North Carolina Science Olympiad — Code Busters Test 1

2018

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: _____ (use to calculate Bonus below)

Question	Value	Incorrect letters	Deduction	Score
Timed	100			
1	125			
2	120			
3	120			
4	125			
5	140			
6	250			
7	60			
8	350			
9	75			
10	120			
11	120			
12	300			
13	50			
14	100			
15	350			
16	75			
17	100			
18	300			
19	50			
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

AAAAA	A	**ABBAA**	N
AAAAB	B	**ABBAB**	O
AAABA	C	**ABBBA**	P
AAABB	D	**ABBBB**	Q
AABAA	E	**BAAAA**	R
AABAB	F	**BAAAB**	S
AABBA	G	**BAABA**	T
AABBB	H	**BAABB**	U/V
ABAAA	I/J	**BABAA**	W
ABAAB	K	**BABAB**	X
ABABA	L	**BABBA**	Y
ABABB	M	**BABBB**	Z

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."

Famous Phrases

Gettysburg address:

```
FOUR SCORE AND SEVEN YEARS AGO OUR FATHERS BROUGHT FORTH ON THIS
CONTINENT, A NEW NATION, CONCEIVED IN LIBERTY, AND DEDICATED TO THE
PROPOSITION THAT ALL MEN ARE CREATED EQUAL.
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Declaration of Independence:

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WHEN IN THE COURSE OF HUMAN EVENTS IT BECOMES NECESSARY FOR ONE PEOPLE
TO DISSOLVE THE POLITICAL BANDS WHICH HAVE CONNECTED THEM WITH ANOTHER
AND TO ASSUME AMONG THE POWERS OF THE EARTH, THE SEPARATE AND EQUAL
STATION TO WHICH THE LAWS OF NATURE AND OF NATURE'S GOD ENTITLE THEM,
A DECENT RESPECT TO THE OPINIONS OF MANKIND REQUIRES THAT THEY SHOULD
DECLARE THE CAUSES WHICH IMPEL THEM TO THE SEPARATION.
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Constitution of United States of America:

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WE THE PEOPLE OF THE UNITED STATES, IN ORDER TO FORM A MORE PERFECT
UNION, ESTABLISH JUSTICE, INSURE DOMESTIC TRANQUILITY, PROVIDE FOR THE
COMMON DEFENSE, PROMOTE THE GENERAL WELFARE, AND SECURE THE BLESSINGS
OF LIBERTY TO OURSELVES AND OUR POSTERITY, DO ORDAIN AND ESTABLISH
THIS CONSTITUTION FOR THE UNITED STATES OF AMERICA.
```

MAGNA CARTA (In Latin):

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JOHANNES DEI GRACIA REX ANGLIE, DOMINUS HIBERNIE, DUX NORMANNIE,
AQUITANNIE ET COMES ANDEGAVIE, ARCHIEPISCOPIS, EPISCOPIS, ABBATIBUS,
COMITIBUS, BARONIBUS, JUSTICIARIIS, FORESTARIIS, VICECOMITIBUS,
PREPOSITIS, MINISTRIS ET OMNIBUS BALLIVIS ET FIDELIBUS SUIS SALUTEM.
```

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

```
EP GERHCK FAKHK XC IKWHQXQL ZXFAERF FKWGAXQL.  XF'C
```

```
NRCF GEYYEQIT HKPKHHKJ FE VT WQEFAKH QWYK:  CGXKQGK.
```

	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	4		5		7	8	5	7	2	1	12	2		1		2	7	3		2		1	4	6	3	1
Replacement																										

1) **[125 Points]** Using a key of **SURFBOARD** encode the string **PHILOSOPHICAL** using the Hill Cipher with a 26-character alphabet. e.g.

$$\begin{pmatrix} S & U & R \\ F & B & O \\ A & R & D \end{pmatrix} \equiv \begin{pmatrix} 18 & 20 & 17 \\ 5 & 1 & 14 \\ 0 & 17 & 3 \end{pmatrix}$$

P	H	I	L	O	S	O	P	H	I	C	A	L		

2) **[120 Points]** The following quote from Abraham Lincoln has been encoded using a running key cipher against a famous document. What does it say?

Y	L	T	Y	E	R	X	S	G		T	W		Z	N	D	L		E		N	E	M	X		E	Q	V

K	E	I	Y	L	I	G	W	F	Q		P	Z	D	S		F		G	Y	M	D	A	K	.	K	L	T
																								.			

W	Y	F	H	Q	P		C	F		E	V	N	X		O	X		T	I	T	V	C		V	O		C	L	;
																													;

M	P	G		X	Z	R	W		C	J		X	K	S		D	I	S	E		B	J	B	E	G	.
																										.

3) **[120 Points]** The following strange 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 **TRAVEL**. What does the message decode to?

Answer: _____

Large green enemy teach after voice alarm alter daily fight.

Angry known model trust upper judge after human heart asked drama guide.

Movie giant never apply.

Brain dream cause added audio began fifth lunch early.

Inner peace album added extra money issue.

Dandy yacht under entry force.

First mixer given every itchy zebra.

Heavy lemon asked about angry legal bloom after heavy robin began extra

fancy entry.

4) **[125 Points]** Solve this Aristocrat which is a quote from John Sladek.

VFK WDVDUK, BSSIUZPOL VI GICK GSPKOVPGVG, HPEE XK

KMBSVEN EPQK VFK RBGV, IOEN CIUK KMRKOGPTK.

	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	2	2	5	2	6	1	5		12	1	2	2	4	6	1	2	4	1	3	8	1	1		1
Replacement																										

5) **[140 Points]** A 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 **KE**. With that knowledge, what does this message say?

K	F	S	I	X	M	C	V	J	O	X	T	C	V	U	I	D	C	U	S

6) **[250 Points]** Solve this Patristocrat which is a quote by Nick Powers and begins with **IT IS**.

BNBWB XHJWW BPYRN JNTIO WUROM NDRYI VWJCO INSTR

EJSUI OJOYE MRNRT XBORN DINEJ STSOM RTWNI OMBOK

JCOIN STRDI WUDIO KRM

	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		6	2	4	3			1	9	7	2		5	10	11	1		10	5	6	3	1	7	2	3	
Replacement																											

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

$a=$ ☐ $b=$ ☐

8) **[350 Points]** Solve this Patristocrat which is a quote by Frederick Maurice Powicke and is encoded using a K1 key and the word **THE** appears three times.

ZAHQP GMAHX ITTPX QZUWU RWKUA YZQPX QZAOY HKZAV

ZZRJU UHVRE UWQZU VPOQG PTPXQ ZUDAO WMUQW GAJUD

ROPOK AQZRS TAOWX PGVU

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	9			2	1		4	4	1	2	3		2		6	8	9	5	1	4	11	4	6	5	2	10
Replacement																										

9) **[75 Points]** The following symbols encodes a phrase using a Baconian alphabet. What does it say?

Answer: _____

_____

«»«‹«‹«‹«›«›»«›«›»«‹«‹«›»«›«›»«‹«›«›«›«‹«›»«‹«›»»«‹«‹«‹«‹«›«‹«‹«›»»«›»»«‹»›»«

»»«›»«‹«‹«›»»«‹«›»«‹«‹«‹«‹«‹«‹«›«›«›«›«‹«›»«‹«‹«›»»»«›»»«›»«‹«‹«‹«›»«‹«‹«‹«‹«‹«

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10) **[120 Points]** Solve this Aristocrat which is a quote from Roy T. Bennett and starts with **DON'T**.

WFI'O XNBOZ SFMQ OEHZ EI NIKZQ, QZKQZOB, XFQQEZB,

NIW KQMWKZB. VEUZ EB OFF BTFQO OF DZ MITNYYS.

	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		6		1	5	7		1	5		4		3	4	7		8		2	2	1	1	3	2	2	9
Replacement																										

11) **[120 Points]** Solve this Aristocrat which is a quote from Albert Einstein which has the word **ASSURE** in it.

`SZ IZR XZKKN MPZWR NZWK SJHHJGWQRJDC JI BMRVDBMRJGC.`

`J GMI MCCWKD NZW BJID MKD CRJQQ TKDMRDK.`

	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	7			3	2	4	8	7		7	3		1	3	7	2	1		1	5	1		6
Replacement																										

12) **[300 Points]** Isaac Asimov would be greatly amused by how badly a computer mangled one of his famous sayings before encrypting it. What does it say?

`Z AFVFW LJYYGP FVGC FAPGAY MDEGS WHF DW VJC Z IJLZS`

`VGDSM ZKKGOW HGZA YJKI FAPGAY HFFP KFSBXDKW HDWI WIG`

`BDAYW XZH.`

	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	2	2	6	1	9	9	5	4	4	5	2	2		1	4			4			4	8	2	6	6
Replacement																										

13) **[50 Points]** G. Byrne's humor has been encoded using a Caesar Cipher. What does it say?

| V | J | G | | O | Q | N | G | | K | U | | C | | S | W | C | P | V | K | V | A | | Q | H | | U | W | D | U | V | C | P | E | G | . |

| V | J | G | | P | G | Y | | R | T | G | H | K | Z | | ' | I | W | C | E | C | ' | | K | U | | F | G | H | K | P | G | F |

| U | W | E | J | | V | J | C | V | | Q | P | G | | I | W | C | E | C | O | Q | N | G | | G | S | W | C | N | U |

| C | X | Q | E | C | F | Q | ' | U | | P | W | O | D | G | T | . |

14) **[100 Points]** Hermann Hesse once said this about things to be found. It has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the 25th through the 30th letters in the code (**KERUPQ**) actually is the word **HIDDEN**. What does the message decode to?

| I | S | R | Y | L | | J | U | R | Y | G | | N | S | R | W | L | | P | M | N | P | U | | A | B | F | E | K |

| E | R | U | P | Q | | O | C | D | P | Z | | D | S | I | P | E | | A | V | Z | Y | G | | P | V | Z | Y | J |

| O | H | Y | P | B | | S | S | I | P | L | | J | H | Y | P | P | | E | B | R | W | O | | K | T | K | S | H | | I |

15) **[350 Points]** Solve this K1 Key encoded Patristocrat which is a quote by Brian Herbert and ends with the letters **LITY**.

```
SJRCO IPJYY MCLUY TELPY CLPGJ BPZBP PIZCP KQGJZ


ZPJBJ YRPKM YMCNY KPBPO CUIJC PCLPZ MEPBM SUIZB


POOUM YMDPB BPJXU CG
```

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		8	9	1	2		3		4	8	3	4	7	1	4	17	1	2	2	1	5			1	8	6
Replacement																										

16) **[75 Points]** Using a key of **XFUN** encode the string **CELEBRATION** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} X & F \\ U & N \end{pmatrix} \equiv \begin{pmatrix} 23 & 5 \\ 20 & 13 \end{pmatrix}$$

C	E	L	E	B	R	A	T	I	O	N	

17) **[100 Points]** Encode the string **CAN'T JUDGE A BOOK BY ITS COVER** using the Affine Cipher with *a=7* and *b=13*.

C	A	N	T	J	U	D	G	E	A	B	O	O	K	B	Y	I	T	S	C	O	V	E	R

18) **[300 Points]** Solve this Xenocrypt which is a quote in Spanish by Miguel de Unamuno.
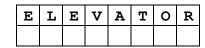
CE FTABFTE AY QB FALABRAUTZ GA TGAEY LQAUREY,

EQBMQA GA ACCEY VQAGA YECTU CE OTGE.

K1	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	13	4	5		9	3	5					2	1			1		5	2		6	3	1			5	1
Replacement																											

19) **[50 Points]** Using a code word of **STAIR**, encode the following quote from Zig Ziglar using the Vigenère cipher.

T	H	E	R	E

I	S

N	O

E	L	E	V	A	T	O	R

T	O

S	U	C	C	E	S	S	.
							.

Y	O	U

H	A	V	E

T	O

T	A	K	E

T	H	E

S	T	A	I	R	S	.
						.