

# Science Olympiad — SSSS

## someone1580's 2019 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	150			
1	150			
2	100			
3	250			
4	100			
5	200			
6	200			
7	200			
8	150			
9	500			
10	250			
11	300			
12	200			
13	400			
14	500			
15	150			
16	200			
17	200			
18	600			
19	600			
<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, MINISTERIS ET OMNIBUS BALLIVIS ET FIDELIBUS SUIS SALUTEM.

Timed Question [150 points] Decrypt this quote from Arnold Schwarzenegger. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

**XGU OQHIX XGSWB S LNW MU SI XGU INTU NI UKUHAMQFA**

**UCIU. S GNXU XGNX.**

	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>Frequency</b>	2	1	1			1	5	2	5		1	1	2	5	1		2		4	1	9		2	7		
<b>Replacement</b>																										

SSSS someone1580's 2019 Codebusters Test

1) [150 points] Decode this phrase which is encoded with the Caesar Cipher.

U	Z	Y	Y	N	S	L	U	N	S	J	F	U	U	Q	J	X	T	S	U	N	E	E	F	X	M	T	Z	Q	I	G	J	
Y	M	J	X	F	R	J	F	X	H	T	R	R	N	Y	Y	N	S	L	F	K	J	I	J	W	F	Q						
T	K	K	J	S	X	J																										

2) [100 points] Encode this quote by Albert Einstein with the Atbash Cipher.

I	N	T	H	E	M	I	D	D	L	E	O	F	D	I	F	F	I	C	U	L	T	Y	L	I	E	S
O	P	P	O	R	T	U	N	I	T	Y																

3) [250 points] Decrypt this nonsense using the Baconian Cipher.

**A TIME APART COMES AS THE CHAOS OF HIS GAMES FEELS**

**SHAME UNTIL ANNOY**

4) [100 points] Encode this quote from Avengers Endgame with a Caesar shift of 7.

Y	O	U	,	R	E	R	E	P	E	A	T	I	N	G	Y	O	U	R	S	E	L	F	!	

## SSSS someone1580's 2019 Codebusters Test

5) [200 points] Decrypt this K2 Aristocrat that includes the word "door" twice.

**"LWTC DCT SDDG DU WPEEXCTHH RADHTH, PCDIWTG DETCH;**

**QJI DUITC LT ADDZ HD ADCV PI IWT RADHTS SDDG IWPI LT**

**SD CDI HTT IWT DCT LWXRW WPH QTTC DETCTS UDG JH."**

Replacement																																		
<b>K2</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	<b>L</b>	<b>M</b>	<b>N</b>	<b>O</b>	<b>P</b>	<b>Q</b>	<b>R</b>	<b>S</b>	<b>T</b>	<b>U</b>	<b>V</b>	<b>W</b>	<b>X</b>	<b>Y</b>	<b>Z</b>								
Frequency	4		11	20	4		4	10	9	2		4				5	2	3	5	19	3	1	9	2								1		

6) [200 points] Decrypt this Aristocrat, which is a quote from Joshua J. Marine.

**IAZCCUSMUY ZPU VAZB HZFU CDRU DSBUPUYBDSM ZSX**

**LWUPLHDSM BAUH DY VAZB HZFUY CDRU HUZSDSMRKC.**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	<b>L</b>	<b>M</b>	<b>N</b>	<b>O</b>	<b>P</b>	<b>Q</b>	<b>R</b>	<b>S</b>	<b>T</b>	<b>U</b>	<b>V</b>	<b>W</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
Frequency	4	5	5	7		2		5	2		1	2	4			3		3	7		12	2	1	1	4	8
Replacement																										



7) [200 points] Decode this Vigenère cipher with the key "GREEN".

N	R	Z	M	A	M	W	Y	R	Q	K	T	S	H	V	T	X	X	L	V	Y		
																	E	S				
																	C	B	A	R	V	I

N	R	D	S	W	G	Z	Y	I	V	R	J	F	R		
											J	U	I	V	C

8) [150 points] Encode this incredibly funny quote with the key "SHAKE".

I	U	S	E	D	T	O	T	H	I	N	K	I	W	A	S	I	N	D	E	C	I	S	I	V	E
																I	'	M							

N	O	T	T	O	O	S	U	R	E	N	O	W

## SSSS someone1580's 2019 Codebusters Test

9) [500 points] Decode this Patristocrat that is about basketball and is by Phil Jackson.

**QEKVQ MKJQP EZWQE KQKLG YVKLF EYJXY SYXOL HGKGT**

**KMQEK VQMKJ PQEZW KLFEG KGTKM YVQEK QKLG**

	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	2	6	1		3	14	5	4		1	2	10		1	2		4	2	2	5	2
Replacement																										

10) [250 points] Decrypt this Aristocrat that is a quote from E.B. White.

**ROIMKEWZI WP U DOIUH HWTI PUFIO. ALK ZUB YLOT**

**LRWBWLBP SWHCLKH CUFWBD HL DIH HCI YUZHP.**

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

11) [300 points] Decrypt this Affine Cipher that is a quote by Abraham Lincoln. The first two letters are "NE"

U	T	H	G	O	B	H	O	O	R	T	U	N	H	U	J	M	H	U	Q	H	Q	S	T	G	J	F	M	B	,	K	P	M
F	W	B	X	P	V	H	U	M	M	X	M	T	J	M	H	R	H	U	'	J	N	C	H	G	H	N	M	T	G	,		
Z	F	S	T	C	F	R	A	X	V	T	G	.																				
												.																				

12) [200 points] Encode this phrase with the 2x2 Hill Cipher using the key "HILL".

$$\begin{pmatrix} H & I \\ L & L \end{pmatrix} \equiv \begin{pmatrix} 7 & 8 \\ 11 & 11 \end{pmatrix}$$

T	I	M	E	I	S	V	A	L	U	A	B	L	E

## SSSS someone1580's 2019 Codebusters Test

13) [400 points] Decode this Xenocrypt.

**QS FIMXNVB WV FI QAG CAFWV, ZAJF PAF AIXH FB**

**ZHXEAÑZVH EF KVVKBF MXHX FIZV.**

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

14) [500 points] Decode this Patristocrat that is a quote by Mark Twain. The last word is "do".

**FMLVF WWLNE HDESJ VSMWS AMGY ZLJSE LIGHN RRSKV**

**FLIZW FXLFX GVQHF XNFW S AIGIV FISFX NVZWF XLSVL**

**HWSAI GIIS**

	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			1	3	10	6	4	8	2		8	3	4			1	2	10			7	7	5	2	3
Replacement																										

15) [150 points] Encrypt this statement using the Affine Cipher with a key of (5, 11).

S	C	I	E	N	C	E	O	L	Y	M	P	I	A	D	I	S	S	O	F	U	N

16) [200 points] Decode this message that is encoded with the Running Key cipher using the Gettysburg Address.

"	N	Q	U	E	F	Q	H	W	M	X	B	Q	L	L	Z	L	B	S	V	O	I	L	H	K	G	D	I	K
"																												

T	R	M	O	I	C	G	P	B	C	L	Z	O	X	B	C	I	W	Z	K	U	B	J	P	D	C	W	Q

M	P	R	J	B	N	N	Q	E	P	V	O	G	Q	H	V	U	H	B	Q	P	W	I	K	D	O	B	T

E	B	W	Z	G	R	H	R	P	L	H	G	T	G	B	X	J	R	K	S	B	R	R	T	N	H	W	O	L	Q

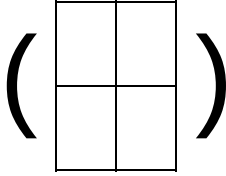
A	I	R	O	X	N	U	G

## SSSS someone1580's 2019 Codebusters Test

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17) [200 points] Find the Decryption Matrix from this Encryption Matrix.

$$\begin{pmatrix} C & Z \\ B & X \end{pmatrix} \equiv \begin{pmatrix} 2 & 25 \\ 1 & 23 \end{pmatrix}$$



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18) [600 points] Mykayla has faithfully followed the steps of the RSA key-generation algorithm. Here are the results:

$$p = 47$$

$$q = 43$$

$$n = 2021$$

$$\phi = 1932$$

$$e = 421$$

Unfortunately, Mykayla doesn't know how to compute the value of  $d$  and needs you to do that final step for her.

Enter the computed value of  $d$ , NOT the formula.

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19) **[600 points]** Victoria and Hayley are accountants for a very large bank, and have started a friendship. They communicate via email, because they live thousands of miles apart. Hayley gets curious and asks Victoria the year that they were born. Victoria doesn't mind telling Hayley, but they know that the bank monitors all employee emails, and is afraid of being the victim of age discrimination. Therefore, Hayley suggests that they use RSA, and they provides their public key: (45792281, 6711197). Victoria replies with the ciphertext 9125223. Hayley's private key is 27885749. In what year was Victoria born?

Enter the answer: