

# The Thirteenth Annual Catonsville Mathematics Competition



- A goat is tied in a square shaped pasture 60 ft on each side with four 50 ft long ropes attached at the four corners of the field. What is the closest the goat can come to any of the sides (distance in ft)?

A) 10                      B)  $10\sqrt{2}$                       C) 20                      D)  $15\sqrt{3}$
- In the above problem what is the approximate area (in sq ft) of the region that the goat can graze on?

A) 186                      B) 197                      C) 219                      D) 230
- Let  $N$  be the smallest positive integer which leaves a remainder of 2 when divided by 11 or 13 and leaves a remainder of 3 when divided by 23. What is the remainder when  $N$  is divided by 19?

A) 1                      B) 5                      C) 9                      D) 11
- Pick a two-digit number (i.e. an integer from 10 to 99). What is the probability that it is not the last two digits of a perfect square?

A) 0.78                      B) 0.80                      C) 0.85                      D) 0.87
- Imagine you have a very large supply of 13¢ and 19¢ stamps. It can be mathematically proved that any postage amount over \$2.15 can be made with these stamps. For instance \$2.50 can be made with nine 13¢ and seven 19¢ stamps. How many different ways can the postage amount of \$200 be made with these stamps?

A) 11                      B) 25                      C) 65                      D) 81

6. Ann said, "I know something. Beth also knows it but Clare does not."  
Beth said, "I know what Ann is talking about."  
Clare said, "I too know it."

If it is known that exactly one of them is lying, who is definitely telling the truth?

- A) Ann      B) Beth      C) Clare      D) Impossible to say.
7.  $A, B, C$  are three points on a circle of radius  $r$  and are the vertices of an equilateral triangle. If a point  $P$  moves in such a way that its distance from one of the three points equals the sum of its distances from the other two,  $P$  must lie on
- A) an equilateral triangle with  $A, B, C$  as midpoints of its sides.  
B) a circle of radius  $r$ .  
C) a circle of radius  $\sqrt{3} r$ .  
D) a circle of radius  $2 r$ .
8. If the point  $P$  in problem 7 moves in a way that the square of its distance from one point equals the sum of squares of its from the other two,  $P$  must lie on
- A) an equilateral triangle with  $A, B, C$  as midpoints of its sides.  
B) a circle of radius  $r$ .  
C) a circle of radius  $\sqrt{3} r$ .  
D) a circle of radius  $2 r$ .
9. The year is 2497. On the terraformed planet Deneb IV, standing on the seventh floor balcony of the newly built City Hall, Mayor Salvor Hardin throws a ball straight up in the air. The ball goes up and then down and passes the mayor after  $t$  seconds. After  $t$  seconds more the ball hits the ground. The acceleration due to gravity on Deneb IV is  $8.5 \text{ m/s}^2$ . The atmosphere of Deneb IV is so dense that any moving object in the air loses speed at the rate of  $1.3 \text{ m/s}$  every second. Given that the vertical distance between floors of City Hall is  $5 \text{ m}$ ,  $t$  is nearly
- A) 1                      B) 2                      C) 3                      D) 4

10. In the first quadrant of the circle of radius 1 centered at the origin  $O$  a circle of radius  $R$  centered at the point  $A$  is drawn which touches the positive  $x$ -axis and  $y$ -axis and the first circle. Another circle of radius  $r$  centered at  $B$  is drawn which touches the positive  $x$ -axis and the other two circles as shown in the figure. Perpendiculars  $BC$  and  $BD$  are drawn from  $B$  to the line joining  $O$  and  $A$  and to the  $x$ -axis. Which one of the following statements is false?

A)  $\overline{OD} = 7r$

B)  $\overline{OB} + \overline{BC} = 2 \overline{OC}$

C)  $R = (2 + \sqrt{2}) r$

D)  $\overline{AC} = 9r - 1$

