

**Intermediate Level
Test Preparation**



**M
A
T
H**

Big 8 REVIEW

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DEDICATION

During the writing of this book, “the Attack on America” (9-11-2001) occurred. The hijacking of United States airplanes, the attack on the Pentagon, the destruction of property, the World Trade Center collapse and the killing of innocent people weighs heavily on us all. This book is dedicated to those who died or were injured as a result of the attack.

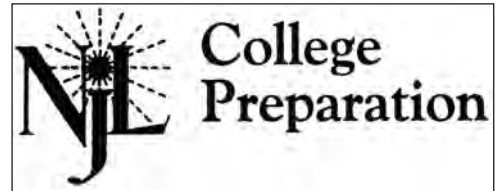
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Front Cover: Photo courtesy of NASA. STS108-S-008 (5 December 2001) Smoke billows from Launch Pad 39B as the Space Shuttle Endeavour lifts off into an afternoon sky to begin the STS-108 mission to the International Space Station (ISS).

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* identifies post-March material



Cover Photo

Space Shuttle Atlantis takes flight on the STS-27 mission in December 2, 1988. The Shuttle takes about 8.5 minutes to accelerate a speed of over 17,000 and go into orbit.

Image Credit: NASA

TO THE STUDENT

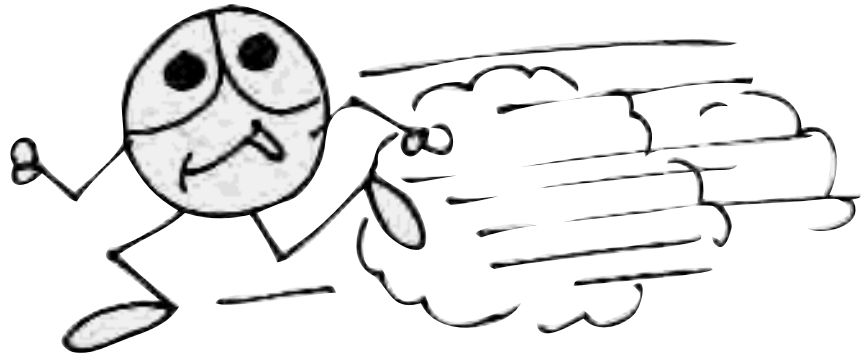
Hello Eighth Grader!

This workbook is designed to help you achieve success on the *March New York State 8th Grade Math Assessment Test*.

Each chapter contains:

- **FAST FACTS**

These are quick chart and picture reviews of the topic. We do not give long, wordy details – just the necessary facts.



- **OUR TURN**

We ask the questions and *we* work out the solutions.

- **YOUR TURN**

You get plenty of practice problems in each subject area.

In addition there are special features:

- **PIZZA π PIZZERIA**

A fun scenario to practice what you have learned.

- **3 COMPLETE TESTS**

All questions are on the level of the March Assessment Test and are just what you need to know in order to do well.



“BIG 8” SPECIAL NOTES

- **SYMBOLS AND REFERENCES**

A comprehensive guide to many of the standard signs and symbols used in math operations

Good luck!

This chapter discusses the basic rules of operations and the laws of exponents.

Sports are all played using rules. Can you imagine playing baseball, where some teams use the rule: 3 Strikes and you're Out; others use: 2 Strikes and you're Out; and still others use 4 Strikes? How could you play the game? Well, math also works on universal rules.

Operations are the manipulation of numbers according to defined rules. If you write a calculation, everyone should understand what that calculation means. Therefore, everyone will get the same answer. For example:

Order to use when calculating:

(Step 1) Work with any numbers within **parentheses** first.

(Step 2) If present, calculate any **exponents***

(Step 3) Then, **multiply** (ex. 1) or **divide** (ex. 2)

(Step 4) Finally, **add** (ex. 1) or **subtract** (ex. 2)

Example 1

Step 1 $6^2 + 2 \times (6 - 1)$

Step 2 $6^2 + 2 \times 5$

Step 3 $36 + 2 \times 5$

Step 4 $36 + 10$

answer = 46

Example 2

$(4 + 2)^2 \div 4 - 1$

$6^2 \div 4 - 1$

$36 \div 4 - 1$

$9 - 1$

answer = 8

*Exponents are the repeated multiplication of a number by itself. It is a useful shorthand. Calculations, such as 6×6 can be expressed as 6^2 .





3.1 BASICS

ORDER OF OPERATIONS

Abbreviation	Terminology	Notes
P	Parenthesis	work within the grouping symbols first
E	Exponents	sometimes called powers
M D	Multiplication Division	in order from left to right
A S	Addition Subtraction	in order from left to right

NAMES OF CALCULATION RESULTS

Calculation Type	Name of Result
Addition	Sum
Subtraction	Difference
Multiplication	Product
Division	Quotient

8 PEMDAS – The mnemonic “**P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally” helps to remember the order of operations

OUR TURN

Q:	A:
1 What is the positive difference between 8 and 2?	1 6 Difference means subtraction. $8 - 2 = 6$
2 In the calculation $3 + 2 \times 4 \div 2 - 1$, which operation should be done first?	2 \times (multiplication) Multiplication and Division come before Addition or Subtraction. Multiplication and Division are done left to right.
3 What is the value of $2 + 3 \times 4 + 1$?	3 15 $2 + 3 \times 4 + 1$ $2 + 12 + 1 = 15$
4 Evaluate $3a + b^2$ when $a = 4$ and $b = 5$	4 37 $3a + b^2 \Rightarrow 3(4) + (5)^2 =$ $12 + 25 = 37$

YOUR TURN

In each of the following sets, which calculation would be done first?

- | | |
|--------------------|-------------------------------|
| 1 $4 \div 2 + 1$ | 3 $3^2 + 4$ |
| 2 $3 \div (4 + 1)$ | 4 $6 + 4 \div 2 \times 1 - 3$ |
| | 5 $3 + 4 + 7 - 1$ |

Find the value of each of the following.

6 $6 \div 3 \times 4 - 1$

7 $4 + 3 \times 7$

8 $(3 + 5) \times 2 + 3$

9 $(1 + 4) \times (6 + 2)$

10 $(2 + 5) - (6 \times 1)$

11 $4 \div (3 - 1) + (2 \times 3)$

12 $(3 + 1)^2 - 4 \times 2$

13 $3^2 + 4^2$

14 $(3 + 4)^2$

15 $(7 - 3)^2 \div (1 + 3)$

Evaluate each of the following.

16 $2a + b$ when $a = 3$ and $b = 4$

17 $2a^2 - b$ when $a = 3$ and $b = 2$

18 $3a^2 + 4b$ when $a = 2$ and $b = 3$

19 $2a^2 - 3b^2$ when $a = 5$ and $b = 2$

20 $(a - b)^2 + a$ when $a = 4$ and $b = 1$

21 $6 + (2 \times 3) - 4 = ?$

A 7

B 8

C 12

D 20

22 $8^2 - (4 + 1)^2 = ?$

A 6

B 17

C 37

D 39

23 $(1 + 2)^2 - (5 - 4)^2 = ?$

A 4

B 8

C 24

D 36

24 $2 \times 3^2 + 1 = ?$

A 19

B 32

C 37

D 49

25 $(1 + 2 + 3)^2 + 4 = ?$

A 16

B 18

C 40

D 100

26 Which one of the following is equal to 10?

A $(4 + 3) - (1 \times 2)$

B $4 + (3 - 1) \times 2$

C $(4 \times 3) - (1 \times 2)$

D $(4 + 3 - 1) \times 2$

27 Which one of the following is equal to 14?

A $(1 + 2 + 3)^2$

B $(1 + 2)^2 + 3$

C $1^2 + (2 + 3)^2$

D $1^2 + 2^2 + 3^2$

28 Which one of the following is equal to 50?

A $1 + (3 + 4)^2$

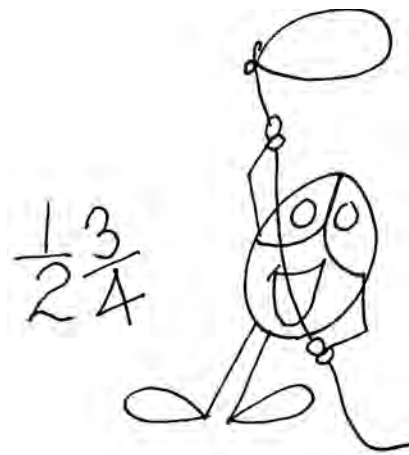
B $1^2 + 3^2 + 4^2$

C $(1 + 3)^2 + 4$

D $(1 + 3 + 4)^2$

3.2 IMPLIED PARENTHESES (GROUPING SYMBOLS)

GROUPING SYMBOLS WITH INVISIBLE (IMPLIED) PARENTHESES



Symbol Name	Example	Implied Parentheses	Description
Fraction	$\frac{6+2}{7+1}$	$\frac{(6+2)}{(7+1)}$	Numerator - one group Denominator - second group
Square Root	$\sqrt{7+1}$	$\sqrt{(7+1)}$	Everything under the $\sqrt{\quad}$ is one group
Absolute Value	$ 6+3 $	$ (6+3) $	Everything inside the absolute value symbol is grouped

OUR TURN

Q:

1 What is the value of $\frac{4+8}{1+2}$?

2 In this example, which operation do you perform first ?

$$\frac{5+3}{2 \times 2}$$

A:

1 4

$$\frac{4+8}{1+2} \Rightarrow \frac{(4+8)}{(1+2)} = \frac{12}{3} = 4$$

2 Adding

$$\frac{5+3}{2 \times 2} = \frac{(5+3)}{(2 \times 2)} = \frac{8}{4} = 2$$

YOUR TURN

Evaluate:

1 $\frac{6+2}{8 \div 2}$

2 $\frac{3+5}{3+1}$

3 $\frac{7-2}{2+3}$

4 $\frac{6+3 \times 2}{2+1}$

5 $\frac{3-(1+1)}{5-2}$

6 $\frac{2+2 \times 2}{2 \times 2+2}$

7 $\frac{12 \div 3+1}{(12 \div 3)+1}$

8 $\frac{12 \div 3+1}{12 \div (3+1)}$

9 $\frac{8-1}{6+1}$

10 $\frac{3^2-1}{2^2}$

11 $\frac{6 + 3 \times (3^2 - 1)}{1^2 + 2^2} = ?$

- A 6
- B 7
- C 8
- D 9

12 $\frac{2+1}{4-1} + \frac{3+2}{6-1} = ?$

- A 2
- B 4
- C 6
- D 8

13 $\frac{6+4+2}{3+2+1} = ?$

- A 1
- B 2
- C 6
- D 10

14 $\frac{(1+2)^2 + 3}{1^2 + 2^2 + 3} = ?$

- A $\frac{1}{2}$
- B 1
- C $\frac{3}{2}$
- D 2

15 $\frac{6 \div (2^2 - 1)}{5 + 1} = ?$

- A $\frac{1}{12}$
- B $\frac{1}{6}$
- C $\frac{1}{3}$
- D 2

16 Which of the following is equal to 18?

- A $|10 - 3 \times 2| + 4$
- B $|10 - 3| \times 2 + 4$
- C $|10 - 3| \times (2 + 4)$
- D $|10 - 3 \times 2 + 4|$

17 $6 \times \sqrt{6 - 2} = ?$

- A 4
- B 12
- C 24
- D 34

18 $\sqrt{\frac{20}{5}} + 3 = ?$

- A 5
- B 7
- C 9
- D 13

19 Which of the following is equal to 2?

- A $\frac{4 + 2 \times 3}{3^2 - 2^2}$
- B $\frac{(4 + 2) \times 3}{3^2 - 2^2}$
- C $\frac{4 + 2 \times 3}{(3 - 2)^2}$
- D $\frac{4 + (2 \times 3)}{(3 - 2)^2}$

20 Which of the following is equal to 2?

- A $\frac{1^2 + 2^2 + 3^2}{1 \times 2 + 3}$
- B $\frac{(1 + 2^2) + 3^2}{1 \times 2 \times 3}$
- C $\frac{1 + (2 \times 3)^2}{1 + 2 + 3}$
- D $\frac{(1 + 2)^2 + 3}{1 + 2 + 3}$

21 Which of the following is equal to 10?

A $\frac{(6 + 8) \div (2 \times 2)}{5 - 2 - 1}$

B $\frac{6 + (8 \div 2) \times 2}{5 - (2 - 1)}$

C $\frac{(6 + 8 \div 2) \times 2}{(5 - 2) - 1}$

D $\frac{6 + (8 \div 2 \times 2)}{(5 - 2) - 1}$

22 $\frac{\sqrt{12 + 4} - 2}{\sqrt{12 + 4} - 7} = ?$

A $\frac{1}{4}$

B $\frac{1}{3}$

C $-\frac{2}{3}$

D $\frac{3}{4}$

23 $|5 - 1| \times 3 = ?$

A 2

B 9

C 12

D 15

Evaluate:

24 $\frac{2a - b^2}{a - b}$ when $a = 9$ and $b = 2$

25 $\frac{a + (b^2 - a)}{2 \times (a^2 - b)}$ when $a = 4$ and $b = 3$

3.3 PROPERTIES/LAWS

TABLE OF PROPERTIES/LAWS

Property	Sample	Explanation
Additive Identity	$a + 0 = a$ $2 + 0 = 2$	Adding a zero to a number maintains its value.
Multiplicative Identity	$a \cdot 1 = a$ $2 \cdot 1 = 2$	Multiplying by one maintains its value.
Associative Property of Addition	$(a + b) + c = a + (b + c)$ $(2 + 3) + 4 = 2 + (3 + 4)$	Regrouped addition maintains its sum.
Associative Property of Multiplication	$(a \cdot b) \cdot c = a \cdot (b \cdot c)$ $(2 \cdot 3) \cdot 4 = 2 \cdot (3 \cdot 4)$	Regrouped multiplication maintains its product.
Commutative Property of Addition	$a + b = b + a$ $2 + 3 = 3 + 2$	Adding can be done in any order.
Commutative Property of Multiplication	$a \cdot b = b \cdot a$ $2 \cdot 3 = 3 \cdot 2$	Multiplying can be done in any order.
Zero Product	$a \cdot 0 = 0$ $2 \cdot 0 = 0$	Multiplying by zero yields a zero product.
Distributive Property of Multiplication over Addition	$a(b + c) = a \cdot b + a \cdot c$ $2(3 + 4) = 2 \cdot 3 + 2 \cdot 4$	Multiplication can be distributed (given out) to each part of the addition.



OUR TURN

Q:

- 1 The following is an example of which property?
 $6 \cdot (4 + 3) = 6 \cdot 4 + 6 \cdot 3$

A:

- 1 Distributive Property of Multiplication over Addition
 $6 \cdot (4 + 3) = 6 \cdot (4) + 6 \cdot (3)$

YOUR TURN

Identify the illustrated property.

1 $7 \cdot 1 = 7$

2 $7 + 0 = 7$

3 $7 \cdot 0 = 0$

4 $7 \cdot (3 + 4) = 7 \cdot (3) + 7 \cdot (4)$

5 $8 + (4 \cdot 3) = 8 + (3 \cdot 4)$

6 $(6 + 2) \cdot (8) = 8 \cdot (6 + 2)$

7 $(6 + 3) + 5 = (3 + 6) + 5$

8 $7 \cdot (2) + 7 \cdot (6) = 7 \cdot (2 + 6)$

9 $6(2) + 5(3) = 5(3) + 6(2)$

10 $6(2) + 5(3) = 6(2) + 3(5)$

- 11 $15(17)$ is equivalent to which of the following?

A $5(17) + 10(17)$

B $5(14) + 10(3)$

C $3(17) \cdot 5(17)$

D $3(10) + 12(7)$

- 12 Which one of the following illustrates an associative rule?

A $8 + 0 = 8$

B $8 + (6 + 4) = (8 + 6) + 4$

C $8 \cdot (6 + 1) = 8 \cdot (6) + 8 \cdot (1)$

D $8 \cdot (4 \cdot 3) = 8 \cdot (3 \cdot 4)$

- 13 Which correctly illustrates the Commutative Property of Multiplication?

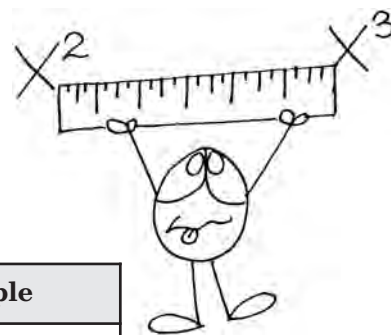
A $2 + 3 = 3 + 2$

B $2 \cdot (4 + 7) = 2 \cdot 4 + 2 \cdot 7$

C $2 \cdot (3 + 5) = (3 + 5) \cdot (2)$

D $2(3) + 7(3) = (2 + 7)(3)$

3.4 RULES OF EXPONENTS



RULES OF EXPONENTS

Pictorial (rules)	Explanation	Example
$x^0 = 1$	Any number to the zero power is 1.	$7^0 = 1$
$x^1 = x$	Any number to the one power is itself.	$7^1 = 7$
$x^a \cdot x^b = x^{a+b}$	To multiply: If the bases are the same, keep the base and add the exponents.	$7^3 \cdot 7^9 = 7^{3+9} = 7^{12}$
$\frac{x^a}{x^b} = x^{a-b}$	To divide: If the bases are the same, keep the base and subtract the exponents.	$\frac{7^{12}}{7^6} = 7^{12-6} = 7^6$
$(x^a)^b = x^{ab}$	To power a power: Keep the bases and multiply the exponents.	$(7^2)^5 = 7^{2 \cdot 5} = 7^{10}$
$(x \cdot y)^a = x^a \cdot y^a$	A product to a power: Distribute the power.	$(7 \cdot 3)^4 = 7^4 \cdot 3^4$
$x^{-a} = \frac{1}{x^a}$	A base to a negative power: It is the reciprocal of the base to the positive exponent.	$7^{-2} = \frac{1}{7^2} = \frac{1}{49}$



+ or - : $x^a + x^b$ and $x^a - x^b$ do not have exponential rules. Just work them out.

The letter x : As a rule, using the same letter means that they must have the same value.

OUR TURN

Q: Perform the indicated operation and express the result in exponential form if possible.

1 $3^7 \cdot 3^2$

2 $\frac{4^8}{4^2}$

3 $3^{-2} \cdot 3^3$

4 $6^2 \cdot 7^1$

A:

1 3^9

$$x^a \cdot x^b = x^{a+b}$$

$$3^7 \cdot 3^2 = 3^{7+2} = 3^9$$

2 4^6

$$\frac{x^a}{x^b} = x^{a-b}$$

$$\frac{4^8}{4^2} = 4^{8-2} = 4^6$$

3 3^1 or 3

$$3^{-2} \cdot 3^3 = 3^{-2+3} = 3^1 = 3$$

4 No exponential solution.
However, the product is 252.

$x^a \cdot x^b$ requires the x values to be the same

$6^2 \cdot 7^1$: the base 6 and the base 7 are not the same; therefore, the exponential rule does not apply.

Without exponents $6^2 = 36$, $7^1 = 7$
 $6^2 \cdot 7^1 = 36 \cdot (7) = 252$

YOUR TURN

Perform the indicated operation and express the result in exponential form if possible.

1 $3^8 \cdot 3^2$

2 $\frac{4^9}{4^3}$

3 $(7 \cdot 3)^2$

4 $4^3 - 4^2$

5 $(6^2)^3$

6 $(7^{-1})^3$

7 $(3 \cdot 2)^{(1+2)}$

8 $6^2 \cdot 6^8$

9 $5^{11} \cdot 5^2 \cdot 5^4$

10 $(5^3 \cdot 5^2)^3$

11 $\frac{16^{16}}{16^2} = ?$

A 16^{14}

B 16^8

C 16^4

D 16^2

12 $3^3 \cdot 3^7 = ?$

A 3^{10}

B 3^{21}

C 9^{10}

D 9^{21}

13 $3^7 \cdot 2^7 = ?$

A 5^7

B 6^7

C 5^{14}

D 6^{14}

14 $7^{-2} = ?$

A -14

B -7^2

C $-\frac{1}{14}$

D $\frac{1}{49}$

15 Which one of the following equalities is true?

A $2^4 = 4^2$

B $3^4 = 4^3$

C $6^3 = 3^6$

D $16^1 = 1^{16}$

16 Which one of the following is equivalent to $(1 + 2 + 3)^2$?

A $1^2 + 2^2 + 3^2$

B $(1 + 2)^2 + 3^2$

C $1^2 + (2 + 3)^2$

D 6^2

17 Which one of the following is equivalent to $4 \cdot 8^{-1}$?

A -32

B -12

C 12^{-1}

D $\frac{1}{2}$

18 $2^0 + 3^0 + 4^0 + 5^0 = ?$

A 0

B 1

C 4

D 14

19 Which one of the following is equivalent to 28^2 ?

A 14^4

B $14^2 + 2^2$

C $14^2 \cdot 2^2$

D 56

20 For what value of n does $7^n = 8^n$?

- A 0
- B 1
- C 10
- D no value

21 Evaluate $x^0 + 4$, when $x = 7$

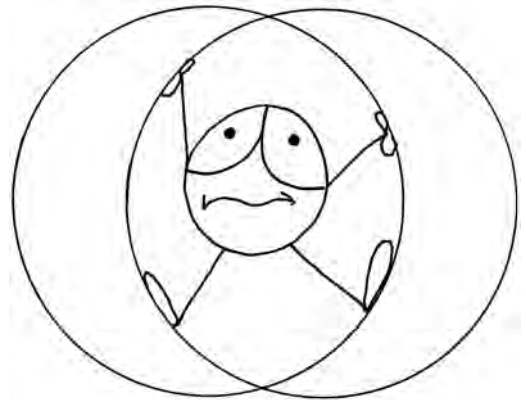
22 $3^0 \cdot 2^0 = ?$

23 $(3 \cdot 2)^0 = ?$

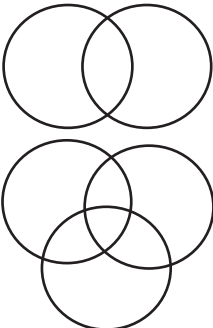
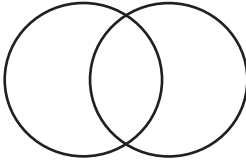
24 $-3^0 + (-3)^0 = ?$

25 Evaluate $3x^0 + (3x)^0$, when $x = 4$

3.5 SETS/CLOSURE



SETS/CLOSURE

Symbol	Name	Definition	Sample
{item, item}	Set	a well defined collection	set of even, positive integers from 1 to 10 inclusive {2, 4, 6, 8, 10}
{Element, element... }	Element	a member of a set	Given {1, 3, 5} 1, 3, and 5 are each elements.
	Venn Diagrams	A pictorial used to view sets and their overlap.	 Set A = {2, 4, 6, 8} Set B = {4, 8, 12, 16} the overlap is {4, 8}
\emptyset or { }	Null or Empty Set	a set with no elements	Set of odd numbers divisible by 2 or \emptyset
Closed	Closed Set	A set is closed if: when any elements of the set are used in an operation, the result is always part of the set.	Set of odd integers is closed under multiplication because: the multiplication of any 2 elements in the set yields a product which is always within the same set.

OUR TURN

Q:

- 1 Name 2 elements in the set of positive odd integers.
- 2 Give an example of an empty set.
- 3 Is the set of whole numbers closed under multiplication?
- 4 Is the set of whole numbers closed under subtraction?

A:

- 1 3 and 7 (Many other answers are possible)
Both numbers are in the set $\{1, 3, 5, 7, 9, 11, \dots\}$.
- 2 The set of numbers which are both even and odd.
No number is both even and odd.
- 3 Yes.
The multiplication of any 2 whole numbers is also a whole number, therefore the set is **closed** under multiplication.
- 4 No
The subtraction of 2 whole numbers does **not** always generate a whole number. For example: $2 - 6 = -4$. Negative four is **not** a whole number.

YOUR TURN

- 1 An element of the set of irrational numbers is:

A $\sqrt{0}$

B $\sqrt{1}$

C $\sqrt{2}$

D $\sqrt{4}$

- 2 The set of negative integers is closed under which one of the following operations?

A addition

B subtraction

C multiplication

D division

- 3 Which one of the following is a member of the set of odd integers?

A $\frac{3}{5}$

B $9 - 5$

C $\sqrt{19}$

D $\sqrt{25}$

- 4 Which of the following represents a member belonging to the set of never ending, repeating decimals?

A $\sqrt{2}$

B π

C 161661666...

D $\frac{2}{3}$

- 5 The integers and the fractions form which of the following sets?

A the counting numbers

B the whole numbers

C the rational numbers

D the irrational numbers

- 6 Which one of the following sets contains only whole numbers?

A $\{-2, -1, 0, 1, 2\}$

B $\{0, 1, 2, 3, 4\}$

C $\{1, 1\frac{1}{2}, 2, 2\frac{1}{2}\}$

D $\{.3, .4, .5, .6\}$

- 7 Multiplying any 2 elements in the set of odd integers gives which of the following sets?
- A integers
 - B even integers
 - C odd integers
 - D positive integers
- 8 Which set represents the overlap of the set of perfect squares and the set of positive integers from 1 to 10 inclusive?
- A {1, 4, 9}
 - B {2, 4, 6, 8, 10}
 - C {1, 2, 3, 4}
 - D {2, 4, 8}
- 9 How many elements belong to the set of prime numbers and the set of even integers?
- A none
 - B one
 - C two
 - D three
- 10 The null set is also known as which one of the following?
- A closed set
 - B empty set
 - C integer set
 - D irrational set
- 11 The set of odd integers is closed under which one of the following operations?
- A addition
 - B subtraction
 - C multiplication
 - D division
- 12 The set of perfect squares is closed under which one of the following operations?
- A addition
 - B subtraction
 - C multiplication
 - D division

3.6 LONG ANSWER QUESTIONS FOR CHAPTER 3

1 Given the following fraction:

$$\frac{6 + 2^2 - 3 \times 2}{10 - 4 \times 2}$$

PART A

What is the value of the above fraction?

Show all work or explain how you arrived at your answer.

Answer _____

PART B

The fraction is repeated here for you to use in Part B.

Insert one set of parentheses so the fraction below will now be equal to 4.

$$\frac{6 + 2^2 - 3 \times 2}{10 - 4 \times 2}$$

2 Dawn performed the following steps:

Given : $7(a + 0) + 3(b + 1)$

Step 1: $7(a) + 3(b + 1)$

Step 2: $7(a) + 3(1 + b)$

Step 3: $7(a) + 3(1) + 3(b)$

Step 4: $7(a) + 1(3) + 3(b)$

Step 5: $7(a) + 3 + 3(b)$

For each of the steps shown above, state which property/law of integers was used. Be as precise as possible. The first answer has been completed for you.

From Given to Step 1 Additive Identity Property

From Step 1 to Step 2 _____

From Step 2 to Step 3 _____

From Step 3 to Step 4 _____

From Step 4 to Step 5 _____

3 Given Set A : {even integers}

Set B : {prime numbers}

Set C : {multiples of 7}

PART A

Give 2 examples of elements that are in Set A and Set C .

Answer : _____ and _____

PART B

What is the set of numbers that are in both Set A and in Set B ?

Answer: _____

PART C

What is the set of numbers that are in both Set B and in Set C ?

Answer: _____