North Carolina Science Olympiad — Code Busters

2016-2017

Names of participants: (Please print neatly)

_____

_____

_____

School Name: _____

V   JV1   JV2   JV3

Warning: Do not open this packet until given permission to do so.

Note: There are useful notes after this page.

Scoring:
Time to solve first problem in seconds: _____

Question	Value	Incorrect letters	Score
Timed	100		
1	100		
2	100		
3	125		
4	100		
5	400		
6	180		
7	50		
8	180		
9	160		
10	300		
11	60		
12	250		
13	100		
14	140		
15	250		
16	250		
17	100		
18	400		
Bonus			
Final Score			

The following tables might be useful during the event.

	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
A	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
B	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	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	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

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
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Frequency Table of English letters:

E	12.51%	S	6.54%	C	3.06%	G	1.96%	K	0.67%
T	9.25%	R	6.12%	U	2.71%	W	1.92%	X	0.19%
A	8.04%	H	5.49%	M	2.53%	Y	1.73%	J	0.16%
O	7.60%	L	4.14%	F	2.30%	B	1.54%	Q	0.11%
I	7.26%	D	3.99%	P	2.00%	V	0.99%	Z	0.09%
N	7.09%								

Frequency Table of Spanish letters:

E	14.08%	I	5.98%	M	3.08%	Y	1.09%	Z	0.47%
A	12.16%	L	5.24%	P	2.89%	V	1.05%	Ñ	0.17%
O	9.20%	D	4.67%	B	1.49%	G	1.00%	X	0.14%
S	7.20%	T	4.60%	H	1.18%	F	0.69%	K	0.11%
N	6.83%	U	4.69%	Q	1.11%	J	0.52%	W	0.04%
R	6.41%	C	3.87%						

For the purposes of cryptograms it is customary to treat n and ñ as distinct letters, but a and á are the same letter. Likewise for e and é, and i and í. In other words, all the accent marks get amputated when working with cryptograms. Also, while some older Spanish dictionaries consider ch, ll, and rr, to be their own letters—this has fallen out of modern usage. Accordingly, "burro" is considered as five letters: "b-u-r-r-o" and not as four letters "b-u-rr-o."

Timed question **[100 Points]**: Solve this Cryptogram which is a quote by George Eliot. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

```
QNSPS LE ZIQNLZY QNCQ VLMM OLMM C
```

```
ACZ EI EIIZ CE NCXLZY ZIDIFJ QI
```

```
KLZF KCBMQ VLQN DBQ NLAESMK.
```

	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
Freq	2	2	6	2	5	2			7	1	3	8	6	6	1	1	8		3			2		1	2	7

1) **[100 Points]** Solve this Cryptogram which is a quote by John Steinbeck where the word THE appears multiple times.

```
KH JTG TGOIJE OHW CKHWE PU JTG



RGPRAG, JTG NIORGE PU FIOJT FGIG



NIPFKHN TGOQL UPI JTG QKHJONG.
```

	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
Freq	1		1		3	3	12	5	6	7	4	1		4	6	5	2	3		7	3		2			

2) **[100 Points]** A famous quote about a treasure has been encoded using the Vigenère cipher using a common 5 letter word. You have been told that the 35th through the 42nd letters in the code (**MGSIFNGS**) actually is the word **TREASURE** . What does the message decode to?

```
PPWKP XHPBN IVQAZ TGSRR DFTVW NSBTH ARMAM



GSIFN GSQAL XRMVL WWL
```

Answer:

_____

3) **[125 Points]** Using a key of **BCEFEDABC** encode the string **DETECTIVES** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} B & C & E \\ F & E & D \\ A & B & C \end{pmatrix} \equiv \begin{pmatrix} 1 & 2 & 4 \\ 5 & 4 & 3 \\ 0 & 1 & 2 \end{pmatrix}$$

D	E	T	E	C	T	I	V	E	S		

4) **[100 Points]** Using a key of **ROTR** encode the string **HELICOPTER** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} R & O \\ T & R \end{pmatrix} \equiv \begin{pmatrix} 17 & 14 \\ 19 & 17 \end{pmatrix}$$

H	E	L	I	C	O	P	T	E	R

5) **[400 Points]** Solve this Patristrocrat.

KLCBH LBGGB OAFWM BYLWA FYBHU TKZWG OWCMG FWXMZ

BIBYI GHMKB YMZTW ZWAFI BYZAW ACZBA FWMBY

	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
Freq	6	11	3			5	5	3	3		3	3	6		2					2	1		9	1	6	6

6) **[180 Points]** Solve this cipher which talks about character.   The first word is **THE** and the last word is **OUT**.

PARLR TNWIR EKTLT ZNIRT XSATI TSPRI HNCAT PARCE

WXMME HKARG ZRCAR CEWXM ZRURI YRKEW ZMEWP

	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
Freq	6		4		6		1	2	5		3	2	4	3		4		12	2	7	1		5	3	1	4

7) **[50 Points]** Using a code word of **SHOVEL**, encode the following quote by Abraham Lincoln sentence using the Vigenère cipher.

NO MAN HAS A GOOD ENOUGH MEMORY TO BE A SUCCESSFUL LIAR

Answer:

_____

8) **[180 Points]** Your teacher has a sign by her desk which has the following written on it. What does it say?

Answer: _____

9) **[160 Points]** Another message encrypted with the Affine Cipher using an alphabet of 26 characters has been intercepted. You have been told that the last two characters of the message are the letters **UL**. With that knowledge, what does this message say?

        XMDYOCTXYXYILTZYITMPTXYCMKN

Answer: _____

10) **[300 Points]** Solve this Cryptogram which is a famous quote from Muhammad Ali.

RAQZBLDXP QSFX'M ZQVF LX ECZP.

RAQZBLDXP QSF ZQVF WSDZ PDZFMALXE

MAFC AQYF VFFB LXPLVF MAFZ.

	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
Freq	6	3	2	4	2	11						6	4			5	7	2	3			4	1	6	1	8

11) **[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 **EUEIR** decodes to say **AGAIN**. What are the values of a and b in the function $ax + b$ that were used to encode the message?

a=_____   b= _____

12) **[250 Points]** Solve this Patristrocrat. In it, you will find the words **TO** and **TIME** at least twice each.

KPKTN NKETY ZZEIK USKUU ZYWKZ GLSNE DTGUU ZAKEZ

SERZY DERHW GTKZY WKZGH TYPKZ GZAKG LLYDK

	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
Freq	2			3	6		6	2	1		12	3		3		2		2	3	5	5		3		6	11

13) **[100 Points]** Encode the string **IFYOUDREAMITYOUCANDOIT** using the Affine Cipher with $a=5$ and $b=9$.

I	F	Y	O	U	D	R	E	A	M	I	T	Y	O	U	C	A	N	D	O	I	T

14) **[140 Points]** Solve this Cryptogram which is a quote by Henry Kissinger talking about himself.

ALT BWOT ALWBH IKCMA KTWBH I OTQTKGWAE

WF ALIA, WN ECM KCGT ZTCZQT, ALTE

ALWBV WA'F ALTWG NIMQA.

	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
Freq	11	4	4		3	2	3	2	4		4	6	3	2	2		3			10		1	9			2

15) **[250 Points]** Solve this Spanish Cryptogram which offers advice about succeeding in life.

```
WL MIH FH RJHKSH HC IC WIEZK FH QLURHCFZ


QLC WL MIH FH LPGJHCH HC LGKL. OKZQZFZK


HC ICZ LQZFJLC B GKJICOZK HC WZ LGKZ
```

	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
Freq		1	11		1	6	4	14	6	4	8	10	2			2	1	4	2	1		1		4			10

16) **[250 Points]** Solve this Cryptogram of famous inventor Charles F. Kettering's take on moving forward.

```
VOZJKRUF HOR GLR VOXQR ZB VOZSORFF.


AZC'G JOXCS UR HCPGLXCS JMG GOZMJKR.


SZZA CRTF TRHNRCF UR.
```

	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
Freq	2	1	6			5	5	3		4	2	2	2	1	7	1	1	11	4	2	3	3		3		7

17) **[100 Points]** You encountered this message from on the wall. What does it say?

Answer: _____

18) **[400 Points]** Someone used voice transcription on their phone to send this quote from Marc Andreessen to a friend. A few of the words didn't come out quite right but we decided to encrypt it anyway.   What does it say?

QVP CIXPWN EK HERILQPXC WZN QVP JZQPXZPQ SJTT ILQ FEDC

JZ QEE HWQPYEXJPC. IPEITP SVE QPTT HERILQPXC SVWQ QSE

NPS, WZN IPEITP SVE WXP QETN DB HERILQPXC SVWQ QE NE.

	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
Freq		1	6	2	16	1		4	9	4	1	4		6		17	16	3	7	7		6	7	7	1	5