

Science Olympiad – Lower Merion Captains Tryouts 2020 2019

Names of participants: (Please print neatly)

School Name: _____

Warning: Do not open this packet until given permission to do so.

Note: There are useful notes after this page.

Scoring:

Time to solve first problem: _____ (use to calculate Bonus below)

Question	Value	Incorrect letters	Deduction	Score
Timed	250			
1	400			
2	700			
3	350			
4	250			
5	150			
6	400			
7	200			
8	400			
9	250			
10	300			
11	200			
12	550			
13	550			
14	350			
15	250			
16	400			
17	500			
18	650			
Bonus				
Final Score				

Question	Value	Incorrect letters	Deduction	Score
19	300			
20	450			
Bonus				
Final Score				

The following tables might be useful during the event.

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

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
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

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

1	3	5	7	9	11	15	17	19	21	23	25
1	9	21	15	3	19	7	23	11	5	17	25

AAAAA	A	AABBA	G	ABBAA	N	BAABA	T
AAAAB	B	AABBB	H	ABBAB	O	BAABB	U/V
AAABA	C	ABAAA	I/J	ABBBA	P	BABAA	W
AAABB	D	ABAAB	K	ABBBB	Q	BABAB	X
AABAA	E	ABABA	L	BAAAA	R	BABBA	Y
AABAB	F	ABABB	M	BAAAB	S	BABBB	Z

Frequency Table of English letters:

E - 12.51%	S - 6.54%	C - 3.06%	G - 1.96%	K - 0.67%
T - 9.25%	R - 6.12%	U - 2.71%	W - 1.92%	X - 0.19%
A - 8.04%	H - 5.49%	M - 2.53%	Y - 1.73%	J - 0.16%
O - 7.60%	L - 4.14%	F - 2.30%	B - 1.54%	Q - 0.11%
I - 7.26%	D - 3.99%	P - 2.00%	V - 0.99%	Z - 0.09%
N - 7.09%				

Frequency Table of Spanish letters:

E - 14.08%	I - 5.98%	M - 3.08%	Y - 1.09%	Z - 0.47%
A - 12.16%	L - 5.24%	P - 2.89%	V - 1.05%	Ñ - 0.17%
O - 9.20%	D - 4.67%	B - 1.49%	G - 1.00%	X - 0.14%
S - 7.20%	T - 4.60%	H - 1.18%	F - 0.69%	K - 0.11%
N - 6.83%	U - 4.69%	Q - 1.11%	J - 0.52%	W - 0.04%
R - 6.41%	C - 3.87%			

For the purposes of cryptograms it is customary to treat n and ñ as distinct letters, but a and á are the same letter. Likewise for e and é, and i and í. In other words, all the accent marks get amputated when working with cryptograms. Also, while some older Spanish dictionaries consider ch, ll, and rr, to be their own letters—this has fallen out of modern usage. Accordingly, “burro” is considered as five letters: “b-u-r-r-o” and not as four letters “b-u-rr-o.”

Morse Code:

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

0	-----	2	••---	4	••••-	6	-••••	8	----••
1	•-----	3	•••--	5	•••••	7	--•••	9	-----•

•	E	-	T	-•	N	--	M	-••	D	-•-	K	-••	G	---	O
••	I	•-	A	•-•	R	•--	W	•--•	P	•---	J	••••-			
•••	S	••-	U	••-•	F	•-••	L	--••	Z	--•-	Q				
••••	H	•••-	V	-•-•	C	-•--	Y								
-•••	B	-••-	X	••---	2	•••---	3								
-----	0	•-----	1	--•••	7	---••	8								
•••••	5	-••••	6												

Timed Question **[250 points]** Solve this quote from Randy Pausch. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

U IN TRUCT JR FXXM AIBUCT VZC XBXSH YIH U AIBX GXVJ,

EXWIZLX JAXSX UL CR RJAXS OIH RV GUVX. HRZ QZLJ AIBX

JR YXWUYX OAXJAXS HRZ ISX I JUTTXS RS IC XXHRSX.

	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	4	5		1	1	2	6	10	8		3	1	1	2		1	10	8	5	8	4	2	22	3	5
Replacement																										

Lower Merion Captains Tryouts 2020

1) **[400 points]** Decrypt the following message. It has been encoded in Hill with a keyword of TART.

$$\begin{pmatrix} T & A \\ R & T \end{pmatrix} \equiv \begin{pmatrix} 19 & 0 \\ 17 & 19 \end{pmatrix}$$

M	L	A	N	K	W	X	O	Y	S	G	P	B	K	T	F	T	P	W	T	K	M	C	

2) **[700 points]** Solve this Patristocrat by Roger de Rabutin de Bussy.

HLQMB RMAQU WPWZM HQTAB YAQUW NAOMA UMJUA BEGAQ

SMQUS MQIHP PHBYM BDABY PMQUS MEOMH U

	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	6		1	2		1	5	1	1		1	11	1	2	4	8	1	3	1	7		3		3	1
Replacement																										

3) [350 points] Solve this quote by Amy Sedaris.

J ZUJOE JZ 'M CSSR KSH I DAHMSO ZS MDAOR ZJFA IBSOA.

JZ CJWAM ZUAF IO SDDSHZVOJZX ZS RJMQSWAH LUS ZUAX

IHA IOR ZS KJCVHA SVZ LUX ZUAX IHA IBLIXM IBSOA.

	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	3	3	4	1	2		7	9	9	2	3	6		8		1	4	14		6	3	2	5		13
Replacement																										

4) [250 points] Solve this K2 Aristocrat.

YDAADMECZ JSX FRJS DY AXRIJ HXIEIJRCUX EI MSRJ BRNXI

TDJS BXC RCW HELXHI UHDDNXW.

Replacement																										
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	3	2	4	6	4	1		4	6	6		1	2	2				6	4	1	2		2	8	2	1

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5) [150 points] Solve this Caesar Cipher.

G	V	F	G	C	V	I	R	I	V	C	P	J	L	T	T	V	V	U	L	E	C	V	J	J	K	Y	V	P	Y	R	M	V
W	L	E	Z	E	N	Y	R	K	K	Y	V	P	R	I	V	U	F	Z	E	X												

6) [400 points] Solve this aristocrat.

EUTZKQ YWK ZB U MEFZMJ. IEJXJ ZB JKFWQE YWK YFX JUME

FY WB. MEFFBZKQ IF EUTJ YWK OJRJKOB FK VFW FKHV.

	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			7	10		1	2	8	9		4		2		3	1		2	4	2	6	2	5	5
Replacement																										

7) [200 points] Decode the following Baconian cipher.

BELOW EARTH A KISS BOMBS AM BOY BEARD YAHOO BASIC

BANJO UNDER POINT YACHT STRIP MIGHT OFFER CREEK BOOTY

FATSO ASHES GRAVY AN APE

8) [400 points] The following quote needs to be decoded with the Affine Cipher where $a=7$ and $b=15$.

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

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9) [250 points] The following quote needs to be encoded with the Vigenère Cipher with a keyword of **ORCHARD**

L	O	V	E	I	S	A	F	R	U	I	T	I	N	S	E	A	S	O	N	A	T	A	L	L	T	I	M	E	S	,

A	N	D	W	I	T	H	I	N	R	E	A	C	H	O	F	E	V	E	R	Y	H	A	N	D	.

10) [300 points] The following quote by Martin Luther King Jr. needs to be encoded with the Affine Cipher using $a=15$ and $b=7$.

H	U	M	A	N	S	A	L	V	A	T	I	O	N	L	I	E	S	I	N	T	H	E	H	A	N	D	S	O	F

T	H	E	C	R	E	A	T	I	V	E	L	Y	M	A	L	A	D	J	U	S	T	E	D	.

11) [200 points] The following quote by Benedict Cumberbatch needs to be decoded with the Vigenère Cipher with a keyword of PENGUIN

I	L	R	L	O	Z	G	W	I	E	E	I	C	T	T	X	N	C	U	G

S	G	S	Z	E	I	C	E	H	I	Y	L	N	P	R	B	S	E	K	W

P	N	A	P	R	T	A	Q	A	V	M	G	O	M	V	B	I	X	B	H

Y	Q	A	N	S	H	X	W	W	Z	U	S	E	Z	T	W	A	T	M	F

M	L	M	N	I	J	H	T

Lower Merion Captains Tryouts 2020

12) [550 points] Solve this Patristocrat that has been encoded with a K1 cipher.

USJAF DMZAO PNGUZ TSFZU LAZOR NDMHP NOJAF DMLAU

ZTLAZ OLAUO YAGMA ZSUZL EAYMO PUZTM XEMXU SMEOA

AEPAD O

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	13			4	4	3	2	1		2		5	8	3	8	4		1	4	3	8			2	2	9
Replacement																										

13) [550 points] A quote has been encoded using the Pollux Cipher for you to decode. You are told that 1=●, 2=-, 5=x, 6=●, 8=x, 9=-

22512521251551255212152225225225115252251521525525222551111512

5111251152152215511215112521551115151552122522251125121552111

5151115255112151215115152152115111551252152115522512521251552

511522515511215222512155212252225112512155111152225211152111

511515111551252152115512215125111511151152225215111

14) [350 points] Solve this quote by Justin Timberlake.

OKT STAO LRIO RSFNO STCJU RYFJT CA OKRO VFN ITRYIV

HFJ'O KRZT OF RJAQTI OF RJVSFHV. VFN HF QKRO VFN

QRJO.

	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		2			10		3	3	6	4	1		4	11		3	10	4	7	1	6			3	1
Replacement																										

15) [250 points] Decode the following message in Baconian.

,./, .?, ./<.<?>/, >/, .?, ./, ./<./<./<./<?>/<.<?>./, >?, .?, .

/<.<?>/, >/, .?, ./, ./<./, ./, >/, >/, ./<.<?>, >?, >?, ./, ./<./<

.?, ./, >/, ./<./<.<?>, >/<?>, .?, ./<./, ./, >/, .

Lower Merion Captains Tryouts 2020

16) [400 points] Solve the following Spanish aristocrat.

YEDTRL RGWGDW DBNL, ILRL GB ETJXGMWL YLTWSJMD SDMD

HEG MGDBJYGW IEW WEGCLW.

	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		3	1	7	5		8	1	2	3		7	4	1					3	2	3			8	1	3	
Replacement																											

17) [500 points] A quote has been encoded using the Morbit Cipher for you to decode. You are told that 2=●●, 4=●-, 6=●x, 7=x●, 8=-●

2 6 1 3 1 7 9 7 6 1 7 7 2 5 3 2 2 7 5 2 6 2 9 3 4 8 7 8 6 6

9 7 2 6 2 9 6 1 6 2 6 7 3 4 6 6 9 3 1 3 4 6 6 7 4 6 2 3 8 5 4

9 6 8 6 9 3 6 4 9 6 2 9 6 1 6 2 8 7 4 7 8 6 9 7 2 6 4 9 6 7 3

4 2 7 8 6 9 7 2 6 6 9 2 6 4 9 6 1 4 7 4 7 9 7 2 5 2 9 6 9 7 2 6

6 7 1 9 1 7 8 7 8 6 8 6

18) **[650 points]** Solve this quote from Donald Trump.

COLWO UDYIL SELUG OVYFI TOPZO CIDQI WTFDI SEULO

VYEZO ZLYPW EUBZT CSNYR BDZTC AYDWU SOVYF LYTYS

OOVIO TQVYL YOVEE ZSLYI DDWCT

	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	7	5	3	1		7			8		1	12	2	2	1	6	7	5	6	5		13	6
Replacement																										

19) **[300 points]** Encode the following quote from Mark Twain with the Hill cipher with a keyword of DOOR.

$$\begin{pmatrix} D & O \\ O & R \end{pmatrix} \equiv \begin{pmatrix} 3 & 14 \\ 14 & 17 \end{pmatrix}$$

N	E	V	E	R	R	E	G	R	E	T	A	N	Y	T	H	I	N	G	T	H	A	?

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20) **[450 points]** Solve the following Spanish aristocrat.

PU TLC FJX FTÑUK NCLC, XJ NDTXOC, XJ OU OCXOU. PU

TLC OJKUNPTLUXPU FJX GKCÑSULTF XJ CKWDSSC; TFJ PU

TLC GCKVDU XC FU TLTK OU CPKT LTXUKT: FJXC TFJ OU

UFFPU LCOC UX VDU XC FCA XJ UKUF, PTX NUKNT VDU PD

LTXC FCÑKU LJ GUNEC UF LJT, PTX NUKNT VDU FU NJUKKTX

PDF CMCF NCX LJ FDUXC.

	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	1		25	9	1	17	3			14	14	13	1	10	3	8	11			3	21	31	4	1	20		
Replacement																											

