OMMC 2023 Sample Problem Set 1

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Instructions

1. This is a 3-question, untimed sample problem set that can be worked on with as many people as you want.

2. All answers are rational numbers (not necessarily integers).

3. Open discussion of any aspect of the test is allowed and encouraged. You can ask for hints and discuss your thoughts with other people.

Any questions on the above should be emailed to ommcofficial@gmail.com. With that, good luck!

PROBLEMS

1. Real numbers a, b, c, d satisfy

$$a^2 + 3b^2 = 10 \text{ and } ad - bc = 3ab + cd = ac + 3bd = 3.$$

Find $c^2 + 3d^2$.

2. Find the number of positive integers n where $n^{\frac{486}{n}}$ is also a positive integer.

3. Regular hexagon $ABCDEF$ has area 13. Translate $\triangle ACE$ one unit in some direction to triangle $\triangle O_1O_2O_3$. Define circles with area 6 centered at points O_1, O_2, O_3. Find the area inside $ABCDEF$ outside any of the three circles.