

Lesson 1.1

Unit 1 Homework Key

Perform the following operations leaving your answer as a number to a power. Remember that the parentheses can mean multiply as well.

$$1. 5^3 \times 5^7 = 5^{10} \quad 2. (12^9)(12^0) = 12^9 \quad 3. \frac{(t^5)(t^4)}{t^2} = t^7 \quad 4. \frac{4^{13}}{4^7} \times 4^{10} = 4^{16} \quad 5. \frac{f^5}{f} = f^4$$

$$6. \frac{u^{11}}{u^4} = u^7 \quad 7. (5^4)^5 = 5^{20} \quad 8. (b^3)^6 \times (b^2)^9 = b^{36} \quad 9. (j^{11})^5 = j^{55}$$

Evaluate, meaning multiply out the exponents.

$$10. 3^2 \times 3^2 = 81 \quad 11. \frac{(2^{10})(2^2)}{2^9} = 8 \quad 12. \frac{(5^3)^2}{5^4} = 25$$

$$13. \frac{4^{12}}{4^{10}} = 16 \quad 14. (5^3)^1 \times 5^0 = 125 \quad 15. (1^4)^2 = 1$$

Determine if the following equations are true. Justify your answer.

$$16. 12^2 \times 12^7 = 12^6 \times 12^3 \quad 17. \frac{x^8}{x^3} = \frac{x^5}{x} \quad 18. (t^5)^2 = (t^2)^5$$

True; $12^9 = 12^9$ False; $x^5 \neq x^4$ True; $t^{10} = t^{10}$

$$19. (5^{10})^2 = (5^5)^5 \quad 20. \frac{6^0 \times 6^8}{6^4} = \frac{6^4}{6^0} \quad 21. m^5 \times m^5 = (m^{10})^0$$

False; $5^{20} \neq 5^{25}$ True; $6^4 = 6^4$ False; $m^{10} \neq m^0$

$$22. \frac{k^6}{k^2} = k^2 \times k^6 \quad 23. \frac{(7^4)^2}{7^3} = 7^3 \times 7^2 \quad 24. \frac{3 \times 3^4}{3^4} = (3^5)^1$$

False; $k^4 \neq k^8$ True; $7^5 = 7^5$ False; $3^1 \neq 3^5$

Determine the appropriate exponent to make the equation true.

$$25. 2^5 \times 2^{\boxed{1}} = 2^3 \times 2^3 \quad 26. \frac{p^6}{p^2} = \frac{p^7}{p^{\boxed{3}}} \quad 27. (3^4)^3 = (3^6)^{\boxed{2}}$$

$$28. (5^{10})^2 = (5^{\boxed{4}})^5 \quad 29. \frac{b^2 \times b^8}{b^{\boxed{6}}} = \frac{b^7}{b^3} \quad 30. 9^{\boxed{7}} \times 9^8 = (9^3)^5$$

$$31. \frac{h^{\boxed{10}}}{h^2} = h^3 \times h^5 \quad 32. \frac{(6^{11})^{\boxed{2}}}{6^6} = 6^8 \times 6^8 \quad 33. \frac{3^{\boxed{0}} \times 3^9}{3^2} = (3^7)^1$$

Lesson 1.2

Evaluate the following negative exponents giving your answer as a fraction.

1. $5^{-3} = \frac{1}{125}$ 2. $2^{-2} = \frac{1}{4}$ 3. $3^{-2} = \frac{1}{9}$ 4. $7^{-2} = \frac{1}{49}$ 5. $4^{-3} = \frac{1}{64}$ 6. $10^{-3} = \frac{1}{1000}$

7. $10^{-2} = \frac{1}{100}$ 8. $1^{-14} = 1$ 9. $6^{-2} = \frac{1}{36}$ 10. $2^{-4} = \frac{1}{16}$ 11. $9^{-1} = \frac{1}{9}$ 12. $5^{-2} = \frac{1}{25}$

13. $10^{-4} = \frac{1}{10,000}$ 14. $8^{-1} = \frac{1}{8}$ 15. $3^{-4} = \frac{1}{81}$ 16. $6^{-1} = \frac{1}{6}$ 17. $4^{-2} = \frac{1}{16}$ 18. $11^{-1} = \frac{1}{11}$

Simplify the negative exponents giving your answer as a fraction.

19. $a^{-3} = \frac{1}{a^3}$ 20. $b^{-2} = \frac{1}{b^2}$ 21. $c^{-5} = \frac{1}{c^5}$ 22. $d^{-6} = \frac{1}{d^6}$ 23. $f^{-11} = \frac{1}{f^{11}}$ 24. $g^{-13} = \frac{1}{g^{13}}$

25. $h^{-1} = \frac{1}{h}$ 26. $j^{-4} = \frac{1}{j^4}$ 27. $k^{-20} = \frac{1}{k^{20}}$ 28. $m^{-9} = \frac{1}{m^9}$ 29. $n^{-7} = \frac{1}{n^7}$ 30. $p^{-10} = \frac{1}{p^{10}}$

Lesson 1.3

Evaluate the following exponents operations giving your answer as a fraction where necessary.

$$1. 5^3 \times 5^{-4} = \frac{1}{5}$$

$$2. (12^9)(12^{-7}) = 144$$

$$3. \frac{(t^{-5})(t^4)}{t^2} = \frac{1}{t^3}$$

$$4. \frac{4^3}{4^{-7}} \times 4^{-10} = 1$$

$$5. \frac{f^5}{f^{-1}} = f^6$$

$$6. (y^{-4})^{-5} = y^{20}$$

$$7. (2^3)^{-6} \times (2^2)^7 = \frac{1}{16}$$

$$8. 12^2 \times 12^{-4} = \frac{1}{144}$$

$$9. \frac{(k^{-3})^2}{k^4} = \frac{1}{k^{10}}$$

$$10. \frac{4^{-2}}{4} = \frac{1}{64}$$

$$11. (5^{-3})^2 \times 5^9 = 125$$

$$12. (0^{-4})^{10} = \emptyset$$

Determine if the following equations are true. Justify your answer.

$$13. 12^{-2} \times 12^7 = 12^{-8} \times 12^3$$

False; $12^5 \neq \frac{1}{12^5}$

$$14. \frac{x^{-5}}{x^{-3}} = \frac{x^5}{x^7}$$

True; $\frac{1}{x^2} = \frac{1}{x^2}$

$$15. (t^{-5})^2 = (t^{-2})^5$$

True; $\frac{1}{t^{10}} = \frac{1}{t^{10}}$

$$16. (5^{10})^2 = (5^{-5})^{-4}$$

True; $5^{20} = 5^{20}$

$$17. \frac{6^{-6} \times 6^8}{6^4} = \frac{6^{-2}}{6^0}$$

True; $\frac{1}{6^2} = \frac{1}{6^2}$

$$18. m^7 \times m^7 = (m^{-7})^2$$

False; $m^{14} \neq \frac{1}{m^{14}}$

$$19. \frac{k^{-6}}{k^2} = k^2 \times k^{-10}$$

True; $\frac{1}{k^8} = \frac{1}{k^8}$

$$20. \frac{(7^{-4})^2}{7^3} = 7 \times 7^{12}$$

False; $\frac{1}{7^{11}} \neq 7^{13}$

$$21. \frac{3 \times 3^4}{3^{10}} = (3^5)^{-1}$$

True; $\frac{1}{3^5} = \frac{1}{3^5}$

Determine the appropriate exponent to make the equation true.

$$22. 2^5 \times 2^{\boxed{-8}} = 2^{-6} \times 2^3$$

$$23. \frac{p^6}{p^{-2}} = \frac{p^{\boxed{10}}}{p^2}$$

$$24. (3^{-4})^3 = (3^{-2})^{\boxed{6}}$$

$$25. (5^{12})^{-2} = (5^3)^{\boxed{-8}}$$

$$26. \frac{b^{-2} \times b^8}{b^5} = \frac{b^{\boxed{4}}}{b^3}$$

$$27. 9^2 \times 9^{-8} = (9^{\boxed{-2}})^3$$

$$28. \frac{h^{-2}}{h^{\boxed{0}}} = h^3 \times h^{-5}$$

$$29. \frac{(6^2)^{\boxed{3}}}{6^6} = 6^{-8} \times 6^8$$

$$30. \frac{3^{-4}}{3^{\boxed{-6}} \times 3^9} = (3^7)^{-1}$$

Lesson 1.4

Estimate each number as a single digit times a power of ten. Then rewrite each number in scientific notation.

1. 1,234,000
 $\approx 1 \times 10^6$
 $= 1.234 \times 10^6$

2. 190,000
 $\approx 2 \times 10^5$
 $= 1.9 \times 10^5$

3. 99,000,000
 $\approx 1 \times 10^8$
 $= 9.9 \times 10^7$

4. 5,390,000,000
 $\approx 5 \times 10^9$
 $= 5.39 \times 10^9$

5. 10,900,000,000
 $\approx 1 \times 10^{10}$
 $= 1.09 \times 10^{10}$

6. 7,800,000,000
 $\approx 8 \times 10^9$
 $= 7.8 \times 10^9$

7. 0.000 000 42
 $\approx 4 \times 10^{-7}$
 $= 4.2 \times 10^{-7}$

8. 0.000 019
 $\approx 2 \times 10^{-5}$
 $= 1.9 \times 10^{-5}$

9. 0.000 000 016 87
 $\approx 2 \times 10^{-8}$
 $= 1.687 \times 10^{-8}$

10. 0.000 000 000 321
 $\approx 3 \times 10^{-10}$
 $= 3.21 \times 10^{-10}$

11. 0.000 001 987
 $\approx 2 \times 10^{-6}$
 $= 1.987 \times 10^{-6}$

12. 0.000 000 008 5
 $\approx 9 \times 10^{-9}$
 $= 8.5 \times 10^{-9}$

13. The Earth has an approximate mass of 5,980,000,000,000,000,000,000 kg.
 $\approx 6 \times 10^{24}$
 $= 5.98 \times 10^{24}$

14. A quarter (meaning the coin) is 0.000 000 25 of a million dollars.
 $\approx 3 \times 10^{-7}$
 $= 2.5 \times 10^{-7}$

15. The mass of a dust particle is 0.000 000 000 753 kg.
 $\approx 8 \times 10^{-10}$
 $= 7.53 \times 10^{-10}$

16. The speed of light is 299,792,458 m/sec.
 $\approx 3 \times 10^8$
 $= 2.99792458 \times 10^8$

Rewrite each number in standard form.

17. $2.3 \times 10^{13} = 23,000,000,000,000$

18. $6.07 \times 10^7 = 60,700,000$

19. $5 \times 10^{23} = 500,000,000,000,000,000,000,000$

20. $1.8 \times 10^3 = 1,800$

21. $2.3 \times 10^{-11} = 0.000\ 000\ 000\ 023$

22. $6.07 \times 10^{-9} = 0.000\ 000\ 006\ 07$

23. $5 \times 10^{-5} = 0.000\ 05$

24. $1.8 \times 10^{-16} = 0.000\ 000\ 000\ 000\ 000\ 18$

Choose the most appropriate unit of measurement for the given situation.

25. The amount of lava coming from a volcano: fluid ounces per hour, cups per hour, or gallons per hour

26. The speed human hair grows: inches per year, feet per year, or yards per year

27. The growth of a tree: inches per hour, inches per year, yards per year

28. Speed of a swimming dolphin: centimeters per hour, meters per hour, kilometers per hour

29. The rate of water flow from a shower head: fluid ounces per minute, cups per minute, gallons per minute

30. A cell phone measures 2.3×10^{-5} kilometers in thickness. Would this be best expressed using kilometers, meters, or centimeters?

31. The average pace for a biker is 3.2×10^6 centimeters per hour. Would this be best expressed using kilometers, meters, or centimeters?

32. A bullet travels 3.4×10^5 millimeters per second. Would this be best expressed using millimeters, centimeters, or meters per second?

Lesson 1.5

Estimate each of the following as a single digit times a power of ten. Then compute each of the following giving your answer in scientific notation.

$$\begin{aligned} 1. (3 \times 10^{-6})(3 \times 10^9) \\ &\approx 9 \times 10^3 \\ &= 9 \times 10^3 \end{aligned}$$

$$\begin{aligned} 2. \frac{6.8 \times 10^9}{2 \times 10^5} \\ &\approx 4 \times 10^4 \\ &= 3.4 \times 10^4 \end{aligned}$$

$$\begin{aligned} 3. 4.5 \times 10^7 + 4,000,000 \\ &\approx 5 \times 10^7 \\ &= 4.9 \times 10^7 \end{aligned}$$

$$\begin{aligned} 4. 8.4 \times 10^7 - 3.1 \times 10^7 \\ &\approx 5 \times 10^7 \\ &= 5.3 \times 10^7 \end{aligned}$$

$$\begin{aligned} 5. (2.4 \times 10^4)(7,000) \\ &\approx 1 \times 10^8 \\ &= 1.68 \times 10^8 \end{aligned}$$

$$\begin{aligned} 6. \frac{5.4 \times 10^8}{9,000} \\ &\approx 5 \times 10^4 \\ &= 6 \times 10^4 \end{aligned}$$

$$\begin{aligned} 7. 3.9 \times 10^{13} + 4.2 \times 10^{13} \\ &\approx 8 \times 10^{13} \\ &= 8.1 \times 10^{13} \end{aligned}$$

$$\begin{aligned} 8. 8.2 \times 10^{-5} - 0.000\ 059 \\ &\approx 2 \times 10^{-5} \\ &= 2.3 \times 10^{-5} \end{aligned}$$

$$\begin{aligned} 9. (2.5 \times 10^{-4})(7 \times 10^{11}) \\ &\approx 2 \times 10^8 \\ &= 1.75 \times 10^8 \end{aligned}$$

$$\begin{aligned} 10. \frac{4.5 \times 10^9}{1.5 \times 10^{13}} \\ &\approx 3 \times 10^{-4} \\ &= 3 \times 10^{-4} \end{aligned}$$

$$\begin{aligned} 11. 1.3 \times 10^7 + 4 \times 10^6 \\ &\approx 1 \times 10^7 \\ &= 1.7 \times 10^7 \end{aligned}$$

$$\begin{aligned} 12. 5.2 \times 10^7 - 120,000 \\ &\approx 5 \times 10^7 \\ &= 5.188 \times 10^7 \end{aligned}$$

Answer the following questions giving both an estimated answer (single digit times a power of ten) and a precise answer (scientific notation).

13. How many times bigger is the distance from Earth to the sun of 9.3×10^6 miles than the furthest distance from Earth to the moon of 3×10^5 miles? (Hint: round the moon distance up.)

$$\begin{aligned} &\approx 3 \times 10^1 \text{ or } 30 \\ &= 3.1 \times 10^1 \text{ or } 31 \end{aligned}$$

14. The temperature halfway to the Sun from Mercury is approximately $1,800^\circ C$ and scientists theorize that it may be up to 26,000 times hotter at the center of the Sun. Approximately how hot is it at the center of the Sun?

$$\begin{aligned} &\approx 6 \times 10^7 \\ &= 4.68 \times 10^7 \end{aligned}$$

15. Each shrimp weighs approximately 0.000 27 g and a shrimp company can bring in over 3,100,000,000 shrimp per year. Approximately how much would that many shrimp weigh?

$$\begin{aligned} &\approx 9 \times 10^5 \\ &= 8.37 \times 10^5 \end{aligned}$$

16. The Earth has a mass of about 6×10^{24} kg. Neptune has a mass of 1.8×10^{27} kg. How many times bigger is Neptune than Earth?

$$\begin{aligned} &\approx 3 \times 10^2 \text{ or } 300 \\ &= 3 \times 10^2 \text{ or } 300 \end{aligned}$$

17. A country has an area of approximately 8,400,000,000 square miles and has approximately 210,000 people. How much area is this per person?

$$\begin{aligned} &\approx 4 \times 10^4 \\ &= 4 \times 10^4 \end{aligned}$$

18. A blue whale can eat 300,000,000 krill in a day. All of that krill weighs approximately 6,300,000,000 mg. About how much does each krill weigh?

$$\begin{aligned} &\approx 2 \times 10^1 \text{ or } 20 \\ &= 2.1 \times 10^1 \text{ or } 21 \end{aligned}$$

19. The US spends on average 9,000 dollars on each student per year. There are about 77,000,000 students in the United States. How about much money total is spent on students each year?

$$\begin{aligned} &\approx 7 \times 10^{11} \\ &= 6.93 \times 10^{11} \end{aligned}$$

20. McDonald's has about 210,000 managers and each makes on average 40,000 dollars per year. How much money does McDonald's spend on managers each year?

$$\begin{aligned} &\approx 8 \times 10^9 \\ &= 8.4 \times 10^9 \end{aligned}$$