

# Science Olympiad — SSSS Codebusters - builderguy135

Names of participants: (Please print neatly)

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School Name: \_\_\_\_\_

Check your team:  Varsity  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	125			
2	125			
3	275			
4	325			
5	325			
6	375			
7	400			
8	425			
9	550			
10	575			
11	650			
12	150			
13	200			
14	175			
15	200			
16	200			
17	275			
18	300			
19	600			
20	250			
21	350			
22	250			
23	350			
24	375			
25	225			
<b>Bonus</b>				
<b>Final Score</b>				

<b>Question</b>	<b>Value</b>	<b>Incorrect letters</b>	<b>Deduction</b>	<b>Score</b>
26	250			
27	350			
28	175			
29	525			
30	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

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

# Morse Code:

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

  

0 -----	2 ••---	4 ••••-	6 -••••	8 ---••
1 •-----	3 •••---	5 •••••	7 --•••	9 -----•

  

• E	- T	-• N	-- M	-•• D	-•- K	-•- G	--- O
•• I	•- A	•-• R	•-- W	•--• P	•--- J		
••• S	••- U	••-• F	•-•• L	--•• Z	--•- Q		
•••• H	•••- V	-•-• C	-•-- Y	••••- 4			
-••• B	-••- X	••--- 2	•••-- 3	----• 9			
----- 0	•---- 1	--••• 7	----•• 8				
••••• 5	-•••• 6						

Timed Question **[400 points]** Decode this quote from Ta-Nehisi Coates's "Between the World and Me". When you have solved it, raise your hand so that the time can be recorded and the solution checked.

**CTAYSNMCTSYIF TA P UTIC MR FYEEMETAS, PIC FQY FQEYPF**

**MR TF PGFYEA FQY MENTF MR PGG MWE GTKYA PIC, GTUY**

**FYEEMETAS, FQTA CTAFMEFTMI TA TIFYIFTMIPG.**

	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>	9		6		11	15	6		8		1		11	2		7	4	3	4	16	2		1		11	
<b>Replacement</b>																										

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1) [125 points] Decode this word, often used to describe rocks, which has been encoded with a Caesar cipher.

T	G	L	J	Q	G	V	A	S	D

2) [125 points] Encode "Encode this with a Caesar shit of ninety" with a Caesar shift of negative forty.

E	N	C	O	D	E	T	H	I	S	W	I	T	H	A	C	A	E	S	A	R	S	H	I	F	T	O	F

  

N	I	N	E	T	Y

3) [275 points] Decode this aristocrat, which is the description of an amoebic parasite and the infection it can cause. The last word of the plaintext is the acronym PAM and the word "amoeba" is used once.

WRFLEFVUR ZJNEFVU UA R ZVFF-EUCUWL BUQVJAQJOUQ

RBJFGR. UX QRW QRIAF R VRVF RWM ZRXRE UWZFOXUJW JZ

XKF GVRUW QREEFM OVUBRVH RBFGUQ BFWUWLJFWQFOKREUXUA (

ORB) .

	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	1		7	15	3	1	1	7	2	3	2	1	4		9	18			16	9	10	5		5
Replacement																										

4) [325 points] Decode this text message which has been corrected of its grammar mistakes and encoded with a K1 aristocrat.

SYM SD ASTCBSJ, X'WC ZMYBXC B JSTC XU MFC IVZM MNS

NCCHZ MFVU X FVWC XU MFC IVZM MNS PCVTZ .

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



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5) [325 points] Decode this aristocrat that discusses a concept in math.

M PREHQVAE HME KS MUUBAJVYMQSI KZ ROVEC M PVEVQS

ERYKSB AP QSBYO AP VQO QMZNAB OSBVSQ.

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

6) [375 points] Decode this quote by Neil deGrasse Tyson which has been encoded as an Aristocrat.

K HSWRY-GKFFWQ, HSWRY-JKWW, GYOD GUOD HKRBM JQREQQO

REU UBRUGSAQA EUSWF JQ KEQAUHQ RU EKRBM.

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

7) [400 points] Decode this meta-cipher encoded with a K2 alphabet.

**KZVBJ NSCC XHQFKVDVCQUZ VDY YZXEYZ ZDXHQFKZY**

**BZJJVRZJ LJSDR XHQFKVDVCQJSJ KZXIDSG LZJ AEH**

**ISJKEHSXVC VDY BEYZHD VYMVDXZY XSFIZHJ.**

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	1	3	5	9	4	4	1	7	3	10	6	2	1	1			5	2	7		1	11		8	8	13			

8) [425 points] Decode this text message which has been encoded as an Aristocrat. The plaintext includes texting language and is a run-on sentence.

**V UWKKW TX GR MKQHV FJ JU NCE GR EMWPJMA PWK FMM UJMK**

**V TX VE WKT VEF EUX WG WKT V TXK'E UWKE JMA EX EJVKY**

**V'G VKFWKM HGWX**

	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	2		1		9	4	5	2		6	12		8	1		2	1	2		5	5	9	10	6	1	
Replacement																										

9) **[550 points]** Decode this controversial quote by Randall Munroe which has been encoded as a K1 patristocrat.

RQEYL FLYLW HRTLN DEFGE HIJKL RGMWR FPNXI ZFIGQ

LWZRZ LGEXG BOWJR GXEHE NXGQL WLRXE RNRG

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

10) **[575 points]** Decode this statement by Edsger Dijkstra, a programmer and computer scientist, which is encoded as a Patristocrat using a K1 alphabet. The key is the country he was born in.

PNYDY PKFET MTWCE HPCDK TNMTJ DYDKF TWHJC TEGDO

IGJEF DSIKH PCDKU GTJWM DJLWE IKHPC DKKUD CE

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

11) **[650 points]** Decode this quote, encoded as a Patristocrat and taken from the trailer of the documentary "Float", which discusses F1D indoor free flight planes.

LTXYX ONIYL HDMHQ DKHIL SFBQN IYHQF ULTXY XVSLT

SLIFU IGOHK QLXKM FHLTS FBSFL TXVHY KUJIF YXNKI

JXLTl LDXXK SFB

	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		3		8	1	7	8	2	6	11	2	3	2		4		6	6	3	2		10	6	
Replacement																										

12) **[150 points]** Encode this phrase with the Affine cipher where  $a=15$  and  $b=8$ .

R	A	I	S	E	D	S	U	B	M	E	D	I	A	N	T

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13) [200 points] Decode the name of a part of the ear with the Affine cipher. The 1st letter is "b" and the last letter is "e".

P	K	W	Y	N	K	R	S	E	S	P	R	K	X	E

14) [175 points] Decrypt this phrase using the Vigenere Cipher with a key of "wright". Do not decode the numbers.

S	Z	V	J	Z	M	K	K	P	K	I	X	W	K	W	L	V	G	A	Y	C	T	K	K	A	U	I	T	K	Y

K	I	B	E	V	G	W	D	M	Z	Y	H	J	F	U	K

15) [200 points] Encode the phrase "pentel orenz nero zero point three" with the Vigenere Cipher with key "pencil"

E	I	A	V	M	W	D	V	R	P	H	Y	T	V	B	B	M	C	D	T	B	K	V	E	I	L	E	G	M

16) [200 points] Decrypt this word, given that the block size is 3 and the last 3 letters are "phy"

I	P	K	G	X	X	S	I	T	G	I	V	L	E	R	S	X	U	K	V	G	T	L	E

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17) **[275 points]** Decode the name of this cryptographic algorithm which is a prime example of encoding with a Baconian Cipher.

**4235672894357235678924357623578235947236578235729345723**

**5762385792435762389457235672357823579423576829357423567**

**23894576235879423657**

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18) **[300 points]** Decrypt this disease which has been encoded using a Baconian cipher.

**APPLY AFTER FEWER BEADS ABOUT CAKES ALARM CAUSE AWAKE**

**DEPTH AWAKE BOOKS EGYPT GERMS BEAMS ADAPT ISAAC ALIBI**

**ALONE MOVIE IDEAS TIGER WALTZ GRUNT MESSY INDIA CROOK**

**SMOKE JOKER CRAIG TWIST**

19) [600 points] Decode this quote by Joshua Marine which has been encoded as a Xenocrypt.

VEX JCXYOAEX XES VEX BKC ZYWCS BKC VY LAJY XCY

ASUCNCXYSUC I XKÑCNYNVEX CX VE BKC ZYWC VY LAJY

XAFSAOAWYUALY

	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	8	3	12		6	1			1	3	4	3		3	1	2				5		3	6	3	11	12	2
Replacement																											

20) [250 points] Encode the phrase "larus argentatus(z)" with the Hill Cipher with a keyword of "bird".

$$\begin{pmatrix} B & I \\ R & D \end{pmatrix} \equiv \begin{pmatrix} 1 & 8 \\ 17 & 3 \end{pmatrix}$$

L	A	R	U	S	A	R	G	E	N	T	A	T	U	S	



21) **[350 points]** Decode the name of this parasite given that the encryption keyword is "trematoda" using a 3x3 Hill Cipher.

$$\begin{pmatrix} T & R & E \\ M & A & T \\ O & D & A \end{pmatrix} \equiv \begin{pmatrix} 19 & 17 & 4 \\ 12 & 0 & 19 \\ 14 & 3 & 0 \end{pmatrix} \quad \text{Decode } \begin{pmatrix} T & R & E \\ M & A & T \\ O & D & A \end{pmatrix}^{-1} \equiv \begin{pmatrix} 1 & 8 & 3 \\ 4 & 6 & 21 \\ 24 & 21 & 20 \end{pmatrix}$$

P	J	C	C	G	S	P	U	Y	U	I	W	Q	T	G	X	Q	D	T	W	N

22) **[250 points]** Decrypt this phrase which has been encoded using the Morbit Cipher. 1=x\*, 2=-, 3=•-, 4=•x, 5=xx, 6=••

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

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

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

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23) **[350 points]** Decode the nickname of this fictional character which has been encoded in a Morbit Cipher. Only 5 mappings are given.

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

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24) **[375 points]** Decode this phrase which has been encoded with the Morbit Cipher. The numbers 7267232 decrypt to "ITIS".

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

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

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

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25) **[225 points]** Decode the name of this class of indoor free flight planes. The letters 2, 3, 4, 6, 7, and 8 all decode to -.

521501592295192919251905221010219259252209522195215912

92105

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26) **[250 points]** Decode this definition from urban dictionary which has been encoded using a Pollux Cipher. 0,5=x, 1,3=•, 2,4=-

480902403008803204100920230039028088024803890801203231

00213103013021028900919103009101390030333801092108922

038203191030123010023110318040018038190331022800890882

09820319103018103

27) [350 points] Decode this phrase which has been encoded with a Pollux Cipher. The numbers "32363121913" encode to the letters "TERE".

50453425961493459014366195374166308904881213132419018016

3236312191351637243082282110768620372557209947666096981646

32528040300535237574229307261310948705569128556903111

28) [175 points] Andrew and Brooklin want to communicate with each other using RSA for encryption. Andrew generates RSA keys obtaining the following values:

$$\begin{aligned}
 n &= 20016863 & q &= 2039 \\
 p &= 9817 & d &= 18819931 \\
 \phi &= 20005008 & e &= 7516195
 \end{aligned}$$

Likewise, Brooklin also generates RSA keys resulting in the values

$$\begin{aligned}
 d &= 21336781 & p &= 5923 \\
 n &= 30675217 & \phi &= 30664116 \\
 q &= 5179 & e &= 18266425
 \end{aligned}$$

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 Andrew needs to calculate in order to transmit the value 2205 to Brooklin

Enter the minimum values that Brooklin needs to transmit to Andrew:

--	--	--

Enter the minimum values that Andrew needs to transmit to Brooklin:

--	--	--

Write the formula Andrew needs to calculate in order to transmit the value 2205 to Brooklin

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29) **[525 points]** Jake, has faithfully followed the steps of the RSA key-generation algorithm. Here are the results:

$$p = 347$$

$$q = 337$$

$$n = 116939$$

$$\phi = 116256$$

$$e = 110077$$

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

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

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30) **[600 points]** Jesse has the following RSA public key:

$$n = 38609821 \quad e = 6315131$$

Unfortunately for them, A quantum computer has successfully factored their  $n$

$$38609821 = 8923 * 4327$$

Compute the value of their private key:

Enter the computed private key: