Modular Arithmetic

Easy Congruence Relations	Harder Congruence Relations	Properties of Modular Arithmetic	Theorems Associated with Modular Arithmetic	Miscellaneous
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400

Player A

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Easy Congruence Relations for 100.

If $62 \equiv x \pmod{5}$

a $x = 0$

b $x = 1$

c $x = 2$

d $x = 3$

e $x = 4$

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Easy Congruence Relations for 200.

$$38 \equiv x \pmod{12}$$

a $x = 0$

b $x = 2$

c $x = 4$

d $x = 8$

e $x = 10$

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Easy Congruence Relations for 300.

$$125 \equiv 1 \pmod{x}$$

a $x = 31$

b $x = 11$

c $x = 9$

d $x = 26$

e $x = 14$

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Easy Congruence Relations for 400.

$x \equiv 7 \pmod{13}$

a $x = 31$

b $x = 45$

c $x = 56$

d $x = 72$

e $x = 86$

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Harder Congruence Relations for 100.

$$-7 \equiv x \pmod{17}$$

a 4

b 6

c 10

d 12

e 16

Harder Congruence Relations for 200.

Solve $x + x + x \equiv 0 \pmod 3$

- a 0
- b 1
- c 2
- d None of the above
- e All of the above

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Harder Congruence Relations for 300.

How would you express: "the sum of two even numbers is even" in $\mod 2$?

a $1 + 0 \equiv 0 \pmod 2$

b $1 + 0 \equiv 1 \pmod 2$

c $0 + 0 \equiv 0 \pmod 2$

d $0 + 0 \equiv 1 \pmod 2$

e $1 + 1 \equiv 0 \pmod 2$

Harder Congruence Relations for 400.

What number would fit within this class of integers?
$\ldots, -14, -8, -2, 0, 6, 12, 18, \ldots$

a 26

b 34

c 48

d 52

e 68

Properties of Modular Arithmetic for 100.

We say that two integers a and b are congruent modulo m if there is an integer k such that

a $a - b = m/k$

b $a - kb = m$

c $ka - b = m$

d $a - b = km$

e $a + b = km$

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Properties of Modular Arithmetic for 200.

What is the name of this property in modular arithmetic?

$$a \equiv a \pmod{m}.$$

- a closed under addition
- b symmetry
- c transitivity
- d reflexivity
- e closed under multiplication

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Properties of Modular Arithmetic for 300.

What is the name of this property in modular arithmetic?

If $a \equiv b \pmod{m}$, then $b \equiv a \pmod{m}$.

- a closed under addition
- b symmetry
- c transitivity
- d reflexivity
- e closed under multiplication

Properties of Modular Arithmetic for 400.

What is the name of this property in modular arithmetic?
If $a \equiv b \pmod{m}$ and $b \equiv c \pmod{m}$, then $a \equiv c \pmod{m}$.

- a closed under addition
- b symmetry
- c transitivity
- d reflexivity
- e closed under multiplication

Theorems Associated with Modular Arithmetic for 100.

What is the name of the following theorem?

$$|G| = |G : H||H|$$

a Euler's Theorem

b Lagrange's Theorem

c Chinese Remainder Theorem

d Fermat's Little Theorem

e None of the above

Theorems Associated with Modular Arithmetic for 200.

What is the name of the following theorem?

$$a^p(n) \equiv 1 \pmod{n}$$

a Euler's Theorem

b Lagrange's Theorem

c Chinese Remainder Theorem

d Fermat's Little Theorem

e None of the above

Theorems Associated with Modular Arithmetic for 300.

What is the name of the following theorem? For p prime, $a^p \equiv a \pmod{p}$

- a Euler's Theorem
- b Lagrange's Theorem
- c Chinese Remainder Theorem
- d Fermat's Little Theorem
- e None of the above

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Theorems Associated with Modular Arithmetic for 400.

What is the name of the following theorem? Suppose n_1, n_2, n_k are positive integers which are pairwise co-prime. Then, for any given set of integers a_1, a_2, a_k, there exists an integer x solving the system of simultaneous congruences $x \equiv a_1 \pmod{n_1}, \quad x \equiv a_2 \pmod{n_2}, \ldots x \equiv a_k \pmod{n_k}$.

- a Euler's Theorem
- b Lagrange's Theorem
- c Chinese Remainder Theorem
- d Fermat's Little Theorem

e None of the above

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Miscellaneous for 100.

Who played a major role in the discovery of Modular Arithmetic?

- a Laplace
- b Lagrange
- c Bernoulli
- d Leibnitz
- e Pascal
- f Gauss

Miscellaneous for 200.

In what year was Modular Arithmetic first discovered?

a Around 2500 BC

b 1651

c 1724

d 1801

e 2001

Miscellaneous for 300.

If $a \equiv b(modN)$ and $c \equiv d \pmod N$ then $(a+c) \equiv (b+d) \pmod N$. Why is this so?

- a Modular arithmetic is reflexive
- b Modular arithmetic is symmetric
- c Modular arithmetic is closed under addition
- d Modular arithmetic is closed under multiplication
- e None of the above

Miscellaneous for 400.

What is the name of the following theorem? $nx + my = 1$

a Euler's Theorem

b Lagrange's Theorem

c Chinese Remainder Theorem

d Fermat's Little Theorem

e Bezout's Theorem

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