North Carolina Science Olympiad — Code Busters

2016-2017

| Names of participants: (Please print neatly) | |
|---|--|
| | |
| | |
| | |
| School Name: | |
| V JV1 JV2 JV3 | |
| 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 in seconds: | |

| | X7 1 | | |
|-------------|-------|-------------------|-------|
| Question | Value | Incorrect letters | Score |
| Timed | 100 | | |
| 1 | 100 | | |
| 2 | 100 | | |
| 3 | 400 | | |
| 4 | 250 | | |
| 5 | 140 | | |
| 6 | 250 | | |
| 7 | 125 | | |
| 8 | 300 | | |
| 9 | 100 | | |
| 10 | 100 | | |
| 11 | 60 | | |
| 12 | 180 | | |
| 13 | 100 | | |
| 14 | 50 | | |
| 15 | 180 | | |
| 16 | 250 | | |
| 17 | 400 | | |
| 18 | 160 | | |
| Bonus | | | |
| Final Score | | | |

The following tables might be useful during the event.

| A B C | A B C D E | B C D E | C D E | D E | E E F | F F | G | H | I | J | K | L | М | N | 0 | P | Q | R | S | T | Ū | V | W | Х | Y | Z |
|-------------|-------------|------------------|-------|--------|-------------|--------|----------|---|---|---|---|---|---|----|---|---|---|--------|---|---|---|---|---|---|---|---|
| B C | B C D | C D | D | E | | F | G | | | | | | | _` |) | | æ | | | | | | | | | |
| С | C D | D | | | 됴 | |) | Η | Ι | J | K | L | M | N | 0 | Р | Q | R | S | Т | U | V | W | Х | Y | Z |
| | D | | E | | T. | G | Η | Ι | J | K | L | M | N | 0 | Р | Q | R | S | Τ | U | V | W | Х | Y | Z | Α |
| D | | F. | | F | G | Η | Ι | J | K | L | M | Ν | 0 | Ρ | Q | R | S | Τ | U | V | W | Χ | Y | Z | Α | В |
| | F | - | F | G | Η | Ι | J | K | L | M | Ν | 0 | Р | Q | R | S | Т | U | V | W | Χ | Y | Z | Α | В | С |
| E | ш | F | G | Н | Ι | J | K | L | M | N | 0 | Р | Q | R | S | Т | U | V | W | Χ | Y | Z | Α | В | С | D |
| F | F | Ŋ | Н | Ι | J | K | L | M | N | 0 | Р | Q | R | S | Т | U | V | M | Χ | Y | Z | Α | В | С | D | Ε |
| G | G | Η | Ι | J | K | L | M | Ν | 0 | Р | Q | R | S | Т | U | V | M | Χ | Y | Z | Α | В | С | D | Ε | F |
| H | Н | Ι | J | K | L | M | Ν | 0 | Р | Q | R | S | Т | U | V | W | Χ | Y | Z | Α | В | С | D | E | F | G |
| I | I | J | K | L | M | N | 0 | Р | Q | R | S | Т | U | V | W | Χ | Y | Z | А | В | C | D | Ε | F | Ŋ | Н |
| J | J | K | L | M | Ν | 0 | Р | Q | R | S | Т | U | V | W | Х | Y | Z | А | В | С | D | E | F | G | Η | Ι |
| K | K | L | M | N | 0 | Р | Q | R | S | Τ | U | V | W | Х | Y | Z | Α | В | С | D | E | F | G | Н | I | J |
| L | L | M | Ν | 0 | Р | Q | R | S | Т | U | V | W | Х | Y | Z | Α | В | \Box | D | Ε | F | G | Н | I | J | K |
| M | M | Ν | 0 | Р | Q | R | S | Т | U | V | W | Х | Y | Z | Α | В | С | D | Ε | F | G | Н | Ι | J | K | L |
| N | N | 0 | Р | Q | R | S | Т | U | V | W | Х | Y | Z | А | В | С | D | Ε | F | Ŋ | Η | I | J | K | Г | M |
| 0 | 0 | Р | Q | R | S | Т | U | V | W | Х | Y | Z | А | В | С | D | Ε | F | Ŋ | Η | I | J | K | L | M | N |
| P | Р | Q | R | S | Т | U | V | W | Х | Y | Z | Α | В | С | D | Ε | F | G | Н | I | J | K | L | M | N | 0 |
| Q | Q | R | S | Т | U | V | W | Χ | Y | Ζ | Α | В | C | D | Ε | F | Ъ | Н | Ι | J | K | L | M | N | 0 | Р |
| R | R | S | Т | U | V | W | Х | Y | Z | А | В | С | D | Ε | F | G | Н | Ι | J | K | L | М | N | 0 | Р | Q |
| S | S | Т | U | V | W | Χ | Y | Z | Α | В | С | D | E | F | G | Н | Ι | J | K | L | M | N | 0 | Р | Q | R |
| T | Т | U | V | W | Х | Y | Z | А | В | С | D | Ε | F | U | Н | I | Ъ | K | L | M | Ν | 0 | Р | Q | R | S |
| U | U | V | W | Х | Y | Z | А | В | С | D | E | F | G | Н | I | J | K | L | М | N | 0 | Р | Q | R | S | Т |
| v | V | W | Х | Y | Z | Α | В | С | D | Ε | F | G | Н | I | J | K | L | M | N | 0 | Р | Q | R | S | Т | U |
| W | W | Х | Y | Z | А | В | С | D | Ε | F | G | Н | I | J | K | L | M | N | 0 | Р | Q | R | S | Т | U | V |
| Х | Х | Y | Z | А | В | С | D | Ε | F | G | Н | I | J | K | L | М | N | 0 | Р | Q | R | S | Т | U | V | W |
| Y | Y | Z | Α | В | С | D | Ε | F | G | Н | Ι | J | K | L | M | N | 0 | Р | Q | R | S | Т | U | V | W | Х |
| Z | Z | Α | В | С | D | E | F | G | Н | Ι | J | K | L | М | N | 0 | Р | Q | R | S | Т | U | V | W | Х | Y |

| Α | В | ŋ | D | E | F | Ф | н | I | J | K | ь | M | N | 0 | Р | Ø | R | ន | T | ם | ٧ | 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 |

Frequency Table of English letters:

| E | 12.51% | S | 6.54% | С | 3.06% | G | 1.96% | K | 0.67% |
|---|--------|---|-------|---|-------|---|-------|---|-------|
| T | 9.25% | R | 6.12% | U | 2.71% | W | 1.92% | X | 0.19% |
| Α | 8.04% | Н | 5.49% | M | 2.53% | Y | 1.73% | J | 0.16% |
| 0 | 7.60% | L | 4.14% | F | 2.30% | В | 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:

| Ε | 14.08% | I | 5.98% | M | 3.08% | Y | 1.09% | Z | 0.47% |
|---|--------|---|-------|---|-------|---|-------|--------------------------|-------|
| Α | 12.16% | L | 5.24% | P | 2.89% | V | 1.05% | $\widetilde{\mathrm{N}}$ | 0.17% |
| 0 | 9.20% | D | 4.67% | В | 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% | С | 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."

| School | V | IV1 | JV2 | IV/3 |
|--------|---|-----|-----|------|
| SCHOOL | V | JVI | JVZ | JVJ |

Timed question [100 Points]: Solve this Cryptogram which is a quote by Stephen Colbert. When you have solved it, raise your hand so that the time can be recorded and the solution checked.

RA IWXIDW DWHTO EXCWQSROL HVXFQ QSW OWYE VM YHQPSROL

QSW ESXY, QSHQ RE ROPRJWOQHD QX CM LXHD.

| | Α | В | C | D | E | F | ъ | Н | I | b | K | L | M | N | 0 | P | Q | R | ន | T | ט | ٧ | W | X | Y | Z |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq | 1 | | 2 | 4 | 4 | 1 | | 6 | 2 | 1 | | 3 | 2 | | 6 | 2 | 9 | 6 | 6 | 1 | | 2 | 8 | 6 | 3 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

| School | V | JV1 | JV2 | JV3 |
|--------|---|-----|-----|-----|

1) [100 Points] Using a key of HPRS encode the string HOVERCRAFT using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} H & P \\ R & S \end{pmatrix} \equiv \begin{pmatrix} 7 & 15 \\ 17 & 18 \end{pmatrix}$$

| Н | 0 | V | E | R | С | R | Α | F | Т |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

2) [100 Points] Advice about a treasure has been encoded using the Vigenère cipher using a very common five letter word. You have been told that the first 8 letters in the code (LKSRQMKS) actually is the word TREASURE. What does the message decode to?

LKSRQ MKSKF WMVZL YLOSM MMMFS LAOKK SDSPM MWWWD

WKSER SGRLL AJIV

Answer:

3) [400 Points] Solve this Patristrocrat of a quote by David Williams.

NAMJX APJRL ASXIT VFTAZ VWAVW AJXPF URUAB AUUIM

VAXPJ RLASX ITVFT AZVWA VWAJX PFUJN LFJRU

| | Α | В | С | D | E | F | G | н | I | J | K | L | M | N | 0 | P | Q | R | ន | Т | Ū | V | W | х | Y | Z |
|------|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq | 13 | 1 | | | | 5 | | | 3 | 7 | | 3 | 2 | 2 | | 4 | | 4 | 2 | 4 | 6 | 7 | 4 | 6 | | 2 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

4) [250 Points] Solve this Patristrocrat containing a quote by Winston Churchill. In it, you will find the word FIVE once and THE twice.

RLIFI ZRPXJ OSIQR PJPVQ ZRKIS AUXPU MVZPN VCISV

QORIU AQCIX ZPRVA QGVRL RLIPC IXPJI CARIX

| | А | В | C | D | E | F | G | н | I | J | K | L | M | N | 0 | P | Q | R | ន | Т | ט | V | W | х | Y | Z |
|------|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq | 4 | | 4 | | | 1 | 1 | | 11 | 3 | 1 | 3 | 1 | 1 | 2 | 8 | 5 | 9 | 3 | | 3 | 6 | | 5 | | 4 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

| School | V | JV1 | JV2 | JV3 |
|--------|---|-------|-------|-------|
| School | | J V I | 3 4 2 | J V J |

5) [140 Points] Solve this Cryptogram which is a quote by Grace Murray Hopper who is known her approach to innovation.

AP AD'Q N ZIIG AGMN, ZI NTMNG NRG GI AD. AD'Q CKWT

MNQAMX DI NJIBIZAHM DTNR AD AQ DI ZMD JMXCAQQAIR.

| | Α | В | U | D | E | F | G | H | I | J | K | L | M | N | 0 | P | Q | R | ន | T | Ū | ٧ | W | X | Y | Z |
|------|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq | 11 | 1 | 2 | 8 | | | 5 | 1 | 9 | 2 | 1 | | 7 | 8 | | 1 | 6 | 3 | | 3 | | | 1 | 2 | | 4 |
| | | | | | | · | | | | | | | | | | | | | | | | | | | | |

6) [250 Points] Solve this Unattributed Cryptogram about helping others.

MJ BOCJ CT BOIJ ATZJ YJTYSJ VRIJ DA OKIRQJ WJQODAJ

MJ LFTM BTM WOKSH CBJH FJJK RC CBJZAJSIJA.

| | Α | В | U | D | E | F | G | н | I | J | K | L | M | N | 0 | P | Q | R | ន | T | ש | V | W | X | Y | Z |
|------|---|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq | 5 | 5 | 5 | 2 | | 2 | | 2 | 4 | 17 | 3 | 1 | 4 | | 5 | | 2 | 3 | 3 | 5 | | 1 | 2 | | 2 | 2 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

7) [125 Points] Using a key of CDEFGHIAD encode the string WRITEITDOIT using the Hill Cipher with a 26 character alphabet. e.g.

$$\begin{pmatrix} C & D & E \\ F & G & H \\ I & A & D \end{pmatrix} \equiv \begin{pmatrix} 2 & 3 & 4 \\ 5 & 6 & 7 \\ 8 & 0 & 3 \end{pmatrix}$$

| W | R | I | T | E | I | T | D | 0 | I | T | |
|---|---|---|---|---|---|---|---|---|---|---|--|
| | | | | | | | | | | | |

8) [300 Points] Solve this Cryptogram by Paul Valery comparing us to something.

PNNZO QVXL EQL OVWL LSLWALO VO KLNKTL - MACL,

QIWABAEJ, VSAWVTO, GLVEQLC, VSB EQLAC NGS RNSELSE.

| | | Α | В | C | D | E | F | U | Н | I | J | K | L | M | N | 0 | P | Q | R | ន | T | U | ٧ | W | X | Y | Z |
|---|-----|---|---|---|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | req | 6 | 2 | 3 | | 6 | | 2 | | 1 | 1 | 2 | 13 | 1 | 5 | 5 | 1 | 5 | 1 | 6 | 2 | | 7 | 4 | 1 | | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | School | V JV1 JV2 JV3 |
|----|--------------|---|-------------------|
| 9) | [100 Points] | You encountered this message from Sir Arthur Conan Doyle on the wall. | What does it say? |



| Answer: | | | |
|---------|--|--|--|

10) [100 Points] Solve this Cryptogram which is a quote by Franklin D. Roosevelt where the word **THAT** appears multiple times.

QUQBD PST KSR S BVFKO OE ZVHQ. OKSO PQSTR OKSO KQ

SZRE KSR S BVFKO OE PSXQ S YEPHEBOSGZQ ZVUVTF.

| | Α | В | C | D | E | F | G | Н | I | Ъ | K | L | M | N | 0 | P | Q | R | ន | T | ש | V | W | x | Y | Z |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|
| Freq | | 4 | | 1 | 5 | 3 | 1 | 2 | | | 7 | | | | 9 | 4 | 7 | 4 | 12 | 3 | 2 | 5 | | 1 | 1 | 4 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

| $\frac{1}{a} = \frac{b}{b} = \frac{1}{a}$ | were used to enco | ode the message | 2 ? | |
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12) [180 Points] Solve this cipher by Sainte-Beave which talks about getting older. The first word is **THERE** and the last word is **AGE**.

LYWJW UJWDW PDRWS YPNWS ULXYN LPDNU LUXWJ LUMOY

PFJUO GSYPJ WTUMO DWJTU OWOLR VULLY ULUZW.

| | Α | В | C | D | E | F | ъ | Н | I | J | K | L | M | N | 0 | P | Q | R | ន | T | U | ٧ | W | x | Y | Z |
|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|----|---|---|---|
| Freq | | | | 4 | | 1 | 1 | | | 6 | | 9 | 2 | 3 | 5 | 5 | | 2 | 3 | 2 | 11 | 1 | 11 | 2 | 6 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |

| School | V J | V1 | JV2 | JV3 |
|--------|-----|----|-----|-----|
| | | | | |

13) [100 Points] Encode the string **IFNOTUSWHOIFNOTNOWWHEN** using the Affine Cipher with a=7 and b=11.

| N | 0 | T | Α | L | L | W | Н | 0 | W | Α | N | D | E | R | Α | R | E | L | 0 | S | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | |

14) [50 Points] Using a code word of **PONDER**, encode the following phrase by Mitch Hedberg using the Vigenère cipher.

MY FAKE PLANTS DIED BECAUSE I DID NOT PRETEND TO WATER THEM

| Answer: | | | |
|---------|--|--|--|
| | | | |
| | | | |

| School | V | JV1 | JV2 | JV3 |
|--------|---|-----|-----|-----|

15) [180 Points] A sign in the local MakerSpace curiously has the following written on it. What does it say?

| Answer: | | | |
|----------|--|--|--|
| Allowel. | | | |

16) [250 Points] Solve this Spanish Cryptogram about Love.

QL HWHKY QHORH VVLPHM H VH VYJBMH; F LOY H VY

ABL VVHWHX VYJBMH, ZHMH WS LO VH BXSJH NYMWH

OLXOHRH KL HWHM. -- NMHXJYSOL OHPHX

| | A | В | C | D | E | F | Ъ | Н | I | J | K | L | M | N | Ñ | 0 | P | Q | R | ន | Т | Ū | ٧ | W | X | Y | Z |
|------|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq | 1 | 4 | | | | 1 | | 24 | | 4 | 2 | 8 | 7 | 2 | | 7 | 2 | 2 | 2 | 3 | | | 9 | 5 | 5 | 7 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| , - | School V JV1 JV2 JV3 [400 Points] Someone used voice dictation to quote a phrase by Stephen Hawking on their phone and then had it encrypted. What does it say? | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------|---|------|---|----|------------|-----|--------------|----------|----|-----|-------|-----|------------|------|-----|-----|-----|----|----|---|----|----|----|---|---|---|---|
| J M | J MRGJRDR ZGJRE GJWR JQ SOJHR NPAAPE JE HIR OEJDRFQR, | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ZGH | ΙP | OC | Ι | JE | HR | GG | JC | RE | H | GJ | WR | J | Q | GR | QÇ |) Ç |)RY | • | QC | A | QZ | ZX | Jŀ | I | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| IZQ | X. | РH | н | VΡ | 7 . | KK. | R <i>7</i> . | F | DЕ | ! 7 | FR | · K | G 7 | F.R | H. | | | | | | | | | | | | |
| 122 | 21. | IXII | | | | 111 | ıνΔ | - | | | T. T. | . 1 | .62 | 1111 | -11 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Α | В | С | D | E | F | G | н | Ι | J | K | L | M | N | Ñ | 0 | P | Q | R | S | Т | U | V | W | x | Y | Z |
| Freq | 3 | | 2 | 2 | 8 | 3 | 9 | 9 | 4 | 13 | 3 | | 1 | 1 | 4 | 5 | 9 | 18 | 1 | | | | 2 | 2 | 2 | 8 | 3 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |

18) [160 Points] Another message encrypted with the Affine Cipher using an alphabet of 26 characters has been intercepted. You have been told that the last two characters of the message are the letters **EN**. With that knowledge, what does this message say?

SJMMKEOCTLTEKKGTLHGWQJMXDET