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CHEMISTRY

Physical Chemistry

Level & Board	**OCR (AS-LEVEL)**
TOPIC:	**ATOMIC STRUCTURE**
PAPER TYPE:	**SOLUTION -4**
TOTAL QUESTIONS	**12**
TOTAL MARKS	**41**

Atomic structure -4

Q.1

(a)

	Protons	Neutrons	Electrons
24	12	121	12
25	12	13	12
26	12	14	12

(b) Relative isotopic masses and their abundance is given in mass spectrum

Interpretation of mass spectrum

- No of peaks = No of isotopes
- Peak on each m/z value represents isotopic mass
- Height of each peak = Relative abundance

Now apply the R.A.M formula,

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

$$= \frac{(24 \times 79) + (25 \times 10) + (26 \times 11)}{100}$$

$$= \frac{1896 + 250 + 286}{100}$$

$$= \frac{2432}{100}$$

$$= 24.32\ amu$$

Answer to two decimal places

Q.2

(a) Similarity

- Same number of protons and Electrons
- Same chemical properties because of same outer shell configuration

Difference

- Different number of neutrons
- Different physical properties

(b)

(i) Spectrum represents isotopic masses and abundance is given

So apply the formula

$$R.A.M = \frac{(54 \times 5.85) + (56 \times 91.75) + (57 \times 2.12) + (58 \times 0.28)}{100}$$

$$= \frac{315.9 + 5138 + 120.84 + 16.24}{100}$$

$$= \frac{5590.98}{100}$$

$$= 55.9098\ amu$$

Round of to two decimal places

$$= 55.91$$

(ii) mass of alloy = 10g

Percentage of ion = 90%

Step 1: Calculate the mass of ion $= \frac{90}{100} \times 10$ = 9g

Convert into mass,

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

$$moles = \frac{9}{56} = 0.1607$$

We have 0.1607 moles of ion

Step 2: No of atoms/particles = moles×Avogadr's number

$$= 0.1607 \times 6.02 \times 10^{23}$$

$$= 9.675 \times 10^{22} atoms$$

Q.3

(a)

Average(mean) mass of an atom of element compared to 1/12th of mass of an atom of carbon – 12

Exam point: Don't forget word 'Average', compared and 1/12th of an atom

(b) Apply the R.A.M formula,

$$R.A.M = \frac{(35 \times 75.77) + (37 \times 24.23)}{100}$$

$$= \frac{2651.95 + 896.51}{100}$$

$$= \frac{3548.46}{100}$$

$$= 35.4846\ amu$$

Q.4

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

Q.5

(a)

(i) Atom of Zinc (having same proton No) but different number of neutrons. They would have the same chemical properties but different physical properties

(ii) Chemical properties are same because of same Electron in valence shell of all isotopes of Zinc. Therefore, as Electronic configuration is same, chemical properties are same.

Exam point: Don't forget to talk about valence shell Electrons

(iii) $Zn^{65.38}$

Protons	Neutrons	Electrons
30	35	30

(b)

(i) Average(mean) mass of an atom of element compared to 1/12th of mass of an atom of carbon – 12

Exam point: Don't forget word 'Average', compared and 1/12th of an atom

(ii) Let x be the mass of the other isotope

Isotopic mass	Abundance
65	85
X	100-85=15

R.A.M is given as 65.38 in question so, apply the formula

$$65.38 = \frac{(65 \times 85) + (x \times 15)}{100}$$

$$65.38 \times 100 = 5525 + 15x$$

$$6538 - 5525 = 15x$$

$$1013 = 15x$$

Divide both side by 15 to get the value of x

$$x = 67.5\ amu$$

Q.6

(a)

(i) Apply the formula to calculate R.A.M

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

$$= \frac{(112 \times 3) + (114 \times 56) + (115 \times 41)}{100}$$

$$= \frac{336 + 6384 + 4715}{100}$$

$$= \frac{11435}{100}$$

$$= 114.35$$

(ii) The element could be indium

Q.7

(a)

	Protons	Neutrons	Electrons
$^{166}Er^{2+}$	68	98	66

(b)

1s – subshell	2
3d – orbital	2
2nd shell	8

Q.8

(a) Average(mean) mass of an atom of element compared to 1/12th of mass of an atom of carbon – 12

Exam point: Don't forget word 'Average', compared and 1/12th of an atom

(b) Let x be the mass of the other isotope

Isotopic mass	Abundance
1	99.98
X	100 – 99.98 =0.02

Now as R.A.M IS given as 1.008

So, apply the formula,

$$1.008 = \frac{(1 \times 99.98) + (x \times 0.02)}{100}$$

$$1.008 \times 100 = 99.98 + 0.02x$$

$$100.8 = 99.98 + 0.02x$$

$$100.8 - 99.98 = 0.02x$$

$$0.82 = 0.02x \Rightarrow x = 41$$

The isotope has mass as 41

Q.9

(a) Isotopes difference

(i) No of Neutrons are different

(ii) Physical properties are different

(iii) masses are different

(b)

Element	mass No	Protons	Neutrons	Electrons	Charge
Oxygen	16	8	8	10	-2
Carbon	12	6	6	6	0

Q.10

(a)

	Protons	Neutrons	Electrons
$^{48}Ti^{+}$	22	26	21

(b) Isotopes and abundance is given So, apply the formula to calculate R.A.M

$$R.A.M = \frac{(46 \times 18.81) + (47 \times 7.47) + (48 \times 73.72)}{100}$$

$$= \frac{865.26 + 351.09 + 3538.56}{100}$$

$$= \frac{4754.91}{100}$$

$$= 47.5491$$

Round off to two decimal places

$$= 47.55\ amu$$

Q.11

Isotopes	Abundance
32	X
34	100 - x

Note: Let x be the abundance of isotopes – 32

R.A.M is given as = 32.1 already, so, apply the formula,

$$R.A.M = \frac{(32 \times x) + (34 \times (100 - x)}{100}$$

$$32.1 = \frac{32x + 3400 - 34x}{100}$$

$$32.1 \times 100 = 32x + 3400 - 34x$$

$$3210 = 32x - 34x + 3400$$

$$3210 - 3400 = -2x \Rightarrow -190 = -2x \Rightarrow x = 95$$

Therefore, Percentage abundance of 8-32

Is = 95%

And, Percentage abundance of 3-34

Is = 5%

Q.12

Particle	*No of each particle in* $^{50-94}V^{3+}$ *ion*
Protons	*23*
Neutrons	*28*
Electrons	*23*

Exam point: Round off the mass no to calculate the values for substance particles

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- Founder & CEO of Chemistry Online Tuition Ltd.
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