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Grade	8
Writer	Virender kumar
TL	Abhishek kumar
SME	Pranjal Gupta
Creative Director	Antony Fenix
Final Sign-off	Vishnu Dev
Key Takeaway	
Mini Takeaway	1.
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Pitch Doc	Pitch
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Character	Presenter
Locations	Drawing room
Assets	Couch

INT. DRAWING ROOM - AFTERNOON

CLOSE-UP of the PRESENTER, with his hand on his chin, thinking. Slow ZOOM-OUT to mid shot.

PRESENTER

Hello, my fellow geniuses,
Today, we'll be exploring the world of what if?
(beat)
What if number one had replaced its value with nine when the number system was announced.
(beat)
What if numbers could be finite or…
What if I say, zero can give you the value of one.

Presenter reflects a brief smile and waits for a second.

PRESENTER

When zero is an exponent to any number.
(beat)
Wanna know how?
(beat)
Let's look into a pattern and I will show you…

INSERT MoG: Display "$5^3 = 125$" followed by the further steps of solution synced with the dialogues.

Divide both sides by 5 and apply division law of same bases that is $a^m \div a^n = a^{m-n}$ in LHS

$5^3 \div 5 = 125 \div 5$

$\Rightarrow 5^{3-1} = 25$

$\Rightarrow 5^2 = 25$

Keep on dividing both sides by 5

$5^2 \div 5 = 25 \div 5$

$\Rightarrow 5^{2-1} = 5$

$\Rightarrow 5^1 = 5$

$5^1 \div 5 = 5 \div 5$

$\Rightarrow 5^{1-1} = 1$

$\Rightarrow 5^0 = 1$

PRESENTER

Let's take five raised to the power of three, which is equal to one hundred twenty five

(beat)
and start dividing both sides by five.
(beat)
Hey, if we Consider five as five raised to the power of one,
(beat)
You know we can easily apply the law of division with the same bases…
(beat)
Which will give us five raised to the power of three minus one, and that is?
(beat)
Brilliant! Five raised to the power of two, which is equal to twenty five.
(beat)
Now, you divide both the sides by five and tell me the answer,

Presenter pauses for a second.

PRESENTER
Absolutely right! The answer is five raised to the power of one and on the right hand side we will have five.
(beat)
Now look at this, we have five raised to the power one which is equals to five,
(beat)
and if we divide both sides by five just one more time. We will get five raised to the power of one minus one equals to five by five.
(beat)
Which presents us that five raised to the power of zero is equal to one.
(beat)
And here we just proved the law of exponents which says that “a” raised to the power of zero is equal to one. But…
(beat)
Let’s practice its application with an example.

INSERT ENDS.

INSERT MoG: Display the following beside the presenter:

Find the value of $\frac{5^4}{5^4}$.

Display the following solutions in sync with the dialogues:

$\frac{5^4}{5^4} = \frac{5 \times 5 \times 5 \times 5}{5 \times 5 \times 5 \times 5}$

Apply law of exponent, $a^m \div a^n = a^{m-n}$ in the left hand side of the equation.

$\Rightarrow 5^{4-4} = 1$

$\Rightarrow 5^0 = 1$

PRESENTER

Find the value of five raised to the power of four by five raised to the power of four.
Okay, Let's do this…

(beat)

So here we have two numbers with similar bases getting divided… Can you tell me which law can we apply to solve this?

(beat)

Correct! We can apply the law of exponents which says "a" raised to the power of "m" divided by "a" raised to the power of "n" is equal to "a" raised to the power of "m" minus "n".

(beat)

And we will get five raised to the power of four minus four And that is…

(beat)

Five raised to the power zero.

(beat)

Hey! we just concluded that any number raised to the power zero results in one. So…

(beat)

Five raised to the power of zero will be equal to one.
Wow! We did it,

QUICK ZOOM on the presenter,

PRESENTER

But what if?

INSERT ENDS.

PRESENTER

An exponent is raised to an exponent.

Well, let's see how this works out…

ZOOM OUT for the MID SHOT of the presenter.

INSERT MoG: Display the following beside the presenter in sync with the dialogues:

$(11^{2})^{5} = 11^{2\times5} = 11^{10}$

$11^{2\times5} = 11^{10}$

PRESENTER

For positive exponents when an exponent is raised to an exponent, they get multiplied…

(beat)

Suppose if we say eleven is raised to the power of two which is raised to another power of five.

(beat)

Then we will get eleven raised to the power of two multiplied by five which is…

(beat)

Correct! Elevent raised to the power of ten

(beat)

Excellent! Let's see what happens with negative exponents..

INSERT MoG: Display this beside the presenter sync with the dialogues:

ILLUSTRATION : $(5^{-2})^{-6}$

$(5^{-2})^{-6} = (\frac{1}{5^{2}})^{-6}$

Again, apply the same law

$(\frac{1}{5^{2}})^{-6} = \frac{1}{(\frac{1}{5^{2}})^{6}} = \frac{(5^{2})^{6}}{1^{6}}$

We know that for positive exponents, when power is raised to a power, they get multiplied.

Therefore,

$\frac{(5^{2})^{6}}{1^{6}} = \frac{5^{12}}{1} = 5^{12} = 5^{(-2)\times(-6)}$

Hence, $(5^{-2})^{-6} = 5^{(-2)\times(-6)}$

PRESENTER

So we have five raised to the power of negative two raised to another power of negative six…

(beat)

Ohh, Negative exponents! Let’s turn them into positive…

(beat)

And how do we do that?

(beat)

Excellent! By turning them into their reciprocals.

(beat)

So! Turning five into its reciprocal gives us five raised to the power of two, whole raised to the power of negative six

(beat)

Wait! Another negative exponent, let’s apply the law again, now we will get…

(beat)

One upon one by five raised to the power of two whole raised to the power of six. Which can also be written as…

(beat)

Five raised to the power of two, raised to another power of six upon one raised to the power of six.

(beat)

We have heard that…

(beat)

For positive exponents when a power is raised to another power, powers get multiplied.

(beat)

So! If we multiply six and two we will get five raised to the power of twelve by one…

(beat)

Which can also be written as five raised to the power of negative two multiplied by negative six.

(beat)

Finally! we can conclude that five raised to the power of negative two, whole raised to the power of negative six is equals to

(beat)
Five raised to the power of negative two multiplied by negative six.
(beat)
Wow! That was amazing! We can apply the laws of positive exponents for negative exponents as well.
(beat)
But… Will other laws hold true for negative exponents too, let's find out…

INSERT MoG: Display the following in sync with the dialogues:

For non zero rational numbers a and b, $a^m \times b^m = (a \times b)^m$

$3^2 \times 4^2 = (3 \times 4)^2 = 12^2$

PRESENTER
So the law of positive exponents says that "a" raised to the power of "m" multiplied by "b" raised to the power of "m" is equal to "a" multiplied by "b" whole raised to the power of "m".
(beat)
Or we can say for if three raised to the power of two is multiplied by four raised to the power of two…
(Beat)
As we can see that they share the same exponent…
(Beat)
We will get three multiplied by four whole raised to the power of two which is twelve squares.
(beat)
Now let's try this with negative exponents!

INSERT ENDS.

INSERT MoG: Display this when the presenter says "Illustrate six raised to…" and follow the solution in sync with the dialogues.

Illustration:

$(6)^{-2} \times (5)^{-2}$

Apply the law

$a^{-m} = \frac{1}{a^m}$

$= \frac{1}{6^2} \times \frac{1}{5^2}$

$= \frac{1}{6^2 \times 5^2}$

$= \frac{1}{6 \times 6 \times 5 \times 5}$

$= \frac{1}{6 \times 6} \times \frac{1}{5 \times 5}$

Rearrange the numbers in denominator

$= \frac{1}{6 \times 5} \times \frac{1}{6 \times 5}$

$= \frac{1}{30} \times \frac{1}{30}$

$= \frac{1}{30 \times 30}$

$= \frac{1}{30^2}$

Apply the law

$a^{-m} = \frac{1}{a^m}$

$= 30^{-2}$

$= (6 \times 5)^{-2}$

Hence, $(6)^{-2} \times (5)^{-2} = (6 \times 5)^{-2}$

If *a* and *b* are non zero integers and *m* is any integer then

$a^m \times b^m = (a \times b)^m$

PRESENTER

Illustrate six raised to the power negative two multiplied by seven raised to the power negative two.

(beat)

First,Let's turn the negative exponents into positive. Can you tell me how to do that?

(beat)

Correct! Convert the number into its reciprocal. And that will give us…

(beat)

One by six square multiplied by one by five square.

(beat)

Or you can say one by six square multiplied by five square,

(beat)

and that is one by six multiplied by six multiplied by five multiplied by five.

(beat)

And this multiplication can also

be expressed as one by six
multiplied by six,
(beat)
multiplied by one by five
multiplied by five.
(beat)
Now we rearrange the denominator and we get one by six multiplied by five,
(beat)
multiplied by one by six
multiplied by five.
(beat)
Which presents us with one by thirty multiplied by one by thirty or we can say one by thirty square.
(beat)
Now here's something for you to observe!
(beat)
…If we apply the law of negative exponents,
(beat)
we can convert one by thirty square into thirty raised to the power of negative two.
(beat)
Which can also be written as six multiplied by five whole raised to the power of negative two…
(beat)
And did you notice, we just proved that six raised to the power of negative two multiplied by five raised to the power of negative two is equals to
(beat)
six multiplied by five raised to the power of negative two.

INSERT ENDS.

INSERT MoG: Retain "$(6)^{-2} \times (5)^{-2} = (6 \times 5)^{-2}$" from the previous transition and highlight both sides when the presenter says "two laws".

PRESENTER

Amazing! Isn't it. We just proved two laws into negative exponents.
(beat)
We just proved for when the numbers are multiplying but what if…

(beat)
we are dividing the numbers with
the same exponents and different
bases…
(beat)
Let’s investigate…

INSERT ENDS.

INSERT MoG: Display this beside the presenter when the presenter says ‘we are dividing’:

$$\frac{10^5}{12^5} = \left(\frac{10}{12}\right)^5 = \left(\frac{5}{6}\right)^5$$

PRESENTER
The law of positive exponents also
states that when we divide the
numbers with same exponents… the
base gets divided
(beat)
So we can say if we are dividing
ten raised to the power of five by
twelve raised to the power of
five…
(beat)
Then we will get ten by twelve
whole raised to the power of five.
(beat)
And dividing both the bases we
will get five by six whole raised
to the power of five.

(beat)
Now let's try this for negative exponents…

INSERT ENDS.

INSERT MoG: Display the following when the presenter says:

Illustration: $\frac{(3)^{-4}}{(5)^{-4}}$

Apply the law $a^{-m} = \frac{1}{a^{m}}$

$= \frac{\frac{1}{3^{4}}}{\frac{1}{5^{4}}}$

$= \frac{5^{4}}{3^{4}}$

$= \frac{5 \times 5 \times 5 \times 5}{3 \times 3 \times 3 \times 3}$

$= \frac{625}{81}$..................... (1)

$\frac{(3)^{-4}}{(5)^{-4}}$

$(\frac{3}{5})^{-4}$

$= \frac{1}{(\frac{3}{5})^{4}}$

$= \frac{1}{\frac{3^{4}}{5^{4}}}$ $\quad [\frac{a^{m}}{b^{m}} = (\frac{a}{b})^{m}, m > 0]$

$= \frac{5^{4}}{3^{4}}$

$= \frac{5 \times 5 \times 5 \times 5}{3 \times 3 \times 3 \times 3}$

$= \frac{625}{81}$ .... (2)

Hence, we can conclude that:

$\frac{(3)^{-4}}{(5)^{-4}} = (\frac{3}{5})^{-4}$

PRESENTER

Illustrate three raised to power negative four divided by five raised to power negative four.

(beat)

Negative powers! Let's turn them positive.

(beat)

If we apply the law of negative exponents and convert the base into its reciprocal,

(beat)

Well, Can you tell me what will come out?

(beat)

Right! One by three raised to power four divided by one by five raised to power four.

(beat)

which can also be written as five raised to power four upon three raised to power four.

(beat)

And if we compute this, we will have six hundred twenty five divided by eighty one.

(beat)

Now let’s try the same with the law which says “a” raised to power “m” divided by “b” raised to the power “m” is equal to “a” upon “b” whole raised to the power “m”.

(beat)

We have three raised to the power of negative four upon five raised to the power of negative four.

(beat)

Which becomes three by five whole raised to the power negative four.

(beat)

Can you tell me how to get rid of negative exponents?

(beat)

Amazing! By converting the number in its reciprocal.

You are getting good at this…

(beat)

We turn this into a positive exponent, and we will get one upon by three by five whole raised to power four.

(beat)

Or we can say five raised to power four by three raised to power four

(beat)

which is six hundred twenty five by eighty one.

Now you can see we applied two different methods and got the same answer…

(beat)

And that concludes that…

(beat)

Three raised to the power of negative four upon five raised to the power of negative four is equal to…

(beat)

Three by five whole raised to the power of four…

INSERT ENDS.

INSERT MoG: Display the following in sync with the dialogues:

Find the value of $(14)^{-2} \div (7)^{-2}$

$(14)^{-2} \div (7)^{-2}$

Apply the law $\frac{a^m}{b^m} = (\frac{a}{b})^m$

$(14)^{-2} \div (7)^{-2} = (\frac{14}{7})^{-2} = (2)^{-2}$

Apply the law $a^{-m} = \frac{1}{a^m}$

$(2)^{-2} = \frac{1}{2^2} = \frac{1}{2 \times 2} = \frac{1}{4}$

NOTE: The pause button appears when the presenter says 'let's match our answers'

PRESENTER

Guys, here comes your brain teaser. So find the value of fourteen raised to power negative two divided by seven raised to power negative two.

(Beat)

Take a break and click on pause. On the other side, let's match our answers.

Presenter takes a moment.

PRESENTER

Ohh! both the numbers have the same exponents and a sign of division in between…

(Beat)

And if we apply the law which says "a" raised to the power of "m" divided by "b" raised to the power of "m" is equal to "a" by "b" whole raised to the power of "m".

(beat)

What do you guys think we will get?

(beat)

Absolutely right! We will have fourteen upon seven whole raised to the power negative two,

(beat)

Divide them and we will get two
raised to the power negative two.
(Beat)
Now let's convert the base in
reciprocal form and we will get…?
(Beat)
What do we have now?
Anybody knows?
(Beat)
Right! It is one by two squares
which comes out to be one by four.
(beat)
This is impressive! You are really
quick with calculation.
But what if?
No, let's save some what if's for
another video… and have a quick
recap for what we've learned…
Because I have a lot many what
if's left up here…

INSERT ENDS.

PRESENTER

First we proved that any number
with exponent zero is equal to
one.
(beat)
Getting to another law we
concluded that for a number "a",
(beat)
"a" raised to the power of "m"
raised to another power of "n" is
equal to "a" raised the power of
"m" into "n"
(beat)
And after that we proved two laws
of positive exponent for negative
exponents in which the first one
says…
(beat)
"a" raised to the power of "m"
multiplied by "b" raised to the
power of "m" is equal to "a"
multiplied by "b" whole raised to
the power "m".
(beat)
And the other one states that "a"
raised to the power of "m" divided
by "b" raised to the power of "m"
is equal to…
(beat)
"a" by "b" whole raised to the
power of "m".

- Zero exponent: The base with zero exponents always gives the value 1.
  $a^0 = 1$, where *a* is any number.
- Power to a power
  If *a* and *b* are non zero integers and *m*, *n* are any integers then
  $(a^m)^n = a^{mn}$
- Multiplying powers with same exponents, bases are multiplied, that is, If *a* and *b* are non zero integers and *m* is any integer then
  $a^m \times b^m = (a \times b)^m$
- Dividing powers with same exponents, bases are divided, that is, If *a* and *b* are non zero integers and *m* is any integer then
  $\frac{a^m}{b^m} = (\frac{a}{b})^m$

PRESENTER
Now that we know how exponential form works for multiply, divide, positives, negatives…
(beat)
But how would you write the distance between you and the massive jupiter,
(beat)
There’s a better way than counting to hundreds of zeros…
(beat)
To figure that out, watch our next video…

FADE OUT: