

Science Olympiad — Throx's Codebuster Test

Names of participants: (Please print neatly)

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	150			
1	100			
2	150			
3	100			
4	100			
5	300			
6	400			
7	250			
8	250			
9	550			
10	650			
11	650			
12	550			
13	200			
14	200			
15	150			
16	350			
17	350			
18	300			
19	300			
20	200			
21	550			
Bonus				
Final Score				

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	ABBBE	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.”

Morse Code:

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	-----•

•	E
••	I
•••	S
••••	H
-•••	B
-----	0
•••••	5

-	T
•-	A
••-	U
•••-	V
-••-	X
•----	1
-••••	6

-•	N
•-•	R
••-•	F
-•-•	C
••---	2
--•••	7

--	M
•--	W
•-••	L
-•--	Y
•••--	3
----••	8

-••	D
•--•	P
--••	Z
••••-	4
-----•	9

-•-	K
•---	J
--•-	Q

-••	G
-----	---

---	O
-----	---

Timed Question **[150 points]** Solve this Timed Aristocrat question which is a quote by Ralph Waldo Emerson. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

DUF RGMI ZTSD TC W QRBDRG RS DUICFMS ... DUF QRFD

EBTGZC UTC QRFH; DUF CUFQUEBN UTC MWHE.

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

Throx's Codebuster Test

1) **[100 points]** The following quote has been split in half! The first half needs to be encoded with the Affine Cipher using $a=11$ and $b=4$.

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

2) **[150 points]** The following quote was split in half! The second half needs to be decoded with the Affine Cipher where $a=5$ and $b=19$.

H	F	K	C	N	K	A	P	N	K	N	F	K	L	S	D	H	U	H	W	H	O	T	K	H	L	G	.

3) [100 points] Decode this quote by the Joyce Brothers that was encoded with a Caesar Cipher.

S	P	C	R	K	U	O	C	Z	O	K	B	O	R	K	N	D	Y	Q	Y	Y	X	K	X	K	E	D	R	Y	B
D	Y	E	B	D	Y	Z	B	Y	W	Y	D	O	B	Y	W	O	Y	K	X	N	T	E	V	S	O	D	,	R	O
X	O	F	O	B	G	Y	E	V	N	R	K	F	O	G	B	S	D	D	O	X	W	K	M	L	O	D	R	.	

4) [100 points] Decode this quote by Eugene Ionesco that has been encoded with a Caesar Cipher.

E	S	F	Q	H	W	G	H	D	W	Z	S	N	W	V	W	D	M	K	A	G	F	K	G	X	Y	J	S	F	V	W	M	J	
T	M	L	Q	G	M	,	J	W	V	W	D	M	V	W	V	T	Q	L	J	A	N	A	S	D	A	L	Q	.					

Throx's Codebuster Test

5) [300 points] Solve this Aristocrat which is a quote by Muhammad Ali.

UC'V YEVC L YWR. ZOLVV ZOWAV, RUONV KPM, ALBGV JWEXN

CTG VLXN. U RGLC JGWJPG EJ.

	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	4		3		5			4	1	5	1	3	3	2		3		1	3	8	4	2	2	2	
Replacement																											

6) [400 points] Solve this Aristocrat that has been misspelled really badly.

UENIVK GY IZTZ SKTYZ IZEI YPVEQY E PEM IZTZ JXS PVSY

TN IZV ZEKI.

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

7) [250 points] Solve this Aristocrat which is a quote from Warren Buffett.

D TDNX UL EL ZLF HDBHYXG. D TDNX UL GYLLU ZDGY DB O

IOFFXT. IMU D TDNX UL CL DU OZUXF UYX AOUXF YOG FMB

LMU.

	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	1	10	1	6	4	2	2			9	3	3	5					4	10			8	5	3
Replacement																										

8) [250 points] Decode this Aristocrat which is a quote by J.C. Raulston.

WP MEJ HUX QED AWZZWQO KZHQDT, MEJ HUX QED UXHZZM

TDUXDGLWQO MEJUTXZP HT H OHUVXQXU.

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

Throx's Codebuster Test

9) [550 points] Solve this K1 Spanish Xenocrypt that has an English keyword.

GP YNÑTMV VP GPO SRQO FV DMVXGPQO FR QVPUMO FGVMOV.

BO ÑGZVM KO BN FOTV.

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		2		1		4	5				1		5	2	2	7	5	4	2	1	2	1	9		1	1	1
Replacement																											

10) [650 points] Decode this K2 Patristocrat which is a quote by George Burns that starts with DEF

UVWMA VKRGC QGDMA VDDXR PEDSE VPCEK DRFZP FRFZV

CDSPA DVVFZ VTPDK RGUR

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	3		3	8	3	4	3				3		2			5	1	6	2	1	2	8	1	1		3		

11) [650 points] Solve this Patristocrat which is a quote by John Ruskin.

YSPTF NOFFH HOXKK XMXWI FNXPB KTPFF KXFRQ EOKFO

OFWXZ XIOSO NXWXA LCXIB RPXSO IFNXP ABOX

	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	3	1		1	11		1	4		5	1	1	4	9	5	1	2	3	2			3	13	1	1
Replacement																										

12) [550 points] Solve this K1 Patristocrat that is a quote by John Skelton that contains the word NEST

GVNXZ GAOZM LJDLF RJFMS ZNSLK GFRGK OLFFR JFPSV

VOFRR SLGBK KOLF

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

Throx's Codebuster Test

13) **[200 points]** Oops! Another quote has been split in half! Encode the first half with a Hill Cipher with the keyword AFRO.

$$\begin{pmatrix} A & F \\ R & O \end{pmatrix} \equiv \begin{pmatrix} 0 & 5 \\ 17 & 14 \end{pmatrix}$$

T	H	E	R	E	A	L	C	H	A	R	A	C	T	E	R	O	F	A	M	A	N	I	S

14) **[200 points]** Oops! Another quote has been split in half! Decode the second half with a Hill Cipher with the keyword HAIR.

$$\begin{pmatrix} H & A \\ I & R \end{pmatrix} \equiv \begin{pmatrix} 7 & 0 \\ 8 & 17 \end{pmatrix}$$

J	S	K	R	V	C	K	P	H	A	X	K	W	O	G	U	W	E	G	I	N	L	W	X	

15) [150 points] The following quote needs to be decoded with the Vigenère Cipher with a keyword of **GHOST**.

C	L

O	J	X

N	H	I	F	M	K	K

P	Q

T	T

P	R	W	T	R

S	W	X	X

,

G	U	R

A	M

O	Z

P	W	V	G	B	G	W

P	K

O	O	N	X

C	P	H	Z	B	T

B	G

L	A	K

I	S	Y	B	T	U	W	F	Z

G	U	R

L	A	K

W	C	K	L	O	I	W	D	B	Z	F

C	X

B	Z

.

16) [350 points] Solve this Baconian Cipher which is a quote by Regina Nadelson.

CHOEALTHDEACOLTHDCEOALDTCHOLDCOLDCOELDATCOHLDCEOALDTC

OLHDCOELDCOALDTCOHLDCOAOLDCHEOALDTCHOLDCOLEDACOTLHDC

EOLDCATOLHDCEOLDATHCOELDCOLDCOATLDHCOELDACOLDCOTLDHCO

LDEATCOLDCOHLDECOALDCOTHLEDATCOLHEDATCOLDHCOELDCATHOL

EDCAOLDCOLTDCOHLDEADCTOLDHCEAOLDCTOLHDCEOLDCOALDCOTHLDC

COEAL

Throx's Codebuster Test

17) **[350 points]** A quote has been encoded using the Pollux Cipher for you to decode. You are told that 7=-, 6=●, 1=●, 8=x, 9=-, 2=-.

39704930365206583457851640311682990799825066820037938647

093330423184653135461100410750742103935299871740641181

07006402556360470442020846078019284414832820454667535171

8527512571904

18) **[300 points]** A quote has been encoded using the Morbit Cipher for you to decode. You are told that the quote has `conQ` in it corresponding to the encoded text 37814367.

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

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

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

9 7 1 4 1 7 4 7 2 9 1 1 8 1 9 1

19) [300 points] Solve this Aristocrat which is a quote by Groucho Marx.

YLXXCLUB CJ L IDHTBXPKZ CHJACAKACDH, VKA IQD ILHAJ

AD ZCEB CH LH CHJACAKACDH?

	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	9	3	10	5	1			8	3	4	4	5				1	1			1	1	1		3	1	2
Replacement																										

20) [200 points] Madison has faithfully followed the steps of the RSA key-generation algorithm. But she has forgotten the last step—how to encrypt a message. First, here are the results from the other steps:

$$\begin{aligned} \phi &= 7021728 & p &= 1297 \\ d &= 3852397 & e &= 2424133 \\ q &= 5419 & n &= 7028443 \end{aligned}$$

As it comes to pass, Haileigh is on vacation in Hawaii, and Madison needs a document that is stored in the company safe. They are communicating via email, and both know it is very unwise to trust the security of computers in a hotel lobby. Madison needs to tell Haileigh his/her public key, knowing well that it can be read by untrustworthy parties. List the minimum set of numbers that Madison needs to email to Haileigh in order for Haileigh to be able to decode the message.

Additionally, Haileigh wants to transmit the combination to the safe (which is 617) in the response email, but encrypted with RSA. What should formula should Haileigh compute in order to know the ciphertext to transmit?

Enter the minimum values to transmit:

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Enter the formula (using correct numbers) to transmit:

Throx's Codebuster Test

21) **[550 points]** Mykayla, has faithfully followed the steps of the RSA key-generation algorithm. Here are the results:

$$p = 283$$

$$q = 809$$

$$n = 228947$$

$$\phi = 227856$$

$$e = 115343$$

Unfortunately, Mykayla doesn't know how to compute the value of d , *the private key*, and needs you to do that final step for them.

Enter the computed value of d , NOT the formula.