MCAMC 2019   **Live Round Set 1 Answer Sheet**   Team ID: _____

1. _____   2. _____   3. _____

MCAMC 2019   **Live Round Set 2 Answer Sheet**   Team ID: _____

4. _____   5. _____   6. _____

MCAMC 2019   **Live Round Set 3 Answer Sheet**   Team ID: _____

7. _____   8. _____   9. _____

MCAMC 2019   **Live Round Set 4 Answer Sheet**   Team ID: _____

10. _____   11. _____   12. _____

MCAMC 2019   **Live Round Set 5 Answer Sheet**   Team ID: _____

13. _____   14. _____   15. _____

MCAMC 2019   **Live Round Set 6 Answer Sheet**   Team ID: _____

16. _____   17. _____   18. _____

MCAMC 2019   **Live Round Set 7 Answer Sheet**   Team ID: _____

19. _____   20. _____   21. _____

MCAMC 2019   **Live Round Set 8 Answer Sheet**   Team ID: _____

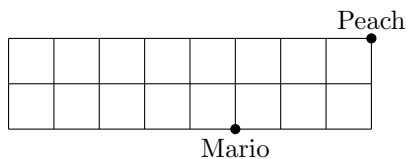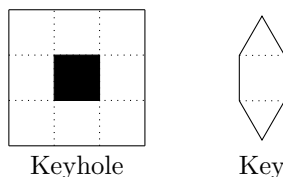22. _____   23. _____   24. _____

1. Mario (without his hat) is 4 feet tall. Mario's hat is $\frac{1}{8}$ the height of Mario (without his hat). If Mario consumes a mushroom, which makes both him and his hat double in height, what is his final height (with his hat), in feet?

2. Princess Peach is trapped in a castle with brick walls. The walls are 360 bricks high, and Princess Peach can climb over the wall in 2 hours. Assuming she climbs at a constant rate, how many bricks can Princess Peach climb in 30 minutes?

3. Luigi joins Mario on his journey to save Peach. Luigi is scared and runs at 3 meters per second, while Mario runs at 5 meters per second. Luigi and Mario begin running in the same direction at the same time from the same place. How far is Mario away from Luigi after 6 seconds?
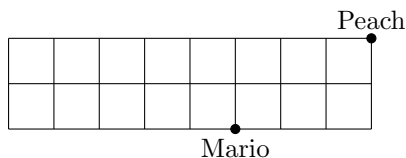
4. Mario, determined to save Peach, wants to move faster. He meets a merchant who has 5 distinct power ups for sale, with only 1 of each type of power up in stock. If Mario must choose exactly 2 power ups, in how may ways can he choose them? (The order in which power ups are chosen does not matter.)

5. The world map is shown in the diagram below, where Mario can only travel along the edges. If Mario wishes to reach Peach as quickly as possible (that is, travel the least distance), how many different paths can Mario take?
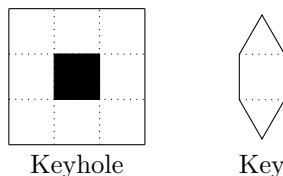
Peach

Mario

6. Yoshi has found a key and is trying to break out of his cage to help Mario, but the key doesn't fit in the keyhole, represented by the black square. If each small square has side length 1 and the triangles are equilateral, how much area does Yoshi need to cut off from the key for it to fit (leave your answer in radical form)?
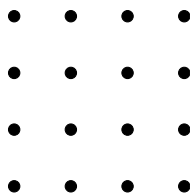
Keyhole   Key

7. Bowser begins deploying minions. He has 3 indistinguishable flying minions and 3 indistinguishable ground minions, and he wishes to deploy a group of 3 minions, at least 1 of which is a ground minion. In howmany ways can he choose this group?

8. Bowser is fighting Mario. Bowser has 100 points of health, and Mario can use 2 attacks:

   (1) Fireblast, dealing 5 damage to Bowser's health

   (3) Jump, dealing 16 damage to Bowser's health the first time it is used, 8 damage the second time, and so on (damage is halved every time it is used)

   Suppose Bowser is magically prevented from being defeated unless *exactly* 100 points of damage are dealt. What is the least number of attacks Mario must use to defeat Bowser?

9. Upon being saved by Mario, Peach gives Mario N kisses. The value of N satisfies the following conditions:

   (1) N Has 4 digits   (2) The sum of the digits of N is 15   (3) N is divisible by 55
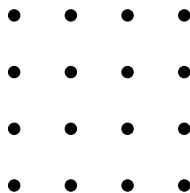
   What is the smallest number N?

10. Princess Peach, now reunited with Mario, asks him for help on the following math question: What is the maximum value of x that satisfies the equation $x^3 - 6x^2 + 11x = 6$? (Hint: $x = 2$ satisfies the equation.)

11. On Mario and Peach's farm, there are 16 posts, arranged as shown below, and they want to connect some number of posts with fencing to create a square playpen for Yoshi. In how many ways can they do this?

$$\begin{matrix} \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \end{matrix}$$
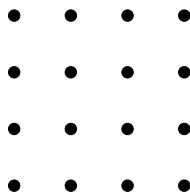
12. 2 Toads and 2 of Bowser's minions are crossing a river using one boat. All 4 are initially on the same side. However, the boat can only carry 2 of them at a time. Given the following constraints, what is the least number of times the boat needs to cross the river so that no one is hurt?

(1) The boat must have at least one Toad or minion in it to move.

(2) When the boat is moving in the river, the Toads and minions will attack each other if on either side of the river the Toads outnumber the minions, or vice versa.
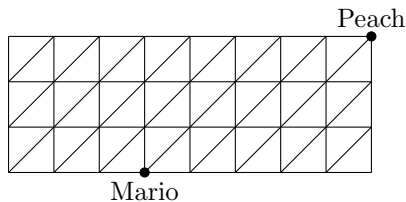
13. Mario (without his hat and shoes) is 3 feet tall. Mario's hat is $\frac{1}{6}$ the height of Mario and Mario's shoes are $\frac{1}{9}$ the height of Mario (without his hat and shoes). If Mario consumes a mushroom, which makes him, his hat, and his shoes all triple in height, what is his final height (with his hat and shoes), in feet?

14. Princess Peach and Princess Daisy live in a castle with brick walls, and they like to climb the walls for fun. Peach can climb the wall 5 times an hour by herself, and Daisy can climb the wall 4 times an hour by herself. When they climb together, they each climb one less time per hour, distracted by chatting with each other. If Peach climbs for 2 hours alone, Daisy climbs for 5 hours alone, and they then climb for 3 hours together, how many times was the wall climbed in total?

15. Luigi joins Mario on his journey to save Peach. Luigi runs at 10 meters per second, while Mario runs at 5 meters per second. Luigi is initially in his mansion, Mario is initially 50 meters north of Luigi's mansion, and Princess Peach is located at 1000 meters north of Luigi's mansion. However, Luigi is scared and whenever he catches up with Mario, he turns around and runs south until he reaches his mansion, where he turns around again. If Mario and Luigi begin running at the same time, how much more distance (in meters) has Luigi run when Mario reaches Peach?

16. Mario, determined to save Peach, wants to run faster. He meets a merchant who has 8 distinct kinds of power ups for sale, with an infinite stock of each type. If Mario must choose exactly 3 power ups (some of them possibly identical), in how may ways can he choose them? (The order in which power ups are chosen does not matter.)

17. The world map is shown in the diagram below, where Mario can only travel along the edges. If Mario wishes to reach Peach as quickly as possible (that is, travel the least distance), how many different paths can Mario take?
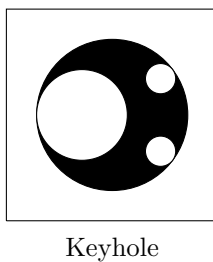
Peach
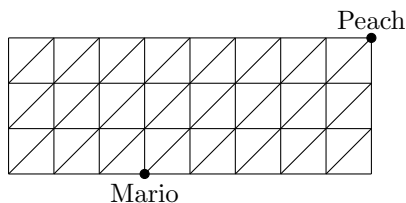
Mario

18. Yoshi is trying to break out of his cage to help Mario, but he doesn't have a key. He's trying to craft a key based on the shape of the keyhole, as shown (in black). If the radius of the circle surrounding the keyhole is 5, the radius of the larger inner circle is 3, and the radius of the smaller inner circles is 1, what is the area of the keyhole?

Keyhole

19. Bowser begins deploying minions. He has 3 distinguishable flying minions, 3 distinguishable ground minions, and 2 distinguishable aquatic minions. There are 4 distinct locations to defend, and Bowser wishes to deploy at least one of each type of minion. In how many different ways can he assign one minion to each location?

20. Mario is fighting Bowser. Bowser has 150 points of health, and Mario knows 2 attacks:

   (1) Iceblast, dealing 3 damage to Bowser's health and freezing Bowser (until Fireblast is used)

   (2) Fireblast, dealing 5 damage normally, but if Bowser is frozen, deals 8 damage and unfreezes Bowser

   (3) Jump, dealing 16 damage the first time it is used, 8 damage the second time, and so on (damage is halved every time it is used)

   Suppose Bowser is magically prevented from being defeated unless *exactly* 150 points of damage are dealt. What is the least number of attacks Mario must use to defeat Bowser?

21. Upon being saved by Mario, Peach gives Mario N kisses. The value of N satisfies the following conditions. What is N?

   (1) N is a perfect square

   (2) N has 4 digits

   (3) The number of numbers satisfying both conditions (1) and (2) is a factor of N

   (4) The sum of the digits of N is prime

22. Princess Peach, now reunited with Mario, asks him for help on the following math question: What the sum of the squares of the solutions to $x^3 - 12x^2 + 44x = 48$? (Hint: $x = 4$ satisfies the equation.)

23. On Mario and Peach's farm, there are 16 posts, arranged as shown below, and they want to connect some number of posts with fencing to create a rectangular playpen for Yoshi. In how many ways can they do this? (Hint: Squares are rectangles)

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●   ●   ●   ●
●   ●   ●   ●
●   ●   ●   ●
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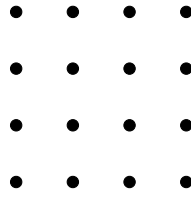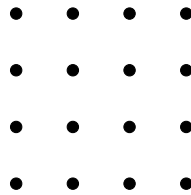
24. 3 Toads and 3 of Bowser's minions are crossing a river using one boat. All 6 are initially on the same side. However, the boat can only carry 2 at a time. Given the following constraints, what is the least number of times the boat needs to cross the river so that no one is hurt?

   (1) The boat must have at least one Toad or minion in it to move.

   (2) When the boat is moving in the river, the Toads and minions will attack each other if on either side of the river the Toads outnumber the minions, or vice versa.