Welcome to Jeff's CHEM 4 lecture!

We'll be starting in just a bit…

While you are waiting:

1) Go to LearningCatalytics.com **Session ID = 14110045**
2) Make sure your Zoom User ID is your "first name last name". You can open "participants", then find your name and click on it to change it.
3) In the chat, let us know… *What is a CHEM 4 study tip that you'd recommend to your classmates?*

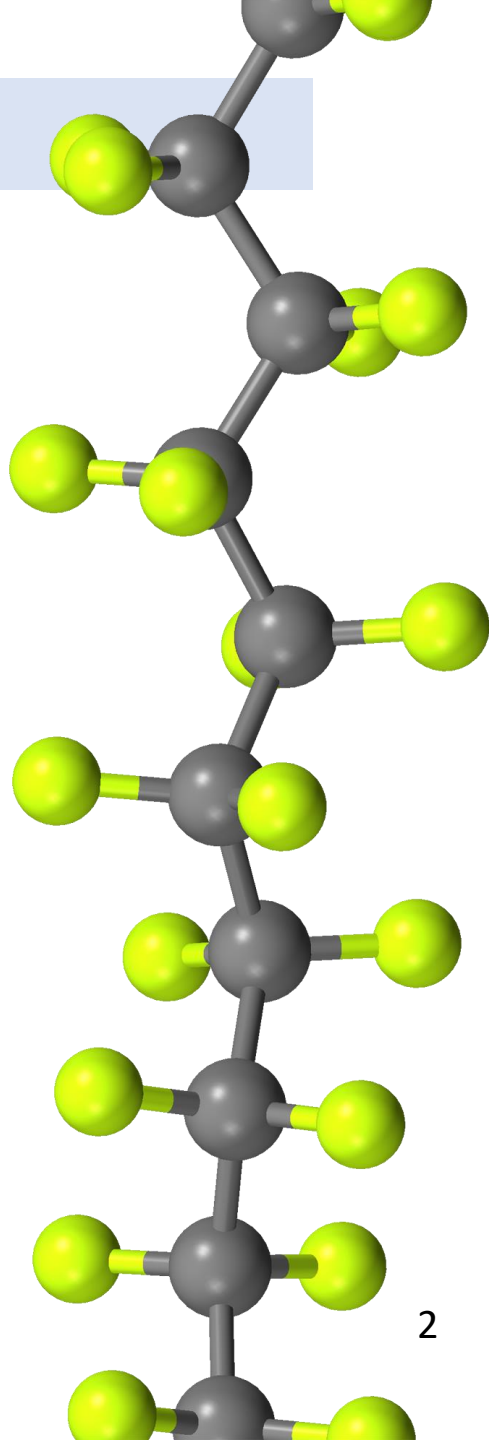
Exam #1 results

- **Class average = 78%**
- Historical ave = 74%, but it wasn't open book.
- Still given everything we are dealing with, I'm genuinely proud of you all!

What to improve? Here's our checklist of key behaviors that lead to success in CHEM 4:

- ✓ Visit our CHEM 4 website regularly: tinyurl.com/SacStateChem4
- ✓ Attend every lecture having completed the assigned reading.
- ✓ Review our PowerPoint slides and/or lecture recordings after each class.
- ✓ Keep up with daily homework. **However, all students will automatically receive full credit for all late homework this semester.**
- ✓ Complete all of the practice exams.
- ✓ Start formal studying for exams 1 week early.
- ✓ Get help when needed:
  - ✓ Put together a weekly study group.
  - ✓ Jeff's office hours: MWF 9 – 9:30 am and 11 – 11:30 am; and by appointment.
  - ✓ PAL office hours: link is on our CHEM 4 website.

- **Everyone deserves a second chance! C2S program allows you to drop lowest exam.**



Survey question

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Thank you for being flexible with regards to rescheduling Exam #1! ☺

How does that impact our semester? I skipped "climate change"

#5 **Sept 28**	**Review Session: Exam #1**	**Exam #1**	Science in the News: Climate change
#6 **Oct 5**	Rd: 2.1-2.4 Sig figs	Rd: 2.4 cont., 5.11 Formula mass	Rd: 2.4 cont. Sig figs
#7 **Oct 12**	Rd: 2.5-2.6 Units/Conversions	Rd: 2.7-2.8 Units/Conversions	Rd: 2.9 Units to power
#8 **Oct 19**	Rd: 2.10-2.11 Density	Rd: 3.8-3.10 Energy and temperature	Rd: 3.11-3.12 Heat capacity
#9 **Oct 26**	Rd: 3.12 cont. Heat capacity	**Review Session: Exam #2**	**Exam #2**

1) In week #9, which two things should we do in addition to Exam #2 on Friday?
   A) Heat capacity (3.12 cont.) and review session
   B) Heat capacity (3.12 cont.) and climate change
   C) Climate change and review session

CHEM 4 lecture

Monday – October 5, 2020

Sec 2.1 – 2.4

Significant figures and measurements

Reading clicker question (Covers material from today's assigned reading)

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2) Which of the following statements is false?

A) Scientific notation is used to convert very large and very small numbers to more compact numbers.

B) Significant figures represent the precision of a measured quantity.

C) A value with fewer significant figures is less precise than a value with more significant figures.

D) Zeros are always treated as significant figures.

E) An exact number has an unlimited number of significant figures.

Background: Exact numbers

Exact numbers are not measurements. They do not have any uncertainty associate with them and therefore they have infinite significant figures.

There are 3 types of exact numbers:

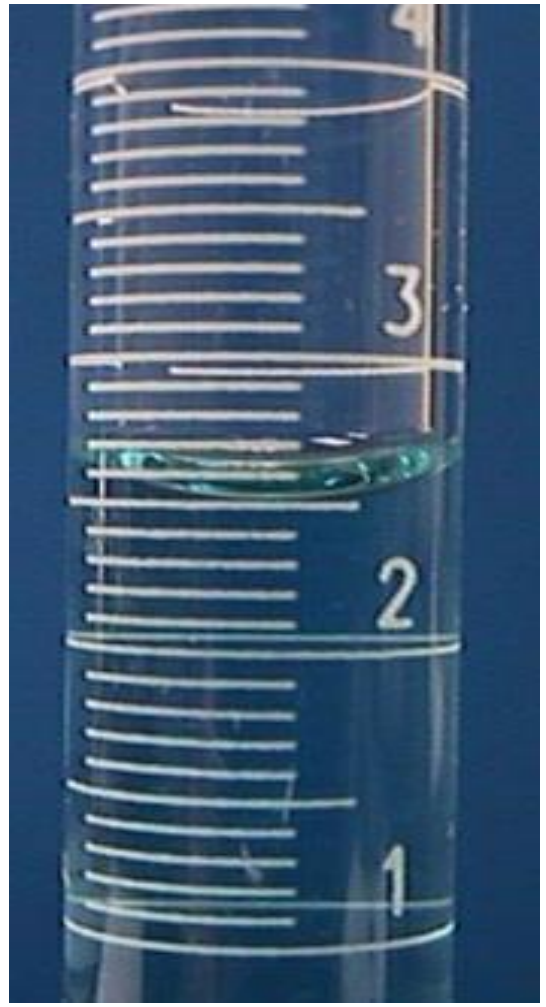
1) **Definitions:**
   - 1 m = 100 cm
   - 1 dozen eggs = 12 eggs = 12.000000000000000000000000… eggs

2) **Whole number things that you can exactly count:**
   - # of CHEM 4 students in our Zoom session right now
   - # of letters on this slide

3) **Integers that are part of mathematical equations:**
   - Volume of a sphere = $^{4}/_{3}\,\pi r^{3}$

Background: Measurements

- In contrast to exact numbers, **measurements** are when we assign a number to a characteristic of an object or event.
- A measurement is made by comparing a quantity with a standard unit.
- Since this comparison cannot be perfect, measurements inherently include error, which is how much a measured value deviates from the true value.



- There is no such thing as an “exact measurement”
- Allowed to have one **guess digit** after all of the **certain digits**
- Certain digits + the guess digits = **significant figures**
- Abbreviated: *sig fig* or *s.f.*

- **Useful guideline:** make the measurement to 1/10th of the smallest division.

Background: Measurements

This mass has 4 significant figures. The *guess digit* is already included.

Background: Measurements

Useful guideline: Make the measurement to 1/10th of the smallest division.

- We are *sure* about the 1.2 cm
- Then we get a *guess digit*.
- It should be reasonable (not 1.21), but it might not be the same as your lab partner.
- For example, 1.27 cm or 1.28 cm would both be acceptable measurements.

Progress clicker question (covers material we are learning now)

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3) Your thermometer has markings every 1°C. Your sample temperature reads between the 20°C and 30°C markings as seen in the photo below. Which reading is reasonable to record in your lab note book?

A) about 20 °C

B) about 30 °C

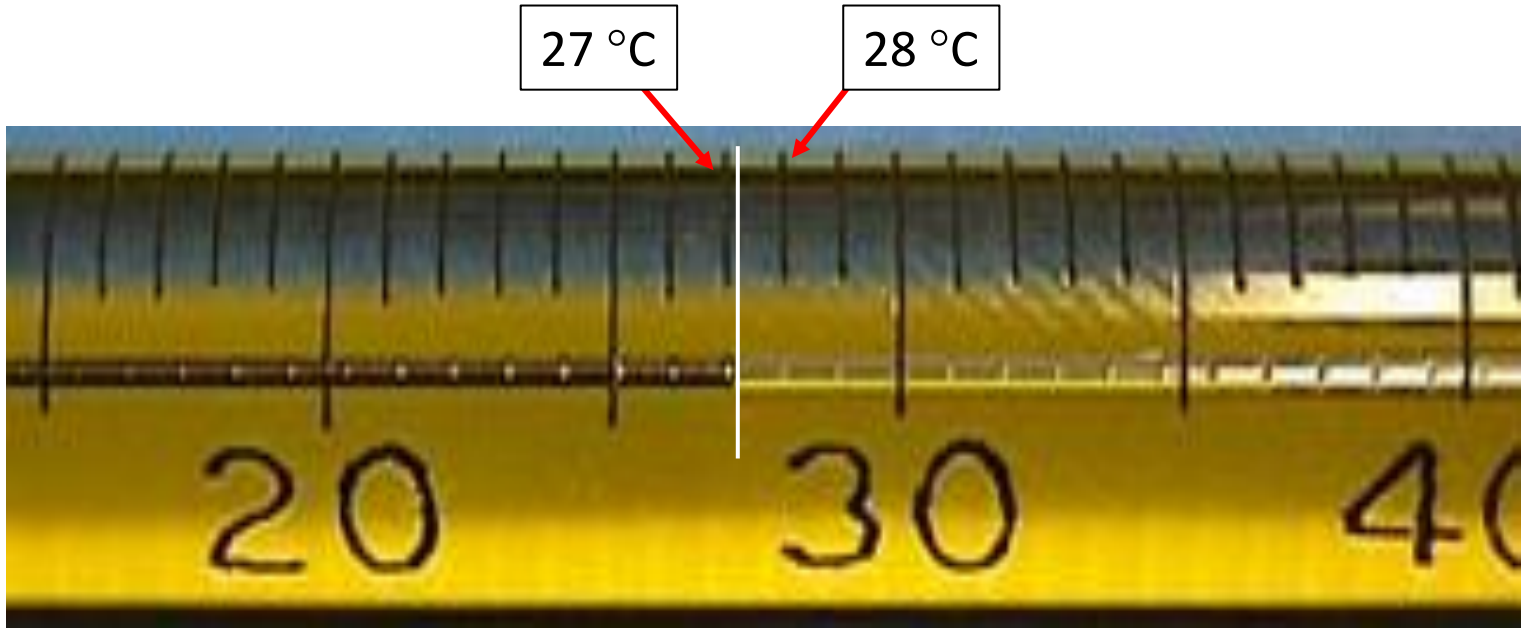
C) 25 °C

D) 27 °C

E) 27.1 °C

F) 27.6 °C

G) 27.05 °C



Background: Rules for determining significant figures

When dealing with someone else's measurement, how do we know if a digit is a significant figure?

1) **The following are always significant:**
   - non-zeros (ex. 684.23 = 5 *sf*)
   - zeros between non-zeros (ex. 5.00301 = 6 *sf*)
   - zeros at the end of a number, ***if*** there is a decimal point (ex. 430.0 = 4 *sf*)

2) **The following are never significant:**
   - zeros at start of a number (ex. 0.0009 = 1 *sf*)

3) **Ambiguous zeros:**
   - zeros at the end of a number, ***if*** there is no decimal point (ex. 6000 = 1 *sf*)

Background: Ambiguous zeros

Notes about ambiguous zeros:

- If we are given a number with ambiguous zeros, we assume the worst and don't count them.
- We never write the results of our calculations with ambiguous zeros. Instead, we can use scientific notation to clarify ambiguous zeros.

Example: If we calculate an answer of 6000 g, it can be written with scientific notation to clarify how many, if any, of the zeros are significant.

- If we want 4 *sf*, we write it as 6.000×10^3 g.
- If we want 3 *sf*, we write it as 6.00×10^3 g.
- If we want 2 *sf*, we write it as 6.0×10^3 g.
- If we want only 1 *sf*, the same number would be written as 6×10^3 g.

Practice: Counting *sig figs* in measured values

Measurement	# of sig figs
2,300.28010 cm	9
0.0000**6800** mL	4
4,500 min	2
704,009 m	6
53,080,000 ft	4
330.000 kg	6

Progress clicker question (covers material we are learning now)

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4) Which of the following measurements has the greatest number of significant figures?

A) 6.0500 **(5 sf)**

B) 0.605 **(3 sf)**

C) 0.06050 **(4 sf)**

D) 605000 **(3 sf)**

E) 0.0000605 **(3 sf)**

F) 605.0 **(4 sf)**

Background: Determining *sig figs* in calculations (x/÷)

When multiplying and dividing measurements:

- Answer can't have more *sig figs* that the measurement with the fewest *sig figs*.

Steps:

1) Write down the entire number from your calculator.
2) Determine *sig figs* for each measurement used in the calculation.
3) Round answer so it has the same # of *sig figs* as measurement with fewest *sig figs*. Round ↓ if leftmost digit dropped is ≤ 4. Round ↑ if leftmost digit dropped is ≥ 5.
4) Make sure final answer has correct units.

Example: If it takes you 12.356 hours to drive 650 miles, what is you velocity in mi/hour reported with the correct number of *sig figs*?

Step 2)

2sf → 650 miles / 12.356 hours ← *5sf*

Step 1)

= 52.60602137

Round answer to 2 sf.
Leftmost dropped digit is "6" so round up.

Step 3)

Step 4)

= 53 mi/hr (or 53 mph)

Progress clicker question (covers material we are learning now)

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5) Perform the following calculation and report the answer with the correct number of significant figures:

$$(0.0030\ \text{cm}) \times (9.55\ \text{cm}) \times (6.13\ \text{cm})$$

A) $0.175625\ \text{cm}^3$

B) $0.17562\ \text{cm}^3$

C) $0.1756\ \text{cm}^3$

D) $0.176\ \text{cm}^3$

E) $0.18\ \text{cm}^3$

F) $0.2\ \text{cm}^3$

Answer:

$(0.0030\ \text{cm}) \times (9.55\ \text{cm}) \times (6.13\ \text{cm}) = 0.1756245\ \text{cm}^3 = 0.18\ \text{cm}^3$

2sf *3sf* *3sf* *keep 2sf* *round up*

Progress clicker question (covers material we are learning now)

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6) Perform the following calculation and report the answer with the correct number of significant figures:

$$4.91 \text{ m} \div 500 \text{ s}$$

A) 0.00982 m/s

B) 0.001 m/s

C) 0.01 m/s

D) 0.0098 m/s

E) 0.009 m/s

Answer:

$$4.91 \text{ m} \div 500 \text{ s} = 0.00982 \text{ m/s} = 0.01 \text{ m/s}$$

3sf *1sf* *keep 1sf* *round up*

The answer is not = 0.001 m/s.
Make sure the 9 rounds up to 10. so 0.009 becomes 0.010, then keep 1 sig fig to give 0.01 m/s.