

A Detective Molecule Chronicle: Answers

Part 1 - Making proteins:

You are presented with the DNA sequence of the 5' to 3' coding (sense) strand of DNA:

```
... AAT GAA TGT AAC AAA CGG TAT CCA ACG TGC AAC TAA ATT AGA ATC GAT ATA GTA ATG TGT  
AAG TAT GGC GAA AAT AAC ATT ACC AGA TGT GGC GAG AAC TGA TCT ATT CTT GTC GAA AGA TTA  
GAA GCA GAC TGC GCC GAT ATG ATT GTC ATG CCC TGC ACA GCA TCT TCC ATT GTC ATG ACT ATT  
ACA GCT AAT ATT GTG ATG ...
```

In transcription, the 3' to 5' template (antisense) strand is used to **create complementary mRNA** to the antisense strand in a 5' to 3' direction.

Making the antisense strand:

```
... TTA CTT ACA TTG TTT GCC ATA GGT TGC ACG TTG ATT TAA TCT TAG CTA TAT CAT TAC ACA TTC  
ATA CCG CTT TTA TTG TAA TGG TCT ACA CCG CTC TTG ACT AGA TAA GAA CAG CTT TCT AAT CTT  
CGT CTG ACG CGG CTA TAC TAA CAG TAC GGG ACG TGT CGT AGA AGG TAA CAG TAC TGA TAA TGT  
CGA TTA TAA CAC TAC ...
```

The mRNA is identical to the coding strand, with the exception of tyrosine (T) being replaced by uracil (U). The mRNA is created:

```
... AAU GAA UGU AAC AAA CGG UAU CCA ACG UGC AAC UAA AUU AGA AUC GAU AUA GUA AUG UGU  
AAG UAU GGC GAA AAU AAC AUU ACC AGA UGU GGC GAG AAC UGA UCU AUU CUU GUC GAA AGA  
UUU GAA GCA GAC UGC GCC GAU AUG AUU GUC AUG CCC UGC ACA GCA UCU UCC GUC AUG  
ACU AUU ACA GCU AAU AUU GUG AUG ...
```

You must then use a codon table to **find the amino acids corresponding to each mRNA codon**.

		Second letter				Third letter
First letter	U	C	A	G		
	UUU } Phe UUC UUA } Leu UUG }	UCU } UCC UCA } Ser UCG }	UAU } Tyr UAC UAA Stop UAG Stop }	UGU } Cys UGC } UGA Stop UGG Trp }	U C A G	(author unknown)
	CUU } Leu CUC CUA } CUG }	CCU } CCC CCA } Pro CCG }	CAU } His CAC CAA } Gln CAG }	CGU } CGC CGA Arg CGG }	U C A G	
	AUU } Ile AUC AUA } AUG Met	ACU } ACC ACA } ACG }	AAU } Asn AAC AAA } Lys AAG }	AGU } Ser AGC AGA Arg AGG }	U C A G	
	GUU } Val GUC GUA } GUG }	GCU } GCC GCA } Ala GCG }	GAU } Asp GAC GAA } Glu GAG }	GGU } GGC GGA Gly GGG }	U C A G	

Each acid can be expressed as single letters ([https://en.wikipedia.org/wiki/Genetic_code#RNA codon_table](https://en.wikipedia.org/wiki/Genetic_code#RNA_codon_table)):

... N E C N N R Y P T C N stop I R I D I V M C N Y G E N N I T R C G E N stop S I L V E R L E A D C A D M I
V M P C T A S S I V M T I T A N I V M ...

We can see some words appear!

... Neon Krypton . Iridium Oxygen Nitrogen . Silver Lead Cadmium Potassium Titanium ...

Rewrite as their chemical symbols:

... NeKr . IrON . AgPbCdKTi ...

'iron' is between the stop codons (It is also the only legible word). This is the antidote!

Part 2 - Different numeral systems:

Dr Element gave you this message:

32 6c 20 34 63 20 31 36 20 34 66 20 33 6a 20 34 62 20 31 36 20 34 63 20 34 30 20 33 6e 20 31 36 20
33 6b 20 34 31 20 34 37 20 33 6c 20 34 30 20 33 6e 20 34 35 20 34 31 20 34 62 20 34 63 20 31 36 20
34 66 20 34 31 20 34 63 20 34 30 20 31 36 20 34 63 20 34 30 20 33 6e 20 31 36 20 33 32 20 32 66 20
33 34 20 31 36 20 34 35 20 33 6a 20 33 6c 20 34 30 20 34 31 20 34 36 20 33 6e 20 31 36 20 34 31 20
34 36 20 31 36 20 34 63 20 34 30 20 33 6e 20 31 36 20 33 6d 20 33 6a 20 34 61 20 34 33 20 31 36 20
34 61 20 34 37 20 34 37 20 34 35 20 31

From the text, "she has now forgotten how to use the last 20 letters of the alphabet", you can deduce that the code is in **base 16** (hexadecimal). Convert to ASCII:

2l 4c 16 4f 3j 4b 16 4c 40 3n 16 3k 41 47 3l 40 3n 45 41 4b 4c 16 4f 41 4c 40 16 4c 40 3n 16 32 2f 34
16 45 3j 3l 41 41 46 3n 16 41 46 16 4c 40 3n 16 3m 3j 4a 43 16 4a 47 47 45

A clue is presented: “you noticed her furiously pointing at the **base** of the **table** next to her and then at the **antidote**”. The antidote was iron, which has atomic number 26 on the periodic table. The ASCII must be in **base 26**. Upon conversion to base 10 (denary/decimal system):

```
73 116 32 119 97 115 32 116 104 101 32 98 105 111 99 104 101 109 105 115 116 32 119 105 116 104  
32 116 104 101 32 80 67 82 32 109 97 99 104 105 110 101 32 105 110 32 116 104 101 32 100 97 114  
107 32 114 111 111 109
```

This can finally be converted to ASCII to produce the answer:

It was the biochemist with the PCR machine in the dark room

Part 3 - The quaternary system:

A piece of paper was left at the crime scene. It contains:

```
AUUG AAUG AGGA AGCU AGCU AGGA AUUA AGCG ACAU GCU GUU AUGA GUU AGGC AUCG AGCC  
ACAC GUU AGGU AUAA GAC ACUC GUU AGGA AGCG GUU AGCA AGUA AGCG AGUC AGGU AGAA  
ACUC ACAU AGAA ACUG
```

The letters “**ATCG**” are written on the front. Since no other clue is included, it is most straightforward to convert the code to its **complimentary base pairs**:

```
TAAC TTAC TCCT TCGA TCGA TCCT TAAT TCGC TGTA CGA CAA TACT CAA TCCG TAGC TCGG TGTG  
CAA TCCA TATT CTG TGAG CAA TCCT TCGC CAA TCGT TCAT TCGC TCAG TCCA TCTT TGAG TGTA  
TCTT TGAC
```

Now all the letters A, T, C and G are present. In this puzzle, the **order matters**. There are 4 bases in the phrase “ATCG”, so we will have a go converting to **base 4**. (Wikipedia makes this connection too - https://en.wikipedia.org/wiki/Quaternary_numeral_system#Genetics)

Starting with setting **A=0, T=1, C=2, G=3**:

```
1002 1102 1221 1230 1230 1221 1001 1232 1310 230 200 1021 200 1223 1032 1233 1313 200 1220  
1011 213 1303 200 1221 1232 200 1231 1201 1232 1203 1220 1211 1303 1310 1211 1302
```

From there we can convert to decimal:

```
66 82 105 108 108 105 65 110 116 44 32 73 32 107 78 111 119 32 104 69 8217 115 32 105 110 32 109  
97 110 99 104 101 115 116 101 114
```

Finally this is rewritten in ASCII to yield:

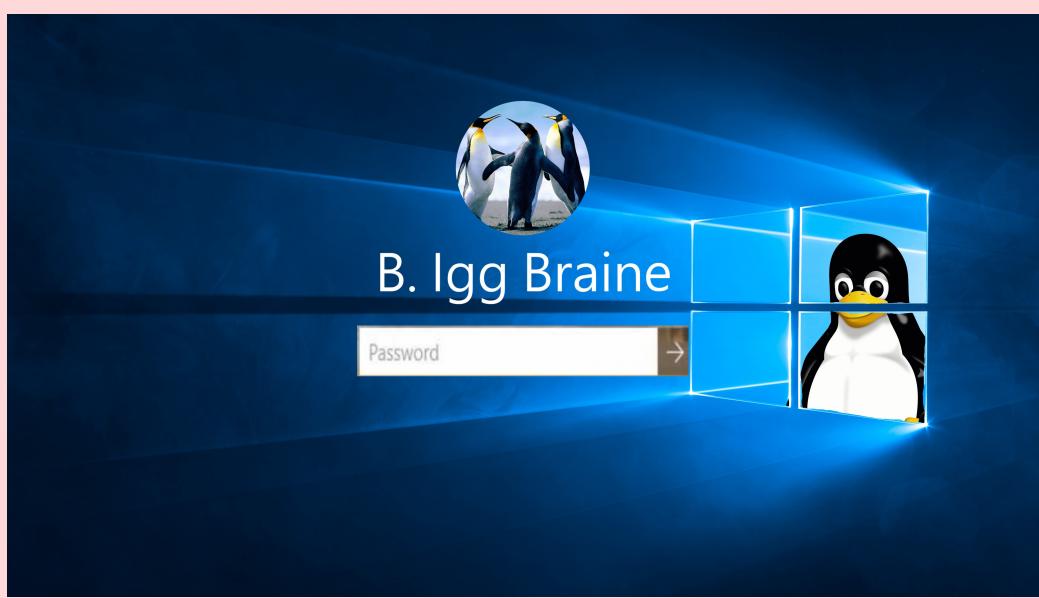
BRilliAnt, I kNow hE' s in manchester

Paying attention to the odd arrangement of capital letters, we spell out a new word:

BRAINE

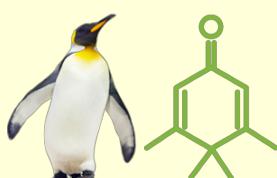
Part 4 - Esoteric facts:

Professor Braine's has personalised his computer screen:

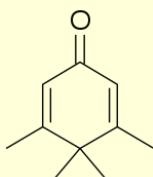


We are looking for a **7-digit numerical password**, but no other clues are given. You know Prof Braine works in the **Chemistry Building**, and he very clearly **likes penguins**, so it is not unreasonable to search the phrase “penguin chemistry”, or something similar.

You will eventually stumble across '**penguinone**'.



<https://www.peakscientific.com/discover/news/penguinone/>



Penguinone : 3, 4, 4, 5 - tetramethylcyclohexa - 2, 5 - dien - 1 - one

Simply take the numbers of its systematic name as the password;

3445251

Further reading on unusual molecules:

https://en.wikipedia.org/wiki/List_of_chemical_compounds_with_unusual_names#Compounds

Part 5 - Odd use of ASCII:

Professor Braine's corrupted PC contains an encrypted file:

```
[DC1]Q[SOH].XCIX[DC1]A[SOH][DC1]iq[BS][DLE] VII[DLE]Yq[DLE].XCIX[DLE][DC1][DC1][DLE]![BS
]IXy VIII
[DC1][DC1][DC4]IXq[SYN][DC1][DC1][DC4][DC2][EM]q[NAK][DC1]Yq[NAK][DC1]Q[ENQ][DC1][SOH
][NAK]
```

The letters in the square brackets are recognisable as **non-printing control codes**. These are used by computers to format and organise text written in ASCII

(https://en.wikipedia.org/wiki/C0_and_C1_control_codes). These have decimal and hex values.

Some parts of the code are written in a different font. These are clearly **roman numerals**, which also have decimal and hex values.

Programmers usually convert ASCII to hexadecimal, as it is more representative of the binary system:

```
115101XCIX1141011169710810 VII10597110.XCIX101111102108IX79 VII111114IX7116111114
1219711511597115115105110115
```

The roman numerals will be converted to decimal:

```
115101991141011169710810810597110991011111021089798111114971161111141219711511597
115115105110115
```

It is not obvious to carry out these steps, but translating this as decimal number into ASCII gives

```
se©n©o©YorjoÜssins
```

which is more convincingly legible than using any other combination of conversions. Trial and error, along with some assumptions, will eventually lead you to the answer.

Letters in ASCII fall within the decimal range 65-90, 97-122. We must separate the string of numbers so that they fall in this range:

```
115 101 99 114 101 116 97 108 108 105 97 110 99 101 111 102 108 97 98 111 114 97 116 111 114
121 97 115 115 97 115 115 105 110 115
```

Then a final conversion to ASCII reveals the answer

```
secretallianceoflaboratoryassassins
```

Part 6 - Surfing the web:

Simply put, Mr Electrician has left some incriminating evidence behind:



OMG GUYS!! 😂😂 I JUST COMMITTED ANOTHER
MURDER!! 🤢 I'm so smart! I managed to kill the lab technician at
Cambridge and Mr Biochemist. MWUAHHHAHA ! I've also just
received the news that my poison has successfully worked to kill Dr
Element! And the best news is that the authorities have no idea!! 🤣
I'm so smart!!

mrelectrician86 · 4 days ago · Reply