

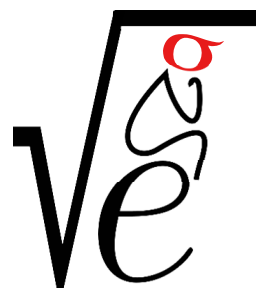
SigmaCamp's Problem of the Month Contest

NOVEMBER 2023

Mathematics

5 points:

You're a famous detective and you're trying to solve a murder. You know that the murderer was one of exactly 6 suspects. Among the suspects, one was actually a witness of the crime, but you don't know who this is. The witness is afraid of the murderer and will not say anything if the murderer will be able to hear it. What you can do is repeatedly select a group of people to go to a separate room. There you can ask them if anyone knows who the murderer is. If the witness is in the room and the murderer is not, they will speak up. You could take all 6 people aside one-by-one, but that will take a long time. How small of a number of groups can you take aside to guarantee that the witness speaks up? (The smaller the number of groups you need in your strategy and the cleaner your solution, the more points you'll get!)



Hint:

If you make each group too small you might not get the witness in the group, but if you make each group too big you risk including the murderer. One needs to strike a balance with the group size! What happens if you only identify people by the set of groups they belong to?

Solution:

Answer:

We can do it in 4 groups! If our suspects are A, B, C, D, E , and F , one possible set of groups that works is $\{A, B, C\}$, $\{A, D, E\}$, $\{B, D, F\}$, and $\{C, E, F\}$. One way to think about our suspects is by what set of groups they are part of. For a moment, suppose that the number of suspects was too large to find the number of groups by brute force, such as 70. One suspect among these 70 might be part of the first group, not the second, the third and the fourth, and so on. We might call them $\{1, 3, 4, \dots\}$. Then, when we call a group, we ask all suspects who have that group's number in their set to attend. Since the suspects all initially appear identical and we should balance our group size, we should probably have each suspect go to half of the groups and for each group to involve half of the suspects. This means that if we have $2n$ groups, each suspect can be identified by a set of n numbers from 1 to $2n$. If $2n = 8$, then there are $\binom{8}{4} = 70$ such subsets. This means that 70 suspects can be interrogated with just 8 groups, while $6 = \binom{4}{2}$, so for our problem we only need 4 groups.

10 points:

You're a famous detective and you're trying to solve a second murder. You know that the murderer was one of exactly 4 suspects: A, B, C, or D. You have 4 witnesses, P, Q, R, and S, who all know who the murderer is. However, exactly one of the witnesses always lies (the other witnesses always tell the truth) and you don't know which one! You are allowed to ask *each* of your witnesses *exactly one question* of the form "Is one of [some improper subset of A,B,C,D] the murderer?". The sets of suspects can be the same or different in your questions, but your questions must be submitted in writing in advance, so you do not get to find out the answer to one question before deciding what to ask the next witness. Your brilliant detective mind realizes that there is a guaranteed way to establish who the murderer was as well as which witness is lying! What sets of people do you ask about and why does that always let you find the murderer?

Hint:

After every question you ask, the number of possibilities for who the murderer and who the liar is should be halved, no matter what the answer is.

Solution:

Answer:

We can do this with the sets $\{A, B\}$, $\{A, B\}$, $\{A, B\}$, and $\{A, C\}$. If you figure out the murderer, you will also be able to tell which witness is lying. Since there are 16 possibilities for the pairs of (murderer, liar) and since your 4 questions can only give you 2^4 distinct answer combinations, you cannot waste any information. Each answer combination must correspond to a unique (murderer, liar) pair. Since a question's answer must match 8 combinations, we need the answer to be *Yes* or *No* exactly half of the time, so we should always ask about a pair of suspects. Another key idea is that most witnesses are truthful, so by asking the same question enough times, we can figure out the true answer to it. Specifically, if we ask about the pair $\{A, B\}$ three times, at least two answers will agree and will be the truth. If the third answer is different from the majority, then the dissenter is lying. If all three answers agree, the liar is the fourth witness. Knowing which witness is lying and whether one of $\{A, B\}$ is the killer allows us to ask the last witness about $\{A, C\}$ and figure out who the killer must be. This last step can be done by imagining a 2×2 box with A and B in the top row and C and D in the bottom row. Knowing whether A or B is the killer tells us the row of the killer and knowing whether A or C is the killer tells us the column of the true murderer.

Physics

5 points:

Two friends, [Simplicio and Sagredo](#), are discussing a container of water on their table (pictured in Fig. 1). The container is peculiarly shaped – its base is perfectly square, with side length L_1 , but at height H_0 its neck contracts to a smaller square of side length L_0 .

Simplicio brags to Sagredo about an interesting fact he recently learned from their mutual friend Salviati. “Sagredo,” he says, “did you know that the pressure of stationary water in a container is precisely determined by its depth below the surface? At depth h , the water pressure P is given by the formula

$$P = \rho gh,$$

where g is the gravitational constant, and ρ is the density of the water.

“For example,” he goes on, “in this container, the water at the base is at height H below the surface. The pressure at the base is ρgH , and so I can immediately deduce that the total force exerted by the container on the table must be $L_1^2 \rho gH$. How neat is that?”

Sagredo ponders this for a second. “But Simplicio,” he asks, “the force the container exerts on the table should be equal to its weight. How is it that you’ve managed to deduce the weight without considering at all the weight or volume?”

“That’s a great question,” agrees Simplicio, confused. “But I am one hundred percent sure I understood Salviati correctly. What am I doing wrong?”

Can you help resolve Simplicio and Sagredo’s confusion? What is the correct value for the force of the container on the table? What did Simplicio do wrong when calculating the force, and how can he correct his mistake? Ignore the weight of the container itself, and assume that only the water’s weight matters.

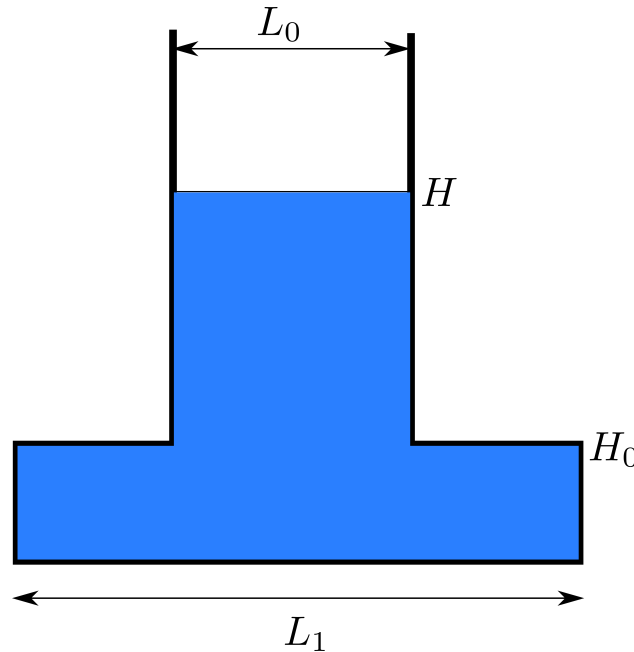
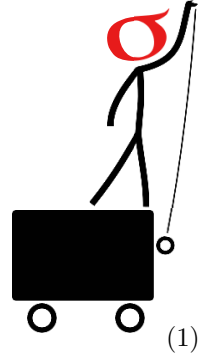


Figure 1: The shape of the water container Simplicio and Sagredo are discussing, as viewed from the side. The container is perfectly square when viewed from the top, and is a perfect square with side length L_1 narrowing to another perfect square of side length L_0 at height H_0 .

Hint:

No hint this month.

Solution:**Answer:**

Simplicio did in fact give the correct value for the downward force the water exerts on the bottom of the container. However, there is also an upward force on part of the container, so the total force exerted by the container on the table is less than the value Simplicio gave.

Specifically, the force on the upper horizontal part of the container is $F = A \cdot P = A(\rho gh) = (L_1^2 - L_0^2)\rho g(H - H_0)$. The forces on the sides can be neglected since they perfectly cancel. The overall force the water exerts on the container and the force the container exerts on the table is $L_1^2\rho gH - (L_1^2 - L_0^2)\rho g(H - H_0) = L_0^2\rho g(H - H_0) + L_1^2\rho gH_0$. This is exactly the volume of the water multiplied by ρg .

10 points:

When you cover the mouth of a running hose with your finger, the water sprays further. A typical garden hose has about a 1cm diameter, and a water pressure of about 50 N/cm². If you point the hose perfectly horizontal at a height of 1m, how far away from you will the water hit the ground? What percentage (by area) of the mouth of the hose will you have to plug with your finger in order to spray the water a distance of 10m? Ignore air resistance in your calculations.

Hint:

No hint this month.

Solution:

Answer:

Part (a): The distance d that the water is projected from the mouth of the hose is precisely determined by its exit velocity v . The time of flight from height h is

$$T = \sqrt{\frac{2h}{g}},$$

giving us

$$d = vT = v\sqrt{\frac{2h}{g}}.$$

What is left is to determine the exit velocity. We do this by converting the static pressure of the hose when capped off to the dynamic pressure of the flowing water when the hose is open using Bernoulli's equation:

$$P = \frac{1}{2}\rho v^2 \implies d = \sqrt{\frac{4Ph}{\rho g}}.$$

Plugging in the given numbers, we find $d \approx 14\text{m}$.

Part (b): 14m is already greater than 10m, so there is no need to cover any of the hose's entrance to launch it this far. This was an error on the part of the problem's author. In general, to launch the water a distance $d' > d$, we note the relationship between flow rate and area as $A'v' = Av$. We therefore determine that

$$d' = \frac{A}{A'}d.$$

So we may solve for the ratio of opening area A/A' .

Chemistry

5 points:

Circle all the explosive molecules, and justify your answers.

Hint:

A necessary (although not a sufficient) condition for a substance to be explosive is a presence of a large amount of electronegative atoms in a high oxidation state and, simultaneously, of a large amount of electropositive atoms in a low oxidation state.



Solution:

Answer: Explosive compounds are shown at the figure below

To be explosive, the substance must contain highly electronegative atoms that are present in a high oxidation state, AND it must contain electropositive atoms in its low oxidation state. A typical example is nitro compounds (marked with red): highly electronegative nitrogen atoms are deprived of a significant amount of its valence electrons (because the electrons are displaced towards oxygen atoms), whereas the electron density on carbon atoms is pretty significant. Obviously, this state is not stable: the total energy would be significantly lower if oxygen atoms from the NO_2 group connect to carbon atoms (yielding CO_2), and nitrogen atoms connect together to form N_2 , which is one of the most stable states of nitrogen. This transformation produces a significant amount of energy, which propagates through the solid explosive in a form of the shock wave, and when the front of this wave reaches intact regions of the explosive, the temperature jump causes new portions of the material to explode, thereby making the propagation of the shock wave a self-supported process.

That means, the presence of NO_2 is not sufficient for a compound to be explosive: if the content of NO_2 is low (like in *p*-nitroaniline, the top left structure), the energy released due to rearrangement of NO_2 is not sufficient to support the shock wave, which means this compounds is not explosive.

Another example of explosive compounds is peroxides, such as acetone peroxide (marked with pink): a single oxygen-oxygen bond has a very high energy, so its rearrangement to O_2 and ROR (where R denotes an alkyl group) leads to a release of a significant amount of energy.

A third example of explosives is azides. These compounds contain three nitrogens in different oxidation states: some of them are too electron rich, whereas others are deprived of a significant part of electronic density. That makes azides very explosive (they rearrange to N_2).

Azides and peroxides explode in the same way as nitro compounds: that occurs via a shock wave propagation (this process is also called "detonation"). Therefore, if the content of peroxy or azido groups is relatively small (AZT is an example), no self-sustained shock wave can form in such a material, which means it is not explosive. That is why methylazide (green) is highly explosive, but AZT is not.

The last example of highly explosive material is tetrazolyldiazonium (blue). This compound is among the most explosive materials known to humans: even its relatively diluted aqueous solutions are explosive.

10 points:

Using materials from you kitchen or garage, find the best chemical that accelerates hardening of superglue. Propose the experiment to measure the acceleration/deceleration effect of additives, and do it. Provide a description of your experimental protocol (including photos of your experimental setup, if possible), your results and your conclusion.

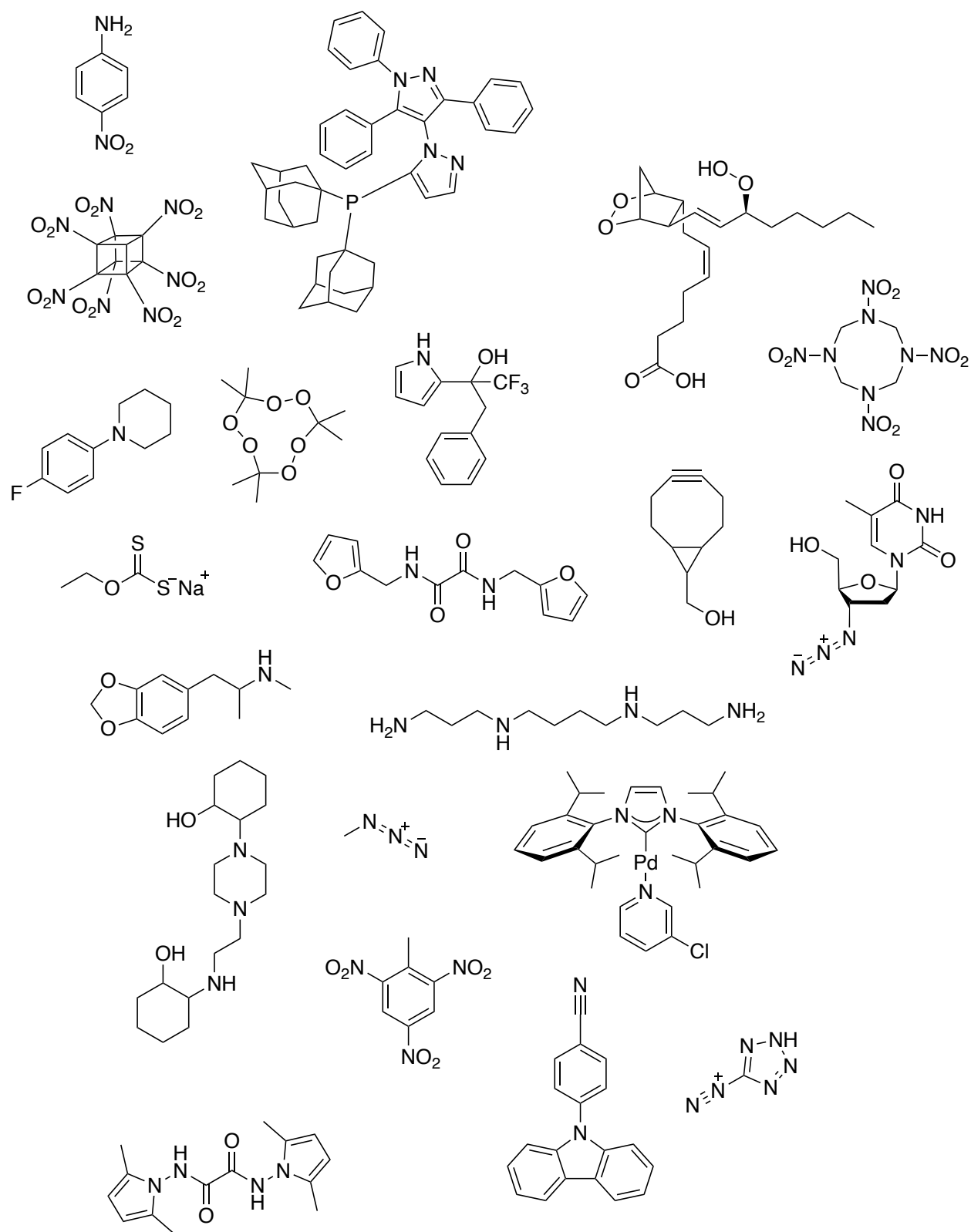


Figure 2: Possibly explosive compounds

you can write your solution in any form.

Hint:

Acrylic glue hardens due to polymerization. This process belongs to a very specific class of chemical reactions that are called "chain reactions". An important factor that affect the rate of this type reactions is the process of initiation.

Solution:

Answer: Baking soda seems to be the most efficient hardener.

We first need to design a simple experimental setup to measure the speed of the superglue hardening. The main problem here is that we must measure a fairly quick process that starts after mixing two different components, and measuring the rate of hardening is not straightforward. The simplest approach would be to start several experiments in parallel, such that each experiment starts at a different moment in time, but ends at the same time as the others. We first cut a piece of thick paper (or thin cardboard) as shown in Figure 4. Each spot is labeled as 600 sec, 240 sec, 120 sec, 60 sec, 20 sec, 10 sec, 5 sec, 2 sec, 1 sec, and 0 sec.



Figure 4

Then, we put a toothpick into each slot such that the toothpick touches each spot, as shown in Figure 5.

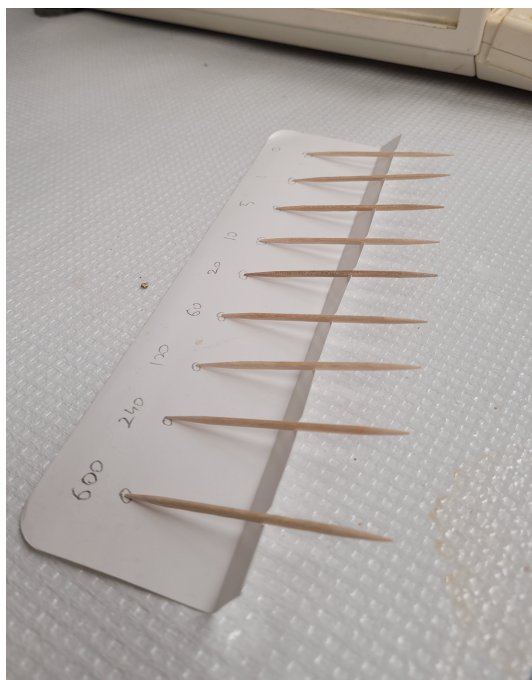


Figure 5

Our setup is now ready. We set a timer for 10 minutes (600 sec), start it and immediately put a drop of a superglue on the “600” spot, as shown in Figure 6.

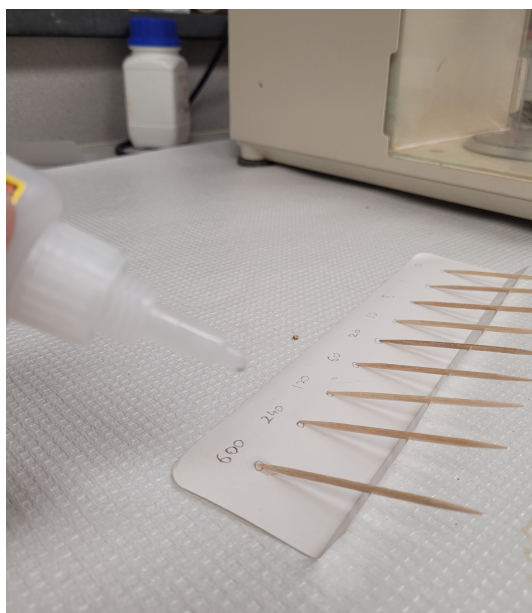


Figure 6

After 6 minutes have passed (and 240 seconds remain), we put a drop on the “240” spot, and so forth. When the glue has been added at the very last spot (labeled as “0”), which happens exactly after the 600 sec interval has passed, we immediately hold the paper up to allow the toothpicks to fall, as in Figure 7.

As we can see, all toothpicks but the first and the second ones fell, meaning that the hardening of the glue

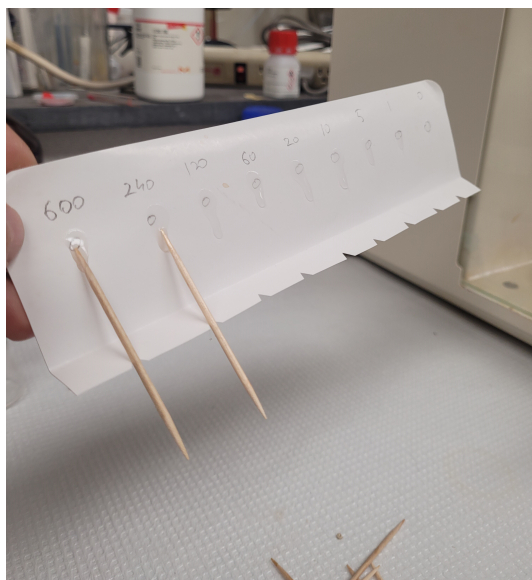


Figure 7

takes more than 2 minutes.

Now we repeat the same experiment using a new piece of paper. Let's add a little bit of baking soda to each spot. Repeating the same instructions as above, we get the following:

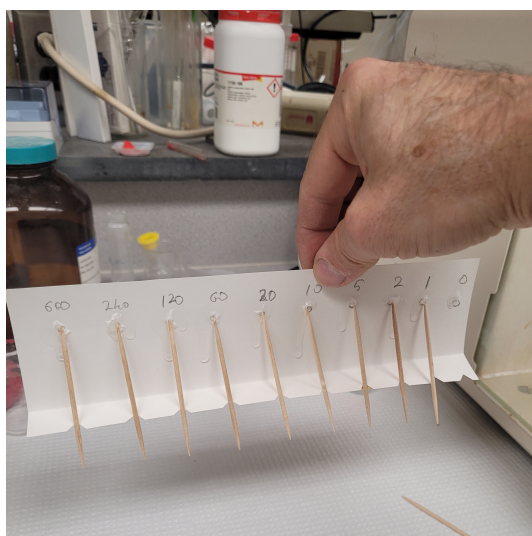


Figure 8

That means that sodium bicarbonate drastically accelerates the hardening process: the glue solidifies in a few seconds. Repeating the same experiment with other chemicals, including vinegar, table salt, citric acid, hydrogen peroxide, demonstrates little to no acceleration.

How can all of this be explained? A good explanation can be found on [Wikipedia](https://en.wikipedia.org/wiki/Cyanoacrylate). The superglue becomes hard due to polymerization: in this reaction, small molecules of cyanoacrylate form a long chain due to the step-wise addition of individual monomers to the end of the growing chain. This reaction is initiated by addition of a nucleophilic molecule to one cyanoacrylate molecule, as shown in Figure 9. This converts the cyanoacrylate into the anionic molecule that attacks the second cyanoacrylate molecule, and this process

continues until all cyanoacrylate molecules become incorporated into the polymeric chain (which is a solid). Obviously, the reaction is catalyzed by nucleophilic chemicals. We have no time and space to explain the concept of nucleophilicity here, but we can explain it in simple (although not fully precise) terms. It would be correct to say that the term “nucleophilic” is closely related to the term “basic”, and most basic compounds are nucleophilic (although the opposite is not always true). Sodium bicarbonate (baking soda) is a base, therefore, it is not a surprise that it is a good hardener for the super glue.

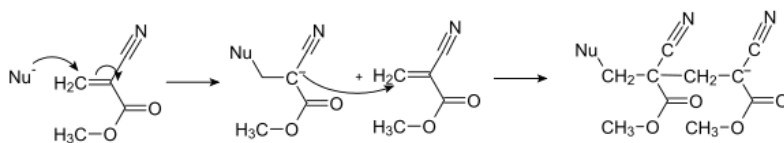
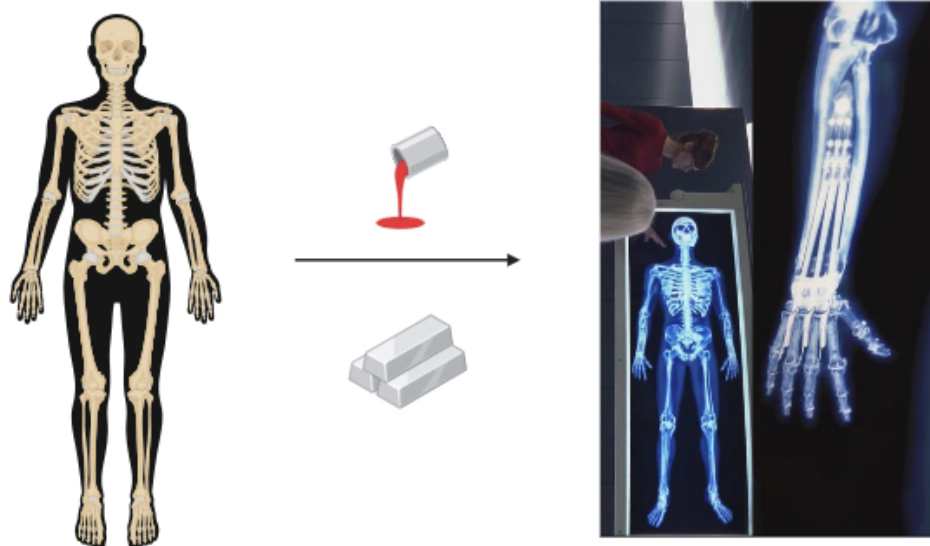
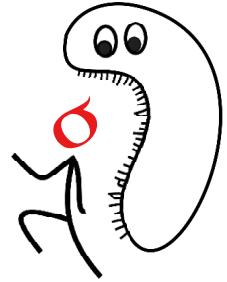


Figure 9: Polymerization of methyl 2-cyanoacrylate (Wikimedia Commons)

Biology

5 points:

The following question was asked to a popular generative AI chat-bot, and the answer it returned is shown below. AI generated answers are not always entirely accurate, and often fail to successfully answer the question. Which aspects of the AI's answer shown below are accurate, and which are not? Justify your choices and provide the correct answers for the parts of the AI's answer that were incorrect. Keep in mind that in some cases the AI's answer may be right but its reasoning is wrong, or vice versa!



Created in BioRender.com **bio**

A character from a popular movie franchise undergoes the procedure shown below in order to acquire an 'adamantium' (hypo-allergenic, non-reactive, same density as bone) plated skeleton. Assuming he retains his superhuman ability to heal any wound, why is the procedure still likely to end in his death? What new dietary cravings is he likely to have before dying?

AI Answer:

Reasons for his probable death:

1. *Toxicity: Most metals, including hypothetical ones like adamantium, could be highly toxic to the body. Even if the character can heal tissue damage, the body might not be able to handle the systemic toxicity caused by the metal, leading to organ failure.*

2. *Immune Response:* The body's immune system might recognize the metal as a foreign object and launch an aggressive immune response. While the healing factor could repair any physical damage, it might not be able to fully counteract a systemic immune reaction.
3. *Thermal Conductivity and Electrical Conductivity:* Metals conduct heat and electricity. The introduction of a large amount of metal into the body could disrupt the body's natural thermal regulation and electrical signals, potentially causing fatal disturbances in cardiac and neurological functions.
4. *Weight and Density:* The weight and density of the metal could physically burden the body's structure and organs, possibly leading to skeletal and muscular issues that even a superhuman healing ability might not fully rectify.

Regarding dietary cravings, the character might experience the following:

1. *High Iron Intake:* Given the metabolic demands of healing and incorporating a metal into the skeleton, there might be an increased need for iron, leading to cravings for iron-rich foods like red meat and leafy greens.
2. *Calcium and Vitamin D:* To support skeletal health, there might be cravings for calcium and vitamin D-rich foods, such as dairy products, fish, and eggs.
3. *Electrolytes:* The presence of metal in the body might disrupt electrolyte balance, causing cravings for foods high in potassium, sodium, and magnesium.

It's important to note that this analysis is purely speculative and based on a fictional scenario, as the concept of an adamantium skeleton and superhuman healing abilities does not exist in real life.

Hint:

the very name "adamantium" refers to "adamant" (an ancient name of diamond), which implies inertness, and a material that is non-reactive is very unlikely to be toxic or allergenic. What is more important is the following: our bones are not only a mechanical backbone, they play other important roles. And that is the hint.

Solution:

Answer: Reasons for his probable death:

1. Toxicity: From the hint and the question itself, we understand that adamantium is unlikely to be highly toxic, and moreover even if it is, there are far bigger issues that would kill the character first.
 2. Immune Response: Again, the metal is hypoallergenic, and non-reactive. There might be a mild immune response, and chronic inflammation could cause problems for the character later in life, but is not the biggest issue here.
 3. Thermal Conductivity and Electrical Conductivity: This could theoretically cause some problems for the character, but again, this hypothetical metal is non-reactive and the body's homeostasis mechanisms work to maintain a constant internal temperature, so it's unlikely this would cause death.
 4. Weight and Density: The metal has the same density as bone, however, as it is plating the bone (and is thus on top of the skeleton), it would add some extra weight - plenty of patients get implants or rods in their spines, but a little extra weight won't kill someone.
 5. Bones are endocrine organs: This is the most important reason, and the AI missed it. Our bones are calcium reservoirs, and are in a state of constant change (remodeling) in order to provide for and store calcium as needed by the body. Moreover, bones are hollow, and have bone marrow inside. Bone marrow is responsible for the production of all our blood cells, from RBCs to carry oxygen to WBCs to mount immune responses. The character is likely to die of anemia and cytopenia, or eventual infection.
- Regarding dietary cravings, the character might experience the following:
1. High Iron Intake: The metal is merely plating the skeleton, not being incorporated into it, but during the procedure the character could lose blood and therefore
 2. Calcium and Vitamin D: The body would no longer be able to access the calcium stores within the bone, so there would likely be extreme cravings for calcium and vitamin D (which is essential to the process of storing calcium ions)
 3. Electrolytes: Unlikely, as the metal is non-reactive.

10 points:

Ten pots are filled with clean quartz sand with the following seeds planted:

- Pots 1 and 6: *Arabidopsis thaliana*
- Pots 2 and 7: *Brássica olerácea*
- Pots 3 and 8: *Phaseolus vulgaris*
- Pots 4 and 9: *Triticum aestivum*
- Pots 5 and 10: *Salix alba*

The pots were then supplemented with the following solutions in water:

- Pots 1-5: Calcium nitrate (1 g/L), sodium hydrogen phosphate, magnesium chloride (0.5 g/L each).
- Pots 6-10: Calcium chloride (1 g/L), potassium hydrogen phosphate, magnesium sulfate (0.5 g/L each).

In most pots, plant growth was significantly suppressed. However in one or more of the pots, plant growth was normal. Name those pot(s) and explain why that happened.

Hint:

Most plants need fertilizers that contain three most essential elements. Without them, they cannot grow normally. However, some plants possess a "superplant ability", which allows them to grow normally even if this essential element is not present in the soil.

Solution:

Answer: The three essential elements that are absolutely necessary for plant growth are potassium, nitrogen and phosphorus. As we can see, the pots 1-5 contain nitrogen and phosphorus, whereas the pots 6-10 contain phosphorus and potassium. No pots contain all three essential elements, so it would be natural to expect that no normal plant growth is observed in all pots. However, one plant, *Phaseolus vulgaris*, belongs to the *Fabáceae* family. These plants are able to take N_2 out of the air and convert it to a form that is usable to the plant growth. That means the plant in the pot 8 will grow normally.

Linguistics & Applied Sciences

5 points:

This month, Applied Sciences is diving into experimental design! It is an important skill that scientists use all the time to test hypotheses, no matter what discipline they are in.

People are always looking for ways to efficiently memorize information. For this problem, we'd like you to test out a method of memorization.

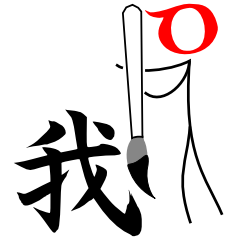
Find or create a technique that is supposed to help with memory. Some examples you can use:

1. Mnemonics
2. Chunking
3. Peg words
4. Imagery

Recruit a participant. This can be a parent, sibling, friend, etc.

Conduct the following experiment on them:

1. Show them the below list of 10 words and ask them to memorize it.
 - goofy
 - far
 - whirl
 - deliver
 - waves
 - sidewalk
 - gullible
 - value
 - connection
 - scarecrow
2. After 1 minute, take the list of words away and ask them to list as many as they can. Write down which words they remembered.
3. Ask them what technique they used to memorize the words and write down their answer.
4. Explain your chosen technique to the participant and ask them to use it. Make sure it is different from the technique they used.
5. Show them the below 10 list of words and ask them to memorize it.
 - teeth
 - dress
 - exotic
 - building



- stingy
- party
- tumble
- coherent
- beneficial
- ignore

6. After 1 minute, take the list of words away and ask them to list as many as they can. Write down which words they remembered.

For your submission, define the technique you chose to research with a scientific justification for why you believe it may work. Submit a list of which words they recalled both times, with a description of what technique they used each time.

Based on the results of the experiment, write about if your chosen technique worked. Explain the results of both the first and second trial. Some concepts you can cite include the recency effect, primacy effect, self reference effect, and of course the two techniques used. It is expected that you cite any external sources.

Grading: 1 point for explaining the chosen technique, 1 point for writing trial results, 2 points for explaining the results of the first and second trial, 1 point for citing sources.

Hint:

No hint this month.

Solution:

Answer: Grading was done by the rubric listed in the question. In general, a successful submission clearly explained the scientific research that supported the chosen technique, how the experiment was conducted, detailed results, and a conclusion about the effectiveness of the chosen technique.

10 points:

For this problem, we would like you to design and conduct an experiment on memory. The question you will be researching is "Do you retain information better if you learn it before you go to sleep or when you wake up?"

Write a hypothesis answering the question with a justification for said hypothesis. Design and write up an experimental procedure that you will conduct on yourself. Then run this procedure and record the results. Expected study length is anywhere between 3-10 days, but you may go longer. Write a conclusion explaining if your results support your hypothesis or not, with an explanation that is justified by scientific ideas. It is expected that you cite any external sources.

Grading: 2 points for the hypothesis, 3 points for a good/detailed experimental design, 2 points for the results, 2 points for the conclusion, 1 point for citing sources.

Hint:

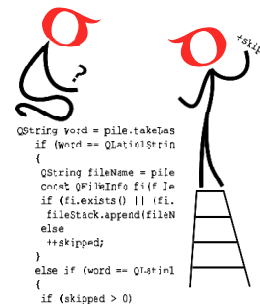
No hint this month.

Solution:

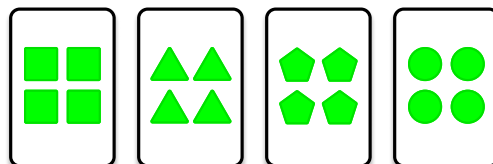
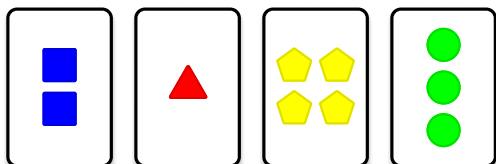
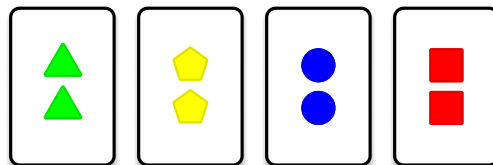
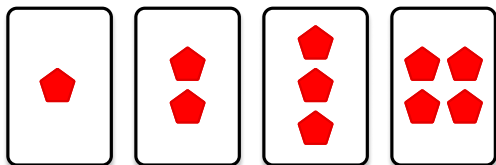
Answer: Grading was done by the rubric listed in the question. A successful submission clearly described or explained the scientific research that supported the hypothesis, each step of the experiment, the experimental results, and potential explanations for the results that were backed by scientific research.

Computer Science

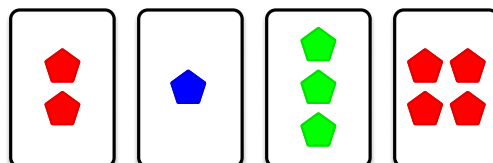
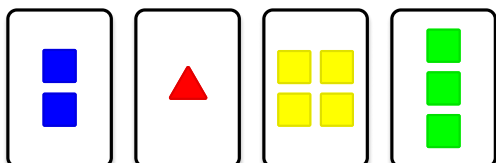
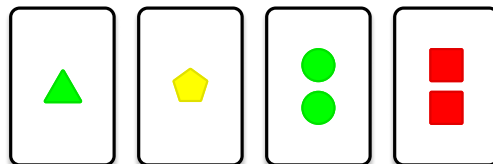
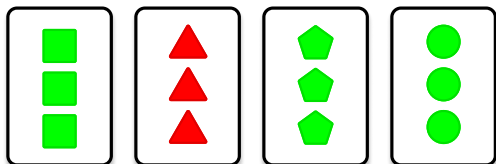
- Your program should be written in Java or Python-3.
- No GUI should be used in your program (e.g. `easygui` in Python).
- All the input and output should be done through files named as specified in the problem statement.
- Java programs should be submitted in a file with extension `.java`; Python-3 programs should be submitted in a file with extension `.py`. **No .txt, .dat, .pdf, .doc, .docx, etc. Programs submitted in the incorrect format will not receive any points!**



The card game “Batch” consists of many cards varying in three features: the number of shapes (1, 2, 3, 4), type of shape (square, circle, triangle, pentagon), and the color of the shapes (red, blue, yellow, green). A batch is a set of four different cards such that for every feature, each card in the batch shares the feature (e.g. all cards have the same number of shapes), or all cards in the batch differ on that feature (e.g. all cards are of a different color). Below are four examples of Batches:



The following are not Batches:



Boris isn't very good at playing Batch (he is colorblind), so he wants to write a program that will read in a list of cards and find Batches among the cards.

5 points:

Given a list of Batch cards, determine the number of different batches that could be formed using cards from the list.

Note: A card can be used in more than one batch.

Hint:

No hint this month.

Solution:

The SigmaCamp GitHub repository contains the solutions for both the 5 point and 10 point questions:

<https://github.com/SigmaCode/POM-QQ/tree/main/CS/2023-2024/November>

10 points:

Given a list of Batch cards, determine the maximum number of *non-intersecting* batches. Two batches are non-intersecting if there is no overlap in the cards used (each card in the list is used for at most one batch).

Input specifications:

The 5pt and 10pt questions will use the same input format: Your program should read the file `input.txt`, with the lines of the file specified as below:

- The first line of the input will contain a single integer n denoting the number of Batch cards in the list.
- The next n lines will consist of three space-separated characters in the format `N S C`, representing each Batch card and its features. **Each line is guaranteed to be unique**, i.e., there are no duplicate cards.
 - The first character `N` represents the number of shapes on the card, and is either “1”, “2”, “3”, or “4”.
 - The second character `S` represents the type of shape on the card, and is either “S” (square), “C” (circle), “T” (triangle), or “P” (pentagon).
 - The third character `C` represents the color of the shapes, and is either “R” (red), “G” (green), “B” (blue), or “Y” (yellow).

Output specifications:

(5pt) Your program should produce the file `output.txt`, which contains a single integer representing the total number of Batches in the list of Batch cards.

(10pt) Your program should produce the file `output.txt`, which contains a single integer representing the maximum number of *non-intersecting* Batches in the list of Batch cards.

Examples:

Sample Input:

```
7
4 S R
2 C B
3 C B
1 C B
4 P G
4 T Y
4 C B
```

Sample Outputs:

(5pt)

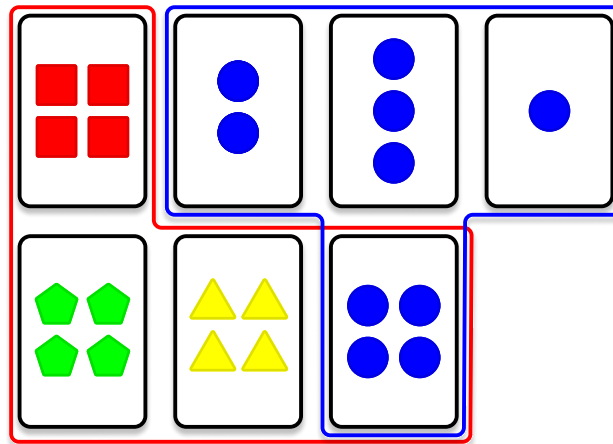
2

(10pt)

1

Explanation:

The set of cards are below with the two Batches circled:



Note that the card 4 C B is used in both Batches, so the maximum number of non-intersecting Batches is 1.

Hint:

No hint this month.

Solution:

The SigmaCamp GitHub repository contains the solutions for both the 5 point and 10 point questions:

<https://github.com/SigmaCode/POM-QQ/tree/main/CS/2023-2024/November>