CHEMISTRY ONLINE
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CHEMISTRY

Physical Chemistry

Level & Board	AQA (A-LEVEL)
TOPIC:	ATOMIC STRUCTURE
PAPER TYPE:	SOLUTION - 5
TOTAL QUESTIONS	19
TOTAL MARKS	48

Atomic structure AQA -5

Q.1 (b)

Q.2 (c)

Q.3 (c) Hydrogen with mass number 1 has zero neutrons

Q.4 (b)

Q.5 (b) Neon has the lightest first ionization energy

Q.6 (a) Explain

Q.7 (b)

Q.8 (c)

Q.9 (a)

Q.10 (c)

Q.11 (b)

Q.12 (d)

Q.12 (d)

Q.13 (b)

Q.14

(a)

- Current model includes: Neutrons and protons whereas Rutherford doesn't.
- Current model shows electrons revolving around in different energy levels where as Rutherford model doesn't

(b) $^{20}N_e^+$

Lightest ion is going to reach to h first the delector
First

First calculate the missing abundance

Isotope	Abundance
Neon-20	90.9
Neon-21	0.3
Neon-22	100-(90-9+0.3=8.8

Now play in the values into the R.A.M

$$R.A.M = \frac{\sum(20 \times 90.9) + (21 \times 0.3) + (22 \times 8.8)}{100}$$

$$= \frac{1818+6.3+193.6}{100}$$

$$= \frac{2017.9}{100}$$

$$= 20.179$$

Q.15

(a) The number of Protons are follows as Atomic no

(b) Look at question people

(c) First calculate the percentage abundance of $^{58}Ni^{+}$in the

<u>Sample</u>

Let

$^{62}Ni^{+}$be = y

So, $^{60}Ni^{+}$=2y

$^{58}Ni^{+}$ = 3y

Let's apply the formula of R.A.M

$$58.7 = \frac{(62\times y)+(60\times 2y)+(58\times 3y)}{100}$$

$$58.7 \times 100 = 62y + 120y + 174y$$

$$5870 = 356y$$

$$y = 16.48\%$$

Therefore, the abundance of$^{58}Ni^{+}$ 16.48%is

Q.16

(a)

Relative atomic mass is the average mass of an atom compared to $\frac{1}{12^{th}}$ Of mass of an atom of carbon-12

(b) Formula

$$R.A.M = \frac{\sum isotopic\ mass \times abundance}{100}$$

$$= \frac{(36 \times 70) + (38 \times 10) + (40 \times 20)}{100}$$

$$= \frac{(2520) + (380) + (800)}{100}$$

$$= \frac{3700}{100}$$

$$= 37amu$$

(c) Important information

$K.E = 4.83\times10^{-16}J$

$t = 1072\times 10^{-5}s$

Ion = $^{20}Ne^{+}$

Step I: Calculate the mass of single ion of $^{20}Ne^{+}$ by dividing if by Avogadro's number

Mass of one ion

$$= \frac{20}{6.02\times10^{23}}$$

$$= 3.32 \times 10^{-3} g$$

Convert into kg to be used in next equation

$$= \frac{3.32 \times 10^{-23}}{1000} kg = 3.32 \times 10^{-26} kg$$

Step 2: we know

$$K.E = \frac{1}{2}mv^2$$

$$4.83 \times 10^{-16} = \frac{1}{2}(3.32 \times 10^{-26}(v^2)$$

$$v = \sqrt{\frac{2(4.83 \times 10^{-16})}{3.32 \times 10^{-26}}}$$

$$v = 170046m/s$$

(d) $Velocity = \frac{distance}{time}$

$$= \frac{x}{1.72 \times 10^{-5}}$$

$$x = 2.92m$$

Q.17

(a)

Relative atomic mass is the average mass of an atom compared to $\frac{1}{12^{th}}$ Of mass of an atom of carbon-12

(b) Calculate the abundance of two isotopes

Step 1: Let's assume the abundance of

^{50}X be = x

Question tell us that ^{52}X = 86.1

The abundance of ^{58}X will be

= (100-(86.1)-x)

= 13.9 x

Now,

Isotope	abundance
^{50}X	x
^{52}X	86.1
^{53}X	13.9x

Step 2 Apply the formula;

$$52.1 = \frac{(50 \times x) + (52 \times 86.1) + (53 \times (13.9 - x))}{100}$$

$$52.1 \times 100 = 50x4477.2 + 736.7 - 53x$$

$$5210 = 50x - 53x + 5214.1$$

$$5210 - 5214 = -3x$$

-4.1=-3x

Divide both sides by 3, therefore

$$1.3 = x$$

The abundance are as follows:

^{50}X = 1.3%

^{52}X = 86.1%

^{53}X = 12.6

(c) Similarly

- Both have same protons number present in nucleus
- Both contain same Electron number revolving around the nucleus

Difference

- Different number of Neutrons

(d) Ions cab be accelerated by an Electric field
Ions generate current when hitting the detector which is proportional is this abundance

(c) Important information

Length = 1.25m

K.E = 1.102×10^{-13}
Ion = $^{53}X^{+}$

Step 1: Calculate the mass of single ion so divide '53' by Avogadro's number

$$= \frac{53}{6.022 \times 10^{23}}$$
$$= 8.80 \times 10^{-23} g$$

Step 2: Convert the mass calculated in grams to kg to be used in K.E equation

SO,

$$= \frac{8.80\times10^{-23}}{1000}$$

$$= 8.80 \times 10^{-26} kg$$

$$K.E = \frac{1}{2}mv^2$$

$$1.102 \times 10^{-13} = \frac{1}{2}(8.80 \times 10^{-26})(v^2)$$

$$\sqrt{\frac{(1.12 \times 10^{-13})2}{8.80 \times 10^{-26}}} = v$$

$$v = \frac{1119049m}{s}$$

Step3: $velocity = \frac{distance}{time}$

$$1119049 = \frac{1.25}{x}$$

$$x = \frac{1.25}{1119049}$$

$$= 1.1170 \times 10^{-6} s$$

Q.19

Trends in the first ionization energy from sodium to Argon

Q.20

(a) The ionization process can be described as follows:

(i) A high voltage creates charged droplets from a solution containing biomolecule P.

(ii) Solvent molecules evaporate from these droplets.

(iii) Highly charged, desolvated ions of P are formed.

(iv) These ions are introduced into the mass spectrometer for analysis.

The ionization equation is:

P (in solution) → P^+ (gas phase) + e^-.

In this equation, "P" represents biomolecule P in solution, "P^+" represents the positively charged ion of biomolecule P in the gas phase, and "e^-" represents the electron removed from biomolecule P during the ionization process. The positive charge on biomolecule P allows it to be analyzed in a mass spectrometer, and the mass-to-charge ratio (m/z) of the resulting ions is 556 results.

(b) 555

(c) Important information

$K.E = 2.09 \times 10^{-15}$

$time = 1.23 \times 10^{-5}$

$Length = 1.5m$

Step 1: Calculate the velocity

$$velocity = \frac{distance}{time}$$

$$= \frac{1.5}{1.23 \times 10^{-5}}$$

$$= 121951 m/s$$

Step 2:

$$K.E = \frac{1}{2}mv^2$$

$$2.09 \times 10^{-15} = \frac{1}{2}(m)(121951)^2$$

$$\frac{(2.09 \times 10^{-15})2}{(121951)^2} = v$$

$$m = \frac{4.18 \times 10^{-15}}{(121951)^2}$$

$$m = 2.8 \times 10^{-25} kg$$

This is the mass of single ion

Step 3: We need to calculate molecules mass

So, multiply it by Avogadro's constant

$$= (2.8 \times 10^{-25})(6.02 \times 10^{23})$$

$$= 0.1692\ kg$$

Convert it into grams

$$= 0.1692 \times 1000\ \ = 169.2\ grams$$

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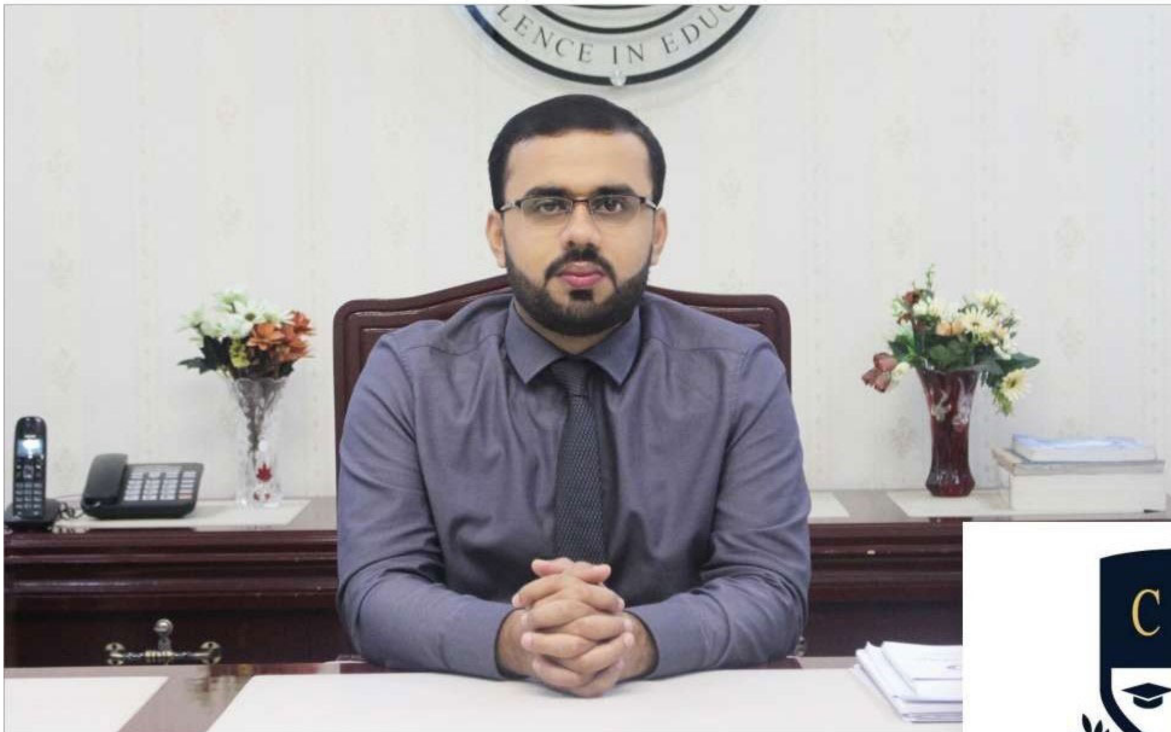

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