

Science Olympiad — Jhahria Cødebusters

Exam I

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

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

X:31	116
X:37	92
X:43	68
X:49	44
X:55	20

X:32	112
X:38	88
X:44	64
X:50	40
X:56	16

X:33	108
X:39	84
X:45	60
X:51	36
X:57	12

X:34	104
X:40	80
X:46	56
X:52	32
X:58	8

X:35	100
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	6
2	8
3	13
4	7
5	2
6	14
7	5
8	4
9	10
10	3
11	17
12	18
13	19
14	Timed
15	16
16	11
17	15
18	12
19	9
20	1

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 [200 points] Solve this aristocrat which is a line from a famous song by twenty øne piløts song. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

**J PWY FMBO PILV J HLF MBOLU WBB SX KLUY PMCBO
I WAS TOLD WHEN I GET OLDER ALL MY FEARS WOULD**

**YIUJVR ZCF VMP J'S JVYLECUL, WVO J EWUL PIWF QLMQBL
SHRINK BUT NOW I'M INSECURE, AND I CARE WHAT PEOPLE**

**FIJVR.
THINK.**

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

1) [100 points] Decode this phrase from a twenty øne piløts song using a Caesar Cipher.

H	V	S	M	G	O	M	,	"	G	H	O	M	W	B	M	C	I	F	Z	O	B	S	,	P	C	M	,	Z	O	B	S	,
T	H	E	Y	S	A	Y	,	"	S	T	A	Y	I	N	Y	O	U	R	L	A	N	E	,	B	O	Y	,	L	A	N	E	,
P	C	M	"	P	I	H	K	S	U	C	K	V	S	F	S	K	S	K	O	B	H	H	C	H	V	S	M					
B	O	Y	"	B	U	T	W	E	G	O	W	H	E	R	E	W	E	W	A	N	T	T	O	T	H	E	Y					
H	V	W	B	Y	H	V	W	G	H	V	W	B	U	W	G	O	V	W	U	V	K	O	M	,	V	W	U	V	K	O	M	
T	H	I	N	K	T	H	I	S	T	H	I	N	G	I	S	A	H	I	G	H	W	A	Y	,	H	I	G	H	W	A	Y	
P	I	H	K	W	Z	Z	H	V	S	M	P	S	O	Z	W	J	S	H	C	A	C	F	F	C	K	?						
B	U	T	W	I	L	L	T	H	E	Y	B	E	A	L	I	V	E	T	O	M	O	R	R	O	W	?						

2) [500 points] Solve this aristocrat which encodes the opening lines of a song from the twenty øne piløts album "Trench".

**FPKBMYKBF M WBBJ NPJX, BHBR UGOGJZDBX. KZ MRYBOMPO
SOMETIMES I FEEL COLD, EVEN PARALYZED. MY INTERIOR**

**TPOJX RBBXF YP FGRMYMDB. M'HB QPY YP FYBU YSOPVQS PO
WORLD NEEDS TO SANITIZE. I'VE GOT TO STEP THROUGH OR**

**M'JJ XMFFMUGYB. M'JJ OBNPOX KZ FYBU YSOPVQS WPO KZ
I'LL DISSIPATE. I'LL RECORD MY STEP THROUGH FOR MY**

**IGFBKBRY YGUBF.
BASEMENT TAPES.**

	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		19		2		10	6	2	1	8	6		11	2	10	12	3	5	4	1	5	2	2	6	13	4
Replacement	Q	E	K	Z	J	S	A	V	B	L	M	X	I	C	R	O	G	N	H	W	P	U	F	D	T	Y

3) [300 points] Solve this aristocrat which encodes the opening verse of the twenty øne piløts song "Johnny Boy".

QZ FEMIF QAKZ NOAK VAOY EQRF ERKZ, QZ SZDZO OZMHHI
HE STAYS HOME FROM WORK THIS TIME, HE NEVER REALLY

EAHB QRF VRNZ, QZ SZDZO OZMHHI EAHB M HRZ, GXE EQRF
TOLD HIS WIFE, HE NEVER REALLY TOLD A LIE, BUT THIS

ERKZ QZ BZPRBZF EQME RE'F MHORJQE.
TIME HE DECIDES THAT IT'S ALRIGHT.

	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	4		2	12	7	1	8	3	1	4		6	2	7	1	10	10	2			2		1	1	17
Replacement	O	D	Q	V	T	S	B	L	Y	G	M	X	A	F	R	C	H	I	N	P	J	W	Z	U	K	E

4) [350 points] Solve this aristocrat which encodes lines from a twenty øne piløts song.

NBFCYX EF JPY ZBLXEQ SZ JPEG JPEFC E UBNY. E
DANGER IN THE FABRIC OF THIS THING I MADE. I

IXSLBLMV GPSWMNF'J GPST VSW, LWJ EJ'G TBV JSS MBJY.
PROBABLY SHOULDN'T SHOW YOU, BUT IT'S WAY TOO LATE.

UV PYBXJ EG TEJP VSW PENEFC, LWJ UV UEFN'G FSJ UBNY.
MY HEART IS WITH YOU HIDING, BUT MY MIND'S NOT MADE.

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

5) [400 points] Solve these twenty øne piløts song lyrics misheard by a smart speaker and encoded as a K1 aristocrat.

NGN OY QAOKNR, QOZ GAJ UNMN. V EN'KK SKG, EVLU XZAE
EYE AM COALED, CAN YOU HERE. I WE'LL FLY, WITH KNOW

UABN, XZAE SNOM. OZR LUN TMAJZR, LOJZLD YG EUVZTD.
HOPE, KNOW FEAR. AND THE GROUND, TAUNTS MY WHINGS.

BKJY YNL OD NGN DVZTU, BKJY YNL OD NGN DVZTU.
PLUM MET AS EYE SINGH, PLUM MET AS EYE SINGH.

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	3		6	5		6			5	6	6	3	15	8		2	3	2	4	7	5		2	6	9
Replacement	O	P	Q	S	W	X	Y	Z	V	U	L	T	R	E	A	B	C	D	F	G	H	I	J	K	M	N

6) [900 points] Solve these twenty øne piløts song lyrics misheard by a smart speaker and encoded as a K2 aristocrat.

JCJ OTC ONPH YTE00 UJJ OSX TMW ONTJS ONJ HEWI. EH
EYE TRY THIS PRATT LEE TWO RUN THREW THE SAND. AS

JCJ XUI ONJ SEOJT PW ONJ YXV XK VC EWI. 'GEMHJ POH
EYE OLD THE WATER IN THE POM OF MY AND. 'CAUSE ITS

XPU ONEO JCJ NEUAJ EWI POH EUU ONEO JCJ RWJEI EWI
OIL THAT EYE HALVE AND ITS ALL THAT EYE KNEAD AND

ONJ SEPAJH XK ONJ SEOJT VJEW WXONPWL OSX VJ.
THE WAIVES OF THE WATER MEAN NOTHING TWO ME.

Replacement	E	F	G	I	J	K	L	N	P	Q	R	U	V	W	X	Y	Z	T	H	O	M	A	S	B	C	D
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	2		6		16		1	7	6	24	2	1	2	11	21	7		1	6	6	6	4	10	8	2	

7) [500 points] Solve this K2 patristocrat that encodes lines from a twenty øne piløts song that begins with **PETR**.

BUFDY VYUTH VKXHN HGPDU PITKX HNHGX PJUQU RHLUN
PETRI FIEDO FWHOY OUARE ANDWH OYOUH AVEBE COMEY

HGKYA AXYTU VDHLU JUDNH IUTUI NYIWN HGIUU TEHLU
OUWIL LHIDE FROME VERYO NEDEN YINGY OUNEE DSOME

HIUFH UMFUD LYIPF UNHGD QHIUE
ONETO EXTER MINAT EYOUR BONES

Petrified of who you are and who you have become. You will hide from everyone, denying you need someone to exterminate your bones.

Replacement	P	Q	R	T	U	V	W	X	Y	Z	S	A	L	I	H	B	C	D	E	F	G	J	K	M	N	O
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	2	1		6	2	4	5	15	8	2	3	4	1	7		4	2	1		5	19	3	1	4	6	

8) [600 points] Solve this patristocrat which encodes lines from a twenty øne piløts song.

EWTDT OPLNT OAUNM ZSLZU DAZEA UFOMZ SGTDT SILZV
THERE SMILE SOFLA NDINF RONTO FUSAN DWERE DYING

GLEWT KTDIO ETBGT EMYTG TDTSI LZVGL EWTKT DIQDT
WITHE VERYS TEPWE TAKEW EREDY INGWI THEVE RYBRE

MEWGT PMYTM ZSMNN UMNLL ZNLZT
ATHWE MAKEA NDALL FALLI NLINE

There's miles of land in front of us. And we're dying with every step we take. We're dying with every breath we make. And all fall in line.

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	3	1		7	7	1	6		4		2	8	8	7	4	2	1		5	18	4	2	4		2	9
Replacement	O	P	Q	R	T	U	W	X	Y	Z	V	I	A	L	S	M	B	C	D	E	F	G	H	J	K	N

9) [100 points] This famous line from a hit twenty øne piløts song needs to be encoded with the Affine Cipher using $a=23$ and $b=10$.

M	Y	N	A	M	E	'	S	B	L	U	R	R	Y	F	A	C	E	,	A	N	D	I	C	A	R	E	W	H	A	T
A	Q	X	K	A	Y	'	I	H	D	C	L	L	Q	V	K	E	Y	,	K	X	B	M	E	K	L	Y	W	P	K	F

Y	O	U	T	H	I	N	K	.
Q	U	C	F	P	M	X	G	.

10) [300 points] The following well-known line from a twenty øne piløts song beginning with **WH** needs to be decoded with the Affine Cipher.

S	H	A	O	,	G	'	C	J	O	D	D	G	B	I	,	W	A	G	'	C	V	O	E	G	B	I	C	Q
W	H	O	A	,	I	'	M	F	A	L	L	I	N	G	,	S	O	I	'	M	T	A	K	I	N	G	M	Y

V	G	C	K	A	B	C	Q	X	G	L	K	.
T	I	M	E	O	N	M	Y	R	I	D	E	.

11) [120 points] Encode this phrase heard in the twenty øne piløts song "Migraine" using Vigenere with a keyword of "SKELETON".

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

12) [100 points] Decode these lines from the twenty øne piløts song "Message Man" which were encoded with the keyword "CLIQUE".

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

13) [500 points] Decode this baconian which encodes yet more lines from "Message Man", by twenty øne piløts.

ψϕλ|/ψ-λϕ*/ψ|-ϕλ*/ψ|ϕ-ϕ/ϕ*ψ|-ϕϕ*/|-/ϕψϕ*/|-ϕ/ϕψϕ*/
BABBAABBABBAABBAAABBABBABABBAABAABAABAABBAAABBABBAB
Y O U D O N T K N O W

|-ϕ/ψλ|/ψ-ϕ*/|-λϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/
AAABABBABBABBAABBAABBAABBAABBAABBAABBAABBAABBAABBAAB
M Y B R A I N T H E

ϕ|-ϕ/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/
ABAAAAAABABBABABBAABBABBAABBABAABABBAAABBABBABAAABAB
W A Y Y O U K N O W M

λ|/ψ-ϕλ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/
BBABBAABBAAAAAABABBAABAABABBAABBABBAABBAAABBABBABBAB
Y N A M E Y O U D O

ϕ|-/ϕ*ψ|-ϕϕ*/|/ψ-ϕλ*/|/ψ-ϕλ*/|ϕ-ψϕ*/|/ψ-ψϕ*/|/ψ-ψϕ*/|
BAABAABAABAABBAAABBABBABAAABABBABBAAABBBAABAABAAAAAA
N T K N O W M Y H E A

ψ*|-ϕϕ*/|ϕ-ψϕ*/|-ϕλ*/|ψ-ϕϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/|-ϕ*/
BAAAABAABABAABAABBBAAABAABABAAAAAABABBABABBBAABBABBAA
R T T H E W A Y Y O U

λ*/|-ψϕλ*/|-ψϕλ*/|-ψϕλ*/|-ψϕλ*/|-ψϕλ*/|-ψϕλ*/|-ψϕλ*/|-ψϕλ*/
BBABAABBBAABBABBABAAABABBABBAAABABAAAAAABAAABAA
K N O W M Y F A C E

You don't know my brain the way you know my name. You don't know my heart the way you know my face.

14) [400 points] Figure out what these strange headlines encoded using a Baconian alphabet mean. It encodes some lines from a twenty one pilots song that begins with the word "YOU'RE".

BADLY A PLAN BE OLD BACK A ACRES BE ITS EARTH ACRES
BABBA ABBAB BAABB BAAAA AABAA BAABA AABBB AABAA
Y O U/V R E T H E

A BOOK BE OLD A CALL AMPLE ACRES A PLAN EARTH ABBEY
ABAAA BAABB AAABB AABBA AABAA ABBAB AABBB ABBAA
I/J U/V D G E O H N

A PLAN BACON ACRES BE ITS A HAND ACRES A SHOT BACK A
ABBAB BAAAB AABAA BAABA ABABB AABAA AABAB BAAAA
O S E T M E F R

ACRES ACRES A BOOK A BEAT ABBEY A PLAN BABES A HAND
AABAA AABAA ABAAA ABAAB ABBAA ABBAB BABAA ABABB
E E I/J K N O W M

BADLY BACON A PLAN BE OLD A BABY BACON A SHOT BACK A
BABBA BAAAB ABBAB BAABB ABABA BAAAB AABAB BAAAA
Y S O U/V L S F R

ACRES ACRES BIRTH A BOOK ABBEY AMPLE EARTH ACRES
AABAA AABAA BABBB ABAAA ABBAA AABBA AABBB AABAA
E E Z I/J N G H E

A BABY A BABY BACON EARTH A PLAN BE ITS A SHOT A PLAN
ABABA ABABA BAAAB AABBB ABBAB BAABA AABAB ABBAB
L L S H O T F O

BACK A AMPLE A PLAN A PLAN A CALL BACK A ACRES A CASE
BAAAA AABBA ABBAB ABBAB AAABB BAAAA AABAA AAAAA
R G O O D R E A

BACON A PLAN ABBEY BACON A PLAN ALPHA A BABY ACRES
BAAAB ABBAB ABBAA BAAAB ABBAB ABBBA ABABA AABAA
S O N S O P L E

A CASE BACON ACRES BE ITS A CASE A BEAT ACRES A HAND
AAAAA BAAAB AABAA BAABA AAAAA ABAAB AABAA ABABB
A S E T A K E M

ACRES
AABAA
E

You're the judge, oh no
Set me free
I know my soul's freezing
Hell's hot for good reason
So please, take me

15) [100 points] Using a key of **NICONINER**, encode the following phrase heard repeatedly in the twenty øne piløts song "Nico and the Niners".

$$\begin{pmatrix} N & I & C \\ O & N & I \\ N & E & R \end{pmatrix} \equiv \begin{pmatrix} 13 & 8 & 2 \\ 14 & 13 & 8 \\ 13 & 4 & 17 \end{pmatrix}$$

E	A	S	T	I	S	U	P	
K	S	U	J	U	N	O	Z	R

16) [160 points] Decode this phrase heard in the twenty øne piløts song "Car Radio" with a keyword of **VSSL**.

$$\begin{pmatrix} V & S \\ S & L \end{pmatrix} \equiv \begin{pmatrix} 21 & 18 \\ 18 & 11 \end{pmatrix}$$

G	K	M	A	X	O	M	A	Q	G	S	G	K	V	Y	E	N	Y	Y	J	G	H	R	T
S	O	M	E	T	I	M	E	S	Q	U	I	E	T	I	S	V	I	O	L	E	N	T	Z

17) [250 points] The opening lines from "Isle of Flightless Birds", by twenty øne piløts, have been encoded using the Pollux Cipher for you to decode. You are told that 6=-, 3=-, 8=-, 2=x, 5=x, 9=x.

84933897630541547759801174042281342734794198897308113

-●x---x●--xx●●x●●●xx-x●●●●x●xx-●-●x●-●●x●●x--x●-x-●●-
N O W I S T H E C L I M A X

0269383253911442492741569868073108138523044475765652887

xx-x---xx-x●●●●x●xx●●●x-x---x●-●x-●---xx-x●●●●x●-x-xx--●
T O T H E S T O R Y T H A T G

94101713979114208514410122377215839368964971195765875847

x●●x●●●-x●x●●●xx-x●●●●x●xx-●●x●x--x---x-●x●●●xx●-x-●x-●●
I V E S T H E D E M O N S A N D

991653408640127311947720766191785731976670683911127226

xx●-x-●x--●x●x●-●●x●●●xx●--●x●●-x●-●x●--●x---x●●●x●xx-
A N G E L S P U R P O S E T

21141212816602478421317561330243973408689178084564750738

x●●●●x●x-●---xx●●-●x●-●●x-●---xx●-x●-●x---x●●-x-●x-●●xx●--
H E Y F L Y A R O U N D W

9741151157677570518307227327310150733976076742346577581

x●●●●x●●x●-●●x●xx●--x●xx●-x●-●x●xx●--x●-x●-●●x-●-x●●x-●
H I L E W E A R E W A L K I N

5864

x--●
G

18) [249 points] We'll end with the beginning. The opening lines from "Implicit Demand for Proof", twenty øne piløts's first song, have been encoded using the Morbit Cipher for you to decode. You are told that 1=xx, 6=•x, 2=-x, 3=x•, 7=••, 5=•-.

7 1 9 2 9 8 4 3 4 1 9 4 8 4 3 5 1 5 6 6 8 6 4 2 2
••xx-•-x-•x---x•--xx-•---x---x••-xx•-•x•xx-•x---x-x
I / K N O W / Y O U / R E / N O T

3 2 3 9 6 7 3 2 5 6 3 2 9 8 7 1 7 1 9 2 9 8 4 3 4
x•-xx•-••x••x•-x•-•xx•-x-x•-••xx••xx-•-x-•x---x•--
/A /L I A R /A N D /I /K N O W

1 9 4 8 4 3 5 1 9 9 8 4 3 5 3 9 6 9 6 3 7 3 8 1 7 9
xx-•---x---x••-xx-•-•x---x••-x•-••x-••xx•••x•x-xx••-•
/ Y O U / C O U L D /S E T/ F

3 6 5 6 6 8 3 7 6 7 3 7 1 9 6 5 8 5 2 8 9 8 4 1 5
x••x•-•x•xx-x••••x••x•••xx-••x•-x-•---xx---x---xx•-
I R E /T H I S /D A Y /G O /A

3 7 6 6 5 8 7 1 5 8 6 9 6 8 2 5 8 5 3 1 4 3 1 5 7
x••••x•x•-x-••xx•-x-x•-••xx--x•-x-•-x•xx--x•xx•-••
H E A D /A N D /M A K E/ M E/ L

8 4 8 4 8 5 1 5 3 4 3 2 9 4 1 7 6 2 5 6 7 8 5 3 1 4
x---x---x-•-xx•-x•---x-x-•---xx•••x-x•-•x••x-•-x•xx--
O O K /A W A Y /S T R I K E/ M

3 1 9 6 4 2 5 2 9
x•xx-••x---x•---x-•
E/ D O W N

19) [200 points] Compute the decryption matrix for this hill cipher key which is the name of the drummer of a band that you might have heard of. Take a guess as to which band it is.

$$\begin{pmatrix} J & O \\ S & H \end{pmatrix} \equiv \begin{pmatrix} 9 & 14 \\ 18 & 7 \end{pmatrix}$$

25	2
10	21