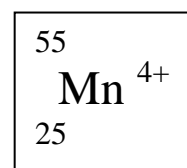
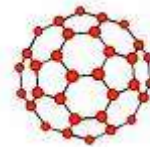


Review for Atomic Theory Quiz #1

Practice Multiple Choice Questions:

- Which of the following is/are quantitative physical property(s) of matter?
 - mass
 - volume
 - density
 - all of the above
- Which statement(s) is/are **true** about **ALL** of these substances: P_4 PH_3 H_2 Ar
 - they are all molecules
 - they are all compounds
 - they are all elements
 - none of the these statements is true
- A pure element is shiny, silver-coloured, brittle and does not conduct electricity. This element should be classified as:
 - a metal
 - a metalloid
 - a non-metal
 - a mixture
- Which of the following is a pure substance that contains more than one type of atom?
 - an element
 - a compound
 - a solution
 - a mechanical mixture
- What number of each type of atom is present in a molecule of $Sn_3(PO_3)_4$?
 - 3 (Sn) + 1 (P) + 3 (O)
 - 1 (Sn) + 4 (P) + 12 (O)
 - 12 (Sn) + 4 (P) + 12 (O)
 - 3 (Sn) + 4 (P) + 12 (O)
- Buckyballs are used in nanotechnology. One type of buckyball has the chemical formula C_{60} and is shown in the diagram to the right. Buckyballs can be classified as both a(n):
 - molecule and element
 - molecule and compound
 - atom and element
 - atom and compound
- Which of the following statements is/are **true** about the atom shown to the right?
 - this atom has 25 protons
 - this atom has 25 neutrons
 - this atom has 29 electrons
 - I only
 - I and II only
 - I and III only
 - II and III only
- Copper metal reacts with sulfuric acid in the air to produce the green colour of copper roofs. This is a:
 - quantitative chemical property
 - quantitative physical property
 - qualitative chemical property
 - qualitative physical property
- Which of the following is/are physical properties of bromine?
 - it is liquid at SATP
 - it reacts with sodium to produce the salt sodium bromide
 - it has a density of 79.904 g/mL
 - I only
 - I and II only
 - I and III only
 - II and III only
- Which of the following is/are examples of chemical change?
 - liquid nitrogen bubbles as it boils
 - water bubbles as it goes over a waterfall
 - baking soda bubbles when it is added to vinegar
 - these are all chemical changes
- Which of the following is/are examples of a chemical change?
 - liquid Jello turns solid as it sets
 - a drop of silver nitrate turns skin grey/brown
 - a halogen light glows with a purple colour
 - none of these are chemical changes



12. What contribution did the Alchemists make to modern chemistry?
- they turned base metals to gold
 - they discovered the elixir of life
 - they invented laboratory tools that are still used today
 - they first proposed that all matter is made of atoms
13. Which model of matter was proposed by Empedocles and supported by Aristotle?
- the atom as an indivisible particle
 - the raisin bun model
 - the four element model
 - the planetary model
14. Rutherford's gold foil experiment was instrumental in:
- the discovery of the electron
 - the discovery of alpha particles
 - the discovery that an atom is mostly empty space
 - both "a" and "c"
15. Which researcher first disproved Dalton's atomic model?
- Democritus
 - Thomson
 - Rutherford
 - Bohr
16. The Law of Conservation of Mass states that:
- all atoms of an element have the same mass
 - a compound always contains the same elements in a fixed ratio by mass
 - the total mass of the products of a chemical reaction is equal to the total mass of the reactants
 - all of the above
17. Which of the following statements is **NOT** part of Dalton's atomic model?
- each element has its own type of atom
 - atoms of the same element are identical
 - all matter is made of tiny particles called atoms
 - atoms can be broken down into sub-atomic particles
18. Which atomic model was the **first** one to include electrons?
- Dalton's billiard ball model
 - Thomson's raisin bun model
 - Rutherford's electron cloud model
 - Bohr's planetary model
19. The cathode ray tube was instrumental in the discovery of:
- the electron
 - the proton
 - the neutron
 - the atom, which is mostly empty space
20. Which atomic model was the **first** one to include a nucleus?
- Dalton's billiard ball model
 - Thomson's raisin bun model
 - Rutherford's electron cloud model
 - Bohr's planetary model
21. Which of the following items was used by Bohr to investigate the structure of the atom?
- x-rays
 - cathode ray tube
 - spectroscope
 - particle accelerator
22. What is the key difference between the models of the atom proposed by Bohr and Rutherford?
- Bohr's model includes a nucleus, but Rutherford's does not
 - Bohr's model has the atom made up of mostly empty space, but Rutherford's does not
 - Bohr's model includes neutrons, but Rutherford's does not
 - Bohr's model has the electrons moving in fixed energy levels, while in Rutherford's they do not
23. The gold foil experiment contributed to the discovery that:
- atoms contain electrons
 - atoms contain a nucleus
 - atoms are mostly empty space
 - both "b" and "c"
24. Which of the following is/are part of Bohr's interpretation of the hydrogen line spectrum?
- electrons release energy as light as they move to a higher energy level
 - different wavelengths of light correspond to electrons dropping between different quantum levels
 - the potential energy of an electron decreases as it moves further from the nucleus
 - all of the above

25. Which of the statements of Dalton's atomic model is now known to be incorrect?
- each element has its own type of atom
 - atoms of the same element are identical
 - all matter is made of tiny particles called atoms
 - atoms can be joined together to form compounds
26. Who discovered the neutron?
- Schrodinger
 - Bohr
 - Einstein
 - Chadwick
27. Which sub-atomic particles have approximately the same size and mass?
- protons and electrons
 - protons and neutrons
 - electrons and neutrons
 - protons and positrons
28. When you change the number of electrons in an atom, you produce a different:
- isotope
 - type of atom
 - ion
 - mass number
29. All isotopes of an element:
- have the same chemical properties
 - have a different atomic number
 - have a different bright line spectrum
 - have different numbers of electrons
30. Which isotope of Ruthenium (Ru, atomic number 44) has the greatest nuclear stability?
- Ru – 100
 - Ru – 101
 - Ru – 102
 - Ru – 104
31. Atoms of an unknown element have the following masses and percent abundance: 90.92% of the atoms have a mass of 19.988 u, 0.26% of the atoms have a mass of 20.983 u and 8.82% of atoms have a mass of 21.978 u. Calculate the average atomic mass of this element.
- 20.983 u
 - 20.166 u
 - 25.567 u
 - 19.988 u
32. Iron has three isotopes. 5.84 % of iron is Fe-54, 91.68% of iron is Fe-56 and 0.31% of iron is Fe-58. Without doing any calculations, what is the approximate average atomic mass of iron?
- about 54 amu
 - about 55 amu
 - about 56 amu
 - about 57 amu
33. Alpha radiation has the following characteristics:
- it is the release of a helium nucleus and can be stopped by a piece of paper
 - it can travel unlimited distances and is very high energy
 - it can travel 1-2 metres through the air at the speed of light
 - it is the release of a high speed electron and can be stopped by a piece of lead 2 mm thick
34. A researcher starts with 10.0 g of a radioactive isotope and measures the amount of the radioisotope at two-hour intervals. He records the following data. What is the half-life of this radioisotope?
- | Time: | 8:00 am | 10:00 am | 12:00pm | 2:00 pm | 4:00 pm | 6:00 pm | 8:00 pm | 10:00 pm |
|------------------|---------|----------|---------|---------|---------|---------|---------|----------|
| Mass of Isotope: | 10.00 g | 7.10 g | 5.00 g | 3.55 g | 2.50 g | 1.78 g | 1.25 g | 0.89 g |
- 1 h
 - 2 h
 - 4 h
 - 8 h
35. Referring to the data for the radioisotope in the question above, we know that this isotope is:
- very stable
 - very unstable
 - breaking down by alpha-decay
 - breaking down by gamma-decay
36. Which type of radiation is unaffected by magnetism?
- alpha
 - beta
 - gamma
 - no type of radiation is affected by magnetism

37. Which of the following statements is/are true about the average atomic mass of an element?
- it is reported on the Periodic Table
 - it is always a whole number
 - it has no units
 - all of the above
38. The number of neutrons in the nucleus of an atom determines the:
- the identity of the atom
 - the atom's nuclear charge
 - the physical and chemical properties of the atom
 - the nuclear stability of the atom
39. A beta particle is also known as a:
- helium nucleus
 - high speed electron
 - neutron
 - form of electromagnetic radiation (light)
40. An isotope of radon has a half-life of 14 days. A child goes to visit his grandmother in Northern Ontario. While playing in the basement, he breathes in 4,800 atoms of radioactive radon. Assuming that all of the radon decays in the child's lungs, how many weeks will it take until there are only 75 atoms of the radio-isotope left?
- 12 weeks
 - 14 weeks
 - 10 weeks
 - 6 weeks
41. Which of the following is/are properties of gamma radiation?
- it travels at the speed of light
 - it can travel a few meters through the air
 - it can be stopped by a piece of metal 2 mm thick
 - all of the above
42. Which of the following is/are true about alpha particles?
- they are positively charged
 - they can be stopped by a piece of paper
 - they were used Rutherford's gold foil experiment
 - all of the above
43. Which of the following types of nuclear decay produce a new element?
- alpha decay
 - beta decay
 - gamma decay
 - both "a" and "b"
44. The number of electrons in a **neutral** atom of chromium-52 is:
- 52
 - 24
 - 26
 - 28
45. Which of the following has the same number of electrons as an atom of krypton?
- Br^{1-}
 - Br^{1+}
 - Cl^{1-}
 - Sr^{2-}
46. Which symbol represents the atom with the largest number of neutrons?
- Th - 234
 - Pb - 208
 - U - 234
 - Ra - 226
47. Which of the following isotopes is the most stable?
- Co - 60, half-life = 5.27 a
 - P - 32, half-life = 14.3 d
 - Na - 22, half-life = 15.0 h
 - Rn - 220, half-life = 51.5 s
48. Which of the following is/are disadvantages of using nuclear fission to generate electricity?
- only small amounts of energy can be generated at a time
 - large amounts of green house gases are produced
 - nuclear wastes can take thousands of years to break down
 - all of the above

Review for Atomic Theory Quiz #1

1. Define the following terms. Include one additional piece of information such as an example or explanation:

| | | | |
|--------------------------------|-------------------|---------------------|----------------------------|
| Matter | Chemical Property | Metalloid | Radio-isotopes |
| Atom | SATP | Atomic number | α (alpha) particle |
| Molecule | Element | Mass number | β (beta) particle |
| Physical Property | Compound | Isotope | γ (gamma) radiation |
| Qualitative Physical Property | Metal | Average atomic mass | Half-life |
| Quantitative Physical Property | Non-metal | Ion | Nuclear fission |

- What are the three types of sub-atomic particles? Describe each particle in terms of its charge, mass and location in the atom.
- Which of the following are reported on the Periodic Table: atomic number, mass number, actual atomic mass, average atomic mass, percent abundance?
- Clearly distinguish between average atomic mass and mass number. In what three ways do they differ?
- The average atomic mass of calcium is 40.08 u. What is probably its most abundant isotope?
- What are two possible isotopes of nickel?
- How many neutrons are found in one atom of each: ${}_{27}^{60}\text{Co}$, ${}_{38}^{90}\text{Sr}$, ${}_{47}^{108}\text{Ag}$, ${}_{82}^{207}\text{Pb}$, ${}_{85}^{210}\text{At}$, ${}_{92}^{238}\text{U}$?
- What is meant by the expressions “carbon-14” and “silver-108”?
- How many electrons, protons and neutrons are in a neutral atom which has:
 - atomic number of 38 and the mass number of 90?
 - atomic number of 82 and the mass number of 207?
- Natural neon consists of a mixture of three isotopes: 90.92 % neon-20, atomic mass 19.9924 u; 0.257 % neon-21, atomic mass 20.9930 u; and 8.82% neon-22, atomic mass 21.9914 u.
 - Without doing any calculations, estimate the approximate average atomic mass of neon.
 - Calculate the average atomic mass of neon.
- Natural potassium consists of 93.1 % potassium-39 (atomic mass 38.964 u) and 6.9 % potassium-41 (atomic mass 40.962 u). Estimate and then calculate the average atomic mass of natural potassium.
- What are the four signs (indications) that a chemical change has taken place?
- Describe 5 physical properties of the carbon (graphite) in your pencil.
- Outline the contributions of Dalton, Thomson, Rutherford and Bohr to the present understanding of atomic structure. For each, describe their experiment and model of the atom.
- Refer back to the note “In Search for a Model for Matter: 2400 Years of Atomic Theory”. Two of the statements made by Dalton in his atomic model are incorrect. Which two statements are incorrect, and why?
- Three experiments or pieces of scientific equipment were key to our present understanding of atomic structure. For each of the following, outline the major discovery that it contributed to:
 - cathode ray tubes (also called gas discharge tubes or Crooke's tube)
 - Rutherford's gold foil experiment
 - the bright line spectrum for hydrogen
- Explain where the different colours of light come from in the bright line spectrum of an element.
- Compare and contrast the models of the atom that were proposed by Thomson and Rutherford.
- Compare and contrast the models of the atom that were proposed by Rutherford and Bohr.
- Write the balanced nuclear equations for the following nuclear reactions:
 - polonium-209 undergoes alpha decay
 - carbon-14 undergoes beta decay (this is the nuclear reaction that is used for “carbon dating”)
 - Sr-90 undergoes beta decay (Sr-90 is a by-product of some nuclear reactors. It replaces calcium in mammals' bones. When Sr-90 decays, it can damage bone tissue and lead to cancer.)
 - uranium-234 undergoes alpha decay

21. Nuclear power has been suggested as a solution to our current environmental problems with global warming and acid rain. What are two advantages of nuclear power? Two disadvantages?
22. The half-life of cesium-137 is 30 a (years). Begin with a 64 g sample of Cs-137, and draw a graph showing the rate of radioactive decay of cesium. How much Cs-137 will remain after 120 years?
23. Does a shorter half-life indicate that an isotope is more stable or less stable?
24. Classify the following as elements or compounds. Identify the number and type of atom(s) in one molecule:
- | | |
|---|--|
| a) $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ | c) S_8 |
| b) P_4 | d) $\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_3$ |
25. Classify the following changes as either a chemical (C) or physical (P) change:
- | | |
|--|--|
| a) iron is heated until it melts and glows red | i) zinc fizzes when it dissolves in acid |
| b) a sausage is roasted over the fire | j) flax seeds are ground up in a blender |
| c) a puddle evaporates in the sun | k) a log decomposes into soil |
| d) a fluorescent light gives off light | l) "Koolaid" dissolves in water |
| e) the wires in a toaster glow red | m) a solid deodorant "puck" sublimates in a bathroom |
| f) crystals form in liquid honey | n) gel turns solid when hair is "spiked" |
| g) when clear, colourless AgNO_3 is added to tap water, it turns white and cloudy | |
| h) a "silver" penny turns to "gold" when Mrs. Patterson heats it | |
26. Are the following statements true or false? If a statement is false, be able to explain why it is false.
- Atoms can not be created nor destroyed.
 - A beta-particle is really a high speed electron.
 - A neutron (as far as we know) is a high-speed electron.
 - Neutrons are released by atoms when they undergo gamma decay.
 - Adding more neutrons to an atom's nucleus will make the nucleus more stable.
 - The Alchemists did not make any contribution to modern Science or Chemistry.
 - Rutherford discovered the proton.
 - The cathode ray (Crooke's) tube was used to discover that electrons move in fixed orbits around the nucleus.
 - James Chadwick discovered the neutron.
 - All atoms of an element are identical.
 - The number of neutrons is equal to the number of protons in a neutral atom.
 - The number of electrons always equals the number of protons in an atom.
 - An O^{2-} ion and a Mg^{2+} ion have the same number of electrons.
 - Neutrons act as "spacers" to help to stabilize the nucleus of an atom.
 - The number and arrangement of an atom's electrons determines the its physical and chemical properties.
27. Indicate whether the following substances are elements or compounds:
- Uranium ore (U_2O_3) that is used in a CANDU reactor
 - The gold foil used by Rutherford for his experiment
 - The hydrogen gas (H_2) that Bohr excited during his studies of the hydrogen spectrum
 - The hydrochloric acid used to test the reactivity of metals
 - Pure "heavy" water (deuterium oxide) that is used to control a nuclear reaction
 - A sample of magnesium ribbon that contains a mixture of Mg-24, Mg-25 and Mg-26
28. Indicate which of the following observations are qualitative or quantitative. Which of them are **properties**?
- | | |
|--|---|
| a) Pure silver is a good conductor of electricity. | f) Pure distilled water does not conduct electricity. |
| b) The mass of the gold is 36 g. | g) Magnesium metal burns with a bright white flame. |
| c) Chlorine gas has a density of 3.214 g/L. | h) Silicon is a semi-conductor. |
| d) Iodine is a solid at SATP. | i) The volume of pure water is 1.45 L |
| e) The temperature of the mercury is 23 °C. | j) Salt (sodium chloride) melts at 1200 °C. |

Review Questions for Atomic Theory Quiz #1 (cont.)

29. Compare the properties of metals and non-metals:

| Property | Metal | Non-metal |
|------------------------------------|-------|-----------|
| Does it conduct electricity? | | |
| “Usual” state at room temperature | | |
| Is the solid malleable or brittle? | | |
| “Usual” colour | | |
| Lustre of the solid? | | |

30. Complete the following chart:

| Element | Atomic Number | Number of Protons | Mass Number | Number of Neutrons | Charge | Number of Electrons |
|----------|---------------|-------------------|-------------|--------------------|--------|---------------------|
| Fe | | | 56 | | 3+ | |
| | 27 | | | 31 | | 24 |
| | | | | 125 | 1+ | 81 |
| | 14 | | | 14 | | 18 |
| Cd - 112 | | | | | 3+ | |
| | | 40 | | 51 | | 38 |
| Rn | | | 222 | | 0 | |
| | 29 | | | 35 | | 28 |
| Cl | | | 37 | | 1- | |
| | 12 | | | 14 | | 10 |
| | | 56 | 138 | | | 54 |
| | | | | 18 | 0 | 17 |
| Mg - 25 | | | | | 0 | |

31. From the chart above, identify

- a) any isotopes of the same elements: _____
 b) any ions of the same elements: _____

32. Complete the following chart that compares the properties of the three types of nuclear radiation:

| | α (alpha) particle | β (beta) particle | γ (gamma) radiation |
|---|---------------------------|-------------------------|----------------------------|
| Another name for this type of particle | | | N/A |
| The symbol for this particle | | | N/A |
| Approximate speed it moves and amount of energy | | | |
| How far will it travel through the air? | | | |
| What thickness of material is require to contain it (stop it from penetrating)? | | | |

33. Iron – 59 is radioactive. Predict five (5) characteristic physical properties of Fe – 59.