

North Carolina Science Olympiad — Code Busters Test 3

2016-2017

Exam Preparation

You will need:

1. Folders for each of the teams to hold the tests
2. Sufficient copies of the test for all teams. They don't need to be stapled.
3. Multiple timers which have a lap function on them - ideally one per volunteer. The timer app on an iPhone or Android Phone that has a stopwatch function with lap function is sufficient.

Before the event begins:

1. Practice starting the timers and using the lap function to record the times. Make sure volunteers understand how to use the lap function and are not accidentally stopping the timer completely.
2. Memorize the answer to the timed question.
3. Check to make sure that this key matches the test you are proctoring.
4. Place one copy of the test for each team in the provided folders with the first page outside the folder.
5. Adjust desks and chairs – teams may have up to 3 students for this event.

Running the Event

1. When the students enter the room, instruct them to sit down, **DO NOT OPEN THE FOLDER**, and put their names, school name and school number on the first page.
2. Encourage them to write their team number on all the other pages **AFTER** they begin the test. This way if their papers gets separated from each other we can make sure to give them credit.
3. **CRITICAL:** Check to see that students have **ONLY** brought
 - i. Something to write with (pencils, pens, erasers)
 - ii. Five function calculators (addition, subtraction, multiplication, division, and usually square root). The calculator can have a simple memory store/recall function but must not have a modulus or other scientific and programmable functions. If their calculator doesn't meet these requirements, they may not use it.
 - iii. If there are spare calculators in the kit, you may loan up to one per team to use for the test.
4. Instruct the students that if they answer the timed question within 10 minutes, they can be awarded a bonus.
 - i. When they have a solution for the cryptogram they should raise their hand.
 - ii. Let them know that you will announce when the 10-minute time is up. After the first 10 minutes, no additional bonus points will be awarded.
 - iii. When you see a team raise their hand, hit the LAP function and head to the team.
 - iv. Determine if their answer is correct (see next page for grading), If so, write the time on their score sheet.
 - v. If their score is incorrect, tell the team that the answer is wrong, but **DO NOT** tell them what is wrong. They can continue to work on the question and raise their hand again to be checked. A team has an unlimited number of attempts during the 10-minute bonus.
5. Tell the teams that they do not have to fill in the frequency table. It is simply there as an aid to them solving the cryptogram. It will not be graded.
6. Some students may never have used a non-scientific calculator. You should have them enter a simple formula on their calculator: $1 / 26 = * 26 = ..$ Most will be surprised to see that the answer is not rounded to 1 as they expected but .9999999999
7. When the timers hit the 10-minute point, announce that no bonus points will be awarded and put away the timers. The students may continue to work on the question, but they may not receive any extra points.

- A team is not restricted to only the timed question during the 10 minutes. They can move on or split up the work if they would like, but it is in their best interest to try for the bonus.
- When time is up, have the students put writing instruments down and put their answer pages back into the folder in the correct order.

How to grade

- Teams can have up to two incorrect letters total on their cryptogram and still be correct. The frequency of the incorrect letter is irrelevant. See the example below.

If the cryptogram was as shown:

KZBAOF KFXMFXFYF

SAMPLE SENTENCE

and the students answered (underlined letters indicate mistakes)

SAMPLE SFNTFNCF

then it counts as four mistakes (even though the mistake was only in the letter E) and the answer DOES NOT count.

However, if they put

SAMPUL SENTENCE

It is considered correct with two letter mistakes.

- For questions which have a numeric answer (such as determining the a= and b= values), no mistakes are allowed.
- Teams do NOT have to fill in the frequency table. It is simply there as an aid to them solving the cryptogram. It WILL NOT be graded. It is included in the answer key as an aid to the grader.
- When scoring the Dancing Man ciphers (with text like $\times \uparrow \uparrow \uparrow \uparrow$), they can write the answer under the Dancing Man symbols or on the line provided.
- As you score each question, if correct, put the number of incorrect letters (0, 1, or 2) next to the question number on the scoring page. Also, put the value for the question into the score column. There is no partial credit for wrong answers, but the number of wrong letters does come in use when breaking a tie.
- If they correctly answered the timed question in 10-minutes or less, you need to compute the bonus time.

Take the value for the minute from this first table below

0:xx	1,620	1:xx	1,440	2:xx	1,260	3:xx	1,080	4:xx	900
5:xx	720	6:xx	540	7:xx	360	8:xx	180	9:xx	0

and then add the seconds value from this table:

X:00	180	X:01	177	X:02	174	X:03	171	X:04	168	X:05	165
X:06	162	X:07	159	X:08	156	X:09	153	X:10	150	X:11	147
X:12	144	X:13	141	X:14	138	X:15	135	X:16	132	X:17	129
X:18	126	X:19	123	X:20	120	X:21	117	X:22	114	X:23	111
X:24	108	X:25	105	X:26	102	X:27	99	X:28	96	X:29	93
X:30	90	X:31	87	X:32	84	X:33	81	X:34	78	X:35	75
X:36	72	X:37	69	X:38	66	X:39	63	X:40	60	X:41	57
X:42	54	X:43	51	X:44	48	X:45	45	X:46	42	X:47	39
X:48	36	X:49	33	X:50	30	X:51	27	X:52	24	X:53	21
X:54	18	X:55	15	X:56	12	X:57	9	X:58	6	X:59	3

For example if they solved the time question at the 6:46 mark, you would add 540 (from the 6:xx entry in the first table) to 42 (from the X:46 entry in the second table) to get a bonus of 582. If they had solved it in exactly 4:00 minutes, you would add 900 and 180 to get a bonus of 1080.

- Add up all the scores and put the total on the bottom of score sheet.
- If there is a tie, you have to break the tie. You indicate the tie breaker by adding .1 to the score of the team ahead. With multiple teams tied, you will add more. I.e. if five teams all scored 200 points, the final scores that you would enter on the score sheet would be 200.4, 200.3, 200.2, 200.1 and 200.

9. To determine how to break the tie, you need to look at the correctly answered questions in the order from the table below. If both teams answered the same (i.e. they answered the question with zero mistakes) then you go on to the next question. If one team had no mistakes and the other team had one mistake then the team with no mistakes is ahead. For example if one team answered question #18 (which is the highest value question) and another team didn't, the first team will be ahead.

Tie Breaker Order	Question #
1	15
2	3
3	9
4	17
5	16
6	2
7	18
8	13
9	1
10	10
11	14
12	Timed Question
13	12
14	8
15	7
16	5
17	4
18	11
19	6

10. If there is still a tie (typically when you have teams which answered either zero, one or two questions) then you will need to look at the tie breaker questions again and count the number of correctly answered letters. The team with the most correctly matched letters is to be ahead.

Timed question [100 Points]: Solve this Cryptogram which is a quote by Aaron Machado. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

**HYU SCQBSEQLP TLSUEVZ S YQV QZ Q RSV VLJIIUV CU
 THE IMAGINARY FRIENDS I HAD AS A KID DROPPED ME**

**FUXQMZU HYUSL TLSUEVZ HYJMBYH S VSVE'H UKSZH.
 BECAUSE THEIR FRIENDS THOUGHT I DIDN'T EXIST.**

	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
Freq		2	2		4	1		6	2	2	1	5	2			1	6	1	10	2	9	8		1	5	5
		G	M		N	B		T	P	O	X	R	U			Y	A	K	I	F	E	D		C	H	S

1) [160 Points] Another message encrypted with the Affine Cipher using an alphabet of 26 characters has been intercepted. You have been told that the last two characters of the message are the letters **OX**. With that knowledge, what does this message say?

K	M	T	F	T	H	B	V	B	Y	K	M	T	G	T	E	A	N	S
T	H	E	K	E	Y	I	S	I	N	T	H	E	R	E	D	B	O	X

2) [250 Points] Solve this Spanish Cryptogram which is a quote by Benjamin Disraeli.

PO TQDXTQO DA MOWO DP VCXKJ VJKDWXJ PJ LCD
 LA CIENCIA ES PARA EL MUNDO MODERNO LO QUE

DP OWGD BCD MOWO DP OXGQFCJ.
 EL ARTE FUE PARA EL ANTIGUO

	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
Freq	1	1	4	9		1	2			5	2	1	2			8	5	3			2		2	4	4		
	S	F	U	E		G	T			O	D	Q	P			A	L	I			C		M	R	N		

3) [400 Points] Solve this Patristocrat.

AUVMD IUEUU NVIBD RRAUV HMDHE UUNHR RCRXH IXHIN CGAUV
 YOURE NOGOO DUNLE SSYOU AREAG OODAS SISTA NTAND IFYOU

HMDAU VMDXU UEUUN XUSDH IHRRC RXHIX.

AREYO URETO OGOOD TOBEA NASSI STANT.

	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
Freq	4	1	3	6	3		1	9	6				4	4				8	1		14	5		6		
	Y	L	I	E	G		F	A	N				R	D				S	B		O	U		T		

4) [100 Points] Encode the string PRIVATEDETECTIVEAGENCY using the Affine Cipher with $a=7$ and $b=9$.

P	R	I	V	A	T	E	D	E	T	E	C	T	I	V	E	A	G	E	N	C	Y
K	Y	N	A	J	M	L	E	L	M	L	X	M	N	A	L	J	Z	L	W	X	V

5) [100 Points] Using a key of **FIXT** encode the string **QUIZMASTERS** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} F & I \\ X & T \end{pmatrix} \equiv \begin{pmatrix} 5 & 8 \\ 23 & 19 \end{pmatrix}$$

Q	U	I	Z	M	A	S	T	E	R	S	
G	U	G	J	I	Q	I	V	A	Z	E	F

6) [50 Points] Using a code word of **THINK**, encode the following quote from Stephen Hawking using the Vigenère cipher.

I	N	T	E	L	L	I	G	E	N	C	E	I	S	T	H	E
B	U	B	R	V	E	P	O	R	X	V	L	Q	F	D	A	L

A	B	I	L	I	T	Y	T	O	A	D	A	P	T	T	O	C	H	A	N	G	E
I	O	S	E	P	B	L	D	H	H	L	N	Z	M	A	W	P	R	T	U	O	R

7) [100 Points] Solve this Cryptogram which is a quote by Wayne Heizenga and where the last word is HAPPEN.

DAES XSAXHS PJSCE AQ DWNNSDD, ITYHS AGTSJ

SOME PEOPLE DREAM OF SUCCESS, WHILE OTHER

XSAXHS VSG WX SOSJM EAJRYRV CRP ECBS YG TCXXSR.

PEOPLE GET UP EVERY MORNING AND MAKE IT HAPPEN.

	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
Freq	6	1	4	4	4		3	3	1	4			1	2	1	2	1	4	14	3		2	2	7	3	
	O	K	A	S	M		T	L	W	R			Y	C	V	D	F	N	E	H		G	U	P	I	

8) [100 Points] Napoleon Bonaparte once said this about a the value of treasures. It has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the 36th through the 43rd letters in the code (ORPUWPRP) actually is the word TREASURE. What does the message decode to?

M	I	N	B	I	N	D	Z	H	S	O	C	Z	H	W	D	S	E	C	R	O	H	P	J	S
R	I	C	H	E	S	D	O	N	O	T	C	O	N	S	I	S	T	I	N	T	H	E	P	O

N	S	P	M	W	D	O	Y	I	J	O	R	P	U	W	P	R	P	M	F	P	T	T	H	X
S	S	E	S	S	I	O	N	O	F	T	R	E	A	S	U	R	E	S	B	U	T	I	N	T

C	E	F	M	I	H	A	O	Y	S	A	T	S	Y	Q
H	E	U	S	E	M	A	D	E	O	F	T	H	E	M

9) [300 Points] Solve this Cryptogram which is a quote by Thomas Edison.

LJWKVNW! OCX, QZI, Y CZDJ HFNNJI Z VFN FA LJWKVNW. Y
RESULTS! WHY, MAN, I HAVE GOTTEN A LOT OF RESULTS. I

MIFO WJDJLZV NCFKWZIE NCYIHW NCZN OFI'N OFLM.
KNOW SEVERAL THOUSAND THINGS THAT WON'T WORK.

	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
Freq	1		5	2	1	7		2	6	6	3	4	2	10	4		1					4	7	1	3	6
	F		H	V	D	O		G	N	E	U	R	K	T	W		M					L	S	Y	I	A

10) [140 Points] Solve this Cryptogram which is a quote by Bernie Siegel, M.D. The word YOU appears twice.

BG JLR KQWTC CLK FQWRZU EUQVM KBWC QEPUZMBWJ,
IF YOU WATCH HOW NATURE DEALS WITH ADVERSITY,

TLFWBFRQVVJ ZUFUKBFD BWMUVG,
CONTINUALLY RENEWING ITSELF,

JLR TQF'W CUVX YRW VUQZF.
YOU CAN'T HELP BUT LEARN.

	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
Freq		6	4	1	2	7	2			4	4	4	3			1	7	5		3	8	6	8	1	1	4
		I	H	G	D	N	F			Y	W	O	S			V	A	U		C	E	L	T	L	B	R

11) [60 Points] You know that a message has been encrypted using the Affine Cipher with an alphabet of 26 characters. You have discovered that the message **GCUPCX** decodes to say **SECRET**. What are the values of a and b in the function $ax + b$ that were used to encode the message?

$a =$ 17 $b =$ 12

12) [100 Points] Your teacher laughs whenever they look at this sign on the wall. What does it say?



DO NOT EAT THIS SIGN

13) [180 Points] Solve this Patristocrat which quotes George Santayana It starts with **THE DISEASES**.

**MFRYC AROAR ANFCG FYRAM XIVOT OHOXR HIWRA AHOMZ XOWMF
 THEDI SEASE SWHIC HDEST ROYAM ANARE NOLES SNATU RALTH**

OHMFR CHAMC HGMAN FCGFK XRARX ERFCT.

ANTHE INSTI NCTSW HICHP RESER VEHIM.

	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
Freq	9		6		1	8	3	6	2		1		7	2	7			10		2		1	2	5	2	1
	S		I		V	H	C	N	O		P		T	W	A			E		M		Y	L	R	D	U

14) [125 Points] Using a key of **WHODIDITZ** encode the string **ALGEBRAICALLY** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} W & H & O \\ D & I & D \\ I & T & Z \end{pmatrix} \equiv \begin{pmatrix} 22 & 7 & 20 \\ 3 & 8 & 3 \\ 8 & 19 & 25 \end{pmatrix}$$

A	L	G	E	B	R	A	I	C	A	L	L	Y		
P	C	V	T	T	I	S	S	U	L	R	Q	H	J	S

15) [400 Points] Your phone badly misheard this quote from engineer and astronaut Buzz Aldrin but got a few words wrong before encrypting it. What does it say?

EM MXGVXBV IPX WUC DX MKEJV JEKMCUVM EBZ DIQJV UEBZVZ
AS SOMEONE WHO FLU TO SPACE CAPSULES AND TWICE LANDED

QBB DPV XJVEB, VAV JEB EDDVMD WOYG KVOMXBEU VSKVOQVBJV
INN THE OCEAN, EYE CAN ATTEST FROM PERSONAL EXPERIENCE

PXI GCJP UXYQMDQJM IXON QM BVVZVZ DIX YVD VIV PXGV
HOW MUCH LOGISTICS WORK IS NEEDED TWO GET EWE HOME.

	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
Freq	1	10	3	9	9		4		6	8	4		10	1	4	5	6		1		5	23	2	12	2	5
	Y	N	U	T	A		M		W	C	P		S	K	R	H	I		X		L	E	F	O	G	D

16) [250 Points] Solve this Patristocrat containing a quote by Dean Koontz. In it, you will find the word BELIEVE appear twice.

HWSIH STSHX BJSZD NNHWH IHBPZ ARHEK FISNW VBRZE
IBELI EVEIN THEPO SSIBI LITYO FMIRA CLESB UTMOR

SBZBJ SDZHX BHWSI HSTSH XZVEX SSCAZ EBJSR
ETOTH EPOIN TIBEL IEVEI NOURN EEDFO RTHEM

	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
Freq	2	7	1	2	4	1		11	4	3	1			3		1		3	13	2		2	4	4		7
	F	T	D	P	R	C		I	L	H	A			S		Y		M	E	V		U	B	N		O

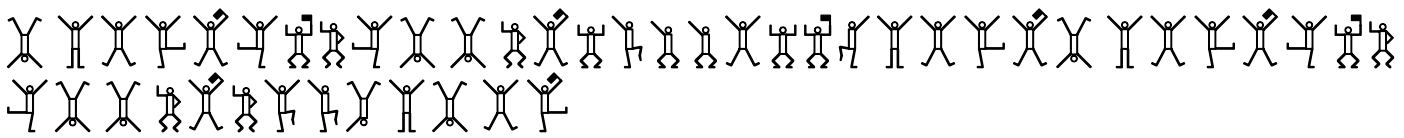
17) [250 Points] Solve this Cryptogram which is quote by Sean Stewart.

DUS RBSKSPD XK G BVRS KDBSDNUSJ VQSB DUS RGKD. DUS
 THE PRESENT IS A ROPE STRETCHED OVER THE PAST. THE

KSNBSD DV IGWAXPY XD XK, EVC PSQSB WVVA JVIP.
 SECRET TO WALKING IT IS, YOU NEVER LOOK DOWN.

	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
Freq	2	6	1	10	1		3		2	2	6			2		4	2	3	13		4	7	2	4	1	
	K	R	U	T	Y		A		W	D	S			C		N	V	P	E		H	O	L	I	G	

18) [180 Points] Andrew Carnegie once said this. What was it?



THERE IS LITTLE SUCCESS WHERE THERE IS LITTLE LAUGHTER