

Chapter 1

The Periodic Table

Multiple Choice Items

(1) The Periodic Table – Historical Development

Question 1

Around 1800 a number of scientists observed that a pure compound always contains the same proportion of elements by mass. This was one of the observations used by Dalton when he formulated his atomic theory. If 0.191 g of copper can be obtained from 0.239 g of copper oxide what mass of copper oxide (in grams) would be needed to give 0.450 g of copper?

- A. 0.360 B. 0.402 C. 0.498 D. 0.563

Question 2

When a high voltage is applied between electrodes in a sealed glass tube containing a gas at low pressure, cathode rays are seen as a glow in the tube. Cathode rays

- A. flow from anode to cathode.
B. follow a curved path.
C. consist of particles.
D. have a positive charge.

Question 3

Of the elements argon, chlorine, silver and sodium, which one was discovered first?

- A. Argon B. Sodium
C. Silver D. Chlorine

Question 4

Mendeleev produced his version of the periodic table in 1869. He determined the position of each element by considering their

- A. electron configuration and relative mass.
B. chemical properties and relative mass.

2 Chemistry

- C. atomic number and chemical properties.
- D. physical properties and electron configuration.

Question 5

When chemists, such as Mendeleev, produced the early forms of the periodic table, the elements chlorine (a gas), bromine (a liquid) and iodine (a solid) were placed in the same group because they

- A. had similar chemical properties.
- B. had the same number of outer shell electrons.
- C. were all non-metals.
- D. showed a gradation in physical properties.

Question 6

James Chadwick was responsible for the discovery of

- A. the electron.
- B. the proton.
- C. the neutron.
- D. transuranic elements.

Question 7

Which one of the following ideas is **not** common to the theories of both Bohr and Schrödinger?

- A. Atoms have a central nucleus surrounded by orbiting electrons.
- B. Electrons exist in energy levels called shells.
- C. Each shell can hold a certain maximum number of electrons.
- D. Shells are subdivided into energy levels called subshells.

Question 8

The following statements refer to Mendeleev's periodic table, which he published in 1869.

- I Mendeleev left a number of gaps in the table.
- II All of the elements were placed in order of increasing atomic weight.
- III Using his table Mendeleev predicted the existence of some then unknown elements as well as their properties.
- IV The elements with similar chemical properties were placed in the same vertical group.

Which of the above statements about Mendeleev's table are correct?

- A. I, II and III
- B. II, III and IV
- C. I and III
- D. I, III and IV

The Periodic Table 3**Question 9**

Which one of the following ideas was **not** suggested by Dalton?

- A. Atoms are neither created nor destroyed in chemical reactions.
- B. In a given compound the proportion of each atom is fixed.
- C. For a given element the atoms can have different weights.
- D. Atoms combine in simple whole number ratios.

Question 10

In his model of the atom Thomson suggested that an atom has

- A. a nucleus with a positive charge.
- B. negative particles embedded in a sphere of positive charge.
- C. a nucleus surrounded by electrons.
- D. three types of particles, positive, negative and neutral.

Question 11

Below are some statements concerning sub-atomic particles and atoms.

- I most of an atom is empty space
- II positive particles (protons) are much heavier than electrons
- III neutral particles (neutrons) have about the same mass as protons
- IV most of the mass of an atom and all of the positive charge is in a very tiny nucleus

Which of these statements were used by Rutherford when he first proposed his model of the atom in 1911?

- A. I and IV
- B. I, II and III
- C. I, II and IV
- D. I, II, III and IV

Question 12

Below are four statements concerning electrons in atoms

- I electrons move in orbits around the nucleus
- II an electron behaves like a cloud of negative charge
- III when an electron is in an orbit it has a defined energy
- IV energy is emitted or absorbed if an electron changes orbit

Which of these statements did Bohr use to explain the emission spectra of elements?

- A. I, II, III and IV
- B. I, III and IV
- C. II, III and IV
- D. I, II and IV

4 Chemistry

(1) The Periodic Table – Trends and Patterns of Properties

Question 13

Of the following elements which one is most likely to have similar chemical properties to the element with atomic number 16?

- A. Phosphorus
- B. Chlorine
- C. Argon
- D. Selenium

Question 14

In which one of the following sets are all the compounds most likely to be coloured?

- A. KMnO_4 , CaCl_2 , NH_4NO_3
- B. Ag_3PO_4 , $(\text{NH}_4)_2\text{SO}_4$, BaBr_2
- C. $\text{Cu}(\text{OH})_2$, $\text{Fe}(\text{NO}_3)_3$, $\text{K}_2\text{Cr}_2\text{O}_7$
- D. NaCl , MgBr_2 , AlI_3

Question 15

In going down Group 1 of the periodic table, i.e. from Li to Na to K, the first ionisation energy

- A. decreases and the atomic radius decreases.
- B. decreases and the atomic radius increases.
- C. increases and the atomic radius decreases.
- D. increases and the atomic radius increases.

Question 16

The properties of the elements used to produce the modern form of the periodic table are their

- A. atomic number and ionisation energy.
- B. atomic mass and chemical properties.
- C. chemical properties and ionisation energy.
- D. atomic number and electron configuration.

Question 17

When compared with transition metals, main group metals

- A. are more reactive.
- B. form more than one oxidation state.
- C. can be magnetized more easily.
- D. form compounds that are often coloured.

Question 18

Which one of the following statements about transition metals is incorrect?

The Periodic Table 5

- A. Most transition metals have a partly filled d-subshell.
- B. Many compounds of transition metals are coloured.
- C. Transition metals have high melting temperatures, are hard and dense and are highly reactive.
- D. Most transition metals can form more than one oxidation state.

Question 19

The properties of the elements of the third period vary as one goes across the period from Na to Ar. Which one of the following shows how the atomic radius and first ionisation energy vary from Na to Ar?

- | | Atomic radius | First ionisation energy |
|----|---------------|-------------------------|
| A. | increases | increases |
| B. | increases | decreases |
| C. | decreases | increases |
| D. | decreases | decreases |

Question 20

Which one of the following properties shows a general increase across the periodic table from sodium to chlorine?

- A. Metallic character
- B. Atomic radius
- C. First ionisation energy
- D. Reducing strength

Question 21

Which one of the following will have the largest radius?

- A. Be atom
- B. Mg atom
- C. Ca atom
- D. Sr atom

Question 22

When main group metals, such as potassium and calcium, are compared with transition metals in the same period, such as iron and copper, which of the following is correct?

	Main Group metals	Transition metals
A.	form coloured compounds	usually hard
B.	highly reactive	usually soft
C.	have lower ionisation energy	have higher melting temperatures
D.	displays one oxidation state	have larger atomic radius

Question 23

When going down Group I, from lithium to caesium, which one of the following statements is correct?

6 Chemistry

- A. The first ionisation energy increases.
- B. The atoms are more likely to react to form 2+ cations.
- C. The elements become more reactive.
- D. The attraction between the nucleus and the outermost electron increases.

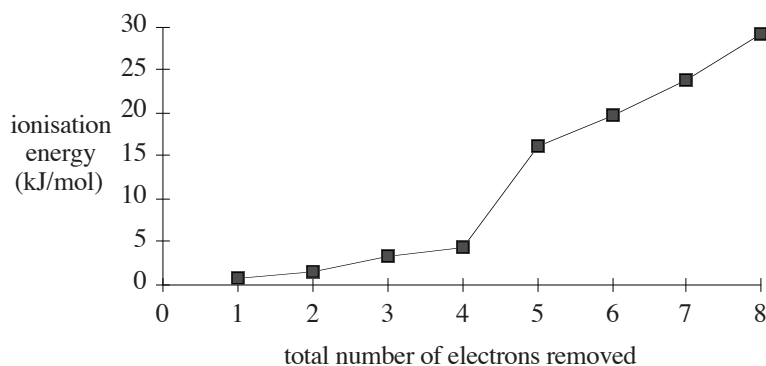
Question 24

Which one of the following lists contains only non-metallic elements?

- A. hydrogen, helium, lithium, beryllium
- B. oxygen, chlorine, sulfur, arsenic
- C. lithium, sodium, magnesium, aluminium
- D. iron, sulfur, carbon, phosphorus

Question 25

The first eight ionisation energies of an element are shown in the graph below.



The element is most likely to be

- A. carbon.
- B. oxygen.
- C. neon.
- D. silicon.

(2) Atomic Theory – Models of the Atom and their Limitations

Question 26

The chemist John Dalton stated that atoms can neither be created nor destroyed. Which one of the following statements should be added to make this statement accurate?

- A. without the application of heat.
- B. when a chemical reaction occurs.
- C. during a nuclear reaction.
- D. except at high pressure.

The Periodic Table 7**Question 27**

The first understanding that the atom consists of even smaller particles was gained from

- A. Boyle's work with gases.
- B. the invention of the mass spectrometer.
- C. observations of cathode ray tube experiments.
- D. Rutherford's gold foil experiment.

Question 28

Which one of the following was **not** part of Bohr's model of the atom?

- A. Electrons move in regions of space called orbitals.
- B. Electrons move in energy levels called shells.
- C. Electrons closer to the nucleus have lower energy.
- D. Orbiting electrons do not lose energy.

Question 29

The work of the alchemists in attempting to convert base metals into gold failed because

- A. the furnaces which they used could not reach sufficiently high temperatures.
- B. they did not have the required chemical reactants.
- C. they did not use suitable metals in their experiments.
- D. they had no knowledge of nuclear reactions.

Question 30

Which one of the following deductions was not made by Rutherford after carrying out his gold foil experiment?

- A. the atom is mostly empty space.
- B. positively charged particles make up a central nucleus.
- C. neutrons make up the remainder of the mass of the nucleus.
- D. electrons occupy the space around the nucleus.

(2) Atomic Theory – Structure of Atoms**Question 31**

The mass number of an atom is defined as the

- A. total number of neutrons and protons in an atom.
- B. number of protons in an atom.
- C. total mass of the neutrons and protons in the atoms.
- D. number of neutrons in an atom.

8 Chemistry

Question 32

The neutral species ${}^{40}_{20}\text{Ca}$ would contain

- A. 20 neutrons, 40 protons and 40 electrons.
- B. 40 neutrons, 20 protons and 20 electrons.
- C. 20 neutrons, 20 protons and 20 electrons.
- D. 40 neutrons, 20 protons and 40 electrons.

Question 33

The atomic structures of three particles (X, Y, Z) are given in the table below

Particle	No. of protons	No. of electrons	No. of neutrons
X	13	10	14
Y	12	10	13
Z	11	10	12

These particles are

- A. isotopes.
- B. anions.
- C. non-metals.
- D. cations.

Question 34

An atom of copper has 29 protons and 35 neutrons. The correct symbol for this atom is

- A. ${}^{64}_{29}\text{Cu}$
- B. ${}^{29}_{64}\text{Cu}$
- C. ${}^{35}_{29}\text{Cu}$
- D. ${}^{64}_{35}\text{Cu}$

Question 35

The electronic configuration of an atom of phosphorus is

- A. $1s^2 2s^2 2p^6 3s^3 3p^3$
- B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$
- C. $1s^2 2s^2 2p^6 3s^2 3p^5$
- D. $1s^2 2s^2 2p^6 3s^2 3p^3$

Question 36

A very dangerous radioactive isotope of strontium produced during nuclear explosions is ${}^{90}_{38}\text{Sr}$. When this isotope decays a stable isotope of zirconium, ${}^{90}_{40}\text{Zr}$ is eventually formed. Compared with the isotope of Sr, the isotope of Zr has

- A. two more protons and two less neutrons.
- B. two more neutrons and two less protons.
- C. one more proton and one more neutron.
- D. two more protons and the same number of neutrons.

The Periodic Table 9

Question 37

Naturally occurring iridium has a relative atomic mass of 192.2 and consists of two isotopes, $^{191}_{77}\text{Ir}$ and $^{193}_{77}\text{Ir}$. The percentage of the lighter isotope is

- A. 80% B. 60% C. 40% D. 20%

Question 38

Which one of the following species would have the smallest radius?

- A. Na^+ B. K^+ C. Cl^- D. F^-

Question 39

A particle has 27 protons, 28 neutrons and 25 electrons. If the element has the symbol X then this particle may be represented by the symbol

- A. $^{55}_{27}\text{X}^{2+}$ B. $^{53}_{25}\text{X}^{2+}$ C. $^{55}_{27}\text{X}^{2-}$ D. $^{53}_{25}\text{X}^{2-}$

Question 40

Which one of the following species will have the largest radius?

- A. Na atom B. Na^+ ion C. K atom D. K^+ ion

Question 41

Which one of the following transitions could not contribute to the emission spectrum of an excited magnesium atom?

- A. An electron in a 4s orbital moves to a 3p orbital.
B. An electron in a 3s orbital moves to a 4p orbital.
C. An electron in a 5p orbital moves to a 4s orbital.
D. An electron in a 5d orbital moves to a 3p orbital.

Question 42

Of the following elements which one is most likely to have similar chemical properties to the element with atomic number 16?

- A. Phosphorus B. Chlorine
C. Argon D. Selenium

Question 43

The electron configuration of a neutral atom with its electrons in an excited state is

- A. $1s^2 2s^2 2p^2$ (atomic number = 6)
B. $1s^2 2s^2 2p^3 3s^1$ (atomic number = 8)

10 Chemistry

- C. $1s^2 2s^2 2p^5 3s^1$ (atomic number = 9)
 D. $1s^2 2s^2 2p^5$ (atomic number = 10)

Question 44

The 3d subshell can take a maximum of

- A. 2 electrons B. 6 electrons
 C. 10 electrons D. 14 electrons

Question 45

An ion which has the same electron configuration as a magnesium ion and has a charge of negative two is the

- A. oxide ion. B. sulfide ion.
 C. sodium ion. D. aluminium ion.

Question 46

Four particles, I, II, III and IV are described in the table below.

	Mass number	Atomic number	Number of electrons
I	127	53	54
II	127	53	53
III	129	53	53
IV	127	52	54

Which of the following pairs of particles are isotopes?

- A. I and II B. II and III
 C. I and IV D. II and IV

Question 47

The transition metal titanium forms the ion Ti^{3+} in water. The electronic configuration of Ti^{3+} ion is most likely to be

- A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$ B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
 C. $1s^2 2s^2 2p^6 3s^2 3p^5 4s^2$ D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$

Question 48

The number of neutrons in an atom of $^{197}_{79}\text{Au}$ is

- A. 79 B. 118 C. 197 D. 276

Question 49

The elements in Group IV of the periodic table become more metallic in character down the group. This trend is best explained by the