CHEMISTRY ONLINE
TUITION

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CHEMISTRY

Physical Chemistry

Level & Board	AQA (A-LEVEL)
TOPIC:	ATOMIC STRUCTURE
PAPER TYPE:	SOLUTION -1
TOTAL QUESTIONS	14
TOTAL MARKS	77

I am Sorr

Atomic Structure – 1

1.

D. $X(g) + H^+ \rightarrow XH^+ (g)$

2.

C. Silicon

3.

(a)

Remember the following steps of Electrospray ionisation.

1 .Sample dissolve in a volatile solvent.
2 .Then injected into the spectrometry through the hypodermic needle having high voltage at the tip.
3 .As soon as molecules comes out, solvent being volatile evaporates away and sample gains H^+ ion.

(b)

$C_3H_5O_2NH^+$
This would be detected as it.

(c)

$Ge_{(g)}{}^+ \longrightarrow Ge^+{}_{(g)}{}^+ e^-$

(d)

Step 1: Highlight important information
Time $\Rightarrow 4.654 \times 10^{-6}$ s

K.E $\Rightarrow 2.438 \times 10^{-15}$ J

Length of tube = 96cm

Convert in meters = 96/100 = 0.96m

Step 2: Calculate velocity

$v \Rightarrow d/t = 0.96 / 4.654 \times 10^{-6} = 206274$ m/s

Now we know K.E

Step 3: $2.438 \times 10^{-15} = 1/2\ (m)\ (206274)^2$

$(2.438 \times 10^{-15})^2 / 206272)^2 =$

Step 4: Multiply by N_A

This is mass of one in kg

4.

(a)

1 Sample dissolved in volatile solvent.
2. Solvent + sample mixture is injected into the mass spectrometer using needle.
3. The needle is attached to a high voltage, and as soon as the molecule comes out, it attains an H^+ ion.

(b)

555

(c)

Highlight important information
K.E $=2.09 \times 10^{-15}$
Time $=1.23 \times 10^{-5}$s
Length of tube = 1.5m

We know that
velocity $= 1.5 / 1.23 \times 10^{-5}$

$= 121951$ m/s

Now:

$K.E = 1/2\ mv^2$

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

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

$m = 2.8\ 1 \times 10^{-25}$ kg

This is the mass of single in this time, multiply this by N_A

to calculate molecular mass.

2.81×10^{-25} kg $\times N_A$

= 0.169 kg

= 169 g

5.

A.H

6.

(a)

- Central nucleus has protons and neutrons.
- Electrons revolve around the nucleus in specified pathways known as shells.

(b)

Ans: $1s^2\ 2s^2\ 2p^6\ 3s^1$

(c)

Ans: NaCl

7.

(a)

Cl^- : $1s^2\ 2s^2\ 2p^6$ 3s2 3p6 { chlorine in not atom}

Fe^{2+} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$ { take away point : learn transition metal configuration}

(b)

$Mn_{(g)}^{2+} \rightarrow Mn_{(g)}^{3+} + e$

Take away point: never miss to mention gases (g) in ionization energy definition.

(c)

Aluminum has lower ionization energy as compared to

magnesium because electron in aluminum is removed from p orbital.

Aluminum configuration ⇒ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

Magnesium ⇒ $1s^2\ 2s^2\ 2p^6\ 3s^2$

(d)

Ion reaching detector = $^{58}Ni^+$

R.A.M = Σ isotopic mass × abundance / Total abundance

= (58 ×61) + (60 ×29.1) + (61×9.9) / 100

= 3538 + 1746 + 603.9 / 100

= 58.879

8.

(a)

Three isotopes different only in number of Neutrons.

(b)

Chemical properties are same because Electronic Configuration is same in isotopes.

(c)

Let Mg^{24} be = x

We know Mg^{25} be = 10%

Therefore Mg^{26} would be (100-10)= 90- x

R.A.M 24.3 = 24x+(25×10) + (26×(90- x) / 100

24.3 ×100 = 24x +250 + (2340-26 x)

2430 = 24x + 250 + (2340 – 26x)

2430 - 2340 – 250 = 24x – 26x

2430 - 2590 = -2x

-160 /2 = -2x /2

x = 80%

Now we know Mg^{24} is = 80%

So Mg^{24} = 100 - 10 – 80

= 100 – 90 = 10%

(d)

Step1: Highlight Important Information

K.E=4.52×10^{-16}

Time=1.44×10^{-5}

Ion given = $25Mg^{+}$

K.E = 1 /2 mv^2

Step2: Calculate mass of single atom of Mg

Convert grams into kg because K.E equation kg are used.

Step 3: $4.52 \times10^{-16} = (m)(v^2)$

$4.52 \times10^{-16} = 1/2\ (4.15\times 10^{-26})\ (v^2)$

$(4.52 \times10^{-16})\ (2) = v$

4.15×10^{-26}

v = 147591 m/s

Step 4: distance = velocity × time

$147591\times (1.44 \times10^{-5})$

= 2.125 meter

I am Sorry !!!!!

9.

(b) $[Ne]3s^2$

10. (a)

R.A.M = Σ isotopic mass × abundance / Total Abundance

= (82×5) + (83×3) + (84×26) + (86×7) / 41

= 410 + 249 + 2184 + 602 / 41

= 84.024

let's say kinetic energy of ^{82}Q is ⇒ K.E = 1 /2 $m_1v_1^2$

similarly kinetic energy of $^{86}Q^+$ is ⇒ K.E = 1 /2 $m_2v_2^2$

As kinetic energy is the same for both so we can equal them.

$K.E_1 = K.E_2$

$1/2\ m_1v_1^{2\ 1} = 1/2\ m_2v_2^2$ →(1)

Now 1/2 cancels out on both sides

$m_1v_1^2 = m_2v_2^2$ →(2)

we know that velocity = distance / time

$m_1(d_1/t_1)^2 = m_2(d_2/t_2)^2$

$m_1.d_1^2/t_1^2 = m_2.d_2^2/t_2^2$

I am Sorry !!!!!

As distance is the same far both ions so

$m_1/t_1^2 = m_2/t_2^2$

Now, lets put in the values

$82/(1.243\times10^{-5})^2 = 86/(x)^2$

$x = 86\times(1.243\times10^{-5})^2/82$

$x = 1.273\times10^{-5}s$

11.

C. The mass spectrum of C_3H_7Br has two molecular ion peaks at 122 and 124

12.

(a) $Ca_{20} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

(b) $Ca_{(s)} + 2H_2O_{(l)} \rightarrow Ca_2^{+}{}_{(aq)} + 2OH^-_{(aq)} + H_2I_{(g)}$

(c) Oxidizing agent

(d) $Ca_{(g)} \rightarrow Ca^+_{(g)} + e^-$

(e) As we move from magnesium to barium, the size of the ion gets bigger as move shells are added.

Therefore, it becomes easier to lose electrons from the shell further away from the nucleus. As size get bigger, the attraction between the nucleus and the electron get weaker

13.

(a)

let x be the isotopic mass of third isotopes

R.A.M = Σ isotoic mass× abundance / Total abundance

$3216 = (32\times91) + (33\times1.8) + (x+7.2)/ 100$

$32.16\times100 = (32\times91)+(33\times1.8)+(7.2x)$

$3216 = 2912+59.4+7.2x$

$3216 - 2971.4 = 7.2x$

244.6/7.2 = 7.2x/7.2

x = 33.972

x = 34

(b)

- Electron impact method
- Electrospray ionization

Electron Impact ionization (EI) – The sample is vapourized and injected into the ionization chamber.The gas phase molecules are B ombarded by a beam of electrons formed by heating a filament bias at a negative voltage compared to the source.

(b)

Ions are detected by the detector present at the last in spectrometry

14.

(a)

$[CH_3OCOCOOH]^+$
$[CH_3OCOCOOHCH_3]^+$

Note: Ester linkage has developed between alcohol and acid

(b) One ions are formed in ionization chamber, they are accelerated by an electric field to a constant kinetic energy. Both species/positives would be accelerated by different velocity because of different masses.

Lighter ions are going to move
faster and heavier one's are going to move slower. These is going separate these two ions.

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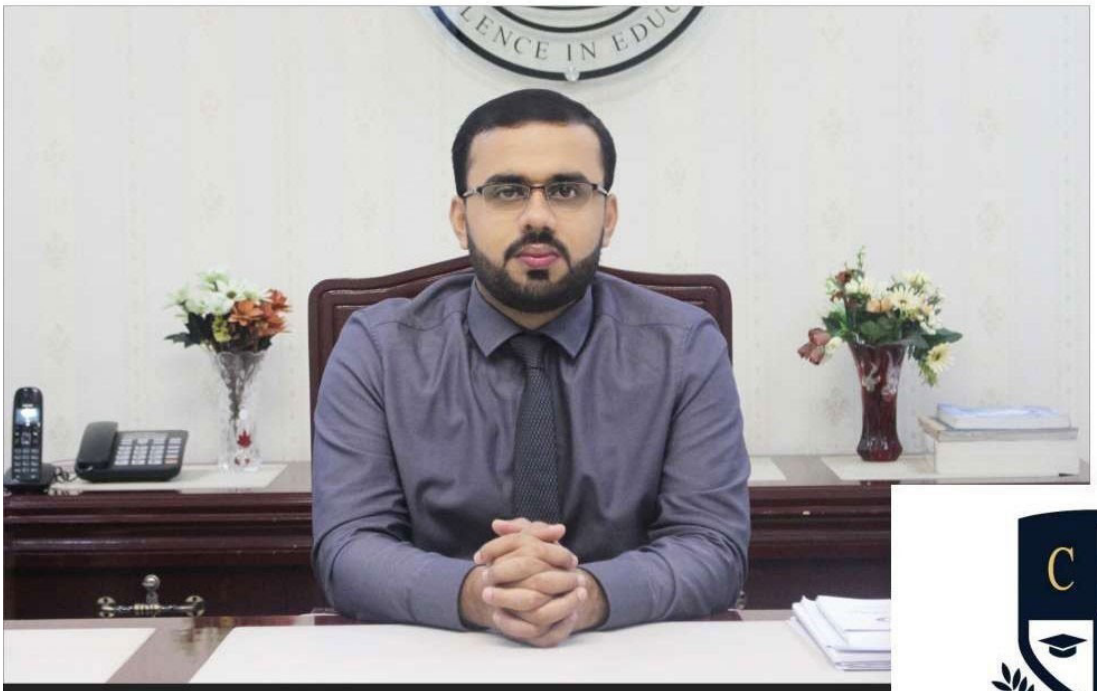

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