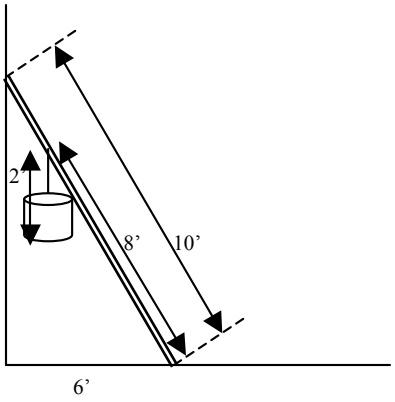
WSMC High School State Competition

Topical Problems
Part One
April 22, 2006

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.

A ten foot ladder is leaning against a wall with a bucket tied to the ladder eight feet from the foot of the ladder. The bottom of the bucket is two feet below the point where the bucket is tied to the ladder.



1. If the foot of the ladder is 6 feet from the wall, how far in inches is the bottom of the bucket from the ground?
   A. 64 B. 40 C. 53 D. 58
2. If the foot of the ladder is 6 feet from the wall, what is the angle in degrees between the ladder and the wall?
   A. 33 B. 36 C. 42 D. 39
3. If the ladder's feet slipped out and the ladder slid down the wall, how far in feet would the foot of the ladder be from the wall when the bucket reaches the ground? Assume that the bucket continues to hang straight down.
   A. 9.2 B. 8.5 C. 9.5 D. 8.9

The following equations represent the vertical position [V(t)] and horizontal position [H(t)] of a projectile when it is launched from ground level. Distances are in meters and time is in seconds. Assume that the surrounding area is flat ground.

$V(t)= -4.9t^2 + 80t$ $H(t)= 25t$

4. What is the maximum height in meters that the projectile reaches?
   A. 185 B. 200 C. 325 D. 415
5. How far in meters from the launch site does the projectile land?
   A. 365 B. 385 C. 410 D. 395
6. Determine the angle of the flight of the projectile with respect to the ground 2 seconds after its launching?
   A. 74 B. 76 C. 72 D. 69

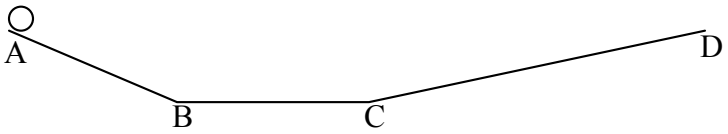
An 8 _" x 11" sheet of paper is cut in half along a diagonal to form two triangular 'half sheets' of paper.

7. What is the perimeter in inches of one of these 'half sheets' of paper?
   A. 34 B. 32 C. 31 D. 33
8. What is the measure in degrees of the smallest angle of the triangular 'half sheet'?
   A. 38 B. 35 C. 41 D. 32
9. What is the area in square inches of the largest square that could be cut out of one of these 'half sheets'?
   A. 24 B. 23 C. 23.5 D. 22.5
10. Consider all possible semicircles drawn on the 'half sheet' of paper with their centers on the 8.5-inch side. What is the radius of the largest of the possible semicircles?
    A. 3.95 B. 3.75 C. 4.25 D. 4.15

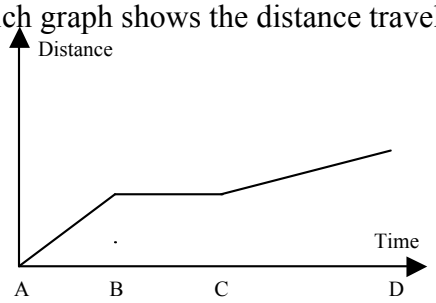
Joe DiMaggio set a record in baseball that has stood for many years. He had a hit in 56 consecutive games. Ichiro Suzuki has had a batting average for a year of near 0.350. That means that he had hit safely an average of 35% of the time. On average a regular player has four At Bats (batting opportunities) during a game.

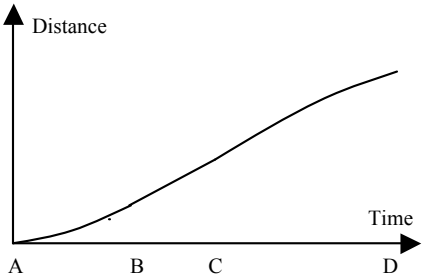
11. What is the lowest batting average that a player could have for 56 games and have at least one hit per game?
    A. 0.200 B. 0.250 C. 0.300 D. 0.350
12. If Ichiro Suzuki was batting 0.350, what is the probability that he will have at least one hit in an average game?
    A. 0.75 B. 0.85 C. 0.80 D. 0.90
13. Using the correct information in problem 12, what is the probability that Ichiro Suzuki will have at least one hit in 57 consecutive games?
    A. 0.0001 B. 0.001 C. 0.00001 D. 0.01

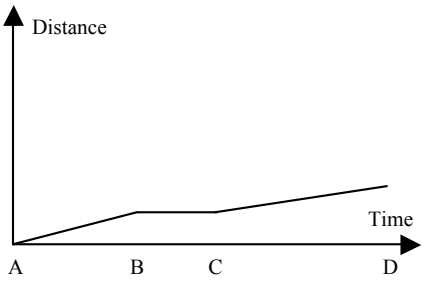
The figure shows a scale drawing of a ball about to roll along a frictionless track.

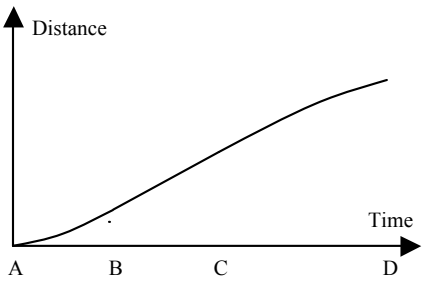


14. Which graph shows the distance traveled?

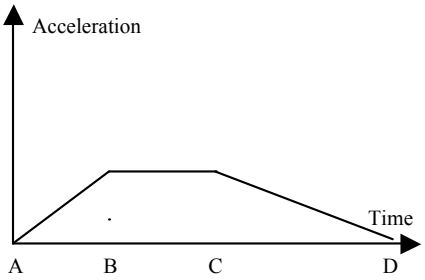
A.


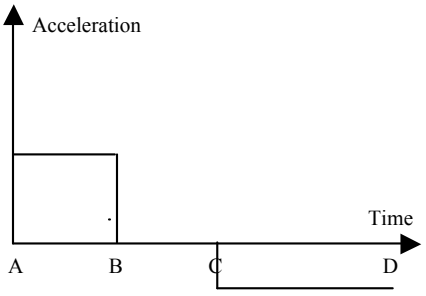
B.


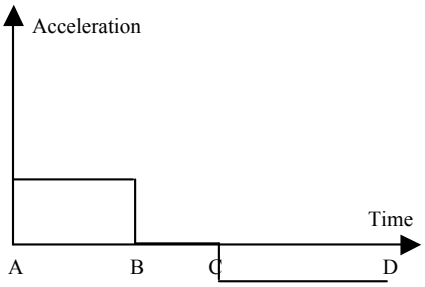
C.


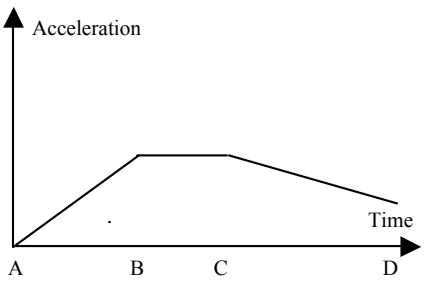
D.


15. Which graph shows the acceleration?

A.


B.


C.


D.


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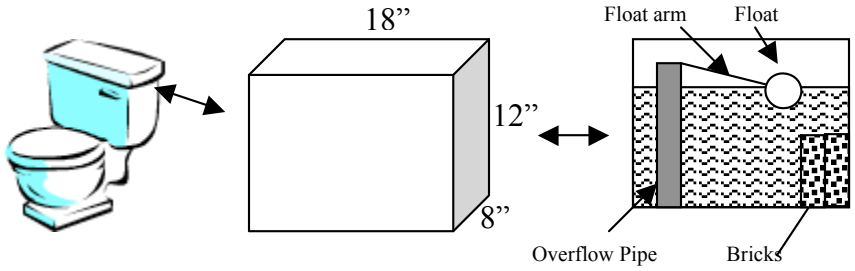
Year	US Population (Millions)	Traffic Fatalities	Licensed Drivers (Millions)
1977	220	47,878	138
2000	281	41,821	185

An insurance company is studying its traffic fatality data and they are using the table.

1. What is the traffic fatality rate per 10,000 people in the US in 1977?
   A. 20 B. 10 C. 5 D. 3
2. If there were 1.55 fatalities per 100 million miles driven in 2000, how many trillions of miles were driven in 2000?
   A. 20 B. 10 C. 2 D. 30
3. If there were 100 licensed drivers in a circle of friends in 2000, what was the probability that none were a fatality in a traffic accident?
   A. 0.97 B. 0.99 C. 0.01 D. 0.00

Suppose that an older toilet water tank was in the shape of a rectangular box with outside dimensions of 18”x8”x12” as shown. The tank has 1/2” thick walls and bottom. Inside the tank is a float that is spherical (radius 2”) with about half of it above water. When the toilet is flushed, the weight of the float turns on the water to refill the tank. When the tank is full the float rises and shuts off the water.



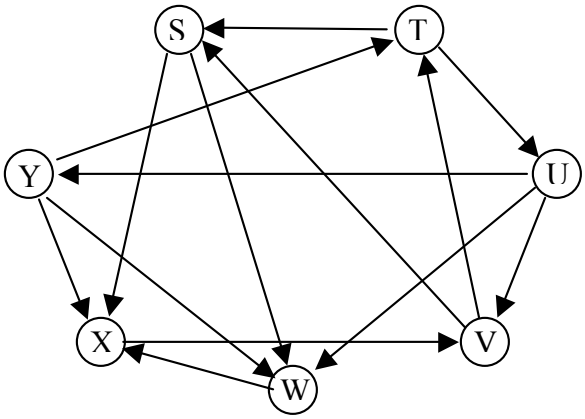
The distance from the center of the float to the arm’s pivot point is 12 inches. The tank stops flushing when 1 inch of water is left in the tank. The overflow pipe is 11” tall when measured from the bottom of the inside of the tank. The overflow pipe has a diameter of 1” and the water fills to within 1 inch of its top.

4. If no bricks are in the tank, how many cubic inches of water are used in one flush?
   A. 1070 B. 1080 C. 1060 D. 1050
5. If two 3.5”x 2.5”x 6” solid bricks are set in the tank on their side as shown, what percentage of water is conserved per flush?
   A. 6% B. 10% C. 8% D. 12%
6. How many degrees does the float arm move down when the float drops during a flush?
   A. 50 B. 45 C. 55 D. 60

Four spheres are touching each other so that their centers would form a planar square and are setting on a flat surface. Each sphere has a radius of 5 centimeters. A fifth sphere, congruent to the others is set centered and on top of the other four and tangent to all four.

7. What is the height in centimeters of the pile of five balls?
   A. 19 B. 16 C. 18 D. 17
8. If another four like the first four are set on top of the first **four** so that they would fit in the smallest right rectangular box possible, what is the surface area in square centimeters of the box?
   A. 2400 B. 3200 C. 800 D. 1600
9. If the first five spheres were inside of a square pyramid externally tangential to the spheres, what would be the width in centimeters of the base of the pyramid?
   A. 24 B. 30 C. 33 D. 27
10. Using the pyramid in the problem 9, what would be the angle in degrees between a face of the pyramid and the base of the pyramid?
   A. 55 B. 60 C. 50 D. 45

Each of the seven teams (S, T U…Y) in a league have played four of the other teams. The diagram indicates the games that have been played with a ray. The rays point to the loosing teams.



11. If ties are broken by considering the total wins of the teams a team defeated, break the ties and rank the teams. Using this ranking, identify the 2nd and 3rd place teams respectively?
   A. Y and T B. U and Y C. Y and S D. U and S
12. Based on the ranking of the teams, which team has the toughest two teams left to play?
   A. X B. W C. S D. V

Carlos is looking at three savings plans.

- Plan 1 offers 5% interest compounded annually with an $8 annual fee
- Plan 2 offers 4.75% interest compounded monthly with a 5 dollar annual fee
- Plan 3 offers 4.5% compounded continuously with no annual fee.

13. Which plan will yield the highest earnings in 3 years?
   A. Plan 1 B. Plan 2 C. Plan 3 D. Cannot be determined
14. How many years does it take for an investment to double in Plan 3?
   A. 13 B. 16 C. 19 D. 22
15. How much would need to be invested in Plan 2 to yield $8000 in 5 years?
   A. $6340 B. $6320 C. $6360 D. $6300

Answer Key State Topical April 22, 2006

Part One		Part Two	
1.	C 52.8	1.	D 2.17
2.	B 37	2.	C 2.7
3.	A 97	3.	A 0.977
4.	C 327	4.	D 1050+
5.	C 408	5.	C 8.4
6.	D 67.5	6.	B 44
7.	D 33.4	7.	D 17.01
8.	A 37.69	8.	A 2400
9.	B 23	9.	B 29.34
10.	B 3.75	10.	A 54.7
11.	B 0.250	11.	A Y and T
12.	C 0.82	12.	C S
13.	C 0.000014	13.	D It Changes
14.	B	14.	B 15.4
15.	C	15.	B 6331