

WSMC High School State Competition

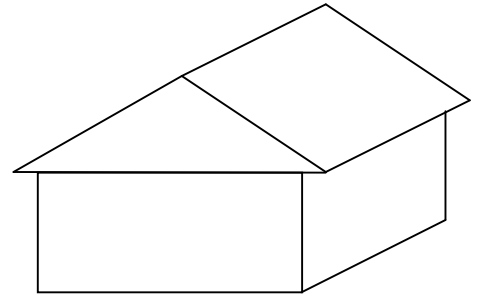
Topical Problems

Part One

April 18, 2009

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.

Trish is tearing the shingles off of the garage and replacing them with new ones that are also 3-tab asphalt shingles. The shingles come in packages that contain 120 lbs of shingles. Three packages cover the area equivalent to one roofing square (10'x10'). The garage is 24 feet wide and 24 feet long. The roof has a pitch of 4-12 which means that the roof rises 4" for every 12" of horizontal run. The eaves on all sides extend one foot horizontally from the building.



1. What is the total area in square feet of the roof?
A. 700 B. 690 C. 660 D. 720
2. If re-cycling costs \$0.05 per pound of shingles, what will be the re-cycling charge?
A. 90 B. 110 C. 100 D. 120
3. Each shingle is one foot wide by three feet long and requires four nails. Also because each shingle is overlapped, only 50% of the shingle's area is used in covering the roof. How many nails are required?
A. 1200 B. 1800 C. 2100 D. 1600
4. Using the additional information in the question above, how many 1'x3' shingles are in a bundle?
A. 11 B. 22 C. 44 D. 33

My car's odometer has six digits and the smallest digit counts the miles. Over the last year, the odometer of my car has had the same second from the right digit about 90 times. A year ago the reading of the odometer was about 2% less than the current reading and back then I could have written the total miles driven with the digits in any order and had the same reading. I retired last year and have driven the car half as much as I used to over all prior years.

5. How many miles did I put on the car in the last year?
A. 5,000 B. 9,000 C. 7,000 D. 11,000
6. My car has averaged 25 mpg ever since I bought it new. I had considered a car that would have averaged 20 mpg. How many gallons of gas have I saved so far by buying the 25 mpg car instead of the 20 mpg car?
A. 1,000 B. 2,000 C. 3,500 D. 5,000
7. The average speed I have driven over the years is estimated to be 40 mph. How much time in days have I spent behind the wheel (assuming I was the only driver)?
A. 500 B. 200 C. 400 D. 300
8. The average price of a gallon of gas this past year was \$2.25. Over the past 30 years the price has increased an average of 6 cents per year. What was the total dollar value spent on gas? Assume that the car was driven roughly the same number of miles each year prior to my retirement.
A. 20,000 B. 27,000 C. 35,000 D. 80,000

There are 150 student drivers in a particular high school and there is a 0.005% chance that a student driver from that school will be involved in an accident on any given day. Assume that the occurrence of accidents is independent events.

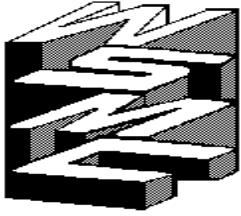
9. What are the chances in percent that there will be no accident on a given day?
A. 93.0% B. 99.99% C. 99.0% D. 47.0%
10. What are the chances in percent that exactly two students will be in an accident on a given day?
A. 1% B. 0.1% C. 0.01% D. 0.001%
11. What is the probability (not in percent) that 20 days will pass without an accident?
A. 0.8 B. 0.85 C. 0.9 D. 0.50

The following table is an attempt of one person using several sources to develop a table for the relationship between shoe sizes in different systems and relating shoe sizes to the length of the human foot.

Adult Men's and Women's Shoe Size Conversion Table

System		Sizes															
Foot length in inches		9	9 ¹ / ₈	9 ¹ / ₄	9 ³ / ₈	9 ¹ / ₂	9 ⁵ / ₈	9 ³ / ₄	9 ⁷ / ₈	10	10 ¹ / ₈	10 ¹ / ₄	10 ¹ / ₂	10 ³ / ₄	11	11 ¹ / ₄	11 ¹ / ₂
US	Men	3 ¹ / ₂	4	4 ¹ / ₂	5	5 ¹ / ₂	6	6 ¹ / ₂	7	7 ¹ / ₂	8	8 ¹ / ₂	9	10 ¹ / ₂	11 ¹ / ₂	12 ¹ / ₂	14
US	Women	5	5 ¹ / ₂	6	6 ¹ / ₂	7	7 ¹ / ₂	8	8 ¹ / ₂	9	9 ¹ / ₂	10	10 ¹ / ₂	12	13	14	15 ¹ / ₂
European		35	35 ¹ / ₂	36	37	37 ¹ / ₂	38	38 ¹ / ₂	39	40	41	42	43	44	45	46 ¹ / ₂	48 ¹ / ₂

12. If US Women's sizes were expressed as a linear function of the US Men's sizes, determine the slope and y-intercept respectively.
A. 1.5, 1 B. 1, -1.5 C. 1, 1.5 D. -1.5, 1
13. Every inch increase in the length of a human foot results in approximately how many shoe sizes increase in US shoe size?
A. 1/4 B. 1 C. 2 D. 4
14. If a linear relationship is established between US Women's shoe sizes and the length of a human foot, what is the length of a human foot predicted for a US Women's shoe size of zero?
A. 7 1/2 B. 7 3/4 C. 8 D. 8 1/4
15. Shaquille O'Neal's shoe size is reported to be 22 in US Men's sizes. What would be his shoe size in the European System?
A. 55 B. 59 C. 50 D. 63



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Rosalyn is shopping at a famous retailer of clothes. A pair of designer jeans is on a 30% off (the original marked price) sale rack. That would make the price \$148. Because she is using her store credit card, she receives an additional 10% off of the marked down price.

1. After paying 9% sales tax on her purchase, what percent of the original price did she pay?
A. 60% B. 63% C. 66% D. 69%
2. If the store had marked the original price up from its cost by 120%, how much money did they make on the jeans? Remember that the sales tax is not income for the store.
A. 40 B. 50 C. 60 D. 70

For this problem use a sphere with a maximum circumference of 20π cm. All points are on the surface of the sphere but the straight line distances are chord lengths through the sphere.

3. Two points are placed on the sphere as far apart as possible. Using straight line distance, how far in cm are they apart?
A. 10 B. 20 C. 200 D. 100
4. Three points are placed on the sphere as far apart as possible. What is the difference in centimeters between the shortest distance on the sphere and the straight line distance through the sphere between two points?
A. 2.4 B. 3.0 C. 3.6 D. 1.8
5. Eight points are placed on the sphere as far apart as possible. Using straight line distance, how far in centimeters is any one point from its closet neighboring point?
A. 2 B. 7 C. 10 D. 12
6. Eight points are placed on the sphere as far apart as possible. What is the measure of the central angle in degrees between one point and another point that is neither as close as possible nor as far as possible from the first? (The central angle is the angle with its vertex at the center of the sphere and each point is on a different side of the angle.)
A. 110 B. 90 C. 120 D. 100

The effective resistance of resistors in a parallel arrangement is given by:

If two resistors: $1/R_{\text{effective}} = 1/R_1 + 1/R_2$, where R_1 and R_2 are the resistances of the two resistors.

If three resistors: $1/R_{\text{effective}} = 1/R_1 + 1/R_2 + 1/R_3$.

If n resistors: $1/R_{\text{effective}} = 1/R_1 + 1/R_2 + 1/R_3 + \dots + 1/R_n$.

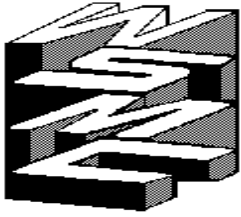
7. If a resistor with resistance of 5 ohms is in a parallel arrangement with a resistor of 10 ohms, what is the effective resistance in ohms of the two resistors?
A. 3/10 B. 2/15 C. 15/2 D. 10/3
8. What resistance in ohms would have to be placed in a parallel arrangement with a 100 ohm resistor to create an effective resistance of 20 ohms?
A. 80 B. 40 C. 25 D. 20
9. If there are four resistances in a parallel arrangement with resistances of 200 ohms, 300 ohms, 400 ohms, and an unknown resistance, what is the difference in ohms between the maximum and the minimum effective resistance the arrangement could have?
A. 100 B. 50 C. 90 D. 200

A goat is tethered to a square solid-walled shed.

10. If the shed is 12 feet wide and the goat is tied to a corner with a rope 15 feet long, how much area in square yards can the goat graze in?
A. 500 B. 50 C. 60 D. 100
11. The next day, the goat is tied to the same shed with the same rope as above but to the middle of an opposing side (not one of the sides that made the original corner). What is the maximum **new** area in square feet the goat might graze? (Do not include the area that is overlapped with the previous days grazing.)
A. 380 B. 390 C. 365 D. 405

A power line is attached to two transmission towers of equal height 800 feet apart on level ground. The power line sags to 80 feet above the ground in the middle. If the origin is thought to be ground level half-way between the towers, the power line follows the Catenary curve $f(x) = 2001.66(e^{x/4003.33} + e^{-x/4003.33}) + C$.

12. Determine C in feet for this particular situation.
A. 80 B. -4000 C. -3900 D. 800
13. What is the height of the power line at one of the towers?
A. 85 B. 100 C. 93 D. 107
14. If a circle is used to approximate the shape of the power line from tower to tower, how far in feet above the lowest point of the power line is the center of this imaginary circle?
A. 4000 B. 3900 C. 3800 D. 3700
15. Using the equation of the imaginary circle in the above question, estimate the length in feet of the power line from tower to tower.
A. 801.5 B. 800.5 C. 802.0 D. 802.5



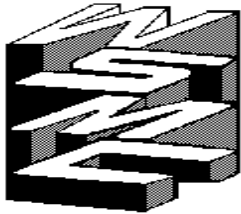
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Answers

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Part One		Part Two	
1.	D 712.6 sq ft	1.	D 68.7%
2.	D \$128.26	2.	A \$37.10
3.	B 1900 nails	3.	B 20 cm
4.	B 22 shingles	4.	C 3.62 cm
5.	B ~9000 miles	5.	D 11.55 cm
6.	D ~4500 gallons	6.	A 109.5 degrees
7.	A 470 days	7.	D 10/3 ohms
8.	B \$27,100	8.	C 25 ohms
9.	C 99.25%	9.	C 92.3 ohms
10.	D 0.0028%	10.	C 60 sq yd
11.	B 0.86	11.	B 391.5 sq ft
12.	C 1, 1.5	12.	C -3923.32 feet
13.	D 4	13.	B 100 feet
14.	B 7 3/4	14.	C 4010 feet
15.	B ~59 depending on method	15.	A 801.33 feet



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