Time limit: 30 minutes.
Instructions: For this test, you work in teams of five to solve 20 short answer questions. All answers must be expressed in simplest form unless specified otherwise. Submit a single answer sheet for grading. Only answers written inside the boxes on the answer sheet will be considered for grading.
No calculators.

1. Given that $7 \times 22 \times 13 = 2002$, compute $14 \times 11 \times 39$.

2. Ariel the frog is on the top left square of a 8×10 grid of squares. Ariel can jump from any square on the grid to any adjacent square, including diagonally adjacent squares. What is the minimum number of jumps required so that Ariel reaches the bottom right corner?

3. The distance between two floors in a building is the vertical distance from the bottom of one floor to the bottom of the other. In Evans hall, the distance from floor 7 to floor 5 is 30 meters. There are 12 floors on Evans hall and the distance between any two consecutive floors is the same. What is the distance, in meters, from the first floor of Evans hall to the 12th floor of Evans hall?

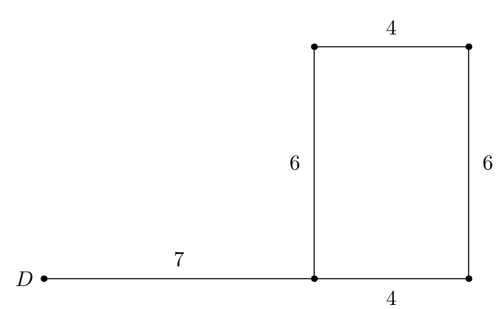
4. A circle of nonzero radius r has a circumference numerically equal to $\frac{1}{3}$ of its area. What is its area?

5. As an afternoon activity, Emilia will either play exactly two of four games (TwoWeeks, DigBuild, BelowSaga, and FlameSymbol) or work on homework for exactly one of three classes (CS61A, Math 1B, Anthro 3AC). How many choices of afternoon activities does Emilia have?

6. Matthew wants to buy merchandise of his favorite show, Fortune Concave Decagon. He wants to buy figurines of the characters in the show, but he only has 30 dollars to spend. If he can buy 2 figurines for 4 dollars and 5 figurines for 8 dollars, what is the maximum number of figurines that Matthew can buy?

7. When Dylan is one mile from his house, a robber steals his wallet and starts to ride his motorcycle in the direction opposite from Dylan's house at 40 miles per hour. Dylan dashes home at 10 miles per hour and, upon reaching his house, begins driving his car at 60 miles per hour in the direction of the robber's motorcycle. How long, starting from when the robber steals the wallet, does it take for Dylan to catch the robber? Express your answer in minutes.

8. Deepak the Dog is tied with a leash of 7 meters to a corner of his 4 meter by 6 meter rectangular shed such that Deepak is outside the shed. Deepak cannot go inside the shed, and the leash cannot go through the shed. Compute the area of the region that Deepak can travel to.

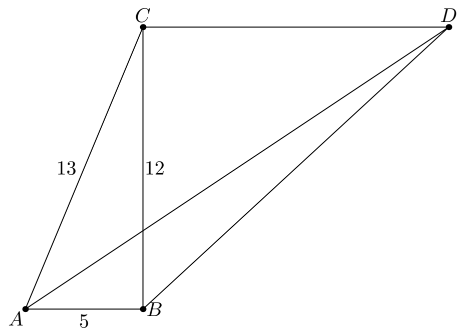


9. The quadratic equation $a^2x^2 + 2ax - 3 = 0$ has two solutions for x that differ by a, where $a > 0$. What is the value of a?

10. Find the number of ways to color a 2×2 grid of squares with 4 colors such that no two (non-diagonally) adjacent squares have the same color. Each square should be colored entirely with one color. Colorings that are rotations or reflections of each other should be considered different.

11. Given that $\frac{1}{y^2+5} - \frac{3}{y^4-39} = 0$, and $y \geq 0$, compute y.

12. Right triangle ABC has $AB = 5$, $BC = 12$, and $CA = 13$. Point D lies on the angle bisector of $\angle BAC$ such that CD is parallel to AB. Compute the length of BD.



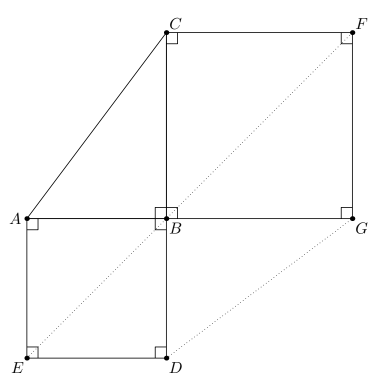
13. Let x and y be real numbers such that $xy = 4$ and $x^2y + xy^2 = 25$. Find the value of $x^3y + x^2y^2 + xy^3$.

14. Shivani is planning a road trip in a car with special new tires made of solid rubber. Her tires are cylinders that are 6 inches in width and have diameter 26 inches, but need to be replaced when the diameter is less than 22 inches. The tire manufacturer says that 0.12π cubic inches will wear away with every single rotation. Assuming that the tire manufacturer is correct about the wear rate of their tires, and that the tire maintains its cylindrical shape and width (losing volume by reducing radius), how many revolutions can each tire make before she needs to replace it?

15. What's the maximum number of circles of radius 4 that fit into a 24×15 rectangle without overlap?

16. Let a_i for $1 \leq i \leq 10$ be a finite sequence of 10 integers such that for all odd i, $a_i = 1$ or -1, and for all even i, $a_i = 1$, -1, or 0. How many sequences a_i exist such that $a_1 + a_2 + a_3 + \cdots + a_{10} = 0$?

17. Let $\triangle ABC$ be a right triangle with $m\angle B = 90°$ such that AB and BC have integer side lengths. Squares $ABDE$ and $BCFG$ lie outside $\triangle ABC$. If the area of $\triangle ABC$ is 12, and the area of quadrilateral $DEFG$ is 38, compute the perimeter of $\triangle ABC$.



18. What is the smallest positive integer x such that there exists an integer y with $\sqrt{x} + \sqrt{y} = \sqrt{1025}$?

19. Let

$$a = \underbrace{19191919\ldots1919}_{\text{19 is repeated 3838 times}} .$$

What is the remainder when a is divided by 13?

20. James is watching a movie at the cinema. The screen is on a wall and is 5 meters tall with the bottom edge of the screen 1.5 meters above the floor. The floor is sloped downwards at 15 degrees towards the screen. James wants to find a seat which maximizes his vertical viewing angle (depicted below as θ in a two dimensional cross section), which is the angle subtended by the top and bottom edges of the screen. How far back from the screen in meters (measured along the floor) should he sit in order to maximize his vertical viewing angle?