This test consists of five relays of six questions each. "TAFTPQITR" stands for "the answer from the previous question in this relay," so if question 3 in a relay references TAFTPQITR, that is the answer from question 2 in that relay.

All answers on this test are integers.

RELAY 1

1. How many types of regular polygons can tile a plane?

2. Let $A = TAFTPQITR$. Find the minimum number of regions that A distinct planes can separate three-dimensional space.

3. Let $B = TAFTPQITR$. Find the y-intercept (y-coordinate only) of the line parallel to $y = 9 - 5x$ that passes through (B, 2).

4. Let $C = TAFTPQITR$. The area enclosed by $4x^2 + 24x - 17 + 5y^2 - 10y - C = 0$ is $\sqrt{D}\pi$. Find D.

5. Let $D = TAFTPQITR$. Find the number of consecutive terminating zeros in $D!$.

6. Let $E = TAFTPQITR$. A regular convex polygon has an exterior angle of measure (E – 6) degrees. How many sides does the polygon have?

RELAY 2

1. The area of a sector of a circle of radius 12 is 6π. Find the degree measure of the arc of this sector.

2. Let $A = TAFTPQITR$. Find the base 8 representation of A. (Do not write the subscript base.)

3. Let $B = TAFTPQITR$. Find the tens digit of B^4.

4. Let $C = TAFTPQITR.$ Find the coefficient of the sixth term in the expansion of $(x + C)^8$ when written in descending powers of *x*.

5. Let $D = TAFTPQITR.$ Find the sum of the positive integral divisors of *D*.

6. Let $E = TAFTPQITR.$ Sam and Ella are train conductors. Sam's train, the *Ecoli Express*, travels at 84 mph and Ella's train, the *Listeria Liner*, travels at 56 mph. If both trains leave from the same station heading in opposite directions on a straight track, how long, in hours, will Sam have to travel before the two trains are *E* miles apart, if Ella's train leaves 2 hours after Sam's train?

RELAY 3

1. If $(x - y)^2 = 39$ and $xy = -16,$ what is the value of $x^2 + y^2$?

2. Let $A = TAFTPQITR.$ The ratio of logarithm problems to matrix problems on a test is 17:23. If $1/A$ of the matrix problems are replaced with logarithm problems, the new ratio (when reduced) is *x*:*y*, where *x*, *y* > 0 are integers. Find the value of $x + y$.

3. Let $B = TAFTPQITR.$ How many positive integers between 1 and *B*, inclusive, have exactly three divisors?

4. Let $C = 4(TAFTPQITR)$. Evaluate $\sqrt{(C-3)(C-1)(C+1)(C+3)+(C-4)}$.

5. Let $D = TAFTPQITR.$ Find the number of digits in the expansion of 3^D.

6. Let $E = TAFTPQITR.$ The perimeter of an equilateral triangle is $\sqrt{E}$. If the area enclosed by its circumscribed circle is $F\pi,$ what is the value of *F*?

RELAY 4

1. Find the smallest positive integer value for x such that $\dfrac{x}{44+\dfrac{x}{44+\dfrac{x}{44+\cdots}}}$ is an integer.

2. Let $A = TAFTPQITR.$ If B is a positive integer and $B^2 - A$ is also a perfect square (integer), find the smallest possible value of B.

3. Let $B = TAFTPQITR.$ The hyperbola $(x-B)^2 - 2(y-3)^2 = 8$ has directrices, when simplified, $x = \dfrac{B \pm P\sqrt{Q}}{T}$. Find the value of $B+P$.

4. Let $C = TAFTPQITR.$ In Jack's piggy bank, he has only pennies, dimes, and quarters. If he has $2C$ coins in the bank totaling \$2.00, what is the greatest number of dimes that he can have?

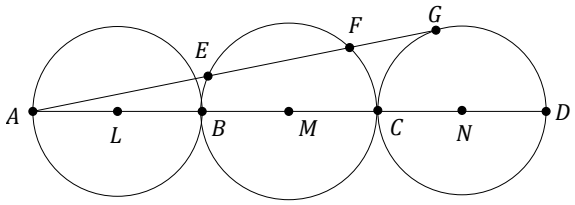
5. Let $D = TAFTPQITR.$ If $f(n+1) = \dfrac{2f(n)+1}{2}$ for $n \geq 1$ and $f(1) = 2$, find $f(D+1)$.

6. Let $E = TAFTPQITR.$ If $x > 0$ and grows beyond all bounds, what value does the expression $40\log_E(6x-5) - 40\log_E(2x+1)$ approach?

RELAY 5

1. If three of the roots of $x^4 + ax^2 + bx + c = 0$ are 1, 2, and 3, what is the value of $|a + c| - 1$?

2. Let $Z = TAFTPQITR$. Points B and C lie on $\overline{AD}$; and $\overline{AB}$, $\overline{BC}$, and $\overline{CD}$ are diameters of length $Z/2$ of circles L, M, and N, respectively. If $\overline{AG}$ is tangent to circle N at G and intersects circle M at E and F (per the diagram), what is the length of $\overline{EF}$?



3. Let $B = TAFTPQITR$. The tens digit of B is a and the units digit of B is b. If $x * y = \frac{b^x}{a^y}$, find the value of p such that $p * a = b$.

4. Let $C = TAFTPQITR + 1$. All of the positive integers with an initial digit of C are written down in succession in increasing order. What is the 2018th digit thus written?

5. Let $D = TAFTPQITR$. Find the value of $\frac{D}{\log_{a^D}(ab)} + \frac{D}{\log_{b^D}(ab)}$.

6. Let $E = TAFTPQITR$. E lines parallel to the base of a triangle divide the other sides into $E+1$ congruent segments and the area into $E+1$ distinct parts. If the area of the largest of these parts is 38, what is the area of the original triangle?