Name: _____ **Student number: _____**

Chemistry 1E03 **Term Test** **Oct. 2, 2015**

McMaster University ***VERSION 1***

Instructors: Drs. R.S. Dumont & P. Kruse

Duration: 90 minutes

This test contains 14 numbered pages printed on both sides. There are **20** multiple-choice questions appearing on pages numbered 3 to 10. Pages 11 and 12 provide extra space for rough work. Page 13 includes some useful data and equations, and there is a periodic table on page 14. You may tear off the last pages to view the periodic table and the data provided.

You must enter your name and student number on this question sheet, as well as on the answer sheet. Your invigilator will be checking your student card for identification.
You are responsible for ensuring that your copy of the question paper is complete. Bring any discrepancy to the attention of your invigilator.

All questions are worth 1 mark; the total marks available are 20. There is **no** additional penalty for incorrect answers.

BE SURE TO ENTER THE CORRECT VERSION NUMBER OF YOUR TEST (shown near the top of page 1), IN THE SPACE PROVIDED ON THE ANSWER SHEET.

ANSWER ALL QUESTIONS ON THE ANSWER SHEET, IN PENCIL.
Instructions for entering multiple-choice answers are given on page 2.
SELECT ONE AND ONLY ONE ANSWER FOR EACH QUESTION from the answers **(A)** through **(E). No work written on the question sheets will be marked**. The question sheets may be collected and reviewed in cases of suspected academic dishonesty.

Academic dishonesty may include, among other actions, communication of any kind (verbal, visual, *etc*.) between students, sharing of materials between students, copying or looking at other students' work. If you have a problem please ask the invigilator to deal with it for you. Do not make contact with other students directly. Try to keep your eyes on your own paper – looking around the room may be interpreted as an attempt to copy.

Only Casio FX 991 electronic calculators may be used; but they must NOT be transferred between students. Use of periodic tables or any aids, other than those provided, is not allowed.

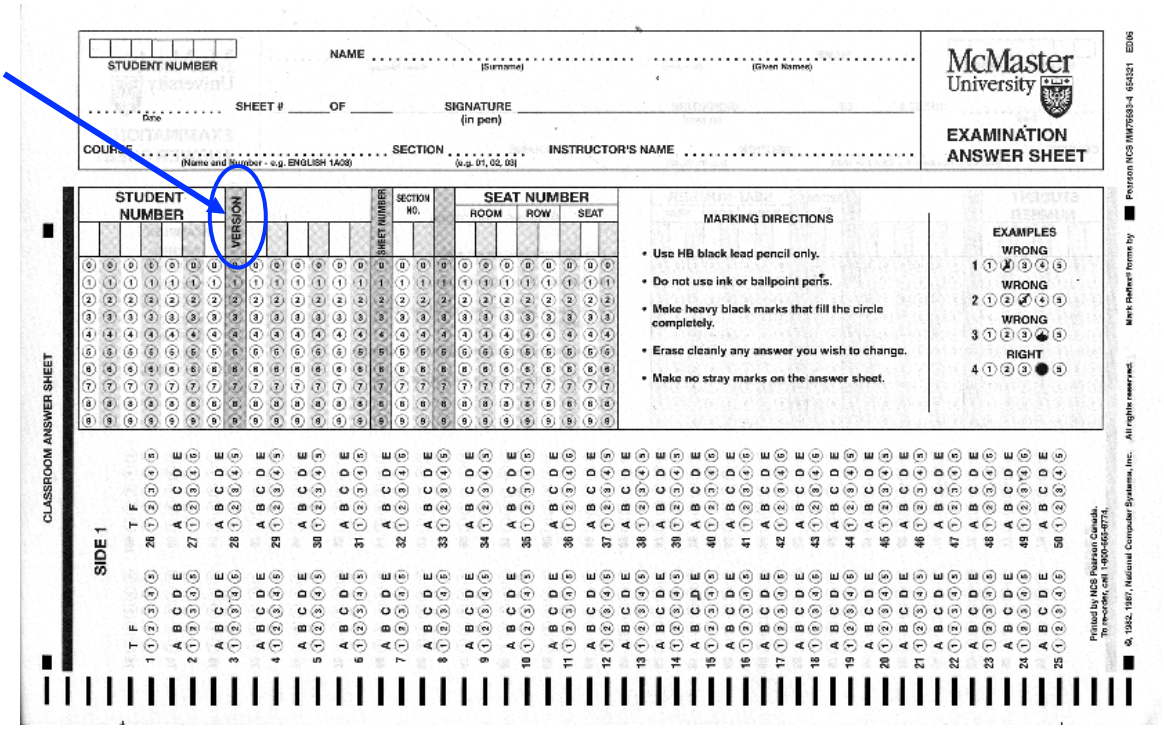
Name: _____ Student number: _____

OMR EXAMINATION – STUDENT INSTRUCTIONS

NOTE: IT IS YOUR RESPONSIBILITY TO ENSURE THAT THE ANSWER SHEET IS PROPERLY COMPLETED: YOUT EXAMINIATION RESULT DEPENDS UPON PROPER ATTENTION TO THESE INSTRUCTIONS.

The scanner, which reads the sheets, senses the bubble shaded areas by their non-reflection of light. A heavy mark must be made, completely filling the circular bubble, with an HB pencil. Marks made with a pen will **NOT** be sensed. Erasures must be thorough or the scanner will still sense a mark. Do **NOT** use correction fluid on the sheets. Do **NOT** put any unnecessary marks or writing on the sheet.

1. On SIDE 1 (**red side**) of the form, in the top box, *in pen*, print your student number, name, course name, and the date in the spaces provided. Then you **MUST** write your signature, in the space marked SIGNATURE.
2. In the second box, *with a pencil*, mark your student number, **exam version number** in the space provided and <u>fill in the corresponding bubble numbers underneath</u>.
3. Answers: mark only **ONE** choice from the alternatives (A,B,C,D,E) provided for each question. The question number is to the left of the bubbles. Make sure that the number of the question on the scan sheet is the same as the number on the test paper.
4. Pay particular attention to the Marking+ Directions on the form.
5. Begin answering the question using the first set of bubbles, marked “1”.



Name: _____ Student number: _____

1. Identify the **incorrect** chemical name from among the following:
.

A) $KClO_3$ potassium perchlorate
B) $Ca(NO_2)_2$ calcium nitrite
C) NaH_2PO_4, sodium dihydrogenphosphate
D) AlN, aluminum nitride
E) $FeSO_4$, iron(II) sulfate

2. What is the correct **chemical formula** for calcium nitrate?
.

A) Ca_2NO_2
B) $Ca(NO_3)_2$
C) Ca_2NO_3
D) $CaNO_3$
E) $Ca(NO_2)_2$

3. How many **moles of Na_2O (s)** are produced when 56 grams of nitrogen gas are produced in the reaction below?

$5\ NaN_3\ (s) + NaNO_3\ (aq) \rightarrow 3\ Na_2O\ (s) + 8\ N_2\ (g)$
.

A) 0.75
B) 1.5
C) 0.63
D) 8.0
E) 0.38

4. What **volume** (in mL) of a 0.0850 M $Ba(OH)_2$ solution, when diluted to 250.0 mL with water, will give a solution that is 0.0400 M in hydroxide ions (*i.e*. $[OH^-] = 0.0400$ M)?
.

A) 58.8
B) 27.4
C) 76.2
D) 14.7
E) 118

5. The empirical formula of a compound is CH. At 200 °C, 0.145 g of this compound in the gas phase occupies a volume of 97.2 mL at a pressure of 0.75 bar. What is the **molecular formula** of the compound?
.

A) C_5H_5
B) C_6H_6
C) C_8H_8
D) C_2H_2
E) C_7H_7

6. How many **grams** of Na_2CO_3 are required for complete neutralization of 50.0 mL of 0.155 M HNO_3? The products are sodium nitrate, carbon dioxide and water.
.

A) 0.922
B) 0.206
C) 0.411
D) 0.00388
E) 0.00776

7. The anion $^{33}S^-$ contains
.

A) 33 neutrons, 16 protons, 17 electrons
B) 17 neutrons, 17 protons, 16 electrons
C) 33 neutrons, 17 protons, 18 electrons
D) 16 neutrons, 17 protons, 18 electrons
E) 17 neutrons, 16 protons, 17 electrons

8. If light with a wavelength of 400. nm falls on the surface of cesium metal, electrons with a kinetic energy of 1.60×10^{-19} J are ejected. The **minimum frequency** of light required to eject an electron from sodium is (in Hz):
.

A) 3.20×10^{8}
B) 7.10×10^{14}
C) 5.63×10^{-19}
D) 5.08×10^{14}
E) 3.46×10^{-19}

9. Which atom has the **greatest number of *unpaired* electrons** in its ground-state electron configuration?

.

A) N
B) Mn
C) Be
D) Ni
E) S

10. What is the wavelength of an electron travelling with a velocity of 1000 m s^{-1}? :

.

A) 40.0 nm
B) 145 nm
C) 400 mm
D) 72.7 mm
E) 727 nm

11. Which of the following statements regarding quantum mechanics are **FALSE**?
(i) The energy of a photon is proportional to its frequency.
(ii) In a hydrogen atom, the electron is at a fixed distance from the nucleus.
(iii) As the velocity of a given particle gets larger, its wavelength gets shorter.
(iv) The size of atomic orbitals is mainly determined by the magnetic quantum number.
(v) For a given shell of a many-electron atom, d orbitals have higher energy than s orbitals.

.

A) i, iii, v
B) ii, iv
C) iii, iv
D) i, iii
E) i, ii, v

12. Which of the following is/are believed to be **TRUE** for **all** atoms?
(i) Electrons move in circular orbits around the nucleus.
(ii) The energy of the electrons is restricted to specific, discrete values.
(iii) The energy of each electron depends only on its principal quantum number, *n*.
.

A) i, ii
B) ii
C) i
D) i, ii, iii
E) ii, iii

13. Which electron configuration(s) correspond(s) to an **excited state** of a **non-metallic** atom?
(i) [Ne] $3s^2\ 4p^1$
(ii) [Ar] $4s^2\ 3d^{10}\ 4p^5$
(iii) [Ne] $3s^2\ 3p^3\ 4s^1$
(iv) [Ar] $4s^1\ 3d^5$
(v) [Ar] $4s^2\ 3d^{10}\ 4p^5\ 4d^1$
.

A) iii, v
B) iv, v
C) i, ii, iii
D) i, iii, iv
E) ii, v

14. From the O=O bond dissociation energy (499 kJ/mol), compute the **maximum wavelength** (in nm) of light capable of dissociating the O_2 molecule into O atoms.
.

A) 699
B) 3.98×10^{-22}
C) 240
D) 2.18×10^{6}
E) 213

15. Which one of the following statements is **false**?
.

A) Light is emitted when electrons are promoted to higher energy levels.
B) As the quantum number ***n*** of an orbital increases, so does the average distance between nucleus and electron.
C) When the quantum number ℓ = 2, the possible values of m_ℓ are -2, -1, 0, 1, or 2.
D) As the wavelength of light increases, the energy decreases.
E) The photoelectric effect occurs when light strikes the surface of a metal and electrons are ejected.

16. An element is a molecular solid at room temperature. It burns to form a solid oxide, which is acidic when dissolved in water. The element's first ionization energy is higher than either of its neighbouring elements (to the left and right) in the periodic table. **Which element is this**?
.

A) Cl
B) P
C) Al
D) Si
E) S

17. Which one of the following is the **correct** size sequence?

.

A) $Cl^- > Rb^+ > Ca^{2+} > K+$
B) $Rb^+ > K^+ > Cl^- > Ca^{2+}$
C) $Rb^+ > Cl^- > K^+ > Ca^{2+}$
D) $Ca^{2+} > Cl^- > K^+ > Rb^+$
E) $Rb^+ > Ca^{2+} > K^+ > Cl^-$

18. Which of the following statements about periodic trends are **TRUE**?

(i) The ions Na^+ and F^- have the same ionic radius because they are isoelectronic.
(ii) The bonds in a phosphorus trichloride molecule are polar covalent.
(iii) The metallic character of Group 15 elements increases with increasing atomic mass.
(iv) The energy required for removing an electron from an atom in the gas phase is called the atom's electron affinity.

.

A) ii, iv
B) i, iii
C) iii, iv
D) ii, iii
E) i, iv

19. Which ONE of the following choices lists the species in order of **increasing** size?
.

A) $F^- < Cl^- < Cl$
B) $I^- < I < Br$
C) $F^- < F < Cl$
D) $Cl^+ < Cl^- < Cl$
E) $F < F^- < Cl^-$

20. Put the following elements in order of **increasing atomic radius.**
.

A) As < S < F <Ne
B) As < S < Ne < F
C) Ne < F < S < As
D) F < Ne < S < As
E) F < Ne < As < S

Name: _____ Student number: _____

Extra space for rough work:

Name: _____ Student number: _____

Extra space for rough work:

Name: _____ Student number: _____

- **Some general data are provided on this page.**
- **A Periodic Table with atomic weights is provided on the next page.**

$R = 8.3145\ \text{J K}^{-1}\ \text{mol}^{-1} = 0.08206\ \text{L atm K}^{-1}\ \text{mol}^{-1}$

$N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$

$c = 2.9979 \times 10^{8}\ \text{m s}^{-1}$

$h = 6.6256 \times 10^{-34}\ \text{Js}$

$m_e = 9.10 \times 10^{-31}\ \text{kg}$

1 bar = 100.0 kPa

0°C = 273.15 K

$1\ \text{J} = 1\ \text{kg m}^2\ \text{s}^{-2} = 1\ \text{kPa L} = 1\ \text{Pa m}^3$

$1\ \text{m} = 10^9\ \text{nm} = 10^{10}\ \text{Å}$

$1\ \text{cm}^3 = 1\ \text{mL}$

$1\ \text{g} = 10^3\ \text{mg}$

1 Hz = 1 cycle/s

De Broglie wavelength:

$\lambda = h / mv = h / p$

Hydrogen atom energy levels:

$E_n = -R_H / n^2 = -2.178 \times 10^{-18}\ \text{J} / n^2$

END OF EXAM

Name: _____

Student number: _____

PERIODIC TABLE OF THE ELEMENTS

I 1												III 13	IV 14	V 15	VI 16	VII 17	VIII 18
1 H 1.0079	II 2					Transition Metals											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 20.180
11 Na 22.990	12 Mg 24.305	3	4	5	6	7	8	9	10	11	12	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	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 85.468	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 105.42	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 186.21	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	104 Unq [261]	105 Unp [262]	106 Unh [263]												

Atomic weights are based on $^{12}C = 12$ and conform to the 1987 IUPAC report values rounded to 5 significant digits.
Numbers in [ ] indicate the most stable isotope.

* Lanthanides	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	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
** Actinides	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]	103 Lr [262]