Science Olympiad — SSSS

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.
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)
   SAMPL<u>F</u> S<u>F</u>NT<u>F</u>NC<u>F</u>

   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
   SAMP<u>UL</u> 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 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.
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. 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 6×100=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.
6. 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
X:06	216	X:07	212	X:08	208	X:09	204	X:10	200	X:11	196
X:12	192	X:13	188	X:14	184	X:15	180	X:16	176	X:17	172
X:18	168	X:19	164	X:20	160	X:21	156	X:22	152	X:23	148
X:24	144	X:25	140	X:26	136	X:27	132	X:28	128	X:29	124
X:30	120	X:31	116	X:32	112	X:33	108	X:34	104	X:35	100

X:36	96
X:42	72
X:48	48
X:54	24

X:37	92
X:43	68
X:49	44
X:55	20

X:38	88
X:44	64
X:50	40
X:56	16

X:39	84
X:45	60
X:51	36
X:57	12

X:40	80
X:46	56
X:52	32
X:58	8

X:41	76
X:47	52
X:53	28
X:59	4

For example if they solved the time question at the 6:46 mark, you would add 720 (from the 6:xx entry in the first table) to 56 (from the X:46 entry in the second table) to get a bonus of 776. If they had solved it in exactly 4:00 minutes, you would add 1200 and 240 to get a bonus of 1440.

7. 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	14
2	10
3	2
4	17
5	13
6	11
7	8
8	19
9	15
10	5
11	4
12	18
13	16
14	9
15	20
16	7
17	6
18	3
19	Timed
20	12
21	1

0. 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 **[200 points]** Solve this Aristocrat about Tetris. When you finish, yell "Boom, Tetris for Jeff!" When you have solved it, raise your hand so that the time can be recorded and the solution checked.

DCF TJAAFB XL DCF OMVRRJO DFDBJR TXBMI OCVGKJXARCJKR
THE WINNER OF THE CLASSIC TETRIS WORLD CHAMPIONSHIPS

LXB DCF KVRD DTX UFVBR TVR VA VRJVA DFFAVPFB LBXG
FOR THE PAST TWO YEARS WAS AN ASIAN TEENAGER FROM

OVMJLXBAJV.
CALIFORNIA.

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

1) **[100 points]** Solve this Caesar about the number that is the shift.

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

M	X	U	H	U		Q	T	T	Y	D	W		E	D	U		Q	V	J	U	H		H	Q	Y	I	Y	D	W		J	M	E		J	E
W	**H**	**E**	**R**	**E**		**A**	**D**	**D**	**I**	**N**	**G**		**O**	**N**	**E**		**A**	**F**	**T**	**E**	**R**		**R**	**A**	**I**	**S**	**I**	**N**	**G**		**T**	**W**	**O**		**T**	**O**

J	X	U		F	E	M	U	H		E	V		J	X	Y	I		D	K	C	R	U	H		Y	I		F	H	Y	C	U	.
T	**H**	**E**		**P**	**O**	**W**	**E**	**R**		**O**	**F**		**T**	**H**	**I**	**S**		**N**	**U**	**M**	**B**	**E**	**R**		**I**	**S**		**P**	**R**	**I**	**M**	**E**	.

2) **[400 points]** Special Agent, Grace, has the following RSA public key:

n = 14960779 e = 3982641

Unfortunately for them, A quantum computer has successfully factored their n

14960779 = 2579 * 5801

Compute the value of their private key:

Enter the computed private key:

5802561

3) **[200 points]** Solve this K1 aristocrat.

EN MNNQ BX WKUN "ANDNMBNNM PXWN ACMQKG" VNAA PJNNYG.
WE NEED TO MAKE "SEVENTEEN COME SUNDAY" LESS CREEPY.

VNB'A PSKMIN LB BX "NLISBNNM PXWN BCNAQKG." BSKB'VV
LET'S CHANGE IT TO "EIGHTEEN COME TUESDAY." THAT'LL

RLF LB! JLISB?
FIX IT! RIGHT?

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	6	11	2	1	1	1	3		3	2	5	5	6	19		4	3	1	4		1	4	3	4	1	
Replacement	S	T	U	V	W	X	Y	Z	G	R	A	I	N	E	B	C	D	F	H	J	K	L	M	O	P	Q

4) **[300 points]** Solve this Hill using the keyword HELP.

$$\begin{pmatrix} H & E \\ L & P \end{pmatrix} \equiv \begin{pmatrix} 7 & 4 \\ 11 & 15 \end{pmatrix}$$

M	O	A	N	X	Y	E	X	R	F	C	Z	S	A	P	R
I	**C**	**A**	**N**	**T**	**F**	**I**	**N**	**D**	**M**	**Y**	**R**	**E**	**E**	**D**	**S**

5) **[300 points]** Solve this Baconian where 4 digits correspond to A and the other 4 correspond to B.

1534215321507321532153264105321532157632153241532153201
AAABAAAAAAABBAAAAAAAAAABBABAAAAAAAAABBAAAAAABAAAAAAAABA
C A N A D I A N B A C

5763420715362154321057362145321053721653215321450732615
ABBABABBAAABAAABAAABABABAABAAAABAABAABAAAAAAAABABBAABAA
O N I S L I K E A M E

4321530215321753215326415321503215321573264105763215324
BAAAAABAAAAAABAAAAAAABBAAAAAABAAAAAAAAABAABBABABBAAAAAAB
R I C A N B A C O N B

0157643201537264153210532157321645321507362415032153721
BAABBBAABAAABABBAAAAABAAAAABAAABBAAAAABBABABAABAAAAABAA
U T F R I E N D L I E

6532153215340215327641053271536214532076153241503271563
BAAAAAAAAAABBAAAAABBBABAAABAAABAABAAABBBAAAABAABAABAABA
R A N D W I T H B E T

4210532715632153240715632153215430271563214075326153215
BAABAAABAABAAAAAABBBAABAAAAAAAAABABABAABAAABBBAAABAAAAA
T E R H E A L T H C A

4321532015
BAAAAAABAA
R E

canadian bacon is like american bacon, but friendlier and with better healthcare.

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6) **[200 points]** Solve this Affine where A=7 and B=16 that also gives the key for the next question. The quote is a sentence with a "random" nonsensical word thrown in, which is the key for the next question.

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

7) **[200 points]** Solve this Vigenere where the key was given in the previous question.

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

R	A	D	O	X	P	A	R	A	D	O	X	P	A	R	A	D	O	X	P	A	R	A	D	O	X
B	S	W	V	F	H	I	J	T	K	S	O	T	A	C	P	D	F	X	S	O	O	H	H	F	B
K	**S**	**T**	**H**	**I**	**S**	**I**	**S**	**T**	**H**	**E**	**R**	**E**	**A**	**L**	**P**	**A**	**R**	**A**	**D**	**O**	**X**	**H**	**E**	**R**	**E**

8) **[350 points]** Solve this tongue-twister Aristocrat.

QH OIB IQOTVPR IBXWF ICOTV OIB ICOTVPR, IVQTV IQOTV
IF TWO WITCHES WOULD WATCH TWO WATCHES, WHICH WITCH

IBXWF ICOTV IVQTV ICOTV?
WOULD WATCH WHICH WATCH?

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

9) **[250 points]** A quote has been encoded using the Morbit Cipher for you to decode. You are told that the quote ends with **NE/IT**.

```
9 8 4 6 7 8 3 9 8 4 9 3 3 4 9 4 2 6 9 1 8 4 8 1 2
-●●●×●●-×-●●●×-●●●×●-●●×●××●-●×●-×●--●××●●×●●●××-×
B    U   B    B    L    E /R   A   P   / I   S   / T

8 8 4 1 5 3 3 9 4 9 4 1 5 2 8 9 1 5 4 6 4 8 4 3 9 9
●●●●×●××--●×●×-●×●-●×●××---×●●-●××--×●●-×●●●×●●×-●-●
H    E/ G   E N  R   E/ O   F   / M  U   S   I   C

1 6 2 8 8 4 4 9 4 1 9 5 7 5 4 6 1 6 7 9 7 9 4 9 4
××●--×●●●●×●×●-●×●××-●--×---×●●-××●-×--●×--●×●-●×●
/ W   H    E R   E/ Y    O   U   / A  G   G   R   E

4 8 4 8 4 3 8 6 4 4 9 3 9 5 1 6 9 7 5 4 5 3 7 8 3
×●●●×●●●×●●×●●●-×●×●-●●×-●--××●--●×---×●--●××-●●●×
 S   S   I  V    E L   Y   / P   O   P    /B

8 2 9 8 7 8 3 6 8 4 1 6 2 6 3 6 4 5 3 4 2 9 7 8 1 6
●●-×-●●●×-●●●×●-●●×●××●--×●-●×●-×●--●××●-×-●×-●●××●-
U   B    B    L    E/ W   R   A  P    /A  N  D  / A

4 6 7 7 5 7 4 6 7 3 3 4 3 2
×●●-×-×---×-×●●-×-●×●××●●×-×
 U   T O   T U   N  E /I  T
```

10) **[500 points]** Solve this K2 Patristocrat.

```
TDUWY VRGIF XLWKF ZGETR UDBTD UDJKI LAYDK UJRFL
ANICE BYPRO DUCTO FPLAY INGAN INSTR UMENT ISYOU

JLXXY DERVY WFAYI YTEER BFFXT KIORK OABTA YJ
SUDDE NLYBE COMER EALLY GOODA TRHYT HMGAM ES
```

a nice byproduct of playing an instrument is you suddenly become really good at rhythm games.

Replacement	T	V	W	X	Y	Z	B	O	U	N	C	E	A	D	F	G	H	I	J	K	L	M	P	Q	R	S
K2	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	3		6	4	6	2		4	4	5	4			2			6		6	4	2	3	4	7	1

11) **[350 points]** A quote has been encoded using the Pollux Cipher for you to decode. You are told that `1=–`, `2=×`, `3=×`, `4=●`, `5=×`, `6=●`

```
12448634269424556758162433943997337430903162026965682844 1
–×●●●●×●×●–●×●××●–×●–●×●××–●×–––××–●×–––×–●×–×●–●×●●×●●●–
T H   E R   E A R   E N O   N O   N T R   I V

3665412418425486502641380785862948239740368726246621244
×●●×●–×●–●●××●●●×–×●●–×●––●×●●×–●●××––●–×●●–×●×●●●×–×●●
 I A L   S T U P   I D   Q   U E S T I

5977296584632872042066531617382684326734883080368214307 6
×–––×–●×●●●××●–×–●×–●●××–●––×●×●●●××●–×●●●×–●–×●●×–●×––●
 O N S   A N D   Y   E S   A S K I N G

2241736468561505316143910366039820288625643684251349 8
××●––×●●●●×●–×–××–●–●×–––×●●–×–●×–×●●●××●●×●●●××–×●–●
  W H   A T C   O U N T S   I S   T R

3845864056626126966326050839843560482638808372369286 8
×●●×●●●–×●●×●–×●–●●××●–×–●×–●●××●–●●×●×●●–●×–××●–×●●●
 I V   I A L   A N D   L   E F   T A S

2249274556208802456142969428838462852120902503868828356 14
××●–×–●×××●×–●●–×●×●–●×–●–●×●●×●●●×●××–×–––××–×●●●●×●××●–●
  A N   E X   E R   C   I S   E T O   T H   E R

285403048562674
×●×●–×–●●×●×●–●
 E A D   E R
```

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12) **[150 points]** Solve this Caesar.

X	U		N	D	J		P	S	S		T	X	V	W	I		I	D		I	W	T		E	G	T	K	X	D	J	H		H	W	X	U	I	,
I	F		Y	O	U		A	D	D		E	I	G	H	T		T	O		T	H	E		P	R	E	V	I	O	U	S		S	H	I	F	T	,

N	D	J		V	T	I		I	W	T		H	W	X	U	I		U	D	G		I	W	X	H		F	J	T	H	I	X	D	C	!		Q	N
Y	O	U		G	E	T		T	H	E		S	H	I	F	T		F	O	R		T	H	I	S		Q	U	E	S	T	I	O	N	!		B	Y

I	W	T		L	P	N	,		I	W	T		H	W	X	U	I		X	H		I	W	T		H	B	P	A	A	T	H	I
T	H	E		W	A	Y	,		T	H	E		S	H	I	F	T		I	S		T	H	E		S	M	A	L	L	E	S	T

C	J	B	Q	T	G		I	W	P	I		X	H		I	W	T		E	G	D	S	J	R	I		D	U		P		E	P	X	G		D	U
N	U	M	B	E	R		T	H	A	T		I	S		T	H	E		P	R	O	D	U	C	T		O	F		A		P	A	I	R		O	F

I	L	X	C		E	G	X	B	T	H	.
T	W	I	N		P	R	I	M	E	S	.

13) **[350 points]** Solve this Xenocrypt.

ZY LPSOFSPY USP MG OPDRDUY SG DKNY JMS TS NMUBD, JMS
YO PREFIERO SER UN FRACASO EN ALGO QUE ME GUSTA, QUE

MG SVFBY SG DKNY JMS YÑFY.
UN EXITO EN ALGO QUE ODIO.

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

Translation: *I'd rather be a failure at something I love than a success at something I hate.*

14) **[500 points]** Solve this Patristocrat which is a question about a math concept.

YXNJE IQOPI AMEAB IQGOM VOQBI MXCIH UIVXD NIASX
WASTH EPIGE ONHOL EPRIN CIPLE NAMED BECAU SEOFA

CXJEI CXJOV OXMJE XJEXH XUOGH AUNIN NOAM
MATHE MATIC IANTH ATHAD ABIRD OBSES SION

was the pigeonhole principle named because of a mathematician that had a bird obsession?

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

15) **[300 points]** Hayley and Brendan are accountants for a very large bank, and have started a friendship. They communicate via email, because they live thousands of miles apart. Brendan gets curious and asks Hayley the year that they were born. Hayley doesn't mind telling Brendan, but they know that the bank monitors all employee emails, and is afraid of being the victim of age discrimination. Therefore, Brendan suggests that they use RSA, and they provides their public key: (7663, 2761). Hayley replies with the ciphertext 4026. Brendan's private key is 697. In what year was Hayley born?

Enter the answer:

1988

16) **[250 points]** Solve this Vigenere which is the description of a mathematical result. The keyword is the the person it is named after. It ends with "the half of pi."

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

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

L	E	T	D	I		R	I	C	H	L		E	T	D
T	W	M	K	M		Y	I	N	M	Z		J	I	L
I	**S**	**T**	**H**	**E**		**H**	**A**	**L**	**F**	**O**		**F**	**P**	**I**

17) **[350 points]** Solve this Hill.

$$\begin{pmatrix} B & R & I \\ G & H & T \\ E & S & T \end{pmatrix} \equiv \begin{pmatrix} 1 & 17 & 8 \\ 6 & 7 & 19 \\ 4 & 18 & 19 \end{pmatrix} \qquad Decode \begin{pmatrix} B & R & I \\ G & H & T \\ E & S & T \end{pmatrix}^{-1} \equiv \begin{pmatrix} 15 & 7 & 25 \\ 24 & 13 & 7 \\ 22 & 4 & 21 \end{pmatrix}$$

H	Z	R	I	Z	Q	V	M	S	R	I	G	Y	D	V	H	I	Y	A	H	D	O	F	S	J	D
D	**O**	**N**	**T**	**F**	**O**	**R**	**G**	**E**	**T**	**I**	**M**	**W**	**I**	**T**	**H**	**Y**	**O**	**U**	**I**	**N**	**T**	**H**	**E**	**D**	**A**

X	L	I	D
R	**K**	**Z**	**Z**

18) **[250 points]** Solve this Affine that begins with "SO"

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

M	X	X	G	K	D	C	C	O	N	Z	G	Z	D	P	H	Q	T
F	**O**	**O**	**T**	**B**	**A**	**L**	**L**	**J**	**U**	**S**	**T**	**S**	**A**	**Y**	**I**	**N**	**G**

19) **[300 points]** Solve this Aristocrat about a French composer.

NIBYXCZ GATPSYX LIAUS B ZAYBUB NAI ULA XPBICYSUZ,
FRANCIS POULENC WROTE A SONATA FOR TWO CLARINETS,

LRSIS AYS CZ UTYSH RBPN B ZUSG ANN AN URS AURSI. CU
WHERE ONE IS TUNED HALF A STEP OFF OF THE OTHER. IT

CZ WTCUS XAYUSJGAIBIM BYH ZATYHZ PCDS ZAJSURCYQ ATU
IS QUITE CONTEMPORARY AND SOUNDS LIKE SOMETHING OUT

AN ZUIBKCYZDM'Z PCEIBIM.
OF STRAVINSKY'S LIBRARY.

	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	15	11	10	2	1		3	3	11	2	1	3	3	7		5	1	5	14	5	14		1	4	11	12
Replacement	O	A	I	K	B	J	P	D	R	M	V	W	Y	F	X	L	G	H	E	U	T	Z	Q	C	N	S

20) **[200 points]** A quote has been encoded using the Morbit Cipher for you to decode. You are told that 1=−●, 2=●●, 3=●−, 4=××, 5=●×, 6=−×

6 2 2 7 4 8 6 1 7 1 5 1 8 4 1 1 9 8 7 3 9 5 6 3 5
−×●●●●×●××−−−×−●×●−●●×−●−−××−●−●×−−−×●●−×−●×−×●−●×
T H E/ O N L Y / C O U N T R

1 8 4 6 2 2 7 6 6 7 2 5 3 7 2 4 5 2 3 7 7 1 4 3 2
−●−−××−×●●●●×●−×−××●●●●×●−×●●●××●×●●●−×●×●−●××●−●●
Y / T H A T /H A S / E V E R / L

9 8 7 2 9 4 3 4 3 6 3 7 1 4 3 6 2 9 7 2 5 7 6 9 5
×−−−×●●●×−××●−××●−−×●−×●−●××●−−×●●×−×●●●●××●−××−●×
O S T/ A / W A R / W I T H /A /N

8 6 1 4 2 2 7 3 9 6 3 9 5 7 6 1 7 5 8 7 6 3 2 4 2
−−−×−●××●●●●×●●−×−−×●−×−●××●−×−●×●●×−−×●−×●−●●××●●
O N / H U M A N /A N I M A L / I

7 2 4 3 7 3 7 2 9 7 1 7 6 3 2 7 5 3
×●●●××●−×●●−×●●●×−×●−●×●−×●−●●×●●×●−
S / A U S T R A L I A