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 LP Fanatics Club decides to hold a silent auction of their surplus LPs to raise money to provide direct-drive turntables to deserving youths. In order to get the auction off the ground, the officers of the club bring their donations to the next meeting of the Club. Altogether, the officers donated 51 blues LPs, 19 folk LPs, 33 rock LPs and 17 classical LPs.

Bud, who has a fairly large collection of LPs, donated 30 LPs, including 23 blues LPs and no rock LPs.

Bill, who has the largest collection, donated the most LPs, including, 17 blues LPs, 13 rock LPs and 9 classical LPs.

Dwight, whose musical tastes are somewhat limited, made a donation of 33 LPs, including 8 blues LPs, 20 rock LPs and no classical LPs.

Sean, who only recently began collecting LPs, donated a collection of 10 LPs that included 5 folk LPs.

How many LPs of each type did each of the officers donate? Use an appropriate table to externalize and show work to support your answers!

	Blues	Folk	Rock	Classical	Totals
Bud	**23**	**1**	**0**	**6**	**30**
Bill	**17**	**8**	**13**	**9**	**47**
Dwight	**8**	**5**	**20**	**0**	**33**
Sean	**3**	**5**	**0**	**2**	**10**
Totals	**51**	**19**	**33**	**17**	**120**

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

Now, from the column totals for Blues and Rock, we can infer that Sean donated 3 Blues LPs and 0 Rock LPs.

From that and the row total for Sean, we can infer that Sean donated 2 classical LPs.

From the final column total, we can infer that Bill donated a total of 47 LPs; and now we can infer that Bill must have donated 8 Folk LPs.

We can also infer from the row total for Dwight that he donated 5 Folk LPs.

Then, finally we can use the column totals for Folk and Classical to infer that Bud donated 1 Folk LP and 6 Classical LPs.

2. [16 points] Four sisters, Prudence, Chastity, Temperance and Hope, have jobs in the big city as a lawyer, a surgeon, a chef and a detective (not necessarily in that order). Prudence shares a duplex with her sisters the surgeon and the lawyer. Chastity goes to the same gym as her sisters the lawyer and the detective. The detective lives alone. Hope envies her sister the lawyer. Which sister has which career? Externalize, and justify your conclusions.

	Lawyer	Surgeon	Chef	Detective
Prudence	X	X	O	X
Chastity	X	O	X	X
Temperance	O	X	X	X
Hope	X	X	X	O

In the table above, an X indicates that an occupation has been eliminated for the sister in that row, and an O indicates we have confirmed the occupation for that sister.

If Prudence lives with the sisters the surgeon and the lawyer, then Prudence cannot be either of those.

Since Chastity goes to the same gym as her sisters the lawyer and the detective, she cannot be either of those.

Since the detective lives alone, Prudence cannot be the detective either; that forces the conclusion that Prudence is the chef and rules out that occupation for everyone else.

But now, the only possibility for Chastity is that she is the surgeon.

And, since Hope envies her sister the lawyer, Hope cannot be the lawyer. Thus, Hope must be the detective and Temperance must be the lawyer.

3. [12 points] In the language of the Wahoo tribe, the phrase *gabba oofa do* means "pass the beer", *guzzla oofa* means "drink beer", *og gabba unno* means "I passed math", and *og goppa ubba* 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 "gabba oofa do" means "pass the beer" tells us that "oofa" must mean "beer" and that "pass" is either "gabba" or "do".

But, if "og gabba unno" means "I passed math", then "gabba" must mean "pass", and hence "do" means "the".

And, if "og goppa ubba" means "I eat nuts", then "og" must mean "I" (since it occurs it two sentences using I and no other word here does); so "goppa" means "eat" and "ubba" means "nuts".

So, "Pass the nuts" would be expressed as "gabba ubba do".

Note that "do" must come last to be consistent with the phrasing of the first Wahoo 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 Cirrus must be a mammal.

In addition, we 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] Five bricklayers can lay a total of 100 bricks in 40 minutes. How many bricklayers would be required to lay a total of 60 bricks in 20 minutes? Externalize and justify your conclusion.

If 5 bricklayers can lay 100 bricks in 40 minutes, then (assuming all work at the same rate), we know that one bricklayer can lay 20 bricks in 40 minutes, or 10 bricks in 20 minutes.

So, six bricklayers could lay 60 bricks in 20 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 558 times. What was the serial number that she marked on the last coupling? Externalize and justify your conclusion.

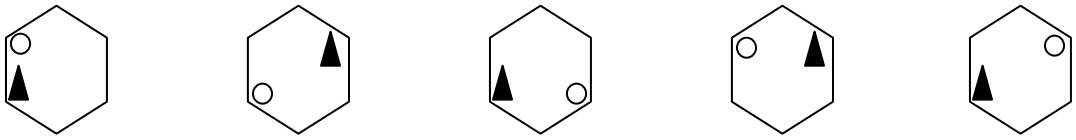
The first 9 couplings would get serial numbers '1' through '9', accounting for 9 hammer blows.

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

That leaves 558 – 189 or 369 hammer blows, which would account for 369/3 or 123 three-digit serial numbers.

So, the total number of couplings must have been 9 + 90 + 123 or 222 couplings and the last coupling would have had serial number '222'.

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.

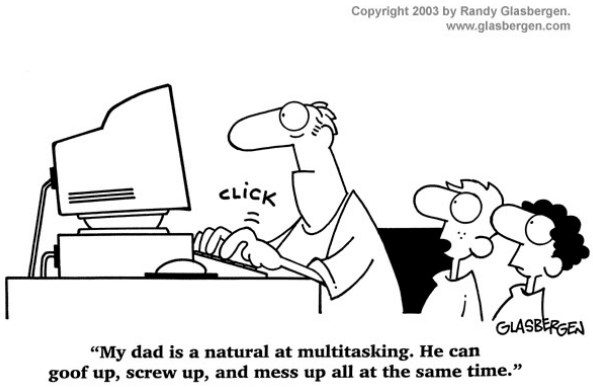
Looking at the sequence of diagrams, in each transition the triangle moves to the opposite corner of the hexagon and the circle moves counter-clockwise 1 edge, then 2 edges, then 3 edges and then 4 edges.

So, on the next transition we would expect the triangle to move across to the opposite corner and the circle to move counter-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 5 or more. For example, the algorithm should report 6 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 5 or more


# . . . 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 5 or more
   # larger than its successor, and the case where the preceding value
   # is 5 or more 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] >= 5 | )

      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."