UNIVERSITY OF SWAZILAND

FINAL EXAMINATIONS ACADEMIC YEAR 2017/2018

TITLE OF PAPER: INTRODUCTORY CHEMISTRY

COURSE NUMBER: CHE151

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS: THERE ARE TWO SECTIONS: SECTION A AND SECTION B. ANSWER ALL THE QUESTIONS IN SECTION A AND ANY TWO QUESTIONS FROM SECTION B.

SECTION A IS WORTH 50 MARKS AND EACH QUESTION IN SECTION B IS WORTH 25 MARKS.

THE **ANSWER SHEET** FOR SECTION A IS ATTACHED TO THE QUESTION PAPER.GIVE YOUR ANSWERS TO SECTION A QUESTIONS BY RECORDING ON THE ANSWER SHEET THE LETTER CORRESPONDING TO THE CORRECT ANSWER.

AT THE END OF THE EXAM,BEFORE YOU LEAVE, PLACE THE ANSWER SHEET INSIDE THE UNISWA ANSWER BOOKLET CONTAINING YOUR ANSWERS TO SECTION B

A PERIODIC TABLE AND A TABLE OF CONSTANTS HAVE BEEN PROVIDED WITH THIS EXAMINATION PAPER.

PLEASE DO NOT OPEN THIS PAPER UNTIL AUTHORISED TO DO SO BY THE CHIEF INVIGILATOR.

SECTION A (Answer ALL the questions in this section)

1) Vanadium has two naturally occurring isotopes, ^{50}V with an atomic mass of 49.9472 amu and ^{51}V with an atomic mass of 50.9440. The atomic weight of vanadium is 50.9415. The percent abundances of the vanadium isotopes are _____% ^{50}V and _____% ^{51}V.
A) 0.25, 99.75
B) 99.75, 0.25
C) 49, 51
D) 1.0, 99
E) 99, 1.0

2) An unknown element is found to have three naturally occurring isotopes with atomic masses of 35.9675 (0.337%), 37.9627 (0.063%), and 39.9624 (99.600%). Which of the following is the unknown element?
A) Ar
B) K
C) Cl
D) Ca
E) None of the above could be the unknown element.

3) 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

4) Elements _____ exhibit similar physical and chemical properties.
A) with similar chemical symbols
B) with similar atomic masses
C) in the same period of the periodic table
D) on opposite sides of the periodic table
E) in the same group of the periodic table

5) Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties?
A) H, Li
B) Cs, Ba
C) Ca, Sr
D) Ga, Ge
E) C, O

6) Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties?
A) O, S
B) C, N
C) K, Ca
D) H, He
E) Si, P

7) Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties?
A) As, Br
B) Mg, Al
C) I, At
D) Br, Kr
E) N,O

8) The elements in groups 1A, 6A, and 7A are called, _____, respectively.
A) alkaline earth metals, halogens, and chalcogens
B) alkali metals, chalcogens, and halogens
C) alkali metals, halogens, and noble gases
D) alkaline earth metals, transition metals, and halogens
E) halogens, transition metals, and alkali metals

9) 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

10) An element in the upper right corner of the periodic table _____.
A) is either a metal or metalloid
B) is definitely a metal
C) is either a metalloid or a non-metal
D) is definitely a non-metal
E) is definitely a metalloid

11) An element that appears in the lower left corner of the periodic table is _____.
A) either a metal or metalloid
B) definitely a metal
C) either a metalloid or a non-metal

D) definitely a non-metal
E) definitely a metalloid

12) What is the maximum mass in grams of NH_3 that can be produced by the reaction of 1.0 g of N_2 with 3.0 g of H_2 via the equation below?

$N_2\,(g) + 3H_2\,(g) \rightarrow 2NH_3\,(g)$

A) 2.0
B) 1.2
C) 0.61
D) 17
E) 4.0

13) What is the maximum amount in grams of SO_3 that can be produced by the reaction of 1.0 g of S with 1.0 g of O_2 via the equation below?

$2S\,(s) + 3O_2\,(g) \rightarrow 2SO_3\,(g)$

A) 0.27
B) 1.7
C) 2.5
D) 3.8
E) 2.0

14) Solid aluminum and gaseous oxygen react in a combination reaction to produce aluminum oxide:

$4Al\,(s) + 3\,O_2\,(g) \rightarrow 2\,Al_2O_3\,(s)$

The maximum amount of Al_2O_3 that can be produced from 2.5 g of Al and 2.5 g of O_2 is _____ g.

A) 9.4
B) 7.4
C) 4.7
D) 5.3
E) 5.0

15) Sulfur and fluorine react in a combination reaction to produce sulfur hexafluoride:

$S\,(s) + 3\,F_3\,(g) \rightarrow SF_6\,(g)$

The maximum amount of SF_6 that can be produced from the reaction of 3.5 g of sulfur with 4.5 g of fluorine is _____ g.

A) 12
B) 3.2
C) 5.8
D) 16
E) 8.0

16) Solid aluminum and gaseous oxygen react in a combination reaction to produce aluminum oxide:

$4Al\,(s) + 3\,O_2\,(g) \rightarrow 2\,Al_2O_3\,(s)$

In a particular experiment, the reaction of 2.5 g of Al with 2.5 g of O_2 produced 3.5 g of Al_2O_3. The % yield of the reaction is _____.

A) 74
B) 37
C) 47
D) 66
E) 26

17) Sulfur and oxygen react in a combination reaction to produce sulfur trioxide, an environmental pollutant:

$2S\,(s) + 3O_2\,(g) \rightarrow 2SO_3\,(g)$

In a particular experiment, the reaction of 1.0 g S with 1.0 g O_2 produced 0.80 g of SO_3. The % yield in this experiment is _____.

A) 30
B) 29
C) 21
D) 88
E) 48

18) Sulfur and fluorine react in a combination reaction to produce sulfur hexafluoride:

$S(s) + 3F_2(g) \rightarrow SF_6(g)$

In a particular experiment, the percent yield is 79.0%. This means that in this experiment, a 7.90-g sample of fluorine yields _____ g of SF_6.

A) 30.3
B) 10.1
C) 7.99
D) 24.0
E) 0.110

19) Which one of the following is a correct expression for molarity?

A) mol solute/L solvent
B) mol solute/mL solvent
C) mmol solute/mL solution
D) mol solute/kg solvent
E) μmol solute/L solution

20) Which one of the following is <u>not</u> true concerning 2.00 L of 0.100 M solution of $Ca_3(PO_4)_2$?

A) This solution contains 0.200 mol of $Ca_3(PO_4)_2$.
B) This solution contains 0.800 mol of oxygen atoms.
C) 1.00 L of this solution is required to furnish 0.300 mol of Ca^{2+} ions.
D) There are 6.02×10^{22} phosphorus atoms in 500.0 mL of this solution.
E) This solution contains 6.67×10^{-2} mol of Ca^{2+}.

21) A 0.200 M K_2SO_4 solution is produced by _____.

A) dilution of 250.0 mL of 1.00 M K_2SO_4 to 1.00 L
B) dissolving 43.6 g of K_2SO_4 in water and diluting to a total volume of 250.0 mL
C) diluting 20.0 mL of 5.00 M K_2SO_4 solution to 500.0 mL
D) dissolving 20.2 g of K_2SO_4 in water and diluting to 250.0 mL, then diluting 25.0 mL of this solution to a total volume of 500.0 mL
E) dilution of 1.00 mL of 250 M K_2SO_3 to 1.00 L

22) Which solution has the same number of moles of NaOH as 50.00 mL of 0.100*M* solution of NaOH?

A) 20.00 mL of 0.200*M* solution of NaOH
B) 25.00 mL of 0.175*M* solution of NaOH
C) 30.00 mL of 0.145*M* solution of NaOH
D) 50.00 mL of 0.125*M* solution of NaOH
E) 100.00 mL of 0.0500*M* solution of NaOH

23) Which solution has the same number of moles of KCl as 75.00 mL of 0.250*M* solution of KCl?
A) 20.0 mL of 0.200*M* solution of KCl
B) 25.0 mL of 0.175*M* solution of KCl
C) 129 mL of 0.145*M* solution of KCl
D) 50.0 mL of 0.125*M* solution of KCl
E) 100 mL of 0.0500*M* solution of KCl

24) What are the respective concentrations (M) of Fe^{3+} and I^- afforded by dissolving 0.200 mol FeI_3 in water and diluting to 725 mL?
A) 0.276 and 0.828
B) 0.828 and 0.276
C) 0.276 and 0.276
D) 0.145 and 0.435
E) 0.145 and 0.0483

25) What are the respective concentrations (M) of Mg^{+2} and $C_2H_3O_2^-$ afforded by dissolving 0.600 mol $Mg(C_2H_3O_2)_2$ in water and diluting to 135 mL?
A) 0.444 and 0.889
B) 0.0444 and 0.0889
C) 0..889 and 0.444
D) 0.444 and 0.444
E) 4.44 and 8.89

26) What are the respective concentrations (M) of Cu^{+2} and Cl^- afforded by dissolving 0.200 mol $CuCl_2$ in water and diluting to 345 mL?
A) 0.200 and 0.200
B) 0.580 and 1.16
C) 0.200 and 0.400
D) 1.16 and 2.32
E) 0.580 and 0.290

27) A tenfold dilution of a sample solution can be obtained by taking _____.
A) 1 part sample and 9 parts solvent
B) 1 part sample and 10 parts solvent
C) 9 parts sample and 1 part solvent
D) 10 parts sample and 1 part solvent
E) 99 parts sample and 1 part solvent

28) Mixing 10.00 mL of an aqueous solution with 10.00 mL of water represents a _____.
A) crystallization
B) neutralization
C) twofold dilution
D) tenfold dilution
E) titration

29) You are given two clear solutions of the same unknown monoprotic acid, but with different concentrations. Which statement is true?
A) There is no chemical method designed to tell the two solutions apart.
B) It would take more base solution (per milliliter of the unknown solution) to neutralize the more concentrated solution.
C) A smaller volume of the less concentrated solution contains the same number of moles of the acid compared to the more concentrated solution.
D) If the same volume of each sample was taken, then more base solution would be required to neutralize the one with lower concentration.
E) The product of concentration and volume of the less concentrated solution equals the product of concentration and volume of the more concentrated solution.

30) A 0.100 M solution of _____ will contain the highest concentration of potassium ions.
A) potassium phosphate
B) potassium hydrogen carbonate
C) potassium hypochlorite
D) potassium iodide
E) potassium oxide

31) The ground-state electron configuration of the element _____ is $[Kr]5s^14d^5$.
A) Nb
B) Mo
C) Cr
D) Mn
E) Tc

32) The ground-state electron configuration of _____ is $[Ar]4s^13d^5$.
A) V
B) Mn
C) Fe
D) Cr
E) K

33) Which one of the following configurations depicts an excited oxygen atom?
A) $1s^2 2s^2 2p^2$ **B)** $1s^2 2s^2 2p^2 3s^2$ **C)** $1s^2 2s^2 2p^1$ **D)** $1s^2 2s^2 2p^4$
E) $[He]2s^2 2p^4$

34) Which one of the following configurations depicts an excited carbon atom?
A) $1s^2 2s^2 2p^1 3s^1$
B) $1s^2 2s^2 2p^3$
C) $1s^2 2s^2 2p^1$
D) $1s^2 2s^2 3s^1$
E) $1s^2 2s^2 2p^2$

35) How many different principal quantum numbers can be found in the ground state electron configuration of nickel?
A) 2
B) 3
C) 4
D) 5
E) 6

36) The valence shell of the element X contains 2 electrons in a 5s subshell. In the same shell, element X has 5 electrons in a 5p subshell. What type of element is X?
A) main group element
B) chalcogen
C) halogen
D) transition metal
E) alkali metal

37) 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

38) Atomic radius generally decreases 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

39) Of the following, which gives the correct order for atomic radius for Mg, Na, P, Si and Ar?
A) Mg > Na > P > Si > Ar
B) Ar > Si > P > Na > Mg
C) Si > P > Ar > Na > Mg
D) Na > Mg > Si > P > Ar
E) Ar > P > Si > Mg > Na

40) Of the following, which gives the correct order for atomic radius for Ca, K, As, Ge and Kr?
A) Ca > K > As > Ge > Kr
B) Kr > Ge > As > K > Ca
C) Ge > As > Kr > K > Ca
D) K > Ca > Ge > As > Kr
E) Kr > As > Ge > Ca > K

41) Which one of the following atoms has the largest radius?
A) O
B) F
C) S
D) Cl
E) Ne

42) Of the compounds below, _____ has the smallest ionic separation.
A) KF
B) K_2S
C) RbCl
D) $SrBr_2$
E) RbF

43) _____ is isoelectronic with argon and _____ is isoelectronic with neon.
A) Cl^-, F^-
B) Cl^-, Cl^+
C) F+, F^-
D) Ne^-, Kr^+
E) Ne^-, Ar^+

44) Which of the following is an isoelectronic series?
A) B^{5-}, Si^{4-}, As^{3-}, Te^{2-}
B) F^-, Cl^-, Br^-, I^-
C) S, Cl, Ar, K
D) Si^{2-}, P^{2-}, S^{2-}, Cl^{2-}
E) O^{2-}, F^-, Ne, Na^+

45) Which isoelectronic series is correctly arranged in order of increasing radius?

A) $K^+ < Ca^{2+} < Ar < Cl^-$

B) $Cl^- < Ar < K^+ < Ca^{2+}$

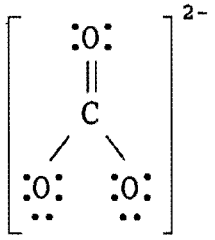
C) $Ca^{2+} < Ar < K^+ < Cl^-$

D) $Ca^{2+} < K^+ < Ar < Cl^-$

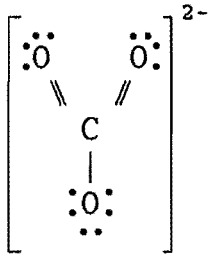
E) $Ca^{2+} < K^+ < Cl^- < Ar$

46) The Lewis structure of the CO_3^{2-} ion is _____.

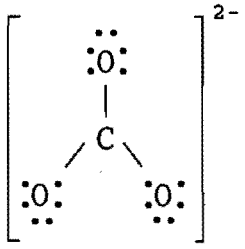
A)



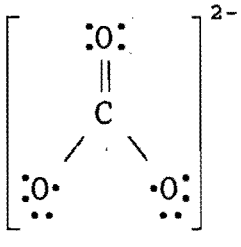
B)



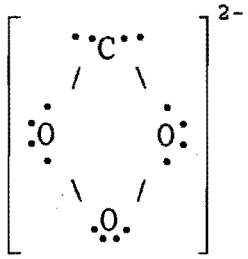
C)



D)



E)



47) A valid Lewis structure of _____ cannot be drawn without violating the octet rule.

A) PO_4^{3-}

B) SiF_4

C) CF_4

D) SeF_4

E) NF_3

48) The central atom in _____ does not violate the octet rule.

A) SF_4

B) KrF_2

C) CF_4

D) XeF_4

E) ICl_4^-

49) The central atom in _____ violates the octet rule.
A) NH_3
B) SeF_2
C) BF_3
D) AsF_3
E) CF_4

50) A valid Lewis structure of _____ cannot be drawn without violating the octet rule.
A) NF_3
B) BeH_2
C) SO_2
D) CF_4
E) SO_3^{2-}

SECTION B (Answer any two questions in this section)

Question One

a) Determine the volume, in milliliters, of 3.0 *M* H_2SO_4 that is needed to make 450 mL of 0.10 *M* H_2SO_4.

[4]

b) In a titration experiment, 45.7 mL of 0.500 *M* H_2SO_4 is required to neutralize 20.0 mL of NaOH solution. Determine the concentration of the NaOH solution.

[6]

c) The quantity of Cl^- in a municipal water supply is determined by titrating the sample with Ag^+. The precipitation reaction taking place during the titration is

$$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$$

The end point in this type of titration is marked by a change in color of a special type of indicator. **(a)** How many grams of chloride ion are in a sample of the water if 20.2 mL of 0.100 *M* Ag^+ is needed to react with all the chloride in the sample? **(b)** If the sample has a mass of 10.0 g, what percent Cl^- does it contain?

[7]

d) Name the following compounds: (i) $CaSO_4.2H_2O$ (ii) $Cu(NO_3)_2$ (iii) SO_3 (iv) Fe_2O_3

[8]

Question Two

a) Antimony, Sb, has two stable isotopes: Sb-121, mass = 120.904 g/mol and Sb-123, mass = 122.904 g/mol. What are the relative abundances of these isotopes?

[6]

b) Which family of elements is characterized by an ns^2np^2 electron configuration in the outermost occupied shell? Give symbols for four of the elements in the family.

[3]

(c) (i) Based on its position in the periodic table, write the condensed electron configuration for bismuth, whose symbol is Bi. **(ii)** How many unpaired electrons does a bismuth atom have? **[4]**

d) Use the periodic table to write the condensed electron configuration for (i) Ca^{2+} (ii) S^{2-}

[4]

e) Sodium sulphide, Na_2S, is used in the leather industry to remove hair from hides. The compound is made by the reaction

$$Na_2SO_4(s) + 4C(s) \rightarrow Na_2S(s) + 4CO(g)$$

Suppose you mix 15 g of Na_2SO_4 and 7.5 g of carbon. Which is the limiting reactant? What mass of Na_2S is expected to be produced?

[8]

Question Three

a) Which of the following atoms and ions is largest: S^{2-}, S, O^{2-}? **[2]**

b) Write formula of the compound you expect to form when lithium, Li, reacts with nitrogen, N. **[3]**

c) Which has the lowest first ionization energy, B, Al, C, or Si? Which has the highest? **[2]**

d) Write the balanced chemical equation for the reaction of solid tetraphosphorus hexoxide, P_4O_{10}, with water. **[2]**

e) Which substance do you expect to have the greatest lattice energy, MgF_2, CaF_2, or ZrO_2? **[3]**

f) Give the Lewis structure of each of the species SF_2 and the nitrate ion, NO_3^-. For each of the species, calculate and indicate the formal charge of each atom. **[13]**

CHE151 EXAM DATA: Solubility Rules

TABLE 4.1 Solubility Guidelines for Common Ionic Compounds in Water

Soluble Ionic Compounds		Important Exceptions
Compounds containing	NO_3^-	None
	CH_3COO^-	None
	Cl^-	Compounds of Ag^+, Hg_2^{2+}, and Pb^{2+}
	Br^-	Compounds of Ag^+, Hg_2^{2+}, and Pb^{2+}
	I^-	Compounds of Ag^+, Hg_2^{2+}, and Pb^{2+}
	SO_4^{2-}	Compounds of Sr^{2+}, Ba^{2+}, Hg_2^{2+}, and Pb^{2+}
Insoluble Ionic Compounds		**Important Exceptions**
Compounds containing	S^{2-}	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}
	CO_3^{2-}	Compounds of NH_4^+ and the alkali metal cations
	PO_4^{3-}	Compounds of NH_4^+ and the alkali metal cations
	OH^-	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}

CHE151/C201 Exam Section A Answer Sheet. Stud ID No. Programme:

Ques No.	Letter corresponding to the correct answer	Ques No.	Letter corresponding to the correct answer
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

PERIODIC TABLE OF THE ELEMENTS

GROUPS

PERIODS	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1.008 H 1																	4.003 He 2
2	6.941 Li 3	9.012 Be 4											10.811 B 5	12.011 C 6	14.007 N 7	15.999 O 8	18.998 F 9	20.180 Ne 10
3	22.990 Na 11	24.305 Mg 12											26.982 Al 13	28.0855 Si 14	30.9738 P 15	32.06 S 16	35.453 Cl 17	39.948 Ar 18
4	39.0983 K 19	40.078 Ca 20	44.956 Sc 21	47.88 Ti 22	50.9415 V 23	51.996 Cr 24	54.938 Mn 25	55.847 Fe 26	58.933 Co 27	58.69 Ni 28	63.546 Cu 29	65.39 Zn 30	69.723 Ga 31	72.61 Ge 32	74.922 As 33	78.96 Se 34	79.904 Br 35	83.80 Kr 36
5	85.468 Rb 37	87.62 Sr 38	88.906 Y 39	91.224 Zr 40	92.9064 Nb 41	95.94 Mo 42	98.907 Tc 43	101.07 Ru 44	102.906 Rh 45	106.42 Pd 46	107.868 Ag 47	112.41 Cd 48	114.82 In 49	118.71 Sn 50	121.75 Sb 51	127.60 Te 52	126.904 I 53	131.29 Xe 54
6	132.905 Cs 55	137.33 Ba 56	138.906 *La 57	178.49 Hf 72	180.948 Ta 73	183.85 W 74	186.207 Re 75	190.2 Os 76	192.22 Ir 77	195.08 Pt 78	196.967 Au 79	200.59 Hg 80	204.383 Tl 81	207.2 Pb 82	208.980 Bi 83	(209) Po 84	(210) At 85	(222) Rn 86
7	(223) Fr 87	226.025 Ra 88	(227) **Ac 89	(261) Rf 104	(262) Ha 105	(263) Unh 106	(262) Uns 107	(265) Uno 108	(266) Une 109									

TRANSITION ELEMENTS

* Lanthanide series	140.115 Ce 58	140.908 Pr 59	144.24 Nd 60	(145) Pm 61	150.36 Sm 62	151.96 Eu 63	157.25 Gd 64	158.925 Tb 65	162.50 Dy 66	164.930 Ho 67	167.26 Er 68	168.934 Tm 69	173.04 Yb 70	174.967 Lu 71
** Actinide series	232.038 Th 90	231.036 Pa 91	238.029 U 92	237.048 Np 93	(244) Pu 94	(243) Am 95	(247) Cm 96	(247) Bk 97	(251) Cf 98	(252) Es 99	(257) Fm 100	(258) Md 101	(259) No 102	(260) Lr 103

Numbers below the symbol of the element indicates the atomic numbers. Atomic masses, above the symbol of the element, are based on the assigned relative atomic mass of ^{12}C = exactly 12; ( ) indicates the mass number of the isotope with the longest half-life.

SOURCE: International Union of Pure and Applied Chemistry, I. Mills, ed., *Quantities, Units, and Symbols in Physical Chemistry*, Blackwell Scientific Publications, Boston, 1988, pp 86-98.

Fundamental Physical Constants (six significant figures)

Avogadro's number	N_A	$= 6.02214 \times 10^{23}$/mol
atomic mass unit	amu	$= 1.66054 \times 10^{-27}$ kg
charge of the electron (or proton)	e	$= 1.60218 \times 10^{-19}$ C
Faraday constant	F	$= 9.64853 \times 10^{4}$ C/mol
mass of the electron	m_e	$= 9.10939 \times 10^{-31}$ kg
mass of the neutron	m_n	$= 1.67493 \times 10^{-27}$ kg
mass of the proton	m_p	$= 1.67262 \times 10^{-27}$ kg
Planck's constant	h	$= 6.62607 \times 10^{-34}$ J·s
speed of light in a vacuum	c	$= 2.99792 \times 10^{8}$ m/s
standard acceleration of gravity	g	$= 9.80665$ m/s^2
universal gas constant	R	$= 8.31447$ J/(mol·K)
		$= 8.20578 \times 10^{-2}$ (atm·L)/(mol·K)

Rydberg constant = 1.097 x 10^7 m^{-1}

SI Unit Prefixes

p	n	μ	m	c	d	k	M	G
pico-	nano-	micro-	milli-	centi-	deci-	kilo-	mega-	giga-
10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^{3}	10^{6}	10^{9}

Conversions and Relationships

Length
SI unit: meter, m

1 km = 1000 m
= 0.62 mile (mi)
1 inch (in) = 2.54 cm
1 m = 1.094 yards (yd)
1 pm = 10^{-12} m = 0.01 Å

Volume
SI unit: cubic meter, m^3

1 dm^3 = 10^{-3} m^3
= 1 liter (L)
= 1.057 quarts (qt)
1 cm^3 = 1 mL
1 m^3 = 35.3 ft^3

Pressure
SI unit: pascal, Pa

1 Pa = 1 N/m^2
= 1 kg/m·s^2
1 atm = 1.01325×10^5 Pa
= 760 torr
1 bar = 1×10^5 Pa

Mass
SI unit: kilogram, kg

1 kg = 10^3 g
= 2.205 lb
1 metric ton (t) = 10^3 kg

Energy
SI unit: joule, J

1 J = 1 kg·m^2/s^2
= 1 coulomb·volt (1 C·V)
1 cal = 4.184 J
1 eV = 1.602×10^{-19} J

Math relationships

$\pi = 3.1416$
volume of sphere = $\frac{4}{3}\pi r^3$
volume of cylinder = $\pi r^2 h$

Temperature
SI unit: kelvin, K

0 K = −273.15°C
mp of H_2O = 0°C (273.15 K)
bp of H_2O = 100°C (373.15 K)
T (K) = T (°C) + 273.15
T (°C) = $[T\,(°F) - 32]\frac{5}{9}$
T (°F) = $\frac{9}{5}T$ (°C) + 32