

Math Field Day

Mad Hatter 11-12 sample questions

(taken from previous years)

Note: the problems given below are examples of problems given in previous years. They do not cover all the topics that can occur on the contest this year. They are only intended to give you a rough idea of the difficulty of the problems that may be given.

1. You have 16 pairs of socks, 8 black and 8 blue, but they are not paired up. Instead, they are all mixed up in a drawer. It's early in the morning, and you don't want to turn on the lights in your dark room. How many socks must you pull out to guarantee that you have a pair of one color?
 - (a) 2
 - (b) 3
 - (c) 4
 - (d) 5
 - (e) None of the above
2. If $5^{3\log_5 x} = 64$ then
 - (a) $x = 15$
 - (b) $x = 125$
 - (c) $x = \frac{64}{3}$
 - (d) $x = 4$
 - (e) None of the above
3. If the diagonals of a rhombus are 6 and 8, then the side of the rhombus is:
 - (a) 3
 - (b) 4
 - (c) 5
 - (d) 6
 - (e) None of the above

4. At a sandwich shop there are 2 kinds of bread, 5 kinds of cold cuts, 3 kinds of cheese, and 2 kinds of dressing. How many different sandwiches can be prepared using one kind of bread, cold cuts, cheese, and dressing?
- (a) 12
 - (b) 50
 - (c) 42
 - (d) 30
 - (e) None of the above
5. Solve: $|2x + 5| > 9$
- (a) $-7 < x < 2$
 - (b) $x > 2$
 - (c) $x > 2$ or $x < -2$
 - (d) $x > 2$ or $x < -7$
 - (e) None of the above
6. What is the probability of flipping a penny three times and seeing at least one head?
- (a) 25
 - (b) 50
 - (c) 75
 - (d) 87.5
 - (e) None of the above
7. Given that the statement “*all Glock numbers are divisible by 3 and are multiples of 7*” is **true**, find which one of the following statements is **true**:
- (a) 42 is a Glock.
 - (b) All Glock numbers are divisible by 21.
 - (c) All numbers divisible by 21 are Glocks.
 - (d) 7 is a Glock.
 - (e) None of the above is true or more than one true statement.

8. A car leaves point A going at 28 miles/hour. Five hours later another car leaves point A going at 63 miles/hour. How long will it take the second car to catch up with the first?
- (a) 5 hours
 - (b) 12 hours
 - (c) 4 hours
 - (d) 7 hours 18 minutes
 - (e) None of the above
9. Is the sum of two irrational numbers also an irrational number?
- (a) Always
 - (b) Sometimes
 - (c) Never
 - (d) None of the above
10. How many different factors does the number 72^3 have?
- (a) 40
 - (b) 50
 - (c) 60
 - (d) 70
 - (e) None of the above
11. Suppose that a given square and a given circle have the perimeter and circumference equal to each other. Find the ratio of the circle's area to the square's area.
- (a) 4
 - (b) π
 - (c) $\pi/4$
 - (d) $4/\pi$
 - (e) None of the above
12. $\frac{254 \times 399 - 145}{254 + 399 \times 253} =$
- (a) 253,254
 - (b) 1
 - (c) 0.5
 - (d) 254^2
 - (e) 399

13. If $a = 5$ and $b = 25$, then $a^2(a + b^2)(a^4 - b^{10})(a^2 - b) =$
- (a) 0
 - (b) 1
 - (c) 5
 - (d) 25
 - (e) $1/5$
14. Factor: $a^3 + 2a^2 - 3 =$
- (a) $(a - 1)(a^2 + 3a - 3)$
 - (b) $(a - 1)(a^2 - 3a - 3)$
 - (c) $(a + 1)(a^2 - 3a + 3)$
 - (d) $(a - 1)(a^2 - 3a - 3)$
 - (e) $(a - 1)(a^2 + 3a + 3)$
15. Find the sum of the squares of the roots of the equation $ax^2 + bx + c = 0$:
- (a) $-b$
 - (b) b
 - (c) b^2
 - (d) $(b - a)^2$
 - (e) $(b^2 - 2ac)/a^2$
16. Simplify: $-\log_2 \log_2 \sqrt{\sqrt[4]{2}}$
- (a) 1
 - (b) $\sqrt{2}$
 - (c) $\sqrt[4]{2}$
 - (d) 3
 - (e) 2
17. ABC is a right triangle, C is its right angle, CH is the corresponding height, and CD is the corresponding bisector. The angle between CH and CD is 12° . Find the acute angles of the triangle ABC .
- (a) $12^\circ, 78^\circ$
 - (b) $33^\circ, 57^\circ$
 - (c) $30^\circ, 60^\circ$
 - (d) $45^\circ, 45^\circ$
 - (e) $12^\circ, 75^\circ$

18. $\frac{1}{20} + \frac{1}{30} + \frac{1}{42} + \frac{1}{56} + \frac{1}{72} + \frac{1}{90} + \frac{1}{110} + \frac{1}{132} =$

- (a) $\frac{1}{6}$
- (b) 1
- (c) 0.1
- (d) 0.5
- (e) $\frac{2}{7}$

19. Find the greatest possible number of diagonals that can be drawn in a polygon with 103 sides.

- (a) 103
- (b) 206
- (c) 1030
- (d) 5150
- (e) None of the above

20. What is greater: m or n ?

$$m = 4 + \frac{5}{8} + \frac{6}{8^2} + \frac{3}{8^3} + \frac{7}{8^4}$$

$$n = 4 + \frac{5}{8} + \frac{5}{8^2} + \frac{7}{8^3} + \frac{6}{8^4}$$

- (a) m
- (b) n
- (c) $m = n$
- (d) Undefined
- (e) None of the above

21. The base of an isosceles triangle is 16 cm, and the lateral side is 10 cm. Find the radius of the inscribed circle.

- (a) 8 cm
- (b) $\frac{8}{3}$ cm
- (c) 16 cm
- (d) 4.5 cm
- (e) 2 cm

22. In the proportion $x_1 : x_2 = x_3 : x_4$, the sum of the first three numbers is 58. The third number is equal to $2/3$ of the first number, and the second number is equal to $3/4$ of the first number. Find the fourth number x_4 .

(a) 12

(b) 58

(c) 10

(d) 15

(e) 20

23. Simplify: $\tan 255^\circ - \tan 195^\circ =$

(a) $2\sqrt{3}$

(b) $3\sqrt{2}$

(c) $-2\sqrt{3}$

(d) $\tan 60^\circ$

(e) None of the above