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CHEMISTRY

Physical Chemistry

Level & Board	**OCR (AS-LEVEL)**
TOPIC:	**ATOMIC STRUCTURE**
PAPER TYPE:	**SOLUTION -1**
TOTAL QUESTIONS	**12**
TOTAL MARKS	**32**

Atomic Structure-1

Q.1

(i) Mean mass of an atom compared to $1/_{12^{th}}$ of mass of atom of carbon-12

Exam point: Don't mass the word "atom", "mean" or "$1/_{12th}$"

(ii) Let x be the mass of the third isotope of Neon
Abundance of two isotopes are given.
So, the third isotopic abundance is

Isotopic mass	abundance
20	90.5
21	0.27
X	100-(90.5+0.27)=9.23

Now

Let's calculate the negative atomic mass

$$= \frac{(20\times 90.5)+(21\times 0.27)+(x\times 9.23)}{100}$$

$$20.18 = \frac{1810+5.67+9.23x}{100}$$

$$20.18 \times 100 = 1815.67 + 9.23x$$

$$20.18 = 1815.67 + 9.23x$$

$$20.18 - 1815.67 = 9.23x$$

$$202.33 = 9.23$$

divide by 9.23 to find the value of x

$$x = 21.92 \sim 22 (approximately)$$

Q.2

(a) $_8O^{16}$ and $_8O^{18}$

- Both have 8 protons each but they have different number of neutrons $^{16}_{8}O$ has got eight neutrons whereas $^{18}_{8}O$ has to neutrons.
- Both will have different physical properties.

(b)

Element	Mass No	Proton	Neutron	Electron	Charge
Sulphur	32	16	16	18	-2
Phosphorus	31	15	18	15	0

Q.3

(i)

	Protons	Neutrons	Electron
C^{14}	6	8	6

(ii)

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

$$= \frac{(12 \times 98.9) + (13 \times 1.06) + (14 \times 0.01)}{100}$$

$$= \frac{1186.8+13.78+0.14}{100}$$

$$= \frac{1200.75}{100}$$

$$= 12.0072$$

Q.4

(a) (i)

m/z	Protons	Neutrons	Electrons
20	10	10	10
21	10	11	10
22	10	12	10

(ii) Calculate relative atomic mass

$$R.A.M = \frac{\sum Isotopic\ mass \times abundance}{Total\ abundance}$$

$$R.A.M = \frac{(20\times90.48)+(21\times0.27)+(22\times9.25}{100}$$

$$= \frac{1809.6 + 5.67 + 203.5}{100}$$

$$= \frac{2018.77}{100}$$

$$= 20.187$$

Q.5

(a)

Similarly: same number of protons
same chemical properties

Difference: different number of Neutrons
different physical properties

(b)

(i) R.A.M Calculation, Apply the formula,

$$= \frac{(63\times69.17)+(65\times30.83)}{100}$$

$$= \frac{4357.71+2003.95}{100}$$

$$= \frac{6361.66}{100}$$

$$= 63.6166$$

Round it off up to two decimal places

$= 63.62$

Exam point: Normally student make error while rounding it off.

(ii)

Total mass 5g

Composition of copper = 84%

Mass of copper in the ion is $= 5 \times {}^{84}/_{100}$

$= 4.2g$

Convert this into moles by using the equation: moles$= \frac{mass}{molic\ mass}$

$$= \frac{4.2}{63.62}$$

$=0.066$ moles

Now

We have the moles, so

No of atom =moles×Avogadr's constant

$= 0.066 \times (6.02 \times 10^{23})$

$= 3.974 \times 10^{23}$ atoms

Q.6

(i) Mean mass of an atom compared to ${}^{1}/_{12^{th}}$ of the mass of atom of carbon-12

Exam point: Don't mass the word ''atom'', ''mean'' or ''

(ii) R.A.M of copper is calculated as follows

$$R.A.M = \frac{(107\times51.84)+(109\times48.)}{100}$$

$$= \frac{5546.88 + 5249.44}{100}$$

$$= \frac{10796.32}{100}$$

$= 107.9632$

Q.7

Proton	1	+1	Nucleus
Neutron	1	0	Nucleus
Electron	${}^{1}/_{1840}$	-1	shell

Q.8

Let x be the abundance of Cl^{35}
Then, abundance of C-37 would be = (100 - x)
Now apply the formula of R.A.M

$$35.5 = \frac{(35 \times x) + (37(100 - x))}{100}$$

$$3550 = 35x + 3700 - 37x$$

$$3559 - 3700 = -2x$$

$$-150 = -2x$$

$$x = 75$$

The abundance of cl35 is 75% so, Cl^{37} is = (100 – 75) = 25%

Q.9

Proton	+1	62
Neutron	0	88
Electron	-1	60

Q.10

(a) (i) Atoms of element with different number of neutrons

(ii) Yes, gold's isotopes exhibit identical chemical properties because they all have the same electronic configuration. The number of electrons are the same; therefore same chemical properties.

(iii)

Protons	Neutrons	Electrons
79	118	79

(b) (i) Mean mass of an atom compared to $1_{/12^{th}}$ of the mass of atom of carbon-12

Exam point: Don't mass the word ''atom'', ''mean'' or ''$1_{/12^{th}}$''

(ii) Let x be the mass of isotope of all unknown.

Isotope of all	abundance
197	100-90
x	=10

Now apply the formula:

$$R.A.M = \frac{\sum(isotope\ mass \times abundace)}{Total\ abundace}$$

$$196.76 = \frac{(197 \times 90) + (x \times 10)}{100}$$
$$196.76 \times 100 = 17730 + 10x$$
$$196.76 = 17730 + 10x$$
$$196.76 - 17730 = 10x$$
$$1946 = 10x$$
$$x = 194.6$$

The mass of unknown isotope is 194.

Q.11

(i) R.A.M Calculation, Apply the formula

$$R.A.M = \frac{(85 \times 72.1) + (27.83 \times 87)}{100}$$
$$= \frac{6128.5 + 114.83)}{100}$$
$$= \frac{(8549.71)}{100}$$
$$= 85.4971$$

(ii) The element could be strontium.

Q.12

(a) $^{158}Dy^{3+}$

Protons	Neutron	Electrons
66	92	63

(b) Number of electrons

1s – subshell	2
3p – orbital	2
3rd - shell	18

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