## Section 2.1a - Exponent Basics and Negative Bases

This booklet belongs to: $\qquad$ Block: $\qquad$

## Exponents

- Exponents are simply the short hand of writing repeated multiplication
- Much like multiplication is the same as repeated addition

Example: $\quad 2+2+2=3 \cdot 2$
But exponents work like this

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

- Write these out as repeated multiplications.


## Example:

$5^{4}=5 \cdot 5 \cdot 5 \cdot 5$
$2^{3}=2 \cdot 2 \cdot 2$
$4^{2}=4 \cdot 4$

Where it gets tricky is with negative bases, it comes down to how the brackets, if any, are used.
$(-2)^{2}$ this means that everything inside the brackets is multiplied repeatedly

$$
(-2) \cdot(-2)
$$

This has a profound effect on the final result

- A negative number multiplied an EVEN NUMBER of times will always finish POSITIVE

$$
\begin{gathered}
(-2)^{4}=(-2)(-2)(-2)(-2) \\
=4 \cdot 4 \\
=16
\end{gathered}
$$

- When we have an EVEN POWER, we can REWRITE the statement without the brackets:

As a POSTIVE statement.

$$
(-2)^{4}=2^{4}
$$

- A negative number multiplied an ODD NUMBER of times will always finish NEGATIVE

$$
\begin{gathered}
(-2)^{5}=(-2)(-2)(-2)(-2)(-2) \\
=4 \cdot 4 \cdot(-2) \\
=16 \cdot(-2) \\
\quad-32
\end{gathered}
$$

- When we have an ODD POWER, we can REWRITE the statement without the brackets:

As a NEGATIVE statement.

$$
(-2)^{5}=-2^{5}
$$

So far, we know this...

$$
(-a)^{\text {Even }}=a^{\text {Even }}
$$

$$
(-a)^{o d d}=-a^{o d d}=-1\left(a^{o d d}\right)
$$

- But what about when there are no brackets?

Example: $\quad$ The negative is a hidden factor of negative $1 \quad \rightarrow \quad-2=(-1) 2$

| $-2^{3}=(-1) 2^{3}$ | $-2^{4}=(-1) 2^{4}$ |
| :---: | :---: |
| $=(-1) * 2 * 2 * 2$ | $=(-1) * 2 * 2 * 2 * 2$ |
| -8 | -16 |

Regardless of the power, even or odd, if the base is negative and there are no brackets the answer is ALWAYS NEGATIVE

## Summary

- If the negative is in brackets the result depends on the exponents being odd or even.

$$
\text { FOREVER POSITIVE } \quad(-2)^{4}=2^{4} \quad \text { Even exponent, the answer is always POSITIVE }
$$

FOREVER NEGATIVE $(-2)^{5}=-2^{5}=(-1) 2^{5}$ Odd exponent, the answer is always NEGATIVE

- If there are NO BRACKETS, the answer is ALWAYS NEGATIVE

```
FOREVER NEGATIVE \(-2^{5}=(-1) 2^{5}\)
FOREVER NEGATIVE \(-2^{4}=(-1) 2^{4}\)
```


## Determining Exponential Form of a Given Number

- Use a factor tree and factor down to only the desired base

Example: $2^{?}=64$

Since $64=2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

$$
64=2^{6}
$$

Solution: Continuously divide down


## Section 2.1a - Practice Questions

## EMERGING LEVEL QUESTIONS

Write the following expressions as repeated multiplication, use brackets when/where necessary.

| 1. | 2 |  |  |
| :--- | :--- | :--- | :--- |
|  |  | 2. | $(-3)^{7}$ |
| 3. | $(5)^{2}$ | 4. | $-2^{4}$ |
| 5. | $(-2)^{4}$ | 6. | $(-3)^{5}$ |
| 7. | $-2^{2}$ | 8. | $-7^{3}$ |
|  |  |  |  |
| 9. | $-(-2)^{3}$ | 10. | $-(-5)^{6}$ |

Find the whole number that should be the exponent, use repeated division using the base shown
11.
$8=2^{?}$
12.
$81=3$ ?
13. $\quad 625=5$ ?
15. $216=6$ ?
14.

$$
64=2 ?
$$

16. $\quad 1024=2$ ?

## PROFICIENT LEVEL QUESTIONS

Will the following answers end up positive or negative? Why?
17. $-a^{30}$
18.
$(-a)^{30}$
19. $\quad-(a)^{30}$
21. $\quad(-a)^{E V E N}$
20.
22. $\quad(-a)^{O D D}$

$$
(-a)^{25}
$$

Solve the following.
23.

$$
5^{3}
$$

24. 

$6^{3}$
26. $\quad(-3)^{4}$
28.
$-2^{6}$

## Answer Key - Section 2.1a

| 1. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$ | 2. $(-3)(-3)(-3)(-3)(-3)(-3)(-3)$ |  | 3. $5 \cdot 5$ | 4. $(-1) 2 \cdot 2 \cdot 2 \cdot 2$ |
| :---: | :---: | :---: | :---: | :---: |
| 5. $(-2)(-2)(-2)(-2)$ | 6. $(-3)(-3)(-3)(-3)(-3)$ |  | 7. $(-1) 2 \cdot 2$ | 8. $(-1) 7 \cdot 7 \cdot 7$ |
| 9. $(-1)(-2)(-2)(-2)$ | 10. $(-1)(-5)(-5)(-5)(-5)(-5)(-5)$ |  | 11. 3 | 12. 4 |
| 13. 4 | 14. 6 |  | 15. 3 | 16. 10 |
| 17. Negative | 18. Positive | 19. Negative |  | 20. Negative |
| 21. Positive | 22. Negative |  |  |  |
| 23. 125 | 24. 216 | 25. -64 |  | 26. 81 |
| 27. 32 | 28. -64 |  |  |  |

## Extra Work Space

