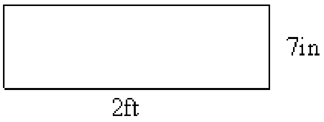
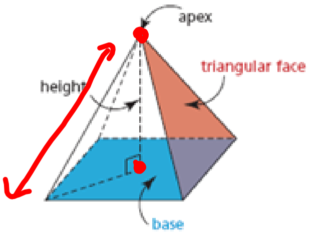
Lesson 8: Surface area of right pyramids and right cones

Scheduled Review

What is the area of the rectangle in cm^2 to the nearest tenth?



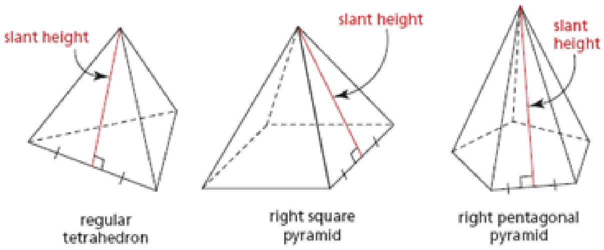
A **right pyramid** is a 3-dimensional object that has triangular faces and a base that is a polygon. The shape of the base determines the name of the pyramid. The triangular faces meet at a point called the **apex**. The *height* of the pyramid is the perpendicular distance from the apex to the centre of the base.



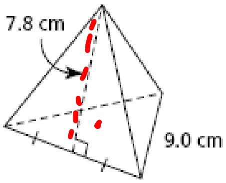
When the base of a right pyramid is a regular polygon, the triangular faces are congruent. Then the **slant height** of the right pyramid is the height of a triangular face.

A *tetrahedron* is a triangular pyramid.

A *regular tetrahedron* has 4 congruent equilateral triangular faces.



Example 1 Determining the Surface Area of a Regular Tetrahedron Given Its Slant Height



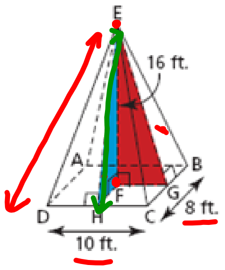
What is the surface area to the nearest square centimetre?

Surface Area = Sum of area of each side

$$\boxed{\text{Surface Area} = \sqrt{3}\ s^2}$$

Example 2 Determining the Surface Area of a Right Rectangular Pyramid

A right rectangular pyramid has base dimensions 8 ft. by 10 ft. and a height of 16 ft. Calculate the surface area of the pyramid for the nearest square foot.



SA = Sum of area of each face

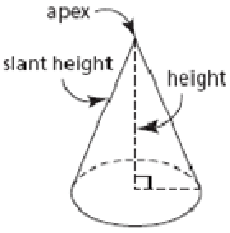
$= \text{Area of bottom} + 2(\text{Area of Front}) + 2(\text{Area of Left})$ Front = Back

$= 80 \text{ ft}^2 + 2(82.5) + 2(66.8 \text{ ft}^2)$ Left = Right

$= 80 \text{ft}^2 + 165 \text{ft}^2 + 133.6 \text{ft}^2$

$= 378.6 \text{ft}^2 \xrightarrow{\text{Round}} \boxed{379 \text{ ft}^2}$

Right Cone

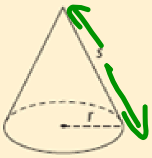


Surface Area of a Right Cone

Surface area = lateral area + base area

For a right cone with slant height s and base radius r:

$\boxed{SA = \pi r s + \pi r^2}$

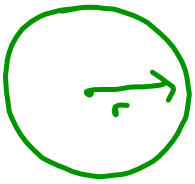


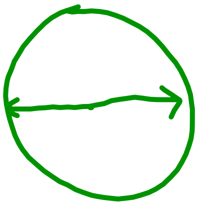
S = Slant height

r = radius (center to outer)

d = diameter (entire distance across)

Note: A right circular cone is usually called a right cone

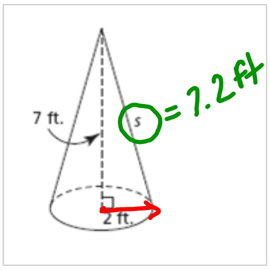




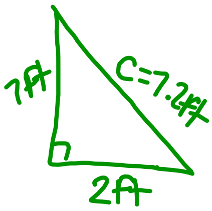
Example 3 Determining the Surface Area of a Right Cone

A right cone has a base radius of 2ft. and a height of 7 ft.

Calculate the surface area of the cone to the nearest square foot.



$SA = \pi r^2 + \pi r s$ — We need to solve for s.



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

$2^2 + 7^2 = c^2$

$4 + 49 = c^2$

$53 = c^2$

$c = 7.2\text{ ft}$

$SA = \pi\underbrace{(2ft)^2} + \underbrace{\pi(2ft)(7.2ft)}$

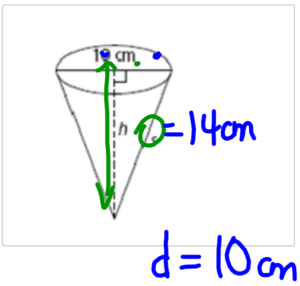
$= 12.57 + 45.24$

$\boxed{= 57.81\ ft^2}$

Example 4 Determining an Unknown Measurement

The lateral area of a cone is 220 cm². The diameter of the cone is 10 cm

Determine the height of the cone to the nearest tenth of a centimetre.



$d = 10cm$

$r = 5cm$

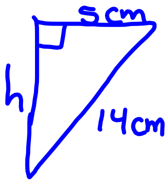
$SA = \underset{\underset{\text{circle}}{\uparrow}}{\pi r^2} + \underset{\underset{\text{lateral}}{\uparrow}}{\pi r s}$

** In order to solve for h, solve for s. **

$\frac{\cancel{\pi r}s}{\cancel{\pi r}} = \frac{220\ cm^2}{\pi r}$

$s = \frac{220cm^2}{\pi(5cm)}$

$= 14\ cm$



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

$5^2 + h^2 = 14^2$

$25 + h^2 = 196$

$h^2 = 196 - 25$

$h^2 = 171$

$\boxed{h = 13.1\ cm}$

Example 5:

The great pyramid of Giza has a square base with length 755 ft. and an original height of 481 ft. Determine its original surface area to the nearest square foot.

Note: When an object's base is not seen, like in this question's pyramid, the base is not calculated as part of the surface area.

Example 6:

A farmer unloaded grain onto a tarp on the ground. The gain formed a cone-shaped pole that had a diameter of 12 ft. and a height of 8 ft. Determine the surface area of the exposed grain to the nearest square foot.

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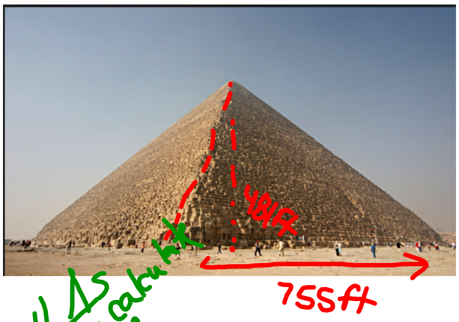
Example 5:

The great pyramid of Giza has a square base with length 755 ft. and an original height of 481 ft. Determine its original surface area to the nearest square foot.

> *Note: When an object's base is not seen, like in this question's pyramid, the base is not calculated as part of the surface area.*

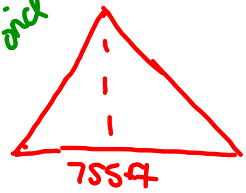


All Δs same ∴ calculate one

$$SA = \text{Sum of the } \triangle \text{ areas}$$

$$= 4(\text{area of front triangle})$$

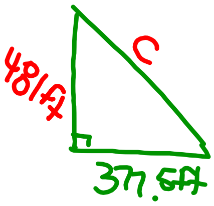
$$= 4\left(\frac{B \times \bigcirc\!\!\!\!\!H}{2}\right)$$



Pythagorean

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

$$481^2 + 377.5^2 = c^2$$



$$231\,361 + 142\,506.25 = c^2$$

$$373\,861.25 = c^2$$

$$c = 611.4 \text{ ft}$$

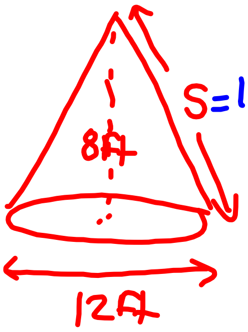
C is the height of our triangle.

$$SA = 4\left(\frac{B \times H}{2}\right)$$

$$= 4\left(\frac{755\text{ft} \times 611.4\text{ft}}{2}\right)$$

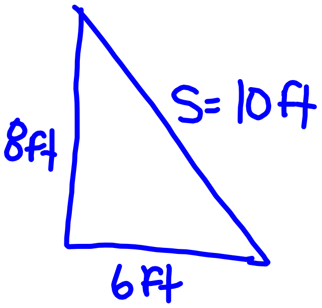
$$\boxed{= 923\,214 \text{ ft}^2}$$

$\boxed{\text{Ex 6}}$



$SA = \cancel{\pi r^2} + \pi r \textcircled{s}$

need to solve for s.



diameter = 12ft

radius = 6ft

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

$6^2+8^2=s^2$

$36+64=s^2$

$100=s^2$

$s=10\text{ft}$

$SA = \pi r s$

$= \pi(6\text{ft})(10\text{ft})$

$\boxed{= 188.5\text{ft}^2}$