1. What is the area of a right triangle whose base has length 9 and whose hypotenuse is 4 greater than the third side?

   (A) $8\frac{1}{8}$

   (B) $12\frac{1}{8}$

   (C) $29\frac{1}{4}$

   (D) $36\frac{9}{16}$

   (E) $42\frac{7}{16}$

   Solution. C
   Let x be the length of the third side. Then the hypotenuse is $x+4$. Using the Pythagorean Theorem, we have that $(x+4)^2 = x^2 + 81$. Solving for x yields $x = \frac{65}{8}$. Thus the area is $0.5(9)(\frac{65}{8}) = 36\frac{9}{16}$.

2. A bowl contains 100 colored marbles: 26 green, 20 red, 18 blue, 16 yellow, 12 black, and 8 white. What is the smallest number of marbles you must pick to guarantee you have at least 14 of the same color?

   (A) 14

   (B) 28

   (C) 46

   (D) 60

   (E) 73

   Solution. E
   You could get 8 white, 12 black, 13 yellow, 13 blue, 13 red, and 13 green. This gives 72 marbles. The next draw (number 73) is guaranteed to give you 14 of some color.

3. Consider the given drawing. Suppose that $0 < \theta < \frac{\pi}{2}$ on a circle of radius 1. Then the ratio of length of $\overline{BD}$ to the length of $\overline{CA}$ is

   (A) $\sin\theta$

   (B) $\cos\theta$

   (C) $\tan\theta$

(D) $\cot\theta$

(E) θ

Solution. B
Let $x = \overline{BD}$. Then $\sin\theta = \frac{x}{1}$. So $x = \sin\theta$. Let $y = \overline{CA}$. Then $\tan\theta = \frac{y}{1}$. So $y = \tan\theta$. Then $\frac{x}{y} = \frac{\sin\theta}{\tan\theta} = \frac{\sin\theta}{\frac{\sin\theta}{\cos\theta}} = \cos\theta$.

4. Suppose you have a circle of radius r. One fourth of the circle is removed as described in the figure below. The remaining part is made into a cone. Express the height of the cone on terms of the radius r.

   (A) $\frac{1}{4}r$

   (B) $\frac{\sqrt{3}}{4}r$

   (C) $\frac{1}{2}r$

   (D) $\frac{\sqrt{7}4}{r}$

   (E) r

   Solution. D. The circumference of the original circle is $2\pi r$. If one fourth of the circle is removed then the remaining part of the circumference is $\frac{3}{4}\pi r$. When the cone is created the circumference of the base of the cone is thus $\frac{3}{4}\pi r$. If $\tilde{r}$ represents the radius of the cone, then $2\pi\tilde{r} = \frac{3}{4}\pi r$. Thus $\tilde{r} = \frac{3}{4}r$. Notice that the edge of the cone has length r and the radius of the cone is $\frac{3}{4}r$. Together with the height, these three lengths form a right triangle and thus their lengths satisfy the Pythagorean Theorem. If h is the height of the cone. then $h^2 + (\frac{3}{4})^2 = r^2$. So $h = \frac{\sqrt{7}}{4}$.

5.

   (A)

   (B)

   (C)

   (D)

   (E)

   Solution.