

WSMC High School Regional Competition

Topical Problems

Part One

March 11, 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.

Imagine there are towns A, B, C, D, E, and F. The matrix indicates how many scenic routes connect which towns. Suppose you wanted to travel each route without duplication.

1. In which town could you start and complete your objective?
A. A B. B C. Can't be done D. D
2. Which towns would have to be connected with a scenic route so that the tour of all routes could be started in town F?
A. F to C B. E to F C. C to B D. D to E

Towns	A	B	C	D	E	F
A	0	1	2	1	1	1
B	1	0	0	0	1	1
C	2	0	0	1	0	0
D	1	0	1	0	0	0
E	1	1	0	0	0	0
F	1	1	0	0	0	2

A clock has a minute hand that is 10 cm long and an hour hand that is 7 cm long. The hands move at a constant rate (no jerking as in some clocks).

3. At what time after 1 AM are the hands for the first time at 180 degrees from each other?
A. 1:38:30 B. 1:39:00 C. 1:38:00 D. 1:37:30
4. How many times will the hands pass each other between 1 AM and 3 PM?
A. 15 B. 12 C. 14 D. 13
5. How far in cm does the tip of the minute hand move in 15 minutes?
A. 15 B. 16 C. 14 D. 13
6. How far apart in cm are the tips of the hands at 4 o'clock?
A. 15 B. 16 C. 14 D. 13
7. At what time is the distance between the tips of the hands changing at the greatest rate?
A. 12:00 B. 12:05 C. 12:10 D. 12:15

A regular four-sided polyhedron with an edge length of 18 mm is being used for a die. The faces are to be marked with dots similar to those on a regular six-sided die. The manufacturer wishes to have the dots placed on the surface so that three conditions are met: the centers of the dots are as far apart as possible, no center is closer to an edge of the die than it is to another dot or edge, and there is as much symmetry in the pattern as possible.

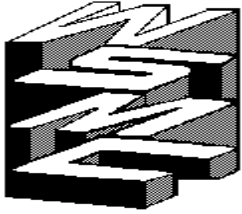
8. On the face with one dot, how far in mm is the dot's center from the edge?
A. 5.2 B. 4.9 C. 6.0 D. 5.6
9. How many lines of symmetry are there on the face with three dots?
A. 1 B. 2 C. 3 D. 6
10. If an optic sensor could count all of the dots on the faces not on the surface which the die rests, the formula that predicts the face down number from the total number of dots face up has which of these characteristics?
A. linear with slope of 1 B. Inverse C. linear with slope of -1 D. none of these

Assume that you have only dimes, nickels, and quarters.

11. How many different combinations of coins would make 50 cents?
A. 11 B. 10 C. 9 D. 8
12. Consider having exactly a dollar in change that consists of only dimes, nickels, and/or quarters. What is the probability that the change has at least one quarter?
A. 0.8 B. 0.6 C. 0.7 D. 0.9

The amount 'A' in milligrams of a medication left in a 80 kilogram body after 't' hours is given by the formula $A(t) = 5(1/2)^{t/10}$.

13. What is the half-life in hours of the drug? That is how long will it take for half of the drug to be left?
A. 5 B. 10 C. 20 D. 30
14. There is a danger of a reaction to a second drug if the remaining amount is more than 1×10^{-6} percent of the body mass. How long in hours before the second drug can be given safely?
A. 1 B. 5 C. 10 D. 20
15. Which function would express the hours as a function of the amount left?
A. $t(A) = \ln((5/A)^{14.4})$ B. $t(A) = 10 \log_2(A/5)$
C. $t(A) = (4A)^{10}$ D. $t(A) = (\log(A) - \log(5))/(10 \log(0.5))$



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A car travels an average of 50 mph for 6 hours. This particular car gets 25 mpg at the average speed of 50 mph and 24 mpg at 55 mph.

1. How many minutes would be cut off of the trip traveling an average of 55 mph?
A. 35 B. 50 C. 45 D. 40
2. If gasoline costs \$2.10 per gallon, by what percentage will the total cost of the fuel for this trip increase due to the increased speed?
A. 4 B. 1 C. 3 D. 2
3. If the car is making the trip again and is only able to average 40 mph for the first half of the distance, what will the average speed on the second half of the trip have to be to average 50 mph?
A. 50 B. 55 C. 60 D. 65

A playing card deck has 52 cards: A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, and K of each of four suites diamond, hearts, club, and spades.

4. If two cards are selected at random, what is the probability that the two are not the same kind (not two 5's or two K's or...)?
A. 0.91 B. 1.00 C. 0.94 D. 0.97
5. If five cards are drawn at random, how many different hands are there?
A. 260 B. 3.1×10^8 C. 2,500,000 D. 790,000
6. If five cards are drawn at random from a regular deck where the A, J, Q, and K cards are all removed, what is the probability that the five card hand will contain four of a kind? (An example of four of a kind would be four 7's and another card.)
A. 0.0001 B. 0.001 C. 0.01 D. 0.00001

An 8x10 senior portrait is being framed. The portrait uses the entire area of the 8x10. The frame will be an 11x14. (Measurements are in inches.)

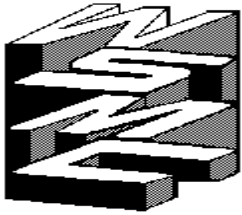
7. If the matting overlaps each edge of the photo by 1/4 inch and is cut out of an 11x14 piece of matte board, what percent of the matting material will be removed?
A. 50% B. 45% C. 40% D. 35%
8. The 8x10 portrait is reduced as much as possible and with no distortion. The reduction still covers the entire area of a 5x7. What is the area in square inches of the reduction?
A. 39 B. 35 C. 31 D. 42
9. The reduction in the above question is matted with a pre-cut matting that covers 1/4 inch on each edge of 5x7 print. What percentage of the original un-matted portrait will not be visible in the matted reproduction?
A. 10% B. 20% C. 25% D. 15%

Suppose there are available quantities of 40% acidic solution and 10% acidic solution.

10. How many milliliters of the 40% acidic solution must be added to an appropriate amount of 10% acidic solution to get 50 ml of solution that is 14% acidic?
A. 5 B. 6 C. 7 D. 8
11. If 'x' milliliters of 40% acidic solution is added to some of the 10% acidic solution to get 'M' ml of solution P% acidic solution, which equation relates the variables 'x', 'M', and 'P'?
A. $30x/(10-P) = M$ B. $P = 30x/M + 10$ C. $50x = (P-40)M$ D. $x = (P-10)M/30$

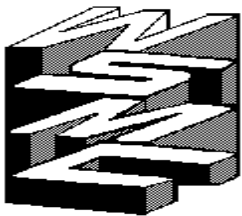
Albert has just learned in Physics class that a projectile's flight path will be modeled by these equations: vertically $v(t) = -4.9t^2 + v_0 t \sin(\phi)$ and horizontally $h(t) = v_0 t \cos(\phi)$ where ϕ is the angle of launch relative to the flat ground, v_0 is the initial velocity in m/s, and t is the number of seconds following launch. Albert, being the Einstein he was, wanted to use these equations in the upcoming snowball fight.

12. If Albert threw a snowball with an initial velocity of 10 m/s and at an angle of 30 degrees, how far in meters would it land from him?
A. 12 B. 5 C. 8 D. 15
13. What would be the maximum height in meters the snowball would reach in the previous problem?
A. 1.50 B. 1.25 C. 1.00 D. 1.75
14. If Albert was 10 meters from a 2 meter high wall and he wanted his snowball to land one meter behind the wall, what would be his minimum launch angle?
A. 60 B. 75 C. 70 D. 65
15. Using the situation in problem 14 including the minimum launch angle, what would be the required launch speed in m/s?
A. 9 B. 10 C. 11 D. 12



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Answer Key Regional Topical
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Part One		Part Two	
1.	B	1.	A 32.7
2.	C	2.	A 4.2%
3.	C 1:38:11	3.	D 66 2/3
4.	D 13	4.	C 0.94
5.	B 15.7	5.	C 2,598,960
6.	A 14.8	6.	B 0.00076
7.	C 12:10 the rate is 6.9	7.	B 46%
8.	A 5.20	8.	A 39.2
9.	C 3	9.	C 25%
10.	C	10.	C 6 2/3
11.	B 10	11.	D
12.	B 18/2	12.	C 8.8
13.	B 10	13.	B 1.28
14.	D 27	14.	D ~65 degrees (depends on initial h_0)
15.	A	15.	D ~11.8 (depends on initial h_0)



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**WSMC High School
Math Contest
Answer Form for Part One**

School

Team Number

Name(s)

1.

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**WSMC High School
Math Contest
Answer Form for Part Two**

School

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**WSMC High School
Math Contest
Answer Form for Part Two**

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Team Number

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