Science Olympiad — Scioly.org Codebusters Test 2019

Names of participants: (Please print fleatily)		
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			
Bonus				
Final Score		1		I

The following tables might be useful during the event.

	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	M	N	0	Р	Q	R	S	Т	U	٧	W	Х	Υ	Z
Α	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Х	Υ	Z
В	В	С	D	Е	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α
С	С	D	Е	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В
D	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С
Е	Е	F	G	Н	Ι	J	K	L	М	Ν	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D
F	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Е
G	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F
Н	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Е	F	G
I	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Х	Υ	Z	Α	В	С	D	Ε	F	G	Н
J	J	K	L	М	Ν	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι
K	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J
L	L	М	N	0	Р	Q	R	S	T	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K
М	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L
N	N	0	Р	Q	R	S	Т	U	٧	W	Х	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М
0	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N
Р	Р	Q	R	S	Τ	U	٧	W	Χ	Υ	Z	Α	В	С	D	Е	F	G	Н	Ι	J	K	L	М	N	0
Q	Q	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р
R	R	S	Т	U	٧	W	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q
S	S	T	U	٧	W	Χ	Υ	Z	Α	В	С	D	Е	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R
T	Т	U	>	W	Χ	Υ	Ζ	Α	В	С	D	Е	H	G	Η	Ι	J	K	ᆚ	М	N	0	Р	Q	R	S
U	U	٧	W	Χ	Υ	Ζ	Α	В	O	D	Е	F	G	Ξ	Ι	J	K	ᆚ	Μ	Ν	0	Р	Q	R	S	Т
٧	٧	W	Χ	Υ	Z	Α	В	O	D	Е	F	G	Ξ	Ι	J	K	L	Μ	Ν	0	Р	Q	R	S	Т	U
W	W	Х	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧
Х	Χ	Υ	Z	Α	В	С	D	Ε	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W
Υ	Υ	Z	Α	В	С	D	Е	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Х
Z	Z	Α	В	С	D	Е	F	G	Н	Ι	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Χ	Υ

	Α	В	C	D	Е	F	G	H	I	7	K	L	M	N	0	P	Q	R	S	T	>	٧	W	X	Υ	Z
ſ	0	1	2	ω	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Α	В	C	D	Е	F	G	Н	I	J	K	L	M	N	0	Р	Q	R	S	Т	U	>	W	X	Υ	Z
Z	Υ	Χ	W	٧	U	Т	S	R	Q	Р	0	N	М	L	K	J	Ι	Н	G	F	Е	D	С	В	Α

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	Α	AABBA	G	ABBAA	N	BAABA	Т
AAAAB	В	AABBB	Н	ABBAB	0	BAABB	U/V
AAABA	С	ABAAA	I/J	ABBBA	Р	BABAA	W
AAABB	D	ABAAB	K	ABBBB	Q	BABAB	Χ
AABAA	Е	ABABA	Г	BAAAA	R	BABBA	Υ
AABAB	F	ABABB	М	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%
            H - 5.49% M - 2.53%
                                     Y - 1.73%
                                                  J - 0.16%
A - 8.04%
0 - 7.60% L - 4.14% F - 2.30% B - 1.54%
                                                  0 - 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%
0 - 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, II, 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.

Timed Question [400 points] Solve this Aristocrat. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

NCPH HV BXAVIR GVC, RVPH YCVHZP AVI HJBP HZPH QIZ

WVRBXE AIVR DVPHP VX HJZ PHCLZXH PWBZXWZ VOGRDBQL

TBSB.

	Α	В	С	D	E	F	G	Н	I	J	K	L	М	N	0	P	Q	R	S	T	U	٧	W	Х	Υ	Z
Frequency	3	7	4	2	1		2	11	4	2		2		1	1	9	2	5	1	1		11	3	5	1	7
Replacement																										

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

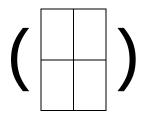
DZNKEKIQ ZQQBQQBT AX SXYN ZOOXYKA, TBFBKTEKI XK UXD

BINBIEXYQ AUB HEXMZAEXK EQ.

	Α	В	С	D	E	F	G	Н	Ι	J	K	L	M	N	0	Р	Q	R	S	T	U	٧	W	Х	Υ	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	poi	nts]	So	lve	this	quo	ote f	rom	the	Sci	oly	Ass	assi	inati	on í	133	3: Z	00 E	Esca	ape	thre	ad	whi	ch h	as b	een	enc	ode	d w	ith	the	Ca		ır C	iphe	er.		
С	D	,		W	Т		Н		s	Т	U	>	< c	>	(]	. 7	Г	Α	N		Р		G	D	Q	D	I].	Ī	P	J	Ι	Т	G		Р	Α	Α	,
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G	D	Q	D	I	Н		s	D	С	-	I		W	F	P k	(]	г		U	Т	Т	Α	Х	С	٧	Н].	_											
										١.								-																					
4)	[180) po	oints	s] A	ph	rase	froi	m th	e 10	000	Way	ys t	o Ge	t Ki	icke	d Oı	ut o	of W	/alm	nart	thre	ad h	nas	bee	en ei	1000	led	usin	g the	e Vi	ger	nère	e cip	 her	 r wi	ith a	cod	le w	ord of
RIC	E. V	Vha	t do	es it	sa	ay?																																	
J	Р	Q	Υ	К]	К	Q	R	K	Q		P	Υ	F	С	U	Г	P	Р	Q	Р	F	Γ	ı	W	М	ı	E	к	J	M	1 6		м					
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U	Ι	G	Q	F		K	Z	٧	G	R		Х	Т	K	W	Υ	ı	E	J	Ι	Е	G		Q	Υ	R	Z	G	G	С	М	1 (١ د	V					
			1	Π	1 1				1			1					_																						
С	G	Р	S	K		W	Н	Е	J	Q	_	С	R	F	Z	K	-	K	Z	٧																			
																	L																						

5)		0 рс	oints	s] T	his	quo	te fr	om t	he `	⁄our	Dai	ly Ra	and	lom	Cor	nme	ent th	nrea	d ha	as b	een	end	code	d us	sing	the	beg	jinn	ing	of a	ı far	nou	ıs d	ocur	nen	t. Wl	nat d	oes it
E	Α	Т	Z		Α	Р	Р	Υ	>	Y	′ K	٧		Т	F	L	Е	ŀ	н (ξ	ξ I	Р	Е	٧	J	Х		Α	E	Р	Q		Р	В	D	Z		
Q	К	Z	L		Z	N	D	G	() [) A	В		Z	G	Т	Ε	E	Ξ]	[_ (С	W	N	В	0		С	G	S	L		Α	E	I	Z		
А	Н	Р	С		U	D	L	W	k	(Δ	W	Н		D	Х	E	Х	ŀ	< ()	1 :	I	L	Н	В	С		D	٧	М	٧		Т	N	М	С		
U	L																																					
6)	[10	0 pc	oints	s] E	ncc	de t	his	quot	te fro	om t	he P	enn	sylv	/ani	a 20	19	threa	ad ir	nto th	ne A	tba	sh a	lpha	abet														
S	0	U	Т	Н	Е	А	S	Т		Α	N	D		N	0	R	Т	Н	E	Α	S	Т		S	Е	Е	М		Т	0		Н	А	V	Е			
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S	N	Α	Z	Z	Υ		N	E	W		W	E	В	S	Ι	Т	E	S		(Т	Н	0	U	G	Н		Т	Н	Е		С	0	N	Т	E	N	Т
Α	Р	Р	Е	Α	R	S]	Т	Н	Е		S	Α	М	Е)																						
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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	Α	В	С	D	Е	F	G	Н	I	J	K	L	М	N	Ñ	0	Р	Q	R	S	Т	U	٧	W	Х	Υ	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.

BACDEGFHIJLKMONQSPRTUVXWZBYDACFEGHIKMJLNOQPSUWRTVYAXZCBDEFGIKMHOQ

JSUWYALNCPEGRITKMVOXQZSBUWYDACFEHGJLIKNMOQSUWYPRTACEVGIKXMOQZSUWB

YACEGDIFKMOQHSUWYAJLNCEPGIKRTVMXOQSZUWYBDACEFGHJLIKNPMROTVQXSZBUW

YDACEGFHIKMOJLNQSUWYAPCREGITKV

9) [120 points] Encode this phrase from the Way Too Early Predictions thread using the Vigenère cipher with the key Cornell.

I L I K E H O W I C O U L D R E V E A L B O T H O F Y O U R

I D E N T I T I E S

NC SPJ'V UOV NCONS PR IPWQHOKR... YNEO HWQO IOZ

VCTJE VZTAO NFPWV ODOQIZNQO IPW HVOM NV UQNJSYN'H

CPWHO TJ ROFQWNQI

	Α	В	С	D	Е	F	G	Н	I	J	K	L	М	N	0	Р	Q	R	S	T	U	٧	W	Х	Υ	Z
Frequency	1		4	1	2	2		5	5	4	1		1	10	13	6	7	3	3	3	2	7	6		2	3
Replacement																										

 $^{10) \ \}textbf{[525 points]} \ Solve \ this \ A ristocrat \ with \ errors \ which \ is \ a \ quote \ from \ the \ Scioly \ Assassination \ 133: \ Zoo \ Escape \ thread.$

11) [700 points] Solve this Patristocrat which is a quote from the Your Daily Random Comment thread.

MHMYP NRXKP SRRSH PCRVK ERGBL VUPZN KUPPN KBZLJ

PNUZN KFULM BWRNR WZWLP APWNK NUZNX KPKVU PZNKU PPNK

	Α	В	С	D	Е	F	G	Н	I	J	K	L	М	N	0	Р	Q	R	S	T	U	٧	W	Х	Υ	Z
Frequency	1	3	1		1	1	1	2		1	10	4	3	11		13		7	2		7	3	4	2	1	6
Replacement																										

12) [275 points] Using a key of MULTITONE encode the string MEMBRANOPHONES using the Hill Cipher with a 26-character alphabet.

$$\begin{pmatrix} M & U & L \\ T & I & T \\ O & N & E \end{pmatrix} \equiv \begin{pmatrix} 12 & 20 & 11 \\ 19 & 8 & 19 \\ 14 & 13 & 4 \end{pmatrix}$$

М	E	М	В	R	Α	N	0	Р	Н	0	N	E	S	

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

"BDYOM, T ETBGFJJFY JDVFDGF EOIA YDEG BUF UOIIEOM DG

BUFTX UOGYJ."

		Α	В	C	D	Е	F	G	Н	I	J	K	L	M	N	0	Р	Q	R	S	T	U	٧	W	Χ	Υ	Z
	Frequency	1	4		5	4	6	5		3	4			2		5					3	4	1		1	4	
Ī	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	Α	В	С	D	Е	F	G	Н	I	J	K	L	М	N	0	Р	Q	R	S	Т	U	٧	W	Х	Υ	Z
Frequency	4	6		2	3		3		4		5	2		5	3		1	5		4			1	2	7	

15) [200 points] Solve this Aristocrat which is a quote from the Anatomy and Physiology B/C thread.

Y ESKYSWS GP DOYRX VOP O QSOXJZS AVSZS BHJ FOR GHWS

O DOZX HQ O DYFXJZS QZHG HRS KHFOXYHR XH ORHXVSZ.

	Α	В	С	D	Е	F	G	Н	I	J	K	L	М	N	0	Р	Q	R	s	T	U	٧	W	Х	Υ	Z
Frequency	1	1		3	1	3	3	9		3	2				10	2	3	5	11			3	2	7	5	6
Replacement																										

^{16) [350} points] Solve this Aristocrat which is a quote from the Science Olympiad at MIT Invitational 2019 thread.

...AGW TWRUBDWK BWDWR WJWDA RYZWKJURCK OUNN LW AGW

DEAUCDENR RYZWKJURCK? (U AGUDX UA'R TWRUBDWK BWDWR.)

	Α	В	С	D	Е	F	G	Н	I	J	K	L	М	N	0	Р	Q	R	S	T	C	٧	W	X	Υ	Z
Frequency	6	4	3	8	2		3			3	6	1		3	1			10		2	9		15	1	2	2
Replacement																										

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 0 OS XHMRSF Q UQPQD

BMDMGQF.

Replacement																											
K2	Α	В	С	D	Е	F	G	Н	Ι	J	K	L	М	N	Ñ	0	Р	Q	R	S	Т	U	٧	W	Х	Υ	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.

Г	٧	0	М	М	٧	Х	D	D	Н	Х	N	K	М	Q	D	Т	0	В	F	٧	٧	М	

19) [125 points] Andrew and Lauren want to communicate with each other using RSA for encryption. Andrew generates RSA keys obtaining the
following values:
$p = 163 \qquad e = 8597$
q = 521 $d = 22253$
$\phi = 84240 \qquad n = 84923$
Likewise, Lauren also generates RSA keys resulting in the values
e = 90119 $q = 163$
p = 751 $n = 580523$
$d = 75479$ $\phi = 579000$
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:
Enter the minimum values that Lauren need to transmit to Andrew:
Write the formula Lauren needs to calculate in order to transmit the value 79184 to Andrew