

Boyceville Science Olympiad Invitational—Code Busters

by Prof. Gregory V. Bard

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Names of participants: (Please print neatly, using only capital letters!)

- _____
- _____
- _____
- School Name: _____
- School Id Number: _____

Warning: Do not open this packet until given permission to do so!!

Note: There are frequency tables on the back of this page.

Frequency Table of English: The following table might be useful during the event.

E	12.51%	L	4.14%	Y	1.73%
T	9.25%	D	3.99%	B	1.54%
A	8.04%	C	3.06%	V	0.99%
O	7.60%	U	2.71%	K	0.67%
I	7.26%	M	2.53%	X	0.19%
N	7.09%	F	2.30%	J	0.16%
S	6.54%	P	2.00%	Q	0.11%
R	6.12%	G	1.96%	Z	0.09%
H	5.49%	W	1.92%		

Frequency Table of Spanish: The following table might be useful during the event.

E	14.08%	T	4.60%	V	1.05%
A	12.16%	U	4.69%	G	1.00%
O	9.20%	C	3.87%	F	0.69%
S	7.20%	M	3.08%	J	0.52%
N	6.83%	P	2.89%	Z	0.47%
R	6.41%	B	1.49%	Ñ	0.17%
I	5.98%	H	1.18%	X	0.14%
L	5.24%	Q	1.11%	K	0.11%
D	4.67%	Y	1.09%	W	0.04%

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*.”

Question Two:

Hint: This message was sent by the Chinese embassy to North Korea, and was intercepted by the US Navy, operating a listening post atop the superstructure of a destroyer in the Sea of Japan. The message probably contains the phrase “North Korea” and/or “North Koreans.”

Value: 100 points

Ciphertext

OU SIWU PUIXFZ YF EUMQUWU YSIY ZFPYS AFPUIZ

IJUZYX IPU LMIZZQZJ YF AQKZIL XUWUPIM FR YSU

EUXY OQZU TIAUPX QZ RPIZHU. YSUB IPU LMIZZQZJ

YF YIAU YSUT EIHA YF ZFPYS AFPUI IZK YF RFPHU

YSUT YF UXYIEMQXS WQZUBIPKX RFP UNLFPYQZJ OQZU.

In Question Two:

Ciphertext U appears 27 times.

Ciphertext I appears 19 times.

Ciphertext Z appears 19 times.

Ciphertext Y appears 19 times.

Ciphertext F appears 15 times.

Ciphertext P appears 14 times.

Ciphertext Q appears 10 times.

Ciphertext S appears 9 times.

Ciphertext X appears 8 times.

Ciphertext A appears 6 times.

Ciphertext M appears 5 times.

Ciphertext E appears 4 times.

Ciphertext R appears 4 times.

Ciphertext J appears 4 times.

Ciphertext L appears 4 times.

Ciphertext W appears 4 times.

Ciphertext H appears 3 times.

Ciphertext K appears 3 times.

Ciphertext T appears 3 times.

Ciphertext O appears 3 times.

Ciphertext B appears 2 times.

Ciphertext N appears 1 times.

Ciphertext C appears 0 times.

Ciphertext G appears 0 times.

Ciphertext V appears 0 times.

Ciphertext D appears 0 times.

Question Three:

There is a terrorist group that has been using the Caesar cipher, also called the shift cipher. Their very short message is the name of the county where their next target is. Can you figure out what county it is?

Value: 141 points

Ciphertext

MRSZZOGK

In Question Three:

Ciphertext Z appears 2 times.
Ciphertext G appears 1 times.
Ciphertext K appears 1 times.
Ciphertext M appears 1 times.
Ciphertext O appears 1 times.
Ciphertext R appears 1 times.
Ciphertext S appears 1 times.
Ciphertext A appears 0 times.
Ciphertext B appears 0 times.
Ciphertext C appears 0 times.
Ciphertext D appears 0 times.
Ciphertext E appears 0 times.
Ciphertext F appears 0 times.
Ciphertext H appears 0 times.
Ciphertext I appears 0 times.
Ciphertext J appears 0 times.
Ciphertext L appears 0 times.
Ciphertext N appears 0 times.
Ciphertext P appears 0 times.
Ciphertext Q appears 0 times.
Ciphertext T appears 0 times.
Ciphertext U appears 0 times.
Ciphertext V appears 0 times.
Ciphertext W appears 0 times.
Ciphertext X appears 0 times.
Ciphertext Y appears 0 times.

Question Four:

Hint: The following is a list of the top ten highest paying majors for Bachelor's Degrees, in terms of starting salary. As you can see, the list is encrypted. Remember, these are all highly paying subjects to major in. You might also notice that the last word is the same in each case.

Note: The rules normally ask that you decipher two full sentences, with a total of 0, 1, or 2 mistakes, to get a question's points. For this one, you should get a majority of the majors (6 out of the 10) with 0, 1, or 2 mistakes.

Value: 282 points

Ciphertext

1. OLSIRQLKD LPCBPLLIBPC
2. OTZVBFBHP HVVBVSHPS VSKNBLV
3. FRDOKSLI VFBLPFL HPN LPCBPLLIBPC
4. DBPBPC LPCBPLLIBPC
5. FTLDBFHQ LPCBPLLIBPC
6. FRDOKSLI LPCBPLLIBPC
7. PKFQLHI LPCBPLLIBPC
8. LQLFSIBFHQ HPN FRDOKSLI LPCBPLLIBPC
9. LQLFSIRPBFV HPN FRDDKPBFHSBRPV LPCBPLLIBPC
10. LQLFSIBFHQ LPCBPLLIBPC

In Question Four:

Ciphertext L appears 43 times.

Ciphertext P appears 39 times.

Ciphertext B appears 31 times.

Ciphertext C appears 19 times.

Ciphertext F appears 17 times.

Ciphertext I appears 17 times.

Ciphertext H appears 11 times.

Ciphertext S appears 11 times.

Ciphertext V appears 9 times.

Ciphertext Q appears 8 times.

Ciphertext D appears 8 times.

Ciphertext R appears 7 times.

Ciphertext K appears 7 times.

Ciphertext O appears 5 times.

Ciphertext N appears 4 times.

Ciphertext T appears 2 times.

Ciphertext Z appears 1 times.

Ciphertext X appears 0 times.

Ciphertext M appears 0 times.

Ciphertext W appears 0 times.

Ciphertext E appears 0 times.

Ciphertext U appears 0 times.

Ciphertext Y appears 0 times.

Ciphertext A appears 0 times.

Ciphertext J appears 0 times.

Ciphertext G appears 0 times.

Question Five:

Someone is using an affine cipher, based on the following encryption function

$$c \equiv f(p) \equiv 17p + 19 \pmod{26}$$

Now find for me the ciphertext associated with the plaintext "MONTANA."

Please use the following alphabet mapping:

$$\left\{ \begin{array}{lllllll} a = 01 & b = 02 & c = 03 & d = 04 & e = 05 & f = 06 & g = 07 \\ h = 08 & i = 09 & j = 10 & k = 11 & \ell = 12 & m = 13 & n = 14 \\ o = 15 & p = 16 & q = 17 & r = 18 & s = 19 & t = 20 & u = 21 \\ v = 22 & w = 23 & x = 24 & y = 25 & z = 0 & & \end{array} \right.$$

For ease of grading, please put a box around your final answer.

Hint: Your ciphertext should be composed of letters, not numbers.

Value: 400 points

This page has been intentionally left blank, and can serve as scratch work for Question Five or any other question.

Question Six:

Hint: This message is a from a CIA group resident in the Russian embassy, sent back to headquarters. Therefore, it is likely that it begins with “to headquarters:”

Note: The punctuation has been removed. However, the message is only two sentences, so you have to decode the whole thing to get points.

Value: 565 points

Ciphertext

M I S P J D K A J Z M P Z V H P N A V M X N Y Z

I Q P M S P S P J T M S Z P K A X Z P N P B M V

G I Z V P F Z P M J L P B M V X B F T A D X B L

J T T P Z L X P V I B P B P H J L P B M N J B J

L P D M I F T X N O M S Z I A L S M S P V P H P

Z V M S P O J V P N P B M J B D M S P J X Z D A

F M V I G J Z A V V X J B Y Z X V I B J B D H J

V F J A L S M O P F J A V P S P S J D J V B P P

E X B L G X M

In Question Six:

Ciphertext P appears 30 times.

Ciphertext J appears 19 times.

Ciphertext M appears 18 times.

Ciphertext V appears 16 times.

Ciphertext B appears 15 times.

Ciphertext Z appears 13 times.

Ciphertext S appears 12 times.

Ciphertext X appears 11 times.

Ciphertext A appears 9 times.

Ciphertext L appears 8 times.

Ciphertext I appears 8 times.

Ciphertext D appears 7 times.

Ciphertext F appears 6 times.

Ciphertext N appears 6 times.

Ciphertext T appears 5 times.

Ciphertext H appears 4 times.

Ciphertext O appears 3 times.

Ciphertext G appears 3 times.

Ciphertext Y appears 2 times.

Ciphertext K appears 2 times.

Ciphertext Q appears 1 times.

Ciphertext E appears 1 times.

Ciphertext W appears 0 times.

Ciphertext R appears 0 times.

Ciphertext U appears 0 times.

Ciphertext C appears 0 times.

Question Seven:

We return to Question Five.

The ciphertext “JMPSNWJ” was intercepted. What is the associated plaintext that encodes into this plaintext?

Hint: If you think you can solve Question Nine, then you should probably do that first, and return to this one. If you think that you cannot solve Question Nine, then rest assured that you can still puzzle this one out anyway, if you got Question Five.

Value: 800 points

This page has been intentionally left blank, and can serve as scratch work for Question Seven or any other question.

Question Eight:

Sorry, there is no hint for this one. Good luck!

Value: 1131 points

Ciphertext:

YDTX VMDXP BEG VPUPE HPBXV BND DTX YBZFPXV

AXDTNFZ YDXZF DE ZFWV MDEZWEPEZ B EPQ EBZWDE,

MDEMPWUPG WE OWAPXZH, BEG GPGWMBZPG ZD ZFP

JXDJDVWZWDE ZFBZ BOO RPE BXP MXPBZPG PSTBO. EDQ

QP BXP PENBNPG WE B NXPBZ MWUWO QBX, ZPVZWEN

QFPZFPX ZFBZ EBZWDE, DX BEH EBZWDE VD MDEMPWUPG

BEG VD GPGWMBZPG, MBE ODEN PEGTXP. QP BXP RPZ

DE B NXPBZ ABZZOPYWPOG DY ZFBZ QBX.

In Question Eight:

Ciphertext P appears 38 times.

Ciphertext B appears 31 times.

Ciphertext Z appears 30 times.

Ciphertext E appears 29 times.

Ciphertext D appears 24 times.

Ciphertext X appears 20 times.

Ciphertext W appears 18 times.

Ciphertext G appears 15 times.

Ciphertext M appears 11 times.

Ciphertext F appears 10 times.

Ciphertext V appears 9 times.

Ciphertext N appears 8 times.

Ciphertext O appears 8 times.

Ciphertext Q appears 7 times.

Ciphertext Y appears 5 times.

Ciphertext T appears 5 times.

Ciphertext U appears 4 times.

Ciphertext A appears 3 times.

Ciphertext H appears 3 times.

Ciphertext R appears 2 times.

Ciphertext J appears 2 times.

Ciphertext S appears 1 times.

Ciphertext L appears 0 times.

Ciphertext C appears 0 times.

Ciphertext I appears 0 times.

Ciphertext K appears 0 times.

Question Nine:

Compute the decryption function associated with the encryption function of Question Five.

Please write your answer in the form

$$d(c) = p = \#c + \# \text{ mod } \#$$

where the # symbols are replaced by actual numbers.

For ease of grading, please put a box around your final answer.

Value: 1600 points

This page has been intentionally left blank, and can serve as scratch work for Question Nine or any other question.

Question Ten:

Hint: This message has been sent to a minor diplomat of Venezuela, who has just been promoted to be the consul of Venezuelan consulate to Argentina in Corrientes. Accordingly, he wired for information about Corrientes, Argentina. One might imagine that the words “Corrientes” and “Argentina” will be found somewhere in the message.

Value: 2262 points

Ciphertext: EJFFSRQHRN RN IO ESPGOG BON OQHSLPO GRI

QJFGRNHR GR OFLRQHSQO, A RN IO EODSHOI GR IO

DFJCSQESO EJFFSRQHRN. RNHO ESPGOG GR 428 OTJN

RNHO NSHPOGO O JFSIION GRI FSJ DOFOQO, GSNHOQHR

50 WB OLPON OXOZJ GR IO EJQKIPRQESO EJQ RI FSJ

DOFOLPOA. ESPGOG OGBSQSNHFOHSCO, RGSISESO,

PQSCRFNSHOFSSO A NOQSHOFSSO, EJQ LFOQ OPLR RQ RI

HPFSNBJ DJF NPN OHFOEHSCJN QOHPFOIRN A EPIHPFOIRN.

In Question Ten:

Ciphertext O appears 50 times.

Ciphertext S appears 29 times.

Ciphertext R appears 27 times.

Ciphertext F appears 22 times.

Ciphertext N appears 22 times.

Ciphertext H appears 20 times.

Ciphertext Q appears 19 times.

Ciphertext G appears 17 times.

Ciphertext I appears 16 times.

Ciphertext J appears 15 times.

Ciphertext P appears 15 times.

Ciphertext E appears 14 times.

Ciphertext L appears 6 times.

Ciphertext D appears 5 times.

Ciphertext B appears 4 times.

Ciphertext C appears 4 times.

Ciphertext A appears 4 times.

Ciphertext X appears 1 times.

Ciphertext K appears 1 times.

Ciphertext Z appears 1 times.

Ciphertext W appears 1 times.

Ciphertext T appears 1 times.

Ciphertext U appears 0 times.

Ciphertext M appears 0 times.

Ciphertext Y appears 0 times.

Ciphertext V appears 0 times.

Question One: TIMED QUESTION

This is the timed question, and a bonus will be given. Furthermore, the plaintext is a telegram. That means that it is composed only of letters, with no symbols. Numerals (if any) have to be spelled out, and take up a lot of space. Divisions between sentences are marked with the word "STOP," which might therefore occur frequently. The message will end with "END OF MESSAGE."

IMPORTANT: Please write the name of your school and your school ID number on this page.

Value: 200 points PLUS timing bonus!

Ciphertext

QIAA ZAA QDZUIQ VB KLAGZSTII

UICVUOLPE CVUJVUZHLVP QHVJ

GI DZYI DIZUO ZOYZPCIO CVJLIQ VB

HDILU PIGIQH QLPEIU GDV LQ

ZFXQKZA QHVJ QVSPOQ ALTI Z OSCT

JAZXLPE HDI FZEJLJIQ GDLAI FILPE

USP VYIU FX Z QHIZKUVAAIU IPO VB

KIQQZEI

In Question One:

Ciphertext I appears 25 times.

Ciphertext Z appears 16 times.

Ciphertext Q appears 16 times.

Ciphertext V appears 14 times.

Ciphertext L appears 12 times.

Ciphertext U appears 12 times.

Ciphertext A appears 11 times.

Ciphertext P appears 10 times.

Ciphertext O appears 7 times.

Ciphertext D appears 7 times.

Ciphertext J appears 7 times.

Ciphertext H appears 7 times.

Ciphertext E appears 6 times.

Ciphertext C appears 5 times.

Ciphertext G appears 5 times.

Ciphertext F appears 4 times.

Ciphertext K appears 4 times.

Ciphertext S appears 4 times.

Ciphertext B appears 3 times.

Ciphertext T appears 3 times.

Ciphertext Y appears 3 times.

Ciphertext X appears 3 times.

Ciphertext N appears 0 times.

Ciphertext M appears 0 times.

Ciphertext W appears 0 times.

Ciphertext R appears 0 times.