# North Carolina Science Olympiad — Code Busters Test 3 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.	
<b>Note:</b> 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	250			
2 3	100			
	120			
4	300			
5	75			
6	50			
7	350			
8	50			
9	350			
10	120			
11	125			
12	125			
13	75			
14	140			
15	120			
16	60			
17	300			
18	120			
19	100			
Bonus				
Final Score				

The following tables might be useful during the event.

	A	В	С	D	E	F	G	H	I	J	K	L	M	N	0	P	Q	R	S	T	Ū	٧	W	Х	Y	Z
A	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Z
В	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Ζ	А
С	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	W	Χ	Y	Ζ	А	В
D	D	Ε	F	U	Н	Ι	J	K	L	М	Ν	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Z	Α	В	С
E	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Ζ	Α	В	С	D
F	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Ζ	Α	В	С	D	E
G	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	W	Χ	Y	Ζ	А	В	С	D	Ε	F
Н	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Z	А	В	С	D	Ε	F	G
I	Ι	J	K	L	М	Ν	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Z	Α	В	С	D	Ε	F	G	Н
J	J	K	L	М	Ν	0	Р	Q	R	വ	Т	IJ	V	M	Χ	Y	Ζ	А	В	С	D	Ε	F	G	Н	I
K	K	L	М	N	0	Р	Q	R	S	Т	U	V	W	Χ	Y	Ζ	Α	В	С	D	Ε	F	G	Н	Ι	J
L	L	М	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Ζ	А	В	С	D	Ε	F	G	Н	Ι	J	K
M	М	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Z	А	В	С	D	Ε	F	G	Н	Ι	J	K	L
N	N	0	Р	Q	R	S	Т	U	V	M	Χ	Y	Z	А	В	С	D	Ε	F	G	Н	Ι	J	K	L	М
0	0	Р	Q	R	S	Т	U	V	W	Χ	Y	Ζ	Α	В	С	D	Ε	F	U	Н	Ι	J	K	L	М	N
P	Р	Q	R	S	Т	U	V	W	Χ	Y	Z	А	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0
Q	Q	R	S	Т	U	V	M	Χ	Y	Ζ	Α	В	$\cup$	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р
R																										
S	S	Т	U	V	W	Χ	Y	Ζ	Α	В	$\cup$	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R
T	Т	U	V	W	Χ	Y	Ζ	Α	В	$\cup$	О	Ε	F	G	Н	Ι	Ŋ	K	L	М	N	0	Р	Q	R	S
Ū	U	V	M	Χ	Y	Ζ	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т
V	V	W	Χ	Y	Ζ	А	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U
W	M	Χ	Y	Z	А	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V
X	Χ	Y	Ζ	А	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	M
Y	Y	Z	Α	В	С	D	Ε	F	G	Н	I	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	M	Χ
Z	Z	А	В	С	D	E	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	V	W	Χ	Y
	_																									

AAAABA       B         AAABA       C         AAABBA       E         AABAAA       F         AABBAB       G         AABBBA       III         ABAAAA       IVI         ABAABAB       K         ABABBA       L         ABABBB       M	AAAA	Α
AAABB       D         AABAA       E         AABAB       F         AABBA       G         AABBB       H         ABAAA       I/J         ABAAB       K         ABABA       L	AAAAB	В
AABAA       E         AABAB       F         AABBA       G         AABBB       H         ABAAA       I/J         ABAAB       K         ABABA       L	AAABA	C
AABAB       F         AABBA       G         AABBB       H         ABAAA       I/J         ABAAB       K         ABABA       L	AAABB	D
AABBA       G         AABBB       H         ABAAA       I/J         ABAAB       K         ABABA       L	AABAA	Е
AABBB       H         ABAAA       I/J         ABAAB       K         ABABA       L	AABAB	F
ABAAA         I/J           ABAAB         K           ABABA         L	AABBA	G
ABAAB K ABABA L	AABBB	Н
ABABA L	ABAAA	I/J
	ABAAB	K
ABABB M	ABABA	L
	ABABB	M

Ι

GH

5

A B

CDFF

3

4

J

K L M

ABBAA	N
ABBAB	Ο
ABBBA	P
ABBBB	Q
BAAAA	R
BAAAB	S
BAABA	T
BAABB	U/V
BABAA	W
BABAB	X
BABBA	Y
BABBB	Z

R S T

9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

0

N

## **Frequency Table of English letters:**

Ε	12.51%	S	6.54%	С	3.06%	G	1.96%	K	0.67%
Т	9.25%	R	6.12%	U	2.71%	M	1.92%	X	0.19%
Α	8.04%	Н	5.49%	M	2.53%	Y	1.73%	J	0.16%
0	7.60%	L	4.14%	F	2.30%	В	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%
Α	12.16%	L	5.24%	P	2.89%	V	1.05%	Ñ	0.17%
0	9.20%	D	4.67%	В	1.49%	G	1.00%	X	0.14%
S	7.20%	T	4.60%	Н	1.18%	F	0.69%	K	0.11%
N	6.83%	U	4.69%	Q	1.11%	J	0.52%	M	0.04%
R	6.41%	С	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.

#### Declaration of Independence:

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.

#### Constitution of United States of America:

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):

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.

School	V	IV1	JV2	IV3

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

# AB'U YHEZ TKBWP ZYX'IW UBWLLWN YXBUANW ZYXP OYJKYPB

# GYHW BFTB ZYX RWDAH BY OFTHDW, DPYM, THN BPTHUKYPJ.

	A	B	C	D	E	F	G	H	Ι	J	K	L	M	N	0	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	3	9		3	1	2	1	6	1	2	3	2	1	3	2	6		1		5	4		8	4	11	4
Replacement																										

1) [250 Points] Solve this Patristocrat which is a quote by Bertrand Russell and begins with IT HAS.

LZFIB UVVGB ILNZF IZQIG LBIDI ZLWGI PIGLQ IPIPP

QHPLC VLFIX VUVVG BVIDY FLGMC WDVXL NVGYV RFLYF

# YWOPN BOKKW DZZFL B

	A	В	C	D	E	F	G	H	I	J	K	L	M	N	0	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency		6	2	4		7	7	1	12		2	11	1	3	2	6	3	1			2	10	4	2	4	6
Replacement																										

2) [100 Points] Encode the string A GOLDEN KEY CAN OPEN ANY DOOR using the Affine Cipher with a=11 and b=11.

Α	Ġ	0	L	D	E	N	K	E	Y	С	Α	N	0	P	E	N	Α	N	Y	D	0	0	R

								School _		_ V	JV1	JV2	JV3
ence	oded mess	sage whe	re some l	etters end	code as o	ne charac	ter and t		t in reality, as another to?	•			
Answer	:												
Power	laser	wisps	apple	press									
Peter	never	wears	quilt	sleep	trend	•							
Debut	renew	force	field										
Prime	prism	below	clear	wands	apply	xrays	where	roger	drove	seve	en w	impy	7
weeds	•												
Never	lower	fluid	fruit	allow	large	block	•						
Break	wrong	drill	, delay	y leve	l added	d early	y fibe	r weav	e.				
Seven	sweet	worms	spent	newly	clear	fleet	,drove	royal	apple,	leav	re a	lert	Ξ,
weird	whale	speak											

4) [300 Points] Solve this Xenocrypt which is a translation of a quote by Mark Twain into Spanish.

# NQK GIAK MA HNAIA TEQMGIABKB TEWE NQK GZNMGEQ CKMUK

# XNA IGTCK GIAK MA TEQYGABUA AQ BAKZGIKI.

	A	В	C	D	E	F	G	H	I	J	K	L	$\mathbf{M}$	N	Ñ	0	P	Q	R	S	T	U	V	$\mathbf{W}$	X	Y	Z
Frequency	12	4	2		5		8	1	7		10		5	5				6			4	2		1	1	1	2
Replacement																											

- 5) [75 Points] Using a key of SPRY encode the string CERTIFICATE using the Hill Cipher with a 26
- character alphabet. e.g.  $\begin{pmatrix} S & P \\ R & Y \end{pmatrix} \equiv \begin{pmatrix} 18 & 15 \\ 17 & 24 \end{pmatrix}$

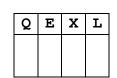
С	E	R	Т	I	F	I	С	A	Т	E	

6) [50 Points] Bruno Mars' observation has been encoded using a Caesar Cipher. What does it say?

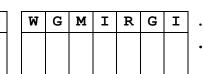
Q	Y	W	M	G



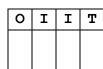






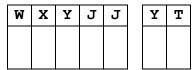






Q	M	В	M	R	K

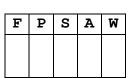


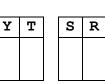


	 _

Y	R	Х	M	P





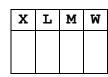


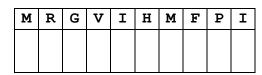
С	S	Y





F	I	G	S	Q	I	W





Т	s	X	M	s	R

															Scl	100	l				V	JV	IJ	/2	JV	3
7) [350 Point encoded									-				_		e in	a B	Brief	Hi	stor	y o	f T	ime	anc	l is		
ORYFT	VOBE	Ğ	TIC	PU	J O	GT:	BU	00	OR	PC	) (	)R	YJ	U	Bl	ΚY	IV	Y	B\	<b>V</b> A	Т					
KYIUY	XWSE	V	YOT	[Z]	P	OB'	TU	PI	Œ	ΡI	. 7	<b>70</b> I	RP(	0	L?	ΥQ	PU	<b>.</b>	(B)	<b>J</b> Q	T					
KYIPU	XJUX	Υ	IVO	PÜ	JХ																					
K1	A B	<b>C</b>	D E	F	G H	Ι	J ]	K L	M	N	0	P	$\mathbf{Q}$	R	S '	T U	J <b>V</b>	W	<b>X</b>	Y	Z					
Frequency	y 1 6	;	2	2	2	6	2	3 2			13	10	2	4	1	7 9	7	1	5	10	1	1				
Replaceme	nt																									
													•			•	•									
8) [50 Poir cipher.	<b>ıts]</b> Usi	ng a	code	wor	d of I	MIG	нт,	enco	ode	the	fol	low	ing	qu	ote	froi	n M	Iark	Tw	vair	ı us	sing	the	Vig	gen	ère
ALL	Y O U	J	N E	Е	D	I	N	T	н	ı İ	s	L	I	F	E	Γ	I S	3	I	G	N	0	R A	N	С	E
																F	Ť			_						T

T H E N

S U C C E S S

I S

SURE.

CONFIDENCE, AND

9) [350 Points] Solve this K1 Key encoded Patristocrat which is a quote by Frederick Maurice Powicke in "History, Freedom & Religion" and ends with the word **FORCE**.

# XQPFC LJQPN OAACN FXMWM TWHMQ SXFCN FXQRS PHXQV

## XXTGM MPVTD MWFXM VCRFL CACNF XMBQR WJMFW LQGMB

# TRCRH QFXTU AQRWN CLVM

K1	A	В	C	D	E	F	G	Н	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	$\mathbf{W}$	X	Y	Z
Frequency	4	2	8	1		9	2	3		2		4	11	5	1	4	9	6	2	5	1	4	6	10		
Replacement																										

10) [120 Points] The following quote from Abraham Lincoln has been encoded using a running key cipher against a famous document. What does it say?

E		K	s	A	•	В		X	G	v	A		Y	. 7	7	Ι	]	D	Q		K	F	F	U	Х	R	2	A	G	L	Z	v
					'																											
J	Т	K	;		Q		Т	N	Ç	Q V	7 (	2	Т		Q	G	E	I		E	s	F	' τ	J	e :	Γ :	L	J	R		K	С
			<b>;</b>																													
Х	R	D	A		K	W	L	X		A	W	v		0	J	s	Е	3 (	Э	N	s	G		D	M	A	Z		M	M	] .	

School	V	JV1	JV2	JV3

11) [125 Points] Solve this Aristocrat which is a quote from an unknown source.

# PMDZD GZD DUJMP VHGIDPR, KIHDRR FQ WFKZRD NFK RPUHH

# WFKIP VHKPF UI OMUWM WGRD PMDZD GZD IUID BUHHUFI

# VHGIDPR.

	A	В	C	D	E	F	G	H	Ι	J	K	L	M	N	0	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency		1		13		6	5	8	8	1	5		5	1	1	8	1	7			7	3	4			5
Replacement																										

12) [125 Points] Using a key of MULTITUDE encode the string CIRCUMSTANCES using the Hill Cipher with a 26-character alphabet. e.g.

$$\begin{pmatrix} M & U & L \\ T & I & T \\ U & D & E \end{pmatrix} \equiv \begin{pmatrix} 12 & 20 & 11 \\ 19 & 8 & 19 \\ 20 & 3 & 4 \end{pmatrix}$$

С	I	R	С	U	M	S	T	A	N	С	E	S	

13) [75 Points] The following symbols encodes a phrase using a Baconian alphabet. What does it say?
Answer:
?¿?¿¿¿???¿¿??¿¿??¿¿¿???¿¿???¿???¿???¿????
5?3.5.6???3.6???3.6?????????????????????
5?3.5?3?3?3.5.5.6.5.6.5.6.5.6.6.6.6.6.6.6.6.6.6.6.
325.37.37.37.37.37.37.37.37.37.37.37.37.37.
33.57.5.7.6.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.
32323333333335399399399399399399399393333333
35.27.27.27.27.27.27.27.27.27.27.27.27.27.

<sup>14) [140</sup> 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 **TS**. With that knowledge, what does this message say?

W	R	F	G	E	В	W	R	С	V	S	P	ტ	X	ტ	K	Q	S	N	W

School	V	JV1	JV2	JV3

15) [120 Points] Solve this Aristocrat which is a quote from Winston Churchill and starts with MAN.

# EQM GJSS TKKQRJTMQSSO RWYENSI TXIU WFI WUYWF, NYW

# ETRW TD WFI WJEI FI GJSS ZJKC FJERISD YZ QML

KTMWJMYI TM.

	A	В	C	D	E	F	G	H	I	J	K	L	M	N	0	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency			1	2	5	5	2		8	7	4	1	6	2	1		4	4	8	7	2		9	1	5	2
Replacement																										

16) <b>[60 Poin</b>	ts] You	know t	hat a me	ssage has	s been en	crypted	using the	Affine (	Cipher with	h an alphabe	et of 26
character	s. You	have di	scovered	d that the	message	ZIPPY	B decode	s to say	HIDDEN.	What are th	ne values
of a and	b in the	functio	nax + b	that wer	e used to	encode	the messa	age?			

KPK XECKN EDD OKTH GFTG WGFKH KDVEDKKHA MWWN AGWL SK

EDD GFK AGHKKG TDN TAJ SK T STGF ZRKAGEWD, TDN KPK

MWRXND'G DW GFK TDAMKH.

	A	В	C	D	E	F	G	H	Ι	J	K	L	$\mathbf{M}$	N	0	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency	6		1	12	5	5	11	5		1	18	1	3	5	1	2		2	3	8		1	7	2		1
Replacement																										

<sup>17) [300</sup> Points] A computer badly mangled Gurjeet Singh's quiet statement before encrypting it. What did he say?

18) [120 Points] Solve this Aristocrat which is a quote from the British Comedy series "A bit of Fry and Laurie" which has the word GIVE in it.

# L OILMU ZMLNZD OVYOLMJ LY Z OVGGLRDV LBVZ; OIVH JVO

# ZDD MVGPEWY ZMB JLPV OIV CGEMJ ZMYCVGY.

	A	В	C	D	E	F	G	H	Ι	J	K	L	M	N	0	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency		2	2	4	2		5	1	3	4		8	7	1	7	2		1			1	10	1		5	7
Replacement																										

19) **[100 Points]** Edgar Ramirez once said this about what to look for. It has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the 23<sup>rd</sup> through the 28<sup>th</sup> letters in the code (**UMBPSA**) actually is the word **HIDDEN**. What does the message decode to?

U	0	Y	A	Y		K	G	U	٧	W		F	U	Y	ហ	M		W	T	В	V	R		T	Ø	ט	M	В
_		_	-	17	1		~	_	-	_	1	_	~	_	-	37	l	_	_	_	7.5	_	l	_	**		-	_
P	S	A	J	Y		0	S	В	J	R		Т	S	P	L	Y		D	0	P	Х	С		D	H	Ū	Ι	F
																	ı						ī			ī		
U	R	Q	I	L		R	0	P	Ι	R		T	0	G	A	С		M	Z	Y	L	Y		H	S			