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Mathematics

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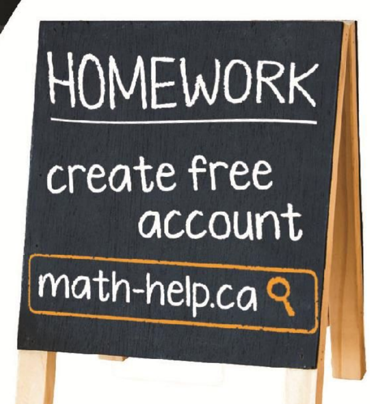

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$3^2 \times 2^3$ 4^{-3}

UNIT 1

FACTORS AND POWERS

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

1.1 Multiples and Factors

A **prime number** is an integer greater than 1 whose only integer factors are 1 and itself.

Examples:

2, 3, 5, and 7 are prime numbers since their only factors are 1 and themselves.
6 is not prime since it has two different sets of integer factors: 1 and 6 or 2 and 3

A **factor** of a number is a divisor of that number. It divides evenly into it.

Examples:

1. List all factors of 10.
   - 1, 2, 5, and 10 are factors of 10 since they all divide evenly into it.
   - Of these factors, only 2 and 5 are prime factors.

2. Show the following numbers as products of prime factors.
   - 12 = 2 x 2 x 3
   - 50 = 2 x 5 x 5

A **multiple** of a number is the product of that number times another whole number greater than 0.

Examples: Multiples of 5 are (5 x 1) = 5; (5 x 2) = 10; (5 x 3) = 15; (5 x 4) = 20 ; etc.

A **composite number** is not a prime number and can be factored in more than one way. All numbers that are not prime are composite (with the exception of 1).

Example: 15 is a composite number since it can be factored as 15 x 1 or 5 x 3.

Examples with Solutions:

1. Which of the following numbers are not prime?

   1, 3, 4, 5, 7, 9, 11, 15

Solution

- 1 is not prime since it is not greater than 1.
- 4, 9, and 15 are not prime. They are composite, since they have more than one pair of factors (9 can be factored as 9 x 1 or 3 x 3).

2. List all factors of 20.

- Factor 20 as follows 2 x 2 x 5 or 2^2 x 5.
- The set of all factors consists of all numbers that divide evenly into 20.
- The numbers are 1 plus all combinations of 2, 2, and 5 shown in step 1.
- Answer: 1, 2, 4, 5, 10, and 20.

3. List all multiples of 7 less than 40.

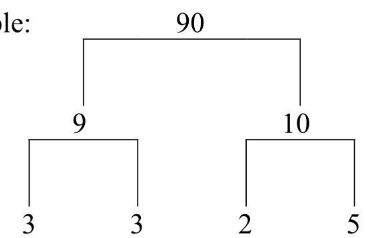
- Multiples of 7 consist of numbers that are the product of 7 times 1, 2, 3, 4, ...
- We want multiples of 7 less than 40.
- 7 x 1, 7 x 2, 7 x 3, 7 x 4, 7 x 5, (7 x 6 is 42, which is larger than 40).
- Answer: 7, 14, 21, 28, 35

4. Show 90 as a product of <u>prime</u> factors.

- Factor 90 until all factors are broken down into prime factors.
- $90 = 9 \text{ x } 10 = 3 \text{ x } 3 \text{ x } 2 \text{ x } 5$ or $3^2 \text{ x } 2 \text{ x } 5$

Sometimes a **factor tree** can help in breaking down a number into prime factors.

Example:



The prime factors of 90 are 3 x 3 x 2 x 5.

Exercises 1.1

1. Identify whether or not each number is prime. Give a reason for your answer.

Number	Yes/No	Reason
a. 22		
b. 31		
c. 77		
d. 57		
e. 43		
f. 51		

2. List all factors of each number. Then list the prime factors.

Number	All Factors	Prime Factors
a. 30		
b. 100		
c. 75		
d. 90		
e. 135		
f. 38		

3. List all multiples of the following numbers that meet each condition.

Number	Multiples of the Number
a. All multiples of 11 that are greater than 40 and less than 100	
b. All multiples of 5 between 11 and 41	
c. All multiples of 9 less than 100	
d. All multiples of 20 less than 200	
e. All multiples of 13 less than 100 that are odd numbers.	

4. Write each number as a product of prime factors.

a. 30
b. 12
c. 26
d. 36
e. 250
f. 1000
g. 90
h. 216
i. 196
j. 242

5. List all factors that are common to both 9 and 30.

6. List all factors that are common to 10, 14, and 70.

7. List all numbers less than 100 that are multiples of both 15 and 10.

8. List all numbers less than 50 that are multiples of both 3 and 5.

9. I am a multiple of both 9 and 15. I am less than 200 and more than 150. Who am I?

10. I am a multiple of 3, 5, and 10. I am less than 100. Who am I?

11. I am a multiple of 3, 5, and 7 between 300 and 400. Who am I?

12. I am a number less than 50. If I am a multiple of both 2 and 14, who am I?

1.2 Least Common Multiple and Greatest Common Factor

The **greatest common factor** (GCF) of two or more numbers is the largest factor that is common to each of them.

To find the **GCF** of two numbers, use the following steps.

1. Write each number as a product of prime factors.
2. Select all of the prime factors common to both.
3. The product of those factors is the greatest common factor.

Examples:

1. Find the GCF for 20 and 28.
   - 20 = 2 x 2 x 5 2 x 2 is common to both numbers
   - 28 = 2 x 2 x 7 ∴ 4 is the GCF

2. Find the GCF for 30 and 45.
   - 30 = 3 x 2 x 5 3 x 5 is common to both numbers
   - 45 = 3 x 3 x 5 ∴ 15 is the GCF

The **least common multiple** (LCM) is the smallest multiple of each number that is common to both.

To find the **LCM** of two numbers, use one of the following methods.

1. Write multiples of each number.
2. Select the smallest multiple common to both.

OR

1. Write each number as the product of prime factors
2. Select all of the prime factors from the first number and then select only those prime factors from the second that are not already there.
3. Find the product of those factors.

Examples:

Method 1

Find the LCM of 15 and 10

- Multiples of 15 are 15, 30, 45, 60, 75, ...
- Multiples of 10 are 10, 20, 30, 40, 50, 60, 70, ...
- 30 is the smallest multiple of both numbers.

Method 2

Find the LCM of 15 and 10

- 15 = 3 x 5 Write as the product of prime factors.
- 10 = 2 x 5 Write as the product of prime factors.
- 3 x 5 x 2   Select all factors of the first and then add factors not there from the 2^{nd} number.
- LCM = 30 The product of the above factors (the smallest number that both 10 and 15 divide into).

Examples with Solutions:

Solution

1. Find the GCF of 40 and 50.

- Write each number as the product of prime factors:
  40 = 2 x 2 x 2 x 5
  50 = 2 x 5 x 5
- Select those factors that are common to both.
- Answer: 2 x 5 = 10.
- 10 is the greatest factor common to both numbers.

2. Find the LCM of 15 and 20.

Method #1

- Write multiples of each number until you find the smallest one that is common to both.
- Multiples of 15 = 15, 30, 45, 60, 75, ...
- Multiples of 20 = 20, 40, 60, ...
- Answer: 60 is the smallest number that is a multiple of both.

Method #2

- Factor each number as a product of prime factors:
  15 = 5 x 3
  20 = 2 x 2 x 5
- Use all of the factors of the first number and then add those from the second number that you do not already have.
- Start with 5 x 3, add 2 x 2.
- The LCM = 5 x 3 x 2 x 2 = 60

3. Find (a) the GCF and (b) the LCM of the following numbers:

   44, 66

a. GCF
   44 = 2 x 2 x 11
   66 = 2 x 3 x 11
   Factors common to both are 2 x 11
   GCF = 22 (largest factor that divides into both numbers)

b. LCM
   2 x 2 x 11 (all prime factors of the 1st)
   2 x 2 x 11 x 3 (factors of 1st plus factors in the 2nd not already listed)
   LCM = 132 (smallest multiple that both numbers divide into)

Exercises 1.2

1. Find the greatest common factor (GCF) for each set of numbers.

   a. 20, 70
   b. 27, 54
   c. 40, 72
   d. 14, 42
   e. 30, 45, 60
   f. 120, 80, 200
   g. 580, 145
   h. 10, 30, 50, 90

2. Find the least common multiple (LCM) for each set of numbers.

   a. 9, 5
   b. 14, 35

c. 25, 15

d. 40, 16, 5

e. 10, 35, 14

f. 12, 20, 60

3. Each set of numbers in the first column below is written in ascending order. Find the missing number in each of these sets that would produce the least common multiple (LCM) shown.

Numbers	Least Common Multiple (LCM)	Missing Number
a. 6, ___ , 18	72	
b. ___, 5, 20	60	
c. 7, ___, 14	126	
d. 10, ___, 100	2100	
e. __, 6, 12	60	
f. 3, __, 9, 10	630	

4. Three friends walked around a circular track. It took the first one 15 minutes, the second 20 minutes, and the third 30 minutes to complete one revolution. If they all began at the same time and continued walking at the same rates, how long would it take before they all met again at the starting point?

5. The GCF of 70 and a second number is 35. List all possibilities less than 100 for the second number.

6. The LCM of 50 and a second number is 350. What is the smallest possible value for the second number?

7. Sue can run around a track 4 times in the same time that it takes Jack to run around it 3 times. If they both start at the same time, how many times will Sue have run around the track before she meets Jack at the starting location? How many times will Jack have run around the track?

8. Two buses travel from a chalet to the ski hill and back several times each day. It takes bus A 20 minutes for a return trip and bus B 30 minutes. If they both start at 8:00 am, at what time will they both be back at the chalet together.

1.3 Powers and Exponents

Writing an expression with a power is shorter than showing an expression with repeated multiplication.

Examples:
1. 7^3 is shorter than 7 x 7 x 7
2. $(-2)^4 = 16$ is shorter than -2 x -2 x -2 x -2 = 16

The **order of operations** is very important when evaluating expressions with exponents. Remember the following rules when applying the order of operations**.**

1. **Brackets** (If there are brackets or parentheses, perform any operations inside of them first.)
2. **Exponents** (**Powers**)
3. **Divide** and **Multiply** (in order from left to right)
4. **Add** and **Subtract** (in order from left to right)

Examples with Solutions:

Evaluate	Solutions
1. $2(3)^4$	$2(3)^4 = 2 \times 81$ (power first) $= 162$
2. $-4(-5)^2$	$-4(-5)^2 = -4(25)$ (Both the 5 and the negative sign are squared.) $= -100$ (Multiply)
3. -5^4	$-5^4 = -625$ (Only the 5 is raised to the power of 4)
4. $(3 + 5)^2 – 4 \times 3^2$	$(3 + 5)^2 – 4 \times 3^2 = 8^2 – 4 \times 3^2$ (brackets) $= 64 – 4 \times 9$ (powers) $= 64 – 36$ (multiply) $= 28$ (subtract)
5. $-2(-13 – 3^2) + 4(1 + 3)^2$	$-2(-13 – 3^2) + 4(1 + 3)^2$ $= -2(-13 – 9) + 4(4)^2$ (powers/add inside brackets) $= -2(-22) + 4(16)$ (subtract/powers) $= 44 + 64$ (multiply) $= 108$ (add)

Exercises 1.3

Express each of the following with a coefficient and power first, then simplify (evaluate).

1. $3 \times 2 \times 2 \times 2 \times 2 \times 2$

2. $7 \times (-2)(-2)(-2)$

3. $5 \times 10 \times 10 \times 10 \times 10$

4. $-6 \times 8 \times 8 \times 8$

Evaluate.

5. a. $3^2 - 1$

   b. $(3 - 1)^2$

6. a. $(2 - 4)^2$

   b. $2^2 - 4^2$

7. $2^3 - (-3)^3$

8. $6^3 - 6^2$

9. $(4 + 5)^2 - 11$

10. $7^3 - 3(-4)^3$

11. $(3 + 4)^2 \times (5 - 7)^3$

12. $(21 \div (-7))^3 \times 2$

13. $(16 \div 2^3 + 1)^3 - 3^4$

14. $2^6 \div (8(5^0 - 2^1))$

15. $(9^3 + 6^2)^0 + (3^4 - 9^2)$

1.4 Negative Exponents

Two of the laws of exponents are $a^m \bullet a^n = a^{m+n}$ and $a^0 = 1$.
If we choose $7^{-2} \bullet 7^2 = 7^{-2+2} = 7^0 = 1$, we can rewrite them as $7^{-2} = \frac{1}{7^2}$ and $7^2 = \frac{1}{7^{-2}}$. These are reciprocals. This leads to the following definition for negative exponents.

If x is any non-zero number and n is a rational number, x^{-n} is the reciprocal of x^n, that is $x^{-n} = \frac{1}{x^n}$ and $x^n = \frac{1}{x^{-n}}$, $x \neq 0$.

Examples with Solutions:

Evaluate each of the following. Solution

1. 6^{-2} $\quad$ $6^{-2} = \frac{1}{6^2} = \frac{1}{36}$
2. $\left(\frac{11}{3}\right)^{-3}$ $\quad$ $\left(\frac{11}{3}\right)^{-3} = \left(\frac{3}{11}\right)^3 = \frac{27}{1331}$

Exercises 1.4

Evaluate each of the following.

1. 3^{-2}
2. $\left(-\frac{2}{3}\right)^{-2}$
3. $(0.3)^{-4}$
4. $(-2)^{-5}$
5. $\frac{1}{5^{-3}}$
6. $\left(\frac{-6}{5}\right)^{-4}$
7. -3^{-2}
8. $(-3)^{-2}$
9. $(-3)^{-3}$
10. -3^{-3}

Write each of the following with a positive exponent.

11. 5^{-3}

12. $(-7)^{-2}$

13. $(\frac{1}{2})^{-2}$

14. $(\frac{2}{5})^{-3}$

15. $(-\frac{7}{5})^{-4}$

1.5 Laws of Exponents

By looking at patterns for the multiplication and division of expressions written to the same base, we can discover several useful relationships. From these we can discover several shortcuts to use when working with bases and exponents. The tables that follow illustrate some of these.

Multiplying and Dividing Terms to the Same Base

Examples	Long Method	Short cut	Generalization (Law of Exponents)
Multiplying Terms with the same base			**When we multiply terms with the same base written to powers, we can add the exponents.**
b^2b^5	$b^2b^5 = (bb)(bbbbb) = b^7$	$b^2b^5 = b^{2+5} = b^7$	
a^2a^4	$a^2a^4 = (aa)(aaaa) = a^6$	$a^2a^4 = a^{2+4} = a^6$	
$7r^23r^3$	$7r^23r^3 = (7)(3)(rr)(rrr) = 21r^5$	$7r^23r^3 = (7)(3)r^{2+3} = 21r^5$	$\mathbf{a^m a^n = a^{m+n}}$
Dividing Terms with the same base			**When we divide terms, we can subtract exponents if the bases are the same.**
$\frac{y^5}{y^3}$	$\frac{y^5}{y^3} = \frac{yyyyy}{yyy} = y^2$	$\frac{y^5}{y^3} = y^{5-3} = y^2$	
$\frac{n^2}{n^{-3}}$	$\frac{n^2}{n^{-3}} = n^2n^3 = (nn)(nnn) = n^5$	$\frac{n^2}{n^{-3}} = n^{2-\,-3} = n^5$	$\frac{a^m}{a^n} = \mathbf{a^{m-n}}$

Examples with Solutions

Multiply and simplify.	Solution
1. y^4y^5	$y^{4+5} = y^9$
2. $(3t^7)(8t^3)$	$(3)(8)t^{7+3} = 24t^{10}$
3. $(-4n^{-3})(5n^6)$	$(-4)(5)n^{-3+6} = -20n^3$
4. $(2x^{-3}y^2)(7x^4y^4)$	$(2)(7)x^{-3+4}\,y^{2+4} = 14xy^6$
5. $\left(\frac{1}{3}\right)^3\left(\frac{1}{3}\right)^2$	$\left(\frac{1}{3}\right)^{3+2} = \left(\frac{1}{3}\right)^5$

6. $\frac{15y^7}{5y^2}$	$3y^{7-2} = 3y^5$
7. $\frac{x^6y^7}{x^2y^3}$	$x^{6-2}\, y^{7-3} = x^4y^4$
8. $\frac{r^{-1}t^9}{r^5t}$	$r^{-1-5}t^{9-1} = r^{-6}t^8 = \frac{t^8}{r^6}$
9. $\frac{10n^{-2}}{2n^{-3}}$	$5n^{-2\,-\,-3} = 5n^{-2\,+\,3} = 5n$
10. $\frac{a^2b^{-1}}{ab^{-2}}$	$a^{2\,-\,1}b^{-1\,-\,-2} = ab^{-1\,+\,2} = ab$

Raising a Power to a Power

Examples	**Long Method**	**Short cut**	**Generalization (Law of Exponents)**
Raising a Power to a Power			
1. $(x^4)^2$	$(x^4)(x^4) = x^{4+4} = x^8$	$x^{(4)(2)} = x^8$	**To raise a power to a power, we can multiply the xponents.**
2. $(3^5)^3$	$(3^5)(3^5)(3^5) = 3^{5+5+5} = 3^{15}$	$3^{(5)(3)} = 3^{15}$	$(a^m)^n = a^{mn}$
3. $(7^{-2})^3$	$(7^{-2})(7^{-2})(7^{-2})$ $= 7^{-2+-2+-2} = 7^{-6}$	$7^{(-2)(3)} = 7^{-6}$	
4. $(5x^3y^5)^3$	$(5x^3y^5)(5x^3y^5)(5x^3y^5)$ $=(5)(5)(5)x^3x^3x^3y^5y^5y^5$ $= 5^{1+1+1}x^{3+3+3}y^{5+5+5}$ $= 125x^9y^{15}$	$5^{(1)(3)}x^{(3)(3)}y^{(5)(3)}$ $= 125x^9y^{15}$	

A Non-Zero Number to the Power of 0			Any non-zero base written to the power of zero is equal to 1.
1. $\frac{5^2}{5^2}$	$5^{2-2} = 5^0$ or $\frac{25}{25} = 1$	$5^{2-2} = 5^0 = 1$	$a^0 = 1, a \neq 0$
2. $\frac{y^3}{y^3}$	$y^{3-3} = y^0$ or $\frac{yyy}{yyy} = 1$	$y^{3-3} = y^0 = 1$	

Examples with Solutions

Simplify.	Solution
1. $(2^4)^3$	$2^{(4)(3)} = 2^{12}$
2. $(r^{-5})^2$	$r^{(-5)(2)} = r^{-10}$
3. $(\frac{1}{2}t^4)^4$	$(\frac{1}{2})^{(1)(4)}t^{(4)(4)} = \frac{1}{16}t^{16}$
4. $(xy^2)^7$	$x^{(1)(7)}y^{(2)(7)} = x^7y^{14}$
5. $(5r^3t^{-4})^2$	$5^{(1)(2)}r^{(3)(2)}t^{(-4)(2)} = 25r^6t^{-8}$
6. $(2x^{-3}y^4)^7$	$2^{(1)(7)}x^{(-3)(7)}y^{(4)(7)} = 2^7x^{-21}y^{28} = 128x^{-21}y^{28}$
7. $(x^5)^0$	$x^{(5)(0)} = x^0 = 1$
8. $(a^3b^{-2})^0$	$a^{(3)(0)}b^{(-2)(0)} = a^0b^0 = (1)(1) = 1$
9. $\left(\left(\frac{2}{3}\right)^2\right)^2$	$(\frac{2}{3})^{(2)(2)} = (\frac{2}{3})^4 = \frac{16}{81}$
10. $\left(\frac{2r^3t^{-2}}{7}\right)^2$	$\frac{2^2r^6t^{-4}}{7^2} = \frac{4r^6}{49t^4}$
11. $5^2 + 5^3$	$5^2 + 5^3 = 25 + 125 = 150$
12. $4^3 - 4^2$	$4^3 - 4^2 = 64 - 16 = 48$

Exercises 1.5

Simplify:

1. $7x^{-3}5x^4$

2. $-\frac{2}{3}xy^5(x^3y^2)$

3. $(a^2b^2c^2)(abc)(abc)$

4. $\frac{r^5s^2t^5}{rst^3}$

5. $\frac{n^3m^2}{n^{-2}m^{-1}}$

6. $(0.5x^{-4})(0.5x^{-2})$

7. $(3r^{-2}y^3z^{-1})(2ryz^{-2})$

8. $(3^0x^5)^5$

9. $y^{-3}y^3$

10. $(\frac{1}{2}r^2t^{-3})^3$

11. $\left(\frac{1}{3}\right)^{-3}$

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

13. $(\frac{1}{2}x^{-3}y^0)^2$

14. $(-3a^3b^4c^{-2})^3$

15. $(y^2z^{-5})^2(y^{-3}z^{-2})^{-5}$

16. $(3a^{-2}b^4)^4(a^{-1}b^{-2})^{-8}$

17. $3^4 + 3^5$

18. $2^6 - 2^3$

19. $6^3 - 6^2$

20. $10^5 - 10^2$

Find the missing values for a and b.

21. $(4y^{\mathbf{a}}x^3)(2y^7x^{\mathbf{b}}) = 12y^9x^2$

22. $(ax^{-1}y)(-\frac{1}{2}xy^{\mathbf{b}}) = 6y^{-6}$

Solve each equation.

23. $\frac{y}{5^{-3}} = \frac{1}{5}$

24. $\frac{t}{5^5} = \frac{1}{5^3}$

25. Which of the following equations are **incorrect**?

a. $3^2 \bullet 3^3 = 3^6$

b. $3x^0 = 1$

c. $(3x^2)^2 = 6x^4$

d. $(x^4)^5 = x^9$

e. $x^{-1} = -x$

f. $(3x^2)(4x^3) = 7x^5$

g. $\frac{10x^6}{5x^4} = 5x^2$

h. $\frac{x^{20}}{x^4} = x^5$

i. $\frac{x^4}{x^5} = -x$

j. $\sqrt{9^2 + 16^2} = 25$

26. Make the appropriate correction to each of the incorrect questions above.

ANSWERS TO EXERCISES AND CHAPTER TESTS

UNIT 1

Exercises 1.1 (page 3)
1. a) No; Factors are 1 x 22 and 2 x 11
b) Yes; Only factors are 1 and 31
c) No; Factors are 1 x 77 and 7 x 11
d) No; Factors are 1 x 57 and 3 x 19
e) Yes; Only factors are 1 and 43
f) No; Factors are 1 x 51 and 3 x 17
2. a) All factors: 1, 2, 3, 5, 6, 10, 15, 30; Prime factors: 2, 3, 5 **b)** All factors: 1, 2, 4, 5, 10, 20, 25, 50, 100; Prime factors: 2, 5 **c)** All factors: 1, 3, 5, 15, 25, 75; Prime factors: 3, 5 **d)** All factors: 1, 2, 3, 5, 6, 9, 10, 15, 30, 18, 45, 90; Prime factors: 2, 3, 5 **e)** All factors: 1, 3, 5, 9, 15, 27, 45, 135; Prime factors: 3, 5
f) All factors: 1, 2, 19, 38; Prime factors: 2, 19
3. a) 44, 55, 66, 77, 88, 99 **b)** 15, 20, 25, 30, 35, 40 **c)** 9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 99 **d)** 20, 40, 60, 80, 100, 120, 140, 160, 180
e) 13, 39, 65, 91 4. **a)** 2 x 3 x 5 **b)** 2 x 2 x 3
c) 2 x 13 **d)** 2 x 2 x 3 x 3 **e)** 2 x 5 x 5 x 5
f) 2 x 2 x 2 x 5 x 5 x 5 **g)** 3 x 3 x 2 x 5
h) 2 x 2 x 2 x 3 x 3 x 3 **i)** 2 x 2 x 7 x 7
j) 2 x 11 x 11 **5.** 1, 3 **6.** 1, 2 **7.** 30, 60, 90
8. 15, 30, 45 **9.** 180 **10.** 30, 60, 90 **11.** 315
12. 14, 28, 42

Exercises 1.2 (page 8)
1. a) 10 **b)** 27 **c)** 8 **d)** 14 **e)** 15 **f)** 40
g) 145 **h)** 10 **2. a)** 45 **b)** 70 **c)** 75 **d)** 80
e) 70 **f)** 60 **3. a)** 8 **b)** 3 **c)** 9 **d)** 21 **e)** 5
f) 7 **4.** 60 minutes **5.** 35, 70 **6.** 7 **7.** Sue 12, Jack 9 **8.** 9:00 am

Exercises 1.3 (page 12)
1. 3 x 25 = 96 **2.** 7 x (-2)3 = -56
3. 5 x 104 = 50 000 **4.** -6 x 83 = -3072 **5. a)** 8
b) 4 **6. a)** 4 **b)** -12 **7.** 35 **8.** 180 **9.** 70
10. 535 **11.** -392 **12.** -54 **13.** -54 **14.** -8
15. 1

Exercises 1.4 (page 13)
1. $\frac{1}{9}$ **2.** $\frac{9}{4}$ **3.** $\frac{1000}{81}$ **4.** $-\frac{1}{32}$ **5.** 125 **6.** $\frac{625}{1296}$
7. $-\frac{1}{9}$ **8.** $\frac{1}{9}$ **9.** $-\frac{1}{27}$ **10.** $-\frac{1}{27}$ **11.** $\frac{1}{5^3}$ **12.** $\frac{1}{7^2}$
13. 2^2 **14.** $\left(\frac{5}{2}\right)^3$ **15.** $\left(\frac{5}{7}\right)^4$

Exercises 1.5 (page 18)
1. 35x **2.** $\frac{-2}{3}x^4y^7$ **3.** $a^4b^4c^4$ **4.** r^4st^2
5. n^5m^3 **6.** $\frac{0.25}{x^6}$ **7.** $\frac{6y^4}{rz^3}$ **8.** x^{25} **9.** 1
10. $\frac{r^6}{8t^9}$ **11.** 27 **12.** $\frac{x^6}{4}$ **13.** $\frac{1}{4x^6}$ **14.** $\frac{-27a^9b^{12}}{c^6}$
15. y^{19} **16.** $81b^{32}$ **17.** 324 **18.** 56 **19.** 180
20. 99 900 **21.** a = 2, b = -1 **22.** a = -12, b = -7
23. $y = \frac{1}{625}$ **24.** t = 25 **25.** All are incorrect.
26. a) $3^2 \bullet 3^3 = 3^5$ **b)** $3x^0 = 3 \bullet 1 = 3$
c) $(3x^2)^2 = 3^2 \bullet x^4 = 9x^4$ **d)** $(x^4)^5 = x^{20}$
e) $x^{-1} = \frac{1}{x}$ **f)** $(3x^2)(4x^3) = 3 \bullet 4x^5 = 12x^5$
g) $\frac{10x^6}{5x^4} = \frac{10}{5}x^2 = 2x^2$ **h)** $\frac{x^{20}}{x^4} = x^{20-4} = x^{16}$ **i)** $\frac{x^4}{x^5} = \frac{1}{x}$
j) $\sqrt{9^2 + 16^2} = \sqrt{81 + 256} = \sqrt{337}$

Exercises 1.6 (page 21)
1. 294 cm^2 **2. a)** 400 **b)** 1600 **c)** $200(2)^h$
3. a) 400π or 1256 64 cm^2 **b)** 900π or 2827.43 cm^2 **4. a)** 84.375 m **b)** 281.25 m **5.** $1817.02

Unit 1 Test (page 24)
1. a) 3 x 3 x 2 x 5 **b.** 2 x 2 x 3 x 3 x 3 x 3
2. a) 32, 36, 40, 44, 48 **b)** 45, 90 **3. a)** 10
b) 15 **4. a)** 60 **b)** 180 **5.** -3(2)5 **6. a)** -216
b) -36 **c)** -18 **d)** 9 **e)** $1\frac{21}{25}$ **f)** 24 **7. a)** $\frac{1}{(-8)^3}$
b) $\left(\frac{2}{3}\right)^2$ **8. a)** $-\left(\frac{1}{125}\right)$ **b)** 625 **9. a)** $5x^3y^5$
b) $\frac{m^5}{n}$ **10.** 12 150

UNIT 2

Exercises 2.1 (page 28)
1. Novel D has more pages and more words than Novel C. **2.** Hockey players E and F played the same number of games, but player F scored more goals. Player K played more games than player F but scored the same number of goals.
3. Building M has the least number of storeys, but its cost per storey is the highest. Building P