2024 MMU Spring Competition (6-8) Theme Round

You will have 20 minutes to complete as much of this test as you can. There are 10 free response questions all based around a common theme, and questions are arranged roughly from easiest to most difficult. Units are not needed. Write answers on the given line below each question. Calculators are not allowed. Do not begin the test until told to do so. Good Luck!

Full Name: _____

Grade: _____

Age: _____

1. _____ An enderman does 5 damage, while a zombie does only 3. If Phil has 25 health points and he must respawn if he ever gets to 0 or lower. If David will take e hits from an enderman and z hits from a zombie, compute $z - e$.

2. _____ people If there are exactly 7 skins in Tfarcenim, how many people must be in the same room to have above a 50% chance of 2 people having the same skin?

3. _____ pixels^2 A skeleton has a head with a width of 8 pixels, a height of 8 pixels, and a depth of 9 pixels. What is the surface area of this skeleton's head?

4. _____ hours If cobblestone generator A produces $45,000$ pieces of cobblestone an hour and takes 11 hours to make, and cobblestone generator B produces $50,000$ pieces of cobblestone an hour, but takes 24 hours to make. If production of both begins at the same time, how long will it take for both generators to produce the same amount of cobblestone?

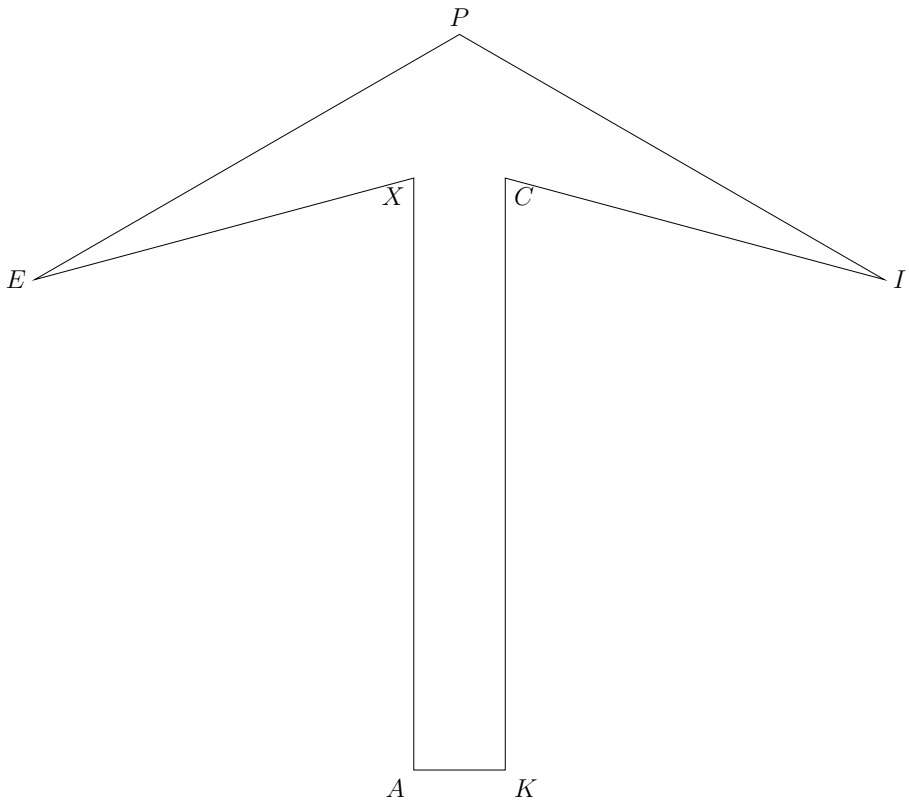
5. _____ minutes Dinnerbone likes making Porkchops. If it takes 5 minutes for his furnace to cook a Porkchop and he has 5 friends coming over, how long will it take David to make a porkchop for everyone, including himself?

6. _____ subsets Suppose that Steve has ten dogs, numbered from $1 - 10$, inclusively. His dogs have a unique habit of talking to each other when they're not supposed to. However, for each dog i, they will only talk to dogs $i - 1$ and $i + 1$, if they exist. For example, dog 1 will only talk with dog 2, and dog 5 will only talk to dogs 4 and 6. How many subsets of dogs can Steve pick such that only two dogs will talk to each other? For example, Steve can pick dogs 2 and 3, or he can pick dogs 1, 3, 5, 6, and 8.

7. _____ Alex has gone fishing. Suppose that she whenever she fishes, she can only catch either cod, salmon, or tropical fish. The chance of fishing cod is $\frac{3}{4}$ and the chance of fishing salmon is $\frac{1}{8}$. If Alex fishes a total of three times, what is the probability that he gets all three types of fish? Express your answer as a common fraction.

8. _____ If the game of Tfarcenim allows a player to score $4, 7, 15, 19, 23, 24$, or 36 points, and all players start at 0 points, what is the largest integer score that cannot be made?

9. _____ units^2 Septagon $PICKAXE$ is defined as shown below. Given that $\angle IPE = 120°$, $PI = CK = AX = EP = 10$, $EX = CI = 8$, $AK = 5\sqrt{3} - 2\sqrt{6} - 2\sqrt{2}$, and $\angle ICK = \angle AXE = 75°$, find the area of $PICKAXE$. Express your answer in simplest radical form.



10. _____ Jeb wants to make a polygon by putting blocks at points of his favorite shape, a hyperbola. His hyperbola $x^2 - 7y^2 = 1$ has integer solutions $(x, y) = (x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4)$ where $0 < x_1, x_2, x_3, x_4 < 250$ and $y_1, y_2, y_3, y_4 \neq 0$. Let $P_i = (x_i, y_i)$, for $i = 1, 2, 3, 4$. Find the area polygon $P_1P_2P_3P_4$.