2005 San Diego County Regional Tournament Practical Data Gathering Exam

Answer Key

- (15 pts)

	Martians	Saturnians	
Mean	*54.7*	*55.0*	1pt each
Median	*63.3*	*54.3*	
Standard Deviation	*40.1*	*40.5*	
25th percentile	*23.4*	*27.3*	
75th percentile	*75.9*	*69.3*	
Normal Distribution?	*no*	*ye*	

Why? _*mean does not equal median for population A; mean is close to median for population B* — 3 pts

- (15 pts)

Area of room__*22.85 m^2* _____ — 4 pts

Perimeter of room_____*29.2 m*_____ — 3 pts

Area of carpet ____*25.8 m^2*_____ — 4 pts

Cost of recarpeting __*$1310* _____ — 4 pts

- (15 pts)

Level of water of — 5 pts

Cylinder A ___*150 mL* — 5 pts

Cylinder B____*152 mL* — 5 pts

- (10 pts)

Probability of another sister?__*slightly > 50%; 4 pts for 50%* — 10 pts

Probability of aunt/uncle having 3 girls?__1/8=12.5%_ — 5 pts

- (15 pts)

Minimum area for 21 coins?__*12096 mm^2*_ — 4 pts

Description of arrangement ____3x7 or 21x1 — 3 pts

Minimum area for 50 coins?__*27403 mm^2*_ — 5 pts

Description of arrangement __interlaced 5/4 alternating — 3 pts

15 pts

85 point total

10 pts for correct criteria for stopping, but incorrect calculations

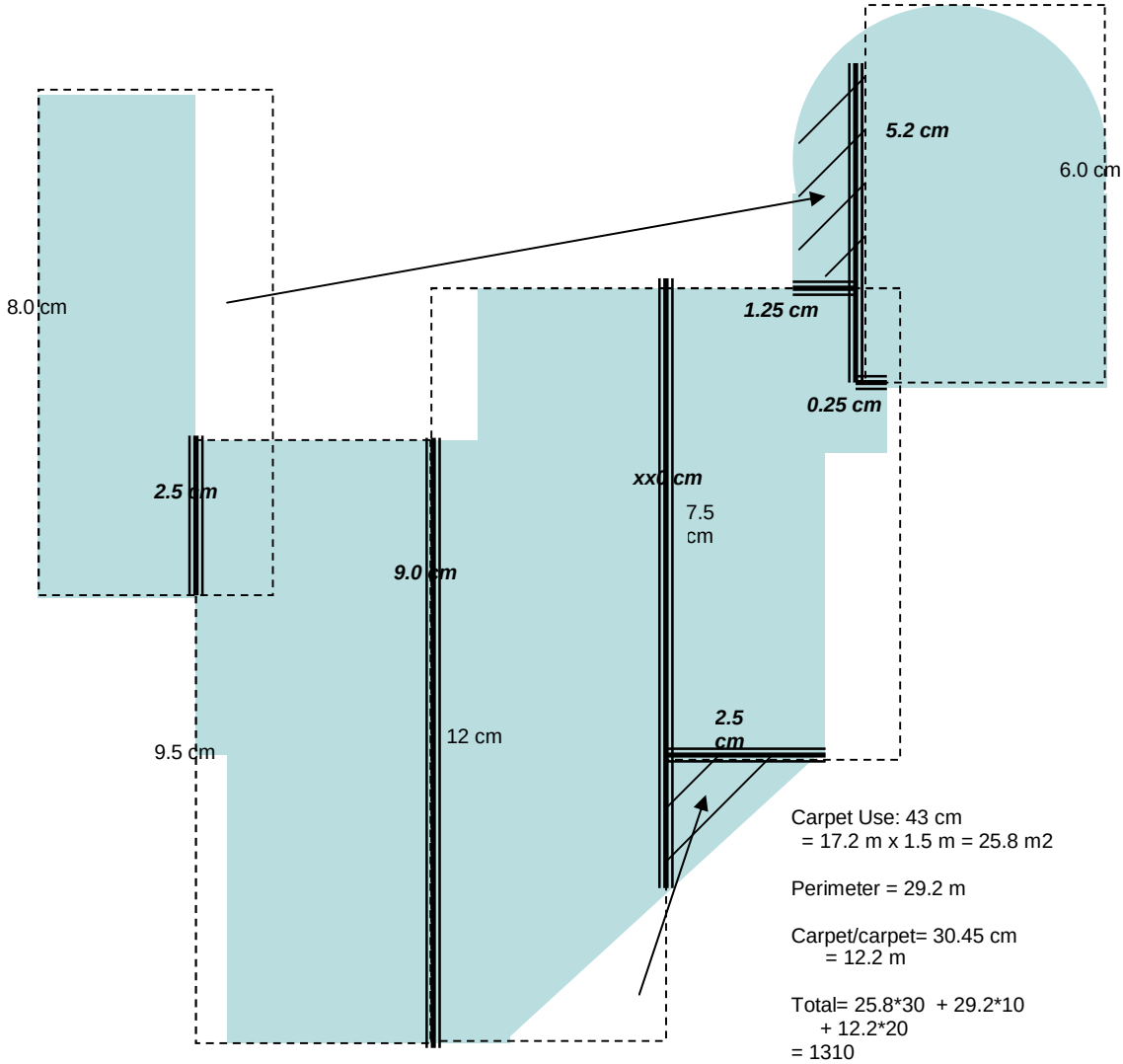
5 points for showing power based approach rather than iterative

1. Find the mean (μ), median, standard deviation (σ) and 25th and 75th percentiles for population A and population B. Do the data seem to be drawn from a normally distributed population? Why or why not?

$\sigma^2=(\sum(x-\mu)2)/N$

	A=Height of Martians	B=Height of Saturnians
	70.5	69.3
	52.2	23.3
	21.9	79.3
	63.3	55.9
	69.1	103.7
	40.1	40.5
	77.3	54.3
	42.9	56.1
	25.6	10.2
	75.9	43.9
	14.0	98.7
	78.3	45.5
	79.3	34.0
mean	54.7	55.0
median	63.3	54.3
25%	40.1	40.5
75%	75.9	69.3
stdev	23.4	27.3

2. You are a homeowner and need to recarpet your part of your house. You are charged based on 3 things. 1) Length of boundary between carpet and wall ($10/m) 2) length of seam (carpet/carpet) ($20/m) and 3) total amount of carpet required to cover area (including waste that you do not use) ($30/m2). Carpet is provided in strips 1.5m wide. The carpet has a directionality, so can only be laid in one orientation. What is the minimum cost to recarpet the space below? Please provide the area of this space as well as the perimeter. Scale= 2.5 cm=1 m. Provide calculations.



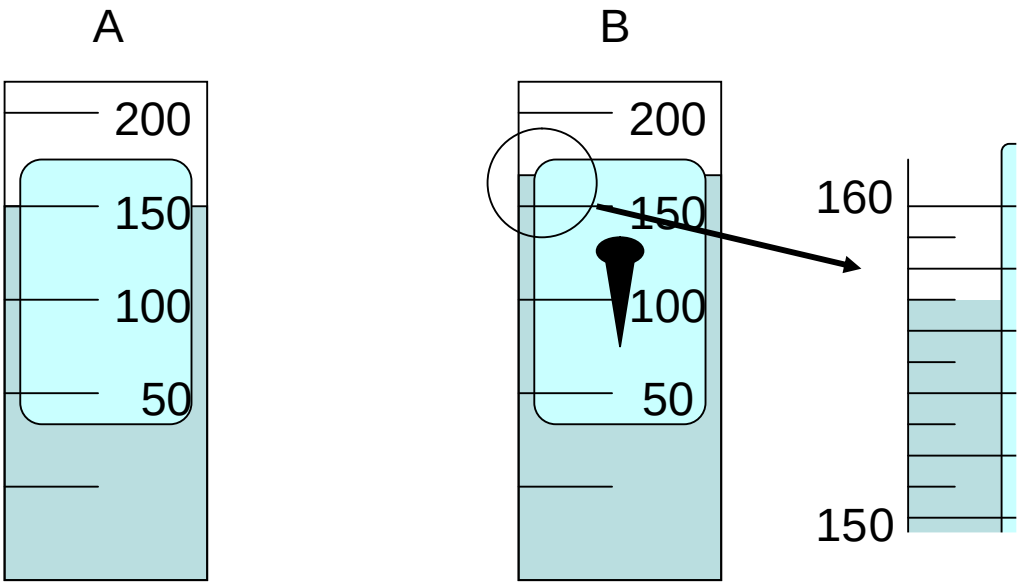
Carpet Use: 43 cm
= 17.2 m x 1.5 m = 25.8 m2

Perimeter = 29.2 m

Carpet/carpet= 30.45 cm
= 12.2 m

Total= 25.8*30 + 29.2*10
+ 12.2*20
= 1310

3. You are provided with two frozen ice cubes, each contains the same amount of water. In one ice cube, a screw is frozen in the middle. You place the ice cubes into a metric graduated cylinder (containing 100 mL of water) and observe figures A and B when the samples are first put in the water. Knowing that the density of the metal used to make the screw is 3500 kg/m3, what will the levels of the water be once the two ice cubes have defrosted? Provide all calculations. Note, only the water levels are drawn to scale.



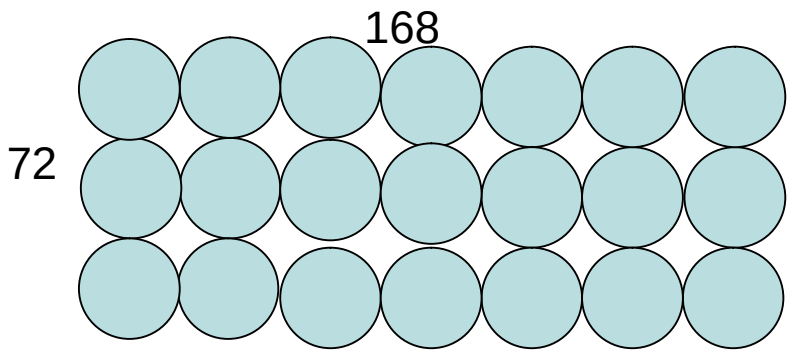
A: Ice cube is displacing volume equivalent of the weight. When the ice cube melts, the it will displace the same volume. **Final value=150 mL**
Volume of water in ice cube =50 mL

B: When the screw is floating in the ice cube, it is displacing the weight of the screw + water = 157 mL. Water=150 mL; screw=7mL=7g
Once it defrosts, the screw will fall to the bottom of the water and displace its volume.
Density=wt/volume → volume=wt/density

Density 3500 kg/m3=3500 kg/m3 * (1000 g/kg) * (1m3/10e6 cm3)=
3.5 g/cm3
Volume of screw = 7g/(3.5 g/cm3)=2 cm3

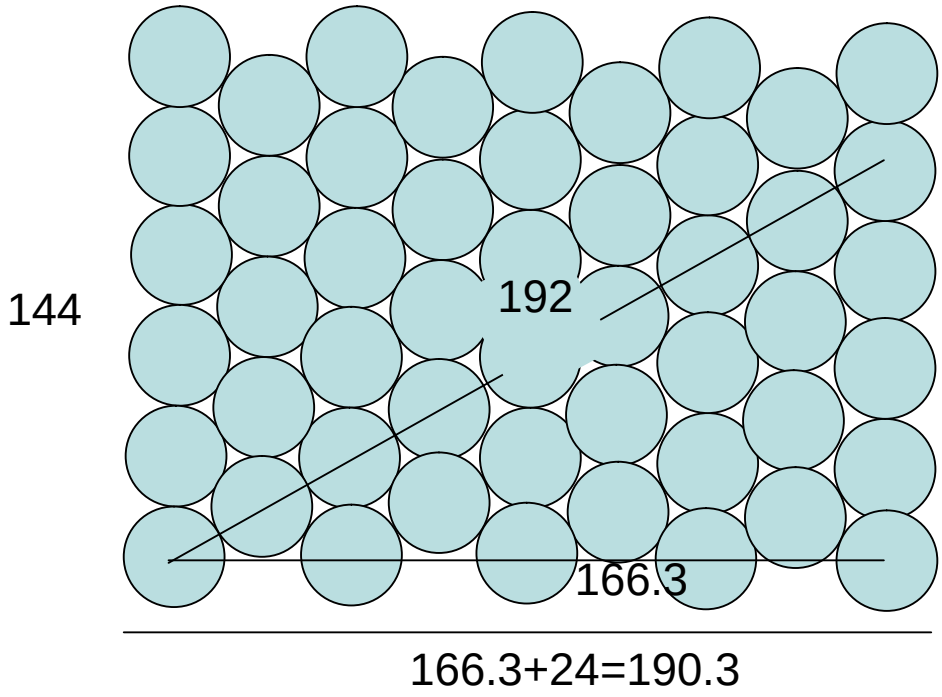
Final volume = 152 mL

The US mint just released the 21st state quarter into circulation-- the California Quarter! Please calculate the smallest area rectangle that you could display all 21 quarters in. What is the smallest rectangle you will be able to display them in once all 50 have been released in 2008. FYI: the Diameter of a quarter is: 24 mm.



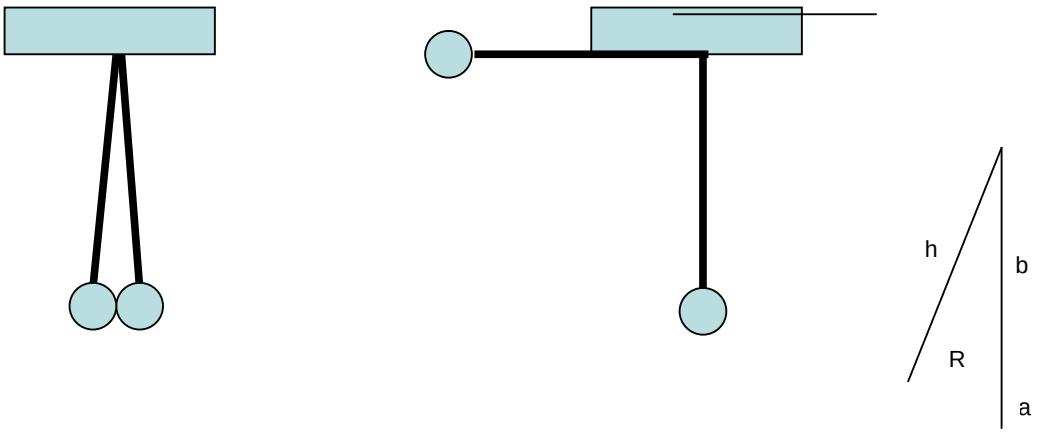
12096 mm2

Or one row of 21 12096 mm2



166.3+24=190.3

6. Two 3 cm balls are attached to 25 cm strings as shown. One of the balls is raised to the horizontal and released. Assuming that 20% of the energy is lost with each collision, how many times will the balls collide before they stop moving? Note: potential energy = mgh; kinetic energy = 1/2*mv2; g = 9.8 m/s2



Initial potential energy= mgh
Collisions stop when potential energy is <= to that of the balls resting on left
Final potential energy = mga
A=h-sqrt(h2-r2)

For each collsion 1 E =0.8*mgh
collision 2 E =0.8*0.8*mgh
collsion 3 E =0.8*0.8*0.8*mgh …
For nth collision, energy E =0.8^N*mgh

Oscillations stop when …

0.8^N*mgh <=mg(h-sqrt(h2-r2)) canceling out m and g

0.8^N <= 1-(sqrt(h2-r2))/h)
<= 1-sqrt(1-(r2/h2))

Solving for N

Log (0.8^N) <= log (1-sqrt(1-r2/h2))
N*log(0.8) <= log (1-sqrt(1-r2/h2))

N <= log (1-sqrt(1-r2/h2))/log(0.8)

Using r=1.5, h=25 the above equation results in 28 collisions