2015 Four-by-Four Competition
Thursday, January 29th, 2015

# Round 1

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1. What is the volume, in cubic meters, of a right circular cylinder with a base radius of 8 m and a height of 9 m?

2. How many liters of a 25% acid solution should be added to 12 liters of a 60% acid solution to produce a 45% acid solution?

3. What is the sum of the positive two-digit integers?

4. How many distinguishable sets are subsets of the set of one-digit positive integers, supersets of the set of one-digit prime numbers, and have exactly three even elements?

 


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# Round 2

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5. What is the product of the number of vertices on an icosahedron, the number of days in August, and the number of donuts in a baker's dozen?

6. What time is one-third of the way from 8:13 AM to 4:04 PM?

7. How many factors of 3600 are also factors of 4050?

8. If $\cos q = \frac{2}{3}$ and $\pi < q < 2\pi$, evaluate $\sin\left(\frac{q}{2}\right)$.

 


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# Round 3

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9. What is the area, in square meters, of an isosceles triangle with sides measuring 10 m and 30 m?

10. Every card in a standard 52-card deck is worth a certain number of points. Each numbered card is worth the number shown on that card. Jacks, Queens, and Kings are worth 10 points each, while Aces are worth 11 points. When a single card is drawn, what is the expected value of the number of points it will be worth?

11. What value(s) of $p$ satisfy $2^{2p-2} + 2^{p-2} = 4 + 2^{3p-6}$?

12. What is the area of the convex quadrilateral in the Cartesian plane with vertices at $(3,4)$, $(-5,-6)$, $(-7,8)$, and $(9,-10)$?

 


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# Round 4

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13. What value(s) of $g$ satisfy $9(7g - 5) + 3g(2 + 4) = 6(8g + 1)$?

14. Convert $\frac{14\pi}{225}$ to degrees, minutes, and seconds in the form $d°m's''$.

15. The number that is 24% less than 620 is 24% greater than what number?

16. Using the numerals 9, 7, 6, 4, and 1 exactly once each, and the operations of addition, subtraction, multiplication, and division (and parentheses) as much or as little as you like, create an expression that evaluates to 101.

 


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# Round 5

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17. If $k$ varies jointly as $m$ and the square of $n$, and $k = 24$ when $m = 7$ and $n = 3$, then what is the value of k when $m = 2$ and $n = 6$?

18. Two circles have radii of 11 m and 17 m and their centers are 40 m apart. What is the length, in meters, of one of their common internal tangents?

19. What is the remainder when $j^5 + 6j^4 - 17j^3 + 28j^2 - 23j + 15$ is divided by $j^2 + 8j - 4$?

20. How many distinguishable arrangements of the letters in "BANANAS" do not have any A's adjacent to other A's?

 


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# Round 6

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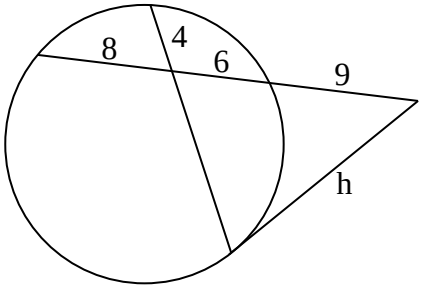


21. In the figure shown to the right, all given measurements are in meters. What is the value of $h$, the length of the tangent line segment?

22. Evaluate: $7 \times 8 - (34 + 6) \times 5 + 76^2 - 35 \div 7 + 56$

23. If five Cheetahs can be exchanged for three Dogs, four Elephants can be exchanged for seven Foxes, and two Foxes can be exchanged for one Dog, how many Elephants can be exchanged for 6965 Cheetahs?

24. What is the tenth term of a recursive sequence with first term $a_1 = 48$, $a_2 = 64$, and $a_n = \frac{a_{n-1}+a_{n-2}}{2}$ for $n \geq 3$?

 


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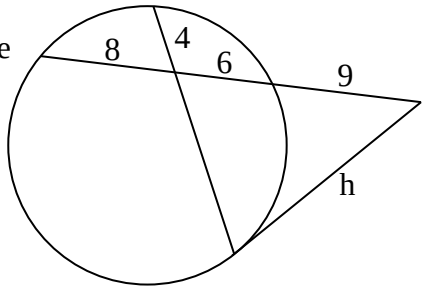



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# Round 7

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25. What is the sum of the positive perfect cubes less than 100?

26. What is the total surface area, in square meters, of a right rectangular pyramid with a base measuring 32 m by 18 m and a height of 12 m?

27. Simplify in terms of $i = \sqrt{-1}$: $(1 - 3i)^5$

28. How many positive three-digit integers are multiples of three with their digits in strictly ascending order?

 


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# Round 8

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Round 8

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29. Express in simplest radical form: $\sqrt[3]{12960}$

30. Expand and combine like terms: $(b-2)(3b^2-7b+12)(2b+4)$

31. A square has vertices (0,0), (9,6), $(a,b)$, and $(c,d)$, where $(c,d)$ is in the second quadrant. Find $a+b+c+d$.

32. Hannah will arrive at the arcade between noon and 1 PM, stay for 20 minutes, and leave. Phaedra will arrive at the arcade between 11 AM and 12:30, stay for 45 minutes, and leave. What is the probability that Hannah and Phaedra will be at the arcade at the same time?

 


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# Round 9

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33. Consider a triangle with sides measuring 8 m, 12 m, and 15 m. If the angle bisector of the largest angle is drawn, what is the length, in meters, of the smaller segment into which it divides the opposite side of the triangle?

34. Express the base-8 numeral $23675_8$ as a base-4 numeral.

35. Evaluate: $9356774 \div 574$

36. I won the lottery! Being frugal, I simply took the million dollars and put it in an account earning 2% annual interest, compounded annually. After five years, how much will be in my account? Answer to the nearest hundredth of a dollar (cent).

 

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# Round 10

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37. What is the shortest distance from the point $(1, -2)$ to the line $3x - 4y = 5$?

38. When four standard dice are rolled, what is the probability that at most one of the dice does not show the same number as another die?

39. Consider a circle inscribed in a square. A 3 m by 5 m rectangle is drawn outside the circle but inside the square such that one of its vertices is a vertex of the square, another of its vertices is on the circle, and two of its sides are on the square. What is the radius, in meters, of the circle?

40. When Mr. Brown asks students to find the roots of a quadratic of the form $Ax^2 + Bx + C = 0$, Sam miscopies the value of $A$ and gets roots of 2 and 3, and Anthea miscopies the value of C and gets roots of -1 and 4. What are the actual roots of Mr. Brown's equation?

 


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