

Bohr model in variable dimensionality

Optimal configurations are calculated for different cartesian dimensionalities of the configuration space. For each dimensionality, we list the distances between electrons and the nucleus R and the minimal energy E .

I. HELIUM ATOM - 2 ELECTRONS.

Electron configuration $1s^2$.

Electron shell configuration $\{2\}$.

Number of shells: 1

A. He. Dimensionality 1

Energy: $E = -3.0625$.

1. *Shell No. 1 (2 electrons)*

$R = 0.571428571$ (2 electrons)

II. LITHIUM ATOM - 3 ELECTRONS.

Electron configuration $[\text{He}]2s^1$.

Electron shell configuration $\{2, 1\}$.

Number of shells: 2

A. Li. Dimensionality 1

Energy: $E = -7.6836946$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.362229875$$

$$R = 0.364715112$$

2. *Shell No. 2 (1 electrons)*

$$R = 4.1865451$$

B. Li. Dimensionality 2

Energy: $E = -7.690457$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.363805896 \text{ (2 electrons)}$$

2. *Shell No. 2 (1 electrons)*

$$R = 3.84895086$$

III. BERYLLIUM ATOM - 4 ELECTRONS.

Electron configuration $[\text{He}]2s^2$.

Electron shell configuration $\{2, 2\}$.

Number of shells: 2

A. Be. Dimensionality 1

Energy: $E = -10.0967816$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.250843169$$

$$R = 1.14473213$$

2. *Shell No. 2 (2 electrons)*

$$R = 1.86460736$$

$$R = 3.19482214$$

B. Be. Dimensionality 2

Energy: $E = -14.8403479$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.266904962 \text{ (2 electrons)}$$

2. *Shell No. 2 (2 electrons)*

$$R = 2.23196083 \text{ (2 electrons)}$$

C. Be. Dimensionality 3

Energy: $E = -14.8403479$.

1. *Shell No. 1 (2 electrons)*

$R = 0.266904962$ (2 electrons)

2. *Shell No. 2 (2 electrons)*

$R = 2.23196083$ (2 electrons)

IV. BORON ATOM - 5 ELECTRONS.

Electron configuration $[\text{He}]2s^22p^1$.

Electron shell configuration $\{2, 3\}$.

Number of shells: 2

A. B. Dimensionality 1

Energy: $E = -16.8309465$.

1. *Shell No. 1 (2 electrons)*

$R = 0.200347725$

$R = 0.834039204$

2. *Shell No. 2 (3 electrons)*

$$R = 1.25416359$$

$$R = 1.88683349$$

$$R = 4.78878644$$

B. B. Dimensionality 2

Energy: $E = -24.7525419$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.210435194$$

$$R = 0.21048555$$

2. *Shell No. 2 (3 electrons)*

$$R = 1.6113783 \text{ (2 electrons)}$$

$$R = 1.77417096$$

C. B. Dimensionality 3

Energy: $E = -24.7935809$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.210813591 \text{ (2 electrons)}$$

2. *Shell No. 2 (3 electrons)*

$$R = 1.6177747 \text{ (3 electrons)}$$

D. B. Dimensionality 4

Energy: $E = -24.7935809$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.210813591 \text{ (2 electrons)}$$

2. *Shell No. 2 (3 electrons)*

$$R = 1.6177747 \text{ (3 electrons)}$$

V. CARBON ATOM - 6 ELECTRONS.

Electron configuration $[\text{He}]2s^22p^2$.

Electron shell configuration $\{2, 4\}$.

Number of shells: 2

A. C. Dimensionality 1

Energy: $E = -25.0513012$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.166151583$$

$$R = 0.742585065$$

2. *Shell No. 2 (4 electrons)*

$$R = 0.896414785$$

$$R = 2.05113595$$

$$R = 2.42461683$$

$$R = 7.85917318$$

B. C. Dimensionality 2

Energy: $E = -37.6742454$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.173862144 \text{ (2 electrons)}$$

2. *Shell No. 2 (4 electrons)*

$$R = 1.22487523 \text{ (2 electrons)}$$

$$R = 1.4410191 \text{ (2 electrons)}$$

C. C. Dimensionality 3

Energy: $E = -37.8167994$.

1. *Shell No. 1 (2 electrons)*

$R = 0.173983756$ (2 electrons)

2. *Shell No. 2 (4 electrons)*

$R = 1.29353426$ (4 electrons)

D. C. Dimensionality 4

Energy: $E = -37.8662499$.

1. *Shell No. 1 (2 electrons)*

$R = 0.17421343$ (2 electrons)

2. *Shell No. 2 (4 electrons)*

$R = 1.27545582$ (4 electrons)

E. C. Dimensionality 5

Energy: $E = -37.8662499$.

1. *Shell No. 1 (2 electrons)*

$R = 0.17421343$ (2 electrons)

2. *Shell No. 2 (4 electrons)*

$$R = 1.27545582 \text{ (4 electrons)}$$

VI. NITROGEN ATOM - 7 ELECTRONS.

Electron configuration $[\text{He}]2s^22p^3$.

Electron shell configuration $\{2, 5\}$.

Number of shells: 2

A. N. Dimensionality 1

Energy: $E = -52.4819748$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.147555963$$

$$R = 0.147648947$$

2. *Shell No. 2 (5 electrons)*

$$R = 0.825156332$$

$$R = 0.838103117$$

$$R = 2.21681865$$

$$R = 2.35172426$$

$$R = 8.35223488$$

B. N. Dimensionality 2

Energy: $E = -53.817805$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.148043293$$

$$R = 0.148077018$$

2. *Shell No. 2 (5 electrons)*

$$R = 0.930251899$$

$$R = 0.975919672$$

$$R = 1.02208634$$

$$R = 1.06793964$$

$$R = 4.04988688$$

C. N. Dimensionality 3

Energy: $E = -54.1609863$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.148219971$$

$$R = 0.148272837$$

2. *Shell No. 2 (5 electrons)*

$$R = 1.05175462 \text{ (2 electrons)}$$

$$R = 1.06095105 \text{ (2 electrons)}$$

$$R = 1.15886845$$

D. N. Dimensionality 4

Energy: $E = -54.3127825$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.148274473$$

$$R = 0.148280081$$

2. *Shell No. 2 (5 electrons)*

$$R = 1.05538495 \text{ (3 electrons)}$$

$$R = 1.07788564 \text{ (2 electrons)}$$

E. N. Dimensionality 5

Energy: $E = -54.3720983$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.148445972 \text{ (2 electrons)}$$

2. *Shell No. 2 (5 electrons)*

$R = 1.05454746$ (5 electrons)

F. N. Dimensionality 6

Energy: $E = -54.3720983$.

1. *Shell No. 1 (2 electrons)*

$R = 0.148445972$ (2 electrons)

2. *Shell No. 2 (5 electrons)*

$R = 1.05454746$ (5 electrons)

VII. OXYGEN ATOM - 8 ELECTRONS.

Electron configuration $[\text{He}]2s^22p^4$.

Electron shell configuration $\{2, 6\}$.

Number of shells: 2

A. O. Dimensionality 1

Energy: $E = -48.758197$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.124408678$$

$$R = 0.516206934$$

2. *Shell No. 2 (6 electrons)*

$$R = 0.586675353$$

$$R = 1.14039332$$

$$R = 1.25454015$$

$$R = 2.65974325$$

$$R = 2.8970517$$

$$R = 10.1660756$$

B. O. Dimensionality 2

Energy: $E = -73.4891511$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.12895004 \text{ (2 electrons)}$$

2. *Shell No. 2 (6 electrons)*

$$R = 0.816675922$$

$$R = 0.833661241 \text{ (2 electrons)}$$

$$R = 0.944014055 \text{ (2 electrons)}$$

$$R = 4.31604657$$

C. O. Dimensionality 3

Energy: $E = -74.1779887$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.129100856 \text{ (2 electrons)}$$

2. *Shell No. 2 (6 electrons)*

$$R = 0.877695033 \text{ (4 electrons)}$$

$$R = 1.02673634 \text{ (2 electrons)}$$

D. O. Dimensionality 4

Energy: $E = -74.3831777$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.129152182$$

$$R = 0.129189528$$

2. *Shell No. 2 (6 electrons)*

$$R = 0.891723819 \text{ (3 electrons)}$$

$$R = 0.908168726 \text{ (2 electrons)}$$

$$R = 0.986739013$$

E. O. Dimensionality 5

Energy: $E = -74.5551102$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.129187175$$

$$R = 0.129194372$$

2. *Shell No. 2 (6 electrons)*

$$R = 0.896793357 \text{ (4 electrons)}$$

$$R = 0.923257205 \text{ (2 electrons)}$$

F. O. Dimensionality 6

Energy: $E = -74.6246524$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.129320746 \text{ (2 electrons)}$$

2. *Shell No. 2 (6 electrons)*

$$R = 0.899544323 \text{ (6 electrons)}$$

G. O. Dimensionality 7

Energy: $E = -74.6246524$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.129320746 \text{ (2 electrons)}$$

2. *Shell No. 2 (6 electrons)*

$$R = 0.899544323 \text{ (6 electrons)}$$

VIII. FLUORINE ATOM - 9 ELECTRONS.

Electron configuration $[\text{He}]2s^22p^5$.

Electron shell configuration $\{2, 7\}$.

Number of shells: 2

A. F. Dimensionality 1

Energy: $E = -64.0053901$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.110668773$$

$$R = 0.440299591$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.511570324$$

$$R = 0.893046531$$

$$R = 1.06722378$$

$$R = 1.8947348$$

$$R = 2.42452498$$

$$R = 4.46910845$$

$$R = 7.43620352$$

B. F. Dimensionality 2

Energy: $E = -96.9418695$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.11419593 \text{ (2 electrons)}$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.66423929$$

$$R = 0.696747338 \text{ (2 electrons)}$$

$$R = 0.761129914 \text{ (2 electrons)}$$

$$R = 2.61701182$$

$$R = 2.62778672$$

C. F. Dimensionality 3

Energy: $E = -98.0590348$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.114325952$$

$$R = 0.114327718$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.716026787 \text{ (2 electrons)}$$

$$R = 0.735057035 \text{ (2 electrons)}$$

$$R = 0.801661901$$

$$R = 0.805188543$$

$$R = 3.65641704$$

D. F. Dimensionality 4

Energy: $E = -98.4631944$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.114414901$$

$$R = 0.114463853$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.787308847 \text{ (6 electrons)}$$

$$R = 0.853300307$$

E. F. Dimensionality 5

Energy: $E = -98.665202$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.114445806$$

$$R = 0.114454689$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.783850924 \text{ (3 electrons)}$$

$$R = 0.797020264 \text{ (2 electrons)}$$

$$R = 0.799323448 \text{ (2 electrons)}$$

F. F. Dimensionality 6

Energy: $E = -98.8580776$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.114459331$$

$$R = 0.114461689$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.785390664 \text{ (4 electrons)}$$

$$R = 0.792226507 \text{ (3 electrons)}$$

G. F. Dimensionality 7

Energy: $E = -98.93738$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.114562165 \text{ (2 electrons)}$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.784569025 \text{ (7 electrons)}$$

H. F. Dimensionality 8

Energy: $E = -98.93738$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.114562165 \text{ (2 electrons)}$$

2. *Shell No. 2 (7 electrons)*

$$R = 0.784569025 \text{ (7 electrons)}$$

IX. NEON ATOM - 10 ELECTRONS.

Electron configuration $[\text{He}]2s^22p^6$.

Electron shell configuration $\{2, 8\}$.

Number of shells: 2

A. Ne. Dimensionality 1

Energy: $E = -81.5903384$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0996092822$$

$$R = 0.386129552$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.447801184$$

$$R = 0.742651707$$

$$R = 0.89553411$$

$$R = 1.46006537$$

$$R = 1.9490997$$

$$R = 3.1863024$$

$$R = 8.57114165$$

$$R = 34.1585601$$

B. Ne. Dimensionality 2

Energy: $E = -124.343234$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.102471778$$

$$R = 0.102471831$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.58011791 \text{ (2 electrons)}$$

$$R = 0.611974687 \text{ (2 electrons)}$$

$$R = 0.636471572$$

$$R = 1.89673088$$

$$R = 1.95173587 \text{ (2 electrons)}$$

C. Ne. Dimensionality 3

Energy: $E = -126.053064$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.10260885$$

$$R = 0.102624759$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.656297239 \text{ (2 electrons)}$$

$$R = 0.664119484 \text{ (2 electrons)}$$

$$R = 0.666956376$$

$$R = 0.692749352$$

$$R = 0.713479588$$

$$R = 3.78111269$$

D. Ne. Dimensionality 4

Energy: $E = -126.776214$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.102671729$$

$$R = 0.10277851$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.657088946 \text{ (6 electrons)}$$

$$R = 0.725602205$$

$$R = 2.18245197$$

E. Ne. Dimensionality 5

Energy: $E = -127.096779$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.102728964 \text{ (2 electrons)}$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.701134387 \text{ (4 electrons)}$$

$$R = 0.705665874 \text{ (4 electrons)}$$

F. Ne. Dimensionality 6

Energy: $E = -127.320317$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.10271976$$

$$R = 0.102744277$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.690971421 \text{ (4 electrons)}$$

$$R = 0.696311021 \text{ (3 electrons)}$$

$$R = 0.762786357$$

G. Ne. Dimensionality 7

Energy: $E = -127.534125$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.102743312$$

$$R = 0.102746821$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.695011938 \text{ (5 electrons)}$$

$$R = 0.704061119 \text{ (3 electrons)}$$

H. Ne. Dimensionality 8

Energy: $E = -127.623726$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.10282773 \text{ (2 electrons)}$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.695804347 \text{ (8 electrons)}$$

I. Ne. Dimensionality 9

Energy: $E = -127.623726$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.10282773 \text{ (2 electrons)}$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.695804347 \text{ (8 electrons)}$$

X. SODIUM ATOM - 11 ELECTRONS.

Electron configuration $[\text{Ne}]3s^1$.

Electron shell configuration $\{2, 8, 1\}$.

Number of shells: 3

A. Na. Dimensionality 1

Energy: $E = -146.881149$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0925496751$$

$$R = 0.0925771112$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.419973678$$

$$R = 0.422503427$$

$$R = 0.817091312$$

$$R = 0.828424034$$

$$R = 1.65674933$$

$$R = 1.7198528$$

$$R = 3.97725523$$

$$R = 5.05152161$$

3. *Shell No. 3 (1 electrons)*

$$R = 17.0367776$$

B. Na. Dimensionality 2

Energy: $E = -155.776654$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0929422795$$

$$R = 0.0929591926$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.528077989 \text{ (2 electrons)}$$

$$R = 0.536186872 \text{ (2 electrons)}$$

$$R = 0.620979907$$

$$R = 0.626692773$$

$$R = 1.67764625 \text{ (2 electrons)}$$

3. *Shell No. 3 (1 electrons)*

$$R = 7.66199208$$

C. Na. Dimensionality 3

Energy: $E = -158.4273$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0930558653$$

$$R = 0.0930577125$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.609793596 \text{ (4 electrons)}$$

$$R = 0.611740229 \text{ (4 electrons)}$$

3. *Shell No. 3 (1 electrons)*

$$R = 8.92708091$$

D. Na. Dimensionality 4

Energy: $E = -159.653042$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0931127863 \text{ (2 electrons)}$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.587885733 \text{ (3 electrons)}$$

$$R = 0.589290359 \text{ (3 electrons)}$$

$$R = 0.644945754 \text{ (2 electrons)}$$

3. *Shell No. 3 (1 electrons)*

$$R = 8.83485293$$

E. Na. Dimensionality 5

Energy: $E = -159.998498$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0931913086$$

$$R = 0.0931944519$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.596053276 \text{ (4 electrons)}$$

$$R = 0.598431634 \text{ (2 electrons)}$$

$$R = 0.600044831 \text{ (2 electrons)}$$

3. *Shell No. 3 (1 electrons)*

$$R = 8.66492707$$

F. Na. Dimensionality 6

Energy: $E = -160.263996$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0931913583$$

$$R = 0.093207821$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.592776708 \text{ (3 electrons)}$$

$$R = 0.593881346 \text{ (3 electrons)}$$

$$R = 0.603283444 \text{ (2 electrons)}$$

3. *Shell No. 3 (1 electrons)*

$$R = 8.61110244$$

G. Na. Dimensionality 7

Energy: $E = -160.515154$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0932066154$$

$$R = 0.0932090882$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.593491957 \text{ (4 electrons)}$$

$$R = 0.594471072 \text{ (4 electrons)}$$

3. *Shell No. 3 (1 electrons)*

$$R = 8.6475276$$

H. Na. Dimensionality 8

Energy: $E = -160.632323$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0932829505$$

$$R = 0.0932871546$$

2. *Shell No. 2 (8 electrons)*

$$R = 0.591990675 \text{ (8 electrons)}$$

3. *Shell No. 3 (1 electrons)*

$$R = 8.49580255$$

I. Na. Dimensionality 9

Energy: $E = -160.632373$.

1. *Shell No. 1 (2 electrons)*

$$R = 0.0932850947 \text{ (2 electrons)}$$

2. *Shell No. 2 (8 electrons)*

$R = 0.591990831$ (8 electrons)

3. *Shell No. 3 (1 electrons)*

$R = 8.48368389$

J. Na. Dimensionality 10

Energy: $E = -160.632373$.

1. *Shell No. 1 (2 electrons)*

$R = 0.0932850947$ (2 electrons)

2. *Shell No. 2 (8 electrons)*

$R = 0.591990831$ (8 electrons)

3. *Shell No. 3 (1 electrons)*

$R = 8.48368389$