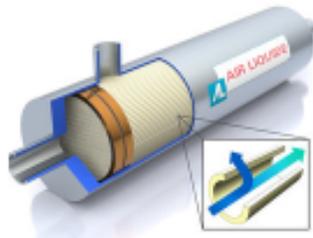


***QRProblems.org***  
*Open-Sourced System for Variable Parameter  
Quantitative and Qualitative Engineering  
Problems*



*Amanda P. Malefyt and John Wagner*  
Trine University, McKetta Department of Chemical  
and Bioprocess Engineering

Helium gas is produced by separating it out of natural gas. Several separation technologies exist including cryogenic, pressure swing absorption and membrane separation.



In one application, a gaseous mixture containing **8 mol%** helium in methane is fed as stream 1 to a membrane separator as shown in the figure below:



Stream 3 flows at **10 mol/s**, is composed of **50 mol%** helium and contains **20%** of the helium fed to the separator.

Determine the:

- flowrate of the feed, stream 1 in mol/s
- concentration (mol %) of helium in stream 2
- mass flow (kg/min) of helium in stream 2
- mass percentage of helium in stream 2
- average molar mass of stream 3



## Quick Response Checker

Name: Ima Student Assign Num: 1 Problem: 2 Max Attempts: infinite

Time delay starts at 5 tries per part for 30 s then 60 s after 15 tries

Problem Number: 653 - 5

a) flowrate of the feed, stream 1 in mol/s

a)(19%)  mol/s - **Correct** count 1 - Computed value is: 92.66

b) concentration (mol %) of helium in stream 2

b)(19%)  mol% - **Not Correct** count 1

c) mass flow (kg/min) of helium in stream 2

c)(19%)  kg/min - count 0

d) mass percentage of helium in stream 2

d)(19%)  wt% - count 0

e) average molar mass of stream 3

e)(19%)  g/mol - count 0

**Provisional Score on Problem: 19 out of 95 %**

note - Score only includes quantitative parts of the problem. These points awarded when work is uploaded.

Total Count: 1

Check 

- Each student sees a different version of the problem
- YouTube videos or links to solution/hint videos of similar problems
- Multiple attempts, immediate feedback
- 600+ problems for: MEB, Fluids, Numerical Methods, Statistics, Process Safety, Design, Dynamics & Controls, Eng Economics
- Integrates with some LMS (moodle)

Student interface



# QRproblems.org – Bonus Features



Problems can be collected into an assignment



Pre-problem reflection  
(First look policy)



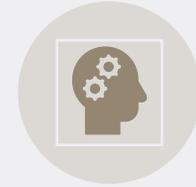
Stepped delivery & Base case support



Delayed response time for random guessing



Chatbot add-in



Post problem reflection and connections



- Post problem reflection and connections

*i. Reflect* – Expert problem solvers reflect on the process. Describe in words your problem-solving methodology and your ability to solve this problem. Some questions you may want to consider include:

- Did you get the answer to all parts on the first try? If not, what was your most serious mistake and how could you minimize that type of mistake in the future.
- What part of your solution strategy went well? What part could use improvement?
- Were you stuck on one part? What process was effective in getting unstuck?
- Did you use a well-defined problem-solving algorithm? If not, why not?
- Did you start early enough to give yourself time to step away from the problem and “incubate the problem”?
- If you could give advice to your former self regarding this problem, or homework set, what would it be?

*ii. Explore* – Does the height of the pipe,  $h_2$ , effect the height of the jet,  $h$ ? Explain your answer using a complete sentence. If we did an experiment we would find that as the height  $h_2$  increases the height of the jet,  $h$ , decreases. This disagrees with our solution using Bernoulli equation. Explain this contradiction.

*iii. Connect* – The [fountains at the Bellagio Casino](#) in Los Vegas are amazing. Some of the water jets shoot upwards of 420 feet. What is the minimum pressure required to shut a jet of water up that high?

*iv. Safety & Society* – Pressurizing tanks filled with fluids can be dangerous. What would the exit speed of a water jet have to be to be dangerous to humans? Cite your source for this number.



## Quick Response Question Management

Target Number of New Questions to Deliver:

Monday  Tuesday  Wednesday  Thursday  Friday  Saturday  Sunday

**Delivery Timing:**

Global Start Date  Global End Date  Time to Email First Question

**Participants:**

Current Class:

**Types of Problems:**

Grade Level  Target Percentage of Current Questions  Target Percentage of Basic Level Questions

**Concepts Covered:**

Discipline (re-select to edit):

Current Course

Note - you can adjust start date for each concept

Data Visualiation   Priority (high = 1)

Ideal Gas Law   Priority (high = 1)

Instructor interface

- In class assessment (similar to PollEverywhere or Kahoots)
- Semi-automatic curriculum review and retrieval practice
- Adapts to each student
  - A question that is missed gets recycled again
  - A question must be answered correctly twice to be “retired” for that student.

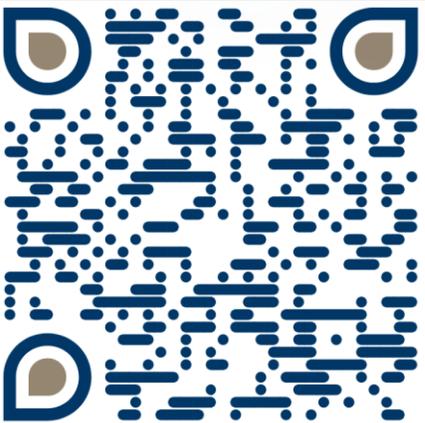


# Consolidated repository: QR-ED.org

QR-ED.org is suite of educational material and applications written by and for Instructors of quantitative subjects



- 1000+ static options
  - Problems
  - Questions
- Mostly chemical engineering but also mechanical engineering, civil engineering, mathematics, chemistry, and physics
- Video tutorials for each application
  - QRProblems.org
  - QRQuestions.org
  - QRGames.org (*our spin on Gimkit*)





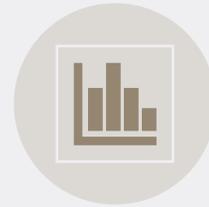
# Future Goals



Partner with computer science program to develop an app with streamlined coding and cybersecurity



Increase user base



Utilize data tracking features for engineering education research



# Related Workshops, Presentations, and Posters

1. **Liberatore M, Malefyt AP.** (2023) Visual, Creative Problems for Any Engineering Course *Keen National Conference Atlanta GA (1.5 Hour Workshop).*
2. **Wagner JE, Malefyt AP, Hersel A, Borden J.** (2022) Increase Recycle to Reduce the Purge – A System to Improve Curriculum Retention *Poster Session - AIChE National Meeting Phoenix AZ*
3. **Wagner JE, Malefyt AP.** (2021) Gamification of Quantitative Problems to Increase Student Engagement? (2021) *Poster Session - AIChE National Meeting Boston MA*
4. **Wagner J, Malefyt AP, Canino J.** (2019) Can We Spend Less Time Grading Without Decreasing Student Learning? *AIChE National Conference (Poster).*
5. **Wagner J, Malefyt AP, Thomas G.** (2018) Check Your Homework with your phone. *AIChE National Conference (Presentation).*
6. **Wagner J, Hersel H, Malefyt AP.** (2017) Supplement Homework with Problems from a Freely Available Repository. *AIChE National Conference (Presentation).*
7. **Wagner J, Malefyt AP, Koch J.** (2017) Tools for Creating Variable Parameter Homework Problems. *ASEE National Conference.*
8. **Wagner J, Malefyt AP.** (2016) Spreadsheet Template to Aid in Creating Individualized Version of Objective Homework Problems. *AIChE National Conference (Presentation)*