University of Michigan Science Olympiad
2021 Invitational Tournament

Codebusters C Answer Key

Test length: 50 Minutes

Team name: KEY

Student names: KEY

Timed Question **[100 points]** Solve this quote from one of my favorite shows. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

```
PE BAA YDPEQN,  ZEC LBEEZY JPE JPYD UCKCENC BAZEC.  YZ
IN ALL THINGS,  ONE CANNOT WIN WITH DEFENSE ALONE.  TO

JPE,  FZM OMNY BYYBLH.
WIN,  YOU MUST ATTACK.
```

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

1) **[100 points]** Solve this Caesar Cipher with a shift of 11.

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

E	S	P		E	Z	F	C	T	D	E	D		Q	C	Z	X		E	S	P		Q	F	E	F	C	P	?
T	**H**	**E**		**T**	**O**	**U**	**R**	**I**	**S**	**T**	**S**		**F**	**R**	**O**	**M**		**T**	**H**	**E**		**F**	**U**	**T**	**U**	**R**	**E**	?

2) **[150 points]** Solve this quote from a Russian author. It has been encoded with a Caesar Cipher.

X	L	I	V	I	'	W		S	R	P	C		S	R	I		X	L	M	R	K		X	L	E	X		G	E	R		W	E	Z	I		E
T	**H**	**E**	**R**	**E**	'	**S**		**O**	**N**	**L**	**Y**		**O**	**N**	**E**		**T**	**H**	**I**	**N**	**G**		**T**	**H**	**A**	**T**		**C**	**A**	**N**		**S**	**A**	**V**	**E**		**A**

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

3) **[250 points]** Solve this Aristocrat encoded with a K1 alphabet.

```
EHR EXMPWQ SDO MPVMPMEO: EXO FPMGODQO SPL XFNSP
TWO THINGS ARE INFINITE: THE UNIVERSE AND HUMAN

QEFBMLMEJ; SPL M'N PRE QFDO STRFE EXO FPMGODQO.
STUPIDITY; AND I'M NOT SURE ABOUT THE UNIVERSE.
```

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

4) **[250 points]** Solve this saying by Benjamin Franklin.

```
SVJ UPOMJLS NQJLSCPU CU SVJ FPYMB CL, FVTS ZPPB GTD
THE NOBLEST QUESTION IN THE WORLD IS, WHAT GOOD MAY

C BP CU CS?
I DO IN 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		3	6	1		2	1			4		3	2	1	1	6	1		6	2	4	3			1	1
Replacement	P	D	I	Y	Z	W	M	V	X	E	C	S	L	Q	B	O	U	K	T	A	N	H	J	F	R	G

5) **[350 points]** Solve this Aristocrat about the existence of extraterrestrial life.

```
TDSHEASHT A ERAUF ERH TIYHTE TAOU ERZE AUEHKKAOHUE
SOMETIMES I THINK THE SUREST SIGN THAT INTELLIGENT

KAJH HQATET HKTHGRHYH AU ERH IUALHYTH AT ERZE UDUH
LIFE EXISTS ELSEWHERE IN THE UNIVERSE IS THAT NONE

DJ AE RZT EYAHV ED BDUEZBE IT.
OF IT HAS TRIED TO CONTACT US.
```

	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	13	2		5	17	1	1	17	3	2	4	1			2		1	7	2	12	9	1			4	4
Replacement	I	C	Z	O	T	K	W	E	U	F	L	V	Y	B	G	J	X	H	M	S	N	D	P	Q	R	A

6) **[300 points]** Solve this Aristocrat.

```
L SLT HYE YLC PVVT DYBEFXY PZDDVB VIRVBZVTQVC LTU
A MAN WHO HAS BEEN THROUGH BITTER EXPERIENCES AND

DBLGVNNVU WLB VTMEJC VGVT YZC CFWWVBZTXC LWDVB L
TRAVELLED FAR ENJOYS EVEN HIS SUFFERINGS AFTER A

DZSV.
TIME.
```

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

7) **[400 points]** Solve this Aristocrat with spelling errors. The last word is LIFE.

```
I  BIQ  SDZ  CIVKO  PSZ  SIMOP  SZQ  ZFV  ZW  PDNBK  DIO  HQZP
A  MAN  WHO  DARES  TWO  WAIST  WON  OUR  OF  THYME  HAS  KNOT

CMOUZTKVKC  PDK  TIJFK  ZW  JMWK.
DISCOVERED  THE  VALUE  OF  LIFE.
```

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

8) **[600 points]** Solve this xenocrypt from a Spanish novel, which has been encoded with a K1 alphabet. The keyword is in English.

```
VQFK  FC  JQDUKÑQ  Z  XCXH  FWJNQU  HPQU,  RQTSWK  GH  FHZQT
TOME  MI  CONSEJO  Y  VIVA  MUCHOS  AÑOS,  PORQUE  LA  MAYOR

GQJWTH  SWK  RWKEK  NHJKT  WD  NQFITK  KD  KUVH  XCEH  KU
LOCURA  QUE  PUEDE  HACER  UN  HOMBRE  EN  ESTA  VIDA  ES

EKÑHTUK  FQTCT.
DEJARSE  MORIR.
```

K1	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			4	3	3	6	2	9	1	4	13			3	2		1	10	2	2	8	6	2	6	3		2
Replacement	Z	W	I	N	D	M	L	A	B	C	E	F	G	H	J	K	Ñ	O	P	Q	R	S	T	U	V	X	Y

Translation: *take my advice and live many years, because the greatest madness a man can do in this life is to let himself die.*

9) **[250 points]** Decrypt the following cipher text which was encoded using the Affine Cipher with a=11 and b=3.

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

P	Q	N	A	V	I	T	V	.
U	**N**	**I**	**V**	**E**	**R**	**S**	**E**	.

10) **[150 points]** Encrypt the phrase **The quick brown fox jumps over the lazy dog** using the Affine Cipher with a=15 and b=9.

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

D	O	G	.
C	**L**	**V**	.

11) **[150 points]** A phrase by Robert Frost has been encoded using the Vigenère cipher with a code word of TRAVEL. What does it say?

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

```
T R A V E   L T R A V   E L T R A   V E L T R   A V E L T   R A V
Z Z V Z P   P T I N Z   H L U F U   O P T Y V   I O K Z X   J O I
G I V E L   E A R N E   D A B O U   T L I F E   I T G O E   S O N
```

12) **[450 points]** Solve this cipher.

```
A BOOK  IS NOT  BADLY  ENDED  BY OLD  LINES  IDEAS  BASED
ABAAA   AABAB   BABBA  ABBAB  BAABB   BABAA  ABAAA  BAAAB
 I/J     F       Y      O      U/V     W      I/J    S

WORLD  TOWNS  UNDER  ADOPT  AWAKE  ONION  ASHES  GAMMA  ELVIS
AABBB  BAABA  ABBAB  ABABB  AAAAA  ABAAB  AABAA  AAAAA  ABBAA
  H      T      O      M      A      K      E      A      N

GEESE  ULTRA  ENTRY  CHILI  MEDIA  ULTRA  ABYSS  ACRES  ACTOR
AAAAA  ABBBA  ABBBA  ABABA  AABAA  ABBBA  ABAAA  AABAA  AABAB
  A      P      P      L      E      P      I/J    E      F

JUICE  ORBIT  SHARP  LEMON  GOATS  LOGIC  QUICK  HEAVY  AGING
BAAAA  ABBAB  ABABB  BAAAB  AAABA  BAAAA  AAAAA  BAABA  AAABA
  R      O      M      S      C      R      A      T      C

WORLD  FIFTY  UPPER  PEARL  GRIND  TOOTH  LAUGH  DUSTY  GAVEL
AABBB  BABBA  ABBAB  BAABB  ABABB  BAABB  BAAAB  BAABA  AABAB
  H      Y      O      U/V    M      U/V    S      T      F

AN EYE  DAISY  DEMON  HOWLS  CRIME  ALBUM  POUND  GENIE
ABAAA   BAAAA  BAAAB  BAABA  ABAAA  ABBAA  BAABB  AABAA
 I/J     R      S      T      I/J    N      U/V    E

STRAW  BEADS  BEEPS  EARTH  WIRES  PAINT  ALLOW  CHESS  LIGHT
ABBAA  BAABA  BAABA  AABBB  AABAA  BAABB  ABBAA  ABAAA  BAABB
  N      T      T      H      E      U/V    N      I/J    U/V

CURSE  DOCKS  HEIST  GATES
AABAA  BAAAA  BAAAB  AABAA
  E      R      S      E
```
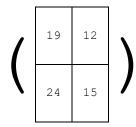
If you wish to make an apple pie from scratch, you must first invent the universe.

13) **[150 points]** Using a key of **VEIL** compute the decryption matrix for a 2x2 Hill with a 26 character alphabet.

$$\begin{pmatrix} V & E \\ I & L \end{pmatrix} \equiv \begin{pmatrix} 21 & 4 \\ 8 & 11 \end{pmatrix}$$

$$\begin{pmatrix} 19 & 12 \\ 24 & 15 \end{pmatrix}$$

14) **[250 points]** Decode this phrase which has been encoded using a 2x2 Hill cipher with a keyword of **DENT.**

$$\begin{pmatrix} D & E \\ N & T \end{pmatrix} \equiv \begin{pmatrix} 3 & 4 \\ 13 & 19 \end{pmatrix}$$

I	Y	J	T	B	L	F	J	B	U
G	E	T	O	V	E	R	I	T	Z

15) **[200 points]** Solve this quote from Oscar Wilde which has been encoded using the Morbit Cipher. You are told that **2=••, 4=•–, 6=××, 9=–•, 1=——, and 7=×–.**

```
9  2  5  6  9  1  7  1  5  4  5  9  5  2  5  5  9  8  2  9  6  8  2  4  5
–●●●×●××–●––×–––×●●–×●–●×●●●×●×●–●●×●●–●××●×●●●–×●
B     E/  Y        O     U     R     S     E  L      F     /  E  V        E

5  9  7  4  3  1  3  9  5  6  8  4  2  5  2  5  6  2  5  2  6  4  5  9  8
×●–●×–●––×–––×–●×●××●×●–●●×●●●×●××●●×●●●××●–×●–●●×
 R     Y     O     N  E/ E  L       S  E/ I  S  /  A  L

4  8  8  4  7  2  7  4  3  7  5  3  9  3  8  9
●–●×●×●–×–●●×–●––××–×●–×–●–×●×–●
R     E  A  D     Y     /T  A  K     E  N
```

16) **[200 points]** Solve this quote from another one of my favorite shows which has been encoded using the Pollux Cipher. You are told that **3=•, 4,9=–, 5,8=×.**

```
98136676729951417318186638534512301552302945473331816
–×●●●●×●×–––×●–●×●●×●×●●●××●–×●–●×●××–●×–––×–×●●●●×●●
T  H     E  O     R     I  E S        A     R     E  N     O     T  H        I

04182237742899203218387976336019523051298499834602135631
×–●×––●××––×–––×●–●×●××–×●●●●×●–×–●××●––×–––×●–●×–●●×●●●
 N     G        M  O     R     E  T H        A     N     W     O     R     D     S

58640462659393018394104081947133101982874694529976395533364
××●–×–●–●×–●–●×●×●––●×–××●––×●●●●●×●–×–××–●––×–––×●●–××●●●–
  A     C        C     E P        T  W     H     A  T  Y     O     U     V

76756118106796
×●××●●●×●×●×–●
 E     S     E  E N
```

17) **[600 points]** A phrase has been encoded as a Patristocrat using a K1 alphabet. What does it say?

```
RSCLW RTWRU WIPWD CSKPI PGFPB WCWDS RUOCS KPXRB
NOTHI NGINL IFEIS TOBEF EARED ITISO NLYTO BEUND

PFDCS SBRSJ WDCLP CWQPC SXRBP FDCGR BQSFP DSCLG
ERSTO ODNOW ISTHE TIMET OUNDE RSTAN DMORE SOTHA

CJPQG OIPGF UPDD
TWEMA YFEAR LESS
```

Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.

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

18) **[500 points]** A quote from Bill Watterson has been encoded as a Patristocrat using a randomized alphabet. The first four letters are INMY.

```
ZOGXS BZOZS OJFUS ORUFL SRFOF YNMXF OSDET PIZFO
INMYO PINIO NWEDO NTDEV OTENE ARLYE NOUGH SCIEN

RZVZI NFPFY NITRS VZOUZ OEYID NFVSN QFNHP
TIFIC RESEA RCHTO FINDI NGACU REFOR JERKS
```

In my opinion, we don't devote nearly enough scientific research to finding a cure for jerks.

	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	10	1	1	4	1		1	1	6	9	3	1	4	7	2	3	3		2	3	8
Replacement	B	P	Q	U	G	E	M	K	C	W	X	V	L	R	N	S	J	T	O	H	D	F	Z	Y	A	I

19) **[500 points]** Solve this Patristocrat encoded with a K2 alphabet. The word **over** is repeated twice.

```
TBGQB  THOTG  VCTBY  HZWGQ  LWHZT  BYCKW  FQBVC  KWFQY
INSAN  ITYIS  DOING  THESA  METHI  NGOVE  RANDO  VERAG

QTBSJ  HWNDW  UHTBY  VTXXW  FWBHF  WGJAH  G
AINBU  TEXPE  CTING  DIFFE  RENTR  ESULT  S
```

Insanity is doing the same thing, over and over again, but expecting different results.

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