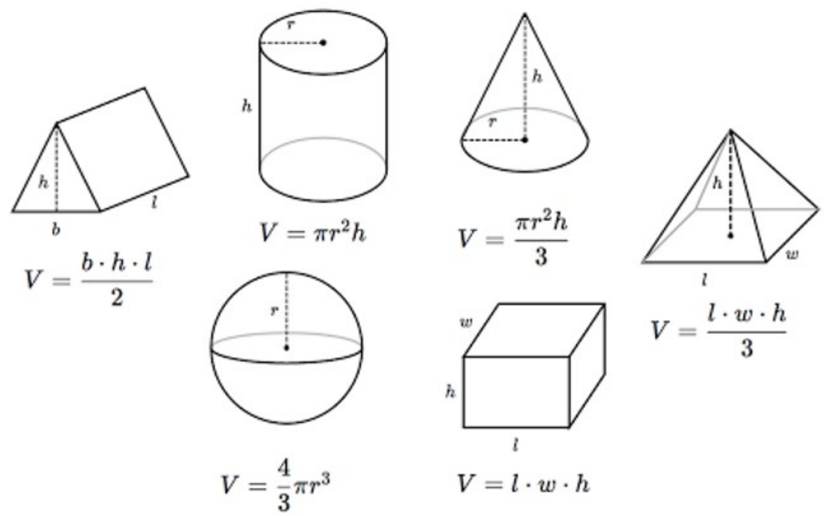
2/22

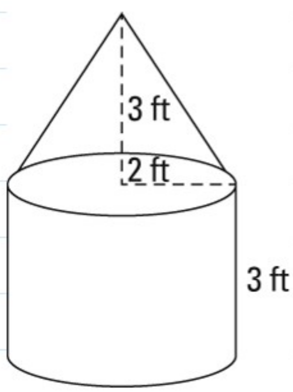
Tuesday, February 22, 2022 12:22 PM

Recap:

Volume Calculation:



Find the volume of the following shape:



Total Volume = Volume of cylinder + volume of cone

$= \pi r^2 h_{cyl} + \frac{1}{3} \pi r^2 h_{cone}$

$= (3.1416) \times (2\,ft)^2 \times (3\,ft) + \frac{(3.1416) \times (2\,ft)^2 \times (3\,ft)}{3}$

$= 37.6992\ ft^3 + 12.5664\ ft^3$

$= 50.2656\ ft^3 = 50.3$ cu. ft

Glue and Chemical Mix Calculation:

We are pressing 36 – 3 ply panels that are 54" x 18". What is the total amount of glue by weight needed for this job?

Convert to feet: $54'' \rightarrow 4.5'$

$18'' \rightarrow 1.5'$

Sqft of 1 glue line: $4.5' \times 1.5' = 6.75\ ft^2$

Hot Press Glue details

Mix ratio:

Resin –	20 parts
Catalyst –	4 parts
Water –	1 part

Convert to feet: $54'' \to 4.5'$

$18'' \to 1.5'$

Sqft of 1 glue line: $4.5' \times 1.5' = 6.75\ ft^2$

Total glue lines = # of gluelines × sqft of 1 glue line × # of panels

$= 2 \times 6.75 ft^2 \times 36 = 486 ft^2$

Total glue before waste = Coverage × total glue lines

$= 20g/sqft \times 486\ ft^2 = 9720g$

Total glue including waste = $9720g + 10\%$ of $9720g$

$= 9720g + 972g = 10692\ g$ needed

Hot Press Glue details

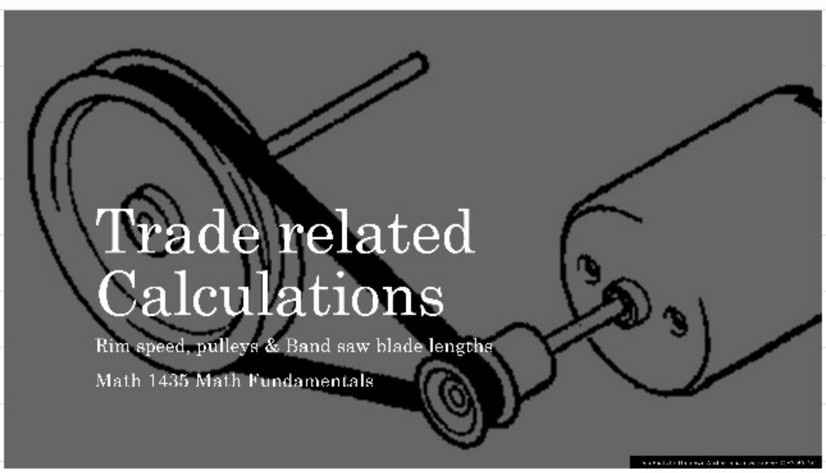
Mix ratio:

Resin –	20 parts
Catalyst –	4 parts
Water –	1 part

Waste: 10%
Coverage: 20g/sqft

TODAY:

1.



2.

Rim Speed

- **Rim speed** definition: The peripheral rate of travel of a blade or cutter head expressed in lineal feet per minute (LFM).

- **Rim speed** definition: The peripheral rate of travel of a blade or cutter head expressed in lineal feet per minute (LFM).
- Rim speed is quite simply measuring the speed at which the outside cutting circle of a cutter head is traveling.
- Most cutting tool manufacturers will specify the optimum rim speed for each of their cutting tools. These speeds are calculated to ensure safety and integrity of the cutting tool.
- The optimum rim speed for woodworking cutter heads is 14,000 lfm.
- Proper rim speeds will reduce heat build up, prolong cutter life and improve the surface quality.
- Other factors to think about: Species of wood and feed speed.

3.

Rim speed calculations

- What do we need to know to calculate rim speed?
  - Diameter of the cutter head or blade.
  - RPM of the arbor
  - The value of Pi (not the kind we eat)
- The formula is as follows.
  - $\frac{\pi\ x\ d}{12}$ x rpm = LFM ← usually diameter d is inches, so $\frac{d}{12}$ converts to feet
  - π = 3.14159 or 3.1416
  - d= Diameter of the cutter.
  - rpm = revolutions per minute of the arbor.
  - LFM = Lineal feet per minute (Rim speed).

4.

Rim Speed Example

- We have a 10" saw blade mounted on the arbor of a table saw. The motor speed is 3,600 RPM. Calculate the rim speed.
  - $\frac{\pi\ x\ d}{12}$ **x rpm = LFM**
  - $\frac{3.14159\ x\ 10}{12}$ x 3600 =
  - = 9,424.77 LFM
- We have now changed the 10" blade to a 12" blade. Motor speed is still at 3,600 rpm. Calculate the new rim speed.
  - $\frac{\pi\ x\ d}{12}$ **x rpm = LFM**
  - 3.14159 x 12

We have now changed the 10" blade to a 12" blade. Motor speed is still at 3,600 rpm. Calculate the new rim speed.

- $\frac{\pi \, x \, d}{12} \, \boldsymbol{x} \textbf{ rpm} = \textbf{LFM}$
- $\frac{3.14159 \, x \, 12}{12} \text{ x } 3600 =$
- $= 11{,}309.72$ LFM

- As you can see, the 10" blade runs slower than the 12" blade. The further away from the arbor (larger dia. Blade), the faster the rim speed unless ……. You can introduce pulleys.

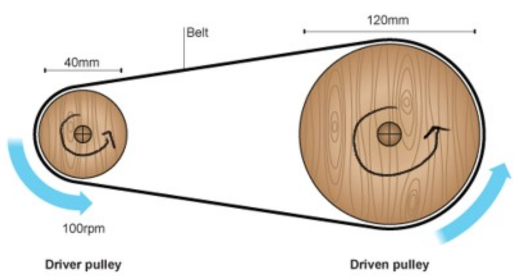
Try it yourself:

A saw blade of 6" with a motor speed of 3600 rpm. What is the Rim speed?

$$\frac{\pi \times d}{12} \times rpm \longrightarrow 5654.862 = 5655 \text{ LFM}$$

5.

Pulleys



Pulleys work in a similar way to gears, except they are not directly joined but linked by a belt. Belts can be elastic bands, tubular springs or some other flexible but strong material. A common example of a belt is the fan belt in a car that links a number of pulleys together.

Pulleys have several advantages over gears, but they also have some disadvantages. The main advantage is that they are simple to make and can be used at a distance from each other, unlike gears that need to touch in order to work. The disadvantage is that they work by friction and so can slip.

Examples of pulleys from everyday life:

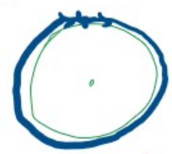
bicycle chain
water pump
grandfather clocks

6.

Pulleys Cont.

- We can use pulleys to either speed up or slow down arbors.
- We achieve this by altering the size of the pulleys in relation to each other.
- To try to understand pulleys, think of them as car tires. Compare a car with 12" tires and a car with 17" tires. If both cars drive the same distance, the 12" tire will need to make more revolutions than the 17" tire.
  - Perimeter = □xd π
  - 12" x 3.14159 = 37.699"
  - 17" x 3.14159 = 53.407"
    - The 12" tire would have to make 1.416 revolutions for every 1 revolution of the 17" tire.

Perimeter = π x d



Perimeter

a.k.a.
Circumference

7.

$$\text{pulley factor} = \frac{\text{driving diameter}}{\text{driven diameter}} \qquad \text{pulley ratio} = \frac{\text{driven rpm}}{\text{drive rpm}}$$

Pulley ratio calculation

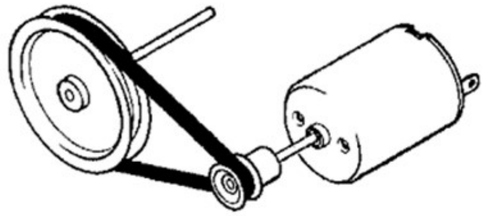
- To calculate the pulley ratio we:
  1. Divide the driving pulley diameter (attached to the motor) by the driven pulley diameter (attached to the arbor).
  2. Take the factor we just calculated and multiply it by the motor RPM to get the new arbor RPM.
  3. Now calculate the new Rim speed of the cutter head.

motor

blade

new arbor rpm = pulley ratio x motor rpm

ratio x rpm



8.

Pulley calculation example

- We have a 10" saw blade. The motor speed is 3,600 RPM. The drive pulley is 3" dia. and the driven pulley has a diameter of 2". Calculate the rim speed.
  - Drive pulley / driven pulley = pulley factor
  - 3"/2" = 1.5
  - Pulley factor x motor rpm = new arbor rpm
  - 1.5 x 3600 rpm = 5400 rpm
  - $\frac{\pi \, x \, d}{12} \, x$ **rpm** = LFM
  - $\frac{3.14159 \, x \, 10}{12}$ x 5400 =
  - = 14,137.155 LFM
  - Therefore, if we add the proper sized pulleys to the table saw, we can achieve the optimum rim speed of 14,000 LFM.

9.

Pulley calculation example B

- What if we know the motor speed, blade diameter and recommended rim speed. How do we find the pulley sizes to reach the recommended rim speed.
  - Example

  Motor speed = 1750 rpm
  Blade dia. = 12”
  Recommended rim speed = 14,000 LFM

  Use to find pulley ratio

  Pulley sizes available: 2”, 2-1/2”, 3”, 3-1/2”, 4”, 4-1/2”, 5”, 6”, 7”, 8”.

  pick two to get right pulley ratio

  What pulley combination should we use to achieve the 14,000 LFM rim speed?

10

Pulley calculation example B cont.

- The equation for rim speed is as follows:
- $\frac{\pi \; x \; d}{12} \, x$ **rpm = LFM**
- We need to figure out the rpm of the arbor first.
- $\left(\frac{3.14159 \; x \; 12}{12}\right) x$ rpm = 14,000
- 3.14159 x rpm = 14,000
- Find rpm: rpm = $\frac{14000}{3.14159}$
- Rpm of the arbor = 4,456 (the rpm of the arbor to give the rim speed of 14,000 lfm for a 12” blade.

11.

Pulley calculation example B cont. page 3

- Now we know the rpm's of the motor (1750 rpm) and the rpm's of the arbor (4456 rpm) to reach the required rim speed.
- Now we must find the pulley ratio value. To do so, we must use Pulley Ratio = Drive/ driven.
- Divide the Drive rpm by the Driven rpm, this will show the missing part of the ratio drive rpm driven rpm
  - 1750 ÷ 4456 = 0.3927289048473968
  - Pulley ratio = 1 (motor) to 0.3927--- (arbor)
- Now find the 2 pulley sizes where 1 pulley is 0.3927--- x's smaller than the other.
  - 5" x 0.3927--- = 1.963644----" (or 2")
- Therefore, if we use a 5" pulley (motor) and a 2" pulley (arbor) with a 1750 rpm motor the rim speed of the 12" blade would be very close to14,000 lfm.

$$\boxed{\text{pulley ratio} = \frac{\text{drive rpm}}{\text{driven rpm}} = \frac{\text{drive diameter}}{\text{driven diameter}}}$$

not Correct

$$\frac{\text{drive rpm}}{\text{driven rpm}} = \frac{\text{driven diameter}}{\text{drive diameter}}$$

12.

Pulley formulas

- Rim speed (LFM) = $\frac{\pi \, x \, d}{12} \, x$ rpm
- Rpm of driven pulley = $\frac{dia.of\ driving\ pulley\ x\ its\ rpm}{dia.of\ driven\ pulley}$
- Dia. Of driven pulley = $\frac{dia.of\ driving\ pulley\ x\ its\ rpm}{rpm\ of\ driven\ pulley}$
- Rpm of driving pulley = $\frac{dia.of\ driving\ pulley\ x\ its\ rpm}{dia.of\ driven\ pulley}$
- Dia. Of driving pulley = $\frac{dia.of\ driven\ pulley\ x\ its\ rpm}{rpm\ of\ driving\ pulley}$

Try it yourself:

What pulley sizes should be on the motor and arbor to obtain a rim speed of 14,000 lfm with a 14" saw blade and a motor speed of 3,600 rpm?

$\frac{\pi \times d}{12} \times$ arbor rpm = LFM , we have d = 14", LFM = 14000 lfm

$\left(\frac{\pi \times 14}{12}\right) \times$ arbor rpm $= 14000$, so: driven rpm $= 3820$ rpm

pulley ratio: $\frac{\text{drive rpm}}{\text{driven rpm}} = \frac{3600 \text{ rpm}}{3820 \text{ rpm}} = 0.942$

So the arbor/driven pulley is 0.94 times the sized of motor/drive pulley.

Suppose arbor pulley is 4" then (0.94 × drive pulley diam = 4")

pulley ratio = 3

So drive pulley needs to be $\frac{4''}{0.94} = 4.25''$

With a ratio of 3 to 1, what size of saw blade should be used when motor speed is 1750 rpm to obtain a rim speed of 14,000?

pulley ratio = $\frac{\text{driven rpm}}{\text{drive rpm}} = \frac{\text{drive diameter}}{\text{driven diameter}}$

so: $3 = \frac{\text{arbor rpm}}{1750 \text{ rpm}} \Rightarrow$ arbor rpm $= 3 \times 1750$ rpm

$= 5250$ rpm

$\frac{\pi \times d}{12} \times$ arbor rpm $= 14000$ lfm

$\Rightarrow \frac{3.1416 \times d}{12} \times 5250 \text{ rpm} = 14000$ lfm, the $d = \frac{14000}{5250} \div \left(\frac{3.1416}{12}\right)$

$d = 2.67 \times \frac{12}{3.1416} = 10.05'' = 10''$

Need 10" blade.

13.

Bandsaw blade length calculations

- To calculate the required length of a two wheel band saw blade, we must have the following information:
  - Diameter of wheels
  - Length between the centers of the band saw wheels
  - Value of π (3.14159)
- The formula is : (π x d) + (2 x center to center dist.)

Note: typo on slides on eConestoga

14.

Bandsaw example

- A bandsaw has 18" diameter wheels and a center-to-center distance of 50". What length of blade is required.
  - = (π x d) + (2 x center to center dist.)
  - = (3.14159 x 18) + (2 x 50)
  - = (56.5486) + (100)
  - = 156.5486"
  - Or 156-½" length blade is required. (calculate to the nearest ¼")

Try it yourself:

What length of bandsaw blade is needed for a 2 wheel bandsaw with 20" dia. Wheels and a center-to-center distance of 75"?

$(\pi \times d) + (2 \times \text{center-to-center distance})$

$= (3.1416 \times 20'') + (2 \times 75'') = 212.832''$

15.

$= (3.1416 \times 20) + (2 \times 75) = 212.832$

15.

Sanding belt calculations

- Most edge sanders have two different size wheels, the drive wheel is generally larger than the idle wheel. So how do we find the proper size belt?
- With the bandsaw, both wheels were the same size, thus π x d finds the circumference of 1 wheel. The blade only sits on ½ of the upper wheel and ½ of the lower wheel (½+ ½ = 1 whole wheel).
- With a edge sander, since there are two different sized wheels, we need to find ½ the circumference of each wheel plus the center to center measurement.
- The altered formula is as follows:
  - (π x d) + (2 x center to center dist.) ⟵ for bandsaw
  - $\underbrace{\left(\frac{\pi \times d\ (wheel\ 1)}{2}\right) + \left(\frac{\pi \times d\ (wheel\ 2)}{2}\right)}_{\text{this is different}}$ + (2 x center to center distance)

16.

Edge sander calculation

- Edge sander example
  - Assume an edge sander has a 8" dia. Drive wheel and a 4" idle wheel, the center to center measures at 66". What size of belt is needed?
  - $\left(\frac{\pi \times d\ (wheel\ 1)}{2}\right) + \left(\frac{\pi \times d\ (wheel\ 2)}{2}\right)$ + (2 x center to center distance)
  - $=\left(\frac{3.14159 \times 8\ (wheel\ 1)}{2}\right) + \left(\frac{3.14159 \times 4\ (wheel\ 2)}{2}\right)$ + (2 x 66)
  - =12.56 + 6.28 + 132
  - = 150.84" or 151" belt length (rounded to the nearest ¼")

Try it yourself:

What belt size is needed for an edge sander with a 10" dia. Drive wheel and a 4" idle wheel, the center-to-center measurement is 60"?

$$\frac{\pi \times d(\text{wheel } 1)}{2} + \frac{\pi \times d(\text{wheel } 2)}{2} + (2 \times \text{center-to-center distance})$$

$$\frac{\pi \times d(\text{wheel } 1)}{2} + \frac{\pi \times d(\text{wheel } 2)}{2} + (2 \times \text{center-to-center distance})$$

$$\frac{3.1416 \times 10''}{2} + \frac{3.1416 \times 4''}{2} + 2 \times 60'' = 141.9912'' = 142''$$

Reminders:

- Assigment One is due March 9th (submission online)
- Success Week next week → no lectures
- From March 8th, lectures are in person (may not be recorded)