

Section A / Afdeling A

Question 1 / Vraag 1

For quality control of the optical reader, please colour the oval 1(h).

Kleur asseblief die kol 1(h), vir die kwaliteitskontrolle van die optiese merklezer, in.

[0]

Question 2 / Vraag 2

The world's oceans contain approximately $1.35 \times 10^9 \text{ km}^3$ of water. What is this volume in liters?
Die wêreld se oseane bevat om en by $1.35 \times 10^9 \text{ km}^3$ water. Wat is hierdie volume in liters?

$$1.35 \times 10^9 \text{ km}^3 \times \frac{(10^3 \text{ m})^3}{1 \text{ km}^3} \times \frac{10^3 \text{ dm}^3}{1 \text{ m}^3}$$

2

- a) 1.35×10^{12} b) 1.35×10^{15} c) 1.35×10^{18} d) 1.35×10^{21}
e) 1.35×10^{24} f) none / geen

[2]

Question 3 / Vraag 3

The physical significance of the magnetic quantum number is the:
Die fisiese betekenis van die magnetiese kwantumgetal is:

- a) Shape of orbital / Vorm van die orbitaal
b) Energy of the electron in the orbital / Energie van die elektron in die orbitaal
c) Energy of the sublevel / Energie van die subvlak
d) Orientation in space of the orbitals / Oriëntasie in die ruimte van die orbitale
e) None of the above / Geen van bogenoemde

2

[2]

Question 4 / Vraag 4

An electron cannot have the quantum numbers $n = ______$, $\ell = ______$, $m_\ell = ______$.
'n Elektron kan nie die kwantumgetalle $n = ______$, $\ell = ______$, $m_\ell = ______$ hê nie.

- a) 2, 1, 0 b) 4, 3, 3 c) 3, 1, -1
d) 1, 0, 0 e) 3, 3, 2 f) none / geen

2

[2]

Question 5 / Vraag 5

What is the effect of Pauli's exclusion principle?
Wat is die effek van Pauli se uitsluitingsbeginsel?

- a) An electron has wave properties / 'n Elektron het golfeienskappe
b) The 4s orbital will be filled before the 3-d orbitals / Die 4s orbitaal sal voor die 3-d orbitale gevul word
c) d-Orbitals will have 2 nodal planes / d-Orbitale sal 2 nodale vlakke besit.
d) No 2 electrons can have the same set of 4 quantum numbers. / Geen 2 elektrone kan dieselfde stel van 4 kwantumgetalle besit nie.
e) None of these. / Geen van hierdie.

[2]

2

Question 6 / Vraag 6

What is the bond order of S-O in the compound SOF_2 ?
 Wat is die bindingsorde van S-O in die verbinding SOF_2 ?

- a) 1 **b) 2** c) 3 d) 4 e) 5 f) None / geeneen

2

[2]

Question 7 / Vraag 7

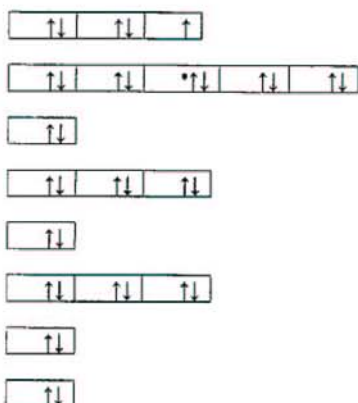
What is the formal charge on the N-atom in the ion NO_2^- ?
 Wat is die formele lading op die N-atoom in die ioon NO_2^- ?

- a) -2 b) -1 **c) 0** d) 1 e) 2 f) None / geeneen

2

[2]

Question 8 / Vraag 8



$$\begin{aligned} n &= 3 \\ l &= 2 \\ m_l &= \\ m_s &= +\frac{1}{2} \end{aligned}$$

3

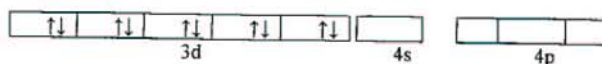
Consider the given electron distribution for an element. The black dot identifies a specific electron. What is a possible set of four quantum numbers for this electron, $n =$, $\ell =$, $m_\ell =$, $m_s =$?

Beskou die gegewe elektrondistribusie van 'n element. Die swart kol identifiseer 'n spesifieke elektron. Wat is 'n moontlike stel van vier kwantumgetalle vir hierdie elektron, $n =$, $\ell =$, $m_\ell =$, $m_s =$?

- a) 4, 0, 0, $+\frac{1}{2}$ **b) 3, 0, 0, $+\frac{1}{2}$** c) 4, 1, 1, $+\frac{1}{2}$ d) 4, 2, 1, $+\frac{1}{2}$
 e) 3, 1, 1, $+\frac{1}{2}$ f) 3, 2, 1, $+\frac{1}{2}$ g) 3, 3, 2, $+\frac{1}{2}$ h) none / geeneen

[3]

Which ion has the following electron configuration?
Watter ion besit die volgende elektronkonfigurasie?



3

- a) Cu^+ b) Zn^{2+} c) Ca^{2+} d) Ni^{2+} e) Cu^{2+}
- f) Both/Beide a & b
- g) Both/Beide c & d
- h) Both/Beide d & e
- i) none / geen

Question 10 / Vraag 10

Place the following atoms or ions in order of increasing atomic radii: Cl, Cl^- , S, S^{2-} , Al and Al^{3+} .
Plaas die volgende atome of ione in order van toenemende atoomradius: Cl, Cl^- , S, S^{2-} , Al en Al^{3+} .

- a) $\text{Al} < \text{S} < \text{Cl} < \text{Al}^{3+} < \text{S}^{2-} < \text{Cl}^-$ b) $\text{Al}^{3+} < \text{S}^{2-} < \text{Cl}^- < \text{Al} < \text{S} < \text{Cl}$
 c) $\text{Al}^{3+} < \text{Cl}^- < \text{S}^{2-} < \text{Cl} < \text{S} < \text{Al}$ d) $\text{Al}^{3+} < \text{Cl} < \text{S} < \text{Al} < \text{Cl}^- < \text{S}^{2-}$
 e) $\text{Al}^{3+} < \text{Cl} < \text{S} < \text{Al} < \text{S}^{2-} < \text{Cl}^-$ f) none / geeneen

[3]

Consider the ion NO_2^- . The electron pair geometry and molecular geometry will be ___ and ____.

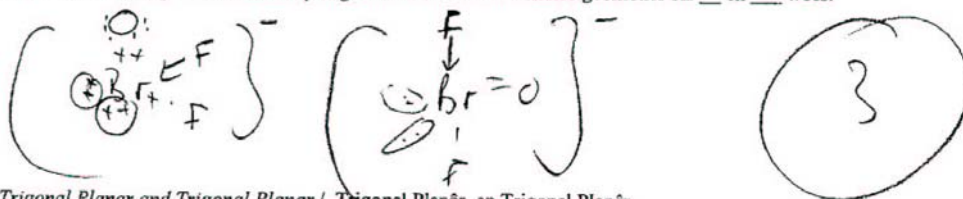
Beskou die ioon NO_2^- . Die elektronpaargeometrie en die molekulêre geometrie sal ___ en ____ wees.

- a) *Trigonal Planar and Trigonal Planar* / Trigonal Planêr en Trigonal Planêr
b) *Tetrahedral and Tetrahedral* / Tetrahedraal en Tetrahedraal
c) *Tetrahedral and Trigonal Pyramidal* / Tetrahedraal en Trigonaal Piraamidaal.
d) *Trigonal Planar and Bent* / Trigonaal Planêr en Gebuig.
e) *Tetrahedral and Bent* / Tetrahedraal en Gebuig
f) *None* / Geeneen

[3]

Question 12 / Vraag 12

Consider the ion BrOF_2^- . The electron pair geometry and molecular geometry will be ___ and _____.
 Beskou die ioon BrOF_2^- . Die elektronpaargeometrie en die molekulêre geometrie sal ___ en ___ wees.



- a) Trigonal Planar and Trigonal Planar / Trigonal Planêr en Trigonal Planêr
- b) Tetrahedral and Tetrahedral / Tetrahedraal en Tetrahedraal
- c) Tetrahedral and Trigonal Pyramidal / Tetrahedraal en Trigonaal Piramidaal.
- d) Trigonal Bipyramidal and Trigonal Bipyramidal / Trigonaal Bipiramidaal en Trigonaal Bipiramidaal.
- e) Trigonal Bipyramidal and See-saw / Trigonaal Bipiramidaal en Wipplank
- f) Trigonal Bipyramidal and T- / Trigonaal Bipiramidaal en T-**
- g) None / Geeneen

[3]

Question 13 / Vraag 13

Three elements have atomic weights very near each other, Lanthanum (139.9055 amu), Cerium (140.105 amu) and Praseodymium (140.9076 amu). The % abundances and isotope mass of 4 isotopes are given in the table below. Identify the element with these 4 isotopes.

Drie elemente het atoomgewigte baie naby aanmekaar, Lantaan (Lanthanum, 139.9055 amu), Serium (Cerium, 140.105 amu) en Praeseodimium (Praseodymium, 140.9076 amu.) Die % voorkoms en die isotoopmassa van 4 isotope word in die onderstaande tabel gegee. Identifiseer die element met hierdie 4 isotope.

Isotope / Isotoop	% Abundance / % Voorkoms	Mass / Massa
1	0.193	135.9090
2	0.250	137.9057
3	88.48	139.9053
4	11.07	141.9090

[3]

$$135.9090 \times 0.00193 + 137.9057 \times 0.00250 + 139.9053 \times 0.8848 + 141.9090 \times 0.1107 = 140.1046043$$

$$\approx 140.105$$

- a) La
- b) Ce**
- c) Pr
- d) All / Almal
- e) None / Geeneen

Question 14 / Vraag 14

Which of the following elements has the highest second ionization energy?
Watter van die volgende elemente het die hoogste tweede ionisasieenergie?

4

- a) Na b) K c) Rb d) Mg e) Ca
f) Sr g) none / geeneen

[4]

Question 15 / Vraag 15

Which element will be paramagnetic to the equivalence of 5 electrons?
Watter element is paramagneties ekwivalent tot 5 elektrone?

4

- a) V b) Cr c) Mn d) Fe e) Cu
f) none / geeneen

[4]

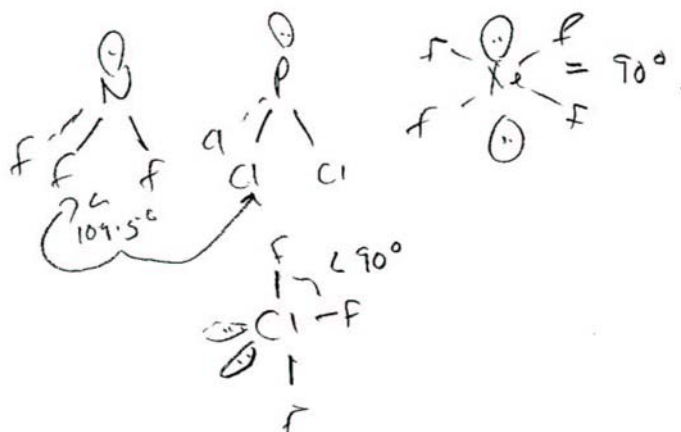
Question 16 / Vraag 16

Which of the following compounds might have a bond angle of 87.5° ?
 Watter van die volgende verbindings kan 'n bindingshoek van 87.5° hê?

4

- a) NF_3 b) PCl_3 c) XeF_4 d) ClF_3 e) Both / Beide a & b f) Both / Beide c & d
 g) None / Geeneen

[4]



Section B / Afdeling B

Question 17/Vraag 17

The mineral cinnabar, has a density of 5.9145×10 lb/gallon. What is the density in g/cm^3 ?

4 quarts (qt) = 1 Gallon

1 qt = 0.9464 dm^3

1 lb = 0.4536 Kg

Die mineral sinnaber, het 'n digtheid van 5.9145×10 lb/gallon. Wat is die digtheid in g/cm^3 ?

4 kwarte (qt) = 1 Gallon

1 qt = 0.9464 dm^3

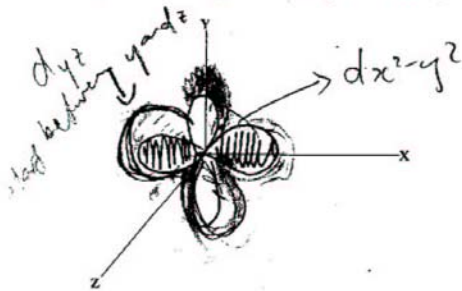
1 lb = 0.4536 Kg

$$\begin{aligned}
 & 5.9145 \times 10 \text{ lb} \times \frac{0.4536 \text{ Kg}}{1 \text{ lb}} \times \frac{1000 \text{ g}}{1 \text{ Kg}} \\
 & \frac{1 \text{ gallon}}{4 \text{ qt}} \times \frac{4 \text{ qt}}{1 \text{ gallon}} \times \frac{0.9464 \text{ dm}^3}{1 \text{ qt}} \times \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \\
 & = \frac{2.6828172 \times 10^4 \text{ g}}{3.7856 \times 10^3 \text{ cm}^3} = 7.086900888 \frac{\text{g}}{\text{cm}^3} \\
 & = 7.0869 \frac{\text{g}}{\text{cm}^3}
 \end{aligned}$$

Question 18/Vraag 18

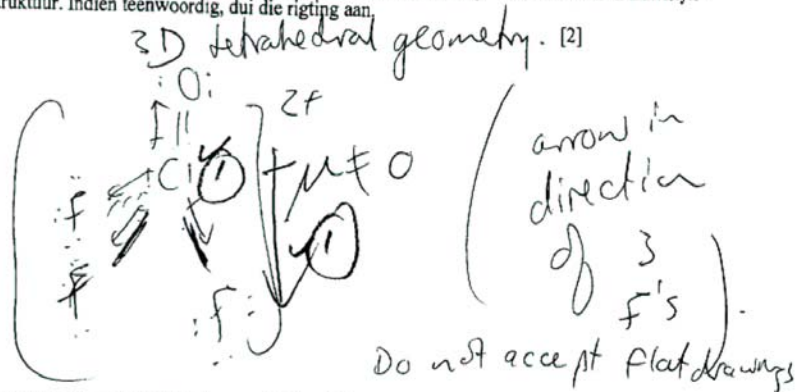
a) Draw the d_{yz} and $d_{x^2-y^2}$ orbitals on the given axes.

a) Teken die d_{yz} en die $d_{x^2-y^2}$ orbitale op die gegewe assestel

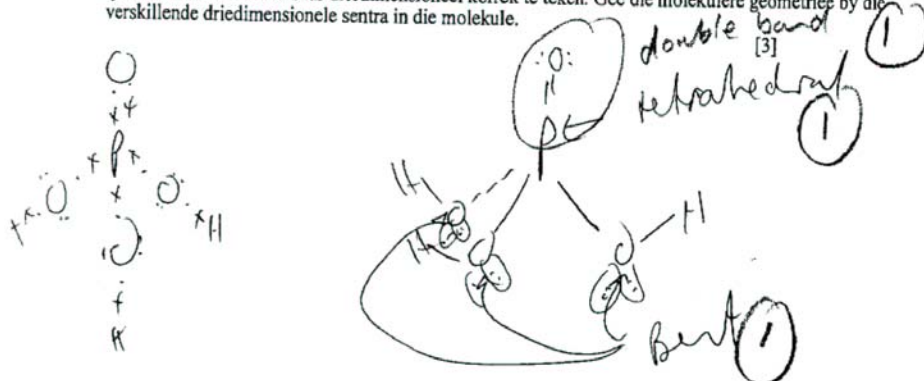


[1]

- b) Indicate the presence (or not) of a dipole moment in the ion ClO_3^{2-} . Use a Lewis line or Couper structure. If present, indicate the direction thereof.
 b) Dui die teenwoordigheid (of nie) van 'n dipoolmoment in die ioon ClO_3^{2-} aan. Gebruik 'n Lewisslyn- of Couperstruktuur. Indien teenwoordig, dui die rigting aan.



- c) The oxoacid phosphoric acid, H_3PO_4 , has one PO bond shorter than the other. Use Lewis dot and line structures to draw this acid three dimensionally correct. Give the molecular geometries at the various three dimensional centres in the molecule.
 c) Die oksosuur fosforsuur, H_3PO_4 , besit een PO binding korter as die ander. Gebruik Lewiskol en -lynstrukture om hierdie suur driedimensioneel korrek te teken. Gee die molekulêre geometrie by die verskillende driedimensionele sentra in die molekule.



- d) The electron affinity of beryllium is 0 kJ/mol, but lithium's and boron's are measured as -50 and -26.7 kJ/mol respectively. Explain shortly.
 d) Die elektronaaffiniteit van berillium is 0 kJ/mol, maar dié van litium en boor word gemeet as -50 and -26.7 kJ/mol respektiewelik. Verduidelik kortliks.

