P20-24

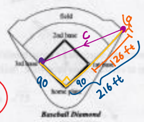
September 10, 2018 1:00 PM

P.20

7. Pythagorean Triples are sets of numbers that satisfy the property $a^2 + b^2 = c^2$. For example, the set of numbers 5, 12, 13 is a Pythagorean Triple since $5^2 + 12^2 = 13^2$ $(25 + 144 = 169)$. Which of the following sets of numbers are Pythagorean Triples? Explain your choices.

Example: 1, 2, 3	No	$1^2 + 2^2 \neq 3^2$, $(1 + 4 \neq 9)$
a) 7, 24, 25		
b) 8, 15, 17		
c) 9, 14, 16		
d) 9, 40, 41		
e) 15, 36, 39		
f) $\sqrt{2}, \sqrt{3}, \sqrt{5}$		
g) $\sqrt{10}$, 4, 5	N	

Use the diagram for questions 8 - 11.



Baseball Diamond

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* Use a calculator!!

8. A baseball diamond is 90 feet on each side. How far is it from second base to home plate?

$a = 90$, $b = 90$, c

$a^2 + b^2 = c^2$

$90^2 + 90^2 = c^2$

$8100 + 8100 = c^2$

$16200 = c^2$

$c = \sqrt{16200}$

$\boxed{c = 127 \text{ ft}}$

9. The short stop plays exactly halfway between second base and third base. How far is the throw to first base from short stop?

10. The second base player backs up 30 ft from second base directly in line with second and third base to field a ball. How far is a throw to home plate?

11. A fielder caught a fly ball on the first base line 126 feet from first base, how far would he have to throw to get the ball to third base?

$a = 90$, $216 = b$, c

$a^2 + b^2 = c^2$

$90^2 + 216^2 = c^2$

$8100 + 46656 = c^2$

$\sqrt{54756} = \sqrt{c^2}$

$\boxed{c = 234 \text{ ft}}$

$$\begin{array}{r} 216 \\ \times 216 \\ \hline 43200 \\ 2160 \\ 1296 \\ \hline 46656 \end{array}$$

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1.4 Defining a Power

4^2 (4 square) 4^3 (4 cube)

Many mathematical situations require multiplying a number by itself repeatedly. Writing these expressions in **exponential form** provides an efficient method for representing the repeated multiplication of the same factor.

The expression $10 \times 10 \times 10 \times 10 = 10^4$ is read "ten to the fourth power". We call the number 4 an **exponent** and we say that the number 10 is the **base**. An expression for a power is called **exponential notation**.

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$3 \times 3 \times 3 \times 3 \times 3 = \underbrace{3}_{\text{base}}{}^{5 \text{ exponent}}$ (3 to the power of 5)

Exponential Notation

An **exponent** (or power) is a number that indicates how many times another number (called the base) is used as a factor.

Ex1) $(-3)^3 = (-3)(-3)(-3) = -27$

Rule #1: $(-b)^{odd} = (-)$ neg; $(-b)^{even} = (+)$ positive

For any natural number n greater than or equal to two, $b^n = \underbrace{b \times b \times b \times b \times \ldots \times b}_{n \text{ factors}}$

Ex2) $-3^3 = -3 \cdot 3 \cdot 3 = -27$

The expression $2^5 = \underbrace{2 \times 2 \times 2 \times 2 \times 2}_{5 \text{ factors}}$ is read "two to the fifth power"; it tells us to use two as a factor five times.

$\underbrace{\underbrace{2 \times 2}_{4} \times \underbrace{\underbrace{2 \times 2}_{4} \times 2}_{8}}_{32}$

Ex3) $(-3)^4 = \underbrace{\underbrace{(-3)(-3)}_{9}\underbrace{(-3)(-3)}_{9}}_{81} = \boxed{+81}$

Ex4) $-3^4 = -81$

Ex5) $(-2)^{5 \text{ odd}} = -32$

Ex6) $-(-5)^3 = 125$

The Product of Negative Numbers

The product of an even number of negative numbers is positive. The product of an odd number of negative numbers is odd.

$(-1)^{30}$ is positive since 30 is even. $(-1)^{19}$ is negative since 19 is odd.

Ex7) $-\left[-\left(-(-1)^2\right)^2\right]^4 = -1$

Another important concept in determining if a product of negative numbers is even or odd is where the negative sign lies in relation to the brackets.

i) $(-2)^4 = (-2) \times (-2) \times (-2) \times (-2) = 16$ — *The negative sign is inside the brackets therefore −2 is the base and an even number of negative numbers is positive.*

ii) $-(2)^4 = -(2) \times (2) \times (2) \times (2) = -16$ — *The negative is outside the bracket therefore only the two is the base and there is only one negative sign. Therefore the answer is negative.*

iii) $-2^4 = -2 \times 2 \times 2 \times 2 = -16$ — *Without the brackets, the base is only two. The negative sign does not belong to the exponent, and the answer is negative again.*

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One and Zero as Exponents

Look for a pattern in the following:

$2 \times 2 \times 2 \times 2 \times 2 = 2^5$
$2 \times 2 \times 2 \times 2 = 2^4$
$2 \times 2 \times 2 = 2^3$
$2 \times 2 = 2^2$

$3^3 = 27$ ÷3
$3^2 = 9$ ÷3
$3^1 = 3$ ÷3
$3^0 = 1$

Rule #2: $b^0 = 1$; except: $\emptyset^0 =$ undefine

ex) $(25.6)^0 = 1$

$\left(\frac{-17}{5}\right)^0 = 1$

$(\sqrt{54})^0 = 1$

On the left side of the equation each step is being divided by 2. On the right side of the equation the exponent decreases by 1 on each step.

~~To continue the pattern we say:~~

$2 = 2^1$
$1 = 2^0$

$0^3 = \emptyset$ $3^0 = 1$
$0^2 = \emptyset$ $2^0 = 1$
$0^1 = \emptyset$ $1^0 = 1$
$0^0 = \emptyset$ X $0^0 = 1$ X

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Exponents of 0 and 1

$a^1 = a$, for any number a.
$a^0 = 1$, for any non-zero number a.

note: 0^0 is not defined.

Ex1) $[2^3 + 3]^0 = 1$

Ex2) $[\underbrace{2^3 - 8}_{\emptyset}]^0 =$ undefine

Rule: $b^0 = 1$; except: 0^0 undefine

$3^3 = 3 \times 3 \times 3 = 27$ ÷3
$3^2 = 9$ ÷3
$3^1 = 3$ ÷3
$3^0 = 1$

$4 \times 4 \times 4$

$(-4)^3 = -64$ ÷(−4)
$(-4)^2 = 16$ ÷(−4)
$(-4)^1 = -4$ ÷(−4)
$(-4)^0 = 1$

4^3	4^2	4^1	4^0	4^{-1}
$4 \times 4 \times 4$	4×4	4	1	$\frac{1}{4}$

÷4 ÷4 ÷4 ÷

$0^3 = \emptyset$ $3^0 = 1$
$0^2 = \emptyset$ $2^0 = 1$
$0^1 = \emptyset$ $1^0 = 1$

$0^0 =$ undefine

Ex3) $3 + (-5)^0 - 3^0$

Ex1) $-(-4)^0 = -1$

Ex2) $4 - \left(\frac{2}{5}\right)^0 = 3$

Exponents of 0 and 1

$a^1 = a$, for any number a.
$a^0 = 1$, for any non-zero number a.
note: 0^0 is not defined.

Ex1) $[2^3+3]^0 = 1$

Ex2) $[2^3-8]^0$ = undefine ($2^3 = 8$, $2^3 - 8 = \varnothing$)

Examples: $5^0 = 1$, $17^1 = 17$, $\left(\frac{2}{3}\right)^0 = 1$, $-5^0 = -1$, $(-5)^0 = 1$

P.22

Q11

Example 1 Simplify.

a) $(a+b)^0$ **b)** $a+b^0$ **c)** a^0+b^0 **d)** $(a \cdot b)^0$ **e)** $a \cdot b^0$ **f)** $(-a)^0$ **g)** $-a^0$

► *Solution:* **a)** 1

b) $a+1$

c) $1+1=2$

d) 1

e) $a \cdot 1 = a$

f) 1

g) -1

Compair Powers

Rule #3

A) Positive (+) > Negative (−)

ex) $(-3)^4 > (-5)^3$ (+, −)

B) • $[b]^n < [b]^m$ (m bigger) → if "b" is bigger than 1

Ex1) $2^3 < 2^7$ (bigger) Ex2) $\left(\frac{5}{3}\right)^5 > \left(\frac{5}{3}\right)^3$

• $[b]^n > [b]^m$ (m bigger, smaller) → "b" is less than 1

Ex1) $\left(\frac{1}{3}\right)^3 > \left(\frac{1}{3}\right)^5$ bigger, smaller value, less than 1

Ex2) $(0.75)^5 < (0.75)^3$

* if base is less than 1, higher power → smaller value

1.4 Exercise Set

1. Complete the table.

	Base 2	Base 3	Base 4	Base 5
Second Power	$2^2 = 2 \times 2 = 4$			
Third Power	$2^3 = 2 \times 2 \times 2 = 8$			
Fourth Power				

2. For each equation, find the integer that can be used as the exponent to make the equation correct.

a) $8 = 2^?$ ______ **b)** $81 = 3^?$ ______

c) $625 = 5^?$ ______ **d)** $64 = 8^?$ ______

e) $64 = 4^?$ ______ **f)** $64 = 2^?$ ______

g) $216 = 6^?$ ______ **h)** $1024 = 2^?$ ______

i) $2401 = 7^?$ ______ **j)** $2187 = 3^?$ ______

Hw
P.23 Q3, 4, 9

3. Circle positive or negative for the values, $a > 0$.

a) $-a^{[illegible]}$ + / − **b)** $-(a)^{[illegible]}$ + / −

c) $(-a)^{[illegible]}$ + / − **d)** $-(-a)^{[illegible]}$ + / −

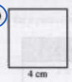
e) $-a^{[illegible]}$ + / − **f)** $-(a)^{[illegible]}$ + / −

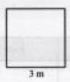
g) $(-a)^{[illegible]}$ + / − **h)** $-(-a)^{[illegible]}$ + / −

i) $(-a)^{[illegible]}$ + / − **j)** $(-a)^{[illegible]}$ + / −

4. Assume that $a > 1$. In order from least to greatest arrange the following: $-(-a)^3$, $-a^3$, $(-a)^4$, $-a^4$.

5. Write the area of each square as a power.

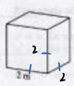
a)


b)


c)

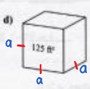

d)


6. Write the volume of each cube as a power.

a)


b)


c)


d)


7. Write in exponential notation. All values are positive.

a) $4 \times 4 \times 4 \times 4 \times 4$ ______ **b)** $5 \times 5 \times 5$ ______

c) $7 \times 7 \times 7 \times 7 \times 7$ ______ **d)** $10 \times 10 \times 10 \times 10$ ______

e) $a \times a \times a \times a$ ______ **f)** $(-a) \times (-a) \times (-a) \times (-a)$ ______

g) $\underbrace{b \times b \times b \times \ldots \times b}_{20 \text{ times}}$ ______ **h)** $\underbrace{b \times b \times b \times \ldots \times b}_{n \text{ times}}$ ______

Ex1) $4^3 > -2^8$

Ex2) $(-3)^7 < (-4)^4$ (even)

Ex3) $(4)^5 > (4)^3$

Ex4 $\left(\frac{7}{11}\right)^5 < \left(\frac{7}{11}\right)^3$

0^0 = undefine

Ex1) $-(-4)^0 = -1$

Ex2) $4 - \left(\frac{2}{5}\right)^0 = 3$

Ex3) $3 + (-5)^0 - 3^0$

Ex) $[x+2-y]^0 = 1$
$[2 \cdot a \cdot b + 4]^0 = 1$
$[\sqrt{4} + 7^3 - 6]^0 = 1$

Ex) $2^3 + 3a^0 = 8 + 3(1) = 11$

Ex) $2^3 + [3a]^0 = 9$

Ex) $[2^3 + 3a]^0 = 1$

Compare Power : Ex) $(-2)^4 > (-3)^3$ (+, −)

Rule #1 : Positive (+) > Negative (−)

Rule #2 : $[\text{bigger than } 1]^n$ → gets larger when "n" gets bigger.

Ex1) $\left(\frac{7}{5}\right)^5 < \left(\frac{7}{5}\right)^6$

$[\text{less than } 1]^n$ → gets smaller as "n" gets bigger.

Ex2) $\left(\frac{2}{5}\right)^5 > \left(\frac{2}{5}\right)^7$ bigger exponent ⇒ small value; less than 1