

Topical Problems

Part One

March 16, 2005

Directions: Mark on the answer form the letter that is closest to the correct answer. Make sure that your name(s) are on the answer form. If you are on a team put your team number and school name on the answer form. Remember that there are 5 points awarded for a correct response, 1 point for no response, and 0 points for an incorrect response.

Use the square array of nine points.

1. How many sets of four points would be vertices of a square? ● ● ●
 A. 6 B. 7 C. 5 D. 4
2. If four points are selected at random, what is the probability that the four would be vertices of a square? ● ● ●
 A. 0.01 B. 0.05 C. 0.10 D. 0.20 ● ● ●
3. If the square array of nine points were increased to a 25 point square array, what is the probability that four randomly chosen points would form a square?
 A. 0.003 B. 0.005 C. 0.001 D. 0.004

The pages of a large novel are numbered consecutively, starting with page number 1. The novel is bound in three volumes (books) and the page numbering continues on through each subsequent volume.

4. If each volume has an equal number of pages and the sum of the numbers printed on the first page of each volume is 1353, what is the number on the first page of volume three?
 A. 899 B. 452 C. 902 D. 450
5. For this problem use the correct results for problem #4. Sharon can read at a rate of 11.2 pages per 15 minutes and when she reads in the evening, she reads about 1.5 hours. However, Sharon only reads about 60% of her evenings. How many weeks will it take Sharon to finish the novel?
 A. 10 B. 3 C. 6 D. 5
6. If the volumes are not the same length, the sum of the first pages of each book is still 1353, the number of pages in the second volume is 80.68% of the number of pages in the first volume, and the number of pages in the third volume is 48.907% of the first two volumes, what is the number on the last page of book three?
 A. 1450 B. 1321 C. 1292 D. 1280

Reported were these changes in living arrangements in the United States for 1970 and 2003:

Year	Average Number of persons per household	Percentage of households with 5 or more persons	Percentage of households with one person	Number of households
1970	3.1	21.5%	17.5%	63,445,000
2003	2.6	10%	26%	105,842,000

7. Based on a linear model, what is the probability that five or more would live in a household selected at random from the United States in 1990?
 A. 11% B. 15% C. 13% D. 17%
8. Based on linear modeling, how many households in millions would have one person in 2010?
 A. 30 B. 27 C. 33 D. 24
9. If the population of the United States in 2000 was 286 million, what percentage error does linear modeling produce?
 A. 1% B. 3% C. 6% D. 10%

The Catsrus family includes Mr. & Mrs. Catsrus and daughters Jill and Courtney. The family owns four cats: a Siamese cat, a Black cat, a Grey cat, and a Calico cat. Each family member named one of the cats and considers it their personal pet.

- Mr. Catsrus' cat, Princess, is not Siamese.
- The Black cat does not get along with Princess, Ginger, or Kitty.
- The cat Jill takes care of is not Grey.
- One cat, Kitty, only sits on its master's, Courtney's, lap and plays with the Grey cat.
- Mrs. Catsrus feeds special treats to her cat, Reggie.

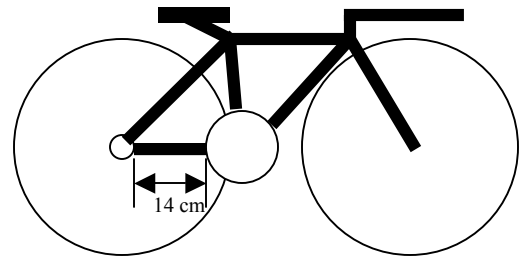
10. What is the name of Jill's cat?
 A. Princess B. Reggie C. Ginger D. Kitty
11. Which statement is needed to determine the name and type of cat each family member owns?
 A. Mr. Catsrus cat is Grey.
 B. Princess is not Black.
 C. The Siamese and Calico cats play together
 D. Jill's cat plays with the Calico cat.

Mrs. Catsrus, Jill, and Courtney took their cats to the local Cat Show. Each cat won one contest.

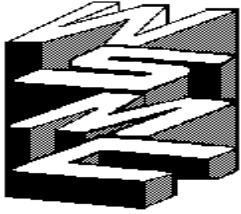
- If Jill's cat won the Friendliest cat contest, then Mrs. Catsrus cat won Best Mouser.
- If Courtney's cat won the Best Mouser, then Jill's cat won the Friendliest cat contest.
- If Courtney's cat won the Best Personality contest, then Jill's cat won the Best Mouser.
- If Courtney's cat won the Friendliest cat contest, then Mrs. Catsrus cat won Best Personality.
- If Mrs. Catsrus cat won the Friendliest cat contest, then Jill's cat on the Best Personality.

12. Who won the "Best Mouser" contest?
 A. Mrs. Catsrus cat B. Jill's cat C. Courtney's cat D. Cannot determine

Two bicycle chain sprockets, one with a 3 cm radius is fastened to the rear tire and the one connected to the pedals with a 7 cm radius, have 14 cm separating them. The circumference of the rear tire is 224 cm. This is a non-shifting racing bike.



13. If the cyclist is pedaling at a cadence of 70 revolutions per minutes, how fast in kilometers per hour is the cyclist moving?
 A. 22 B. 19 C. 16 D. 25
14. What radius in centimeters would the rear sprocket have to be for the cyclist to travel at 30 km/h if the cadence is kept at 70?
 A. 3.2 B. 2.5 C. 2.2 D. 2.0
15. How long in centimeters is the chain needed to wrap around the original sprockets?
 A. 80 B. 81 C. 82 D. 79



Topical Problems

Part Two

March 16, 2005

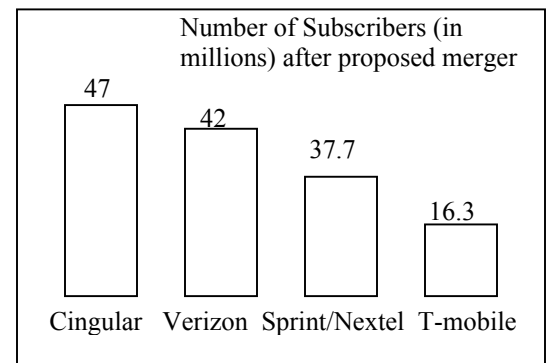
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In this problem two regular fair six sided dice being rolled.

- What is the probability that in a roll at least one die is even?
A. 0.75 B. 0.50 C. 0.35 D. 0.60
- What is the maximum number of times that one might have to roll the dice to have two rolls produce the same sum?
A. 25 B. 100 C. 50 D. 10
- What is the probability of rolling a sum of six or doubles?
A. 0.22 B. 0.28 C. 0.25 D. 0.31

When presenting information on a proposed merger of Nextel and Sprint, USA Today (December 10, 2004) provided the table and graph. Before the proposed merger, Sprint was ranked #3 and Nextel was ranked #5.

	Sprint	Nextel
Revenues per subscriber	\$63	\$69
Percent increase in per share value due to merger	8%	7%
Price per share expected after the proposed merger	\$24.28	\$29.81
Market value of company after percent increase in billions	35.7	33



- What is the range of the number of subscribers (in millions) that Sprint could have had prior to the proposed merger?
A. 21 to 38 B. 16 to 21 C. 16 to 38 D. 0 to 16
- Instead of the expected 7% increase in per share value expected for Nextel, what percent change would be needed to have the same price per share as Sprint's expected post merger value?
A. 33% B. -19% C. -13% D. 23%
- If the average revenue per subscriber of the top five carriers is \$55, what is the mean of the smallest and largest possible average revenues per subscriber for Cingular, Verizon, and T-Mobile combined?
A. \$51.10 B. \$51.70 C. \$52.20 D. \$51.60

When planning a trip to the National Mathematics Competition, the advisors from four different local school districts contacted the recommended travel agency and got price quotes. Genoveva was quoted \$5516 for 10 economy class tickets, 2 first class tickets and 3 business class tickets. Jim's 4 first class tickets, 15 economy tickets, and 2 business class tickets were \$7776. \$5742 would pay for the 2 business class, 2 first class, and 12 economy tickets for Kaneesha's math team. Rick was quoted \$3379 for the tickets he needed. However Rick only remembers that that total included 3 business class tickets.

7. Choose the matrix that best represents the information.

A. $\begin{bmatrix} 10 & 2 & 3 & 5516 \\ 4 & 15 & 2 & 7776 \\ 2 & 2 & 12 & 5742 \\ 3 & x & y & 3379 \end{bmatrix}$ B. $\begin{bmatrix} 10 & 4 & 3 \\ 2 & 15 & x \\ 3 & 2 & y \\ 5516 & 7776 & 3379 \end{bmatrix}$ C. $\begin{bmatrix} 10 & 3 & 2 & 5516 \\ 15 & 2 & 4 & 7776 \\ 12 & 2 & 2 & 5742 \\ x & 3 & y & 3379 \end{bmatrix}$ D. $\begin{bmatrix} 10 & 15 & 12 & 5516 \\ 3 & 2 & 2 & 7776 \\ 2 & 4 & 2 & 5742 \\ x & 3 & y & 3379 \end{bmatrix}$

8. What is the price in dollars of one business class ticket?

- A. 350 B. 400 C. 450 D. 500

9. How many tickets did Rick purchase?

- A. 14 B. 11 C. 8 D. 5

A rectangular swimming 15 feet wide and 20 feet long has a concrete walk around it. The walk's outer edge is always 3 feet from the edge of the pool.

10. What is the surface area in square feet of the walk?

- A. 250 B. 210 C. 230 D. 220

11. The walk is 4 inches thick the concrete is ordered to the nearest quarter cubic yard greater than the amount needed. If the price per cubic yard is \$75.00 with a \$50.00 delivery charge for any order less than 3 cubic yards plus 7.7% sales tax, what is the price in dollars of the concrete?

- A. 280 B. 250 C. 240 D. 260

12. If the walk's outer edge is always the same distance from the edge of the pool and 8 cubic yards of concrete is used (still 4 inches thick) what is the distance in inches to the outer edge of the sidewalk?

- A. 60 B. 70 C. 80 D. 90

The integers, 1-12, (each used once) are located on the vertices and at the midpoints of a hexagon. The sum of the three numbers on each side (*sum of the side*) of the hexagon is 17.

13. What is the difference between the total of the *sum of the sides* and the sum of the numbers used?

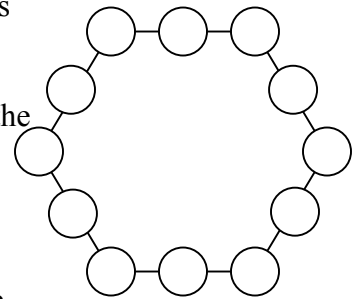
- A. 100 B. 70 C. 25 D. 50

14. Which numbers must be on a vertex?

- A. 6, 1, 2 B. 3, 4, 2 C. 4, 3, 1 D. 5, 2, 1

15. If the number ten is on a side between two vertices, what do the numbers on the vertices have to be?

- A. 1, 6 B. 2, 5 C. 3, 4 D. there is more than one possibility



Answer Key Regional Topical March 16, 2005

Part One		Part Two	
1.	A 6	1.	A 0.75
2.	B 0.048	2.	D 12
3.	D 0.004	3.	B 10/36
4.	C 901	4.	A 21.4 to 37.7
5.	D 4.79	5.	C -12.8%
6.	C 1294	6.	B 51.68
7.	B 14.5%	7.	C
8.	A 31.1	8.	B \$414
9.	C 6%	9.	C 9
10.	C	10.	C 238
11.	D	11.	C \$242.33
12.	B	12.	C 84.5
13.	A 22	13.	C 24
14.	C 2.2	14.	D 1, 2, 3, 5 have to be on all
15.	B 81.36	15.	D 1&6, 3&4