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Period _____

PACKET 7-EXPONENTS

3102.3.4 Simplify expressions using exponent rules,
including negative exponents and zero
exponents

3102.2.5 Perform operations with numbers in scientific
notation(multiply, divide, powers)

3102.2.6 Apply scientific notation to real world problems

SPI 3102.2.2 Multiply, divide, and square numbers
expressed in scientific notation

Exponents Practice

1. $-(2.57)^0$

2. 4^{-2}

3. $(-5)^{-2}$

4. 2^{-6}

5. $\frac{1}{2^0}$

6. 78^{-1}

7. $3ab^0$

8. $5x^{-4}$

9. $\frac{1}{x^{-7}}$

10. $\frac{5^{-2}}{p}$

11. $a^{-4}c^0$

12. $\frac{3x^{-2}}{y}$

13. $\frac{7ab^{-2}}{3w}$

14. $x^{-5}y^{-7}$

15. $x^{-5}y^7$

16. $9^0y^7t^{-11}$

17. $2^3 \times z^{-11}$

18. $\frac{6ac^{-2}}{d^0}$

19. $\frac{7s}{5t^{-2}}$

20. $\frac{7st^{-5}}{2m^{-2}}$

MULTIPLYING AND DIVIDING EXPONENTS

MULTIPLYING EXPONENTS:

**If the bases are the same, keep the base and add the exponents.

EXAMPLE: $m \cdot m \cdot m = m^3$ $2 \cdot 2 \cdot 2 = 2^3 = 8$

**If the bases are not the same, multiply the whole numbers and add the exponents.

EXAMPLE: $2n^5 \cdot 3n^{-2} = (2 \cdot 3)(n^5 \cdot n^{-2}) = 6n^3$

$$5x \cdot 2y^4 \cdot 3x^8 = (5 \cdot 2 \cdot 3)(x \cdot x^8)(y^4) = 30x^9 y^4$$

PRACTICE:

1. $5^3 \cdot 5^6$

2. $2^4 \cdot 2^{-3}$

3. $a^{-2} \cdot a^5$

4. $7n \cdot n^2 \cdot n^3$

5. $6y^2 \cdot 3y^3 \cdot 2y^{-4}$

6. $a \cdot b \cdot a^5$

7. $2y^3 \cdot 7x^{-2} \cdot 2y^4$

8. $3m^2 \cdot n^{-2} \cdot 7m$

DIVIDING EXPONENTS:

**If the bases are the same, keep the base and subtract the exponents.

EXAMPLE: $\frac{a^{14}}{a^6} = a^8$

**If the bases are not the same, divide the base and subtract the exponents.

EXAMPLE: $\frac{9ab^4}{3ab^3} = 3a^2 b^2$

**Remember, you cannot have a negative exponent. MOVE IT, LOSE IT.

EXAMPLE: $\frac{b^4}{b^9} = b^{-5} = \frac{1}{b^5}$ EXAMPLE: $\frac{4mn^{-1}}{2mn^2} = 2m^{-1} n = \frac{2n}{m}$

PRACTICE:

9. $\frac{6^7}{6^5}$

10. $\frac{mn^7}{mn^5}$

11. $\frac{rst^5}{rst^3}$

12. $\frac{124mb^7}{4mb^6}$

13. $\frac{6xy^{11}}{2xy^9}$

14. $\frac{10mt^4}{5mt^5}$

PRACTICE:

1. $c^{-2} \cdot c^7$

2. $r^{-5} \cdot r^3$

3. $b^{-2} \cdot b^4 \cdot b$

4. $(x^5 y^2)(x^{-6} y)$

5. $a^6 \cdot b^3 \cdot a^2 \cdot b^{-2}$

6. $(5x^5)(3y^6)(3x^2)$

7. $(4c^4)(ac^3)(3a^5c)$

8. $m^2 \cdot 4r^3 \cdot 12r^{-4} \cdot 5m$

9. $(7x^{-5})(8x^3)$

10. $\frac{2^5}{2^7}$

11. $\frac{m^5}{m^2}$

12. $\frac{xy^2}{xy}$

13. $\frac{cd^{-3}}{cd^{-1}}$

14. $\frac{abc^{-2-4}}{abc^{-2,5-9}}$

15. $\frac{pqr^{-2,4}}{pqr^{\frac{3}{5}}}$

16. $\frac{6s^{-9}}{3s^{-11}}$

17. $\frac{3mt^{\frac{2,3}{6}}}{3mt^{\frac{5,7}{5}}}$

18. $\frac{24ab^3}{6ab^6}$

19. $\frac{100rs^{\frac{7}{3}}}{10rs^{\frac{2}{5}}}$

RAISING TO A POWER: MULTIPLYING

To raise to a power:

*Raise the base number to the power

*Multiply the exponents

EXAMPLE: $(5^4)^2 = 5^8 = 390625$

EXAMPLE: $(n^2)^5 = n^{10}$

EXAMPLE: $(2x^2)^4 = (2)^4 \cdot (x^2)^4 = 16x^8$

EXAMPLE: $c^5 (c^3)^{-2} = c^5 \cdot c^{-6} = \frac{1}{c}$

EXAMPLE: $(x^{-2})^2 (3xy^2)^4 = (x^{-2})^2 \cdot (3)^4 \cdot (x)^4 \cdot (y^2)^4 = x^{-4} \cdot 81 \cdot x^4 \cdot y^8 = 81y^8$

PRACTICE:

1. $(a^4)^7$

2. $(a^{-4})^7$

3. $(n^4)^3 \cdot n^5$

4. $t^2(t^7)^{-2}$

5. $(a^4)^2 \cdot (a^2)^5$

6. $(2z)^4$

7. $(4g^5)^{-2}$

8. $(3t^6)^4$

9. $(2a^3)^5(3ab^2)^3$

10. $(6mn)^2 \cdot (5m^2)^2$

RAISING TO A POWER: DIVIDING

To raise to a power with division:

*Raise the numerator AND denominator to the power.

EXAMPLE: $\left(\frac{4}{x^2}\right)^3 = \frac{4^3}{(x^2)^3} = \frac{64}{x^6}$

EXAMPLE: $\left(\frac{3}{5}\right)^{-2} = \frac{3^{-2}}{5^{-2}} = \frac{5^2}{3^2} = \frac{25}{9}$

PRACTICE:

1. $\left(\frac{3}{x}\right)^2$

2. $\left(\frac{x}{y^2}\right)^3$

3. $\left(\frac{t^7}{2^3}\right)^2$

4. $\left(\frac{2r}{s}\right)^{-2}$

5. $\left(\frac{ms^{-3}}{ms^4}\right)^{-2}$

6. $\left(\frac{2ab^2}{c^3}\right)^5$

PRACTICE:

1. $(c^5)^2$ 2. $(n^3)^{-2}$ 3. $(c^5)^{-2} \cdot c^4$ 4. $(d^3)^5 \cdot (d^3)^0$ 5. $(t^2)^{-2} \cdot (t^2)^{-5}$

6. $(5y)^4$ 7. $(4m)^{-2}$ 8. $(12g^4)^{-2}$ 9. $(6y^3)^2$ 10. $(12g^3)^{-1}$

11. $(x^2)^5 \cdot (x^3)^2$ 12. $(2xy)^3 \cdot x^2$ 13. $(mg^4)^{-1} \cdot (mg)^4$ 14. $(c^{-3})^3 \cdot (c^{-1})^2$

15. $(3b^2)^2 \cdot (a^2b^4)^3$ 16. $(2a^2c^4)^{-5} \cdot (c^{-1}a^7)^6$

17. $\left(\frac{3}{5}\right)^2$ 18. $\left(\frac{2x}{y}\right)^5$ 19. $\left(\frac{3a}{2b}\right)^4$ 20. $\left(\frac{6}{n^6}\right)^2$

21. $\left(\frac{2p}{5}\right)^3$ 22. $\left(\frac{2}{3}\right)^{-2}$ 23. $\left(\frac{15x}{3x^4}\right)^2$ 24. $\left(\frac{4n}{2n^2}\right)^3$ 25. $\left(\frac{c^5}{c^9}\right)^3$

SCIENTIFIC NOTATION

3102.2.5 Perform operations with numbers in scientific notation(multiply, divide, powers)

3102.2.6 Apply scientific notation to real world problems.

SPI 3102.2.2 Multiply, divide, and square numbers expressed in scientific notation.

SCIENTIFIC NOTATION:
*A number is in scientific notation if it is written as the product of a power and a decimal greater than or equal to 1 and less than 10.
EXAMPLE: 3.72×10^4

*When writing a number in scientific notation, move the decimal so that only 1 number (1-9) is to the left of the decimal. Count the number of spaces you move the decimal.
-If you move the decimal to the left, the exponent will be POSITIVE. If you move the decimal to the right, the exponent will be NEGATIVE.
EXAMPLE: $301,000 = 3.01 \times 10^5$ EXAMPLE: $0.00532 = 5.32 \times 10^{-3}$

PRACTICE: Write the following numbers in scientific notation.

1. 0.000091 2. 65,000 3. 2,700,000

4. 0.00083 5. 450,000,000 6. 0.000000063

7. 123,000 8. 0.000123 9. 0.23

OPERATIONS WITH SCIENTIFIC NOTATION

****Multiply-Multiply the decimal numbers./Add the exponents. (Make sure answer is in scientific notation.)**

EXAMPLE: $(4.65 \times 10^7)(3.2 \times 10^{12}) = 14.88 \times 10^{19} = 1.488 \times 10^{20}$

****Divide-Divide the decimal numbers./Subtract the exponents. (Make sure answer is in scientific notation.)**

EXAMPLE: $\frac{1.8 \times 10^9}{3.6 \times 10^{-3}} = 0.5 \times 10^{12} = 5 \times 10^{11}$

****Raising to a Power-Raise the decimal number to the power. Multiply the exponents. (Make sure answer is in scientific notation.)**

EXAMPLE: $(1.4 \times 10^2)^2 = 1.96 \times 10^4$

PRACTICE:

1. $(6.8 \times 10^3)(5.4 \times 10^2)$

2. $(2.53 \times 10^6)(3.7 \times 10^{-2})$

3. $\frac{9.6 \times 10^8}{2.4 \times 10^5}$

4. $\frac{1.7 \times 10^{15}}{8.5 \times 10^{18}}$

5. $(2.5 \times 10^2)^2$

6. $(0.9 \times 10^{-2})^2$

PRACTICE:

1. $(7 \times 10^7)(5 \times 10^{-5})$

2. $(4 \times 10^9)(4.1 \times 10^8)$

3. $(9.5 \times 10^4)(2 \times 10^{-5})$

4. $(5 \times 10^7)(4 \times 10^3)$

5. $(6 \times 10^6)(5.2 \times 10^4)$

6. $(4 \times 10^6)(9 \times 10^8)$

7. Light travels approximately 5.87×10^{12} miles in one year. The distance is called a light year. Suppose a star is 2×10^4 light years away. How many miles away is that star?

8. $\frac{6 \times 10^{-9}}{3 \times 10^{-5}}$

9. $\frac{8 \times 10^9}{4 \times 10^5}$

10. $\frac{9.5 \times 10^9}{5 \times 10^{12}}$

11. $\frac{1.8 \times 10^{-8}}{9 \times 10^3}$

12. $\frac{3.6 \times 10^6}{9 \times 10^{-3}}$

13. $\frac{3.9 \times 10^3}{1.3 \times 10^8}$

14. The half life of Uranium -238 is 4.5×10^9 years. The half life of Uranium -234 is 2.5×10^5 years. How many times greater is the half life of Uranium, -238 than that of Uranium -234?

15. $(2 \times 10^2)^2$

16. $(3 \times 10^4)^3$

17. $(9 \times 10^7)^2$

18. $(2 \times 10^3)^5$

19. $(2 \times 10^3)^3$

20. $(8 \times 10^7)^3$