

## Practice Code Equations Activity

**VERY IMPORTANT:** Students will need to be well practiced solving equations of the required type and decoding using Caesar Shift Ciphers **BEFORE** using this activity.

### The materials consist of:

1. A PowerPoint presentation for your event (as a separate file).
2. This introduction and instructions.
3. The READ ME sheet to explain how the puzzles are solved.
4. The note from the Hacker Group giving the context and instructions.
5. The coding puzzle sheets.
6. Sheets to mark the six institutions.

### Set Up:

1. Print one copy of each institution marker sheet, preferably onto card and best enlarged to at least A3. Place six chairs around the event room and place the six institution markers **RANDOMLY** onto the chairs so they can be seen from a distance.
2. Print one copy of the READ ME sheet to be distributed to every participating student **before** the event.
3. Print more than enough copies of each of the coding puzzle sheets for the number of participating teams.
4. Make up an envelope for each participating team containing:
  - a. One copy of the note from the Hacker Group
  - b. One coding puzzle sheet chosen from the set **EXCLUDING** the first one with name Clue 3 and Offset Equation  $3x + 2 = 20$  (use roughly the same number of each sheet, so there is exactly one puzzle to get started in each envelope and roughly similar numbers of each sheet in use at the start).
  - c. Write in red on the front: "Open in case of emergency"
5. Place the remaining puzzle sheets on the institution marker chairs as follows.

Offset Equation	Place coding puzzle sheets with this offset equation sheets on:
$3x + 2 = 20$	Borough Market
$5x - 5 = 40$	Queen Mary, University of London
$6x - 3 = 63$	Billingsgate Fish Market
$20x - 2 = 98$	All England Club
$4x + 1 = 53$	London Mathematical Society
$3x - 4 = 53$	The Albert Hall

## The Event:

We suggest you run your event as it was run in the training session.

**It is absolutely essentially that students have practiced solving equations and solving Caesar Shift Ciphers to a high level BEFORE this event. Also, they should have received the READ ME sheet and have read it thoroughly. We recommend that students bring this sheet to the event and it would be sensible to have spare copies just in case.**

Assemble teams of 5 participants for the event, one team per table. Set up the room and the materials as described above. Put an envelope one per group on each table. Show students the presentation slides which give a brief introduction to the institutions.

The presentation will freeze on slide 4 and the words 'Emergency Your System has been Hacked' will appear. Students now have enough information to complete the task and should be left to get on with it. The note from the Hacker Group tells them to elect a runner, to go the next institution and get the next puzzle sheet.

It will be very tempting to try to help out students who are stuck. We would urge that you resist the temptation. If it is completely clear that you will not help, then students will be forced to do it themselves!

The final answer is pi, since the numbers in order are 314159. In the training I wanted 100,000 pi, but 'pi' is good enough. The puzzle sheet with the 3 makes clear that this is the first one, so there is no advantage which one is in your envelope.

I would suggest that you answer all of the sheets yourself in advance, to get a feel for it. Just to be sure the solutions are as follows:

Offset	Solution	Go to:
$3x + 2 = 20$	MARY	Queen Mary, University of London
$5x - 5 = 40$	FISH	Billingsgate Fish Market
$6x - 3 = 63$	CLUB	All England Club
$20x - 2 = 98$	MATH	London Mathematical Society
$4x + 1 = 53$	HALL	The Albert Hall
$3x - 4 = 53$	MARK	Borough Market

I find it very useful to have a table to hand for converting algebraic solutions to letters. You may think it useful to have this available on the tables. However, this will not be available in the event:

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code	1	2	3	4	5	6	7	8	9	10	11	12	13

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code	14	15	16	17	18	19	20	21	22	23	24	25	26

Good luck!

# READ ME

## Decoding from Equations Example

This equation gives the offset number:

$$5x - 2 = 18$$

So, we work out that the offset number is 4.

We can now make a decoding chart.

### Decoding Chart (the code letters are Offset by 4 letters)

Offset Number 4

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>	<i>K</i>	<i>L</i>	<i>M</i>	<i>N</i>	<i>O</i>	<i>P</i>	<i>Q</i>

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code	<i>R</i>	<i>S</i>	<i>T</i>	<i>U</i>	<i>V</i>	<i>W</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>

These equations give the coded message:

$$4x = 28$$

$$2x + 1 = 11$$

$$x - 5 = 19$$

So, the solutions in order are 7, 5 and 24.

Convert these to letters (using A=1, B=2, C=3 etc.)

$$7 = G, 5 = E, 24 = X$$

So GEX is the **code**, now **decode** it to find the message.

$$G = C, E = A, X = T$$

The message is CAT

*The Safety of Six Great London  
Institutions is now in Your Hands  
Identify the Hacker Group's Name  
and YOU can STOP them!*

*Solve your first code to identify the  
next institution.*

*Choose a group RUNNER and send  
them there to collect the next code.*

*Keep going to find all 6 clues.*

*You must keep them in order and  
they will reveal the Hacker's name.*

*Remember: numbers have names too!*

*Get your runner to tell the organiser  
the Hackers name to win the contest.*

Offset

$$3x + 2 = 20$$

Message

$$40 - 2x = 2$$

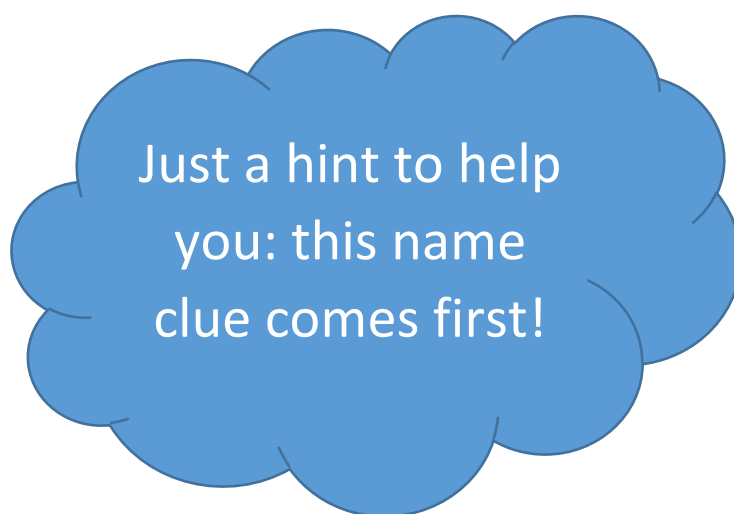
$$7x + 1 = 50$$

$$5x + 2 = 3x + 50$$

$$x^2 - 10x = -25$$

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code													

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code													



Name Clue

3

Offset

$$5x - 5 = 40$$

Message

$$3x - 20 = 25$$

$$4x - 17 = 3x + 1$$

$$3^{x+1} = 27$$

$$5x + 3 = 7x - 31$$

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code													

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code													

Name Clue

1

Offset

$$6x - 3 = 63$$

Message

$$5x - 3 = 67$$

$$8x - 3 = 6x + 43$$

$$x^2 + 36 = 12x$$

$$13x - 1 = 168$$

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code													

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code													

Name Clue

4

Offset

$$20x - 2 = 98$$

Message

$$5x - 7 = 3x + 29$$

$$x^2 - 12x = -36$$

$$4x - 3 = 8x - 103$$

$$2^{x-9} = 16$$

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code													

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code													

Name Clue

**1**



Offset

$$4x + 1 = 53$$

Message

$$7x + 2 = 5x + 44$$

$$8x + 7 = 119$$

$$17^{x-25} = 1$$

$$3x + 1 = 11x - 199$$

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code													

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code													

Name Clue

5

Offset

$$3x - 4 = 53$$

Message

$$13^{x-4} = 169$$

$$5x - 1 = x + 79$$

$$11x - 5 = 5x + 61$$

$$x^2 = 8x - 16$$

Message	A	B	C	D	E	F	G	H	I	J	K	L	M
Code													

Message	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code													

Name Clue

9



Queen Mary  
**University of London**

# Billingsgate Fish Market



# All England Club



**BOROUGH  
MARKET**



**CELEBRATING 1000 YEARS IN SOUTHWARK**



Royal Albert Hall



LONDON  
MATHEMATICAL  
SOCIETY

150 YEARS