

1) Michael knows the squares of the three roots of a monic polynomial  $f(x)$  are 1, 2, and 2. How many distinct functions  $f(x)$  are possible?

- A) 1      B) 3      C) 6      D) 8      E) NOTA

2) How many positive integral values of  $k$  give the equation  $y=2x^2-15x+2k$  rational roots?

- A) 2      B) 3      C) 4      D) infinitely many      E) NOTA

3) Using integer values for  $m$  and  $n$ , what is the smallest positive value the expression  $51m+21n$  can attain?

- A) 0      B) 1      C) 2      D) 3      E) NOTA

4) A population of bacteria doubles its size every year. I place three of these bacteria on a Petri dish. If the population starts TODAY, approximately how many bacteria will be present on July 17<sup>th</sup>, 2525? Assume that  $3=2^{1.59}$ .

- A)  $2^{508}$       B)  $2^{509}$       C)  $2^{508.59}$       D)  $2^{509.59}$       E) NOTA

5) A certain plant takes in energy from the sun and converts it into usable energy. The amount of stored usable energy the plant has is  $s(t) = \sqrt{t}$ , where  $t$  is time exposed to the sun in hours. However this plant must use energy to survive and uses energy at a rate of  $u(t) = \sqrt[3]{t}$  (same units). If the plant needs 18 units of energy to survive the winter (where it shuts down energy production, and its energy usage is constant), how many hours of sunlight must the plant soak up? For simplicity the plant does not use energy at night.

- A) 3      B) 729      C) 81      D) 9      E) NOTA

6) Suli has gotten a score of 88% and 72% on two equally weighted tests in Mr. Kenyon's class. He wants to slack off for the next test but wants to maintain an 86% average in the test category of his final grade. What is the lowest score he can obtain to maintain his desired test average?

- A) 86%      B) 87%      C) 96%      D) 97%      E) NOTA

7) Kaladin has been playing Wheel of Fortune and has already earned  $M$  money. He can spin the Bonus Wheel of Fortune which is divided into 32 sections, 28 of which are a standard size and the remaining four are half the size of the standard. If he lands on any half sized section, he doubles his money. If he lands on any of the other 28 sections of the wheel, he walks away with half of his money. What is the expected value of his takeaway if he spins the wheel once?

- A)  $2M$       B)  $8M/15$       C)  $2M/3$       D)  $3M/5$       E) NOTA

8) Considering leap years, how many days are between July 5, 1917 and July 4, 2017, inclusive?

- A) 36,500      B) 36,524      C) 36,525      D) 36,510      E) NOTA

9) Compute the constant term of the expansion of  $\left(\frac{2}{x^2} - 3x^3\right)^5$ .

- A) 120      B)  $-120$       C)  $-720$       D) 285      E) NOTA

10) Sal is a salamander who must walk from his starting point in the plane at  $(2, 4)$  to his home at  $(7, 1)$  but must stop along the way at the  $y$ -axis. What is the shortest distance he can walk home?

- A) 90      B)  $3\sqrt{10}$       C)  $5\sqrt{2}$       D)  $\sqrt{77}$       E) NOTA

11) What is the radius of a sphere inscribed in a cube inscribed in a unit sphere?

- A)  $\sqrt{3}$       B)  $\sqrt{2}$       C)  $\frac{\sqrt{2}}{2}$       D)  $\frac{\sqrt{3}}{3}$       E) NOTA

12) Four people are arranged by height from shortest on the left to tallest on the right. It is known that Mary is to the left of Jane and Steve is to the right of Billy. How many possible arrangements of these four people are there?

- A) 6      B) 12      C) 24      D)  $6!$       E) NOTA

13) Jason has three urns in which he places into the first two white beads, into the second he places a white and a black bead, and in the third urn he places two black beads. He labels them correctly according to which beads are in the urn. Andrew comes along and rearranges all the labels so that no urn is now labeled correctly. What is the least number of draws (without replacement) that Jason can make to determine the correct labeling of the urns?

- A) 1      B) 2      C) 3      D) 4      E) NOTA

14) How many consecutive zeros are at the end of  $291!$  when it is written instead in base 17?

- A) 17      B) 18      C) 19      D) 20      E) NOTA

15) Joyce drives from Tallahassee, FL to Philadelphia, PA, a distance of 1000 miles, for college in 10 hours. Once she gets there she realizes she left her favorite blanket at home and races back to Tallahassee in 8 hours. She then realizes she will be late to class if she does not return to Philadelphia in 8 hours. She does so. What is her average speed, in miles per hour, for the three-leg trip, to the nearest whole number?

- A) 110      B) 112      C) 115      D) 116      E) NOTA

16) Brandon listened to his mother's good advice and finally opened up a savings account. He deposits \$500.00 into his account which computes compound interest monthly. After one month, his balance is \$501.00. What is his annual interest rate as a percent?

- A) 1.00%      B) 1.20%      C) 2.00%      D) 2.40%      E) NOTA

**For Questions 17-19 use the following:** Matt is a writer who loves to write long-form epic fantasy novels. He is published by Torn Books and has a certain number of fans  $f_0=250$  from his previous works.

17) Matt's new series of books he's planning is projected to be ten books long. He wants each book to be around 375,000 words long, but the final word count per book may vary by as much as 15,000 words per book. Assuming he writes 3,000 words per week and his first drafts are written perfectly so he has to do no editing, what is the maximum amount of years it will take him to write this series? Assume one year is 52 weeks.

- A) 24.5      B) 21      C) 25      D) 30      E) NOTA

18) Torn Books is hesitant to publish such a long series, citing the uncertainty that readers will be invested for the entire run of books. They sign Matt for the first four books with the promise to reassess later. Their chief editor, who was a math major, devises a formula to gauge popularity of the series. He determines that the number of fans Matt gains when book  $n$  is published is  $\Delta f_n = \left[ \left( p + \frac{1}{2} \right) f_{n-1} \right]$ . If Matt and his editor agree that  $p=0.6$ , How many fans will he have after 4 books?

- A) 366      B) 1102      C) 2314      D) 4859      E) NOTA

19) The more copies of Matt's books Torn prints, the cheaper per copy it is to produce. The price to print 10-99 books is \$10 per copy. The price of 100-999 books is \$9 per copy. The price of 1000-9999 books is \$8 per copy, and so on (multiplying the book count by 10 on the lowest amount decreases the price per copy by \$1). The printer does not do continuous pricing (i.e., to get the discount, you have to print at least the indicated amount). How much money would Torn spend on printing if each of Matt's original fans (all  $f_0$  of them) buys 3 copies and there are 423 copies left on the shelves?

- A) \$2500    B) \$1173    C) \$7500    D) \$9384    E) NOTA

20) Convert the repeating decimal  $0.\overline{13D}_{16}$  into a fraction in base 10.

- A) 317/4095    B) 4095/317    C) 17/45    D) 256/4095    E) NOTA

21) Leon is looking to annoy a drive thru worker who got his order wrong last week. He drives through WcDonald's which sells chicken nuggets in increments of 7 and 12. What maximum number of nuggets should he order so that the worker cannot fulfill his order with the given increments?

- A) 84    B) 65    C) 64    D) 55    E) NOTA

22) Roy is typing some random text on his standard QWERTY keyboard. What is the probability that the first time he hits the T key is on his third stroke if he only types letters?

- A) 1/26    B) 625/676    C) 625/17576    D) 25/26    E) NOTA

23) Given that  $\log 2 = a$  and  $\log 3 = b$ , which of the following is equivalent to  $\frac{1-2a-b}{2a+2b}$  in terms of logarithms?

- A)  $\log_6 \sqrt{5}$     B)  $-\frac{1}{2} + \log_6 \sqrt{5}$     C)  $2\log_{\sqrt{5}} 6$     D)  $\log_5 36$     E) NOTA

24) A triangle has all three of its vertices on or to the right of the vertex on the graph of  $y=x^2$ . One point is at the origin, another is at (1, 1). If the area of the triangle is 6, what is the y-value of the third point?

- A) 4    B) 9    C) 25    D) 36    E) NOTA

25) Yngwie knows that the sum of the roots of the quadratic function  $f(x)$  is 7. The product of the solutions is 35. What is the axis of symmetry for  $f(x)$ ?

- A)  $x=7/2$     B)  $x=35/2$     C)  $x=2/7$     D)  $x=2/35$     E) NOTA

26) The sum of three numbers is 28. The first minus twice the third is 4. Thrice the third minus twice the second is 11. What is the largest of these three numbers?

- A) 154      B)  $13/3$       C)  $154/9$       D)  $59/9$       E) NOTA

27) A basketball tournament is being held in Buffalo. The tournament will consist of 64 teams and is double elimination with a Winners and Losers bracket. The tournament has to pay the referees a total of \$500 per game. If the maximum number of games are played, how much do the tournament organizers pay the referees over the whole tournament?

- A) \$31,500    B) \$32,000    C) \$63,000    D) \$63,500    E) NOTA

28) Lina polls her friends and coworkers. She finds that 28 of her friends like bacon with their breakfast, 24 like sausage with breakfast, 25 like ham with their breakfast and 12 vegetarians don't like meat with their breakfast at all. 14 people prefer only bacon, 7 prefer only sausage and 2 prefer only ham. If 4 people like all three, how many people did she survey?

- A) 77      B) 75      C) 67      D) 65      E) NOTA

29) The product of the terms of a five term geometric sequence is 32. If the 5<sup>th</sup> term is  $\frac{338}{49}$ , what is the positive difference between the third and first terms?

- A)  $1/169$       B) 2      C)  $120/169$       D)  $240/169$       E) NOTA

30) Farmer Nicholas has an enclosure in the shape of a regular hexagon for his buffalo named Bill. He wants to put an extra fence around his enclosure that is always 3 meters away from the current fence. If he needs exactly  $120 + 6\pi$  meters of fencing to construct his new fence, how much area, in square meters, does his original fence enclose? Round to the nearest integer if  $\sqrt{3} \approx 1.73$ .

- A) 600      B) 1730      C) 1038      D) 120      E) NOTA