GCSE AQA Chemistry Third Edition Chapter 1 QA

Questions By Topic:

C1: Atomic Structure

Intext Questions:

C 1.1 Atoms:

1. **a)** Arrange these elements into a table showing metals and non-metals: phosphorus, P, barium, Ba, vanadium, V, mercury, Hg, krypton, Kr, potassium, K, and uranium, U. [2 marks]

Answer.

As ELements on the left side of the periodic table are metals and on the right side are non metals, we can classify them as :-

Metals: Barium Ba, Vanadium V , mercury, Hg, potassium, K, uranium, U.

Non Metal: Phosphorus, krypton, Kr.

b) Would you classify hydrogen as a metal or non-metal? [1 mark]

Answer.

Although Hydrogen has 1s1 electronic configuration but it shows none of the properties that resembles Alkali metals. Therefore, hydrogen is a non metals. Hydrogen forms covalent compounds, it does not form cations easily and it exist as a diatomic molecule. Therefore it is considered as non metal.

2. Explain why when you mix two elements together you can often separate them quite easily by physical means, yet when two elements are chemically combined in a compound, they are usually difficult to separate. [2 marks]

Answer.

A compound is made up of two different atoms which are joined together by strong chemical bonds which holds the atoms very tightly. So they are very hard to separate than the two elements mixed together with no bonds shared between them.

3. Draw diagrams to explain the difference between an element and a compound. [2 marks]

Answer.
An element contains only one type of atom, with a unique number of protons, neutrons and electrons.
A compound contains more than one type of atom, chemically combined to form a new substance.

4. Describe the basic structure of an atom.
Answer.
The basic structure of an atom includes a tiny, relatively massive nucleus, containing at least one proton and usually one or more neutrons.
Outside of the nucleus are energy levels (also called shells), which contain one or more electrons. The energy levels are often called rings (see more discussion of the Bohr model below).
The neutrons have the greatest mass and have no charge. The protons have slightly less mass than the neutrons and are positively charged. The electrons have almost no mass and are negatively charged. The electrons move around the nucleus in energy levels.

5. Find out the Latin words from which the symbols of the following metallic elements are derived:
· Sodium, Na [1 mark]
Answer.
Natrium.
· Gold, Au [1 mark]
Answer.
Aurum
· Lead, Pb [1mark]
Answer.
Plumbum.
· Potassium, K [1 mark]
Answer.
Kalium

6. Explain what information can be deducted from the chemical formula of carbon dioxide, CO_2. [2 marks]

C 1.2 Chemical Equations:

1.
a) Explain why all symbol equations must be balanced. [2 marks]

b) Balance the equation: h2 + Cl2 ⟶ HCL [1 mark]

2.

a) A mass of 33.6g of magnesium carbonate, $MgCO_3$, completely decomposed when it was heated. It made 16.0g of magnesium oxide, MgO.

b) Calculate the mass of carbon dioxide, CO_2, produced in this reaction. [1 mark]

3. Balance these symbol equations:

a) $KNO_3 \longrightarrow KHO_2 + O_2$ [1 mark]

b) $Li + O_2 \longrightarrow Li_2O$ [1 mark]

c) $Fe + O_2 \longrightarrow Fe_2O_3$ [1 mark]

d) $Fe_2O_3 + CO \longrightarrow Fe + CO_2$ [1 mark]

4. Sodium metal, Na, reacts with water to form a solution of sodium hydroxide, NaOH and gives off hydrogen gas, H_2. Write a balanced symbol equation, including state symbols, for this reaction. [3 marks]

C 1.3 Separating mixtures:

1. Define what a mixture is. [2 marks]

Answer.

A mixture contains two or more substances that are not chemically combined.

2. 'A mixture has no fixed composition, whereas a compound has'. Explain what this means, using hydrogen, oxygen, and water to illustrate your answer. [3 marks]

Answer.

A compound always has the same composition. Mixture can have different compositions.

A compound consists of the atoms of two or more elements that are chemically joined to each other. Since the atoms are always joined in the same ratio, the composition of a compound is always the same.

A mixture consists of two or more substances that are physically intermingled in different proportions. It often retains many of the properties of its components, and the components can be separated from each other by physical means.

3. Explain how the process of distillation can be used to remove dissolved impurities from a sample of water. [4 marks]

Answer.

Distillation is an effective water treatment technology for commercial and household use. When water is purified by distillation, it is boiled in a container and the steam is sent into cooling tubes. The steam is condensed and then collected as purified water in a second container. The

impurities in the water are left behind in the first container and can be discarded. The distillation process removes almost all impurities from water. Distillers are commonly used for removing nitrates, bacteria, sodium, hardness, dissolved solids, most organic compounds, and lead. Contaminants that easily turn into gases, such as gasoline components or radon, may remain in the water unless the system is specifically designed to remove them. Distilled water may taste flat to some people because the water's natural minerals and dissolved oxygen often have been removed.

4. Sulfur is soluble in the flammable liquid xylene but not in water. Sodium nitrate is soluble in water but not in xylene . Describe and explain two ways to separate a mixture of sulfur powder and sodium nitrate to collect pure samples of each solid. [6 marks]

C 1.4 Fraction distillation and paper chromatography:

1.

a) Draw and label the apparatus you can use to separate a mixture of ethanol and water. [2 marks]

Answer.

To separate a mixture of ethanol and water, we can use a process known as fractional distillation. This technique relies on the fact that the compounds in mixture have different boiling points. We know that ethanol boils at a lower temperature than water, the ethanol vaporises while most of the water remains a liquid. Hance we can separate the mixture of ethanol and water through this process.

b) What is this method of separation called? [1 mark]

Answer.

One common **method of separation** is filtration. ... The particles that are removed from the water by the filter are **called** the residue. Distillation, Another common **separation** process is **called** distillation. Distillation uses boiling to separate mixtures of liquid solutions.

2. Explain why not would be able to collect a more concentrated sample of ethanol from a mixture of water and ethanol using the apparatus drawn in question **1** than by using simple distillation. [4 marks]

3.

a) Describe a method to separate the dyes in colored inks. [4 marks]

Answer.

Chromatography is a method of separating out materials from a mixture. Ink is a mixture of several dyes and therefore we can separate those colors from one another using chromatography. When ink is exposed to certain solvents the colors dissolved and can be separated out.

When we expose a piece a paper with ink on it to a solvent, the ink spreads across the paper when the ink dissolves.

b) A paper chromatogram from a mixture of two substances, A and B, was obtained using a solvent of propanone. Substance B was found to travel further up the paper than substance A.
What does this tell you about substance A and B. [1 mark]

4. Look at the boiling points of the three liquids in the table:

Liquid	Boiling point in °C
Water	100
Ethanol	78
propanol	97

A mixture was made by stirring together equal volumes of these three miscible liquids. Evaluate the effectiveness of fractional distillation as a way of separating this mixture into the three pure liquids. [3 marks]

C 1.5 History of atom:

1. **a) Which one of Dalton's ideas listed below about atoms do scientists no longer believe?**

A Elements contain only one type of atom.
B Atoms get re-arranged in chemical reactions.
C Atoms are solid shares that cannot be split into simpler particles. [1 mark]
Answer.
B Atoms get re-arranged in chemical reactions.

b) Which two of the following substances from Dalton's list of elements are not actually chemical elements?

Soda oxygen carbon gold lime [2 marks]

2. a) Which sub-atomic particle did J.J. Thomson discover? [1 mark]
Answer.

Electron is the sub-atomic particle discovered J.J. Thomson.

b) Describe J.J. Thomson's 'plum pudding' model of atom. [2 marks]

Answer.

- J. J. Thomson, who discovered the electron in 1897, proposed the plum pudding model of the atom in 1904 before the discovery of the atomic nucleus in order to include the electron in the atomic model.
- In Thomson's model, the atom is composed of electrons surrounded by a soup of positive charge to balance the electrons' negative charges, like negatively charged "plums" surrounded by positively charged "pudding".
- The 1904 Thomson model was disproved by Hans Geiger's and Ernest Marsden's 1909 gold foil experiment.

3. State two ways in which Rutherford changed Thomson's model of atom. [2 marks]

Answer.

Rutherford tested Thomson's hypothesis by devising his "gold foil" experiment. Rutherford reasoned that if Thomson's model was correct then the mass of the atom was spread out throughout the atom. Then, if he shot high velocity alpha particles (helium nuclei) at an atom then there would be very little to deflect the alpha particles. He decided to test this with a thin film of gold atoms. As expected, most alpha particles went right through the gold foil but to his amazement a few alpha particles rebounded almost directly backwards.

4. Explain why Bohr revised Rutherford's model of atom. [2 marks]

Answer.

Bohr improved Rutherford's atomic model by proposing that electrons travelled in circular orbits with specific energy levels. Bohr's model was an improvement because it explained why the light emitted by atoms consists of lines of certain colors.

C 1.6 Structure of atom:

1. **Draw a table showing the location, relative charge, and relative mass of the three sub-atomic particles. [3 marks]**

   Answer.

Protons and electrons have an **electrical charge**. This electrical charge is the same size for both, but **protons** are **positive** and **electrons** are **negative**.
Neutrons have no electrical charge; they are **neutral**.
These properties are summarised in the table:

Particle	Relative mass	Relative charge
proton	1	+1
neutron	1	0
electron	0.0005	−1

2. An atom has 27 protons and 32 neutrons. Use the periodic table to name this element and give its symbol, atomic number and mass number. [2 marks]
Answer.
The element is Cobalt. Its symbol is Co, atomic number is 27 and mass number is 58.

3. Explain why all atoms are neutral. [2 marks]
Answer.
Because the number of electrons and protons is always equal. The protons are positively charged (+), the electrons are negatively (-) charged. When their number is equal the number of + and - is also equal. And equal number of - and + would of course give 0.0 represents neutral charge. The overall charge of the atom is neutral.

4. How many protons, electrons, and neutrons do the following atoms contain?
a) A nitrogen atom, with atomic number 7 and mass number 14. [1 mark]
Answer.
Protons = 7, electrons = 7 and neutrons = 7.
b) A chlorine atom, with atomic number 17 and mass number 35. [1 mark]
Answer.
Protons = 17, electrons = 17 and neutrons = 18.
c) A silver atom, with atomic number 47 and mass number 108. [1 mark]
Answer.
Protons = 47, electrons = 47 and neutrons = 61.

d) A uranium atom, with atomic number 92 and mass number 235. [1 mark]

Answer.

Protons = 92, electrons = 92 and neutrons = 143.

C 1.7 Ions, atoms and isotopes:

1. **State how many protons, electrons and neutrons there are in each of the following atoms or ions:**

(_5^11)B [1 mark]

Answer.

```
number of protons = 5 = number of electrons
number of neutrons = mass number - atomic number = 11 - 5 = 6
neutrons
```

(_7^14)N [1 mark]

Answer.

```
number of protons = 7 = number of electrons
number of neutrons = mass number - atomic number = 14 - 7 = 7
neutrons
```

(_12^24)Mg [1 mark]

Answer.

```
number of protons = 12 = number of electrons
number of neutrons = mass number - atomic number = 24 - 12 = 12
neutrons
```

(_17^37)Cl [1 mark]

Answer.

```
number of protons = 5 = number of electrons
number of neutrons = mass number - atomic number = 11 - 5 = 6
neutrons
```

(_53^127)I [1 mark]

Answer.

```
number of protons = 53 = number of electrons
number of neutrons = mass number - atomic number = 127 - 53 = 74 neutrons
```

(_9^19)F^- [1 mark]

Answer.

```
number of protons = 9 = number of electrons
number of neutrons = mass number - atomic number = 19 - 9 = 10 neutrons
```

(_15^31)P^{3-} [1 mark]

Answer.

```
number of protons = 5 = number of electrons
number of neutrons = mass number - atomic number = 11 - 5 = 6 neutrons
```

(_19^39)K^+ [1 mark]

Answer.

```
number of protons = 19 = number of electrons
number of neutrons = mass number - atomic number = 39 - 19 = 20 neutrons
```

(_13^27)Al^{3+} [1 mark]

Answer.

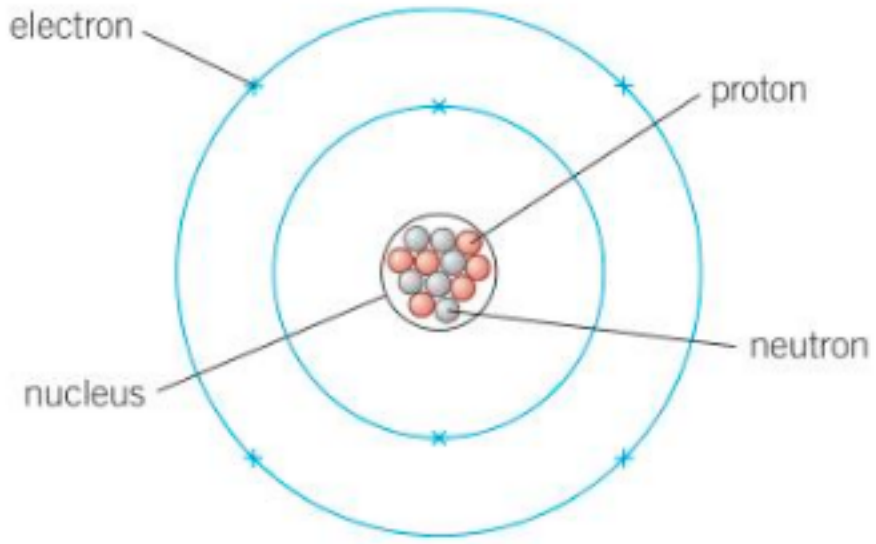
```
number of protons = 13 = number of electrons
number of neutrons = mass number - atomic number = 27 - 13 = 14 neutrons
```

2. **a) Define the word isotopes. [1 mark]**

   Answer.

   Isotopes are atoms with the same number of protons, but differing numbers of neutrons. In other words, they have different atomic weights. Isotopes are different forms of a single element.

   b) Look at the figure. Which isotope of carbon is shown? [1 mark]



3. The atomic radius of a boron atom is 9 × 10

a) Give its atomic radius in nano meters. [1 marks]

b) Calculate the approximate radius of its nucleus (in nm), given that is will be about one ten thousandth the radius of the boron atom. Give your answer in standard form. [1 mark]

4. a) Which physical property will always differ in pure samples of each isotope of the same element? [1 mark]

Answer.

Samples of different isotopes of an element have different physical properties. For example, they have different densities & they may or may not be radioactive.

b) Explain why the isotopes of the same element have identical chemical properties. [2 marks]

Answer.

Isotopes have always the same chemical properties because their reactions depend on their electronic structures. The electronic structure will be the same for all isotopes of an element as their atoms will have the same number of protons, and therefore electrons in their highest energy level.

C 1.8 Electronic structures:

1. a) Which shell represents the lowest energy level in an atom? [1 marks]

Answer.

Innermost shell of first shell represents the lowest energy level in an atom.

b) How many electrons can each of the lowest two energy levels hold? [1 mark]

Answer.

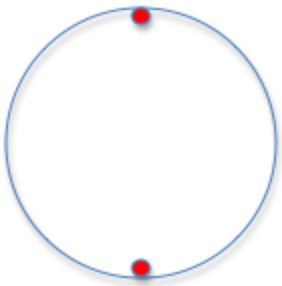
2 electrons can be holded by first shell and 8 electrons can be holded by second shell.

2. Using the periodic table, draw the arrangement of electrons in the following atoms and label each one with its electronic structure.

a) He [1 mark]

Answer.

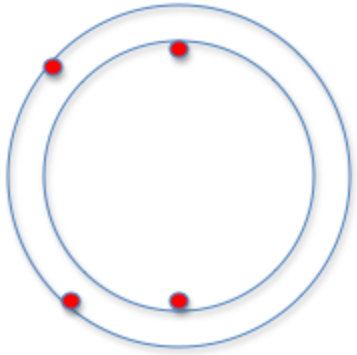
```
Atomic number of He is 2, Therefore number of electrons 2
```



b) Be [1 mark]

Answer.

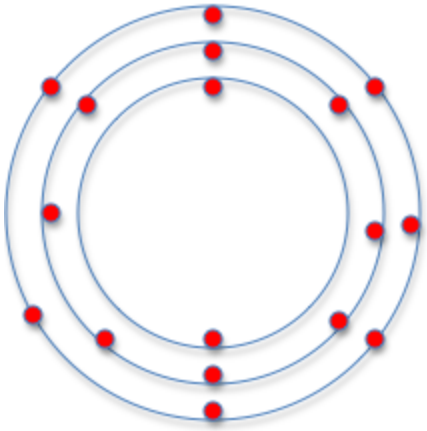
Atomic number of Be is 4, Therefore number of electrons 4



c) Cl [1 mark]

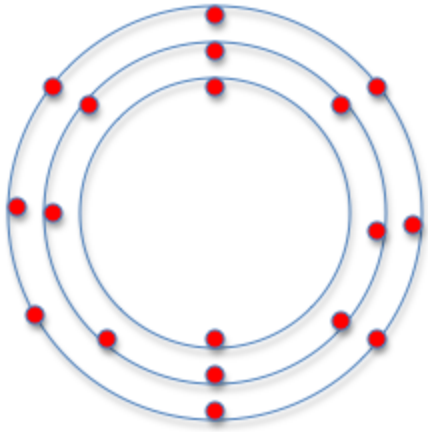
Answer.

Atomic number of Cl is 17, Therefore number of electrons 17



d) Ar [1 mark]

Atomic number of Ar is 18, Therefore number of electrons 18



3. a) Write the electronic structure of potassium (atomic number 19). [1 mark]

Answer.

The electronic structure of potassium is 2,8,8,1.

b) How many electrons does a potassium atom have in its highest energy level (outermost shell)? [1 mark]

Answer.

A potassium atom has 1 electron in its highest energy level

4. Give the name and symbol of the atom shown in figure. [1 mark]

Answer.

The element is phosphorus and the symbol is P.

5. a) Why do the Group 1 metals all react in a similar way with oxygen? [1 mark]

Answer.

Oxygen reacts rapidly with Group 1 elements. All alkali metal oxides form basic solutions when dissolved in water. The principal combustion product is the most stable product with respect to the reactants. For example, with careful control of oxygen, the oxide M_2O can be formed with any of the alkali metals. When heated, lithium, sodium, potassium, rubidium, and cesium ignite through combustion reactions with oxygen.

b) Write word equations for the reactions of lithium, sodium, and potassium with Oxygen to form their oxides. [3 marks]

Answer.

For lithium:

```
Lithium + Oxygen ----> Lithium Oxide
```
For sodium:
```
Sodium + Oxygen ----> Sodium Oxide
```
For potassium:
```
Potassium + Oxygen ----> Potassium Oxide
```

c) The Group 1 metals also react with chloride, LiCl, and sodium chloride, NaCl. Write a balanced symbol equation for the reactions of lithium, Li, and sodium, Na, with chloride gas. [4 marks]

Chapter C1 Summary Questions:

1. **Atomic structure:**

1. a) Name the sub-atomic particles found in the nucleus of an atom. [1 mark]
Answer.
The sub-atomic particles found in the nucleus of an atom are protons, neutrons and electrons.
b) What is the maximum number of electrons that can occupy each of the first two energy levels or shells? [1 mark]
Answer.
Electrons in the first three energy levels for the elements with atomic numbers 1 to 20

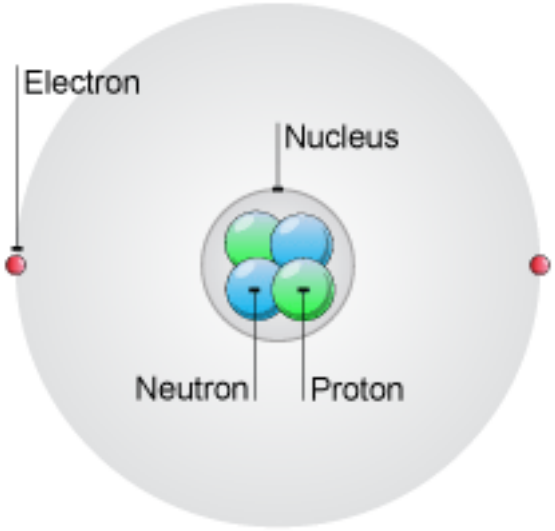
Energy level or shell	Maximum number of electrons
first	2
second	8
third	8

c) Explain the overall charge on an atom. [3 marks]
Answer.
All substances are made from atoms. Each atom is made of a nucleus - containing protons and neutrons - surrounded by electrons.
The atomic number is the number of protons in an atom. The elements are arranged in the periodic table in ascending order of atomic number.

The mass number of an atom is the total of protons plus neutrons. Atoms of the same element with different numbers of neutrons (and hence different mass numbers) are called isotopes of that element.

Atomic structure

All material things are made from atoms. There are just over one hundred different types of atom, called elements. Atoms can join together in millions of different combinations to make **all** the substances on Earth and beyond.



Structure of the atom

Every atom is made of a **nucleus** consisting of **protons** and **neutrons**. The nucleus is surrounded by **electrons**. Protons and electrons are oppositely charged. Neutrons have no charge. This means the nucleus of an atom is always positively charged.

An atom has a **neutral** overall charge because it has the same number of electrons as protons.

Protons and neutrons have the same **mass**. Electrons have such a small mass that this can usually be taken as zero.

Comparing the charge and mass of electrons, protons and neutrons

	Proton	Neutron	Electron
Charge	+1	0	-1
Mass	1	1	0.0005 (almost zero)

The **atomic number** (also called the proton number) is the number of protons in an atom.

The **mass number** (also called the nucleon number) is the total number of protons and neutrons in an atom.

The elements are arranged in the periodic table in ascending order of atomic number so it's easy to find the name or symbol for an atom if you know the atomic number.

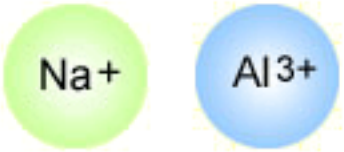
d) How can an atom become an ion with a 2+ charge? Explain you answer. [2 marks]

Answer.

Ions are electrically charged particles formed when atoms lose or gain *electrons*. This loss or gain leaves a complete highest energy level, so the electronic structure of an ion is the same as that of a noble gas - such as a helium, neon or argon.

Metal atoms and non-metals atoms go in opposite directions when they ionise:

- **Metal atoms** lose the electron, or electrons, in their highest energy level and **become positively charged ions**.
- **Non-metals atoms** gain an electron, or electrons, from another atom to **become negatively charged ions**.



charged sodium and aluminium ions

Negatively charged oxide and chloride ions

How many charges?

There is a quick way to work out what the charge on an ion should be:

- the number of charges on an ion formed by a **metal** is **equal to the group number** of the metal
- the number of charges on an ion formed by a **non-metal** is **equal to the group number minus eight**
- hydrogen forms H^+ ions

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
Example element	Na	Mg	Al	C	N	O	Cl	He
Charge	1+	2+	3+	Note 1	3-	2-	1-	Note 2
Symbol of ion	Na^+	Mg^{2+}	Al^{3+}	Note 1	N^{3-}	O^{2-}	Cl^-	Note 2

Note 1: carbon and silicon in Group 4 usually form *covalent bonds* by sharing electrons.
Note 2: the elements in Group 0 do not react with other elements to form ions.

e) Define atomic number and mass number. [2 marks]

Answer.

The **atomic number** (also called the proton number) is the number of protons in an atom.

The **mass number** (also called the nucleon number) is the total number of protons and neutrons in an atom.

2. a) Define what the word mixture means to a scientist. [1 mark]

Answer.

In chemistry, a mixture forms when two or more substances are combined such that each substance retains its own chemical identity. Chemical bonds between the components are neither broken nor formed. Note that even though the chemical properties of the components haven't changed, a mixture may exhibit new physical properties, like boiling point and melting point. For example, mixing together water and alcohol produces a mixture that has a higher boiling point and lower melting point than alcohol (lower boiling point and higher boiling point than water).

b) State the differences between a mixture and a compound. [2 marks]

Answer.

Mixtures have different properties from compounds. The table summarises these differences.

	Mixture	Compound
Composition	Variable composition – you can vary the amount of each substance in a mixture.	Definite composition – you cannot vary the amount of each element in a compound.
Joined or not	The different substances are not chemically joined together.	The different elements are chemically joined together.
Properties	Each substance in the mixture keeps its own properties.	The compound has properties different from the elements it contains.
Separation	Each substance is easily separated from the mixture.	It can only be separated into its elements using chemical reactions.
Examples	Air, sea water, most rocks.	Water, carbon dioxide, magnesium oxide, sodium chloride.

c) Name the technique you would use to separate and collect:

hydrated copper(II) sulfate, ,from its aqueous solution. [1 mark]

3. Look at the data in the table below:

Chemical element	Melting point in °C	Boiling point in °C	Density in g/cm³
Bromine	-7	59	3.12

Caesium	29	669	1.88
Fluorine	-220	-188	0.00158
Strontium	769	1384	2.6
xenon	-112	-108	0.0055

a) What is the physical state of each element in the table at 25°C? [3 marks]

b) Which element exists as a liquid over the widest range of temperature? [1 mark]

c) What is the chemical symbol for atoms of each element in the table? [1 mark]

d) Classify each element in the table as a metal or a non-metal. [1 mark]

e) Write the electronic structure of:

i) a fluorine atom [1 mark]

ii) a fluoride ion, F^-. [1 mark]

4. This question is about some of the elements in the periodic table. You will need to use the periodic table to help you answer some parts of the question.

a) Neon, Ne is the 10^{th} element in the periodic table.

i) Is neon a metal or non-metal? [1 mark]

Answer.

It is a non-metal. It is a noble gas.

ii) Are there more metals or non-metals in the periodic table? [1 mark]

Answer.

If you look at the periodic table, you will notice that there is a staircase that separates the nonmetals from the metals. The right side of the staircase are non-metals, while the metals are on the left side of the staircase. By looking at the periodic table, it is obvious that there are much more metals than non-metals.

iii) How many protons does a neon atom contain? [1 mark]

Answer.

It contains 10 protons.

iv) The mass number of a neon atom is 20. How many neutrons does it contain? [1 mark]

Answer.

It contains 10 neutrons.

v) State the name and number of the group to which neon belongs. [1 mark]

Answer.

It belongs to Group 18.

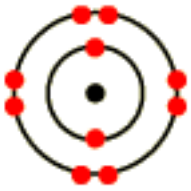
vi) Name two other elements in the same group as neon. [1 mark]

Answer.

Helium and Argon.

vii) Write the electronic structure of a neon atom. [1 mark]

Answer.



viii) What is special about the electronic structure of neon and the other elements in its group? [1 mark]

Answer.

- Elements tend to adopt the stable electron configurations of the noble gases.
- The s block includes the first two groups (alkali metals and alkaline earth metals) as well as hydrogen and helium.
- The p block includes the last six groups, Groups 13 to 18, and contains, among others, all of the metalloids and nonmetals.
- The d block includes Groups 3 to 12 and contains all of the transition metals.
- The f block, usually offset below the rest of the periodic table, includes the lanthanides and actinides.

b) The element radium, Ra, has 88 electrons.

i) How many protons are in the nucleus of each radium atom? [1 mark]

Answer.

88 Protons.

ii) How many electrons does a radium atom have in its highest energy level (outermost shell)? Give a reason for your answer. [1 mark]

Answer.

2 electrons.

iii) Is radium a metal or non-metal? [1 mark]

Answer.

Radium is a silvery white metal that does not occur free in nature.

iv) Radium's three most common isotopes are radium-224, radium-226, and radium-228. Describe the difference between the atomic structures of the three isotopes. [1 mark]

Answer.

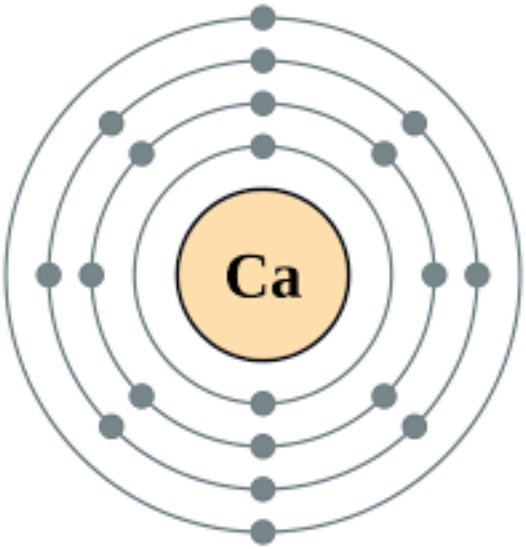
Four naturally occurring isotopes of radium are known. They are radium-223, radium-224, radium-226, and radium-228. Isotopes are two or more forms of an element. Isotopes differ from each other according to their mass number. The number written to the right of the element's name is the mass number. The mass number represents the number of protons plus neutrons in the nucleus of an atom of the element. The number of protons determines the element, but the number of neutrons in the atom of any one element can vary. Each variation is an isotope.

Only radium-226 has any commercial applications. It has a half life of 1,620 years. After that period of time, only half of the original sample would remain. The half life of a radioactive element is the time it takes for half of a sample of the element to break down. The other three isotopes have half lives of only a few days or years. These short half lives make it difficult to work with the isotopes.

The only isotope now used very often, radium-226, is generally not used directly. Instead, it is used to make radon gas. Radon gas is one of the products formed when radium breaks down. The radon gas is easier and safer to work with than is the radium itself.

v) Calcium is in the same group as radium. Its atomic number is 20. Write down its electronic structure. [1 mark]

Answer.



vi) Calcium forms 2+ ions in its compounds. Using the 40 Ca atom, work out the number of protons, neutrons and electrons in a [1 mark]

5. Balance the following symbol equations:

a) $Na + Cl \rightarrow Nacl$ [1 mark]

b) $Al + O_2 \rightarrow Al_2O_3$ [1 mark]

c) $Fe_2O_3 + C \rightarrow H_2O$ [1 mark]

d) $Al(OH)_3 \rightarrow Al_2O_3 + H_2O$ [1 mark]

e) $Ba(NO_3)_2 \rightarrow BaO + NO_2 + O_2$ [1 mark]

f) $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$ [1 mark]