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Motion transmission systems

PAGES 435 TO 441

CONCEPT REVIEW 57
Complete this concept review handout and keep it as a record of what you have learned.

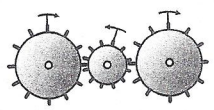
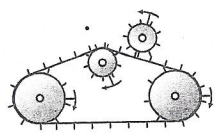
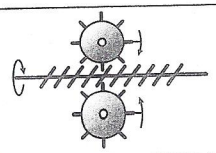
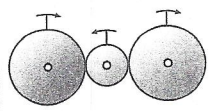
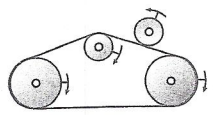
Definitions

- Motion transmission is *the mechanical function of relaying a motion from one part to another without altering the nature of the motion.*
- A motion transmission system is *a set of components that perform the function of transmitting motion.*

Types of components in a mechanical system

Type of component	Description
Driver component	*Component that receives the force required to activate the system.*
Driven component	*Component that receives the motion and transfers it to another part.*
Intermediate component	*Component located between the driver and driven components.*

Characteristics of motion in motion transmission systems

Motion transmission system		Direction of rotation of components	Reversibility
Gear train		*Alternates from one gear to another.*	Yes
Chain and sprocket system		*Depending on the configuration, identical only for sprockets touching the same side of the chain.*	Yes
Worm and worm gear system		*Varies with the direction of the threads on the worm screw shaft.*	No
Friction gear system		*Alternates from one gear to another.*	Yes
Belt and pulley system		*Depending on the configuration, identical only for pulleys touching the same side of the belt.*	Yes

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Elements to consider when building motion transmission systems

System	Elements to consider
Gear train	1. The teeth of all the gears must be identical. 2. Gear type depends on the gears' rotational axis. If the axes are parallel, the gears are straight. If the axes are perpendicular, the gears are bevelled. 3. The larger the diameter of a gear, the slower its rotation.
Chain and sprocket system	1. The teeth on the sprockets must be identical. 2. The chain links must mesh easily with the sprocket teeth. 3. The system requires frequent lubrication. 4. The smaller a sprocket, the faster it turns.
Worm and worm and gear system	1. The groove of the worm must fit the gear teeth so that they can mesh. 2. The driver must be the worm.
Friction gear system	1. Straight, bevel or spherical gears may be positioned along parallel, perpendicular or other rotational axes. 2. The bigger a gear, the slower its rotation. 3. Materials that adhere well to one another must be used for the gear rims.
Belt and pulley system	1. Pulleys must contain a groove where the belt can fit. 2. The belt must adhere to the pulleys. 3. The smaller a pulley, the faster it turns.

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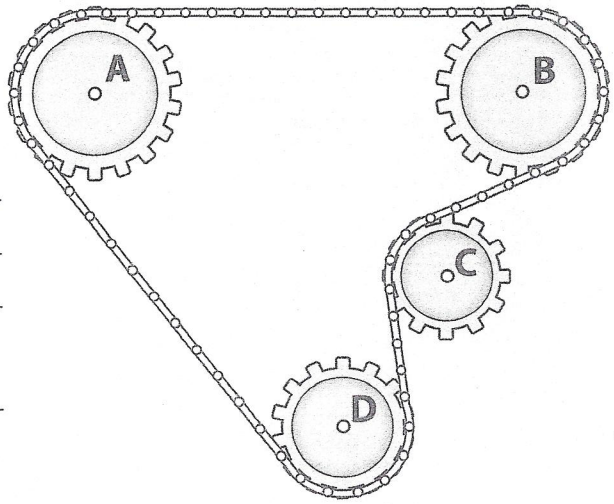
INTEGRATION QUESTIONS

Motion transmission systems

1. Study the illustration opposite.



a) If Wheel A turns clockwise, specify the direction the other wheels will turn in.

B: *Clockwise.*

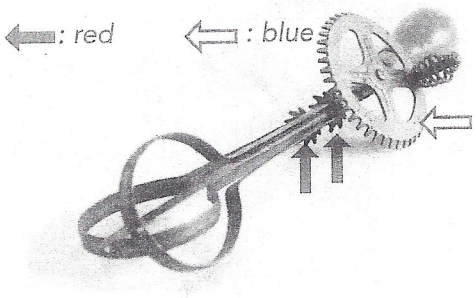
C: *Counter-clockwise.*

D: *Clockwise.*

b) Which wheel will turn fastest?

Wheel C.

2. Study the photo opposite.



a) Draw a red arrow to the driven components in the system.

b) Draw a blue arrow to the driver components of the system.

c) Does this motion transmission system have an intermediate component? If so, draw a black circle around it.

No.

3. What motion transmission system could you use to transmit motion between closely positioned parts?

A gear train or friction gear system.

4. You wish to build a machine with a motion transmission system. The motion transmitted will be rapid. It must connect distant parts, and you do not want to have to lubricate the system. Which system is most suitable? Explain your answer.

The most suitable system is a belt and pulley system.

5. In which situation can gears with helical teeth be used?

When the teeth grooves are not parallel to the rotational axis.

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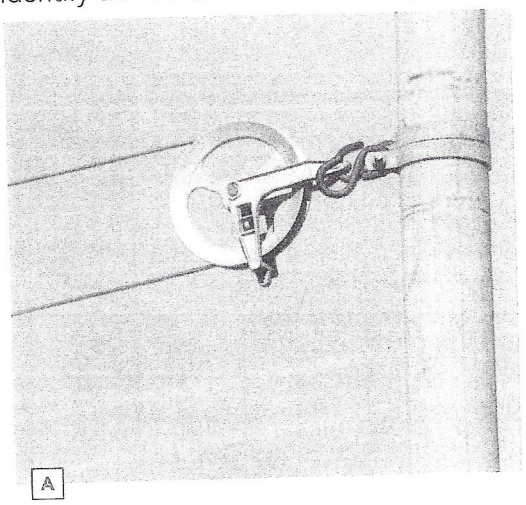
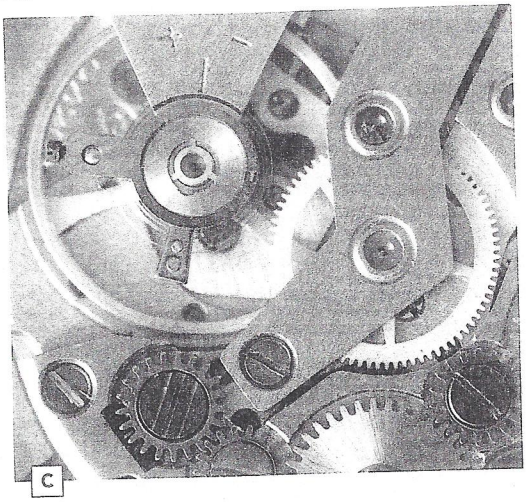
6. Identify the motion transmission systems illustrated below.



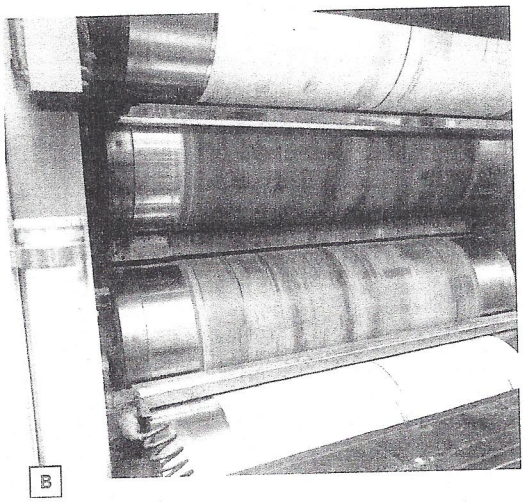
A

Belt and pulley system.



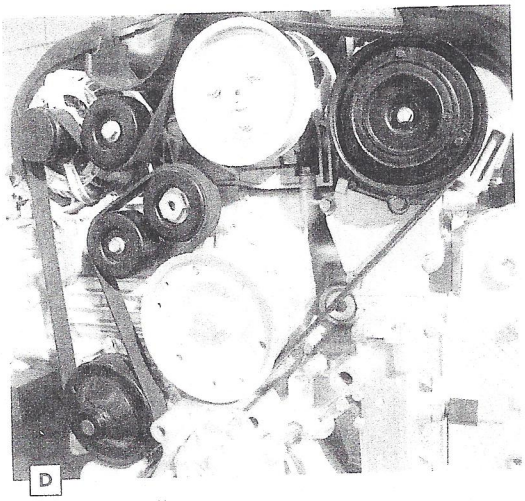
C

Gear train.



B

Friction gear system.



D

Belt and pulley system.

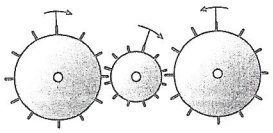
7. Which systems can be used on more than one rotational axis?

Gear trains, friction gear systems worm and worm gear systems.

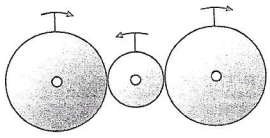
8. Of the motion transmission systems below, identify the ones whose rotational motions are correctly illustrated.

B and C.

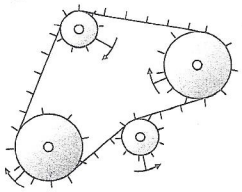
A



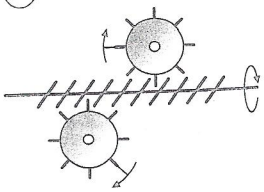
B



C



D



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Speed changes in motion transmission systems

PAGES 442 TO 445

CONCEPT REVIEW 58

Complete this concept review handout and keep it as a record of what you have learned.

Definition

- A speed change occurs in a motion transmission system when *the driver does not turn at the same speed as the driven component or components.*

Speed changes in worm and worm gear systems

The greater the number of teeth on the gear, *the greater the decrease in speed.*

Speed changes in other motion transmission systems

Speed change	Friction gear systems Belt and pulley systems	Gear trains Chain and sprocket systems
Increase	Motion is transmitted *from one gear or pulley to a gear or pulley of smaller diameter.*	Motion is transmitted *from one gear or sprocket to another with fewer teeth.*
Decrease	Motion is transmitted *from one gear or pulley to a gear or pulley of larger diameter.*	Motion is transmitted *from one gear or sprocket to another with more teeth.*
No change	Motion is transmitted *between two gears or pulleys of the same diameter.*	Motion is transmitted *between two gears or sprockets with the same number of teeth.*

Calculation of speed ratio in a motion transmission system

$$\text{Speed ratio} = \frac{\text{Diameter or number of teeth of the 1st gear or pulley}}{\text{Diameter or number of teeth of the 2nd gear or pulley}}$$

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INTEGRATION QUESTIONS

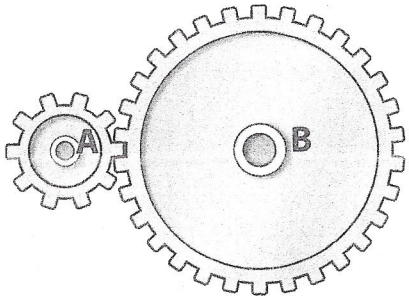
Speed changes in motion transmission systems

1. How is it possible to increase speed in a worm and worm gear system?

By transmitting motion from a gear with more teeth to a gear with less.

2. Calculate the speed ratios between Gear A and Gear B in the following situations.

a)

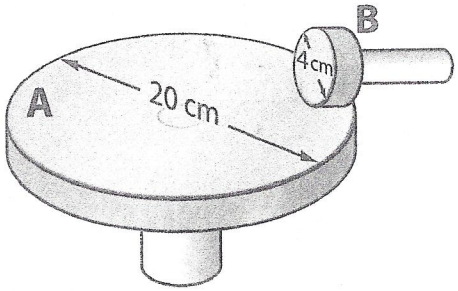


Speed ratio:

$$\frac{10 \text{ teeth}}{30 \text{ teeth}} = \frac{1}{3}$$

Wheel A turns 3 times faster than Wheel B.

b)

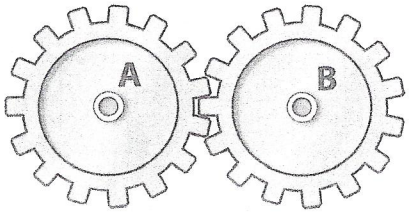


Speed ratio:

$$\frac{20 \text{ cm}}{4 \text{ cm}} = 5$$

Wheel B turns 5 times faster than Wheel A.

c)



Speed ratio:

$$\frac{15 \text{ teeth}}{15 \text{ teeth}} = 1$$

Wheel A and Wheel B turn at the same speed.

3. Your teacher wants you to make a belt and pulley system in which the rotational speed of the pulleys varies. She wants the 7-cm driver component to turn fast, the next two pulleys to move more slowly, the fourth pulley to turn faster than the driver component and the fifth and final pulley to turn at the same speed as the second pulley. Give an example of pulley dimensions that will comply with her specifications.

Answers will vary. Examples. Driver component: 7 cm, 2nd pulley: 15 cm, 3rd pulley: 15 cm, 4th pulley: 5 cm, 5th pulley: 15 cm.