Name_____

Bring your own scientific calculator to lab.

It's best to practice on the calculator you will use for exams.

CHM101 Lab – Math Review and Significant Figures – Grading Rubric

Criteria	Points possible	Deductions
Q1 (0.5 each)	4	
Q2 (0.25 each)	2	
Q3 (Q5 0.25 each)	2	
Q4 (0.5 each)	3	
Q5(0.5 each)	3	
Q6 (0.5 each)	3	
Q7 (0.5 each)	3	
Total	20	

Subject to additional penalties at the discretion of the instructor.

A. Simple Algebra

Q1. Solve for x and show your work. Rounding/Sig Figs do not matter for this question.

$x + 111 = 341$	$x - 5 = 58$
$5x = 315$	$3x - 17 = 172$
$\frac{38}{6} = \frac{x}{3}$	$\frac{4}{x} = \frac{20}{25}$
$\frac{24}{x} = 6$	$\frac{22\times3}{x} = \frac{66\times3}{6}$

B. Significant Figures

All scientific measurements and calculations contain some uncertainty. Scientists have developed rules so that the level of uncertainty can be clearly communicated to other scientists. The last digit of any reported measurement contains uncertainty. In scientific measurements, some zeros are significant and considered part of the measurement while other zeros are non-significant or place-holder zeros and are not considered part of the measurement.

Some numbers in science contain no uncertainty and are called exact numbers. Exact numbers are things that have been counted or numbers that are part of a definition. Since there is no uncertainty, they are considered to have infinite significant figures.

Rules for Counting Significant Figures:	Example	# S. F.
In decimal numbers, everything to the right of the first non-zero is significant	0.003020 cm	4
	60.0 in	3
In non-decimal numbers, everything to the left of the last non-zero is significant	705000 km	3
Counting numbers and numbers in definitions are exact.	28 students	∞
	12 in (= 1 ft)	∞

Q3. Determine the number of significant figures in the following measurements:

226 nm		2.000 cm		0.01050 Kg		600 Km	
18 m		0.05 mL		16.001 g		31 pens	

C. Rounding Numbers

In scientific calculations it is sometimes necessary to round numbers. For instance if you buy an item for $9.99 and there is 6% sales tax, the tax comes to $0.5994. However, the cashier will charge you $0.60 tax, rounded to the nearest penny, or the hundredths place.

To round a number look at the digit immediately to the right of the digit you are rounding to (the first digit to be dropped). If that number is 4 or less, simply drop the digits. If the number is 5 or greater, add 1 to the last retained digit.

Example: Round 8.3547 to the hundredths place: 8.3547 → 8.35
↑ first digit to be dropped is 4 or less

Example: Round 2.685 to the tenths place: 2.685 → 2.7
↑ first digit to be dropped is 5 or greater

Note that zeros may need to be added to keep the number of the same magnitude, or with the correct decimal places. The number must be in the same ballpark as the original – think of the number in terms of money.

Example: Round 23526 to the hundreds place: 23526 → 23500 (not $235!)

Example: Round 1.496 to the hundredths place: 1.496 → 1.50

Q2. Round each of the following to the number of significant figures indicated

	1 sig fig	2 sig figs	3 sig figs	4 sig figs
5823.53	*keep the value roughly the same!			
6.7951			*maintain two decimals	

Rounding for Significant Figures in Calculations

Calculations sometimes have to be rounded to correctly reflect the uncertainty of the final answer. Different rounding rules apply for addition/subtraction and multiplication/division.

Addition/Subtraction – Round the answer to place (tens, ones, hundredths, etc.) with the most uncertainty in the numbers being added/subtracted. In the examples below, the uncertain digit in each number has been underlined. (Note: if numbers have exponents, the exponents must be the same for this rule to be applied.)

0.020 (uncertainty in thousandths place)
+ 0.1256 (uncertainty in ten-thousandths place)
0.1456 → **0.146** (rounded to thousandths place)

254.02 (uncertainty in hundredths place)
+ 40.4 (uncertainty in tenths place)
294.42 → **294.4** (rounded to tenths place)

Q4. Perform the following calculations and round to the correct number of significant figures

	answer from calculator	***rounded based on +/- rule***		*answer from calculator*	***rounded based on +/- rule***
13.22 + 3.6 =			0.952 – 0.502 =		
81.62 – 31.000 =			0.45 + 0.551 =		
11.001 – 6.3 =			2.0 + 1.00 + 22.05 =		

Multiplication/Division – Round the answer to have the same number of significant figures as the number with the least number of significant figures.

5.60 (3 sig figs)
x 0.022 (2 sig figs)
0.1232 → **0.12** (rounded to two sig figs)

2.300 (4 sig figs)
÷ 4 (1 sig fig)
0.575 → **0.6** (rounded to 1 sig fig)

Q5. Perform the following calculations and round to the correct number of significant figures.

	answer from calculator	***rounded based on x/÷ rule***		*answer from calculator*	***rounded based on x/÷ rule***
1700 ÷ 26 =			650 x 7.500 =		
0.350 x 0.4421 =			2.00 x 0.020		
9511 ÷ 9			454.0 ÷ 6.470 =		

***D.* <u>Scientific Notation</u>**

A number in scientific notation has two parts: a number between 1 and 10 and an exponent – 10 raised to a power. We can convert between regular and scientific notation by moving the decimal place either to the left or the right. For every place moved to the right, the power of 10 decreases by 1. For every decimal place moved to the left, the power of 10 increases by one. Place the decimal place after the first non-zero digit. Two examples are shown below.

$5983 = 5.983 \times 10^{3}$ The decimal was moved 3 places to the left and placed after the first non-zero digit 5

$0.000231 = 2.31 \times 10^{-4}$ The decimal was moved 4 places to the right and placed after the first non-zero digit 2

<u>Q6.</u> Convert each of the following numbers to scientific notation or regular notation and indicate the number of significant figures.

Note: the number of significant figures should not change when converting between scientific and regular notation.

Regular notation	Scientific notation	Number of significant figures
250.0	maintain the same number of sig figs!	(it's not 2!)
0.0047		
maintain the same number of sig figs!	1.60×10^{-4}	
109000		
61611		
	5.7×10^{3}	

E. Exponents in Calculations

Entering Scientific Notation on a Calculator

The most efficient way to enter scientific notation on a calculator is to use the exponent button, usually labeled "E" or "EE" or "exp" on or above the button. On most calculators 1.5×10^{-3} would be entered as 1.5E-3. Try entering it this way on your calculator and press return. The display should read 0.0015.

You should be comfortable doing operations with exponents in your calculator. Use of the exponent button allows you to skip using parentheses.

Enter the following in your calculator: **$4.0 \times 10^5 \div 2.0 \times 10^5$**

The answer should be **2**. If you got 2×10^{10}, you need to use either parentheses or your exponent button.

If you enter 4.0 x 10^5 /2.0 x 10^5, your calculator thinks you mean: $\dfrac{4.0 \times 10^5 \times 10^5}{2.0}$

To get the correct answer you must enter either:

4.0 x 10^5 /(2.0 x 10^5)

or

4.0E5/2.0E5

Note that using the exponent button saves time in reducing the number of keystrokes

Q7. Enter the following in your calculator and round to the correct number of significant figures.

$\dfrac{30}{2 \times 5} =$ do this one with calculator and in your head	(the answer is not 75!)	$\dfrac{0.225}{6.02 \times 10^{23}} =$	
$\dfrac{3.3 \times 10^6}{1.0 \times 10^{-4}} =$	(the answer is not 330!, read intro above)	$\dfrac{1.1 \times 10^5}{(68)(4.8 \times 10^4)} =$	
$9.55 \times 10^{-9} \times 5.2 \times 10^4 =$		$\dfrac{3.32 \times 10^{-21}}{(9.11 \times 10^{10})(6.541 \times 10^7)} =$	