CHEMISTRY ONLINE
— TUITION —

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# CHEMISTRY

## Physical Chemistry

| | |
|---|---|
| Level & Board | OCR (A-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

<u>Interpretation of mass spectrum</u>

- 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) <u>Similarity</u>

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

<u>Difference</u>

- 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 1/12$^{th}$ of mass of an atom of carbon – 12

Exam point: Don't forget word 'Average', compared and 1/12$^{th}$ 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 1/12$^{th}$ of mass of an atom of carbon – 12

Exam point: Don't forget word 'Average', compared and 1/12$^{th}$ 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 |
| $2^{nd}$ shell | 8 |

**Q.8**

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

Exam point: Don't forget word 'Average', compared and $1/12^{th}$ 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 $^{50\text{-}94}V^{3+}$ 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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