

Activity 1.1.5 Gears, Pulley Drives, and Sprockets Practice Problems

All problem calculations should assume ideal conditions and no friction loss.

Gears

A simple gear train is composed of three gears. Gear A is the driver and has 8 teeth, gear B has 24 teeth, and gear C has 16 teeth.

1. Sketch and annotate the gear train described above.

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2. If the output is at C, what is the gear ratio?

Formula	Substitute / Solve	Final Answer

3. If gear A rotates at 60 rpm, how fast is gear C rotating?

Formula	Substitute / Solve	Final Answer

4. If the output of torque at gear C is 150 ft·lb, what is the input torque at gear A?

Formula	Substitute / Solve	Final Answer

A compound gear train is composed of four gears: A, B, C, and D. Gear A has 10 teeth and is meshed with gear B. Gear B has 20 teeth and shares a shaft with gear C, which has 16 teeth. Gear C is meshed with gear D, the output gear. Power is supplied at gear A with 100 ft·lb of torque and is traveling at 1,600 rpm.

5. Sketch and annotate the gear train described above.

6. The necessary torque output for the system is 500 ft·lb. What should the gear ratio of the system be?

Formula	Substitute / Solve	Final Answer

7. With a system torque output of 500 ft·lb, how many teeth should gear D have?

Formula	Substitute / Solve	Final Answer

Pulleys and Belts

In a pulley system, pulley A is moving at 1,500 rpm and has a diameter of 15 in. Three pulleys, B, C, and D, all of different sizes, are attached to a single output axle. Speed and torque output are changed within the system by moving the drive belt between pulleys B, C, and D.

8. Sketch and annotate the drive train described above.

9. A speed of 1,750 rpm is required when the drive belt is connected to pulley B. What is the diameter of pulley B?

Formula	Substitute / Solve	Final Answer

10. A speed of 2,000 rpm is required when the drive belt is connected to pulley C. What is the diameter of pulley C?

Formula	Substitute / Solve	Final Answer

11. A speed of 3,250 rpm is required when the drive belt is connected to pulley D. What is the diameter of pulley D?

Formula	Substitute / Solve	Final Answer

Sprockets and Chains

An industrial overhead door has sprocket and chain system designed to reduce the force needed by an operator to open and close the door. The system consists of two individual systems that are connected through a live axle shaft. To operate the door, the operator pulls a continuous loop of chain over a fixed 22-tooth sprocket that is attached to a live axle shaft (system 1). A second 22-tooth sprocket is attached to the live axle shaft and uses a chain connected to a 48-tooth sprocket that is attached to a drum that drives the door.

12. Sketch and annotate the drive train described above.

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13. What is the overall system gear ratio?

Formula	Substitute / Solve	Final Answer

Compound Machine

A new type of catapult is built as a compound machine. The catapult is powered by a 500 lbs weight attached to three simple machines. The weight is attached to a movable pulley and pulls the attached strands as it falls (opposite of how a pulley is normally used). The rope then pulls on an axle. The wheel attached to the axle pulls another rope that pulls the end of a class one lever. The opposite end of the lever is the launching arm of the catapult. The measurements for the simple machine are shown to the right.

Axle = 2.5 in
Wheel = 25 in.
Lever Input = 3ft
Lever Output = 18ft

14. Sketch and annotate the catapult compound machine described above.

15. What is the overall systems ideal mechanical advantage?

Formula	Substitute / Solve	Final Answer

16. What is the ideal force that will be generated by the 500 lb weight?

Formula	Substitute / Solve	Final Answer