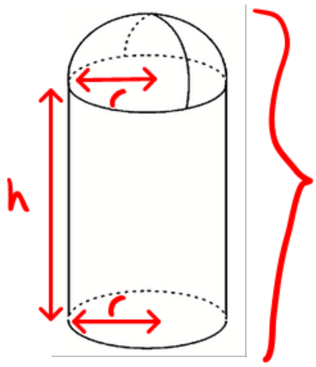
## Storage Capacity of a Silo SOLUTIONS

A)




holds 21,000T of corn

B) Volume of corn → convert to $m^3$

$$21{,}000\cancel{T} \times \frac{1000\,kg}{\cancel{1T}} = 21{,}000{,}000\,kg$$

$$21{,}000{,}000\,\cancel{kg} \times \frac{1\,m^3}{700\,\cancel{kg}} = 30{,}000\,m^3$$ of corn

C&D) skip

E) SA = Cylinder lateral surface + hemisphere (½ sphere)

$$= 2\pi rh + \frac{4\pi r^2}{2}$$

*divide by 2

$$SA = 2\pi rh + 2\pi r^2$$

$\boxed{h = 2r}$

$$SA = 2\pi r(2r) + 2\pi r^2$$

$$SA = 4\pi r^2 + 2\pi r^2$$

$$SA = 6\pi r^2$$

**9.5 Maximizing the Volume of a Cylinder**

The maximum volume for a cylinder, with a fixed surface area, occurs when its height equals its diameter. $h = d$ or $h = 2r$

When volume is maximized the surface area can be found using the formula $SA = 6\pi r^2$ and the height will be twice the value of the radius $r$ or $2r$.

**9.6 Minimizing the Surface Area of a Cylinder**

The minimum surface area for a cylinder, with a fixed volume, occurs when its height equals its diameter, that is $h=d$ or $h=2r$.

When surface area is minimized the volume can be found using $V=2\pi r^3$ and the height will be twice the value of the radius or $2r$.

$$V = V_{cylinder} + V_{hemisphere}$$

$$30{,}000 = 2\pi r^3 + \frac{\frac{4\pi r^3}{3}}{2}$$

calculated in part B)

*divide by 2 (½ sphere)

$$30{,}000 = 2\pi r^3 + \frac{2}{3}\pi r^3$$

$$30{,}000 = \frac{8}{3}\pi r^3$$

$$\frac{30{,}000}{\frac{8}{3}\pi} = \frac{\cancel{\frac{8}{3}}\cancel{\pi} r^3}{\cancel{\frac{8}{3}}\cancel{\pi}}$$

$$3{,}580.98 = r^3$$

$$\sqrt[3]{3580.98} = r$$

*cube root

$\boxed{r = 15.3\,m}$

$h = 2r = 2(15.3)$

$\boxed{h = 30.6\,m}$

$$SA = 6\pi(15.3)^2$$

$$SA = 4{,}412.5\,m^2$$

F) Building cost

$$4{,}412.5\,\cancel{m^2} \times \frac{\$8}{\cancel{m^2}}$$

**$35,299.94**

G) Paint cost

*round up, cant have ½ a can

$4412.5\,\cancel{m^2} \times \frac{1\text{ can}}{40\,\cancel{m^2}} = 110.31\text{ cans} = 111\text{ cans}$

$111\,\cancel{\text{cans}} \times \frac{\$35}{\cancel{\text{can}}} = \$3885$

H) Cost to fill the silo with corn

$21{,}000\,\cancel{T} \times \frac{\$140}{\cancel{T}} = \$2{,}940{,}000$

I) Total Cost

$C_{Total}$ = Building Cost + Paint cost + cost to fill silo with corn

$= 35{,}299.94 + 3885 + 2{,}940{,}000$

$= \$2{,}979{,}184.94$

$V_{cylinder} = \pi r^2 h$

$= \pi(15.3)^2(30.6)$

$= 22{,}503.7\,m^3$

$V_{sphere} = \frac{4\pi r^3}{3}$

$V_{hemisphere} = \frac{\frac{4\pi r^3}{3}}{2}$

* divide by 2

$V_{hemisphere} = \frac{2}{3}\pi r^3$

$= \frac{2}{3}\pi(15.3)^3$

$= 7{,}501.2\,m^3$

$V_{Total} = 22{,}503.7 + 7{,}501.2$

$V_{Total} = 30{,}004.9\,m^3$

yay, the volume matches from part B) !!

*this is a check, don't actually need it

# Investigation

## Mystery of the Pyramids

22. Jeremy is creating a piece of art for an exhibit. He starts with a square-based right pyramid, as shown. He makes a cut parallel to the base through the midpoints of the lateral edges. Then, he removes the top of the pyramid.

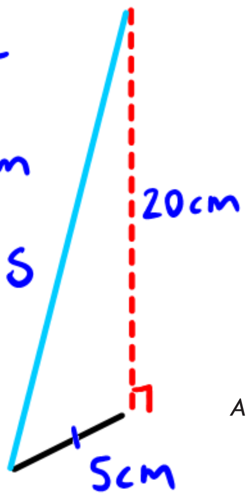
$s^2 = 20^2 + 5^2$

$s^2 = 400 + 25$

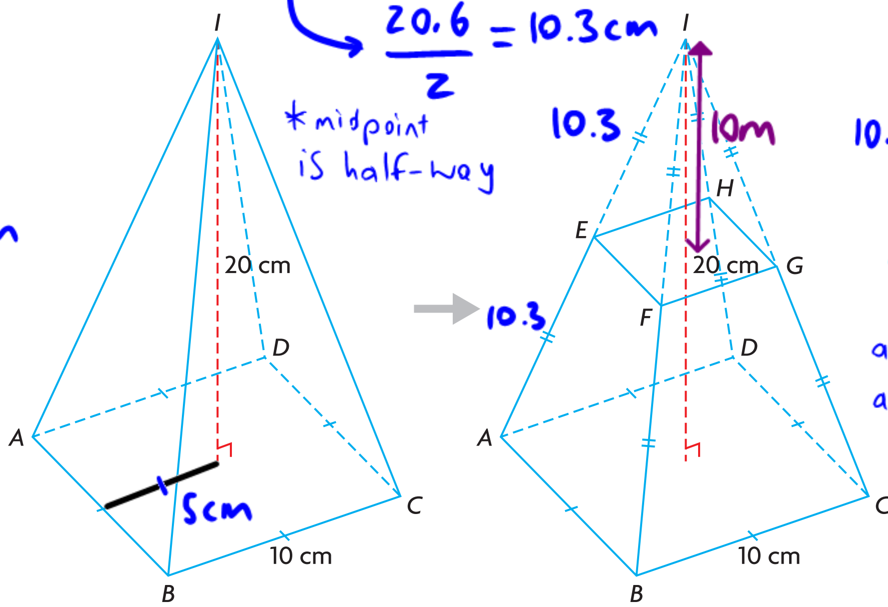
$s^2 = 425$

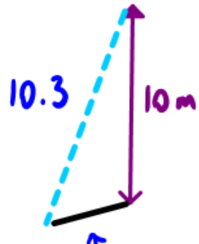
$s = \sqrt{425}$

$s = 20.6$ cm




$\frac{20.6}{2} = 10.3$ cm




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

$a^2 + 10^2 = 10.3^2$

$a^2 = 10.3^2 - 10^2$

$a^2 = 6.09$

$a = \sqrt{6.09}$

$a = 2.467$ cm

$b = 2.467 \times 2$

$b = 4.934$

a) Determine the volume of the original pyramid.

b) Determine what volume of the pyramid was removed.

c) In terms of volume, what fraction of the original pyramid was removed?

d) Investigate whether this fraction would be the same if the original pyramid had a rectangular base.

a) $V_{pyramid} = \frac{b^2h}{3} = \frac{(10)^2(20)}{3} = 666.\overline{6}6 \text{ cm}^3$

b) $V_{\substack{removed \\ pyramid}} = \frac{b^2h}{3} = \frac{(4.934)^2(10)}{3} = 81.147 \text{ cm}^3$

c) Ratio $\rightarrow \frac{V_{removed\ pyramid}}{V_{pyramid}} = \frac{81.147}{666.66} = 0.12$