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CHEMISTRY

Physical Chemistry

Level & Board	**OCR (AS-LEVEL)**
TOPIC:	**ATOMIC STRUCTURE**
PAPER TYPE:	**SOLUTION -3**
TOTAL QUESTIONS	**12**
TOTAL MARKS	**43**

Atomic Structure – 3 OCR

Q.1

(a)

(i) Atoms of the same Element with different number of neutrons

Exam point: Common error is to omit the word 'atoms' and just start from same Element

(ii) Yes, because isotopes have same number of Electrons in the outer most shell therefore the chemical properties are the same

Exam point: Don't forget to mention the same number of Electrons in outer shell

(iii)

Protons	Neutrons	Electrons
47	61	47

(b) The mean mass of an atom of an element compared with 1/12th the mass of an atom of carbon – 12

(ii) First write down isotopes and their abundance
Let x be the mass of the other isotope

Isotope mass	Abundance
107	95
X	100-95
	5

R.A.M Given in the question as = 107.87
Now apply the formula of R.A.M

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

$$107.87 = \frac{(107 \times 95) + (x \times 5)}{100}$$

$$107{,}87 \times 100 = 10165 + 5x$$

$$10787 = 10165 + 5x$$

$$10787 - 10165 + 5x$$

$$622 = 5x$$

$$x = 124.4$$

Mass no of other isotope is 124.4

Q.2

Apply the formula,

$$R.A.M = \frac{(90\times51.5)+(91\times11.2)+(92\times17.1)+(94\times17.4)+(96\times2.08)}{100}$$

$$= \frac{4635 + 1019.2 + 1573.2 + 1635.6 + 268.8}{100}$$

$$= \frac{9131.8}{100} \qquad = 91.318\ amu$$

(ii) The element could be zirconium

Q.3

(a)

	Protons	Neutrons	Electrons
$^{235}NP^{2+}$	93	142	93

(b) No of Electrons

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

Q.4

(i) The mean mass of an atom of an element compared with 1/12th the mass of an atom of carbon – 12

(ii) Let x be the mass of other isotope

Isotopic mass	abundance
40	90.5
38	0.27
X	100-(90.5+0.27) = 9.23

As relative atomic mass is given so apply the formula,

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

$$39.95 = \frac{(40 \times 90.5) + (38 \times 0.27) + (x \times 9.23)}{100}$$

$$39.95 \times 100 = 3620 + 10.26 + 9.23x$$

$$3995 = 3620 + 10.26 + 9.23x$$

$$3995 - 3630.26 = 9.23x$$

$$364.74 = 9.23x$$

Divide both sides by 9.23 to get the answer

$$= 39.5\ amu$$

Q.5

(a) mass of an atom compared to 1/12th of the mass of an atom of carbon – 12

Exam point: Don't mention word ''mean or average ''as its an isotope

(b)

Element	Mass No	Protons	Neutrons	Electrons	Charge
Carbon	12	6	6	5	+1
Nitrogen	28	14	14	14	0

Q.6

(i)

	Protons	Neutrons	Electrons
$^{29}Ni^{0}$	14	52	14

(ii) Write down the isotopes along with their abundance

Isotopic mass	abundance
28	92.23
29	4.67
30	3.10

Now apply the formula of R.A.M

$$R.A.M = \frac{(28 \times 92.23) + (29 \times 4.67\ \ ) + (30 \times 3.1)}{100}$$

$$= \frac{2582.44 + 135.43 + 93}{100}$$

$$= \frac{2210 - 44}{100}$$

$$= 22.1087\ amu$$

Q.7

(a) apply the formula,

$$= \frac{(36 \times 0.337) + (38 \times 0.063) + (40 \times 99.6)}{100}$$

$$= \frac{12.132 + 2.394 + 3984}{100}$$

$$= \frac{3998.526}{100}$$

$$= 39.985\ amu$$

m/z	Protons	Neutrons	Electrons
40	18	22	17
38	18	20	17
36	18	18	17

Q.8

(a) Isotopes of an element have:

- different number of neutrons
- different atomic masses
- different physical masses

Isotopes of an element have:

- same number of protons
- same number of Electrons
- same chemical properties

(b) Apply the formula of R.A.M to calculate the answer

$$= \frac{(116 \times 27) + ((118 \times 58) + (120 \times 100)}{185}$$

$$= \frac{3132 + 6844 + 1200}{185}$$

Note: Total abundance is "185"

$$= \frac{21976}{185}$$

$$= 118.789\ amu$$

Now round it to two decimal places

$$= 118.79\ amu$$

(ii) Step 1: Total mass of piece = 5g

Percentage of tin = 800%

Get the mass of tin in grams

$$= \frac{80}{100} \times 5$$

$$= 4\ grams$$

Now apply the formula to get the moles

$$moles = \frac{mass}{molar\ mass}$$

$$= \frac{4}{118.79}$$

$$= 0..03367\ moles$$

Step 3: convert the moles into the number of particles

$$moles = moles \times Avogadro's\ No$$

$$= 0.03367 \times 6.02 \times 10^{23} = 2.02 \times 10^{22}\ amu$$

Q.9

(i) The mean mass of an atom of an element compared with $1/12^{th}$ the mass of an atom of carbon – 12

(ii) Apply the formula of R.A.M to calculate:

$$R.A.M = \frac{(63 \times 69.17) + (65 \times 30.83)}{100}$$

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

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

$$= 63.61\ amu$$

Q.10

	Relative mass	Relative charge	Position
Proton	1	+1	Nucleus
Neutron	1	0	Nucleus
Electron	1/2000	-1	shell

Q.11

Let x be the abundance of O – 16

So

O-18 abundance would be 100-x

Isotopic mass	Abundance
16	X
18	100-x

R.A.M is given already = 16.5

So,

$$16.5 = \frac{(16 \times x) + (18 \times (100 - x))}{100}$$

$$16.5 \times 100 = 16x + 1800 - 18x$$

$$1650 = 16x + 1800 - 18x$$

$$1650 - 1800 = 16x - 18x$$

$$-150 = -2x$$

Divide both sides by -2x

$$x = 75$$

It means 016 us 75% abundant and 018 is 25%

Q.12

Particle	Relative charge	No of each particle present
Proton	+1	13
Neutron	+1	14
Electron	-1	11

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