2024 MMU Spring Competition (3-5) 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. _____ 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?

2. _____ 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 $z - e$.

3. _____ units Rectangle $DIRT$ is a trench of dirt that has perimeter 30. A person comes by and digs another trench around $DIRT$, such that the shape of the trench dug by this person has every point on this shape a distance of 4 from the closest point on $DIRT$. What is the perimeter of this new trench.

4. _____ 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?

5. _____ pixels^3 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?

6. _____ It is a well-known fact that there is a $\frac{1}{3}$ chance of taming a dog with a bone. Given that I encounter 10 dogs in the forest, what is the probability I tame exactly 5 of them if I only have 10 bones and use one bone per dog?

7. _____ grids David is painting, but he only knows how to paint cubes. He can paint 3 different colors of cubes: grey, brown, and green. If David is making a 3 by 3 grid, how many grids may be created? (Rotations or reflections of one grid are considered different grids)

8. _____ sets 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.

9. _____ sets How many different sets of defensive equipment can David use if there are 5 materials for armor (leather, iron, gold, diamond, and netherite), but David can only make 1 piece of armor out of netherite. David has 4 slots for armor (helmet, chest-plate, leggings, boots) and David can either choose to use or not use a shield?

10. _____ 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.