

# Science Olympiad — Scioly.org Codebusters Test 2019

Names of participants: (Please print neatly)

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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	400			
1	325			
2	100			
3	75			
4	180			
5	300			
6	100			
7	750			
8	300			
9	120			
10	525			
11	700			
12	275			
13	200			
14	675			
15	200			
16	350			
17	725			
18	200			
19	125			
<b>Bonus</b>				
<b>Final Score</b>				



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

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

1	3	5	7	9	11	15	17	19	21	23	25
1	9	21	15	3	19	7	23	11	5	17	25

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

### *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, ARCHIEPISCOPI, EPISCOPI, ABBATIBUS, COMITIBUS, BARONIBUS, JUSTICIARIIS, FORESTARIIS, VICECOMITIBUS, PREPOSITIS, MINISTRIS ET OMNIBUS BALLIVIS ET FIDELIBUS SUIS SALUTEM.



1) [325 points] Solve this Aristocrat which is a quote from the Scioly.org forum rules and has the word "rules" in it.

HEXMZAEXKQ XJ AUBQB NYMBQ DEMM NBQYMA EK WZKQ XN

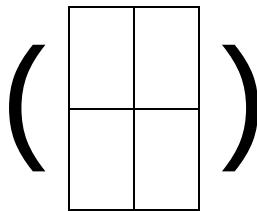
DZNEKIQ ZQQBQBT AX SXYN ZOOXYKA, TFBKTEKI XK UXD

BINBIEXYQ AUB HEXMZAEXK EQ.

	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	11		3	10	1		2	4	1	10		6	6	2		12		1	3	3		1	12	5	6
Replacement																										

2) [100 points] Using a key of FLEX compute the decryption matrix for a 2x2 Hill with a 26 character alphabet.

$$\begin{pmatrix} F & L \\ E & X \end{pmatrix} \equiv \begin{pmatrix} 5 & 11 \\ 4 & 23 \end{pmatrix}$$



3) [75 points] Solve this quote from the Scioly Assassination 133: Zoo Escape thread which has been encoded with the Caesar Cipher.

C	D

,

W	T

,

H

S	T	U	X	C	X	I	T	A	N

P

G	D	Q	D	I

.

P	U	I	T	G

.

P	A	A

,
  

G	D	Q	D	I	H

S	D	C

,

I

W	P	K	T

U	T	T	A	X	C	V	H

.

4) [180 points] A phrase from the 1000 Ways to Get Kicked Out of Walmart thread has been encoded using the Vigenère cipher with a code word of RICE. What does it say?

J	P	Q	Y	K

K	Q	R	K	Q

P	Y	F	C	U

P	P	Q	P	F

I	W	M	I	E

K	J	M	E	M

U	I	G	Q	F

K	Z	V	G	R

X	T	K	W	Y

E	J	I	E	G

Q	Y	R	Z	G

G	C	M	C	V

C	G	P	S	K

W	H	E	J	Q

C	R	F	Z	K

K	Z	V

5) [300 points] This quote from the Your Daily Random Comment thread has been encoded using the beginning of a famous document. What does it say?

E	A	T	Z
A	P	P	Y
X	Y	K	V
T	F	L	E
H	Q	Q	P
E	V	J	X
A	E	P	Q
P	B	D	Z

Q	K	Z	L
Z	N	D	G
Q	D	A	B
Z	G	T	E
E	I	L	C
W	N	B	O
C	G	S	L
A	E	I	Z

A	H	P	C
U	D	L	W
K	A	W	H
D	X	E	X
K	O	H	I
L	H	B	C
D	V	M	V
T	N	M	C

U	L

6) [100 points] Encode this quote from the Pennsylvania 2019 thread into the Atbash alphabet.

S	O	U	T	H	E	A	S	T
A	N	D						
N	O	R	T	H	E	A	S	T
S	E	E	M					
T	O							
H	A	V	E					

S	N	A	Z	Z	Y		
N	E	W					
W	E	B	S	I	T	E	S
(	T	H	O	U	G	H	
(							
T	H	E					
C	O	N	T	E	N	T	

A	P	P	E	A	R	S
T	H	E				
S	A	M	E			
)	.					
)	.					



7) [750 points] Solve this Xenocrypt which is a translation of a quote from the The Event That "Got Away" thread into Spanish and has been encoded with a K1 alphabet using an English keyword.

**TY, J GVYNUMÑC VÑVUQFNUC. OVLVFNT YTLVF VÑVXNOC VPC**

**PCLFV VÑ LFTKC OVÑ FCLCQ UMTROC QMGV ÑT CDCFQMRNOTO.**

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			11	1		7	2			1	1	5	4	5	6	6	2	4	2		7	4	13		1	3	
Replacement																											

8) [300 points] Solve this quote from the thread Poorly Run Event Stories that has been encoded using a Baconian Cipher. The first two letters are TO.

**BACDEGFHIJLKMONQSPRTUVXWZBYDACFEHGHIKJLNOQPSUWRTVYAXZCBDEFGIKMHOQ**

**JSUWYALNCPGKITMVOXQZSBUWYDACFEHGJLIKMOQSUSWYPRTACEVGIKXMOQZSUWB**

**YACEGDIFKMOQHSUWYAJLNCEPGIKRTVMXOQSZUWYBDACEFGHJLIKPMROTVQXSZBUW**

**YDACEGFHIKMOJLNQSUSWYAPCREGITKV**





13) [200 points] Solve this Aristocrat which is a quote from the Your Daily Random Comment thread.

"BDYOM, T ETBGFJJFY JDVFDGF EOIA YDEG BUF UOIEOM DG

BUFTX UOGYJ."

	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	1	4		5	4	6	5		3	4			2		5					3	4	1		1	4	
Replacement																										

14) [675 points] Solve this K2 Patristocrat which is a quote from the How to Get to Nationals and Beat Troy thread.

DWYIB NTDGR ITYKY EGXAA TYBOR NBBIY KOEBL NKORK

YEIBR NLGXA AYTRQ NK

Replacement																											
K2	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	6		2	3		3		4		5	2		5	3		1	5		4			1	2	7		



17) [725 points] Solve this Xenocrypt which is a translation of a quote from the Those Moments You Will Never Forget thread into Spanish and has been encoded with a K1 alphabet using an English keyword.

**WA ESF WFGQVSF, HAQ ZSDQ QAGWF VW RM BDMRWD WJWAGS,**

**SGDSF VSF USRBQLWDSF VW WCHMBS O OS XHMRSF Q UQPQD**

**BMDMGQF .**

Replacement																																							
K2	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	4	4	1	7	1	9	5	3		1		1	6			2	1	9	4	12		2	4	10	1												1		

18) [200 points] This quote from the Your Daily Random Comment thread has been encoded using a key, and you know that the first two letters are LV. Figure out what the rest of it says.

L	V	O	M	M	V	X	D	D	H	X	N							
								K	M	Q	D	T	O	B	F	V	V	M

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19) [125 points] Andrew and Lauren want to communicate with each other using RSA for encryption. Andrew generates RSA keys obtaining the following values:

$$\begin{aligned} p &= 163 & e &= 8597 \\ q &= 521 & d &= 22253 \\ \phi &= 84240 & n &= 84923 \end{aligned}$$

Likewise, Lauren also generates RSA keys resulting in the values

$$\begin{aligned} e &= 90119 & q &= 163 \\ p &= 751 & n &= 580523 \\ d &= 75479 & \phi &= 579000 \end{aligned}$$

They ask each other for the public keys in order to communicate. What information do they each need to transmit in response?

You must also determine what formula Lauren needs to calculate in order to transmit the value 446 to Andrew

Enter the minimum values that Andrew need to transmit to Lauren:

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Enter the minimum values that Lauren need to transmit to Andrew:

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Write the formula Lauren needs to calculate in order to transmit the value 79184 to Andrew

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