

North Carolina Science Olympiad — Code Busters Test 2

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** you start so that if it gets separated from the other pages 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 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	17
2	3
3	8
4	4
5	16
6	6
7	15
8	12
9	18
10	5
11	7
12	Timed Question
13	2
14	1
15	9
16	13
17	10
18	11
19	14

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 Stephen Colbert. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

RA IWXIDW DWHTO EXCWQSROL HVXFQ QSW OWYE VM YHQPSROL
 IF PEOPLE LEARN SOMETHING ABOUT THE NEWS BY WATCHING

QSW ESXY, QSHQ RE ROPRJWOQHD QX CM LXHD.
 THE SHOW, THAT IS INCIDENTAL TO MY GOAL.

	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		2	4	4	1		6	2	1		3	2		6	2	9	6	6	1		2	8	6	3	
	F		M	L	S	U		A	P	D		G	Y		N	C	T	I	H	R		B	E	O	W	

1) [100 Points] Using a key of **HPRS** encode the string **HOVERCRAFT** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} H & P \\ R & S \end{pmatrix} \equiv \begin{pmatrix} 7 & 15 \\ 17 & 18 \end{pmatrix}$$

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

2) [100 Points] Advice about a treasure has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the first 8 letters in the code (**LKSRQMK**) actually is the word **TREASURE**. What does the message decode to?

LKSRQ MKSKF WMVZL YLOSM MMMFS LAOKK SDSPM MWWWD
TREAS URETH ETHIN GSABO UTYOU THATM AKEYO UDIFF

WKSER SGRL L AJIV
ERENT ANDUN IQUE

Answer:

TREASURE THE THINGS ABOUT YOU THAT MAKE YOU DIFFERENT AND UNIQUE

3) [400 Points] Solve this Patristocrat of a quote by David Williams.

NAMJX APJRL ASXIT VFTAZ VWAVW AJXPF URUAB AUUIM
 BEFOR EYOUV EPRAC Ticed THETH EORYI SUSEL ESSAF

VAXPJ RLASX ITVFT AZVWA VWAJX PFUJN LFJRU
 TERYO UVEPR ACTIC EDTHE THEOR YISOB VIOUS

	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	13	1			5				3	7		3	2	2		4		4	2	4	6	7	4	6		2
	E	L			I				A	O		V	F	B		Y		U	P	C	S	T	H	R		D

BEFORE YOU'VE PRACTICED THE THEORY IS USELESS. AF TER YOU'VE PRACTICED THE
 THEORY IS OBVIOUS.

4) [250 Points] Solve this Patristocrat containing a quote by Winston Churchill. In it, you will find the word FIVE once and THE twice.

RLIFI ZRPXJ OSIQR PJPVQ ZRKIS AUXPU MVZPN VCISV
 THEBE STARG UMENT AGAIN STDEM OCRAC YISAF IVEMI

QORIU AQCIX ZPRVA QGVRL RLIPC IXPJI CARIX
 NUTEC ONVER SATIO NWITH THEAV ERAGE VOTER

	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		4			1	1		11	3	1	3	1	1	2	8	5	9	3		3	6		5		4
	O		V			B	W		E	G	D	H	Y	F	U	A	N	T	M		C	I		R		S

THE BEST ARGUMENT AGAINST DEMOCRACY IS A FIVE MI NUTE CONVERSATION WITH THE
 AVERAGE VOTER

5) [140 Points] Solve this Cryptogram which is a quote by Grace Murray Hopper who is known her approach to innovation.

AP AD'Q N ZIIG AGMN, ZI NTMNG NRG GI AD. AD'Q CKWT
 IF IT'S A GOOD IDEA, GO AHEAD AND DO IT. IT'S MUCH

MNQAMX DI NJIBIZAHM DTNR AD AQ DI ZMD JMXCAQQAIR.
 EASIER TO APOLOGIZE THAN IT IS TO GET PERMISSION.

	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	11	1	2	8			5	1	9	2	1		7	8		1	6	3		3			1	2		4
	I	L	M	T			D	Z	O	P	U		E	A		F	S	N		H			C	R		G

IF IT'S A GOOD IDEA, GO AHEAD AND DO IT. IT'S MUCH EASIER TO APOLOGIZE THAN IT IS TO GET PERMISSION.

6) [250 Points] Solve this Unattributed Cryptogram about helping others.

MJ BOCJ CT BOIJ ATZJ YJTYSJ VRIJ DA OKIRQJ WJQODAJ
 WE HATE TO HAVE SOME PEOPLE GIVE US ADVICE BECAUSE

MJ LFTM BTM WOKSH CBJH FJJK RC CBJZAJSIJA.
 WE KNOW HOW BADLY THEY NEED IT THEMSELVES.

	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	5	5	5	2		2		2	4	17	3	1	4		5		2	3	3	5		1	2		2	2
	S	H	T	U		N	D	Y	V	E	D	K	W		A		C	I	L	O		G	B		P	M

WE HATE TO HAVE SOME PEOPLE GIVE US ADVICE BECAUSE WE KNOW HOW BADLY THEY NEED IT THEMSELVES.

7) [125 Points] Using a key of **CDEFGHIAD** encode the string **WRITEITDOIT** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} C & D & E \\ F & G & H \\ I & A & D \end{pmatrix} \equiv \begin{pmatrix} 2 & 3 & 4 \\ 5 & 6 & 7 \\ 8 & 0 & 3 \end{pmatrix}$$

W	R	I	T	E	I	T	D	O	I	T	
X	I	S	E	T	U	Z	D	M	R	R	J

8) [300 Points] Solve this Cryptogram by Paul Valery comparing us to something.

PNNZO QVXL EQL OVWL LSLWALO VO KLNKTL - MACL,
BOOKS HAVE THE SAME ENEMIES AS PEOPLE - FIRE,

QIWABAEJ, VSAWTO, GLVEQLC, VSB EQLAC NGS RNSELS.
HUMIDITY, ANIMALS, WEATHER, AND THEIR OWN CONTENT.

	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	2	3		6		2		1	1	2	13	1	5	5	1	5	1	6	2		7	4	1		1
	I	D	R		T		W		U	Y	P	E	F	O	S	B	H	C	N	L		A	M	V		K

9) [100 Points] You encountered this message from Sir Arthur Conan Doyle on the wall. What does it say?



IF NOT US WHO IF NOT NOW WHEN

Answer: _____

10) [100 Points] Solve this Cryptogram which is a quote by Franklin D. Roosevelt where the word **THAT** appears multiple times.

**QUQBD PST KSR S BVFKO OE ZVHQ. OKSO PQSTR OKSO KQ
EVERY MAN HAS A RIGHT TO LIFE. THAT MEANS THAT HE**

**SZRE KSR S BVFKO OE PSXQ S YEPHEBOSGZQ ZVUVTF.
ALSO HAS A RIGHT TO MADE A COMFORTABLE LIVING.**

	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	5	3	1	2			7				9	4	7	4	12	3	2	5		1	1	4
		R		Y	O	G	B	F			H				T	M	E	S	A	N	V	I		D	C	L

EVERY MAN HAS A RIGHT TO LIFE. THAT MEANS THAT HE ALSO HAS A RIGHT TO MADE A COMFORTABLE LIVING

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 **GDKHX** decodes to say **LARGE**. What are the values of a and b in the function $ax + b$ that were used to encode the message?

$a =$ 5 $b =$ 3

12) [180 Points] Solve this cipher by Sainte-Beave which talks about getting older. The first word is **THERE** and the last word is **AGE**.

LYWJW UJWDW PDRWS YPNWS ULXYN LPDNU LUXWJ LUMOY
THERE AREPE OPLEW HOSEW ATCHS TOPSA TACER TAINH

PFJUO GSYPJ WTUMO DWJTU OWOLR VULLY ULUZW.
OURAN DWHOR EMAIN PERMA NENTL YATTH ATAGE.

	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	1			6		9	2	3	5	5		2	3	2	11	1	11	2	6	1
				P		U	D			R		T	I	S	N	O		L	W	M	A	Y	E	C	H	G

THERE ARE PEOPLE WHOSE WATCH STOPS AT A CERTAIN HOUR AND WHO REMAIN PERMANENTLY AT THAT AGE.

13) [100 Points] Encode the string **NOTALLHOWANDERARELOST** using the Affine Cipher with $a=7$ and $b=11$.

N	O	T	A	L	L	W	H	O	W	A	N	D	E	R	A	R	E	L	O	S	T
Y	F	O	L	K	K	J	I	F	J	L	Y	G	N	A	L	A	N	K	F	H	O

14) [50 Points] Using a code word of **PONDER**, encode the following phrase by Mitch Hedberg using the Vigenère cipher.

MY FAKE PLANTS DIED BECAUSE I DID NOT PRETEND TO WATER THEM
BM SDOV EZNQXJ SWRG FVROHVI Z SWQ QSK EFRWIES HB ZEKTF GKID

Answer:

15) [180 Points] A sign in the local MakerSpace curiously has the following written on it. What does it say?



EVERYTHING IS THEORETICALLY IMPOSSIB



LE UNTIL IT IS DONE

Answer:

EVERYTHING IS THEORETICALLY IMPOSSIBLE UNTIL IT IS DONE

16) [250 Points] Solve this Spanish Cryptogram about Love.

**QL HWHKY QHORH VVLPHM H VH VYJBMH; F LOY H VY
HE AMADO HASTA LLEGAR A LA LOCURA; Y ESO A LO**

**ABL VVHWHX VYJBMH, ZMH WS LO VH BXSJH NYMWH
QUE LLAMAN LOCURA, PARA MI ES LA UNICA FORMA**

**OLXOHRH KL HWHM. -- NMHXJYSOL OPHX
SENSATA DE AMAR. -- FRANCOISE SAGAN**

	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	4				1		24		4	2	8	7	2		7	2	2	2	3			9	5	5	7	1
	Q	U				Y		A		C	D	E	R	F		S	G	H	T	I			L	M	N	O	P

**He amado hasta llegar a la locura; y eso a lo que llaman locura, para mi es la unica forma sensata de amar. --
Francoise Sagan**

Translation: I have loved to the point of madness; And what they call madness, to me, is the only sensible way to love. -- Françoise Sagan

17) [400 Points] Someone used voice dictation to quote a phrase by Stephen Hawking on their phone and then had it encrypted. What does it say?

J MRGJRDR ZGJRE GJWR JQ SOJHR NPAAPE JE HIR OEJDRFQR,
I BELIEVE ALIEN LIFE IS QUITE COMMON IN THE UNIVERSE,

ZGHIPOCI JEHRGGJCREH GJWR JQ GRQQ QRY. QOA QZX JH
ALTHOUGH INTELLIGENT LIFE IS LESS SEW. SUM SAY IT

IZQ XRH HYP ZKKRZF PE ZFR KGZERH.
HAS YET TWO APPEAR ON ARE PLANET.

	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	3		2	2	8	3	9	9	4	13	3		1	1	4	5	9	18	1				2	2	2	8	3
	M		G	V	N	R	L	T	H	I	P		B	C	U	O	S	E	Q				F	Y	W	A	M

18) [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 **EN**. With that knowledge, what does this message say?

SJMMKEOCTLTEKKGTLHGWQJMXDET
CHOOSEKINDNESSANDLAUGHOFTEN

Answer: **CHOOSE KINDNESS AND LAUGH OFTEN**

Note: a=19 b=6