DMC 2024 Individual Theme Round (240 points)
April 27th, 2024

1. (23 points) A group of 20 people go to a movie theater to watch a movie. However, the group cannot decide whether to watch *Oppenheimer* or *Barbie*. They agree to split into two smaller groups, one for *Oppenheimer* and one to *Barbie*. A ticket to *Oppenheimer* costs \$50, while a ticket to *Barbie* costs \$40. If the total amount paid by the whole group is \$880, how many people decided to watch *Barbie*?

2. (25 points) On Friday, July 21st, 2023, the movies *Barbie* and *Oppenheimer* were simultaneously released. If Ryan Gosling's date of birth is November 12th, 1980, on what day of the week was his birthday in 2023?

3. (27 points) In filling his fishbowl of marbles representing the amount of processed Uranium available to the Manhattan Project, Oppenheimer observed the marbles miraculously form the following exact geometric pattern. Each layer is made of a square of marbles with a side length of 2 marbles more than the layer below it. Each marble represents 140 grams of refined Uranium. If the fishbowl will be filled after 7 layers, how many kilograms (nearest whole number) of processed Uranium are needed by the Manhattan Project.

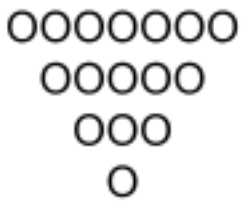
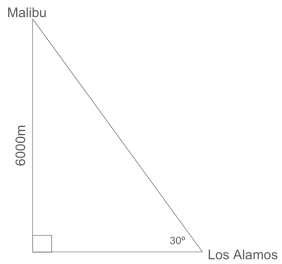


Fig 1. A vertical cross-section of the pattern

4. (29 points) The elevation difference between Malibu and Los Alamos can be approximated as 6000 meters. If the angle of accent is exactly 30 degrees, how much time (in minutes) would it take for Oppenheimer to drive to Barbie's sleepover, assuming he takes a completely linear path and goes at a speed of 60 km/hr?



5. (31 points) Oppenheimer is heading to a Barbie-themed communist cocktail party. He has 5 dresses, 6 necklaces, and 4 pairs of shoes to choose from for his outfit. However, he thinks his pink dress is special: he doesn't like it with his single pair of green necklaces or his single pair of green shoes. If he takes 3 minutes to try on every choice he has, excluding the combinations he doesn't like, how much time (in hours) will he take? Leave as a reduced fraction or decimal. Do not round.

6. (33 points) Barbie, who recently joined the Manhattan Project as a nuclear engineer, is doing a complicated multiplication problem by hand. Unfortunately, Ken brought his paper to the beach, and the ocean water smudged three numbers. Based on the information given below, find $a + b + c$.

$$\begin{array}{r} ab4 \\ \times \quad 6c \\ \hline cab0b \end{array}$$

7. (35 points) During the Trinity Test, Dr. Oppenheimer and the Manhattan project detonated the world's first atomic bomb. 0.4 seconds after detonation, the blast destroyed Ken's Mojo Dojo Casa House, which was located 400 meters away from the center of explosion. We know that the equation for the blast radius is $R = (\frac{Et^2}{\rho})^{(\frac{1}{5})}$, where R is the radius in meters, E is the total instantaneous energy released in J, t is the time since detonation in seconds and ρ is the density of air (1.2 kg/m^3). We also know that the instantaneous energy released by 1 BarbieBomb is around $4 \cdot 10^{12} J$. What is the approximate instantaneous energy released (rounded to the nearest whole number of Barbie Bombs) of the Trinity atomic bomb?

8. (37 points) During the Oppenheimer hearings, the council investigated one instance of suspected communism where Oppenheimer shared his teenage stash of 18 hammers, 4 Barbies, and 8 sickles among Jean Tatlock, Kitty Vissering, and Dr. Ruth Tolman. Assume that Jean values hammers 2 times as much as she values either sickles or Barbies individually; Kitty values Barbies 5 times as much as she values either hammers or sickles individually; Ruth values sickles 2 times as much as she values either hammers or Barbies individually. Since all of these acquaintances are under the impression that they are the only ones sharing gifts with Oppenheimer, he shares his gifts such that none of his acquaintances get less than *half* of the total value of his stash *in their own personal value system.* In that case, what is the maximum number of hammer and sickle *pairs* that were given out to a single person?