Outcome B Study Guide (Key)

1) Simplify & evaluate expressions with integer exponents

Ex. 1 $4^{-2} = \frac{1}{4^2} = \frac{1}{16}$	Ex. 2 $(-2)^{-3} = \frac{1}{(-2)^3} = \frac{1}{(-2)(-2)(-2)} = \frac{1}{-8}$
make the exponent positive by putting the expression in the denominator; then evaluate	*make the exponent positive by putting the expression in the denominator; then evaluate*

Any base raised to the **zero power will always equal: one!

Practice: ***Simplify***

a) $3^{-2} =$ $\frac{1}{3^2} = \frac{1}{9}$

b) $5^{-2} =$ $\frac{1}{5^2} = \frac{1}{25}$

c) $2^{-3} =$ $\frac{1}{2^3} = \frac{1}{8}$

d) $(-4)^{-2} =$ $\frac{1}{(-4)^2} = \frac{1}{16}$

$-4 \cdot -4 = 16$ ↑ pos

e) $3^0 =$ 1

f) $(-3)^{-3} =$ $\frac{1}{(-3)^3} = \frac{1}{-27}$

$-3 \cdot -3 \cdot -3$ $9 \cdot -3 = -27$ ↑ neg

2) Know & apply the exponent properties

Ex. 1 $2^{-2} \cdot 2^5 \cdot 2^3 = 2^6$ *multiplying #s with the same base = add the exponents*	Ex. 2 $\frac{3^5 \cdot 3^4}{3^{-2}} = \frac{3^9}{3^{-2}} = 3^{9-(-2)} = 3^{11}$ *Simplify the numerator first, then subtract the exponents*
Ex. 3 $(6^2)^{-4} = 6^{-8}$ *raising a power to a power = multiply the exponents*	Ex. 4 $\frac{8^6}{8^4} = 8^{6-4} = 8^2 = 64$ *dividing #s with the same base = subtract the exponents*

Practice (solve completely):

a) $3^{-3} \cdot 3^2 \cdot 3^3$ $3^{-3+2+3} = \boxed{3^2}$

b) $(4^2)^{-1}$ $\frac{1}{(4^2)^1} = \frac{1}{4^2} = \frac{1}{16}$ OR $4^{2 \cdot -1} = 4^{-2} = \frac{1}{4^2} = \frac{1}{16}$

c) $\frac{2^3 \cdot 2^{-6}}{2^{-2} \cdot 2^8}$ $\frac{2^{3+(-6)}}{2^{-2+8}} = \frac{2^{-3}}{2^6} = 2^{-3-6} = 2^{-9} = \frac{1}{2^9}$

3) Evaluate small perfect squares and small perfect cubes

Number	1	2	3	4	5	6	7	8	9	10
Perfect Square	$\sqrt{1}$	$\sqrt{4}$	$\sqrt{9}$	$\sqrt{16}$	$\sqrt{25}$	$\sqrt{36}$	$\sqrt{49}$	$\sqrt{64}$	$\sqrt{81}$	$\sqrt{100}$
Perfect Cube	$\sqrt[3]{1}$	$\sqrt[3]{8}$	$\sqrt[3]{27}$	$\sqrt[3]{64}$	$\sqrt[3]{125}$	$\sqrt[3]{216}$	$\sqrt[3]{343}$	$\sqrt[3]{512}$	$\sqrt[3]{729}$	$\sqrt[3]{1000}$

(can fill out the table without radical symbols also)

Practice: ***Evaluate***

a) $\sqrt{49} =$ ±7

b) $\sqrt[3]{8} =$ 2

c) $\sqrt{100} =$ ±10

d) $\sqrt[3]{216} =$ 6

e) $\sqrt{4} =$ ±2

f) $\sqrt[3]{27} =$ 3

4) Use square root and cube root symbols to represent the solution to an equation.

Ex. 1 $x^3 = 27$ $x^3 = \sqrt[3]{27}$ *find the cube root of each side of the equation*	**Ex. 2** $x^3 = -27$ $x^3 = \sqrt[3]{-27}$ *find the cube root of each side of the equation*
Ex. 3 $x^2 = 100$ $x^2 = \pm\sqrt{100}$ *find the square root of each side of the equation*	**Ex. 4** $x^2 = \frac{9}{16}$ $x^2 = \pm\sqrt{\frac{9}{16}}$ *find the square root of each side of the equation*

RADICAL NOTATION

Practice: ***Write an expression to represent the solution to the equation.***

a) $x^3 = 8$ → $X = \sqrt[3]{8}$

b) $x^2 = 36$ → $X = \pm\sqrt{36}$

c) $x^3 = -64$ → $X = \sqrt[3]{-64}$

d) $x^2 = 4$ → $X = \pm\sqrt{4}$

5) Scientific notation

Ex. 1 **Write the number in standard form** $4.56 \times 10^{-4} = 0.000456$ *move the decimal 4 places to the left*	**Ex. 2** **Write the number in standard form** $5.08 \times 10^{5} = 508{,}000$ *move the decimal 5 places to the right*
Ex. 3 **Write the number in scientific notation** $318{,}000{,}000 = 3.18 \times 10^{8}$ *move the decimal 8 places to the left*	**Ex. 4** **Write the number in scientific notation** $0.00704 = 7.04 \times 10^{-3}$ *move the decimal 3 places to the right*

Practice:

a) **A rough estimate of the U.S. Debt as of September 23, 2013 is $16,000,000,000,000. Write this number in scientific notation.** $1.6 \cdot 10^{13}$

b) **Chicago Bear's running back, Matt Forte has a contract that will pay him** $\$3.04 \times 10^{7}$ **over four years. Write that amount of money in standard form.** 30,400,000

c) **The smallest human brain cell is 0.004mm. Write this measurement in scientific notation.** $4 \cdot 10^{-3}$

6) Perform operations (add/subtract/multiply/divide) with numbers in scientific notation.

Ex. 1 Multiply #s in Scientific Notation $(2 \times 10^{-4})(8.1 \times 10^{-1}) = 1.62 \times 10^{-4}$ *multiply the coefficients & use exponent properties to multiply the powers of 10*	**Ex. 2** Divide #s in Scientific Notation $\frac{14.1 \times 10^{6}}{3 \times 10^{4}} = 4.7 \times 10^{2}$ *divide the coefficients & use exponent properties to divide the powers of 10*
Ex. 3 Add/Subtract #s in Scientific Notation $(1.2 \times 10^{5}) + (5.35 \times 10^{6}) = 5.47 \times 10^{6}$ *rewrite the #s so they have the same exponent, then add/subtract the coefficients* ***OR*** *rewrite the numbers in standard form and add/subtract them*	**Ex. 4** Add/Subtract #s in Scientific Notation $(1.33 \times 10^{5}) - (4.9 \times 10^{4}) = 8.4 \times 10^{4}$ *rewrite the #s so they have the same exponent, then add/subtract the coefficients* ***OR*** *rewrite the numbers in standard form and add/subtract them*

Practice:

316,000,000

a) **The population of the United States is approximately 3.16×10^{8}. China's population is approximately 1.35×10^{9}. How much larger is China's population than the United States?**

1,350,000,000 — subtract

$$\begin{array}{r} 1\,3\,\overset{4}{5}0,000,000 \\ -\ 316,000,000 \\ \hline 1\,034,000,000 \end{array}$$

$1.034 \cdot 10^{9}$ more people

b) **Canada's estimated population is 3.5×10^{7}. The United States' estimated population is 3.16×10^{8}. What is their combined population?**

35,000,000 — 316,000,000 — add

$$\begin{array}{r} 35,000,000 \\ +\ 316,000,000 \\ \hline 351,000,000 \end{array}$$

$3.51 \cdot 10^{8}$ people

c) **One ream of paper equals 5×10^{2} sheets of paper. How many sheets of paper equal a pallet of paper that holds 1.3×10^{2} reams of paper?**

$(5 \cdot 10^{2}) \cdot (1.3 \cdot 10^{2})$ ← multiply

$5 \cdot 1.3 = 6.5$

$$\begin{array}{r} 1.3 \\ \times\ \ 5 \\ \hline 6.5 \end{array}$$

$10^{2} \cdot 10^{2} =$

$10^{2+2} = 10^{4}$

$6.5 \cdot 10^{4}$ sheets

Practice Test Key

Pre-Algebra- Outcome B Study Guide Key

Name _____

Simplify the following expressions.

1. 5^0 → 1

2. 5^{-1} → $\frac{1}{5}$

3. 5^2 → 25

4. 3^{-2} → $\frac{1}{3^2} = \frac{1}{9}$

5. 6^1 → 6

6. 2^{-3} → $\frac{1}{2^3} = \frac{1}{8}$

7. 3^3 → $3 \cdot 3 \cdot 3$ → 27 (already simplified)

8. 12^0 → 1

9. 1^{-3} → $\frac{1}{1^3} = \frac{1}{1} = 1$

10. $5^2 \cdot 5^3 \cdot 5^1$ → $2+3+1=6$ → 5^6

11. $5^2 \cdot 5^{-3} \cdot 5^4$ → $2+(-3)+4=3$ → 5^3

12. $2^2 \cdot 2^{-3} \cdot 2^5$ → $2+(-3)+5=4$ → 2^4

13. $3^3 \cdot 3^{-3}$ → $3+(-3)=0$ → $3^0 = 1$

14. $\frac{5^8}{5^5}$ → $8-5=3$ → 5^3

15. $\frac{4^7}{4^{-2}}$ → $7-(-2)=$ ↖ same as adding → $7+2=9$ → 4^9

16. $\frac{3^{10} \cdot 3^{-4}}{3^{-3}}$ → $10+(-4)=6$ → $6-(-3)$ ↖ same as adding → $6+3=9$ → 3^9

17. $\frac{7^{-6} \cdot 7^4}{7^3 \cdot 7^{-7}}$ → $-6+4=-2$, $3-7=-4$ → $7^{-2} \div 7^{-4}$ → $-2+4=2$ ↖ subtract same as add → 7^2

18. $\frac{6^0 \cdot 6^3}{6^{-3} \cdot 6^{-5}}$ → $\frac{6^3}{6^{-8}} = 6^{3-(-8)}$ → 6^{11}

19. $(4^2)^3$ → $2 \cdot 3$ → 4^6

20. $(8^3)^3$ → $3 \cdot 3 = 9$ → 8^9

21. $(9^4)^2$ → $4 \cdot 2 = 8$ → 9^8

22. What is the positive square root of 25?

$\sqrt{25}$ → 5

23. What is the positive square root of 169?

$\sqrt{169}$ → 13

24. What is the cube root of 64?

$\sqrt[3]{64} = 4$

25. What is the cube root of 343?

$\sqrt[3]{343}$ → 7

Solve the following equations. Radical Notation

26. $x^2 = 49$ → $x = \pm\sqrt{49} = \pm 7$ ↖ radical notation

27. $x^2 = 441$ → $x = \pm\sqrt{441}$ → ± 21 ↖ radical notation

28. $x^2 = 256$ → $x = \pm\sqrt{256}$ ↖ radical notation → $\pm\sqrt{256}$

29. $x^3 = 125$ → $x = \sqrt[3]{125}$ ↖ radical notation → 5

30. $x^3 = 1$ → $x = \sqrt[3]{1}$ radical notation → $x = 1$

31. $x^3 = 216$ → $x = \sqrt[3]{216}$ ↖ radical notation → 6

Write the following values in scientific notation.

32. 0.00043 — neg exponent b/c smaller than 1 — $4.3 \cdot 10^{-4}$

33. 25,000,000 — $2.5 \cdot 10^{7}$

34. 121,000 — $1.21 \cdot 10^{5}$

Write the following values in standard notation.

35. 3.12×10^{-4} ← move left — 0.000312

36. 9×10^{5} move right — 900,000

37. 5.125×10^{9} — 5,125,000,000

Perform the operation. Write your answer in scientific notation.

38. $2.3 \times 10^{4} + 5.9 \times 10^{5}$ — 23000 + 590000 = 613000 — $6.13 \cdot 10^{5}$

39. $3.7 \times 10^{3} + 8.5 \times 10^{4}$ — 3700 + 85000 = 88700 — $8.87 \cdot 10^{4}$

40. $3.6 \times 10^{3} \cdot 2 \times 10^{4}$ — 36 × 2 = 72 — 7.2 — $7.2 \cdot 10^{7}$

41. $1.5 \times 10^{9} \cdot 3 \times 10^{-5}$ — 1.5 × 3 = 4.5 — $4.5 \cdot 10^{4}$

42. $\frac{9 \times 10^{-6}}{3 \times 10^{4}}$ — 9 ÷ 3 = 3 — −6 + 4 — $3 \cdot 10^{-10}$

43. $\frac{4.5 \times 10^{7}}{3 \times 10^{-4}}$ — 7 − (−4) — 1.5 × 3 = 4.5 — $1.5 \cdot 10^{11}$

Solve the following problems. Show your work!

44. Nick found a bug in his basement that was one ten thousandth of a meter. Write the bug's measurement in scientific notation.

0.0001 — $1 \cdot 10^{-4}$

45. Which of the following is the reasonable estimate for the distance from Chicago to New York City: 1.9×10^{1} miles or 1.9×10^{2} miles? Explain!

19 miles — 190 — $1.9 \cdot 10^{2}$ is the bigger number. the cities are far apart

46. Ashley is comparing the two numbers 5×10^{9} and 5×10^{7}. Which number is bigger? Why?

5,000,000,000 — 500,000,000

$5 \cdot 10^{9}$ (more zeros than the other)

bigger exponent, same constant (5)

47. A mass of one tennis ball is 6×10^{-2} kg. What is the mass of a bin of 1.8×10^{3} tennis balls? Write your answer in scientific notation.

multiply — add exponents

$6 \cdot 1.8$ — $10^{-2} \cdot 10^{3}$

1.8 × 6 = 10.8

$10.8 \cdot 10^{1} \rightarrow 108$

$1.08 \cdot 10^{2}$ kg

48. A new pop star has 2.34×10^{4} Facebook followers after just one hour. If their popularity continues to grow at this constant rate, how many Facebook followers will they have after 5 hours?

2.34 × 5 = 11.70

multiply

$2.34 \cdot 10^{4} \cdot 5$

$11.7 \cdot 10^{4}$

117000

$1.17 \cdot 10^{5}$ followers

49. Which of the following is the most reasonable estimate for the height of a doghouse: 6.35×10^{-2} cm, 6.35×10^{0} cm, 6.35×10^{1} cm, or 6.35×10^{3} cm? Explain!

0.0635 — 6.35 — 63.5 — 6350

30 cm is ≈ 1 foot

→ this would be about 3 feet - so the $6.35 \cdot 10^{1}$ cm

50. Kayley is helping her grandpa clean out his basement. They pack up an astonishing 1.4×10^{3} boxes! Kayley's moving truck can fit 2×10^{2} boxes. How many trips is she going to need to make? Write your answer in standard form.

Need to divide the total # of boxes by how many fit in each load

2 | 1.4 — 14 — 0 — .7

$\frac{1.4 \cdot 10^{3}}{2 \cdot 10^{2}}$

$0.7 \cdot 10^{1}$

7

$7 \cdot 10^{0}$ trips