North Carolina Science Olympiad — Code Busters Test 2

2018

Exam Preparation

You will need:

1. Folders for each of the teams to hold the tests
2. Sufficient copies of the test for all teams. They don't need to be stapled.
3. Multiple timers which have a lap function on them - ideally one per volunteer. The timer app on an iPhone or Android Phone that has a stopwatch function with lap function is sufficient.

Before the event begins:

1. Practice starting the timers and using the lap function to record the times. Make sure volunteers understand how to use the lap function and are not accidentally stopping the timer completely.
2. Memorize the answer to the timed question.
3. Check to make sure that this key matches the test you are proctoring.
4. Place one copy of the test for each team in the provided folders with the first page outside the folder.
5. Adjust desks and chairs – teams may have up to 3 students for this event.

Running the Event

1. When the students enter the room, instruct them to sit down, DO NOT OPEN THE FOLDER, and put their names, school name and school number on the first page.
2. Encourage them to write their team number on all the other pages AFTER they begin the test. This way if their papers gets separated from each other we can make sure to give them credit.
3. **CRITICAL**: Check to see that students have ONLY brought
    i. Something to write with (pencils, pens, erasers)
    ii. Five function calculators (addition, subtraction, multiplication, division, and usually square root). The calculator can have a simple memory store/recall function but must not have a modulus or other scientific and programmable functions. If their calculator doesn't meet these requirements, they may not use it.
    iii. If there are spare calculators in the kit, you may loan up to one per team to use for the test.
    iv. If the student has a smart watch (Apple watch, Samsung Gear, etc.) they will need to put it away.
4. Instruct the students that if they answer the timed question within 10 minutes, they can be awarded a bonus if they solve the timed question with no more than 2 letters incorrect.
    i. When they have a solution for the cryptogram they should raise their hand.
    ii. Let them know that you will announce when the 10-minute time is up. After the first 10 minutes, no additional bonus points will be awarded.
    iii. When you see a team raise their hand, hit the LAP function and head to the team.
    iv. Determine if their answer is correct (see next page for grading), If so, write the time on their score sheet.
    v. If their score is incorrect (more than 2 letters incorrect), tell the team that the answer is wrong, but DO NOT tell them what is wrong. They can continue to work on the question and raise their hand again to be checked. A team has an unlimited number of attempts during the 10-minute bonus.
5. Tell the teams that they do not have to fill in the frequency table. It is simply there as an aid to them solving the cryptogram. It will not be graded.
6. Some students may never have used a non-scientific calculator. You should have them enter a simple formula on their calculator: 1 / 26 = * 26 = .. Most will be surprised to see that the answer is not rounded to 1 as they expected but .9999999999
7. When the timers hit the 10-minute point, announce that no bonus points will be awarded and put away the timers. The students may continue to work on the question, but they may not receive any extra points.
8. A team is not restricted to only the timed question during the 10 minutes. They can move on or split up the work if they would like, but it is in their best interest to try for the bonus.

9. When time is up, have the students put writing instruments down and put their answer pages back into the folder in the correct order.

How to grade

1. Teams can have up to two incorrect letters total on their cryptogram and still be correct. The frequency of the incorrect letter is irrelevant. See the example below.

If the cryptogram was as shown:

KZBAOF KFXMFXYF

SAMPLE SENTENCE

and the students answered (underlined letters indicate mistakes)

SAMPL<u>F</u> S<u>F</u>NT<u>F</u>NC<u>F</u>

then it counts as four mistakes (even though the mistake was only in the letter E) and the answer DOES NOT count. However, if they put

SAMPU<u>L</u> SENTENCE

It is considered correct with two letter mistakes.

2. For questions which have a numeric answer (such as determining the a= and b= values), no mistakes are allowed.
3. Teams do NOT have to fill in the frequency table. It is simply there as an aid to them solving the cryptogram. It WILL NOT be graded. It is included in the answer key as an aid to the grader.
4. When scoring the Baconian ciphers (with strange text or symbols), they can write the answer under the Dancing Man symbols or on the line provided. Note that you will see lots of As and Bs, but they are not graded as the answer, only what they put on the answer line.
5. As you score each question, if correct, put the number of incorrect letters (0, 1, or 2) next to the question number on the scoring page. Also, put the value for the question into the score column. If they get more than 2 letters wrong, subtract 50 points from the score until it would be zero. If a question is worth 120 points and they get 4 letters wrong, you would start with 120 points (for up to 2 letters wrong) and then subtract 100 points for the next two letters wrong ending up with a final score of 20 points for that question. If they had gotten 5 or more letters wrong on a 120 point question, they would receive 0 points for that question. With a 350 point question, they could get 8 letters wrong and receive 50 points (2 free letters then $6 \times 50 = 300$ points off). Just put the incorrect cost deduction on the score sheet and subtract it from the value for the question. Under no circumstance should the score for any question be less than zero. Note that while the timed question must have 2 or fewer letters incorrect in order to get the timing bonus, a team solving the timed question after the 10 minutes passed would be accepted as correct with 3 incorrect letters receiving 50 points for the timed question.
6. If they correctly answered the timed question in 10-minutes or less with 2 or fewer letters incorrect, you need to compute the bonus time. Take the value for the minute from this first table below

0:xx	1,620	*1:xx*	1,440	*2:xx*	1,260	*3:xx*	1,080	*4:xx*	900
5:xx	720	*6:xx*	540	*7:xx*	360	*8:xx*	180	*9:xx*	0

and then add the seconds value from this table:

X:00	180	*X:01*	177	*X:02*	174	*X:03*	171	*X:04*	168	*X:05*	165
X:06	162	*X:07*	159	*X:08*	156	*X:09*	153	*X:10*	150	*X:11*	147
X:12	144	*X:13*	141	*X:14*	138	*X:15*	135	*X:16*	132	*X:17*	129
X:18	126	*X:19*	123	*X:20*	120	*X:21*	117	*X:22*	114	*X:23*	111
X:24	108	*X:25*	105	*X:26*	102	*X:27*	99	*X:28*	96	*X:29*	93
X:30	90	*X:31*	87	*X:32*	84	*X:33*	81	*X:34*	78	*X:35*	75
X:36	72	*X:37*	69	*X:38*	66	*X:39*	63	*X:40*	60	*X:41*	57
X:42	54	*X:43*	51	*X:44*	48	*X:45*	45	*X:46*	42	*X:47*	39
X:48	36	*X:49*	33	*X:50*	30	*X:51*	27	*X:52*	24	*X:53*	21
X:54	18	*X:55*	15	*X:56*	12	*X:57*	9	*X:58*	6	*X:59*	3

For example if they solved the time question at the 6:46 mark, you would add 540 (from the 6:xx entry in the first table) to 42 (from the X:46 entry in the second table) to get a bonus of 582. If they had solved it in exactly 4:00 minutes, you would add 900 and 180 to get a bonus of 1080.

7. Add up all the scores and put the total on the bottom of score sheet.

8. You must break all ties. Indicate the tie breaker by adding .1 to the score of the team ahead. With multiple teams tied, you will add more. I.e. if five teams all scored 200 points, the final scores that you would enter on the score sheet would be 200.4, 200.3, 200.2, 200.1 and 200.
9. To determine how to break the tie, you need to look at the correctly answered questions in the order from the table below. If both teams answered the same (i.e. they answered the question with zero mistakes) then you go on to the next question. If one team had no mistakes and the other team had one mistake, then the team with no mistakes is ahead. For example, if one team answered question #8 (which is the highest value question) and another team didn't, the first team will be ahead.

Tie Breaker Order	Question #
1	9
2	10
3	2
4	17
5	4
6	1
7	3
8	18
9	6
10	11
11	12
12	16
13	Timed Question
14	7
15	15
16	5
17	13
18	14
19	8
20	19

10. If there is still a tie (typically when you have teams which answered either zero, one or two questions) then you will need to look at the tie breaker questions again and count the number of correctly answered letters. The team with the most correctly matched letters is to be ahead. Note that in the case of teams which got a zero, you may have to go through quite a few tie breaker questions to differentiate.

Timed question **[100 Points]**: Solve this Aristocrat which is a quote from an unknown origin. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

DW'NW AXHW UQWXM AWHJYXB SQTUQWOO JV MEW BXOM

WE'VE MADE GREAT MEDICAL PROGRESS IN THE LAST

UWVWQXMJTV. DEXM ROWH MT KW AWQWBI XV JMYE JO VTD XV

GENERATION. WHAT USED TO BE MERELY AN ITCH IS NOW AN

XBBWQUI.

ALLERGY.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	3	5		3	3			3	2	5	1		7	1	5		6	1	1	4	4	6	14	9	2	
Replacement	M	L	K	W	H	J	Q	D	Y	I	B	Z	T	V	S	X	R	U	P	O	G	N	E	A	C	F

1) **[140 Points]** A message encrypted with the Affine Cipher using an alphabet of 26 characters has been intercepted. You have been told that the first two characters of the message are the letters **PU**. With that knowledge, what does this message say?

X U F I T C I U B F H W T A W T S K G X

P U T O N Y O U R T H I N K I N G C A P

Note a=15 b=6

2) **[300 Points]** Solve this Xenocrypt which is a quote in Spanish.

TCKC TLQLHCT EXICT NEB YLO LE KB YXAB.

SOLO SEREMOS NIÑOS UNA VEZ EN LA VIDA.

TXE LHJBQZC, TXLHWQL WCAQLHCT AXTUQNPBQ

SIN EMBARGO, SIEMPRE PODREMOS DISFRUTAR

AL KB XEHBANQLO.

DE LA INMADUREZ.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Ñ	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	5	7	7		5			5	1	1	3	10		3		2	1	7			8	1		2	6	2	1
Replacement	D	A	O		N			M	Ñ	B	L	E		U		Z	T	R			S	F		P	I	V	G

3) **[125 Points]** Solve this Aristocrat which is a quote from David Hanson.

PV'JV MVVXHL FWV NJJXINE YA UYHIVJMNFXYHNE JYCYFM
WE'RE SEEING THE ARRIVAL OF CONVERSATIONAL ROBOTS

FWNF UNH PNEG XH YQJ PYJEZ. XF'M N LYEZVH NLV YA
THAT CAN WALK IN OUR WORLD. IT'S A GOLDEN AGE OF

XHIVHFXYH.
INVENTION.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	2		1		5	7	1	9	3	7		3	4	9		3	1				2	9	2	7	10	2
Replacement	F	Y	B	X	L	T	K	N	V	R	M	G	S	A	J	W	U	Q	Z	P	C	E	H	I	O	D

4) **[250 Points]** Solve this Patristocrat which is a quote by Evan Esar and ends with **SIONS**.

VUMUR VURWV USQJO FHVWR QOWQU SMUQO MIFQV PRKKQ
STATI STICS THEON LYSCI ENCET HATEN ABLES DIFFE

AQOUQ LDQAU VXVRO NUSQV MCQKR NXAQV UJPAM ZPRKK
RENTE XPERT SUSIN GTHES AMEFI GURES TODRA WDIFF

QAQOU WJOWF XVRJO V
ERENT CONCL USION S

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	5		1	1		3		1	1	4	5	1	5	2	8	3	14	8	3		11	11	5	3		1
Replacement	R	J	M	P	Z	L	K	Y	B	O	F	X	A	G	N	D	E	I	H	Q	T	S	C	U	V	W

5) **[75 Points]** The following symbols encodes a phrase using a Baconian alphabet. What does it say?

Answer: __ Life expectancy would grow by leaps and bounds if vegetables smelled as good as bacon_____

ƎEƎEƎƎEƎƎƎƎEƎEƎƎEƎƎƎƎEƎƎEƎEƎEƎEEEƎƎƎEƎƎƎƎEƎEƎƎEƎƎƎƎ
ABABAABAAAAABABAABAAAABAABABABBBAAABAAAAABABAABAAAAA
L I F E E X P E C T A
ƎƎEEƎƎƎƎEƎEƎEEƎEƎEƎƎƎEEEƎƎEEƎEƎEƎƎƎEEƎƎEEƎEƎƎƎƎEE
AABBAAAAABABABBABABAAABBABBAABBABABAAAABBAABBABAAAAABB
N C Y W O U L D G R O
ƎEEƎEƎƎƎƎEEƎEEƎƎEƎEƎƎƎEƎƎƎƎƎEEEƎEƎƎƎEƎƎƎƎEEƎƎƎƎ
ABBABAAAAAABBABBAABABAAABAAAAAAAABBBABAAABAAAAAABBAAAA
W B Y L E A P S A N
ƎEEƎƎƎEƎEEƎEEƎƎEEƎEEƎƎƎƎEEƎƎƎEƎEƎƎƎƎEƎEEƎƎEEƎƎEƎƎ
ABBAAAABABBABBAABBABBAAAAABBBAAABABAAAAABABBAABBAABAAA
D B O U N D S I F V E
ƎEEƎƎƎEƎƎEƎEƎƎƎƎƎƎƎEEƎEƎEƎƎEƎƎEƎƎEEƎƎƎEƎEEƎƎƎEƎ
ABBAAABAABAABAAAAAAAAAABABABAAABAABAAABBAAABABABBAABAA
G E T A B L E S S M E
ƎEƎEƎƎEƎEƎƎƎEƎƎƎƎEEƎƎƎƎEƎƎƎEƎEƎEEƎƎEEƎEƎEEƎEƎƎƎEEƎƎƎƎ
ABABAABABAAABAAAAABBAAAAABAAABAABBAABBABABBABAAABBAAAA
L L E D A S G O O D A
ƎEƎƎƎEƎƎƎƎEƎƎƎƎƎƎƎEƎƎƎEEƎEƎEEƎƎ
ABAAABAAAABAAAAAAAABAABBABABBAA
S B A C O N.

6) **[120 Points]** Solve this Aristocrat which is a quote from Roy T. Bennett and starts with **DON'T**.

IUL'C HRC CBR RVSRKCQCNULO QLI USNLNULO UT UCBRW
DON'T LET THE EXPECTATIONS AND OPINIONS OF OTHER

SRUSHR QTTRKC MUDW IRKNONULO. NC'O MUDW HNTR, LUC
PEOPLE AFFECT YOUR DECISIONS. IT'S YOUR LIFE, NOT

CBRNWO.
THEIRS.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency		3	10	2				3	3		3	7	2	8	6		3	11	4	4	11	1	4			
Replacement	B	H	T	U	Z	V	M	L	D	Q	C	N	Y	I	S	W	A	E	P	F	O	X	R	K	J	G

7) **[100 Points]** Encode the string **AS STRONG AS ITS WEAKEST LINK** using the Affine Cipher with *a=9* and *b=8*.

A	S	S	T	R	O	N	G	A	S	I	T	S	W	E	A	K	E	S	T	L	I	N	K
I	O	O	X	F	E	V	K	I	O	C	X	O	Y	S	I	U	S	O	X	D	C	V	U

8) **[50 Points]** Using a code word of **BRICK**, encode the following quote from Zig Ziglar using the Vigenère cipher.

B	R
W	E
X	V

I	C	K	B	R
B	U	I	L	D
J	W	S	M	U

I	C	K
O	U	R
W	W	B

B	R	I	C	K	B	R	I	C
C	H	A	R	A	C	T	E	R
D	Y	I	T	K	D	K	M	T

K	B	R	I
F	R	O	M
P	S	F	U

C	K	B
T	H	E
V	R	F

R	I	C	K	B	R
B	R	I	C	K	S
S	Z	K	M	L	J

C	K
O	F
W	H

B	R	I	C	K
H	A	B	I	T
R	B	S	Q	V

B	R
W	E
G	F

I	C	K	B
P	I	L	E
G	Q	N	O

R	I
U	P
V	G

C	K	B
D	A	Y
L	C	I

R	I
B	Y
C	P

C	K	B
D	A	Y
L	C	I

9) **[350 Points]** Solve this Patristocrat which is a quote by Marie Curie and is encoded using a K1 key and the phrase **TO BE** appears twice and **TO** appears a third time.

HJYRG HQGHU GPOGL YJIOP OFEON GYGLJ HUCYJ IOZHN
NOTHI NGINL IFEIS TOBEF EARED ITISO NLYTO BEUND

OELYJ JNHJK GLYRO YGVOY JZHNO ELYFH NVJEO LJYRF
ERSTO ODNOW ISTHE TIMET OUNDE RSTAN DMORE SOTHA

YKOVF CPOFE UOLL
TWEMA YFEAR LESS

K1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency			2		5	5	8	8	2	10	2	8		5	13	3	1	3			3	3			11	2
Replacement	V	X	Y	Z	R	A	I	N	B	O	W	S	C	D	E	F	G	H	J	K	L	M	P	Q	T	U

10) **[350 Points]** Solve this K1 Key encoded Patristocrat which is a quote by Arthur C. Clarke and ends with the letters **IBLE**.

XPFKU ECAGC KIOQW NKZFJ QULXP FEQTQ XWKIX PFHKW
THEON LYWAY OFDIS COVER INGTH ELIMI TSOFT HEPOS

WQMEF QWXKZ FUXYJ FGEQX XEFAG CHGWX XPFTQ UXKXP
SIBLE ISTOV ENTUR EALIT TLEWA YPAST THEMI NTOTH

FQTHK WWQME F
EIMPO SSIBL E

K1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	2		3		6	11	4	3	2	2	8	1	2	1	1	5	10			3	4		8	12	1	2
Replacement	W	X	Y	Z	L	E	A	P	F	R	O	G	B	C	D	H	I	J	K	M	N	Q	S	T	U	V

11) **[120 Points]** 11The following headlines appeared in the newspaper but in reality, they are a Baconian encoded message where some letters encode as one character and the others as another in a pattern. You know that the message starts out as **READNO**. What does the message decode to?

Answer: __ Read not to contradict and confute, nor to believe and take for granted _____

```
Allow class photo today.
BAAAA AABAA AAAAA AAABB
  R     E     A     D
Small party asked noted daily local guide.
ABBAA ABBAB BAABA BAABA ABBAB AAABA ABBAB
  N     O     T     T     O     C     O
Grass upset booth clock today.
ABBAA BAABA BAAAA AAAAA AAABB
  N     T     R     A     D
Sixth hotel added stock teeth stone.
ABAAA AAABA BAABA AAAAA ABBAA AAABB
  I     C     T     A     N     D
Total peace dealt space issue.
AAABA ABBAB ABBAA AABAB BAABB
  C     O     N     F     U
Model shell links price, allow added truly whole words.
BAABA AABAA ABBAA ABBAB BAAAA BAABA ABBAB AAAAB AABAA
  T     E     B     O     R     R     O     B     E
Texas crowd could alter glass clock.
ABABA ABAAA AABAA BAABB AABAA AAAAA
  L     I     W     V     E     A
Small globe model stood lucky.
ABBAA AAABB BAABA AAAAA ABAAB
  N     D     T     A     K
Worst horse drawn booth start block stood least along south storm.
AABAA AABAB ABBAB BAAAA AABBA BAAAA AAAAA ABBAA BAABA AABAA AAABB
  E     F     O     R     G     R     A     N     T     E     D
```

Note that the pattern is BBAABBAABBAA

12) **[100 Points]** The following quote from Abraham Lincoln has been encoded using a running key cipher against a famous document. What does it say?

U	S	N
Y	O	U

O	E	K	I
H	A	V	E

H	D
T	O

O	S
D	O

M	T	N	Y
Y	O	U	R

S	Q	A
O	W	N

O	K	S	Z	A	G	G
G	R	O	W	I	N	G

G	S
N	O

E	I	G	H	V	U
M	A	T	T	E	R

L	F	P
H	O	W

H	F	Z	C
T	A	L	L

K	O	G	F
Y	O	U	R

X	V	P	R	U	K	E	V	A	Y	E
G	R	A	N	D	F	A	T	H	E	R

E	O	F
W	A	S

13) **[75 Points]** Using a key of **RICH** encode the string **DESTINATION** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} R & I \\ C & H \end{pmatrix} \equiv \begin{pmatrix} 17 & 8 \\ 2 & 7 \end{pmatrix}$$

D	E	S	T	I	N	A	T	I	O	N
F	I	Q	N	G	D	W	D	O	K	F	T

14) **[60 Points]** You know that a message has been encrypted using the Affine Cipher with an alphabet of 26 characters. You have discovered that the message **FMDDKV** decodes to say **HIDDEN**. What are the values of *a* and *b* in the function $ax + b$ that were used to encode the message?

a= **7** *b*= **8**

15) **[100 Points]** Phaedrus once said this about something to be found. It has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the 50th through the 55th letters in the code (**JUXVMP**) is the word **HIDDEN**. What does the message decode to?

M	U	S	I	C
F	B	W	Q	P
T	H	E	I	N

M	U	S	I	C
F	Y	D	T	K
T	E	L	L	I

M	U	S	I	C
S	Y	F	K	G
G	E	N	C	E

M	U	S	I	C
A	Z	X	M	Y
O	F	F	E	W

M	U	S	I	C
B	Y	J	K	G
P	E	R	C	E

M	U	S	I	C
U	P	W	A	Y
I	V	E	S	W

M	U	S	I	C
T	U	L	P	C
H	A	T	H	A

M	U	S	I	C
E	V	W	M	P
S	B	E	E	N

M	U	S	I	C
O	U	J	M	H
C	A	R	E	F

M	U	S	I	C
G	F	D	G	J
U	L	L	Y	H

M	U	S	I	C
U	X	V	M	P
I	D	D	E	N

M	U	S	I	C
U	H	L	P	G
I	N	T	H	E

M	U	S	I	C
D	Y	U	M	U
R	E	C	E	S

M	U	S	I	C
E	Y	K	W	H
S	E	S	O	F

M	U	S	I	C
F	B	W	U	K
T	H	E	M	I

M	U
Z	X
N	D

The intelligence of few perceives what has been carefully hidden in the recesses of the mind

16) **[120 Points]** Solve this Aristocrat which is a quote from Bernard Bailey which has the word **CENTER** in it.

AOPZ IREPZRP HEZFNNW NDRFBPI BOP RPZBPY DH BOP
WHEN SCIENCE FINALLY LOCATES THE CENTER OF THE

LZEUPYIP, IDKP SPDSNP AENN TP ILYSYEIPG BD NPFYZ
UNIVERSE, SOME PEOPLE WILL BE SURPRISED TO LEARN

BOPW'YP ZDB EB.
THEY'RE NOT IT.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	2	8		6	6	3	1	2	6		1	2		7	4	18		4	3	1	1		2		6	7
Replacement	W	T	G	O	I	A	D	F	S	X	M	U	Z	L	H	E	J	C	P	B	V	Q	Y	K	R	N

17) **[300 Points]** Neil deGrasse Tyson phone greatly mangled one of his tweets before encrypting it. What does it say?

WQ KNK CMWF KJKF EHBVIAKB HVN EDWKLT, AMK QWFTA
IF EYE WHIR EVER ABDUCTED BUY ALIENS, THE FIRST

AMWLR KNK'B ETG WT CKEAMKF AMKN IEPK QFZP E ODELKA
THING EYE'D ASK IS WEATHER THEY CAME FROM A PLANET

CKEF OKZODK EDTZ BKLN TIWKLIK.
WEAR PEOPLE ALSO DENY SCIENCE.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	7	4	3	4	9	6	1	2	4	1	20	5	5	5	3	2	3	1		6		2	7			3
Replacement	T	D	W	L	A	R	K	B	C	V	E	N	H	Y	P	M	F	G	J	S	X	U	I	Q	Z	O

18) **[125 Points]** Using a key of **MILLSTONE** encode the string **CONCENTRATING** using the Hill Cipher with a 26-character alphabet. e.g.

$$\begin{pmatrix} M & I & L \\ L & S & T \\ O & N & E \end{pmatrix} \equiv \begin{pmatrix} 12 & 8 & 11 \\ 11 & 18 & 19 \\ 14 & 13 & 4 \end{pmatrix}$$

C	O	N	C	E	N	T	R	A	T	I	N	G	
T	B	C	R	D	C	A	V	T	T	C	G	B	D	P

19) **[50 Points]** An anecdote has been encoded using a Caesar Cipher. What does it say?

W	K	H
T	H	E

R	S	W	L	P	L	V	W
O	P	T	I	M	I	S	T

V	D	B	V
S	A	Y	S

W	K	H
T	H	E

J	O	D	V	V
G	L	A	S	S

L	V
I	S

K	D	O	I
H	A	L	F

I	X	O	O	,
F	U	L	L	,

W	K	H
T	H	E

S	H	V	V	L	P	L	V	W
P	E	S	S	I	M	I	S	T

V	D	B	V
S	A	Y	S

W	K	H
T	H	E

J	O	D	V	V
G	L	A	S	S

L	V
I	S

K	D	O	I
H	A	L	F

H	P	S	W	B	,
E	M	P	T	Y	,

W	K	H
T	H	E

H	Q	J	L	Q	H	H	U
E	N	G	I	N	E	E	R

V	D	B	V
S	A	Y	S

W	K	H
T	H	E

J	O	D	V	V
G	L	A	S	S

L	V
I	S

W	R	R
T	O	O

O	D	U	J	H	.
L	A	R	G	E	.