Welcome to our CHEM 4 lecture

Review clicker question: Covers material from last class

Go to LearningCatalytics.com Session ID =

1) A car is rated with a highway mileage of 41 mpg of gasoline. How many liters of gasoline will be needed for a highway trip of 555 km?

A) 6 L D) 3×10^1 L G) 8×10^1 L

B) 82 L E) 31.8 L

C) 32 L F) 5.8

Hints:

- *Write 41 mpg as* $\frac{41 \text{ miles}}{1 \text{ gallon}}$
- *Save conversion factors for converting; don't start with them.*

Answer: 1) Flowchart: km → miles → gallons → L

2) Conversion factors: $\left(\frac{1 \text{ mile}}{1.609 \text{ km}}\right)$ $\left(\frac{41 \text{ miles}}{1 \text{ gallon}}\right)$ $\left(\frac{1 \text{ gallon}}{3.785 \text{ L}}\right)$

3) Calculation: $(555 \cancel{\text{km}}) \left(\frac{1 \cancel{\text{mile}}}{1.609 \cancel{\text{km}}}\right) \left(\frac{1 \cancel{\text{gallon}}}{41 \cancel{\text{miles}}}\right) \left(\frac{3.785 \text{ L}}{1 \cancel{\text{gallon}}}\right) = 31.84336582 = \mathbf{32\ L}$

Keep 2sf

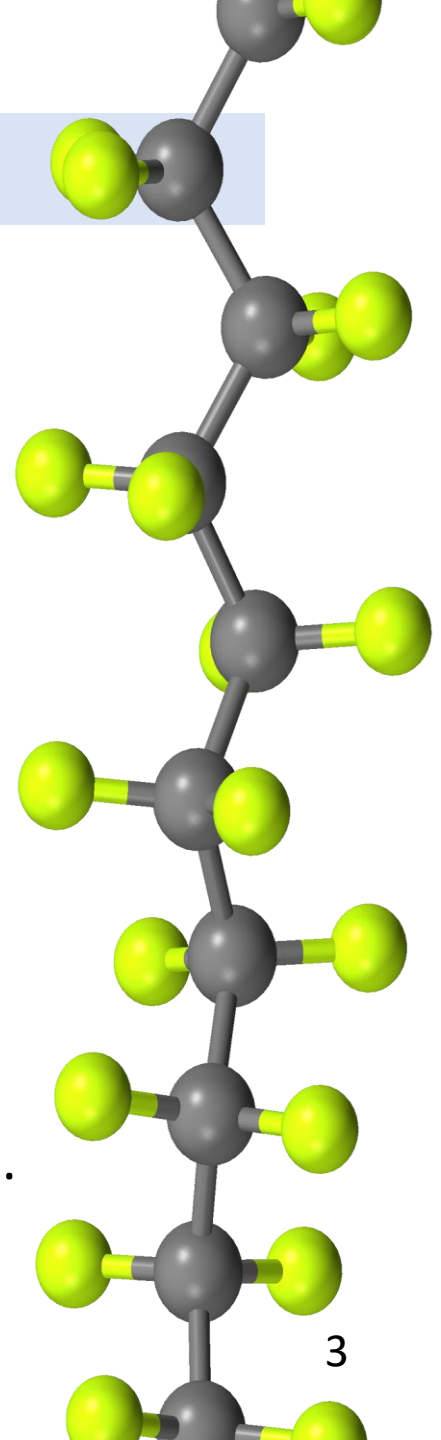
4) Sig figs: *3sf* *4sf* *2sf* *4sf*

- ✓ To vote in the November election, your registration must be postmarked or submitted electronically no later than Monday, October 19.
- ✓ You can register to vote, check your registration status, and get info on upcoming elections including the various mechanism for voting at: www.sos.ca.gov/elections

- ✓ More information: Hornets vote! Hornets count!
- ✓ Among many important issues that will be impacted by our election results is how the United States addresses climate change.
- ✓ I recorded our missed climate change lecture and posted it along with other climate resources on our class website: tinyurl.com/SacStateChem4

Key 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 (they are posted on the above website in the calendar section)
- ✓ 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.
- ✓ **Talk to your Commit to Study peer mentor about how you are doing in CHEM 4.**
- ✓ 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.



Prerequisites for CHEM 1A/1E

Students can meet the *chemistry prerequisite* in any of the following ways:

- ~~Having a Chemistry Diagnostic Score of 35 or higher.~~ (not available during COVID)
- Completed CHEM ALEKS (CARA) with 85% of the topics completed.
- Passing CHEM 4 or CHEM 6A with a ***grade of C or better***.
- Having obtained D to a C- in CHEM 4 AND completing 85% or the topics successfully in CARA.

Students can meet the *math prerequisite* in any of the following ways:

Math Prerequisite for CHEM 1A:	**Math Prerequisite for CHEM 1E:**
• A Math ALEKS PPL Score of 61 or higher • Successful completion of Math 12 or the equivalent • Current enrollment in Math 26A, Math 29 or a higher • Score of a 3 or higher on AB or BC Calculus AP Test • Ability to enroll in Math 26A or Math 29	• A Math ALEKS PPL score of 76 or higher • Successful completion of Math 29 or equivalent • Enrollment in a math course of Math 30 or higher • Score of a 3 or higher on AB or BC Calculus AP Test

- Questions can be directed to **Dr. Susan Crawford (crawford@csus.edu)** or **Dr. Roy Dixon (rdixon@csus.edu)**
- Chem department: https://www.csus.edu/college/natural-sciences-mathematics/chemistry/
- Math dept ALEKS PPL: https://www.csus.edu/college/natural-sciences-mathematics/math-placement-exam/

CHEM 4 lecture

Friday – October 16, 2020

Sec 2.9

Units raised to a power: Area and Volume

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

Go to LearningCatalytics.com Session ID =

2) Which of the following statements is false?

A) When converting quantities with units raised to a power, the conversion factor must also be raised to that power.

B) Starting with 1 in. = 2.54 cm, we can derive that 1 in^3 = 16.387 cm^3.

C) A square meter is much larger than a square centimeter.

D) Starting with 1 km = 10^3 m, we can derive that 1 km^2 = 10^9 m^2.

E) We can derive conversion factors between cubic units from the conversion factors for the basic units.

Background: Deriving squared and cubed units

What should answer D) be on the previous slide?

- If we want to convert between km^2 and m^2, we can use the relations between km and m to derive what we need.
- Start with: $1\ km = 10^3\ m$
- Square both sides including all numbers and units:

$$(1\ km)^2 = (10^3\ m)^2$$

$$(1\ km)(1\ km) = (10^3\ m)(10^3\ m)$$

$$1\ km^2 = 10^6\ m^2$$

- Make into a conversion factor: $\dfrac{1\ km^2}{10^6\ m^2}$
- Common mistakes: $\neq \dfrac{1\ km^2}{10^3\ m^2}$ $\neq \dfrac{1\ km^2}{10^9\ m^2}$

- **You try:** Turn the following equality into conversion factors for area and volume:

$1\ in = 2.54\ cm$

area: $1\ in^2 = 6.4516\ cm^2$

$$\left(\frac{6.4516\ cm^2}{1\ in^2}\right)$$

volume: $1\ in^3 = 16.387\ cm^3$

$$\left(\frac{16.387\ cm^3}{1\ in^3}\right)$$

Background: Deriving squared and cubed units

Example: The volcanic eruption that destroyed the Indonesian island of Krakatau on August 27, 1883 release an estimated 1.8×10^{10} cubic meters of debris and affected global weather for years. How many cubic miles of debris were released?

Answer: 1) Flowchart: $m^3 \rightarrow km^3 \rightarrow mi^3$

2) Conversion factors: $\left(\frac{1\ km}{10^3\ m}\right)^3 = \left(\frac{1\ km^3}{10^9\ m^3}\right)$ $\left(\frac{1\ mi}{1.609\ km}\right)^3 = \left(\frac{1\ mi^3}{4.1655\ km^3}\right)$

3) Perform calculation:

$$1.8 \times 10^{10}\ \cancel{m^3}\left(\frac{1\ \cancel{km^3}}{10^9\ \cancel{m^3}}\right)\left(\frac{1\ mi^3}{4.1655\ \cancel{km^3}}\right) = 4.321209939\ mi^3 = \mathbf{4.3\ mi^3}$$

4) Sig figs: *2 sf* *∞ sf* *4sf* *Keep 2sf*

5) Check answer: Correct units. "mi^3" are bigger than "m^3", so our answer should be a smaller than our starting number. Exponents seem okay: $(10^{10})(10^{-9}) = 10$

Progress clicker question: Covers material we are learning now
Go to LearningCatalytics.com Session ID =

3) A farm has an area of 4.0 km^2. How many acres is the farm? (Note: 1 acre is defined as equal to 43,560 ft^2)

A) 0.023 acres
C) 9.9×10^2 acres
E) 4.4×10^3 acres
B) 6.0×10^3 acres
D) 2.8×10^{-8} acres
F) 8.3×10^2 acres

Answer: 1) Flowchart: $km^2 \rightarrow ft^2 \rightarrow$ acres

2) Conversions: $\left(\frac{1.609\ km}{5280\ ft}\right)^2$ $\frac{1\ acre}{43{,}560\ ft^2}$

Already an area, so don't "square" it again.

Don't forget to square the numbers.

3) Calculation: $(4.0\ km^2)\left(\frac{5280\ ft}{1.609\ km}\right)^2\left(\frac{1\ acre}{43{,}560\ ft^2}\right) = 988.8442149\ acres = \mathbf{9.9 \times 10^2\ acres}$

2 sf *4 sf* *∞ sf*

4) Sig figs: *Keep 2sf. Use scientific notation to avoid ambiguous zeros.*

5) Check answer: Correct units. Don't forget to square the km → ft conversion; if this is something you keep forgetting, you can square it before putting it in the calculation.

Progress clicker question: Covers material we are learning now
Go to LearningCatalytics.com Session ID =

4) The volume of a room is 4.5 x 10^4 ft^3. What is the volume of the room in L?

A) 1.2 x 10^5 L
B) 1372 L
C) 1.27 x 10^6 L
D) 1400 L
E) 1.3 x 10^6 L
F) 1.4 x 10^3 L
G) 1.3 x 10^3 L
H) 1 x 10^3 L

Answer: 1) Flowchart: $ft^3 \rightarrow in^3 \rightarrow cm^3 \rightarrow L$

2) Conv. factors: $\left(\frac{1\text{ ft}}{12\text{ in}}\right)^3 = \left(\frac{1\text{ ft}^3}{1728\text{ in}^3}\right)$ $\left(\frac{2.54\text{ cm}}{1\text{ in}}\right)^3 = \left(\frac{16.387\text{ cm}^3}{1\text{ in}^3}\right)$ $\left(\frac{1\text{ L}}{1000\text{ cm}^3}\right)$

3) Calculation: $(4.5 \times 10^4\ \cancel{ft^3})\left(\frac{1728\ \cancel{in^3}}{1\ \cancel{ft^3}}\right)\left(\frac{16.387\ \cancel{cm^3}}{1\ \cancel{in^3}}\right)\left(\frac{1\text{ L}}{1000\ \cancel{cm^3}}\right) = 1274258.097 =$ **1.3 x 10^6 L**

4) Sig figs: *2 sf* *∞ sf* *∞ sf* *∞ sf*

Keep 2sf. Use scientific notation to avoid ambiguous zeros.

5) Check answer: Correct units. ft^3 are bigger than L, so seems okay. Cubed correctly.

6) Another possible flowchart: $ft^3 \rightarrow km^3 \rightarrow m^3 \rightarrow cm^3 \rightarrow L$

Progress clicker question: Covers material we are learning now
Go to LearningCatalytics.com Session ID =

5) You are asked to convert the volume of a large crystal of potassium permanganate from mm^3 to pL. Which of the following is the most reasonable flow chart for this calculation given the conversion factors we have available?

A) $mm^3 \rightarrow mm \rightarrow cm \rightarrow L \rightarrow pL$

B) $mm^3 \rightarrow ft^3 \rightarrow L \rightarrow pL$

C) $mm^3 \rightarrow cm \rightarrow cL \rightarrow L \rightarrow pL$

D) $mm^3 \rightarrow ft^3 \rightarrow km^3 \rightarrow m^3 \rightarrow cm^3 \rightarrow L \rightarrow pL$

E) $mm^3 \rightarrow m^3 \rightarrow cm^3 \rightarrow L \rightarrow pL$

F) $mm^3 \rightarrow cm^3 \rightarrow L^3 \rightarrow L \rightarrow pL$

Progress clicker question: Covers material we are learning now
Go to LearningCatalytics.com Session ID =

6) A large crystal of potassium permanganate has a volume of 10.8 mm^3. What is the volume of the crystal in pL?

A) 1.08×10^{10} pL
B) 1.08×10^{-15} pL
C) 1.08×10^{9} pL
D) 1.08×10^{7} pL
E) 1.08×10^{11} pL
F) 1.08×10^{-13} pL
G) 1.08×10^{8} pL
H) 1.08×10^{-16} pL

Answer: 1) Flowchart: $mm^3 \rightarrow m^3 \rightarrow cm^3 \rightarrow L \rightarrow pL$

2) Conv. factors: $\left(\frac{10^{-9}\ m^3}{1\ mm^3}\right)$ $\left(\frac{10^{-6}\ m^3}{1\ cm^3}\right)$ $\left(\frac{1\ L}{1000\ cm^3}\right)$ $\left(\frac{1\ pL}{10^{-12}\ L}\right)$

Already volumes, so don't cube.

3) Calculation: $(10.8\ \cancel{mm^3})\left(\frac{10^{-9}\ \cancel{m^3}}{1\ \cancel{mm^3}}\right)\left(\frac{1\ \cancel{cm^3}}{10^{-6}\ \cancel{m^3}}\right)\left(\frac{1\ \cancel{L}}{1000\ \cancel{cm^3}}\right)\left(\frac{1\ pL}{10^{-12}\ \cancel{L}}\right)$ = **1.08×10^{7} pL**

4) Sig figs: *3 sf* *∞ sf* *∞ sf* *∞ sf* *∞ sf*

Keep 3sf. Use scientific notation to avoid ambiguous zeros.

5) Check answer: Correct units. Overall exponent looks good. Cubed correctly.