

Team Members:

1. _____ 3. _____
2. _____ 4. _____

Total Points

Workbook: /32 pts

Challenge: /30 pts

Key Terms

Match the key terms that are listed in the word bank with the correct definition. Write the correct letter in the space provided.

- _____ The distance around a circle.
- _____ Using a force to move an object a distance.
- _____ A shaft that is fixed to the center of a wheel, or placed through the center of a wheel, allowing the wheel to rotate freely.
- _____ The distance from the center of a circle to the outside edge.
- _____ The object or weight being moved or lifted.
- _____ A push or a pull.
- _____ An irrational, infinite number (3.14...), that represent the ratio of a circle's circumference to its diameter.
- _____ The resistance that one surface or object encounters while in contact with and moving across another.
- _____ A circular object that revolves with or around an axle.
- _____ A device that transmits or modifies force or motion.
- _____ The distance through the center of a circle from one side to another.
- _____ A force applied to a machine to do work.
- _____ The amount a machine multiplies force.

Key Terms

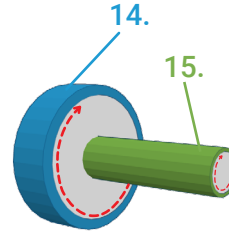
- A. Simple Machine
- B. Wheel
- C. Axle
- D. Friction
- E. Mechanical Advantage
- F. Radius
- G. Diameter
- H. Circumference
- I. Pi
- J. Force
- K. Work
- L. Effort
- M. Load



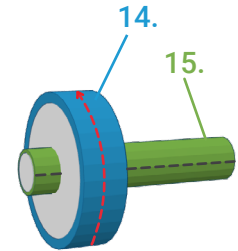
Elements of a Wheel & Axle

Identify the correct element in the spaces provided.

14. _____ 15. _____



Fixed/Connected



Free Spinning

Purpose of a Wheel & Axle

List the two purposes of a wheel & axle in the spaces provided.

16. Purpose : _____

17. Purpose : _____

Real World Application

Research some real world applications of the wheel & axle. In the space provided, write two examples not found in the curriculum packet.

18. _____

19. _____

Build and Modify

Place a check in the boxes below as the team completes each step.

20. Build a Wheel & Axle

21. Test weights on Fixed Pulley System

22. Test Wheel & Axle



Understanding Mechanical Advantage

Fill in the blanks in the statements below.

23. Mechanical Advantage exists when the _____ force of a machine is _____ than the _____ force that was applied to it.

24. For a machine to create mechanical advantage, it must trade increased time or _____ for reduced effort.

Attributes of a Circle

Write the correct answer in the spaces provided below.

25. Calculate the diameter of the circle in example 1.

Diameter: _____

26. Use the formula to calculate the circumference of the circle in example 1.

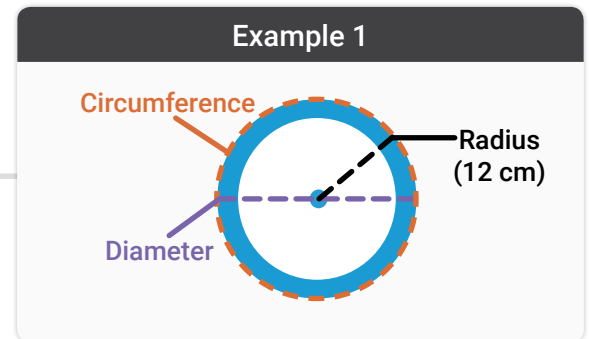
Circumference: _____

27. Calculate the radius of the circle in example 2.

Radius: _____

28. Use the formula to calculate the circumference of the circle in example 2.

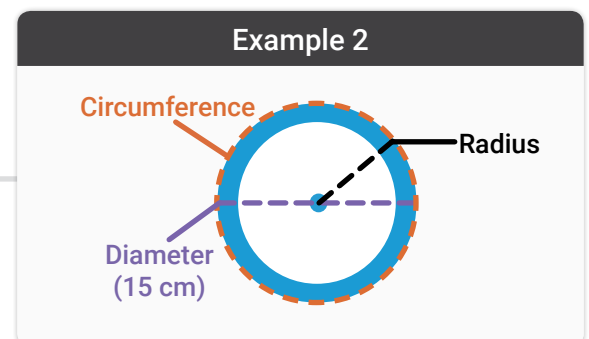
Circumference: _____



Circumference Formula

$$C = 2 \pi r$$

$r = \text{radius}$





Calculating Mechanical Advantage in a Wheel & Axle

Use the formulas to solve the problems below.

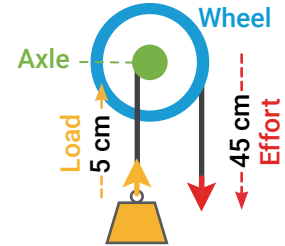
29. Determine the mechanical advantage of the wheel & axle in Example 1.

Mechanical Advantage: _____

Formula #1 (Distance)

$$\text{Mechanical Advantage} = \frac{\text{Distance effort travels}}{\text{Distance load travels}}$$

Example 1 - Wheel & Axle



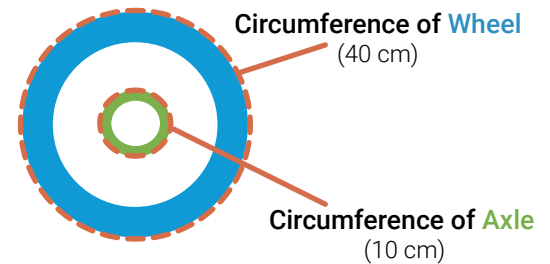
30. Determine the mechanical advantage of the wheel & axle in Example 2.

Mechanical Advantage: _____

Formula #2 (Circumference)

$$\text{Mechanical Advantage} = \frac{\text{Circumference of wheel}}{\text{Circumference of axle}}$$

Example 2 - Wheel & Axle



Modify Wheel & Axle

Place a check in the box below as the team completes each step.

31. Modify Wheel & Axle from 3:1 to 9:1 Mechanical Advantage.

32. Teacher confirms modification is correct.



Design & Engineering Challenge

Follow each step in the design & engineering process to develop a solution to the challenge. Place a check in the box as each step is completed. Fill in the blanks when necessary.

1. Identify The Challenge

- Challenge: _____
- Sub-Challenge: _____
- Sub-Challenge: _____
- Sub-Challenge: _____
- Review specifications.

2. Brainstorm Ideas & Solutions

- Discuss design ideas.
- Consider building components and cost.

3. Build A Prototype

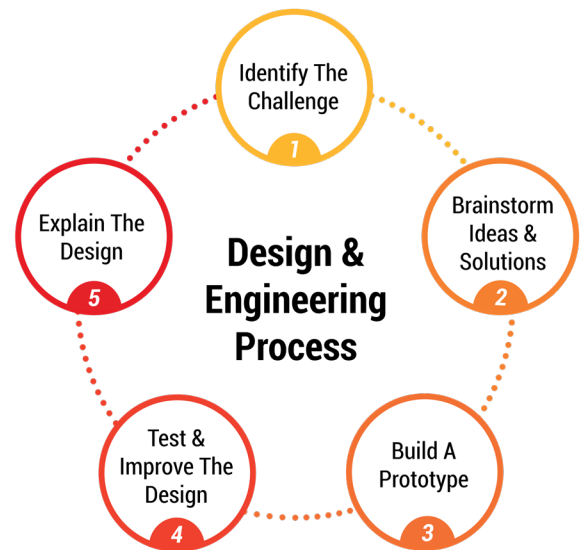
- Build a working prototype of the design.

4. Test & Improve The Design

- Test & improve the design for performance and consistency.
- New challenge discovered: _____
- Review grading rubric and design specifications.
- Consider ways to reduce cost.

5. Explain The Design







- Prepare to demonstrate and present the design to others.
- Review project grading rubric.
- Explain any unique design features that were included.
- Describe at least one new problem/challenge discovered during Step 4 (Test and Improve The Design) and how the team redesigned a new solution.





Challenge Evaluation

When teams have completed the design & engineering challenge, it should be presented to the teacher and classmates for evaluation. Teams will be graded on the following criteria:

-  **Specifications:** Does the design meet all specifications as stated in the design brief?
-  **Performance:** How well does the design work? Does it function consistently?
-  **Team Collaboration:** How well did the team work together? Can each student describe how they contributed?
-  **Design Quality/Aesthetics:** Is the design of high quality? Is it structurally strong, attractive, and well proportioned?
-  **Material Cost:** What was the total cost of the design? Was the team able to stay on or under budget?
-  **Presentation:** How well did the team communicate all aspects of the design to others?

Grading Rubric	Advanced 5 Points	Proficient 4 Points	Partially Proficient 3 Points	Not Proficient 0 Points
Specifications	<input type="checkbox"/> Meets all specifications	<input type="checkbox"/> Meets most specifications	<input type="checkbox"/> Meets some specifications	<input type="checkbox"/> Does not meet specifications
Performance	<input type="checkbox"/> Design performs consistently well	<input type="checkbox"/> Design performs well often	<input type="checkbox"/> Design is partially functional	<input type="checkbox"/> Design does not work
Team Collaboration	<input type="checkbox"/> Every member of team contributed	<input type="checkbox"/> Most members of team contributed	<input type="checkbox"/> Some members of team contributed	<input type="checkbox"/> Team did not work together
Design Quality/ Aesthetics	<input type="checkbox"/> Great design/ aesthetics	<input type="checkbox"/> Good design/ aesthetics	<input type="checkbox"/> Average design/ aesthetics	<input type="checkbox"/> Poor design/ aesthetics
Material Cost	<input type="checkbox"/> On Budget (\$140 or Less)	<input type="checkbox"/> Slightly Over Budget (\$141-145)	<input type="checkbox"/> Over Budget (\$146-155)	<input type="checkbox"/> Significantly Over Budget (\$156+)
Presentation	<input type="checkbox"/> Great presentation/ well explained	<input type="checkbox"/> Good presentation/ well explained	<input type="checkbox"/> Poor presentation/ explanation	<input type="checkbox"/> No presentation/ explanation
Points
Total Points/30			