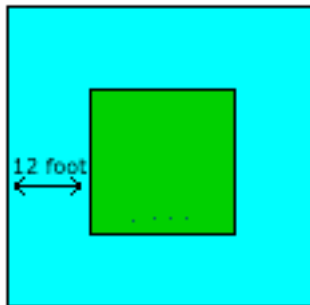


2001 SIGMA XI PUZZLE CONTEST

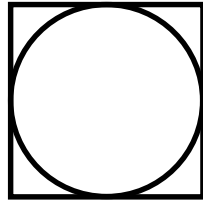
- 1) Take 16 toothpicks and arrange them to form eight equilateral triangles. Then remove four toothpicks so as to leave only four equilateral triangles. The correct solution will have no extra toothpicks or loose ends.

<p>Draw the 8 equilateral triangles using 16 toothpicks here:</p>	<p>Draw the same figure with 4 toothpicks removed to make only 4 equilateral triangles here:</p>
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- 2) Your friends foolishly walked out to the island in the middle of a park pond on a bridge of ice, which then all melted. They are now stranded in the middle of the park's pond. You have two 11 1/2 foot planks, but it is 12 feet to the island. How can you rescue them immediately? Note: the planks will not float if you are standing on them.

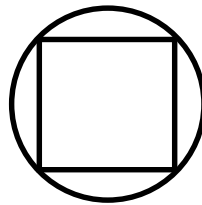


- 3) a) Given a square hole 2 inches on a side, what is the area of the largest circular peg which will fit into it?



Answer \_\_\_\_\_ in<sup>2</sup>

- b) Given a circle of diameter 2 inches, what is the area of the largest square peg which can fit into this hole?



Answer \_\_\_\_\_ in<sup>2</sup>

- 4) Shown below is an aerial survey of gazelle herds in an African game preserve. The numbers represent the number of gazelles spotted in given areas. Each square has a side of 2 km.

23	
37	7
445	17

Using the information given, calculate the average population density of gazelles over the entire area shown..

Answer \_\_\_\_\_

- 5) Andrew the entrepreneur wants to go into the coal transportation business. He has found an old canal barge at a bargain price. It is designed like a rectangular box: 25 meters long, 3 meters wide, and 2 meters deep. It weighs 40 metric tons (a metric ton equals 1,000 kilograms). And its interior cargo space is 120 cubic meters. Andrew has to prepare a business plan in order to get a loan to buy the barge. For his business plan he needs to know if the barge will hold a full load of coal and still float.

Do you think it will float? \_\_\_\_\_

If so, how much clearance will there be between the water level and the top edge of the barge? \_\_\_\_\_

You need to know three more things to answer this question. The first is what Archimedes, a pretty good physicist, taught us: a floating object will displace its own weight in water, producing an upward (buoyant) force. The second is that water weighs 1,000 kilograms per cubic meter, and the third is that bulk coal weighs about 800 kilograms per cubic meter.

Use the space below to work out your answer(s), but make sure that you write the answer(s) in the spaces above.

- 6) KDSSB ELUWKGDB is the coded message you get when you replace each letter in HAPPY BIRTHDAY by the letter 3 places further along in the alphabet. When you get to the end of the alphabet, you keep counting at the beginning. For example, Y is replaced by B.

In the message below, which has to do with this contest, how many places further along in the alphabet is the replacement letter from the real letter?

OHWWF WBGGSJ JVUALZA

Answer: \_\_\_\_\_ letters further along.

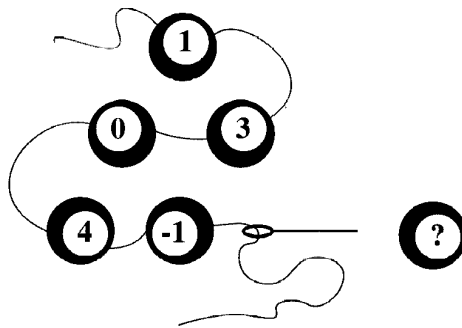
The decoded message is \_\_\_\_\_

- 7) A family of four (father, mother, son, and daughter) went on a hike. They walked all day long and, when evening was already drawing on, came to an old bridge over a deep gully. It was very dark and they had only one lantern with them. The bridge was so narrow and shaky that it could hold no more than two persons at a time. Suppose it takes the son 1 minute to cross the bridge, the daughter 3 minutes, the father 8 minutes, and the mother 10 minutes. When any two persons cross the bridge, their speed is equal to that of the slower one. Also, the lantern must be used while crossing the bridge.

Can the entire family cross the bridge in 20 minutes? \_\_\_\_\_(Y/N)

If so, how?

- 8) What is the missing number?



Answer: The missing number is \_\_\_\_\_.

- 9) After a local Post Office burglary, four suspects were being interviewed. Below is a summary of their statements. Police know that each of them told the truth in one of the statements and lied in the other. From this information can you tell who committed the crime?

Alan said:  
It wasn't Derek  
It wasn't Brian

Brian said:  
It wasn't Charles  
It was Derek

Charles said:  
It was Alan  
It wasn't Derek

Derek said:  
It was Charles  
It wasn't Alan

\_\_\_\_\_robbed the Post Office.

10) Jack has a major crush on Jill. During study hall, he finally gathers all of his courage and writes her a note asking her out on Saturday night. The note passes to five students (who all read it) before it gets to Jill. Just as Jill gets the note, Mrs. Wilson the teacher confiscates it. After reading the note, she wants to know all who were involved in the note passing incident. She questions her students, and receives the following responses.

1. The girl studying English passed it to Paul who passed it to the girl in green.
2. Josephine passed it to the boy in blue who gave it to Alexis who was reading.
3. The girl in black gave it to Jill.
4. Jack first gave it to Mary who was studying English.
5. The girl in black who was reading got the note from Derrick.
6. Paul was wearing yellow.
7. Derrick was studying French.
8. The girl in green was studying science.

From the information given by the students, can you determine what color each culprit was wearing, the subject they were studying and the order that they received the note? Use the chart below to help you.

	English	French	Reading	Science	Math	red	green	blue	black	yellow	first	second	third	fourth	fifth
Mary															
Paul															
Alexis															
Josephine															
Derrick															
first															
second															
third															
fourth															
fifth															
red															
green															
blue															
black															
yellow															

Answers:

Order	Name	Color	Subject
1 <sup>st</sup>			
2 <sup>nd</sup>			
3 <sup>rd</sup>			
4 <sup>th</sup>			
5 <sup>th</sup>			