

Event C

Problem #1 ("Quickie"; 1 point)

Try to solve each problem within one minute.

1. If  $\sin^{-1}\left(\frac{1}{3}\right) = \theta$ , determine exactly the value of  $\cos(2\theta)$ . (MSHSML 2019-20 3C #1)

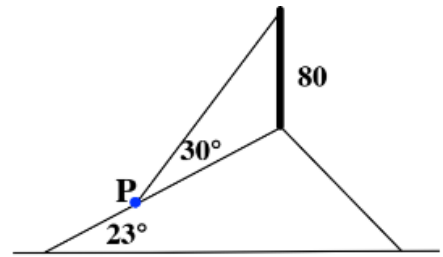
1.  $z = 1 + 6i$ .  $w = z \cdot \bar{z}$ , where  $\bar{z}$  is the conjugate of  $z$ .  
Determine exactly the value of  $w$ . (MSHSML 2018-19 3C #1)

## Event C

## Problem #2 ("Textbook"; 2 points)

Try to solve each problem within two minutes.

2. In *Figure 2*, a hill rises at a constant angle of  $23^\circ$  from the horizontal. At the top of the hill stands a vertical flag pole that is 80 feet tall. A guy wire runs from the top of the flag pole to a point  $P$  down the hill. At  $P$  the guy wire makes a  $30^\circ$  angle with the hill. The length of the guy wire can be written as  $k \sin \theta$  for acute angle  $\theta$ . Determine exactly the ordered pair  $(k, \theta)$ . (MSHSML 2019-20 3C #2)



*Figure 2*

2. If  $z = \text{cis}(30^\circ)$ , determine exactly the value of  $z^3 + \frac{1}{z^3}$ .  
 ( $z = r \cos(\theta)$  is shorthand notation for the complex number  $r \cos \theta + r \sin \theta i$ .) (MSHSML 2018-19 3C #2)

## Event D

## Problem #1 ("Quickie"; 1 point)

Try to solve each problem within one minute.

1. Determine exactly the value of  $\log_3 15 + \log_3 81 - \log_3 5$ . (MSHSML 2019-20 3D #1)

1. Determine exactly the value of  $\left(\frac{1}{64}\right)^{-\frac{1}{1}} + \left(\frac{1}{64}\right)^{-\frac{1}{2}} + \left(\frac{1}{64}\right)^{-\frac{1}{3}} + \left(\frac{1}{64}\right)^{-\frac{1}{6}}$ . (MSHSML 2018-19 3D #1)

Event D

Problem #2 ("Textbook"; 2 points)

Try to solve each problem within two minutes.

2. The solutions to the equation  $2(\log x)^2$  are  $10^m$  and  $10^n$ . Determine exactly the product  $mn$ . (MSHSML 2019-20 3D #2)

2. Determine exactly the value of  $\log_{12} 24 + \log_{12} 72$ .  
(MSHSML 2018-19 3D #2)