

**TMATYC - Survey of Mathematics Test - 2016**

1. If  $x = \frac{2}{3}$  and  $y = -\frac{1}{4}$  then  $\frac{1}{x} - \frac{1}{y} =$   
 A.  $-\frac{5}{2}$       B.  $\frac{3}{7}$       C.  $\frac{5}{12}$       D.  $\frac{11}{12}$       E.  $\frac{11}{2}$
  
2. There are 17 Sickles in one Galleon and 29 Knuts in one Sickle. Hermione buys a pheasant-feather quill that costs fifteen Sickles and two Knuts. If she pays with one Galleon, which of the following would be correct change?  
 A. 2 Sickles, 10 Knuts      B. 2 Sickles, 27 Knuts      C. 1 Sickles, 15 Knuts  
 D. 1 Sickle, 27 Knuts      E. 1 Sickle, 10 Knuts
  
3. Expand and combine like terms:  $2x(x - y) - (x + y)^2$   
 A.  $x^2 - 4xy - y^2$       B.  $x^2 - 2xy - y^2$       C.  $x^2 - xy - y^2$       D.  $x^2 - 2xy + y^2$       E.  $x^2 + y^2$
  
4. Find the **sum** of **all** the solutions to the equation  $\frac{2}{3x} - \frac{1}{x-1} + \frac{2}{3} = 0$   
 A. 0.5      B. 1.5      C. 2      D. 2.5      E. 3
  
5. In base 3 arithmetic,  $101 + 122 =$   
 A. 1000      B. 223      C. 220      D. 300      E. 222
  
6. The equation of the line passing through the points  $(-3, -6)$  and  $(-2, 8)$  has the equation  
 A.  $y = -14x - 48$       B.  $y = 14x - 6$       C.  $y = 14x + 36$   
 D.  $y = -\frac{2}{5}x - \frac{36}{5}$       E.  $y = 2x$
  
7. Among numbers from 1 to 100, how many are multiples of 2 or 3?  
 A. 16      B. 49      C. 60      D. 67      E. 83
  
8. Joe gets a new job. One year later he gets a 10% raise in salary. The next year he gets a 5% raise in salary. What percent of Joe's initial salary is his salary after two years?  
 A. 106%      B. 107.5%      C. 110.5%      D. 115%      E. 115.5%
  
9. In the sequence two bits, four bits, six bits, a dollar, how much is a bit?  
 A. 8¢      B. 10¢      C. 12.5¢      D. 16.7¢      E. 25¢
  
10. There are 3 four-legged tables in a room. Each table has 3 girls standing on it. Each girl carries a backpack with 3 cats in it. Each cat has 3 eight-legged spiders crawling on them. Tables, girls, cats, and spiders, how many legs in all?  
 A. 324      B. 624      C. 786      D. 1173      E. 2592
  
11. If  $a + b = 5$  and  $a - b = 4$ , then  $a^2 - b^2 =$   
 A. 1      B. 9      C. 11      D. 20      E. 21

12. If statement  $p$  is true and statement  $q$  is false, which of the following statements is true?

Notation:  $\wedge$  = and;  $\vee$  = or;  $p \rightarrow q$  = if  $p$ , then  $q$ ;  $\neg p$  = not  $p$

A.  $p \wedge q$       B.  $p \rightarrow q$       C.  $p \rightarrow (\neg p \vee q)$       D.  $(q \rightarrow p) \wedge (p \vee q)$       E.  $(\neg p \wedge q) \vee q$

13.  $8 \times (3 - 1) + 4 \div 2 + 3 - (1 - 2)^2 =$

A. 3      B. 12      C. 14      D. 20      E. 22

14. A crowd of 100 community college students consists of 40 freshmen and 52 students over the age of 20. If there are a total of 73 students who are either freshmen or over the age of 20, how many of the students are freshmen that are over the age of 20?

A. 12      B. 19      C. 21      D. 27      E. 92

15. Suppose you go to a conference attended by 30 Australians and 30 Germans. How many people would you have to meet to be certain that you met two people of the same nationality?

A. 2      B. 3      C. 15      D. 30      E. 31

16. The volume of a gasoline tank is 4 cubic feet. How many cubic inches is the volume of this tank?

A. 16      B. 48      C. 64      D. 576      E. 6,912

17. What is the probability of getting at least one head in 4 tosses of a fair coin?

A.  $\frac{1}{2}$       B.  $\frac{1}{4}$       C.  $\frac{1}{16}$       D.  $\frac{15}{16}$       E.  $\frac{7}{8}$

18. A bottling company has a large vat for mixing ingredients that go into a certain soft drink. At 9 a.m. the vat holds 40,000 gallons of mixture. Sugar water is poured into the vat at a rate of 18 gallons per minute while food coloring is added at a rate of 2 gallons per minute. At the same time, the mixture is drained out of the vat to be bottled at a rate of 30 gallons per minute. Write a linear equation expressing the volume,  $V$ , of mixture in the vat  $t$  minutes after 9 a.m.

A.  $40,000 - 10t$       B.  $40,000 + 10t$       C.  $40,000 - 30t$       D.  $39,990t$       E.  $39,990 + t$

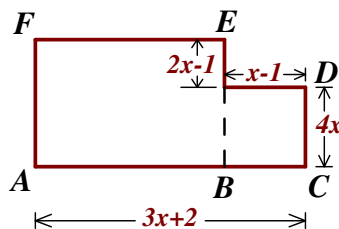
19. Joan walks away from her front door. After 17 feet she turns  $90^\circ$  to the right and walks 4 more feet. She then turns again  $90^\circ$  to the right and walks 5 more feet. Finally, she turns  $90^\circ$  to the left and walks just one foot before stopping. How far is she now from her front door? Give your answer to the nearest foot.

A. 12      B. 13      C. 17      D. 18      E. 27

20. The largest real number less than 1 is

A. 0.9      B.  $0.\bar{9}$       C.  $\frac{99}{100}$       D.  $1 - 1 \times 10^{100}$       E. No such number exists

21. Express the area of rectangle  $ABEF$  in terms of  $x$



- A.  $12x^2 + 4x - 1$       B.  $12x^2 + 16x - 3$       C.  $12x^2 + 8x$   
 D.  $10x^2 - 3x - 2$       E.  $3x^2 - x - 2$

22.  $(2x)^{-2} - 3x^{-1} =$

- A.  $-x$       B.  $-4x^2 + 3x$       C.  $\frac{1-12x}{4x^2}$       D.  $\frac{3-4x}{12x^2}$       E.  $-\frac{1}{12x}$

23.  $\frac{4}{x+1} - \frac{1}{x-3} =$

- A.  $\frac{3x-13}{x^2-2x-3}$       B.  $\frac{3x-11}{x^2-2x-3}$       C.  $\frac{3x-11}{x^2-3}$       D.  $\frac{3}{2(x-1)}$       E.  $\frac{3}{4}$

24. Express the height  $h$  of an equilateral triangle in terms of its side length  $a$ .

- A.  $h = \frac{1}{2}a$       B.  $h = \frac{\sqrt{2}}{2}a$       C.  $h = \frac{\sqrt{3}}{2}a$       D.  $h = \frac{1}{3}a$       E.  $h = \frac{\sqrt{3}}{3}a$

25. Knights always tell the truth but knaves never tell the truth. In a group of three individuals (who we will label as  $N_1$ ,  $N_2$ , and  $N_3$ ) each is either a knight or a knave. Each makes a statement as follows:

$N_1$  : "We are all three knaves."

$N_2$  : "Two of us are knaves and one of us is a knight."

$N_3$  : "I am a knight and the other two are knaves."

Which are knights and which are knaves?

- A.  $N_1$  is a knight,  $N_2$  is a knave,  $N_3$  is a knave      B.  $N_1$  is a knight,  $N_2$  is a knave,  $N_3$  is a knight  
 C.  $N_1$  is a knave,  $N_2$  is a knave,  $N_3$  is a knight      D.  $N_1$  is a knave,  $N_2$  is a knight,  $N_3$  is a knave  
 E.  $N_1$  is a knave,  $N_2$  is a knave,  $N_3$  is a knave