Answers:

Section I – Name That Number (4 pts ea, except #10, which is 14 pts)

1. 241
2. 17
3. 43
4. 109
5. 173
6. 23
7. 191
8. 210
9. 19
10. 333,333,331

Section II – Movie Quotes with Numbers (5 pts ea, 1 pt bonus for movie)

1.	4, 3, 9, 5, 5, 8, 2, 2, 4, 5	movie: *The Jerk*
2.	28, 6, 42, 12	movie: *Donnie Darko*
3.	1066, 1215, 1466, 67, 1469, 1514, 1981, 1986	movie: *Billy Madison*
4.	1985, 1955	movie: *Back to the Future*
5.	500, 500, 4	movie: *Dumb and Dumber*
6.	12	movie: *Star Wars, Episode 4: A New Hope*
7.	3, 3, 3, 4, 2, 3, 5	movie: *Monty Python and the Holy Grail*
8.	250, 100, 25000, 25000	movie: *National Lampoon's Christmas Vacation*
9.	85, 95, 1	movie: *UHF*
10.	9, 13, 6; 17, 22, 6; 9, 22, 6	movie: *Pi*

Section III – Somewhat Humorous Proofs (10 pts ea)

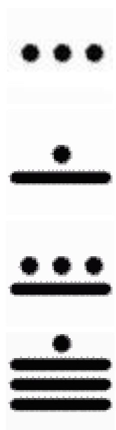
1. Suppose there existed an uninteresting positive integer greater than 2. Then there would be a smallest uninteresting positive integer greater than 2, which is itself interesting by being so, a contradiction. Therefore, all positive integers greater than 2 are interesting.
2. Suppose all rules have an exception. This would then be a rule, thus having an exception. This exception, therefore, is a rule without an exception.
3. If you told someone, "Today is Opposite Day," and it is in fact Opposite Day, then you told a truth, not the opposite. If you told someone, "Today is Opposite Day," and it is Not Opposite Day, then you told the opposite, not the truth.
4. "This statement is false." has no truth value, so 'The statement "This statement is false." is false.' is false. Inserting this statement inside a "The statement…is false." statement makes that statement true. Then inserting that statement inside a "The statement…is false." statement makes that statement false, and doing so again makes the statement true.

5. Suppose one practiced moderation in all things. Then that person is not practicing moderation in practicing moderation. Thus, it is impossible to practice moderation in all things.

Section IV – Million-Tap Challenge (#1 is 2 pts for all; others are 2 pts for month, 4 pts for day, 10 pts for year)

1. July 18, 2011
2. June 11, 2033
3. October 19, 23914
4. August 6, 21905267

Section V – Math in Different Cultures (10 pts ea)

1. (DCCLV)DCCCLVI
2. 
3. $\rho\pi\theta'$
4. 

Section VI – Math from A to Z (2 pts ea)

1. Abelian
2. Bernoulli
3. continuum
4. dense
5. Euler
6. fractal
7. Galois
8. hexahedron
9. idempotent
10. Jacobian
11. kite
12. lemma
13. metric
14. norm
15. orthocenter
16. power

17. quadrilateral
18. Russell
19. surd
20. trivial
21. uncountable
22. versine
23. well-ordered
24. xor
25. Yates
26. Zermelo

Section VII – Name That Number, Non-Math Edition (5 pts ea)

1. 69
2. 43
3. 29
4. 19
5. 1000
6. 867-5309
7. Zack: 1502
   Screech: 1220
   Jessie: 1205
   Lisa: 1140
   Kelly: 1100
   Slater: 1050
8. 94143243431512659321054872390486828512913474876027
   67195923460238582958304725016523252592969257276553
   64363462727184012012643147546329450127847264841075
   62234789626728592858295347502772262646456217613984
   829519475412398501
9. 136199
10. Places: 234, 235, 236; Digits: 678

Section VIII – Relay (n points for question #n)

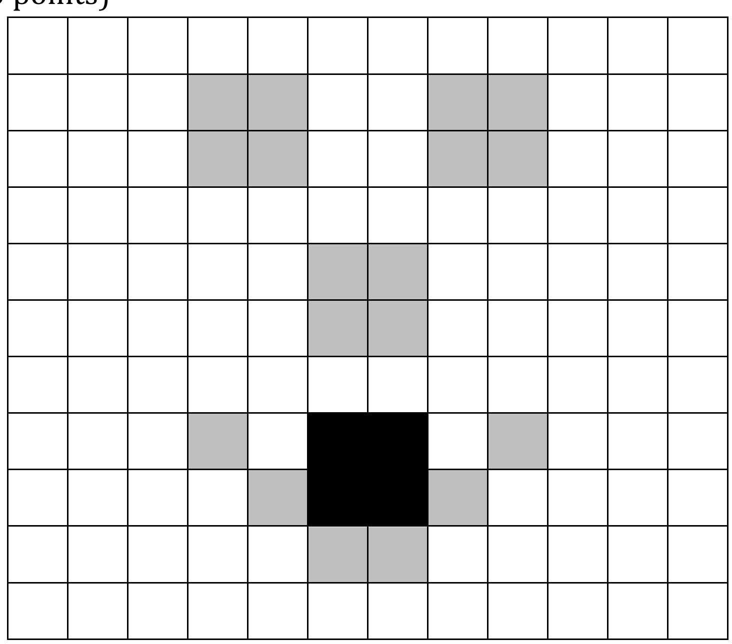
1. 360
2. 3600
3. 15
4. 113
5. 13
6. 16
7. 388
8. 264
9. 25

10. 750

Section IX – Sequences (5 pts ea)

1. 92 (it's the 11th and 28th term)
2. 1
3. 75025 (Fibonacci numbers)
4. 6
5. 4066364671
6. 61258199999
7. 1, 7, 29
8. 27
9. 1113122113121113222114
10. 58
11. $\{\varnothing, \{\varnothing\}, \{\varnothing,\{\varnothing\}\}, \{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\}, \{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\}\},$
$\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\}\}\}\}$
12. $308085/2102594$

Section X – Life (50 points)



Section XI – Homeomorphism (5 pts ea correct grouping)

{A,R} {B} {C,G,J,L,M,N,S,U,V,W,Z} {D,O} {E,F,T,Y} {H,I} {K,X} {P,Q}

Section XII – X-treme Sudoku (+1 (-2) ea non-diagonal, +2 (-4) ea diagonal)

11	3	13	12	10	5	9	16	6	7	1	2	15	14	8	4
5	14	15	1	7	3	4	8	16	13	11	12	6	2	10	9
16	10	9	6	14	11	2	13	8	4	3	15	1	5	12	7
2	8	4	7	1	12	15	6	14	5	10	9	13	16	11	3
6	11	1	5	8	15	14	3	10	16	13	7	2	4	9	12
7	12	14	2	16	13	1	10	9	6	15	4	5	11	3	8
9	15	3	8	11	7	12	4	2	14	5	1	16	13	6	10
13	4	10	16	2	9	6	5	12	11	8	3	14	1	7	15
10	9	12	3	4	16	13	11	15	1	14	6	8	7	2	5
1	16	7	4	3	14	8	2	13	10	9	5	11	12	15	6
8	6	2	13	15	1	5	9	7	12	4	11	10	3	16	14
14	5	11	15	6	10	7	12	3	8	2	16	4	9	13	1
12	7	5	9	13	8	11	1	4	2	6	10	3	15	14	16
15	13	16	10	5	2	3	14	1	9	7	8	12	6	4	11
4	2	8	11	9	6	16	15	5	3	12	14	7	10	1	13
3	1	6	14	12	4	10	7	11	15	16	13	9	8	5	2

Solutions (where applicable):

Section I – Name That Number

1. $111_{15} = 15^2 + 15 + 1 = 225 + 15 + 1 = 241$
2. $17 = 2 + 3 + 5 + 7$; all other such sums are the sum of four odd numbers, which is even and therefore not prime
3. The Chen primes are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 47, …, which skips 43
4. When written in base 10, a two-digit palindrome in base 9 must be divisible by 5, meaning its base 5 representation would end in a 0, making it not a palindrome. So among three-digit palindromes in base 9, $111_9 = 331_5$, $121_9 = 400_5$, and $131_9 = 414_5$. Thus, the answer is $9^2 + 3 \cdot 9 + 1 = 81 + 27 + 1 = 109$
5. Balanced primes: 5, 53, 157, 173,…
   Sophie Germain primes: 2, 3, 5, 11, 23, 29, 41, 53, 83, 89, 113, 131, 173,…
   Primes that are sum of 3 consecutive primes: 23, 31, 41, 59, 71, 83, 97, 109, 131, 173,…
   Thus, the answer is 173.
6. $1 - P(\text{none have same birthday}) = P(\text{at least two have same birthday}) \geq 0.5 \Rightarrow$
   $P(\text{none have same birthday}) \leq 0.5 \Rightarrow P_n = \frac{{}_{365}P_n}{365^n} \leq 0.5$. P_n is decreasing, $P_{22} \approx .524$ and $P_{23} \approx .493$, so the answer is 23.
7. $\frac{n(n+1)}{2} + 1 < 200 \Rightarrow n(n+1) < 398$. The largest value satisfying the inequality is $n = 19$, and the total number of pieces is $\frac{19 \cdot 20}{2} + 1 = 191$
8. This would be the least common multiple of 2, 3, 5, and 7, which is $2 \cdot 3 \cdot 5 \cdot 7 = 210$
9. The first one is XIX, which is 19.
10. $333{,}333{,}331 = 17 \cdot 19{,}607{,}843$, and the numbers with fewer 3's are all prime.

Section VIII – Relay

1. This is 360, no matter how many sides the polygon has.
2. The smallest number with exactly 45 positive integral divisors would be $2^4 \cdot 3^2 \cdot 5^2 = 16 \cdot 9 \cdot 25 = 3600$.
3. The width would be $\frac{3600}{15 \cdot 16} = 15$.
4. $\left(e^{\int_1^{15} \frac{x}{x^2+1}dx}\right)^2 = e^{\int_1^{15} \frac{2x}{x^2+1}dx} = e^{\ln(x^2+1)\big|_1^{15}} = e^{\ln 226 - \ln 2} = e^{\ln 113} = 113$
5. Both numbers would be odd primes, and the pairs whose smaller number is prime would be $(3,117)$, $(5,119)$, $(7,121)$, $(11,125)$, $(13,127)$,…. Since 127 is the first second number in the pairs that is prime, the smallest A is 13.

6. This is the TAK function, which is more easily described as
$$t(x,y,z)=\begin{cases} y, \text{ if } x\le y \\ \begin{cases} z, \text{ if } y\le z \\ x, \text{ otherwise}\end{cases}, \text{ otherwise}\end{cases}$$
. Thus the value of $t(13,11,16)$ is 16.
7. $x+9y\equiv 0(\text{mod}13)$, so multiplying by 3, $3x+y\equiv 0(\text{mod}13)$. Adding $13x$ retains the divisibility, so A may equal 3, 16, 29, 42, 55, 68, 81, or 94, the sum of which is 388.
8. $y'=1.75x-415$, so $y'\big|_{x=388}=1.75\cdot 388-415=264$
9. $\frac{n(n-3)}{2}\ge 264\Rightarrow n(n-3)\ge 528$. The smallest value of n satisfying the inequality is 25.
10. $100a+10b+c=25(a+b+c)\Rightarrow 75a=15b+24c\Rightarrow 25a=5b+8c$. c must be divisible by 5, so c is either 0 or 5. If $c=0$, then $25a=5b\Rightarrow a=1$ and $b=5$, so 150 is one such number. If $c=5$, then $25a=5b+40\Rightarrow 5a=b+8\Rightarrow b=2$ or $b=7$. If $b=2$, $a=2$, and if $b=7$, $a=3$. Thus the other two such numbers are 225 and 375. $150+225+375=750$.

Section IX – Sequences

1. This sequence is 7, 50, 27, 56, 65, 66, 78, 120, 13, 19, 92, 96, 129, 99, 176, 101, 18, 82, 86, 119, 103, 31, 32, 36, 69, 142, 47, 92,…, so the answer is 92.
2. This sequence begins with and repeats the six number sequence 1, 2, 2, 1, 1/2, 1/2, so the 2010th term is also the second 1/2, making the 2011th term 1.
3. This is the Fibonacci sequence beginning with 1, 1, so the 25th term is 75025.
4. The second term is 3+1+73+1=78, the third term is 13+1+2+1+3+1=21, the fourth term is 7+1+3+1=12, the fifth term is 2+2+3+1=8, the sixth term is 2+3=5, the seventh term is 5+1=6, the eighth term is 2+1+3+1=7, the ninth term is 7+1=8. Therefore, the fifth through eighth terms repeat, making the 2008th term 7, the 2009th term 8, the 2010th term 5, and the 2011th term 6.
5. This sequence is $a_n=\frac{n^2(n^2+1)}{2n}=\frac{n(n^2+1)}{2}$, so the 2011th term is $\frac{2011(2011^2+1)}{2}=4{,}066{,}464{,}671$
6. This sequence is $a_n=\frac{n^2(n^2+1)(2n^2+1)}{6n}=\frac{n(n^2+1)(2n^2+1)}{6}$, so the 179th term is $\frac{179(179^2+1)(2\cdot 179^2+1)}{6}=61{,}258{,}199{,}999$
7. $b_n: 1,2,4,8,16,32,64,128,\ldots$

   $c_n: 1,2,4,8,16,31,57,99,\ldots$

$a_n = b_n - c_n : 0,0,0,0,0,1,7,29,...$

Therefore, the answer is 1, 7, 29.

8. This sequence is 72, 18, 36 (geometric), 24 (harmonic), 30 (arithmetic), 27 (arithmetic), so the answer is 27.
9. This sequence is 4, 14, 1114, 3114, 132114, 1113122114, 311311222114, 13211321322114, 1113122113121113222114
10. The only right triangles with legs whose lengths differ by 2 are the multiples of right triangles whose leg lengths differ by 1. Thus the first such triangle is 6-8-10, the second is 40-42-58, making the answer 58.
11. This is the sequence of ordinals written as sets beginning with 0, so the 7th term is 6, which is the set consist of 0, 1, 2, 3, 4, and 5, which written as sets is

$$\left\{\varnothing,\ \{\varnothing\},\ \{\varnothing,\{\varnothing\}\},\ \{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\},\ \{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\}\},\right.$$

$$\left.\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\},\{\varnothing,\{\varnothing\},\{\varnothing,\{\varnothing\}\}\}\}\}\right\}$$

12. For a specific bucket, $\binom{10}{6}$ selects the 6 red balls, $\binom{62}{18}$ selects the blue balls to join the red ones, and $\binom{48}{24}$ selects half of the remaining balls to go in one of the other buckets (thus determining which balls go in the last bucket). There are three buckets which could contain the red balls as well. Thus the probability is

$$\frac{3\binom{10}{6}\binom{62}{18}\binom{48}{24}}{\binom{72}{24}\binom{48}{24}\binom{24}{24}}$$, which when reduced is $308085/2102594$.

Section XI – Homeomorphism

The groupings are:

One loop, two tails: A, R

Two loops: B

Straight line: C, G, J, L, M, N, S, U, V, W, Z

One loop, no tails: D, O

Three tails: E, F, T, Y

One line, four tails, two on each end: H, I

Four tails: K, X

One loop, one tail: P, Q