MATH 131
TEST # 1
Oct 3, 2019

Name: _____

[5] 1. True or False ($\emptyset$ represents the empty set):

(a) $\{1, 4\} \subset \{1, 2, 3, 4\}$ _____

(b) $\{b\} \in \{a, \{b, c\}\}$ _____

(c) $\{a, \{b, c\}\} \subseteq \{a, b, c, d\}$ _____

(d) $\emptyset \subseteq A$ for any set A _____

(e) $A \cup \emptyset = \emptyset$ for any set A _____

[2] 2. List all the elements in the set $A = \{x \mid x = 7k + 1 \text{ where } k = 0, 3, 5\}$.

[5] 3. Use Venn diagrams to determine if $(A \cap B) - C = (A - C) \cap (B - C)$ is true or not.

[6] 4. Given the sets $U = \{a, b, c, d, e, f, g, h, i, j\}$, $A = \{a, b, c, d, f, i\}$, $B = \{d, e, g\}$ and $C = \{b, d, g\}$, find:

(a) $A - (B \cap C)$

(b) $\overline{A} \cup B$

(c) $C \times B$

[7] 5. Use a Venn diagram to find (i) $n(\overline{A \cup B \cup C})$, (ii) $n(A \cap (B \cup C))$ and (iii) $n((A \cup B) - C)$ if $n(A \cap B \cap C) = 5$, $n(A \cap C) = 12$, $n(B \cap C) = 6$, $n(A) = 27$, $n(A - (B \cup C)) = 13$, $n(B) = 12$, $n(C) = 28$ and $n(U) = 55$.

[5] 6. The university's drama department is planning to put on the play "Game of Cones" at the university theatre. If they charge \$5.00 per person, the theatre will be filled to capacity but if they increase the price by \$2.00 per ticket, 15 less tickets will be sold but the total revenue will increase by \$317. Find the capacity of the school theatre.

[4] 7. Given the sets $A = \{1, 2, 3, 4, 5, 6, 7\}$ and $B = \{a, b, c, d, k, u, v\}$,
(a) find a **one-to-one correspondence** between the two sets.

(b) How many different one-to-one correspondences are there between A and B if both 1 and 2 must correspond to consonants (non-vowels)?

[4] 8. How many different 4-digit numbers can be formed using the digits: 1, 3, 4, 5, 7, 8, 9 if the first digit must be even and the second must be odd and repeated digits are **not** allowed?

[3] 9. Determine if it is possible to create a 3×3 magic square with the numbers: 3, 4, 7, 8, 9, 11, 12, 14, 17. Justify your answer.

[6] 10. For each of the following sequences, (i) **identify** the sequence, (ii) find a_{123} and (iii) give a **direct formula** for the n^{th} term of the sequence:

(a) 2, 9, 16, 23, ...

(b) 4, 12, 36, 108, ...

[3] 11. Given the recursive formula: $a_n = 3a_{n-1} + 5a_{n-2}$ with $a_1 = 3$ and $a_2 = 2$, find a_3 and a_4.

[BONUS QUESTION]

[2] Evaluate and simplify $\frac{8-1-7}{3-3}$.

MATH 131 TEST # 2 Oct 31, 2019

Name: _____

[4] 1. Name the **property of whole number operations** demonstrated by each of the following statements:

(a) $(a \times b) \times c = (b \times a) \times c$ _____

(b) $(2x + y) = (2x + y) \cdot 1$ _____

(c) $(a + b) + (c + d) = a + (b + (c + d))$ _____

(d) For all $x, y \in W$, $x + y$ is also a whole number _____

[4] 2. Show that the equation $a + (b + c) = (c + a) + b$ is true. Give a property of addition to justify **each step** in your argument.

[5] 3. An operation $\oplus$ is defined on the set $S = \{d, o, b\}$ as shown in the table on the right. For example, $d \oplus o = o$ and $b \oplus d = d$ etc.

(a) Is S closed with respect to $\oplus$? Explain.

$\oplus$	d	o	b
d	b	o	d
o	b	o	o
b	d	o	b

(b) Is $\oplus$ commutative on S? Explain.

(c) Is there an identity element for $\oplus$ on S? If yes, what is it?

[3] 4. Write $C0DE_{16}$ in expanded form and convert it to base 10.

[9] 5. Perform the following conversions:

(a) Write 487,943,294 in Roman numerals.

(b) Write  in Hindu-Arabic Numerals

(c) Write 124,000 in Mayan numerals.

[4] 6. Use the successive division algorithm discussed in class to convert 2019 to a base 6 number.

[8] 7. Perform each of the following operations using the given bases:

(a)
$$\begin{array}{rr} & 254_7 \\ + & 656_7 \\ \hline \end{array}$$

(b)
$$\begin{array}{rr} & 10010_2 \\ - & 111_2 \\ \hline \end{array}$$

(c)
$$\begin{array}{rr} & BCA8_{16} \\ + & DCD_{16} \\ \hline \end{array}$$

(d)
$$\begin{array}{rr} & FCC7_{16} \\ - & 1F9_{16} \\ \hline \end{array}$$

[3] 8. Use the **lattice algorithm** to perform the following operation: $654_8 + 726_8$.

[3] 9. Use the **scratch algorithm** to find the sum :

$$\begin{array}{rr} & 35_7 \\ & 26_7 \\ & 14_7 \\ & 53_7 \\ + & 32_7 \\ \hline \end{array}$$

[3] 10. Name the 3 different subtraction models discussed in class.

[4] 11.Use **the distributive property** to factor the following expressions completely:

(a) $28x^4y^2 + 35x^3y^5 =$

(b) $15(x+1)^5 + 5(x+1)^2 =$

[BONUS QUESTION]

[2] Explain why for any non-zero number a, $a \div 0$ is undefined.

MATH 131
TEST # 3
Nov 28, 2019

Name: _____

[3] 1. Use **lattice algorithm** to perform the following operation:

$546_7 \times 435_7 =$

[9] 2. Perform the following operations using the **standard algorithms** in the given bases:

(a) $523_6 \times 43_6 =$

(b) $111010_2 \div 110_2 =$

(c) $652_8 \div 7_8 =$

[4] 3. Use **the divisibility tests** developed in class to test the integer $n = 782367742946280$ for divisibility by 2, 3, 4, 5, 6, 8, and 9. Explain.

[3] 4. Use base 10 expanded form for a 5 digit number to explain why the divisibility test for 9 works.

[4] 5. Let a, b and c be integers with $a \neq 0$, use **the definition of divisibility** to prove that if $a|b$ and $a|c$ then $a^2|5bc$.

[6] 6. Find the prime factorization for each of the following integers:
(a) 10584

(b) $35^{26}25^{43}21^{37}$

[2] 7. What is the largest prime that we need to check to determine if 789 is a prime or not?

[3] 8. Find the **smallest odd** natural number that is divisible by 5 different primes.

[6] 9. How many positive divisors does the integer 9720 have? Explain.

[4] 10. Find $GCD(a, b)$ and $LCM(a, b)$ if $a = 2^{52}3^{73}7^{49}$ and $b = 3^{54}7^{55}11^{29}$.

[6] 11. Use the **Euclidean Algorithm** to find $GCD(18375, 9408)$, then use the GCD to find $LCM(18375, 9408)$.

[BONUS QUESTION]

[2] What is the smallest natural number that has exactly 13 different positive divisors?