

Science Olympiad — dragonfruit35's SSSS

Codebusters Test

2019

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.

- 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 .999999999
- 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 KFXMFXYP

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

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 Baconian ciphers (with strange text or symbols), they can write the answer under the Baconian 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 100 points from the score until it would be zero. If a question is worth 240 points and they get 4 letters wrong, you would start with 240 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 40 points for that question. If they had gotten 5 or more letters wrong on a 240 point question, they would receive 0 points for that question. With a 650 point question, they could get 8 letters wrong and receive 50 points (2 free letters then $6 \times 100 = 600$ 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 100 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	2,160	1:xx	1,920	2:xx	1,680	3:xx	1,440	4:xx	1,200
5:xx	960	6:xx	720	7:xx	480	8:xx	240	9:xx	0

and then add the seconds value from this table:

X:00	240	X:01	236	X:02	232	X:03	228	X:04	224	X:05	220
------	-----	------	-----	------	-----	------	-----	------	-----	------	-----

Timed Question [150 points] Solve this aristocrat reprimanding Flash Thompson in *Spider-Man: Homecoming*. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

VTT, LOPVJ, RTSHC WJT LPVWTVW SVH'W POFPNV WJT RTVW
 SEE, FLASH, BEING THE FASTEST ISN'T ALWAYS THE BEST

SL NEA PKT FKEHC.
 IF YOU ARE WRONG.

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

1) [100 points] Find the decryption matrix for encryption key BLIP.

$$\begin{pmatrix} B & L \\ I & P \end{pmatrix} \equiv \begin{pmatrix} 1 & 11 \\ 8 & 15 \end{pmatrix}$$

$$\begin{pmatrix} 3 & 3 \\ 14 & 21 \end{pmatrix}$$

2) [200 points] Solve this aristocrat-encoded quote by Monica Rambeau in *Captain Marvel*.

LTP UJEO J NUJKNO ZT YBL ZUO NTTBOXZ VWXXWTK WK ZUO
 YOU HAVE A CHANCE TO FLY THE COOLEST MISSION IN THE

UWXZTML TY VWXXWTKX. JKR LTP'MO QTWKQ ZT QWEO WZ PG
 HISTORY OF MISSIONS. AND YOU'RE GOING TO GIVE IT UP

ZT XWZ TK ZUO NTPNU JKR SJZNU YMOXU GMWKNO SWZU VO?
 TO SIT ON THE COUCH AND WATCH FRESH PRINCE WITH 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
Frequency		2			2		2			6	9	4	4	7	11	4	3	2	2	14	10	3	12	9	3	12
Replacement	B	L	X	Z	V	K	P	J	Q	A	N	Y	R	C	E	U	G	D	W	O	H	M	I	S	F	T

7) **[350 points]** Skye and Grant are accountants for a very large bank and have started a friendship. They communicate via email, because they live thousands of miles apart. Grant gets curious and asks Skye the year that she was born. Skye doesn't mind telling Grant, but she knows that the bank monitors all employee emails, and is afraid of being the victim of age discrimination. Therefore, Grant suggests that they use RSA, and they provides his public key: (173231, 172931). Skye replies with the ciphertext 167798. Grant's private key is 126971. In what year was Skye born?

Enter the answer:

1992

8) **[650 points]** Solve this Patristocrat that is a quote by Stephen Strange containing "spell".

HLOUH IKNJI EHIKG LORRH VUIKR AUOSL VBIRL JBULE
YEAHY OUKNO WYOUR EALLY SHOUL DHAVE STOLE NTHEW

UIRLZ IINZL DOKVL BULEO GJPJC VBULE OGJPJ CVDIF
HOLEB OOKBE CAUSE THEWA RNING STHEW ARNIN GSCOM

LOYBL GBULV WLRRV
EAFTE RTHES PELLs

Yeah, you know, you really should have stolen the whole book because the warnings... the warnings come after the spells.

	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	4	1	4	4	9	6	4	14		2	7	2		7	1		8	7	1		1	2
Replacement	D	T	G	C	W	M	R	Y	O	N	U	E	Z	K	A	I	X	L	V	Q	H	S	P	J	F	B

9) [250 points] Decode this emotional Affine-encrypted quote from *Avengers: Endgame* given that the first two letters are "TE".

Z	S	X	X	U	K	P	E	U	G	X	K	G	X	O	T	S	Z	J	S	U	.
T	E	L	L	M	Y	F	A	M	I	L	Y	I	L	O	V	E	T	H	E	M	.

10) [250 points] Solve this quote by Natasha Romanoff. It has been encrypted using the Vigenere cipher, and the first three letters are "HEY". (broken up into groups of 5)

N A T N A T N A T N A T N A T N A T N A T N A T N A T N A T

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

N A T N A T N A T N A T N A T N A T N A T N A T N A T N A T

E	E	M	U	E	L	Z	I	M	U	S	H	A	I	T	A	I	L	V	M	A	R	R	X	G	O	I	V	C	D
R	E	T	H	E	S	M	I	T	H	S	O	N	I	A	N	I	S	I	M	H	E	R	E	T	O	P	I	C	K

N A T N A T N A T

H	P	T	S	O	L	F	I	E
U	P	A	F	O	S	S	I	L

13) [550 points] Solve this K1 Patristocrat quote by Steve Rogers that includes the words "price" and "willing" twice each.

ENKSF OBKCL LFKKJ CROUN OMNOE HGXHZ UNHUI KKDHD
 THEPR ICEOF FREED OMISH IGHIT ALWAY SHASB EENAN
 JOEUH SFOBK ORXOG GODME CSHZH DJOLO RENKC DGZCD
 DITSA PRICE IMWIL LINGT OPAYA NDIFI MTHEO NLYON
 KENKD UCIKO EIVEO RXOGG ODMEC IKEOR DCE
 ETHEN SOBEI TBUTI MWILL INGTO BETIM NOT

The price of freedom is high. It always has been. And it's a price I'm willing to pay. And if I'm the only one, then so be it. But I'm willing to bet I'm not.

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		2	8	9	11	3	6	7	4	3	12	3	3	6	16			5	3		5	1		3		3
Replacement	Z	C	O	N	T	R	L	A	B	D	E	F	G	H	I	J	K	M	P	Q	S	U	V	W	X	Y

14) [400 points] Vision was trying to send a message to Wanda, but his communication outputs appear to have been garbled and now resemble a Baconian cipher. What is he trying to say?

@\$^ ^ @\$^ @^\$ ^@\$@\$@\$ ^@\$ @\$e^@\$e@\$ @\$e@\$^@\$e ^\$ @\$e
 AABBBBAABBABABBAAAAABBAABAABAAAAABAAAAABAAABBABAAA
 H U M A N S A R E O D

^ \$e\$^ ^@\$ @\$e^ ^\$e \$e^\$ ^ \$e^@\$ ^ @^@\$e ^\$e\$ @\$^@
 BBAAABBBAABAABBBAABAABABBABAABAABBABAAAABBAAABAABA
 D T H E Y T H I N K

^\$ ^@\$e@\$e @\$e \$e^@\$e@\$e@\$e ^\$e@\$e ^@\$e @\$e^ ^@\$e\$
 BBABBAAAAAABBAABAABAAAAAABBAAAAABBAABAABAABBBAAAA
 O R D E R A N D C H A

@\$ ^@ ^\$e\$ @\$e@\$e^@\$e@\$e \$e^@\$e @^ \$^@ \$^ @\$e@\$e ^ @^
 AABBBABAAABAABAAAAAABAAAAAABAABAABABBABABABBAAABAABBAB
 O S A R E S O M E H

\$^ @^\$e\$ ^@ \$^ ^@\$ ^ @^\$ @^ \$e\$^@ \$e\$^@\$ @\$e^@\$ \$e\$^
 BABBABAAABBABABBBAABBBAABBABBAABAABAABAABAABAABAAB
 O W O P P O S I T E S

@\$e@\$e ^@\$e\$e ^ \$e^\$ @\$e\$^@ ^\$ @\$e^@ ^ \$e\$^@\$ ^@ \$^
 AAAAAABBAAAAABBBAABAABAABAABABBABAABAABBABAAABAABBABABB
 A N D T R Y T O C O N

@\$^@\$ @^\$e\$e\$ ^@ \$^@ \$^@ \$e\$e^ ^\$e\$e\$ @\$^@ \$^@\$e ^\$ @
 AABAABABAAAAABBABABABABABAAAABBBAAAAABAABABABAAABBABA
 T R O L W H A T W O

^ \$e^@\$e \$e\$e\$e^@\$e @\$
 BBAABAABAABAAAAABAABAA
 N T B E

Humans are odd. They think order and chaos are somehow opposites and try to control what won't be.

17) [375 points] Bruce tried to send an Aristocrat text message, but his thumbs are too big to type on a phone and he ended up using autocorrect to type some words, not all of which came out correctly. Can you figure out what he sent?

OAN CTT EJTAUH CT AULR OE EJXN OI, C QLAA AUN IDOCTH
ATE INN MONTHS IN THUG AM MOLE AB, I PUTT THE BRAINS

OTW AUN IDOKT AKJ ROAUND OTW MTJK XJSM OA EN. INHA
AND THE BRAWN TWO GATHER AND KNOW LOCK AT ME. BEST

JYY IJK AUN KUCDXH.
OFF BOW THE WHIRLS.

	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	12		5	4	4			4	5	7	5	2	2	8	9		1	2	1	9	7		2	3	2	
Replacement	T	Y	I	R	M	X	Z	S	B	O	W	U	K	E	A	Q	P	G	C	N	H	J	D	L	F	V

18) [400 points] Agent of S.H.I.E.L.D Daisy has the following RSA public key:

$$n = 68129 \quad e = 48277$$

Unfortunately for her, a quantum computer has successfully factored her n

$$68129 = 353 * 193$$

Compute the value of her private key:

Enter the computed private key:

42685

21) **[700 points]** Like the Avengers, travel back in time to their original movie to decode this Patristocrat quote. No further information will be provided.

**ADXMU XZPSD SAXTZ AUJDE WADXM UQGJG ZZAPT OCZSP
MAYBE YOURA RMYCO MESAN DMAYB EITST OOMUC HFORU**

**JMPGQ GJDKK ZEXZP MUTDP JUQCN UTDEG FSZGU TGGOU
SBUTI TSALL ONYOU BECAU SEIFW ECANT PROTE CTTHE**

**UDSGO XZPTD EMUWD AEUWN UKKJP SUNUK KDYUE VUQG
EARTH YOUCA NBEDA MNEDW ELLSU REWEL LAVEN GEIT**

Maybe your army comes and maybe it's too much for us but it's all on you. Because if we can't protect the Earth, you can be damned well sure we'll avenge it!

	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	11	6	1	10			6	6		5	3	3	8	4		6	6	16	1	3	6	1	9
Replacement	M	K	F	A	N	P	T	X	J	S	L	Z	B	W	H	U	I	Q	R	C	E	G	D	Y	V	O