Name: Notes Key
Date:

CHAPTER 1 NOTES – Square Roots and Surface Area

	Date:
1.1 – Square Roots of Perfect Squares	
1.2 – Square Roots of Non-Perfect Squares	
1.3 – Surface Areas of Objects Made from Right Rectangular Prisms	
1.4 – Surface Areas of Other Composite Objects	
Review:	
Test:	

What You'll Learn:

1.1 - Determine that square roots of fractions and decimals that are perfect squares
1.2 – Approximate the square roots of fractions and decimals that are non-perfect squares
1.3/1.4 – Determine the surface areas of composite 3-D objects to solve problems

What is the difference between a perfect square and non-perfect square?

A perfect square can be written as the product of two equal fractions, whereas a non-perfect square cannot

What does composite mean?

composite means 'combining' or 'combination'

When are square roots needed in the 'real world'?

- when working with mathematical equations in accounting or economics
- when we need formulas such as Pythagoras' Theorem in construction

Why is it important to have an understanding of 'surface area' in the 'real world'?

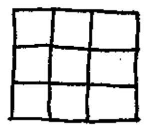
- allows us to solve practical problems such as:
- calculating the amount of paper needed to wrap a gift
- calculating the number of cans needed to paint a room or building
- calculating the amount of siding needed to cover a building

1.1 – Square Roots of Perfect Squares

Focus: Determine the square roots of decimals and fractions that are perfect squares

Main Ideas:

Warmup:
A square rug has an area of $9m^2$.
a) Sketch the rug as a grid.
b) What is the side length of the rug?
c) How are side length & area for a square related?

a) 
b) 3 units
c) $3 \times 3 = 9$ units squared

9 is the square of 3

3 is the square root of 9.

Use the space to the right to complete the **Investigate** on p.6 of the text.

Diagram 1:

area of small square = $1 \times 1 = 1$

shaded area = $9 \times 9 = 81$

square root of area = side length

$\sqrt{81} = 9$

Diagram 2:

$0.1 \times 0.1 = 0.01$

$0.9 \times 0.9 = 0.81$

$\frac{9}{10} \times \frac{9}{10} = \frac{81}{100} = 0.81$

$\sqrt{0.81} = 0.9$

Ex1
For the area of each perfect square in the table:
a) Write the area as a product
b) Write the side length as a square root.

Area as a Product	Side Length as a Square Root
$49 = 7 \times 7$	$\sqrt{49} = 7$
$\frac{49}{100} = 0.49 = 0.7 \times 0.7$	$\sqrt{0.49} = 0.7$
$64 = 8 \times 8$	$\sqrt{64} = 8$
$\frac{64}{100} = 0.64 = 0.8 \times 0.8$	$\sqrt{0.64} = 0.8$
$121 = 11 \times 11$	$\sqrt{121} = 11$
$\frac{121}{100} = 1.21 = 1.1 \times 1.1$	$\sqrt{1.21} = 1.1$
$144 = 12 \times 12$	$\sqrt{144} = 12$
$\frac{144}{100} = 1.44 = 1.2 \times 1.2$	$\sqrt{1.44} = 1.2$

Explain the trend in terms of decimal jumps.

For example, when multiplying 0.7×0.7 there are two digits right of the decimal. That means 0.49, the square must have two numbers after the decimal. This trend holds for all squares and square roots.

* multiply tops, multiply bottoms.

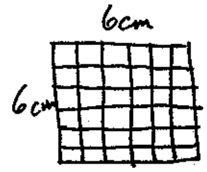
Ex2
Find the area of a square with a side length of:

a) 6cm

b) $\frac{3}{2}cm$

c) 0.12m

a)



$6 \times 6 = \underline{\underline{36cm^2}}$

(units are squared)

(b) $\frac{3}{2}cm \times \frac{3}{2}cm = \underline{\underline{\frac{9}{4}cm^2}}$

(c) $0.12m \times 0.12m = 0.0144m^2$

2 digits after dec | 2 digits after dec | 4 digits after dec.

Ex3
Find the side length if the area is:

a) $\frac{169}{100}m^2$

b) $\frac{1}{9}cm^2$

if area is $\frac{169}{100}m^2$, the side length is $\sqrt{\frac{169}{100}}$ m

or $\frac{\sqrt{169}}{\sqrt{100}}m = \underline{\underline{\frac{13}{10}}}m = \underline{\underline{1.3m}}$

side length: $\sqrt{\frac{1}{9}}cm = \underline{\underline{\frac{1}{3}}}cm$

What is a perfect square?

A number is a perfect square if it can be written as a product of two equal fractions. i.e. $\frac{16}{25}$ is the result of $\frac{4}{5} \times \frac{4}{5}$

↑ result of multiplying

i.e. 9 is the result of 3×3 or $\frac{3}{1} \times \frac{3}{1}$

List all of the whole number perfect squares between 1 and 100.

1 4 9 16 25 36 49 64 81 100

because...

1×1 2×2 3×3 4×4 5×5 6×6 7×7 8×8 9×9 10×10

Ex4
Is each fraction a perfect square?

a) $\frac{8}{18}$ b) $\frac{16}{5}$

(a) $\frac{8}{18}$ Can you simplify the fraction? $\frac{8^{\div 2}}{18^{\div 2}} = \frac{4}{9}$

$\sqrt{\frac{4}{9}} = \frac{2}{3}$ so $\frac{4}{9}$ can be written as $\frac{2}{3} \times \frac{2}{3}$,

so $\frac{4}{9}$ is a perfect square $\therefore \frac{8}{18}$, an equivalent fraction, is also a perfect square.

(b) $\frac{16}{5}$ is in simplest form. $\sqrt{16} = 4$ but 5 is not a perfect square

$\therefore \frac{16}{5}$ is not a perfect square.

Ex5
Is each decimal a perfect square?

a) 6.25

b) 6.30

(a) 2 methods

(i) change to fraction

$6.25 = \frac{625}{100}$

$\sqrt{\frac{625}{100}} = \frac{25^{\div 5}}{10_{\div 5}} = \frac{5}{2}$

So 6.25 is a perfect square

(ii) use your calculator

$\sqrt{6.25} = 2.5$

$2.5 = \frac{25}{10} = \frac{5}{2}$

If the square root is a terminating or repeating decimal, the number is a perfect square.

(b) 6.30

(i) $\frac{630}{100} = \frac{63}{10}$

$\sqrt{\frac{63}{10}}$ = not a perfect square

(ii) calc.

$\sqrt{6.30} = 2.50998008\ldots$

not terminating or repeating

$\therefore$ not a perfect square

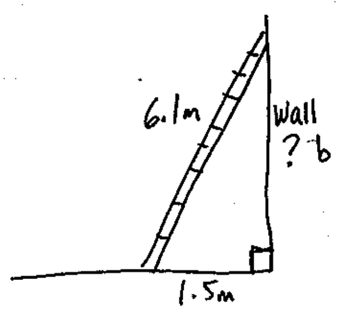
Reflection: Explain the term 'perfect square'. Give an example of: a whole number perfect square, a fraction perfect square, and a decimal perfect square, and a square root for each.

1.2 – Square Roots of Non-Perfect Squares

Focus: Approximate the square roots of decimals and fractions that are non-perfect squares.

Main Ideas:

Warmup:
A ladder is 6.1m long. The distance from the base of the ladder to the wall is 1.5m. How far up the wall will the ladder reach?
*start by drawing a diagram



Pythagoras : $a^2 + b^2 = c^2$ ← hypotenuse (longest side)

$1.5^2 + b^2 = 6.1^2$

$2.25 + b^2 = 37.21 - 2.25$
-2.25

$b^2 = 34.96$ square root...

$b = \text{wall} = \underline{5.9\text{m}}$

What is a non-perfect square?

A number that cannot be written as a product of two equal fractions. When you square root a non-perfect square on your calculator, the answer will be a decimal that doesn't terminate or repeat.

Ex1

a) Estimate the square root of 7 using benchmarks.

square :	1	4	7	9	16
square root :	1	2		3	4

2.6?

b) Estimate the square root of 19.5 using benchmarks

square :	16	19.5	25
square root :	4		5

4.4?

c) Estimate the square root of $\frac{3}{10}$ two ways

(i) fraction benchmarks

$\frac{3}{10}$ close to $\frac{4}{9}$

$\sqrt{\frac{4}{9}} = \frac{2}{3}$

so the square root of $\frac{3}{10}$ is approx $\frac{2}{3}$

(ii) decimal benchmarks.

$\frac{3}{10} = 0.3$

square :	0.25	0.3	0.36
square root :	0.5		0.6

0.55?

d) Estimate the square root of $\frac{8}{3}$ using a similar perfect square fraction.

$\frac{8}{3}$ close to $\frac{9}{4}$

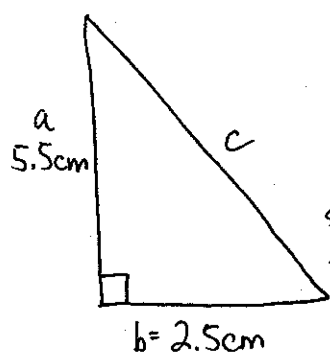
$\sqrt{\frac{9}{4}} = \frac{3}{2}$ so square root of $\frac{8}{3}$ is approximately $\frac{3}{2}$.

Ex2
Identify a decimal that has a square root between 8 and 9.

square:	64	81
square root:	8	9

Any decimal between 64 and 81 would be a correct answer i.e. 67.3.

Ex3
A right triangle has a base of 2.5cm and a height of 5.5cm. ESTIMATE the length of the hypotenuse.
*draw a diagram



pythag: $a^2+b^2=c^2$

estimate $a^2 \Rightarrow$ estimate 5.5^2

square:	25	30.5	36
sq root:	5	5.5	6

5.5^2 is approx 30.5

estimate $b^2 \Rightarrow$ estimate 2.5^2

Square:	4	6.5	9
Square root:	2	2.5	3

2.5^2 is approx 6.5

$a^2+b^2=c^2$

$30.5+6.5=37$

estimate $\sqrt{37}$

square:	36	37	49
square root:	6	6.1	7

hypotenuse = 6.1cm

Reflection: Explain why the square root of a non-perfect square displayed on a calculator is only an approximation. Use the square root of 6.7 as an example.

1.3 – Surface Areas of Objects Made from Right Rectangular Prisms

Focus: Determine the surface areas of composite objects made from cubes and other right rectangular prisms.

Main Ideas:

Warmup:
Using the blocks provided, complete the 'Investigate' on p.25 of your text.

Number of Cubes	Surface Area (sq units)
1	6
2	10
3	14
4	18
5	22
5 (a different way)	?
5 (a different way)	?

Do 5 blocks always give the same surface area?

No, as the blocks can be arranged so that more faces overlap, thereby reducing the surface area.

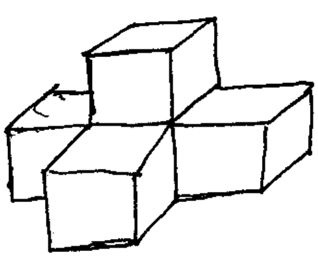
Read through the 'Connect' on p.26

The first strategy is faster, easier, and works in every situation.

What is a 'composite object'?

an object that is made up, or composed, of more than one object.

Ex1
Make the composite shape given below. Suppose each cube has edge length 3cm. Determine the surface area of your shape.



each face has $3 \times 3 = \underline{9\ cm^2}$ area.

how many faces? 5 cubes $\times 6 = 30$

4 areas of overlap $\times 2 = -8$

22 exposed faces.

Surface area $= 22 \times 9\ cm^2 = \underline{198\ cm^2}$

Ex2
p. 31 of text, #8b

Find the surface area of each rectangular prism, and then subtract overlap:

Bottom prism $= 2\times(6\times3) + 2\times(4\times3) + 2\times(6\times4)$
$= 2\times18 + 2\times12 + 2\times24 = 36+24+48 = 108\text{ cm}^2$

Middle prism $= 2\times(4\times2) + 2\times(3\times2) + 2\times(4\times3)$
$= 2\times8 + 2\times6 + 2\times12 = 16+12+24 = 52\text{ cm}^2$

Top prism $= 2\times(2\times1) + 2\times(2\times1) + 2\times(2\times2)$
$= 2\times2 + 2\times2 + 2\times4 = 4+4+8 = 16\text{ cm}^2$

$108 + 52 + 16 = 176\text{ cm}^2$

Overlap $= 2\times(4\times3) + 2\times(2\times2)$
$= 2\times12 + 2\times4 = 24+8 = 32$

Total Surface Area $= 176 - 32 = \underline{144\text{ cm}^2}$

Reflection: If you find the surface area of a composite shape by adding the surface area of each individual shape, how do you account for overlap?

1.4 – Surface Areas of Other Composite Objects

Focus: Determine the surface areas of composite objects made from right prisms and cylinders.

Main Ideas:

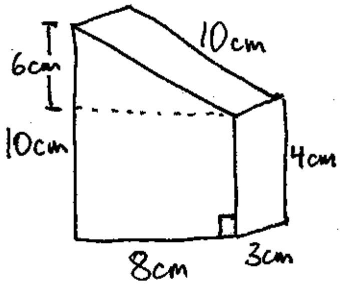
Warmup:
Read p.34 up to Example 1. Then read p.36 up to Example 2. Write formulas for a rectangular prism, triangular prism, and a cylinder.

Rectangular Prism:
Surface Area = 2×area of top face + 2×area of front face + 2× area of side face

Triangular Prism:
Surface Area = 2×area of base + areas of 3 rectangular faces

Cylinder:
Surface Area = $\underbrace{2\pi r^2}_{2\times\text{area of base}} + \underbrace{2\pi r h}_{\text{side of the cylinder}}$

Ex1
Cover p.35 and do example 1 on p.34



Split composite shape into one triangular prism and one rec. prism:

rectangular prism SA = $2\times(8\times4)+2\times(4\times3)+2(8\times3)$
$= 2\times32+2\times12+2\times24 = 64+24+48$
$= 136\text{ cm}^2$

triangular prism = $\cancel{2}\times\left(\frac{8\times6}{\cancel{2}}\right)+(10\times3)+(6\times3)+(8\times3)$
$= 48+30+18+24 = 120\text{ cm}^2$

$136\text{ cm}^2 + 120\text{ cm}^2 = 256\text{ cm}^2$

Overlap: $2\times(8\times3) = 2\times24 = 48\text{ cm}^2$

SA of composite shape = $256\text{ cm}^2 - 48\text{ cm}^2 = \underline{208\text{ cm}^2}$

Ex2
Cover p.37 and do Example 2 on p.36

split composite shape into two cylinders:

Bottom cylinder: if diameter = 26cm, radius = 13cm
SA = $2\times\pi\times(13)^2 + 2\times\pi\times13\times5$
$= 1061.858 + 408.407 = 1470.265\text{ cm}^2$

Top cylinder: diameter = 14cm, so radius = 7cm
SA = $2\times\pi\times(7)^2 + 2\times\pi\times7\times5 = 307.876 + 219.911$
$= 527.787\text{ cm}^2$

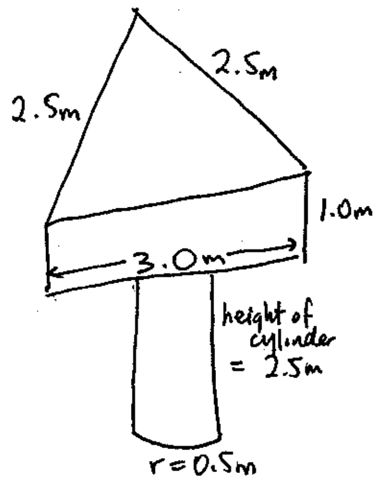
$1470.265 + 527.787 = 1998.052\text{ cm}^2$

Overlap: $2\times\pi\times(7)^2 = 307.876\text{ cm}^2$

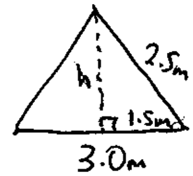
No frosting on bottom: $\pi\times(13)^2 = 530.929\text{ cm}^2$

SA of frosting: $1998.052 - 307.876 - 530.929 = \underline{1159\text{ cm}^2}$

Ex3
p.40 #5a



to find the area of the triangular faces, we must first calculate the height of the triangle:



$a^2+b^2=c^2$

$1.5^2+b^2=2.5^2$

$2.25+b^2=6.25$
$-2.25 \qquad -2.25$

$b^2=4$

square root

$b=2$ so $h=2.0m$

SA of triangular prism:

$2\times\left(\frac{3.0\times2.0}{2}\right)+(3.0\times1.0)+(1.0\times2.5)+(1.0\times2.5)$

$=6.0+3.0+2.5+2.5=14m^2$

SA of cylinder $=2\times\pi\times(0.5)^2+2\times\pi\times0.5\times2.5$

$=1.57+7.85=9.42m^2$

Overlap: $2\times\pi\times(0.5)^2=1.57m^2$

SA of composite shape $=14.0+9.42-1.57=\underline{\underline{21.9m^2}}$

Reflection: Why do you need to use Pythagoras' Theorem for example 3 above (p.40 #5a) but not for p.40 #3e?