

UNIVERSITY OF SWAZILAND
RESIT EXAMINATION – 2018, MAY

TITLE OF PAPER : Chemistry

COURSE NUMBER : CPR 103

TIME : Three Hours

INSTRUCTIONS :

1. Answer all questions in Section A (Total 50 marks)
2. Answer any two questions in Section B (each question is 25 marks)

NB: Non-programmable electronic calculators may be used
A periodic table and answer sheet (for **Section A**) are attached

This Examination Paper Contains Twelve Printed Pages Including This Page

*You are not supposed to open the paper until permission to do so has been granted by the
Chief Invigilator.*

Section A

- 1) A small amount of salt dissolved in water is an example of a _____.
 A) homogeneous mixture B) heterogeneous mixture
 C) compound D) pure substance E) solid
- 2) Which one of the following is a pure substance?
 A) concrete B) wood C) salt water
 D) elemental copper E) milk
- 3) Which states of matter are significantly compressible?
 A) gases only B) liquids only C) solids only
 D) liquids and gases E) solids and liquids
- 4) Gases and liquids share the property of _____.
 A) compressibility B) definite volume C) incompressibility
 D) indefinite shape E) definite shape
- 5) Of the objects below, _____ is the most dense.
 A) an object with a volume of 2.5 L and a mass of 12.5 kg
 B) an object with a volume of 139 mL and a mass of 93 g
 C) an object with a volume of 0.00212 m^3 and a mass of $4.22 \times 10^4 \text{ mg}$
 D) an object with a volume of $3.91 \times 10^{-24} \text{ nm}^3$ and a mass of $7.93 \times 10^{-1} \text{ ng}$
 E) an object with a volume of 13 dm^3 and a mass of $1.29 \times 10^3 \text{ g}$
- 6) Iron has a density of 7.9 g/cm^3 . What is the mass of a cube of iron with the length of one side equal to 55.0 mm?
 A) $2.1 \times 10^4 \text{ g}$ B) $4.3 \times 10^2 \text{ g}$ C) $1.3 \times 10^3 \text{ g}$
 D) 1.4 g E) $2.3 \times 10^{-2} \text{ g}$
- 7) In which one of the following numbers are all of the zeros significant?
 A) 100.090090 B) 0.143290 C) 0.05843
 D) 0.1000 E) 00.0030020
- 8) Round the number 3456.5 to two significant figures.
 A) 3400.0 B) 3400 C) 3000 D) 3500 E) 3000.0
- 9) Which atom has the smallest number of neutrons?
 A) carbon-14 B) nitrogen-14 C) oxygen-16
 D) fluorine-19 E) neon-20
- 10) Which pair of atoms constitutes a pair of isotopes of the same element?
 A) ${}^{14}_6\text{X}$ ${}^{14}_7\text{X}$ B) ${}^{14}_6\text{X}$ ${}^{12}_6\text{X}$ C) ${}^{17}_9\text{X}$ ${}^{17}_8\text{X}$
 D) ${}^{19}_{10}\text{X}$ ${}^{19}_9\text{X}$ E) ${}^{20}_{10}\text{X}$ ${}^{21}_{11}\text{X}$
- 11) Different isotopes of a particular element contain different numbers of _____.
 A) protons B) neutrons C) protons and neutrons
 D) protons, neutrons, and electrons E) None of the above is correct.
- 12) In the symbol below, $x =$ _____.



- A) 19 B) 13 C) 6 D) 7
E) not enough information to determine

- 13) In the periodic table, the elements are arranged in _____.
A) alphabetical order B) order of increasing atomic number
C) order of increasing metallic properties D) order of increasing neutron content
E) reverse alphabetical order

- 14) Which pair of elements below should be the most similar in chemical properties?
A) C and O B) B and As C) I and Br
D) K and Kr E) Cs and He

- 15) Which compounds do not have the same empirical formula?
A) C_2H_2 , C_6H_6 B) CO , CO_2 C) C_2H_4 , C_3H_6
D) $\text{C}_2\text{H}_4\text{O}_2$, $\text{C}_6\text{H}_{12}\text{O}_6$ E) $\text{C}_2\text{H}_5\text{COOCH}_3$, CH_3CHO

- 16) Of the following, _____ contains the greatest number of electrons.
A) P^{3+} B) P C) P^{2-} D) P^{3-} E) P^{2+}

- 17) Which of the following are combination reactions?

- 1) $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
2) $\text{CaO}(\text{s}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s})$
3) $\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{MgO}(\text{s})$
4) $\text{PbCO}_3(\text{s}) \rightarrow \text{PbO}(\text{s}) + \text{CO}_2(\text{g})$
A) 1, 2, and 3 B) 2 and 3 C) 1, 2, 3, and 4 D) 4 only
E) 2, 3, and 4

- 18) The formula weight of potassium phosphate (K_3PO_4) is _____ amu.
A) 173.17 B) 251.37 C) 212.27 D) 196.27 E) 86.07

- 19) The formula weight of a substance is _____.
A) identical to the molar mass
B) the same as the percent by mass weight
C) determined by combustion analysis
D) the sum of the atomic weights of each atom in its chemical formula
E) the weight of a sample of the substance

- 20) There are _____ atoms of oxygen are in 300 molecules of $\text{CH}_3\text{CO}_2\text{H}$.
A) 300 B) 600 C) 3.01×10^{24}
D) 3.61×10^{26} E) 1.80×10^{26}

- 21) How many sulfur dioxide molecules are there in 0.180 mol of sulfur dioxide?
A) 1.80×10^{23} B) 6.02×10^{24} C) 6.02×10^{23}
D) 1.08×10^{24} E) 1.08×10^{23}

- 22) When aqueous solutions of _____ are mixed, a precipitate forms.

- A) NiBr_2 and AgNO_3
 C) K_2SO_4 and CrCl_3
 E) Li_2CO_3 and CsI

- B) NaI and KBr
 D) KOH and $\text{Ba}(\text{NO}_3)_2$

23) The net ionic equation for the reaction between aqueous sulfuric acid and aqueous sodium hydroxide is _____.

- A) $\text{H}^+(\text{aq}) + \text{HSO}_4^-(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{SO}_4^{2-}(\text{aq})$
 B) $\text{H}^+(\text{aq}) + \text{HSO}_4^-(\text{aq}) + 2\text{Na}^+(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + 2\text{Na}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$
 C) $\text{SO}_4^{2-}(\text{aq}) + 2\text{Na}^+(\text{aq}) \rightarrow 2\text{Na}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$
 D) $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
 E) $2\text{H}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) + 2\text{Na}^+(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + 2\text{Na}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$

24) Which one of the following is a weak acid?

- A) HNO_3 B) HCl C) HI D) HF E) HClO_4

25) In which reaction does the oxidation number of hydrogen change?

- A) $\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 B) $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$
 C) $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{s})$
 D) $2\text{HClO}_4(\text{aq}) + \text{CaCO}_3(\text{s}) \rightarrow \text{Ca}(\text{ClO}_4)_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
 E) $\text{SO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{SO}_3(\text{aq})$

26) Which of these metals will be oxidized by the ions of aluminum?

- A) magnesium B) zinc C) chromium
 D) iron E) nickel

27) Oxidation is the _____ and reduction is the _____.

- A) gain of oxygen, loss of electrons B) loss of oxygen, gain of electrons
 C) loss of electrons, gain of electrons D) gain of oxygen, loss of mass
 E) gain of electrons, loss of electrons

28) Which of the following reactions will not occur as written?

- A) $\text{Zn}(\text{s}) + \text{Pb}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{Pb}(\text{s}) + \text{Zn}(\text{NO}_3)_2(\text{aq})$
 B) $\text{Mg}(\text{s}) + \text{Ca}(\text{OH})_2(\text{aq}) \rightarrow \text{Ca}(\text{s}) + \text{Mg}(\text{OH})_2(\text{aq})$
 C) $\text{Sn}(\text{s}) + 2\text{AgNO}_3(\text{aq}) \rightarrow 2\text{Ag}(\text{s}) + \text{Sn}(\text{NO}_3)_2(\text{aq})$
 D) $\text{Co}(\text{s}) + 2\text{AgCl}(\text{aq}) \rightarrow 2\text{Ag}(\text{s}) + \text{CoCl}_2(\text{aq})$
 E) $\text{Co}(\text{s}) + 2\text{HI}(\text{aq}) \rightarrow \text{H}_2(\text{g}) + \text{CoI}_2(\text{aq})$

29) What volume (mL) of a concentrated solution of magnesium chloride (9.00 M) must be diluted to 350. mL to make a 2.75 M solution of magnesium chloride?

- A) 2.75 B) 50.0 C) 45.0 D) 107 E) 350

30) What volume (ml) of a 3.45 M lead nitrate solution must be diluted to 450.0 ml to make a 0.990 M solution of lead nitrate?

- A) 129 B) 109 C) 101 D) 56 E) 45

31) Which one of the following substances is produced during the reaction of an acid with a metal hydroxide?

- A) H_2 B) H_2O C) CO_2 D) $NaOH$ E) O_2

32) 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

33) Which one of the following orbitals can hold two electrons?

- A) $2p_x$ B) $3s$ C) $4d_{xy}$ D) all of the above
E) none of the above

34) The ground state electron configuration of Fe is _____.

- A) $1s^2 2s^2 3s^2 3p^6 3d^6$ B) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$ C) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
D) $1a^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^6$ E) $1s^2 2s^2 3s^2 3p^{10}$

35) The ground state configuration of fluorine is _____.

- A) $[He]2s^2 2p^2$ B) $[He]2s^2 2p^3$ C) $[He]2s^2 2p^4$
D) $[He]2s^2 2p^5$ E) $[He]2s^2 2p^6$

36) 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

37) Which one of the following atoms has the largest radius?

- A) O B) F C) S D) Cl E) Ne

38) Which ion below has the largest radius?

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

39) Which one of the following is a metalloid?

- A) Ge B) S C) Br D) Pb E) C

40) Which of the following does not have eight valence electrons?

- A) Ca^+ B) Rb^+ C) Xe D) Br^-
E) All of the above have eight valence electrons.

41) How many isomers are possible for C_4H_{10} ?

- A) 1 B) 2 C) 3 D) 4 E) 10

42) Which statement about hydrocarbons is false?

- A) The smallest alkane to have structural (constitutional) isomers has 4 carbon atoms.
B) Cyclic alkanes are structural isomers of alkenes.
C) Alkanes are more reactive than alkenes.
D) Alkanes can be produced by hydrogenating alkenes.
E) Alkenes can be polymerized.

43) The following reaction would produce a(n) _____.

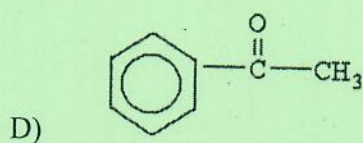
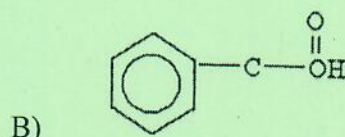
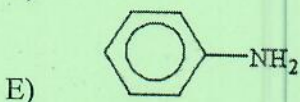
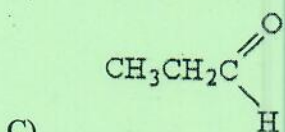
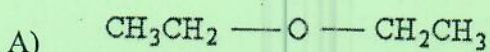


- A) ketone B) ether C) aldehyde D) alcohol E) ester

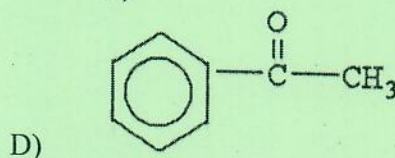
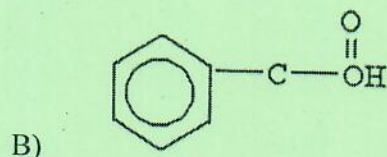
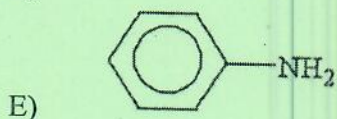
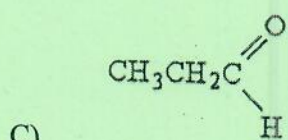
44) What is the general formula for a ketone?

- A) R-O-R B) R-CO-R' C) R-CO-OH D) R-OH E) R-CHO

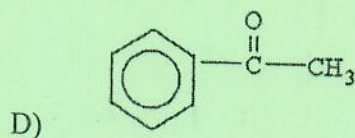
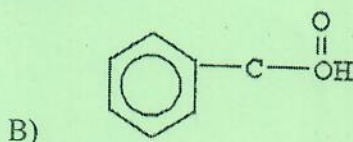
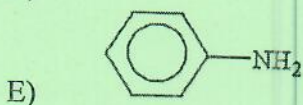
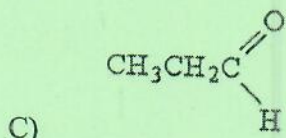
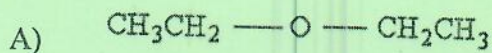
45) Which structure below represents a ketone?



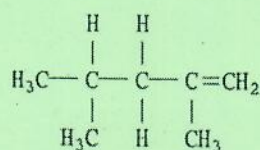
46) Which structure below represents an aldehyde?



47) Which structure below is not correctly drawn?



48) What is the name of the compound below?



- A) 2,4-methylbutene
 D) 2,4-dimethyl-1-pentene
- B) 2,5-dimethylpentane
 E) 2,4-dimethyl-4-pentene
- C) 2,4-ethylbutene
- 49) The addition of HBr to 2-butene produces _____.
 A) 1-bromobutane
 D) 2,3-dibromobutane
- B) 2-bromobutane
 E) no reaction
- C) 1,2-dibromobutane
- 50) Alkenes have the general formula _____.
 A) C_nH_{2n}
 B) $\text{C}_n\text{H}_{2n-2}$
 C) $\text{C}_n\text{H}_{2n+2}$
 D) C_nH_n
 E) C_{2n}H_n

Section B

Question 1

- a) Argon has three naturally occurring isotopes, ^{36}Ar , ^{38}Ar and ^{40}Ar .
- What is the mass number of each? (4)
 - How many protons, neutrons and electrons are present in each? (9)
- b) Name the following anions and give the names and formulas of the acids derived from them: .
- Br^-
 - ClO_3^-
 - SO_4^{2-}
 - I^-
- (12)

Question 2

- a) Indicate whether each of the following molecules is capable of geometrical (cis-trans) isomerism. For those that are, draw the structures: (9)
- 1,1-dichloro-1-butene
 - 2,4-dichloro-2-pentyne
 - 1-chloro-1-pentene
- b) Give the name and structure of the product of the reaction of 6-ethyl-3-nonene with HBr. (6)
- c) Draw the structures of the following compounds: (10)
- 2-chloropropanal
 - 3-hydroxypentanal
 - 1,4-pentadiene-3-one
 - 1,3-cyclopentanedione

v) butanoic acid

Question 3

- a) Write the balanced net ionic equation for the reaction of aqueous solutions of BaI_2 and Na_2SO_4 that yields a precipitate of BaSO_4 . Indicate which ion(s) is/are spectator ions in the reaction?
(5)
- b) What is the concentration (M) of a NaCl solution prepared by dissolving 9.3 g of NaCl in sufficient water to give 350 mL of solution?
(10)
- c) How many grams of sodium chloride are there in 550.0 mL of a 1.90 M aqueous solution of sodium chloride?
(10)

UNIVERSITY OF SWAZILAND
CHEMISTRY DEPARTMENT
C112 SECTION A ANSWER SHEET

STUDENT ID NUMBER: _____

The correct answer must be indicated by putting a circle on the letter for that answer on the answer sheet provided. If you change your answer, please cancel the wrong answer with a cross and then put a circle around the correct one. If more than one option has a circle around it a zero will be given for that question.

1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E
11	A	B	C	D	E
12	A	B	C	D	E
13	A	B	C	D	E
14	A	B	C	D	E
15	A	B	C	D	E
16	A	B	C	D	E
17	A	B	C	D	E
18	A	B	C	D	E
19	A	B	C	D	E
20	A	B	C	D	E
21	A	B	C	D	E
22	A	B	C	D	E
23	A	B	C	D	E
24	A	B	C	D	E
25	A	B	C	D	E

26	A	B	C	D	E
27	A	B	C	D	E
28	A	B	C	D	E
29	A	B	C	D	E
30	A	B	C	D	E
31	A	B	C	D	E
32	A	B	C	D	E
33	A	B	C	D	E
34	A	B	C	D	E
35	A	B	C	D	E
36	A	B	C	D	E
37	A	B	C	D	E
38	A	B	C	D	E
39	A	B	C	D	E
40	A	B	C	D	E
41	A	B	C	D	E
42	A	B	C	D	E
43	A	B	C	D	E
44	A	B	C	D	E
45	A	B	C	D	E
46	A	B	C	D	E
47	A	B	C	D	E
48	A	B	C	D	E
49	A	B	C	D	E
50	A	B	C	D	E

UNIVERSITY OF SWAZILAND

Department of Chemistry

1	H	1.00794	2	He	4.0026
3	Li	6.941	4	Be	9.0122
11	Na	22.990	12	Mg	24.305
19	K	39.098	20	Ca	40.078
37	Rb	85.47	38	Sr	87.62
55	Cs	132.91	56	Ba	137.33
87	Fr	(223)	88	Ra	226.03
21	Sc	44.956	22	Ti	47.88
39	Y	88.906	40	Zr	91.224
57	La	138.91	58	Ce	140.12
89	Ac	227.03	90	Th	232.04
23	V	50.942	24	Cr	51.996
41	Nb	92.906	42	Mo	95.94
73	Ta	180.95	74	W	183.85
72	Hf	178.49	73	Ta	180.95
71	Zr	91.224	72	Nb	92.906
70	Y	88.906	71	Zr	91.224
69	Sc	44.956	70	Y	88.906
68	Ti	47.88	69	Sc	44.956
67	V	50.942	68	Ti	47.88
66	Cr	51.996	67	V	50.942
65	Mn	54.938	66	Cr	51.996
64	Fe	55.847	65	Mn	54.938
63	Co	58.933	64	Fe	55.847
62	Ni	58.69	63	Co	58.933
61	Cu	63.546	62	Ni	58.69
60	Zn	65.39	61	Cu	63.546
59	Ga	69.723	60	Zn	65.39
58	Ge	72.61	59	Ga	69.723
57	As	74.922	58	Ge	72.61
56	Se	78.96	57	As	74.922
55	Br	79.904	56	Se	78.96
54	Kr	83.80	55	Br	79.904
53	I	126.90	54	Kr	83.80
52	Te	127.60	53	I	126.90
51	Sb	121.75	52	Te	127.60
50	Sn	118.71	51	Sb	121.75
49	In	114.82	50	Sn	118.71
48	Cd	112.41	49	In	114.82
47	Ag	107.87	48	Cd	112.41
46	Pd	106.42	47	Ag	107.87
45	Rh	102.91	46	Pd	106.42
44	Ru	101.07	45	Rh	102.91
43	Tc	(98)	44	Ru	101.07
42	Mo	95.94	43	Tc	(98)
41	Nb	92.906	42	Mo	95.94
40	Zr	91.224	41	Nb	92.906
39	Y	88.906	40	Zr	91.224
38	Sr	87.62	39	Y	88.906
37	Rb	85.47	38	Sr	87.62
36	Kr	83.80	37	Rb	85.47
35	Br	79.904	36	Kr	83.80
34	Se	78.96	35	Br	79.904
33	As	74.922	34	Se	78.96
32	Ge	72.61	33	As	74.922
31	Ga	69.723	32	Ge	72.61
30	Zn	65.39	31	Ga	69.723
29	Cu	63.546	30	Zn	65.39
28	Ni	58.69	29	Cu	63.546
27	Co	58.933	28	Ni	58.69
26	Fe	55.847	27	Co	58.933
25	Mn	54.938	26	Fe	55.847
24	Cr	51.996	25	Mn	54.938
23	V	50.942	24	Cr	51.996
22	Ti	47.88	23	V	50.942
21	Sc	44.956	22	Ti	47.88
20	Ca	40.078	21	Sc	44.956
19	K	39.098	20	Ca	40.078
18	Ar	39.948	19	K	39.098
17	Cl	35.453	18	Ar	39.948
16	S	32.064	17	Cl	35.453
15	P	30.974	16	S	32.064
14	Si	28.086	15	P	30.974
13	Al	26.982	14	Si	28.086
12	Mg	24.305	13	Al	26.982
11	Na	22.990	12	Mg	24.305
10	Ne	20.179	11	Na	22.990
9	F	18.998	10	Ne	20.179
8	O	15.999	9	F	18.998
7	N	14.007	8	O	15.999
6	C	12.011	7	N	14.007
5	B	10.811	6	C	12.011
4	Be	9.0122	5	B	10.811
3	Li	6.941	4	Be	9.0122
2	He	4.0026	3	Li	6.941
1	H	1.00794	2	He	4.0026
69	Tm	168.93	70	Yb	173.04
68	Er	167.26	69	Tm	168.93
67	Ho	164.93	68	Er	167.26
66	Dy	162.50	67	Ho	164.93
65	Tb	158.93	66	Dy	162.50
64	Gd	157.25	65	Tb	158.93
63	Eu	151.97	64	Gd	157.25
62	Sm	150.36	63	Eu	151.97
61	Pm	146.92	62	Sm	150.36
60	Nd	144.24	61	Pm	146.92
59	Pr	140.91	60	Nd	144.24
58	Ce	140.12	59	Pr	140.91
90	Th	232.04	91	Pa	231.04
89	Ac	227.03	90	Th	232.04
88	Ra	226.03	89	Ac	227.03
87	Fr	(223)	88	Ra	226.03
86	Po	(209)	87	Fr	(223)
85	At	(210)	86	Po	(209)
84	Bi	208.98	85	At	(210)
83	Pb	207.2	84	Bi	208.98
82	Tl	204.38	83	Pb	207.2
81	Sn	118.71	82	Tl	204.38
80	Hg	200.59	81	Sn	118.71
79	Au	196.97	80	Hg	200.59
78	Pt	195.08	79	Au	196.97
77	Ir	192.22	78	Pt	195.08
76	Os	190.2	77	Ir	192.22
75	Re	186.2	76	Os	190.2
74	W	183.85	75	Re	186.2
73	Ta	180.95	74	W	183.85
72	Hf	178.49	73	Ta	180.95
71	Zr	91.224	72	Hf	178.49
70	Y	88.906	71	Zr	91.224
69	Sc	44.956	70	Y	88.906
68	Ti	47.88	69	Sc	44.956
67	V	50.942	68	Ti	47.88
66	Cr	51.996	67	V	50.942
65	Mn	54.938	66	Cr	51.996
64	Fe	55.847	65	Mn	54.938
63	Co	58.933	64	Fe	55.847
62	Ni	58.69	63	Co	58.933
61	Cu	63.546	62	Ni	58.69
60	Zn	65.39	61	Cu	63.546
59	Ga	69.723	60	Zn	65.39
58	Ge	72.61	59	Ga	69.723
57	As	74.922	58	Ge	72.61
56	Se	78.96	57	As	74.922
55	Br	79.904	56	Se	78.96
54	Kr	83.80	55	Br	79.904
53	I	126.90	54	Kr	83.80
52	Te	127.60	53	I	126.90
51	Sb	121.75	52	Te	127.60
50	Sn	118.71	51	Sb	121.75
49	In	114.82	50	Sn	118.71
48	Cd	112.41	49	In	114.82
47	Ag	107.87	48	Cd	112.41
46	Pd	106.42	47	Ag	107.87
45	Rh	102.91	46	Pd	106.42
44	Ru	101.07	45	Rh	102.91
43	Tc	(98)	44	Ru	101.07
42	Mo	95.94	43	Tc	(98)
41	Nb	92.906	42	Mo	95.94
40	Zr	91.224	41	Nb	92.906
39	Y	88.906	40	Zr	91.224
38	Sr	87.62	39	Y	88.906
37	Rb	85.47	38	Sr	87.62
36	Kr	83.80	37	Rb	85.47
35	Br	79.904	36	Kr	83.80
34	Se	78.96	35	Br	79.904
33	As	74.922	34	Se	78.96
32	Ge	72.61	33	As	74.922
31	Ga	69.723	32	Ge	72.61
30	Zn	65.39	31	Ga	69.723
29	Cu	63.546	30	Zn	65.39
28	Ni	58.69	29	Cu	63.546
27	Co	58.933	28	Ni	58.69
26	Fe	55.847	27	Co	58.933
25	Mn	54.938	26	Fe	55.847
24	Cr	51.996	25	Mn	54.938
23	V	50.942	24	Cr	51.996
22	Ti	47.88	23	V	50.942
21	Sc	44.956	22	Ti	47.88
20	Ca	40.078	21	Sc	44.956
19	K	39.098	20	Ca	40.078
18	Ar	39.948	19	K	39.098
17	Cl	35.453	18	Ar	39.948
16	S	32.064	17	Cl	35.453
15	P	30.974	16	S	32.064
14	Si	28.086	15	P	30.974
13	Al	26.982	14	Si	28.086
12	Mg	24.305	13	Al	26.982
11	Na	22.990	12	Mg	24.305
10	Ne	20.179	11	Na	22.990
9	F	18.998	10	Ne	20.179
8	O	15.999	9	F	18.998
7	N	14.007	8	O	15.999
6	C	12.011	7	N	14.007
5	B	10.811	6	C	12.011
4	Be	9.0122	5	B	10.811
3	Li	6.941	4	Be	9.0122
2	He	4.0026	3	Li	6.941
1	H	1.00794	2	He	4.0026