READ THIS NOW!

- Print your name in the space provided below.
- There are 8 short-answer questions, priced as marked. The maximum score is 100.
- When you have finished, sign the pledge at the bottom of this page and turn in the test.
- This is a closed-book, closed-notes examination.
- No laptops, calculators, cell phones or other electronic devices may be used during this examination.
- Until solutions are posted, you may not discuss this examination with any student who has not taken it.
- Failure to adhere to any of these restrictions is an Honor Code violation.

Name (Last, First) _____

printed

Pledge: On my honor, I have neither given nor received unauthorized aid on this examination.

_____

signed

1. [16 points] The VT Puzzlers Club holds a competition to see who the most accomplished puzzle solver is. There are four competitors and four puzzle categories. Altogether, the competitors solved 20 crosswords, 29 Sudoku puzzles, 32 cryptograms and 21 Kakuro puzzles.

Jim solves 24 puzzles, including 4 crosswords and 2 cryptograms.

Mary solves more puzzles than Jim, including 9 crosswords, 10 cryptograms and 3 Kakuro puzzles.

Ed solves 26 puzzles, including 13 cryptograms and 5 Kakuro puzzles, but no crosswords.

Kay solves 27 puzzles, including 5 Sudoku puzzles.

How many puzzles of each type did each of the competitors solve? Use an appropriate table to externalize and show work to support your answers!

	Crosswords	Cryptograms	Kakuro	Sudoku	Total
Jim	4	2	5	13	24
Mary	9	10	3	3	25
Ed	0	13	5	8	26
Kay	7	7	8	5	27
Total	20	32	21	29	102

The blue text in the table corresponds to the direct information given in the statements above.

From the column totals for Crosswords and Cryptograms, we can infer that Kay solved 7 Crosswords and 7 Cryptograms.

Then, from the row total for Kay, we can infer that Kay also solved 8 Kakuro puzzles.

And, from Ed's row total, we can infer that Ed solved 8 Sudoku puzzles.

The column total for Kakuro puzzles implies that Jim solved a total of 5 Kakuro puzzles.

Then, the row total for Jim implies that Jim solved 13 Sudoku puzzles.

Finally, the column total for Sudoku puzzles implies that Mary solved 3 Sudoku puzzles and a total of 25 puzzles.

2. [16 points] There are four authors: Artemus, Josh, Mark and Charles. Each writes a single type of book, mysteries, humor, biographies and history, but not necessarily in that order. Each also reads only books written by one or more of the other writers (and never his own books). Artemus reads only mysteries and biographies. Josh reads only books written by Artemus and humor. Mark reads only humor. Charles reads only histories and biographies. Which author writes which kind of book? Externalize, and justify your conclusions.

	Mystery	Humor	Biography	History
Artemus	X	X	X	O
Josh		X		X
Mark		X		X
Charles	X	O	X	X

In the table above, an X indicates that the corresponding writer cannot write books of that type, and an O indicates the writer must write books of that type.

Since Artemus reads only mysteries and biographies, he cannot write books of either type.

Josh reads humor and whatever Artemus writes, so we know at least that Josh does not write humor. But we also then infer that Artemus cannot write humor, since Josh reads what Artemus writes. So, Artemus must write histories.

Mark reads humor, so we also know he cannot write humor; and that implies that Charles must write humor, since there's no else one left to do that.

But that leaves us with some uncertainty. Josh could write either mysteries or biographies, and so could Mark.

3. [12 points] In the language of the Wahoo tribe, the phrase *ek ebbeh nowb* means "pass the beer", *smat ebbeh* means "drink beer", *nowb mi iter* means "I passed math", and *spir mi amvi* means "I eat nuts". Moreover, in the Wahoo language, verbs always begin with a consonant and nouns always begin with a vowel.

In the Wahoo language, how would you say "Pass the nuts"? Explain your logic.

Recalling that verbs begin with consonants and nouns with vowels, the fact that "ek ebbeh nowb" means "pass the beer" tells us that "ek" or "ebbeh" must mean "beer" and that "pass" is "nowb". Since "smat ebbeh" means "drink beer", "ebbeh" must mean "beer" since only it occurs in both sentences that refer to beer. Therefore, "ek" must mean "the".

And, if "nowb mi iter" means "I passed math" and "spir mi amvi" means "I eat nuts", then "mi" must mean "I" (since it occurs it two sentences using I and no other word here does); so "spir" means "eat" and "amvi" means "nuts".

So, "Pass the nuts" would be expressed as "ek amvi nowb". Note that the necessary word order is implied by the first sample sentence.

4. [12 points] In each part, state what (other) facts, if any, you can validly infer from the given facts:

a) If Captain Jack drinks too much rum, then he will set the wrong course. Captain Jack set the wrong course.

We can infer NOTHING from the given information.

b) If Captain Jack sailed to the wrong island, then the natives there murdered and ate his crew. All the members of Captain Jack's crew lived long lives and died peacefully of old age.

Since all members of the crew died peacefully of old age, none could have been murdered and eaten. Therefore, Captain Jack did not sail to the wrong island.

c) All cats are mammals. Some cats eat mice. Cirrus is a cat.

Since all cats are mammals, and Cirrus is a cat, then we may infer that Cirrus must be a mammal.

We also may infer that some mammals eat mice.

d) All whales are mammals. All mammals have lungs.

We can infer that all whales have lungs.

5. [10 points] Three bricklayers can lay a total of 60 bricks in 30 minutes. How many bricklayers would be required to lay a total of 200 bricks in 60 minutes? Externalize and justify your conclusion.

If 3 bricklayers can lay 60 bricks in 30 minutes, then (assuming all work at the same rate), we know that one bricklayer can lay 20 bricks in 30 minutes, or 40 bricks in 60 minutes.

So, five bricklayers could lay 200 bricks in 60 minutes.

6. [10 points] A machine shop produces brass couplings, each of which must be marked with an integer serial number before being shipped. Serial numbers are assigned as consecutive integers, starting at 1. A serial number is marked onto a coupling by a worker who has ten steel dies that she can use to stamp a single digit onto the coupling. For example, to mark a coupling with the serial number 732, the worker would use the dies for the digits '7', '3' and '2', striking each with a hammer one time to emboss the corresponding digit on the coupling. When the worker finishes marking a shipment of couplings, she realizes that she has used her hammer exactly 702 times. What was the serial number that she marked on the last coupling? Externalize and justify your conclusion.

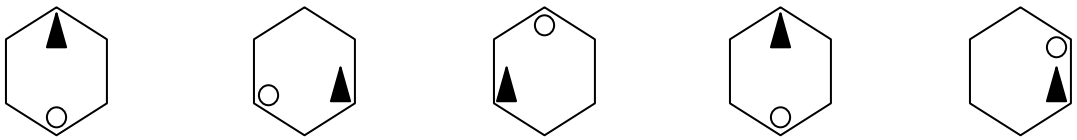
The first 9 couplings would get serial numbers '1' through '9', accounting for 9 hammer blows.

The next 90 couplings would get serial numbers '10' through '99'; which would account for a total of 180 hammer blows.

That leaves 702 – 189 or 513 hammer blows, which would account for 513/3 or 171 three-digit serial numbers.

So, the total number of couplings must have been 9 + 90 + 171 or 270 couplings and the last coupling would have had serial number '270'.

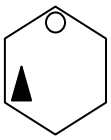
7. [8 points] The following sequence of figures suggests a pattern of changes:



Describe the pattern of changes and draw a single figure that continues that pattern.

Looking at the sequence of diagrams, in each transition the triangle moves two edges in a counter-clockwise direction, and the circle moves clockwise 1 edge, then 2 edges, then 3 edges and then 4 edges.

So, on the next transition we would expect the triangle to move 2 edges counter-clockwise and the circle to move clockwise a distance of 5 edges, which would give us the following figure:



8. [16 points] Design and write pseudo-code (see the test supplement) for an algorithm that counts how many pairs of successive integers in a list differ by 3 or less. For example, the algorithm should report 3 when given the following list of values:

17 14 23 11 13 7 41 37 34 21 26

```
get sizeofA          # get number of elements in the list
get A                # get values for the list variable A
Counter := 0         # number of successive pairs differing by 3 or less


# . . . this part is up to you


currentPosition = 1      # variable for current element location

# We must correctly handle the case where A is empty (or has a single
# element).  The logic used here will do that since the test for the
# loop below will prevent us from even entering the loop in those
# cases, and we have initialized the counter to zero.

while ( currentPosition < sizeofA )     # stop at last element

   # We must detect both the case where the preceding value is 3 or less
   # larger than its successor, and the case where the preceding value
   # is 3 or less smaller... the simplest way is to just employ the
   # mathematical concept of the absolute value (which is perfectly
   # legal under the definition of our pseudo-code notation).

   if ( | A[currentPosition] – A[currentPosition + 1] <= 3 | )

      Counter := Counter + 1            # found another matching case

   endif

   currentPosition = currentPosition + 1    # step to next location

endwhile




display Counter   # report results
halt              # end algorithm
```


"My dad is a natural at multitasking. He can goof up, screw up, and mess up all at the same time."