

North Carolina Science Olympiad — Code Busters Test 3

2018

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.
 - iv. If the student has a smart watch (Apple watch, Samsung Gear, etc.) they will need to put it away.
4. Instruct the students that if they answer the timed question within 10 minutes, they can be awarded a bonus if they solve the timed question with no more than 2 letters incorrect.
 - 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 (more than 2 letters 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.
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.

- 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 KFXMFX~~Y~~F

SAMPLE SENTENCE

and the students answered (underlined letters indicate mistakes)

SAMPLE SENTENCE

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

SAMPLE 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 Baconian ciphers (with strange text or symbols), they can write the answer under the Dancing Man symbols or on the line provided. Note that you will see lots of As and Bs, but they are not graded as the answer, only what they put on the answer line.
- 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. If they get more than 2 letters wrong, subtract 50 points from the score until it would be zero. If a question is worth 120 points and they get 4 letters wrong, you would start with 120 points (for up to 2 letters wrong) and then subtract 100 points for the next two letters wrong ending up with a final score of 20 points for that question. If they had gotten 5 or more letters wrong on a 120 point question, they would receive 0 points for that question. With a 350 point question, they could get 8 letters wrong and receive 50 points (2 free letters then $6 \times 50 = 300$ points off). Just put the incorrect cost deduction on the score sheet and subtract it from the value for the question. Under no circumstance should the score for any question be less than zero. Note that while the timed question must have 2 or fewer letters incorrect in order to get the timing bonus, a team solving the timed question after the 10 minutes passed would be accepted as correct with 3 incorrect letters receiving 50 points for the timed question.
- If they correctly answered the timed question in 10-minutes or less with 2 or fewer letters incorrect, 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.

8. You must break all ties. 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 #8 (which is the highest value question) and another team didn't, the first team will be ahead.

Tie Breaker Order	Question #
1	7
2	9
3	4
4	17
5	1
6	14
7	11
8	12
9	3
10	10
11	15
12	18
13	Timed Question
14	2
15	19
16	5
17	13
18	16
19	6
20	8

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 Aristocrat which is a quote by Roy T. Bennett. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

AB' U YHEZ TKBWP ZYX' IW UBWLLWN YXBUANW ZYXP OYJKYPB
 IT' S ONLY AFTER YOU' VE STEPPED OUTSIDE YOUR COMFORT

GYHW BFTB ZYX RWDAH BY OFTHDW, DPYM, THN BPTHUKYPJ.
 ZONE THAT YOU BEGIN TO CHANGE, GROW, AND TRANSFORM.

	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
Frequency	3	9		3	1	2	1	6	1	2	3	2	1	3	2	6		1		5	4		8	4	11	4
Replacement	I	T	Q	G	L	H	Z	N	V	M	F	P	W	D	C	R	K	B	J	A	S	X	E	U	O	Y

1) [250 Points] Solve this Patristocrat which is a quote by Bertrand Russell and begins with **IT HAS**.

LZFIB UVVGB IILNZF IZQIG LBIDI ZLWGI PIGLQ IPIPP
 ITHAS BEENS AIDTH ATMAN ISARA TIONA LANIM ALALL

QHPLC VLFIX VUVVG BVIDY FLGMC WDVXL NVGYV RFLYF
 MYLIF EIHAV EBEEEN SEARC HINGF OREVI DENCE WHICH

YWOPN BOKKW DZZFL B
 COULD SUPPO RTTHI S

	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
Frequency		6	2	4		7	7	1	12		2	11	1	3	2	6	3	1			2	10	4	2	4	6
Replacement	K	S	F	R	J	H	N	Y	A	Z	P	I	G	D	U	L	M	W	X	Q	B	E	O	V	C	T

2) [100 Points] Encode the string **A GOLDEN KEY CAN OPEN ANY DOOR** using the Affine Cipher with $a=11$ and $b=11$.

A	G	O	L	D	E	N	K	E	Y	C	A	N	O	P	E	N	A	N	Y	D	O	O	R
L	Z	J	C	S	D	Y	R	D	P	H	L	Y	J	U	D	Y	L	Y	P	S	J	J	Q

3) [120 Points] The following strange headlines appeared in the newspaper but in reality, they are a Baconian encoded message where some letters encode as one character and the others as another in a pattern. You know that the message starts out as **INORD**. What does the message decode to?

Answer: In order for the light to shine so brightly, the darkness must be present

Power laser wisps apple press.

ABAAA ABBAA ABBAB BAAAA AAABB

I N O R D

Peter never wears quilt sleep trend.

AABAA BAAAA AABAB ABBAB BAAAA BAABA

E R F O R T

Debut renew force field.

AABBB AABAA ABABA ABAAA

H E L I

Prime prism below clear wands apply xrays where roger drove seven wimpy

AABBA AABBB BAABA BAABA ABBAB BAAAB AABBB ABAAA ABBAA AABAA BAAAB ABBAB

G H T T O S H I N E S O

weeds.

AAAAB

B

Never lower fluid fruit, allow large block.

BAAAA ABAAA AABBA AABBB BAABA ABABA BABBA

R I G H T L Y

Break wrong drill, delay level added early fiber weave.

BAABA AABBB AABAA AAABB AAAAA BAAAA ABAAB ABBAA AABAA

T H E D A R K N E

Seven sweet worms spent newly clear fleet, drove royal apple, leave alert,

BAAAB BAAAB ABABB BAABB BAAAB BAABA AAAAB AABAA ABBBA BAAAA AABAA BAAAB

S S M U S T B E P R E S

weird whale speak

AABAA ABBAA BAABA

E N T

4) [300 Points] Solve this Xenocrypt which is a translation of a quote by Mark Twain into Spanish.

**NQK GIAK MA HNAIA TEQMGIAKKB TEWE NQK GZNMGEQ CKMUK
UNA IDEA SE PUEDE CONSIDERAR COMO UNA ILUSION HASTA**

**XNA IGTCK GIAK MA TEQYGABUA AQ BAKZGIKI.
QUE DICHA IDEA SE CONVIERTE EN REALIDAD.**

	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
Frequency	12	4	2		5		8	1	7		10		5	5				6			4	2		1	1	1	2
Replacement	E	R	H	K	O	Y	I	P	D	Ñ	A	G	S	U	W	B	J	N	Z	F	C	T	X	M	Q	V	L

Translation: An idea can be considered an illusion until that idea becomes reality.

5) [75 Points] Using a key of **SPRY** encode the string **CERTIFICATE** using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} S & P \\ R & Y \end{pmatrix} \equiv \begin{pmatrix} 18 & 15 \\ 17 & 24 \end{pmatrix}$$

C	E	R	T	I	F	I	C	A	T	E	Z
S	A	T	R	L	W	S	C	Z	O	F	S

6) [50 Points] Bruno Mars' observation has been encoded using a Caesar Cipher. What does it say?

Q	Y	W	M	G	M	W	R	S	X	Q	E	X	L	.	M	X	'	W	W	G	M	I	R	G	I	.
M	U	S	I	C	I	S	N	O	T	M	A	T	H	.	I	T	'	S	S	C	I	E	N	C	E	.

C	S	Y	O	I	I	T	Q	M	B	M	R	K	X	L	I	W	X	Y	J	J	Y	T
Y	O	U	K	E	E	P	M	I	X	I	N	G	T	H	E	S	T	U	F	F	U	P

Y	R	X	M	P	M	X	F	P	S	A	W	Y	T	S	R	C	S	Y	,	S	V	M	X
U	N	T	I	L	I	T	B	L	O	W	S	U	P	O	N	Y	O	U	,	O	R	I	T

F	I	G	S	Q	I	W	X	L	M	W	M	R	G	V	I	H	M	F	P	I	T	S	X	M	S	R	.
B	E	C	O	M	E	S	T	H	I	S	I	N	C	R	E	D	I	B	L	E	P	O	T	I	O	N	.

7) [350 Points] Solve this Patristocrat of what Stephen Hawking wrote in a Brief History of Time and is encoded using a K1 key. The word **THAT** appears at least twice.

ORYFT VOBFG TIOPU OGTBU OORPO ORYJU BKYIV YBVAT
THEMO STIMP ORTAN TPOIN TTHAT THEUN IVERS EISGO

KYIUU XWSPV YOTZI POBTU PEEPL VORPO LYQPU XBVQT
VERNE DBYAS ETOFR ATION ALLAW STHAT WECAN DISCO

KYIPU XJUXY IVOPU X
VERAN DUNDE RSTAN D

K1	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
Frequency	1	6		2	2	2		6	2	3	2			13	10	2	4	1	7	9	7	1	5	10	1	
Replacement	G	I	J	K	L	M	P	Q	R	U	V	W	X	Z	T	A	C	H	Y	O	N	S	B	D	E	F

8) [50 Points] Using a code word of **MIGHT**, encode the following quote from Mark Twain using the Vigenère cipher.

M	I	G	H	T	M	I	G	H	T	M	I	G	H	T	M	I	G	H	T	M										
A	L	L	Y	O	U	N	E	E	D	I	N	T	H	I	S	L	I	F	E	I	S	I	G	N	O	R	A	N	C	E
M	T	R	F	H	G	V	K	L	W	U	V	Z	O	B	E	T	O	M	X	U	A	O	N	G	A	Z	G	U	V	Q

I	G	H	T	M	I	G	H	T	M	I	G	H	M	I	G	H	T	M	I	G	H	T	M	I	G	H	T	M	I	G	H	T		
A	N	D	C	O	N	F	I	D	E	N	C	E	,	A	N	D	T	H	E	N	S	U	C	C	E	S	S	I	S	S	U	R	E	.
I	T	K	V	A	V	L	P	W	Q	V	I	L	,	T	Z	L	Z	O	X	Z	A	A	J	V	Q	A	Y	P	L	E	C	X	L	.

9) [350 Points] Solve this K1 Key encoded Patristocrat which is a quote by Frederick Maurice Powicke in “History, Freedom & Religion” and ends with the word **FORCE**.

XQPFC LJQPN OAACN FXMWM TWHMQ SXFCN FXQRS PHXQV
 HISTO RYISF ULLOF THEDE ADWEI GHTOF THING SWHIC

XXTGM MPVTD MWF XM VCRFL CACNF XMBQR WJMFV LQGMB
 HHAVE ESCAP EDTHE CONTR OLOFT HEMIN DYETD RIVEM

TRCRH QFXTU AQRWN CLVM
 ANONW ITHAB LINDF ORCE

K1	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
Frequency	4	2	8	1		9	2	3		2		4	11	5	1	4	9	6	2	5	1	4	6	10		
Replacement	L	M	O	P	Q	T	V	W	X	Y	Z	R	E	F	U	S	I	N	G	A	B	C	D	H	J	K

10) [120 Points] The following quote from Abraham Lincoln has been encoded using a running key cipher against a famous document. What does it say?

W H E N I N T H E C O U R S E O F H U M A N E V E
 E K S A , B X G V A Y V I D Q K F F U X R A G L Z V
 I D O N , T K N O W W H O M Y G R A N D F A T H E R
 N T S ; I T B E C O M E S N E C E S S A R Y F O R O
 J T K ; Q T N Q W Q T Q G E I E S F U E I L J R K C
 W A S ; I A M M U C H M O R E C O N C E R N E D T O
 N E P E O P L E T O D I S S O L V E T H E P O L I
 X R D A K W L X A W V O J S B O N S G D M A Z M M .
 K N O W W H A T H I S G R A N D S O N W I L L B E .

11) [125 Points] Solve this Aristocrat which is a quote from an unknown source.

PMDZD GZD DUJMP VHGIDPR, KIHDRR FQ WFKZRD NFK RPUHH
 THERE ARE EIGHT PLANETS, UNLESS OF COURSE YOU STILL

WFKIP VHKPF UI OMUWM WGRD PMDZD GZD IUID BUHHUFI
 COUNT PLUTO IN WHICH CASE THERE ARE NINE MILLION

VHGIDPR.
 PLANETS.

	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
Frequency		1		13		6	5	8	8	1	5		5	1	1	8	1	7			7	3	4			5
Replacement	Q	M	B	E	D	O	A	L	N	G	U	K	H	Y	W	T	F	S	V	X	I	P	C	J	Z	R

12) [125 Points] Using a key of **MULTITUDE** encode the string **CIRCUMSTANCES** using the Hill Cipher with a 26-character alphabet. e.g.

$$\begin{pmatrix} M & U & L \\ T & I & T \\ U & D & E \end{pmatrix} \equiv \begin{pmatrix} 12 & 20 & 11 \\ 19 & 8 & 19 \\ 20 & 3 & 4 \end{pmatrix}$$

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

15) [120 Points] Solve this Aristocrat which is a quote from Winston Churchill and starts with **MAN**.

**EQM GJSS TKKQRJTMQSSO RWEYNSI TXIU WFI WUYWF, NYW
MAN WILL OCCASIONALLY STUMBLE OVER THE TRUTH, BUT**

**ETRW TD WFI WJEI FI GJSS ZJKC FJERISD YZ QML
MOST OF THE TIME HE WILL PICK HIMSELF UP AND**

**KTMWJMYI TM.
CONTINUE ON.**

	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
Frequency			1	2	5	5	2		8	7	4	1	6	2	1		4	4	8	7	2		9	1	5	2
Replacement	Q	X	K	F	M	H	W	J	E	I	C	D	N	B	Y	G	A	S	L	O	R	Z	T	V	U	P

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

$a =$ **9** $b =$ **14**

17) [300 Points] A computer badly mangled Gurjeet Singh's quiet statement before encrypting it. What did he say?

**KPK XECKN EDD OKTH GFTG WGFKH KDVEDKKHA MWWN AGWL SK
EYE LIVED INN FEAR THAT OTHER ENGINEERS WOOD STOP ME**

**EDD GFK AGHKKG TDN TAJ SK T STGF ZRKAGEWD, TDN KPK
INN THE STREET AND ASK ME A MATH QUESTION, AND EYE**

**MWRXND'G DW GFK TDAMKH.
WOULDN'T NO THE ANSWER.**

	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
Frequency	6		1	12	5	5	11	5		1	18	1	3	5	1	2		2	3	8		1	7	2		1
Replacement	S	Z	V	N	I	H	T	R	X	K	E	P	W	D	F	Y	C	U	M	A	J	G	O	L	B	Q

18) [120 Points] Solve this Aristocrat which is a quote from the British Comedy series “A bit of Fry and Laurie” which has the word **GIVE** in it.

L OILMU ZMLNZD OVVOLMJ LY Z OVGGLRDV LBVZ; OIVH JVO
I THINK ANIMAL TESTING IS A TERRIBLE IDEA; THEY GET

ZDD MVGPEWY ZMB JLPV OIV CGEMJ ZMYCVGY.
ALL NERVOUS AND GIVE THE WRONG ANSWERS.

	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
Frequency		2	2	4	2		5	1	3	4		8	7	1	7	2		1			1	10	1		5	7
Replacement	P	D	W	L	O	C	R	Y	H	G	J	I	N	M	T	V	X	B	Z	F	K	E	U	Q	S	A

19) [100 Points] Edgar Ramirez once said this about what to look for. It has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the 23rd through the 28th letters in the code (**UMBPSA**) actually is the word **HIDDEN**. What does the message decode to?

U O Y A Y	K G G V W	F C Y S M	W T B V R	T S U M B
I A L W A	Y S T R Y	T O L O O	K F O R T	H E H I D

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

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

I ALWAYS TRY TO LOOK FOR THE HIDDEN FACE OF THE CHARACTER, THE HIDDEN FACE THAT WE ALL HAVE