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 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)

SAMPL̲F̲ S̲FNT̲FNCF̲

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

SAMPU̲L̲ 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 𝕏𝕐𝕐𝕋), 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	11
2	18
3	2
4	1
5	4
6	3
7	15
8	6
9	17
10	5
11	13
12	Timed Question
13	14
14	8
15	7
16	9
17	12
18	16
19	10

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

```
MRY  PYWM  MRBLZW  BL  TBDY  XFY
```
THE BEST THINGS IN LIFE ARE

```
LYSYF  FXMBALYN.  DFBYLNWRBV,  TAKXTMK,
```
NEVER RATIONED. FRIENDSHIP, LOYALTY,

```
TASY  NA  LAM  FYGQBFY  UAQVALW.
```
LOVE DO NOT REQUIRE COUPONS.

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

1) **[250 Points]** Solve this Patristrocrat containing a quote by Robert Brault. In it, you will find the word OVERCOME appear twice.

```
COHHA  CCBCU  IUYAF  VFJCI  UHYAC  FQAKH  FTAUP  EVFKA
```
<mark>SUCCE SSISA TALEO FOBST ACLES OVERC OMEAN DFORE</mark>

```
QAKWF  JCIUH  YAFQA  KHFTA  UPARH  OCAPF  IOCAE.
```
<mark>VERYO BSTAC LEOVE RCOME ANEXC USENO TUSED.</mark>

	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	9		2	9		7	4	2	4			3	3	3	1		2	6	2	1		3		
	E	I	S		D	O		C	T	B	R			U	N	V	X		M	A	F	Y		L		

<mark>SUCCESS IS A TALE OF OBSTACLES OVERCOME AND FOR EVERY OBSTACLE OVERCOME AN EXCUSE NOT USED.</mark>

2) **[300 Points]** Solve this Cryptogram which is a quote by Lily Tomlin.

```
NDVVDHBQ  HW  QGDEDUKTV  OEYTUKEYQ  FTVI
```
<mark>MILLIONS OF SPIRITUAL CREATURES WALK</mark>

```
UJY  YTEUJ  KBQYYB,  MHUJ  FJYB  FY  QVYYG
```
<mark>THE EARTH UNSEEN, BOTH WHEN WE SLEEP</mark>

```
TBZ  FJYB  FY  TFTIY.
```
<mark>AND WHEN WE AWAKE.</mark>

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

<mark>MILLIONS OF SPIRITUAL CREATURES WALK THE EARTH UNSEEN, BOTH WHEN WE SLEEP AND WHEN WE AWAKE</mark>

3) **[250 Points]** Solve this Cryptogram which is meaningful advice by Erich Fromm.

```
KAPCP JX TB VPITJTR KB NJEP PQOPSK
```

```
KAP VPITJTR VIT RJMPX AJX NJEP WU
```

```
FTEBNHJTR BE AJX SBZPCX.
```

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

4) **[250 Points]** Solve this Spanish proverb Cryptogram.

```
MJ XLBJ ZC HI GHZED P KH ZYZC ZM FHZ BZOLBZ CL
```

```
ZYZC HIJ WLZRJ D CZYJC HI GHEJBDY.
```

	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		4	6	3	2	1	2	7	3	6	1	4	2			1	1		1				1	1	4	12
		D	S	O	G	Q	J	U	N	A	T	I	L			C	Y		Z				P	V	R	E	D

Translation: Life is a game and you are the one who decides if you are a piece or you will be a player.

5) **[140 Points]** Solve this unattributed quote Cryptogram that talks about a positive outlook.

```
LWV LQAV LU RV WFIIG QK DUT. LWV ICFEV
```
<mark>THE TIME TO BE HAPPY IS NOW. THE PLACE</mark>

```
LU RV WFIIG QK WVBV. LWV TFG LU RV
```
<mark>TO BE HAPPY IS HERE. THE WAY TO BE</mark>

```
WFIIG QK LU AFHV ULWVBK KU.
```
<mark>HAPPY IS TO MAKE OTHERS SO.</mark>

	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	1	1	1	6	4	1	7		5	9					4	3		2	7	12	8			
	M	R	L	N	C	A	Y	K	P		S	T					I	B		W	O	E	H			

6) **[180 Points]** Solve this cipher which quotes Samuel Johnson. The second word is **AM** and the last word is **NATIONS**.

```
WEDET KEXYY JIIXK VMCEC XTECF OEFMW YTJYZ HMQEO
```
<mark>IAMAL WAYSS ORRYW HENAN YLANG UAGEI SLOST BECAU</mark>

```
YMTEC FOEFM YEIMZ VMRML WFIMM YJACE ZWJCY
```
<mark>SELAN GUAGE SARET HEPED IGREE SOFNA TIONS</mark>

	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	1	11	5		1	4	4	2	1	10		3		1	1		4		2	4	3	8	3
	F		N	M	A	G		B	R	O	W	D	E		U		C	P		L		H	I	Y	S	T

<mark>I AM ALWAYS SORRY WHEN ANY LANGUAGE IS LOST BECAUSE LANGUAGES ARE THE PEDIGREES OF NATIONS.</mark>

7) **[100 Points]** Your teacher has this sign on the wall. What does it say?

WE BECOME WHAT WE THINK ABOUT

Answer: _____

8) **[100 Points]** Using a key of **BLOR** encode the string **PHYSIOLOGY** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} B & L \\ O & R \end{pmatrix} \equiv \begin{pmatrix} 2 & 11 \\ 14 & 17 \end{pmatrix}$$

P	H	Y	S	I	O	L	O	G	Y
D	R	M	S	O	M	U	C	Q	Y

9) **[100 Points]** Encode the string **DREAMBIGANDDARETOFAIL** using the Affine Cipher with *a=7* and *b=9*.

D	R	E	A	M	B	I	G	A	N	D	D	A	R	E	T	O	F	A	I	L
E	Y	L	J	P	Q	N	Z	J	W	E	E	J	Y	L	M	D	S	J	N	I

10) **[50 Points]** Using a code word of **GENIUS**, encode the following quote from James A. Garfield using the Vigenère cipher.

```
MAN CANNOT LIVE BY BREAD ALONE; HE MUST HAVE PEANUT BUTTER.
SEA KUFTSG TCNK FL JLWGH NTIFK; LR UOKZ LNDY HKEACN TAXGML.
```

Answer:

SEA KUFTSG TCNK FL JLWGH NTIFK; LR UOKZ LNDY HKEACN TAXGML.

11) **[400 Points]** Your phone badly misheard this quote from Albert Einstein and misheard a few words before encrypting it.   What does it say?

```
IBIOLPWZFX ZF PWI MFZBIOKI WYK Y DEODEKI. ZFJIIJ,
EVERYTHING IN THE UNIVERSE HAS A PORPOSE. INDEED,

PWI ZFBZKZGSI ZFPISSZXIFUI PWYP NSEAK PWOIA
THE INVISIBLE INTELLIGENCE THAT FLOWS THREW

IBIOLPWZFX ZF Y DMODEKINMS NYKWZEF ZK YSKE
EVERYTHING IN A PURPOSEFUL FASHION IS ALSO

NSEAZFX PWOIA LEM.
FLOWING THREW YOU.
```

	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		4	8	11	1		18	2	9	3	4	4	7	9			7		1		9	4	6	14
	W	V		P	O	N	B		E	D	S	Y	U	F	R	T			L		C		H	G	A	I

12) **[100 Points]** Solve this Cryptogram which is a quote by Robert Brault where the word **YOU** appears multiple times.

```
VZ DPN USQA ICFI CPEQ FSY YQLEFVM AQMQ
IF YOU KNEW THAT HOPE AND DESPAIR WERE

EFICL IP ICQ LFWQ YQLIVSFIVPS,
PATHS TO THE SAME DESTINATION,

ACVJC APNTY DPN JCPPLQ?
WHICH WOULD YOU CHOOSE?
```

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

13) **[125 Points]** Using a key of **FARMBATTS** encode the string **MECHATRONIC** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} F & A & R \\ M & B & A \\ T & T & S \end{pmatrix} \equiv \begin{pmatrix} 5 & 0 & 17 \\ 12 & 1 & 0 \\ 19 & 19 & 18 \end{pmatrix}$$

M	E	C	H	A	T	R	O	N	I	C	
Q	S	C	U	G	H	U	K	R	X	U	Q

14) **[100 Points]** Henry Van Dyke once said this about a treasure. It has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the 6th through the 13th letters in the code (MYMNYNYM) actually is the word TREASURE . What does the message decode to?

FHVLG MYMNY NYMOK LPLRY TSQOG UHAVY
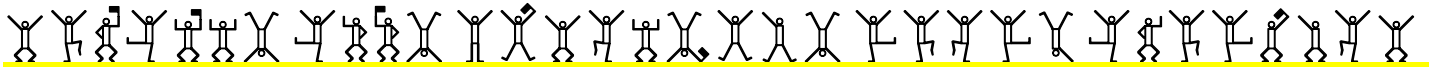**MANYA TREAS UREBE SIDES ALIBA BASIS**

NUTBI DLLJO MOIIK KIIYQ XF
UNLOC KEDWI THAVE RBALK EY

Answer:
MANY A TREASURE BESIDES ALI BABA'S IS UNLOCKED WITH A VERBAL KEY

15) **[180 Points]** John F. Kennedy said this. What did he say?

MAN IS STILL THE MOST EXTRAORDINARY COM

PUTER OF ALL

Answer:

MAN IS STILL THE MOST EXTRAORDINARY COMPUTER OF ALL

16) **[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 **IGCXX** decodes to say **SMALL**. What are the values of a and b in the function ax $+ b$ that were used to encode the message?

$a=$ 9 $b=$ 2

17) **[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 **RD**. With that knowledge, what does this message say?

`DLROTFOZLOBMVAEXQXKMRHTLRKC`
`IWALKSLOWLYBUTNEVERBACKWARD`

Answer:
I WALK SLOWLY BUT NEVER BACKWARD

18) **[400 Points]** Solve this cryptogram.

`IFHNX WFNYF QOWVJ OZWFH JDBOD JYKBO FDKPQ YFHCC VQODK`
`MANYP LAYSA RELIK EBLAN KCHEC KSTHE ACTOR SANDD IRECT`

`PQYXE KKBOV QPLHY VSHFK EQOYP HKBOI`
`ORSPU TTHEI ROWNS IGNAT URESO NTHEM`

	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	2	4	2	7		6	2	3	7	1		2	8	4	6		1			4	3	2	6	1
		H	D	C	U	A		N	M	K	T	W		Y	E	O	R		G			I	L	P	S	B

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