North Carolina Science Olympiad — Code Busters Test 1
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.

8. 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.
9. 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

1. 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 KFXMFXYF

SAMPLE SENTENCE

and the students answered (underlined letters indicate mistakes)

SAMPLF 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.

2. For questions which have a numeric answer (such as determining the a= and b= values), no mistakes are allowed.
3. 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.
4. When scoring the Dancing Man ciphers (with text like 𝕏𝕐𝕐𝕩), they can write the answer under the Dancing Man symbols or on the line provided.
5. 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.
6. 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.

7. Add up all the scores and put the total on the bottom of score sheet.
8. 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	18
2	5
3	10
4	12
5	15
6	16
7	8
8	6
9	9
10	14
11	3
12	Timed Question
13	2
14	4
15	17
16	13
17	1
18	11
19	7

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

QNSPS LE ZIQNLZY QNCQ VLMM OLMM C

THERE IS NOTHING THAT WILL KILL A

ACZ EI EIIZ CE NCXLZY ZIDIFJ QI

MAN SO SOON AS HAVING NOBODY TO

KLZF KCBMQ VLQN DBQ NLAESMK.

FIND FAULT WITH BUT HIMSELF.

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

1) **[100 Points]** Solve this Cryptogram which is a quote by John Steinbeck where the word THE appears multiple times.

```
KH JTG TGOIJE OHW CKHWE PU JTG
```
IN THE HEARTS AND MINDS OF THE

```
RGPRAG, JTG NIORGE PU FIOJT FGIG
```
PEOPLE, THE GRAPES OF WRATH WERE

```
NIPFKHN TGOQL UPI JTG QKHJONG.
```
GROWING HEAVY FOR THE VINTAGE.

	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		1		3	3	12	5	6	7	4	1		4	6	5	2	3		7	3		2			
	L		M		S	W	E	N	R	T	I	Y		H	A	O	V	P		H	F		D			

2) **[100 Points]** A famous quote about a treasure has been encoded using the Vigenère cipher using a common 5 letter word. You have been told that the 35th through the 42nd letters in the code (**MGSIFNGS**) actually is the word **TREASURE** . What does the message decode to?

```
PPWKP XHPBN IVQAZ TGSRR DFTVW NSBTH ARMAM
```
ABOXW ITHOU THING ESKEY ORLID YETGO LDENT

```
GSIFN GSQAL XRMVL WWL
```
REASU REINS IDEIS HID

Answer:

A BOX WITHOUT HINGES KEY OR LID YET GOLDEN TREASURE INSIDE IS HID

Code word is Power

3) **[125 Points]** Using a key of **BCEFEDABC** encode the string **DETECTIVES** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} B & C & E \\ F & E & D \\ A & B & C \end{pmatrix} \equiv \begin{pmatrix} 1 & 2 & 4 \\ 5 & 4 & 3 \\ 0 & 1 & 2 \end{pmatrix}$$

D	E	T	E	C	T	I	V	E	S		
J	K	Q	G	H	O	O	G	D	M	F	X

4) **[100 Points]** Using a key of **ROTR** encode the string **HELICOPTER** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} R & O \\ T & R \end{pmatrix} \equiv \begin{pmatrix} 17 & 14 \\ 19 & 17 \end{pmatrix}$$

H	E	L	I	C	O	P	T	E	R
T	T	N	H	W	Q	B	K	U	B

5) **[400 Points]** Solve this Patristrocrat.

KLCBH LBGGB OAFWM BYLWA FYBHU TKZWG OWCMG FWXMZ
IFYOU FOLLO WREAS ONFAR ENOUG HITAL WAYSL EADST

BIBYI GHMKB YMZTW ZWAFI BYZAW ACZBA FWMBY
OCONC LUSIO NSTHA TAREC ONTRA RYTOR EASON

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

IF YOU FOLLOW REASON FAR ENOUGH IT ALWAYS LEADS TO CONCLUSIONS THAT ARE
CONTRARY TO REASON

6) **[180 Points]** Solve this cipher which talks about character.   The first word is **THE** and the last word is **OUT**.

PARLR TNWIR EKTLT ZNIRT XSATI TSPRI HNCAT PARCE
THEME ASURE OFAMA NSREA LCHAR ACTER ISWHA THEWO

WXMME HKARG ZRCAR CEWXM ZRURI YRKEW ZMEWP
ULDDO IFHEK NEWHE WOULD NEVER BEFOU NDOUT

	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		6		1	2	5		3	2	4	3		4		12	2	7	1		5	3	1	4
	H		W		O		K	I	R		F	M	D	S		T		E	C	A	V		U	L	B	N

THE MEASURE OF A MANS REAL CHARACTER IS WHAT HE WOULD DO IF HE KNEW HE WOULD
NEVER BE FOUND OUT

7) **[50 Points]** Using a code word of **SHOVEL**, encode the following quote by Abraham Lincoln sentence using the Vigenère cipher.

NO MAN HAS A GOOD ENOUGH MEMORY TO BE A SUCCESSFUL LIAR
FV AVR SSZ O BSZV LBJYRZ TSHSCQ AC WI L KBQXIDKMIG PTSY

Answer:

8) **[180 Points]** Your teacher has a sign by her desk which has the following written on it. What does it say?

THE SCIENCE OF TODAY IS THE

TECHNOLOGY OF TOMORROW

Answer: _____

9) **[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 **UL**. With that knowledge, what does this message say?

      XMDYOCTXYXYILTZYITMPTXYCMKN

Answer:

      HOPEISTHEHEARTBEATOFTHESOUL

Note: A=17 B=8

10) **[300 Points]** Solve this Cryptogram which is a famous quote from Muhammad Ali.

RAQZBLDXP QSFX'M ZQVF LX ECZP.
CHAMPIONS AREN'T MADE IN GYMS.

RAQZBLDXP QSF ZQVF WSDZ PDZFMALXE
CHAMPIONS ARE MADE FROM SOMETHING

MAFC AQYF VFFB LXPLVF MAFZ.
THEY HAVE DEEP INSIDE THEM.

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

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 **EUEIR** decodes to say **AGAIN**. What are the values of *a* and *b* in the function *a*x + *b* that were used to encode the message?

a=___7___   b=___4___

12) **[250 Points]** Solve this Patristrocrat. In it, you will find the words **TO** and **TIME** at least twice each.

KPKTN NKETY ZZEIK USKUU ZYWKZ GLSNE DTGUU ZAKEZ
EVERY YEARI TTAKE SLESS TIMET OFLYA CROSS THEAT

SERZY DERHW GTKZY WKZGH TYPKZ GZAKG LLYDK
LANTI CANDM ORETI METOD RIVET OTHEO FFICE

	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			3	6		6	2	1		12	3		3		2		2	3	5	5		3		6	11
	H		C	A		O	D	K		E	F		Y		V		N	L	R	S		M		I	T

EVERY YEAR IT TAKES LESS TIME TO FLY ACROSS THE ATLANTIC AND MORE TIME TO DRIVE TO THE OFFICE

13) **[100 Points]** Encode the string **IFYOUDREAMITYOUCANDOIT** using the Affine Cipher with $a=5$ and $b=9$.

I	F	Y	O	U	D	R	E	A	M	I	T	Y	O	U	C	A	N	D	O	I	T
X	I	Z	B	F	Y	Q	D	J	R	X	A	Z	B	F	T	J	W	Y	B	X	A

14) **[140 Points]** Solve this Cryptogram which is a quote by Henry Kissinger talking about himself.

ALT BWOT ALWBH IKCMA KTWBH I OTQTKGWAE
THE NICE THING ABOUT BEING A CELEBRITY

WF ALIA, WN ECM KCGT ZTCZQT, ALTE
IS THAT, IF YOU BORE PEOPLE, THEY

ALWBV WA'F ALTWG NIMQA.
THINK IT'S THEIR FAULT.

	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	4	4		3	2	3	2	4		4	6	3	2	2		3			10		1	9			2
	T	N	O		Y	S	R	G	A		B	H	U	F	C		L			E		K	I			P

15) **[250 Points]** Solve this Spanish Cryptogram which offers advice about succeeding in life.

`WL MIH FH RJHKSH HC IC WIEZK FH QLURHCFZ`
LO QUE SE PIERDE EN UN LUGAR SE COMPENSA

`QLC WL MIH FH LPGJHCH HC LGKL. OKZQZFZK`
CON LO QUE SE OBTIENE EN OTRO. FRACASAR

`HC ICZ LQZFJLC B GKJICOZK HC WZ LGKZ.`
EN UNA OCASION Y TRIUNFAR EN LA OTRA.

	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	11		1	6	4	14	6	4	8	10	2				2	1	4	2	1		1		4			10
		Y	N		G	S	T	E	U	I	R	O	Q			F	B	C	P	D		M		L			A

Lo que se pierde en un lugar se compensa con lo que se obtiene en otro. Fracasar en una ocasión y triunfar en la otra.
Translation: What is lost in one place is compensated with what you get in another. Fail one time and succeed in the other.

16) **[250 Points]** Solve this Cryptogram of famous inventor Charles F. Kettering's take on moving forward.

`VOZJKRUF HOR GLR VOXQR ZB VOZSORFF.`
PROBLEMS ARE THE PRICE OF PROGRESS.

`AZC'G JOXCS UR HCPGLXCS JMG GOZMJKR.`
DON'T BRING ME ANYTHING BUT TROUBLE.

`SZZA CRTF TRHNRCF UR.`
GOOD NEWS WEAKENS ME.

	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	1	6			5	5	3		4	2	2	2	1	7	1	1	11	4	2	3	3		3		7
	D	F	N			S	T	A		B	L	H	U	K	R	Y	C	E	G	W	M	P		I		O

17) **[100 Points]** You encountered this message from on the wall. What does it say?
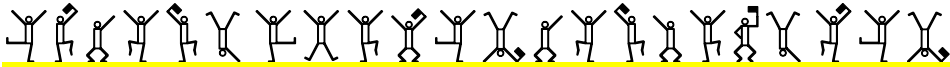
IF YOU DREAM IT YOU CAN DO IT

Answer: _____

18) **[400 Points]** Someone used voice transcription on their phone to send this quote from Marc Andreessen to a friend. A few of the words didn't come out quite right but we decided to encrypt it anyway. What does it say?

QVP CIXPWN EK HERILQPXC WZN QVP JZQPXZPQ SJTT ILQ FEDC
THE SPREAD OF COMPUTERS AND THE INTERNET WILL PUT JOBS

JZ QEE HWQPYEXJPC. IPEITP SVE QPTT HERILQPXC SVWQ QSE
IN TOO CATEGORIES. PEOPLE WHO TELL COMPUTERS WHAT TWO

NPS, WZN IPEITP SVE WXP QETN DB HERILQPXC SVWQ QE NE.
DEW, AND PEOPLE WHO ARE TOLD BY COMPUTERS WHAT TO DO.

	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	6	2	16	1		4	9	4	1	4		6		17	16	3	7	7		6	7	7	1	5
		Y	S	B	O	J		C	P	I	F	U		D		E	T	M	W	L		H	A	R	G	N