

Topical Problems

Part One

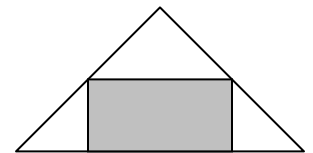
March 5, 2008

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.

Uranium 239 has a half life of 23 minutes. 239 grams of Uranium 239 contains about 6.02×10^{23} atoms.

1. How many atoms of Uranium 239 are there in 1 milligram?
A. 2×10^{18} B. 2×10^{26} C. 2×10^{21} D. 2×10^{23}
2. How many grams of Uranium 239 are left after one day if you started with 1 milligram?
A. 2×10^{-24} B. 2×10^{-22} C. 2×10^{-18} D. 2×10^{-20}
3. How many atoms of Uranium 239 are left after one day if you started with 1 milligram?
A. 1 B. 100 C. 10000 D. 1000000

A right triangular attic space has end access as shown. A rectangular solid grey box is half the height of the attic and just fits into the attic as shown. The sloping side is 10 feet long.



4. What is the sum in feet of the width and height of the grey box?
A. 8 B. 10 C. 11 D. 9
5. Rotate the box 90 degrees onto its side and center it with the attic. Determine the clearance the box has by subtracting the height of the box from the vertical height of the attic at the edge of the box. Give the clearance in feet.
A. 1 B. 2 C. 0 D. -1

Assume a two digit number cannot start with a zero.

6. How many two digit perfect squares are primes when the digits are reversed?
A. 0 B. 2 C. 1 D. 3
7. How many two digit primes are still primes when the digits are reversed?
A. 8 B. 11 C. 9 D. 10
8. How many two digit perfect squares have two or more different common factors (excluding one) with the number when the digits are reversed?
A. 2 B. 1 C. 3 D. 0

A fish grows in length from 3 cm to 14 cm in 120 days. Assume the growth in length follows a linear pattern. Also assume that the fish is similar in shape throughout the 120 days. A 3 cm fish is 4 grams and has a girth (distance around the fish at its thickest point) of 2 cm.

9. How long in cm is the fish after 25 days?
A. 4.5 B. 5.5 C. 5.0 D. 4.0
10. After how many days will the fish have a girth of 6 cm?
A. 35 B. 45 C. 40 D. 30
11. After how many days will the fish be 20 grams?
A. 19 B. 16 C. 22 D. 25

A square is in the first quadrant with one vertex at the origin and sides on the axes. The vertex opposite the vertex at the origin is on a curve.

12. If the curve is $y = 2x^2$, what is the perimeter of the square?

- A. 0.15 B. 2.00 C. 1.00 D. 4.00

13. If the curve is $y = 3x^3$, what is the area of the square?

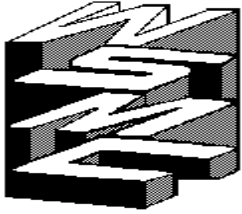
- A. 0.3 B. 1.0 C. 0.4 D. 0.6

14. If the curve is $y = 4x^4$, what is the length of one diagonal of the square?

- A. 0.3 B. 1.0 C. 0.8 D. 0.6

15. If the curves are of the form $y = n(x^n)$ where $n = 2, 3, 4, \dots$, what does the area of the square approach as n gets large?

- A. 0.3 B. 1.0 C. 0.8 D. 0.6



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Part Two

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A hiker hikes at a rate of 2 mph on a trail up a mountain. It took a third less time to come back down. The entire hike took 6 hours and stopped for thirty minutes at the top.

- How many minutes did it take to get back down?
A. 150 B. 160 C. 140 D. 130
- How far in miles was it up the mountain?
A. 5 B. 6 C. 7 D. 8
- What was the average speed for the entire trip including the break?
A. 2.2 B. 2.0 C. 2.1 D. 2.3

If on each visit a typical customer buys bread 60% of the time and fruit 50% of the time. Also, the probability that the customers buy both bread and fruit is 0.3.

- What is the probability that a typical customer buys either bread or fruit?
A. 0.3 B. 1.0 C. 0.8 D. 0.6
- What is the probability that a typical customer buys fruit on the next six visits?
A. 0.3 B. 0.1 C. 0.2 D. 0.0
- What is the probability that a typical customer buys bread on at least one of the next ten visits?
A. 1.00 B. 0.95 C. 0.97 D. 0.99
- What is the probability that a typical customer buys bread exactly three times in the next five visits?
A. 0.30 B. 0.20 C. 0.10 D. 0.40

The table shows some American and metric hat sizes as well as men's and women's head measurements for those sizes.

Relationships among the variables (columns) in the table are linear however all of the measurements for the Men's head size need to be considered to get a model that is reasonably close to accurate.

American Sizes	Men Head Measurement in inches	Ladies' Head Measurement in inches	Metric Sizes
$6\frac{3}{8}$	$20\frac{1}{2}$	$19\frac{1}{2}$	51
$6\frac{1}{2}$	$20\frac{5}{8}$	20	52
$6\frac{7}{8}$	$21\frac{7}{8}$	$21\frac{1}{2}$	55
$7\frac{1}{8}$	24	$24\frac{1}{2}$	61
$7\frac{3}{4}$	$24\frac{1}{2}$	25	62
$7\frac{7}{8}$	25	$25\frac{1}{2}$	63

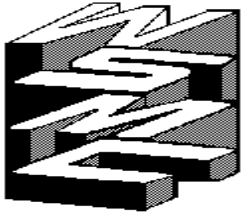
- What metric size of hat fits a woman with a head measurement of 2 feet?
A. 58 B. 61 C. 59 D. 60
- Which formula could relate American Hat sizes to women's head measurements if x and y are properly assigned to one or the other variable?
A. $y - 4x = 5.5$ B. $4y + x = 5.5$ C. $y + 5.5 = \frac{1}{4}(x)$ D. $y - 1.4 = \frac{1}{4}(x)$
- What is the head size for a man that wears a hat size of 9?
A. $27\frac{3}{4}$ B. 28 C. $28\frac{1}{4}$ D. $28\frac{1}{2}$
- Which American hat size fits both men and women with the same head size?
A. $7\frac{1}{4}$ B. $7\frac{3}{8}$ C. $7\frac{1}{8}$ D. $7\frac{1}{2}$

The earth has a radius of approximately 6×10^6 meters. Latitude is the number of degrees north or south of the equator. Longitude is the number of degrees east or west of Greenwich, England.

12. At noon during the vernal equinox, the sun is directly over head at the equator. How far from the base of a 200 foot vertical tree at latitude 40 degrees north does a shadow reach?
A. 150 B. 160 C. 140 D. 170
13. Given point A is at 45 degrees, 10 minutes, 32 seconds north and point B is at 45 degrees, 12 minutes, 23 seconds north and that both points have the same longitude, how many meters apart are A and B?
A. 3230 B. 1610 C. 530 D. 1050
14. Two points are both at latitude 60 degrees north. They are one degree apart in longitude. How many kilometers apart are the two points?
A. 68 B. 96 C. 29 D. 52

You have a 37¢ stamp, a bunch of 23¢, 41¢, and 39¢ stamps.

15. How close in cents to \$1.14 can be gotten realizing that there must be at least \$1.14?
A. 0 B. 3 C. 6 D. 9



WSMC High School Regional Competition

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Answers

March 5, 2008

Part One		Part Two	
1.	A 2.52×10^{18}	1.	D 132
2.	B 1.42×10^{-22}	2.	C 6.6 miles
3.	A 0.36	3.	A 2.2 mph
4.	C 10.6	4.	C 0.8
5.	D 1.77 too high	5.	D 0.0156
6.	C 16-61	6.	A 0.99989
7.	C 11,13,17,31,37,71,73,79,97	7.	A 0.345
8.	A 36, 81	8.	D 60
9.	B 5.29	9.	D
10.	B 43.6	10.	C 28.182
11.	C 22.9	11.	A $7 \frac{1}{4}$
12.	B 2	12.	D 167.8
13.	A $\frac{1}{3}$	13.	A 3229
14.	C 0.89	14.	D 52.3
15.	B 1	15.	A 115¢