UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF CHEMICAL SCIENCES

B Eng Tech in Engineering Metallurgy / Extraction Metallurgy

MODULE CETM1A1

CAMPUS DFC

MAJOR TEST 1

DATE: 13/03/2020 **SESSION: 13H50 – 15:25**

ASSESSOR **Dr. MC FOTSING**

INTERNAL MODERATOR **MR P.P MONAMA**

DURATION 120 MINUTES **TOTAL MARKS 70**

NUMBER OF PAGES: 4 PAGES, INCLUDING 1 ANNEXURE

INSTRUCTIONS:

- ANSWER ALL QUESTIONS IN THE ANSWER SCRIPT PROVIDED.
- GIVE ALL NUMERICAL ANSWERS TO THE CORRECT NUMBER OF SIGNIFICANT FIGURES AND WITH APPROPRIATE UNITS.
- CONSULT THE DATA SHEET AND THE PERIODIC TABLE FOR ALL SUPPLEMENTARY INFORMATION.
- CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT).

REQUIREMENTS: ANSWER SCRIPT

/2…

QUESTION 1

Choose the right answer.

1.1 Solids have a _____ shape and are not appreciably _____.

A) definite, compressible
B) definite, incompressible
C) indefinite, compressible
D) indefinite, incompressible
E) sharp, convertible

Answer: A

1.2 A combination of sand, salt, and water is an example of a _____.

A) homogeneous mixture
B) heterogeneous mixture
C) compound
D) pure substance
E) solid

Answer: B

1.3 Which one of the following has the element name and symbol correctly matched?

A) P, potassium
B) C, copper
C) Mg, manganese
D) Ag, silver
E) Sn, silicon

Answer: D

1.4 Which one of the following is a pure substance?

A) concrete
B) wood
C) salt water
D) elemental copper
E) milk

Answer: D

1.5 Which one of the following is not an intensive property?

A) density
B) temperature
C) melting point
D) mass
E) boiling point

Answer: D

1.6 Which of the following are chemical processes?

1. rusting of a nail
2. freezing of water
3. decomposition of water into hydrogen and oxygen gases
4. compression of oxygen gas

A) 2, 3, 4
B) 1, 3, 4
C) 1, 3
D) 1, 2
E) 1, 4

Answer: C

1.7 _____ and _____ reside in the atomic nucleus.

A) Protons, electrons
B) Electrons, neutrons
C) Protons, neutrons
D) none of the above
E) Neutrons, only neutrons

Answer: C

1.8 The atomic number indicates _____.

A) the number of neutrons in a nucleus
B) the total number of neutrons and protons in a nucleus
C) the number of protons or electrons in a neutral atom
D) the number of atoms in 1 g of an element
E) the number of different isotopes of an element

Answer: C

1.9 The _____ subshell contains only one orbital.

A) 5d
B) 6f
C) 4s
D) 3d
E) 1p

Answer: C

1.10 _____-orbitals are spherically symmetrical.

A) s
B) p
C) d
D) f
E) g

Answer: A

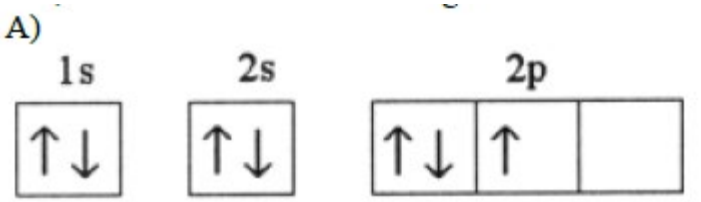
Diff: 1 Page Ref: Sec. 6.6

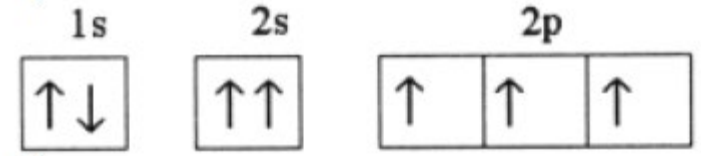
1.11 Each p-subshell can accommodate a maximum of _____ electrons.

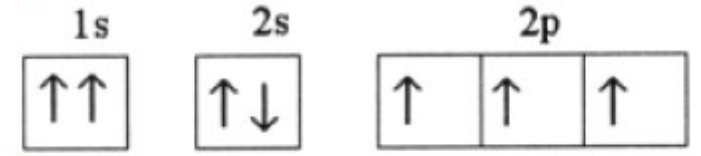
A) 6
B) 2
C) 10
D) 3
E) 5

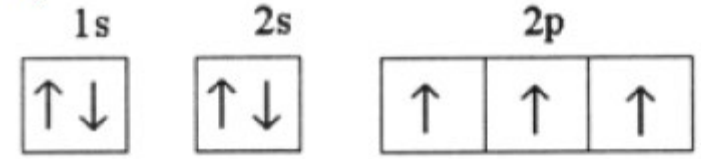
Answer: A

1.12 Which one of the following is the correct electron configuration for a ground-state nitrogen atom?

A)


B)


C)


D)


E) None of the above is correct.

Answer: D

1.13 The ground state electron configuration of Ga is _____.

A) $1s^2\ 2s^2 3s^2 3p^6 3d^{10}\ 4s^2\ 4p^1$
B) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 4s^2\ 4d^{10}\ 4p^1$
C) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6 3d^{10}\ 4s^2\ 4p^1$
D) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6 3d^{10}\ 4s^2\ 4d^1$
E) $[Ar]4s^2 3d^{11}$

Answer: C
Diff: 1 Page Ref: Sec. 6.8

1.14 In general, as you go across a period in the periodic table from left to right:
(1) the atomic radius _____;
(2) the electron affinity becomes _____ negative; and
(3) the first ionization energy _____.

A) decreases, decreasingly, increases
B) increases, increasingly, decreases
C) increases, increasingly, increases
D) decreases, increasingly, increases
E) decreases, increasingly, decreases
Answer: D

1.15 Most of the elements on the periodic table are _____.

A) gases
B) nonmetals
C) metalloids
D) liquids
E) metals
Answer: E
Diff: 1 Page Ref: Sec. 7.

1.16 In which set of elements would all members be expected to have very similar chemical properties?

A) O, S, Se
B) N, O, F
C) Na, Mg, K
D) S, Se, Si
E) Ne, Na, Mg
Answer: A
Diff: 1 Page Ref: Sec. 7.1

1.17 Which element would be expected to have chemical and physical properties closest to those of fluorine?

A) S
B) Fe
C) Ne
D) O
E) Cl
Answer: E
Diff: 1 Page Ref: Sec. 7.1

1.18 Atomic radius generally increases as we move _____.

A) down a group and from right to left across a period
B) up a group and from left to right across a period
C) down a group and from left to right across a period
D) up a group and from right to left across a period
E) down a group; the period position has no effect

Answer: A
Diff: 1 Page Ref: Sec. 7.2

1.19 Which ion below has the largest radius?

A) Cl-
B) K+
C) Br-
D) F
E) Na+

Answer: C
Diff: 1 Page Ref: Sec. 7.4

1.20 Of the following elements, _____ has the most negative electron affinity.

A) Na
B) Li
C) Be
D) N
E) F

Answer: E
Diff: 1 Page Ref: Sec. 7.4

[40]

QUESTION 2

Suggest a method of separating each of the following mixtures into two components:

2.1 Sugar and sand (5)
2.2 Iron and sulfur (5)

2.1.1 Add water to dissolve the sugar, filter this mixture, collecting the sand on filter paper and the sugar water in a flask. Evaporate water from the flask to recover solid sugar.

2.1.2 Heat the mixture until sulfur melts, then decant the liquid sulfur.

[10]

QUESTION 3

Only two isotopes of copper occur naturally. ^{63}Cu (atomic mass = 62.9296 amu; abundance 69.17 %) and ^{65}Cu (atomic mass = 64.9278 amu; abundance 30.83 %).

3.1 Calculate the atomic mass weight (average atomic mass) of copper. (6)

$$\frac{(62.9296 \times 69.17) + (64.9278 \times 30.83)}{100} = 63.54564$$

3.1 63.55 amu

[6]

QUESTION 3

For each of the following elements, write its chemical symbol, determine the group to which it belongs, and indicate whether it is a metal, metalloid, or non metal

3.1 Potassium (3)
3.2 Iodine (3)
3.3 Magnesium (3)
3.4 Argon (3)
3.5 Sulfur (3)

	Potassium	Iodine	Magnesium	Argon	Sulfur
Chemical symbol	K	I	Mg	Ar	S
Group	Alkali earth metals	halogens	Alkali earth metals	Noble gas	chalcogens
Category	Metal	Nonmetal	Metal	nonmetal	Nonmetal

[15]

QUESTION 4

For each element, indicate the number of valence electrons, core electrons, and unpaired electrons in the ground state:

4.1 Carbon (3)
4.2 Phosphorus (3)
4.3 Neon (3)

Element	(a) C	(b) P	(c) Ne
Electron Configuration	$[He]2s^22p^2$	$[Ne]3s^23p^3$	$[He]2s^22p^6$
Core electrons	2	10	2
Valence electrons	4	5	8
Unpaired electrons	2	3	0

[The concept of "valence electrons" for noble gas elements is problematic, since they are mostly unreactive. We could list the core for neon as [Ne], with no valence or unpaired electrons.]

[9]

TOTAL MARKS : 70

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Department of Applied Chemistry

Atomic Number

2
He
4.0026

Atomic Weight

1 **H** *1.0079*																	2 **He** *4.0026*
3 **Li** *6.941*	4 **Be** *9.0122*											5 **B** *10.811*	6 **C** *12.011*	7 **N** *14.007*	8 **O** *15.999*	9 **F** *18.998*	10 **Ne** *20.179*
11 **Na** *22.990*	12 **Mg** *24.305*											13 **Al** *26.982*	14 **Si** *28.086*	15 **P** *30.974*	16 **S** *32.064*	17 **Cl** *35.453*	18 **Ar** *39.948*
19 **K** *39.098*	20 **Ca** *40.078*	21 **Sc** *44.956*	22 **Ti** *47.88*	23 **V** *50.942*	24 **Cr** *51.996*	25 **Mn** *54.938*	26 **Fe** *55.847*	27 **Co** *58.933*	28 **Ni** *58.69*	29 **Cu** *63.546*	30 **Zn** *65.39*	31 **Ga** *69.723*	32 **Ge** *72.61*	33 **As** *74.922*	34 **Se** *78.96*	35 **Br** *79.904*	36 **Kr** *83.80*
37 **Rb** *85.47*	38 **Sr** *87.62*	39 **Y** *88.906*	40 **Zr** *91.224*	41 **Nb** *92.906*	42 **Mo** *95.94*	43 **Tc** *(98)*	44 **Ru** *101.07*	45 **Rh** *102.91*	46 **Pd** *106.42*	47 **Ag** *107.87*	48 **Cd** *112.41*	49 **In** *114.82*	50 **Sn** *118.71*	51 **Sb** *121.75*	52 **Te** *127.60*	53 **I** *126.90*	54 **Xe** *131.29*
55 **Cs** *132.91*	56 **Ba** *137.33*	57 **La** *138.91*	72 **Hf** *178.49*	73 **Ta** *180.95*	74 **W** *183.85*	75 **Re** *186.2*	76 **Os** *190.2*	77 **Ir** *192.22*	78 **Pt** *195.08*	79 **Au** *196.97*	80 **Hg** *200.59*	81 **Tl** *204.38*	82 **Pb** *207.2*	83 **Bi** *208.98*	84 **Po** *(209)*	85 **At** *(210)*	86 **Rn** *(222)*
87 **Fr** *(223)*	88 **Ra** *226.03*	89 **Ac** *227.03*															

58 **Ce** *140.12*	59 **Pr** *140.91*	60 **Nd** *144.24*	61 **Pm** *146.92*	62 **Sm** *150.36*	63 **Eu** *151.97*	64 **Gd** *157.25*	65 **Tb** *158.93*	66 **Dy** *162.50*	67 **Ho** *164.93*	68 **Er** *167.26*	69 **Tm** *168.93*	70 **Yb** *173.04*	71 **Lu** *174.97*
90 **Th** *232.04*	91 **Pa** *231.04*	92 **U** *238.03*	93 **Np** *237.05*	94 **Pu** *(244)*	95 **Am** *(234)*	96 **Cm** *(247)*	97 **Bk** *247*	98 **Cf** *(251)*	99 **Es** *(252)*	100 **Fm** *(257)*	101 **Md** *(258)*	102 **No** *(259)*	103 **Lr** *(260)*