## Formulas Practico nº 10

## Estructura nuclear y aplicacions.

\* Forma simbélica para representar un núcleo

$$A = N + 2 \rightarrow N = A - Z$$

$$A = 11 \Rightarrow N = 11-6 = 5$$
 neutrones  
 $A = 12 \Rightarrow N = 12-6 = 6$  "

$$A = 13$$
  $\Rightarrow N = 13 - 6 = 7$ 
 $A = 14$   $\Rightarrow N = 14 - 6 = 8$ 

\* Unidad de masa unificada: u

Por lo tanto la u es la doceava parte de la masa del C (masa atémica)

\* Tamaño de un nucleo

$$1 \text{ ferm } i = 1 \text{ fm} = 10^{-15} \text{ m}$$

\* Energia de enlace Eb (MeV) = [2 m+ Nm, - M (x)] (4) +931,50 (MeV) MH: masa del atomo neutro del hidrògeno (e+p) M(AX): masa atônica del micleo conpusto.

## Radiactividad

si hay una cantidad de No nucleos radiactivos para un tiempo t=0, al cabo de un tempo t, decaeran algunos y quedaran:

N = No E ... constante de decaimients.

 $R = \left| \frac{dN}{dt} \right| = N_0 \lambda e^{-\lambda t} = R_0 e^{-\lambda t}$ con R = actividad para t = t Ro = u u t = o

( desintanción seg

Trempo de vida media -> Tyz = ln2

es el timpo que necesita la muostra en decale a la mitad  $N = N_0/2$ 

1 Ci = 3,7 ×10 0 decaim/seg. Curie 189 = 1 decaim/sig Becquerel

TABLA A.3 Tabla de masas atómicas\*

| Vúme   | le lab                                                                | Discoglones                                             | ·bab)              | Tralufa, epo.           | Porcentaje<br>olo de abundancia<br>o modo de | Vida                                    |  |
|--------|-----------------------------------------------------------------------|---------------------------------------------------------|--------------------|-------------------------|----------------------------------------------|-----------------------------------------|--|
| tómi   |                                                                       | Símbolo                                                 | Número<br>másico A | Masa<br>atómica†        | decaimiento<br>(si es radiactivo)‡           | media<br>si es<br>(radiactivo)          |  |
|        | e A                                                                   | i k QL                                                  | (D) dr             |                         | 0.0000                                       | from the page                           |  |
| 0      | (Neutrón)                                                             | <u>n</u>                                                | 1,9                | 1.008665                | $oldsymbol{eta}^-$                           | 10.6 min                                |  |
| 1      | Hidrógeno                                                             | H                                                       | 1                  | 1,007825                | 99.985                                       | 1000                                    |  |
|        | Deuterio                                                              | $\mathbf{D}$                                            | 2                  | 2.014102                | 0.015                                        | ippar<br>*                              |  |
| 0      | Tritio                                                                | $\mathcal{L}_{\mathcal{A}}\mathbf{T}_{\mathcal{A}_{i}}$ | 3                  | $\epsilon_{m} 3.016049$ | $\beta^-$                                    | 12.33 y                                 |  |
| 2      | Helio                                                                 | He                                                      | 3                  | 3.016029                | 0.00014                                      | Debivitation                            |  |
| 2      | A Trial                                                               | 370                                                     | 4 350              | 4.002603                | ≈100                                         | A CONTRACTOR                            |  |
| 3      | Litio                                                                 | Li                                                      | 6                  | 6.015123                | 7.5                                          | mirrob de de dornier                    |  |
| 4      | kg/m <sup>3</sup>                                                     | M/L                                                     | 7                  | 7,016005                | 92.5                                         | A STATE OF THE STATE OF                 |  |
| 4      | Berilio                                                               | Ве                                                      | 7                  | 7.016930                | EC, $\gamma$                                 | 53.3 días                               |  |
|        | 5 1 2                                                                 | 1.47.1                                                  | . 8 O:             | 8.005305                | $2\alpha$                                    | $6.7 \times 10^{-17}$                   |  |
| _      | <b>.</b>                                                              |                                                         | 9                  | 9.012183                | 100                                          | A **** A MY 19 7 3 (1) 3                |  |
| 5      | Boro                                                                  | <b>B</b>                                                | 10                 | 10.012938               | 19.8                                         | e filoneigi o                           |  |
| 6      | m.s.V                                                                 | 10                                                      | 11                 | 11.009305               | 80.2                                         | Conglidd                                |  |
| U      | Carbón                                                                | TO/C                                                    | 11                 | 11.011433               | $\beta^+$ , EC                               | 20.4 min                                |  |
|        | 1. V/2m - 23                                                          | ML/Q12                                                  | 12                 | 12.000000               | 98.89                                        | councare edun                           |  |
|        | 18 W/W. By                                                            | MINON!                                                  | 13                 | 13.003355               | 1.11                                         | ogintable of                            |  |
| 7      | kg majes                                                              | 3.1/~IW                                                 | 14                 | 14.003242               | $\beta$                                      | 5730 y                                  |  |
| •      | M Nitrógeno                                                           | H - silly W.                                            | 13                 | 13.005739               | $\beta^+$                                    | 9.96 min                                |  |
|        | gs/cu - Ba                                                            | FINING TH                                               | 14                 | 14.003074               | 99.63                                        | o as e gode                             |  |
| 8      | Out on                                                                | 12/21/683                                               | 15 (311)           | 15.000109               | 0.37                                         |                                         |  |
| 0      | Oxígeno                                                               | 11/10                                                   | 15                 | 15.003065               | $\beta^+$ , EC                               | 122 s                                   |  |
|        | kg mi Ass                                                             | CV, DH. AND                                             | 16                 | 15.994915               | 99.759                                       | 1225 101s                               |  |
| 9      | TOVA                                                                  | 7,100                                                   | 18                 | 17.999159               | 0.204                                        | diciancia                               |  |
| 0      | Flúor                                                                 | TO'E                                                    | (*m'19: -)(T       | 18.998403               | 100                                          | rsiogib creadd                          |  |
| 10     | Neón                                                                  | TON Ne                                                  | 20 (dW)            | 19.992439               | 90.51                                        | oolibagarii equa                        |  |
| 1.1    | Sodio                                                                 | N                                                       | 22 490             | 21.991384               | 9.22                                         | iujo anagnético                         |  |
| A. H.  |                                                                       | Na                                                      | 22                 | 21.994435               | $\beta^+$ , EC, $\gamma$                     | 0.600                                   |  |
|        | kg · m*                                                               | all.                                                    | 23                 | 22.989770               | 100                                          | 2.602 y                                 |  |
| 2      | Magnesio                                                              | TUNA                                                    | 24                 | 23.990964               | $\beta^-$ , $\gamma$                         | Aorgenia de inera                       |  |
| 3      | Aluminio                                                              | Mg                                                      | 24                 | 23.985045               | 78.99                                        | in:15.0,h                               |  |
| 4      | Cillata                                                               | L <sub>4</sub> O/J <b>V</b> J                           | 27                 | 26.981541               | 100                                          | choise                                  |  |
| -      | Grand And                                                             | Si,                                                     | (28.4)             | 27.976928               | CEDEUS OF CEDEUS                             | gracabilidad det                        |  |
| 5      | Fósforo                                                               | MI NOT                                                  | 31/                | 30.975364               | $\beta^{-}, \gamma$ oldage                   | isb be wife of                          |  |
|        | (6)                                                                   | eT/I.IPA                                                | 31(~)(V/           | 30.973763               | 100                                          | 2.62 h                                  |  |
| 6      | Azufre                                                                | Ed. VW                                                  | (2m/v32 (eq)       | 31.973908               |                                              | D 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |  |
|        | S. S. Ch. J. H. A. L. Z. L. L. C. | all Och Stone                                           | 32                 | 31.972072               | զ ,⊈ <b>β−</b><br>19 <b>5.0</b>              | 14.28 días                              |  |
| 7      | Cloro                                                                 | TIME                                                    | 35                 | 34.969033               | β-<br>β-                                     | Resissent is                            |  |
| party. | Cioro                                                                 | Cl .                                                    | 35                 | 34.968853               | 75.77                                        | 87,4 días                               |  |
| 8      | Argón                                                                 | Och T                                                   | 37000              | 36.965903               |                                              | League toqual                           |  |
| 9      | Potasio                                                               | - 1\% (Ar                                               | 40                 | 39.962383               | 24.23<br>99.60                               | rint st quisi?                          |  |
|        | A Oldaio                                                              | K                                                       | 39                 | 38.963708               |                                              | and op o madio,                         |  |
| 20     | Calcio                                                                |                                                         | 40                 | 39.964000               | 93.26                                        | 1 00 V 109 V                            |  |
| 21     | Escandio                                                              | Ca                                                      | 40                 | 39.962591               | $\gamma \beta^-$ , EC, $\gamma$ , $\beta^+$  | $1.28 \times 10^9 \mathrm{y}$           |  |
| 22     | Titanio                                                               | Sc<br>Ti                                                | (45 -)(1)          | 44.955914               | 96.94<br>100                                 | Longitud do onde                        |  |
| 23     | Vanadio                                                               | V V                                                     | 48                 | 47.947947               | W-00                                         | Trabajo -                               |  |
|        |                                                                       | . ▼                                                     | 51                 | 50.943963               | 73.7                                         |                                         |  |

(Continúa tabla)

Escaneado con CamScanner

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A CONTROL OF THE PROPERTY OF T |                                                       |                           |                                   |                    |            | (misselvent) - f. h. f. hit in |                                                                 |                   |                                        |
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| Número<br>atómico<br>Z                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Elemento                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ercenny<br>nabenda<br>nabenda<br>nadiaten<br>radiaten | O                         | Mass old                          | Número<br>másico A | remi       | Masa<br>atómica f              | Porcenta<br>de abunda<br>o modo d<br>decaimien<br>(si es radiac | ncia<br>e<br>ito  | Vida<br>media<br>si es<br>(radiactivo) |
| 24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Cromo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 26.9                                                  | Cr                        | 21100                             | 52                 |            | 51.940510.                     | 83.79                                                           |                   |                                        |
| 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Magnesio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.8                                                   | Mn                        | 31.90415                          |                    | 861        | 54.938046                      | 100                                                             | nou ax            |                                        |
| 26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Hierro                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 100                                                   | $\mathbf{Fe}$             | 35.90729A                         |                    | 361        | 55.934939                      | 91.8                                                            |                   |                                        |
| 27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Cobalto                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 112                                                   | Co                        | 12.90548E                         | , 1 PO             | 133        | 58.933198                      | 100                                                             | ojasjo            |                                        |
| 1.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Miguel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 71.7                                                  |                           | 36,90588 <sup>-</sup><br>37,90324 |                    | 137        | 59.933820                      | β-, γ                                                           | Bario             | 5.271 y                                |
| 11.9 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Níquel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -%                                                    | Ni                        | 43.92.673                         |                    | 138        | 57.935347                      | 68.3                                                            |                   | 6 4                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A Children                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 18.88                                                 |                           | 38.90036                          |                    | 144        | 59.930789                      | 26.1                                                            | olasina.l         | 0 1 1 1 v F                            |
| 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Cabas                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 88.5                                                  | _                         | 38.9054                           |                    | 801        | 63.927968                      | 0.91                                                            | Cerio             | 1 31 1 1                               |
| 29                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Cobre                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 100                                                   | Cu                        | 40,90766                          | 6.7                | 191        | 62.929599                      | 69.2                                                            | Praseodh          |                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 278                                                   |                           | 11.90773                          | 64                 | 191        | 63.929766                      | $\beta^-$ , $\beta^+$                                           | imiboski          | 12.7 h                                 |
| 17.7 v 48                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Cina Marity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EC, o                                                 | _                         | 44,91275                          | 65                 | 77 5 1     | 64.927792                      | 30.8                                                            | Promecia          | 1                                      |
| 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Cinc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 26.6                                                  | $\mathbf{Z}_{\mathbf{n}}$ | 51.91974                          | 04                 | 152        | 63.929145                      | <b>48.6</b>                                                     | Samario           | 1 12 3 18                              |
| 0.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Galio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 52.1                                                  | _                         | 52,98124                          | , 00               | 781        | 65.926035                      | 27.9                                                            | Buropio           |                                        |
| 31                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Germanio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 24.8                                                  | Ga                        | 17.92411                          | 69                 | 881        | 68.925581                      | 60.1                                                            | Gadoline          | 1 745 A \$                             |
| 32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Germanio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 001                                                   | Ge                        | 58,92535                          | 72                 | 188        | 71.922080                      | 27.4                                                            | -oldsa!           | 0 466 14 16                            |
| 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Arsénico                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.82                                                  | A -                       | 63 92918                          | 74                 | 101        | 73.921179                      | 36.5                                                            | laurquitl         |                                        |
| 33                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 100                                                   | As  <br>Se                | 64.93033                          | 75                 | 185        | 74.921596                      | 100                                                             | oimtoH            | 1 7 de de 1                            |
| 34                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Selenio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 33 4                                                  |                           | 65.93031                          | 80<br>79           | 156        | 79.916521<br>78.918336         | 49.8<br>50.69                                                   | Erbig             | 1112                                   |
| 35<br>36                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Bromo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 100                                                   | Br                        | 68.93423                          | 84                 | 991        | 83.911506                      | 57.0                                                            | olluT             | 7 4                                    |
| 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Kriptón                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 31.6                                                  | Kr                        | TEBER.ET                          | 89                 | 941        | 88.917563                      | β-                                                              | rightall          | 3.2 min                                |
| 27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Dubidie 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 97.3                                                  | DL                        | 74.94076                          | 85                 | 175        | 84.911800                      | 72.17                                                           | Lutecic           | 5.2 mm                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Rubidio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 25.3                                                  | Rb<br>Sr                  | 79 94656                          | 86                 | 081        | 85.909273                      | 9.8                                                             | oin: H            | 9                                      |
| 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Estroncio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 6 6 6                                                 | Sr /                      | 80.94801                          | 88                 | 181        | 87.905625                      | 82.6                                                            | olish ol          |                                        |
| DAN STATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                       |                           |                                   | 90                 |            | 89.907746                      | <b>B</b> -                                                      | Tungsten          | 28.8 y                                 |
| 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Tanin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3027                                                  | Y                         | 83.95696                          | 89                 | 184        | 88.905856                      | 100                                                             | Sloat)            |                                        |
| CALL STREET T                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Itrio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 62.6                                                  | Zr                        | \$6.9557T                         | 90                 | 187        | 89.904708                      | 51.5                                                            | olnaA             |                                        |
| The second secon | Circonio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | p- 1                                                  | Nb                        | 90,94094                          | 93                 | IUI        | 92.906378                      | 100                                                             | Osmio             |                                        |
| A STATE OF THE STA | Niobio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.11                                                  | Mo                        | 81198.16                          | 98                 | 192        | 97.905405                      | 24.1                                                            | alble!            | y 1 / 1                                |
| Carlo Carlo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Molibdeno                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 8.70                                                  | Tc                        | 08086.06                          | 98                 | 181        | 97.907210                      | β-, γ                                                           | albir             | $4.2 \times 10^{6}  \mathrm{y}$        |
| 935                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Tecnecio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 02.7                                                  | Ru                        | 98,98284                          | 102                | 193        | 101.904348                     | 31.6                                                            | Onits             | 1 1 1 18                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Rutenio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 33.6                                                  | Rh                        | 62190 19                          | 103                | 175        | 102.90550                      | 100                                                             | 010               |                                        |
| •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Koaio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 001                                                   | Pd                        | 92926 W                           | 106                | 191        | 105.90348                      | 27.3                                                            | Ogo<br>Mazenii le | 0                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Paladio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 8.05                                                  |                           | £8078.10                          | 107                |            | 106.905095                     | 51.83                                                           | 0(16)             |                                        |
| In the second                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Diata                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 70,5                                                  | Ag                        | 177 8 441                         | 109                |            | 108.904754                     | 48.17                                                           | Plomo             |                                        |
| crime D. I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | - 3                                                   | Cd                        | ang area                          | 114                |            | 113.903361                     | 28.7                                                            |                   |                                        |
| THEY LI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Cadmio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -9                                                    | 17                        | 503.8739g                         | 115                |            | 114.90388                      | 95.7;                                                           | 3-                | $5.1 \times 10^{14}$                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ndio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 20                                                    | In                        | 9-1 16.70                         | 100                |            | 119.902199                     | 32.4                                                            |                   |                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Estaño                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 22                                                    | Sn<br>ch                  | 206 97589                         | 121                |            | 120.903824                     | 57.3                                                            | _                 | <b>4</b>                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Antimonio 🚶                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 28                                                    | Sb                        | PRATE LOS                         | 130                |            | 129.90623                      | 34.5;                                                           | 3-                | $2 \times 10^{21} \text{ y}$           |
| 48.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | relurio 🦼                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10                                                    |                           | 81186.803                         | 127                |            | 26.904477                      | 100                                                             |                   |                                        |
| 22,3 y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Yodo 🧦                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -Σ                                                    | Ι                         | 510,98674                         | 121                | 610        | 30.906118                      | β-, γ                                                           |                   | 8.04 días                              |
| 36.1 mid<br>10.64 h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -8                                                    |                           | 88168 117                         | 5.                 | RIR        |                                |                                                                 | (0                | ontinúa tabl                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | - V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0                                                     |                           | 08008.515                         |                    | 608<br>618 | 181                            |                                                                 | Bismuto           | <b>*</b>                               |
| 7 5 6 7 1 2 2 1 1 1 1 1 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                       |                           | 000 BOS                           |                    | 175        |                                |                                                                 |                   |                                        |
| nim 8.82                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 001                                                   |                           | 208,96039<br>210,95726            |                    | 112        |                                |                                                                 |                   |                                        |

\*Los data a Control of the Nuclides, 12a. ed. General Electric, 1977, y de C. M. Lederer y V. S. Shirley, eds, Table