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Welcome to BEAM's Challenge Set 3!

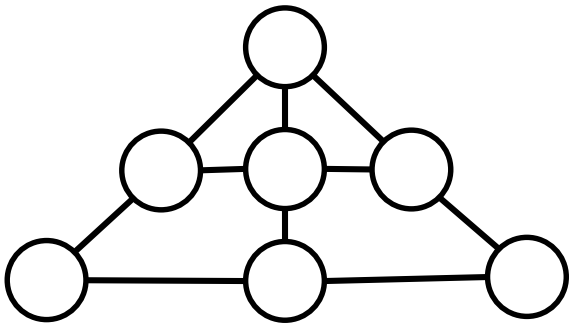
Want to keep doing fun and interesting math? Keep pushing yourself to learn new things? Each month, we're going to send you some fun math puzzles to try out. We don't expect you to get them all right, so it's okay to only try out the ones you think you can do! Send in your solutions by:

- Texting photos to 424-305-6451,
- E-mailing them to mathchallenges@beammath.org, or
- Mailing them to us at the address above.

These problems are challenging, so anyone who sends correct solutions to 2 or more problems by the end of the day December 11 will get recognized in the Challenge Set solutions, and 4 or more wins a special prize. Your solutions may help for BEAM 7 admission, too. You might need to put some work on a separate page.

Problem 1

Place each of the numbers 1, 2, 3, 4, 5, 6, and 7 in the circles at right so that any three circles connected by a straight line add to the same sum. For example, if the bottom three circles have numbers that add to 3, then each other line of three circles must also add to 3.



Problem 2

Abel is running a board game activity. At the beginning of activities, every board game in the room is being played and there are three players at each game. Abel doesn't play because he is helping everyone. At the end of activities, Abel is also playing. This time, there are four players at each game, except for one game that no one is playing. How many board games are there in the room?

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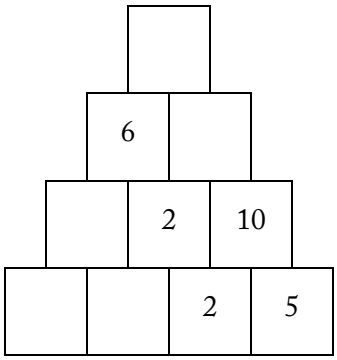
Problem 3

In the diagram on the right, the number in each square is the product of the two squares just below it. For example, since $2 \times 5 = 10$, 10 is in the square above 2 and 5. Fill in the rest of the squares.

Hint: Try to solve Challenge Set 1 Problem 3 first and look at its solution.

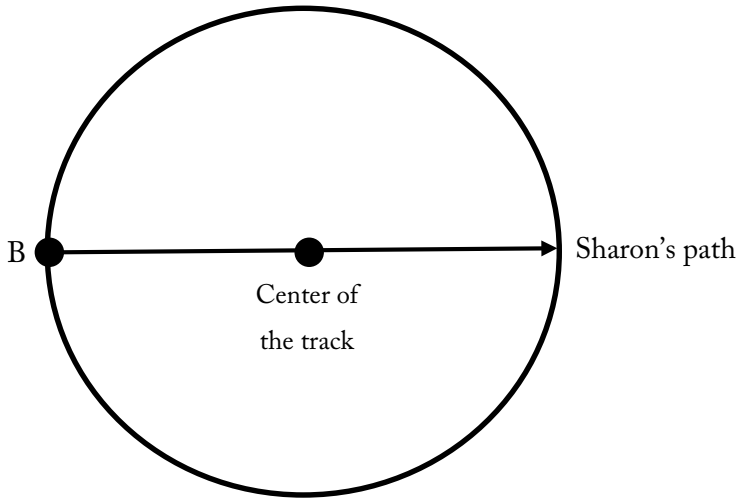


Problem 4

Go to the website below and watch the video

http://aops.com/videos/prealgebra/chapter10/197

Kimberly and Sharon are on a circular running track starting at the same place (point B). Kimberly starts running counterclockwise, and runs 4/5 of the way around the track (almost making a full lap!). Sharon takes a shortcut and runs straight across the middle of the track, as in the diagram below. From the center of the track, what is the angle between Kimberly and Sharon now?



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Problem 5

On Zavier's birthday, BEAM 6 students decide to pull a prank on him: some students will always lie to him, while other students will always tell the truth. Zavier walks up to Abigail and Jose, and asks Abigail: "Does at least one of the two of you always tell the truth?" Abigail says either "yes" or "no" in response to this. You don't hear what Abigail says.

Based on Abigail's answer, Zavier says he now knows whether Abigail always lies or always tells the truth and whether Jose always lies or always tells the truth. Does Jose always lie or always tell the truth? Explain why your answer is correct and why no other answers could be correct.

Hint: Try to solve Challenge Set 1 Problem 1 first and look at its solution.

Problem 6

Five BEAM students decide to hold a chess tournament. Each student plays each of the other students exactly once. There are no ties, so every game ends with a winner. At the end of the tournament, some of the students tie for first place (most number of wins). What is the largest number of first place winners possible? Give one example of how that can happen.

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Problem 7

A book has 30 stories. Each story takes up a different number of pages: one takes up 1 page, another takes up 2 pages, all the way up to the thirtieth story which takes up 30 pages. The first story starts on page 1. If the stories can go *in any order*, what is the greatest number of stories that can start on an odd page?

Problems 1, 2, 5, and 7 are from the Math Kangaroo contest. Problem 6 is from "What is the name of this book?" by Raymond M. Smullyan.