

The School Election Code

Guided notes, practice and a final scenario challenge

TEAM A	TEAM B	TEAM C
10110 (base 2)	43 (base 5)	27 (base 8)

THE MISSION

Decode three vote totals written in different number bases. Compare them fairly and explain the result before the school assembly begins.

Senior 1 Mathematics | Topic 1: Number Bases

Clear steps. Real thinking. Room to try again.

Before you begin

Name: _____ Class: _____ Date: _____

LEARNING GOALS

I can explain base as a grouping rule, identify valid digits, convert numbers to and from base ten, and explain my method.

The situation

Kijani Secondary School has counted votes for the student council election. Three counting teams protected their results by writing them in different number bases. The results officer is unavailable. Your class must decode the slips before the assembly.

1. What does the word 'base' make you think of? There is no wrong prediction yet.

2. Why must the three results be changed to the same base before they are compared?

Start with the number system you already know

Our everyday number system is base ten. This means we bundle objects in groups of ten. When 10 ones collect, we exchange them for 1 ten. When 10 tens collect, we exchange them for 1 hundred.

13 IN BASE TEN

13 means 1 bundle of ten and 3 loose ones. The 1 is written in the tens place. The 3 is written in the ones place.

Now change the grouping rule

Imagine the same 13 ballot papers, but this time we must bundle every five papers.

13 individual papers	2 full bundles of 5 + 3 loose papers	23 (base 5)

The amount stayed the same

13 (base ten) and 23 (base five) name the same quantity. Only the grouping rule changed. Check: 2 groups of 5 + 3 ones = 13.

Draw 13 circles. First group them in tens, then group the same circles in fives.

Each place is built from the grouping rule

Moving one place left creates a larger bundle. In base ten, each new place is 10 times larger. In base five, each new place is 5 times larger.

243 (base 10)	2×100	4×10	3×1	243
243 (base 5)	2×25	4×5	3×1	73

WHY 25?

In base five, five bundles of five make one larger bundle. $5 \times 5 = 25$, so the places are 25s, 5s and 1s.

Complete the meaning

- a) 32 (base 5) means _____ groups of five and _____ loose ones.
- b) 101 (base 2) means _____ group of four, _____ groups of two and _____ one.
- c) The small base number is a label. It tells us _____.

Explain in your own words: what is a number base?

CLUE 1 - VALID DIGITS

A base tells us how many digits are available. The largest allowed digit is always one less than the base.

2	0, 1	102 (base 2)
5	0, 1, 2, 3, 4	341 (base 5)
8	0 to 7	728 (base 8)

Complete the rule

a) The digits used in base 4 are: _____

b) The largest digit allowed in base 9 is: _____

c) Explain why 57 (base 5) is impossible.

CLUE 2 - CONVERT TO BASE
TEN

Multiply each digit by its place value, then add. Example: $1011 \text{ (base 2)} = 1 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 1 = 11$.

A. Complete the place-value tables

1101 (base 2)	8	4	2	1
Digit				
Digit x place value				

243 (base 5)	25	5	1
Digit			
Digit x place value			

36 (base 8)	8	1
Digit		
Digit x place value		

B. Convert to base ten

1) $10101 \text{ (base 2)} =$ _____ 2) $34 \text{ (base 5)} =$ _____

3) $127 \text{ (base 8)} =$ _____ 4) $304 \text{ (base 5)} =$ _____

Show your method for question 4.

CLUE 3 - CONVERT FROM
BASE TEN

Use repeated division. Record each remainder and read the remainders from bottom to top.

Worked example: 19 (base ten) to base 2

DIVIDE

$19 \div 2 = 9$ remainder 1; $9 \div 2 = 4$ remainder 1; $4 \div 2 = 2$ remainder 0; $2 \div 2 = 1$ remainder 0; $1 \div 2 = 0$ remainder 1. Read upward: 10011 (base 2).

Use repeated division

a) Convert 14 (base ten) to base 2.

b) Convert 38 (base ten) to base 5.

c) Convert 45 (base ten) to base 8.

The head teacher has arrived. Decode the three slips and prepare a fair announcement.

A	10110 (base 2)		
B	43 (base 5)		
C	27 (base 8)		

Write the announcement

The mathematically correct result is:

Explain how your conversions prove the result.

REFLECT AND EXTEND

1. Could the school announce that Team C has 27 votes? Explain.

2. A fourth team claims to have 132 (base 3) votes. What should you notice before calculating?

3. Create your own coded vote total in base 4. Exchange with a partner and decode each other's number.

EXIT TICKET

Write one sentence that completes this idea: The value of a number depends on...
