ \text{m}} = \frac{6.80 \times 10^{-7}\ \text{m} \cdot \nu}{6.80 \times 10^{-7}\ \text{m}}$

$4.85 \times 10^{15}\ \text{1/s} = \nu$

energy $E = h \cdot \nu$ $h = 6.626 \times 10^{-34}\ \text{J} \cdot \text{s}$

$E = (6.626 \times 10^{-34}\ \text{J} \cdot \text{s}) \cdot (4.85 \times 10^{15}\ \text{1/s}) =$

$E = 3.21 \times 10^{-18}\ \text{J}$

ii wavelength $c = \lambda \cdot \nu$

$\frac{3.00 \times 10^{8}\ \text{m/s}}{5.25 \times 10^{14}\ \text{1/s}} = \frac{\lambda \cdot 5.25 \times 10^{14}\ \text{1/s}}{5.25 \times 10^{14}\ \text{1/s}}$

$5.71 \times 10^{-7}\ \text{m} = \lambda$

iii $\frac{3.00 \times 10^{8}\ \text{m/s}}{4.85 \times 10^{-7}\ \text{m}} = \frac{4.85 \times 10^{-7}\ \text{m} \cdot \nu}{4.85 \times 10^{-7}\ \text{m}}$

$6.19 \times 10^{14}\ \text{1/s} = \nu$

$E = (6.626 \times 10^{-34}\ \text{J} \cdot \text{s}) \cdot (6.19 \times 10^{14}\ \text{1/s})$

$E = 4.10 \times 10^{-19}\ \text{J}$

iv. $$\frac{3.00\times10^{8}\ m/s}{7.00\times10^{14}\ 1/s} = \frac{\lambda \cdot 7.00\times10^{14}\ 1/s}{7.00\times10^{14}\ 1/s}$$

$$4.29\times10^{-7}\ m = \lambda$$

FIVE STAR.