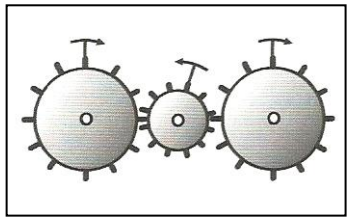
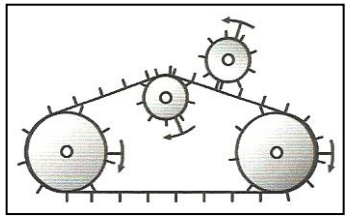
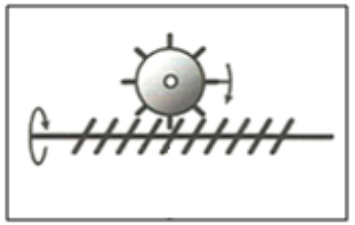
Design Plan / Principles Diagram Symbols:
(may vary slightly)



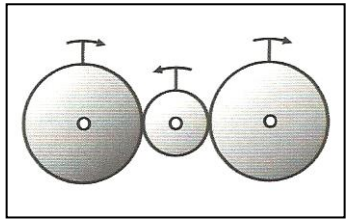
A) Gear trains systems



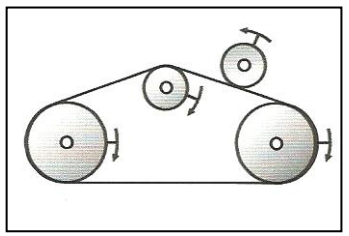
B) Chain and sprocket systems



C) Worm and worm gear systems



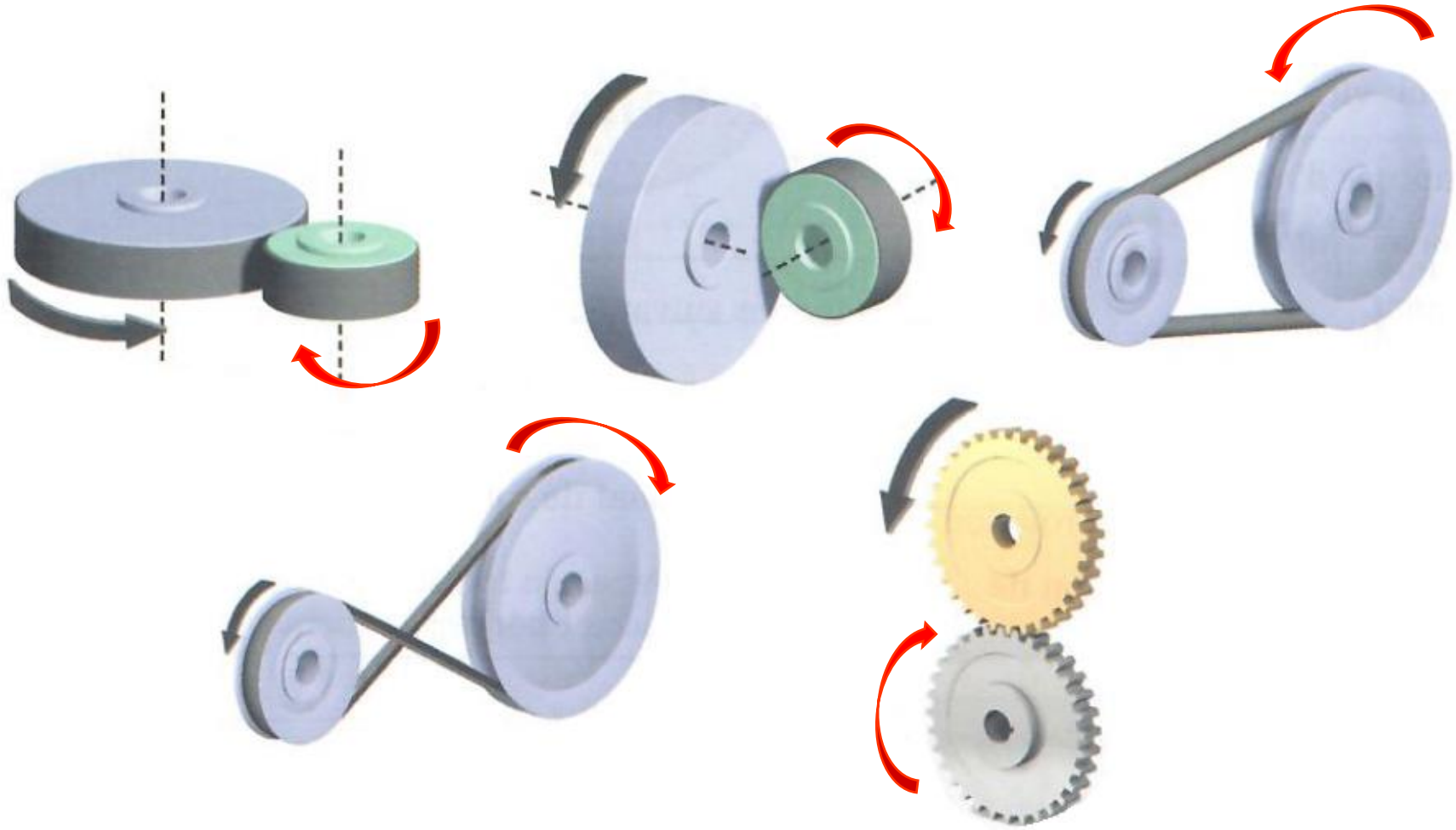
D) Friction gear systems



E) Belt and pulley systems

Activity:

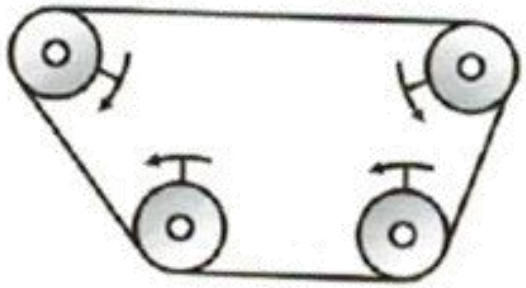
1) In each of the following situation the direction of one component is indicated, using an arrow indicate the direction of motion of the second component?



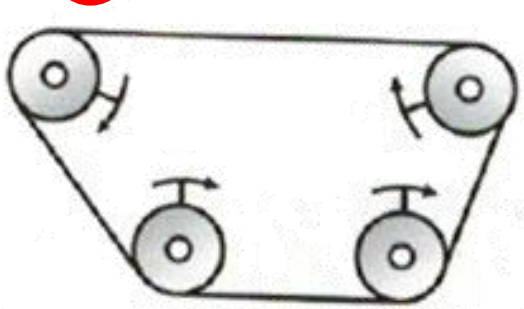
Activity:

2) Which of the following diagram(s) correctly illustrates the motion of the components?

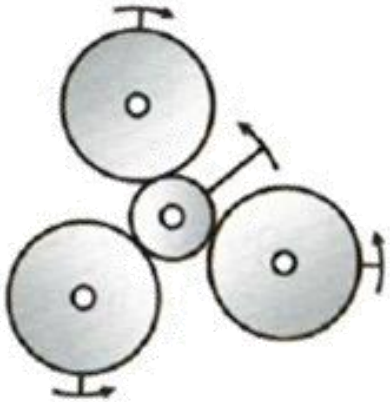
a)



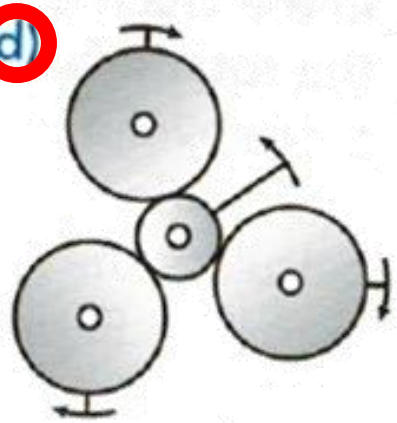
b



c)

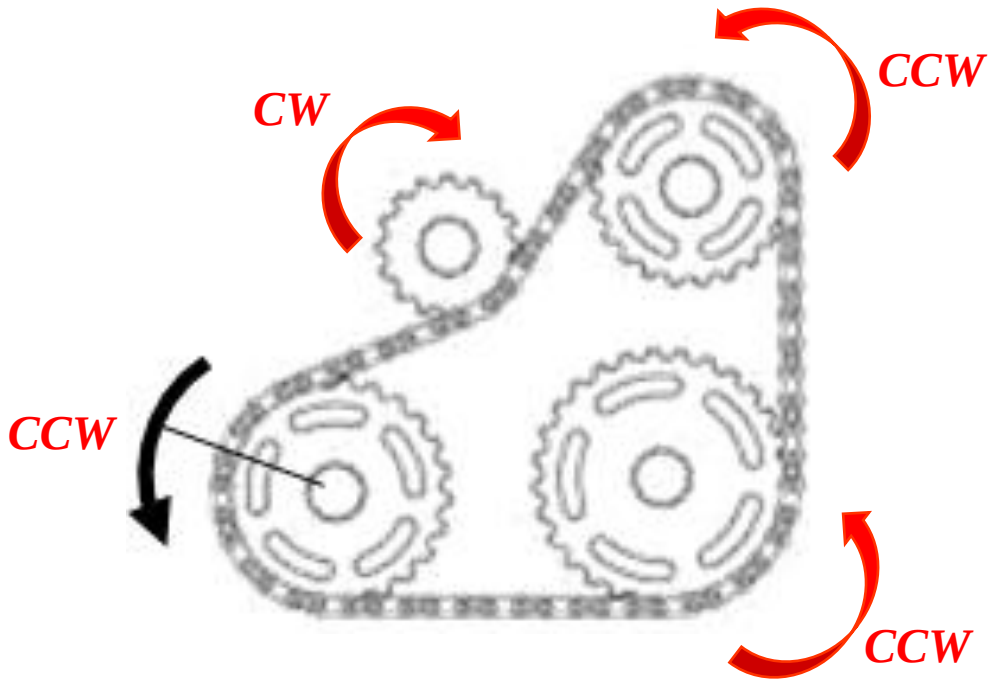


d)



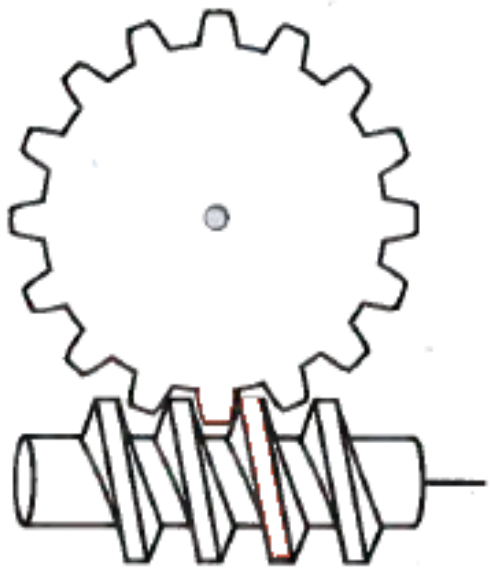
Activity:

3) Based on the information provided, indicate the direction of all the sprockets.



Activity:

4) How many turns must the below worm make in order for the worm gear to make one complete revolution?

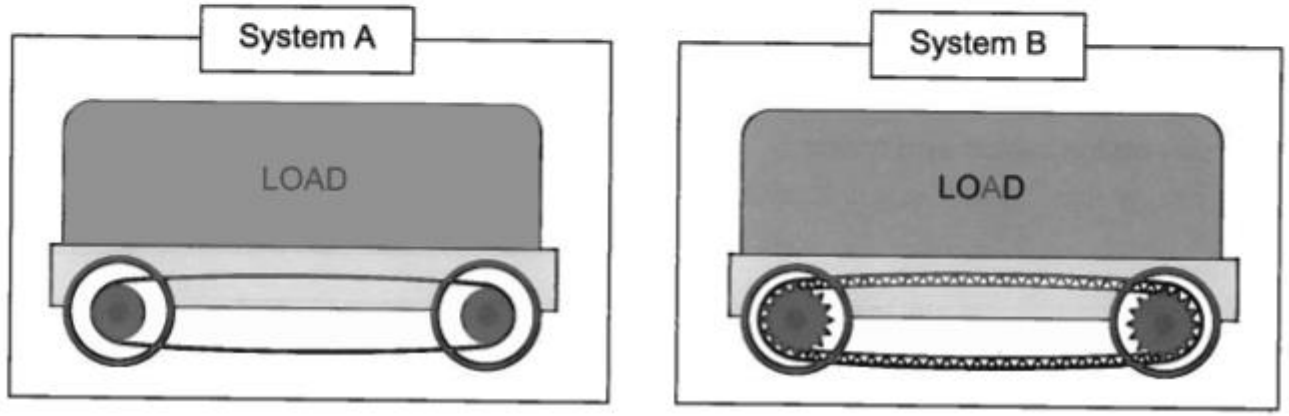


Worm gear must make 16 complete revolutions

One complete turn of the worm (screw) only advances the worm gear by one tooth.

5) In a competition, two teams must manufacture a vehicle that can carry a load over a certain distance. The team whose vehicle moves the largest load the fastest over a distance of 5 m will win the competition.

Given that both vehicles operate with the same motor, which one of the two motion transmission systems shown below will be more effective for winning the competition?



Check off the appropriate box to indicate the system that will be more effective for winning the competition.

☐ System A ◉ System B

Indicate the correct name of the system you have chosen: **Chain & Sprocket**

Explain your answer.

The system prevents Slippage

Indicate a disadvantage of the system you have chosen.

Requires Lubrication, Noisier, More Expensive

Speed Ratio

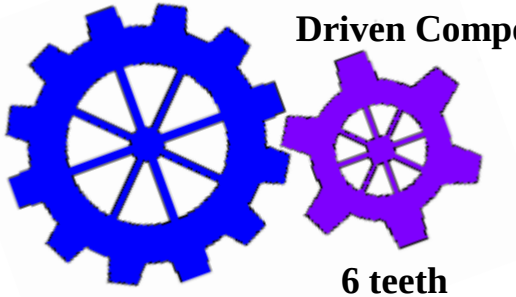
The speed ratio is dependent on the diameter for pulleys/friction gears

The speed ratio is dependent on the number of teeth in gears/sprockets

The Speed Ratio can be used to describe the speed change for a system:

$$\text{Speed Ratio} = \frac{\text{Diameter } \textit{or} \text{ Number if Teeth of A}}{\text{Diameter } \textit{or} \text{ Number if Teeth of B}}$$

Driver Component



Driven Component

12 teeth

6 teeth

Speed Ratio: $\frac{12}{6} = 2$

→ **The driven gear is moving 2 times faster than the driver**

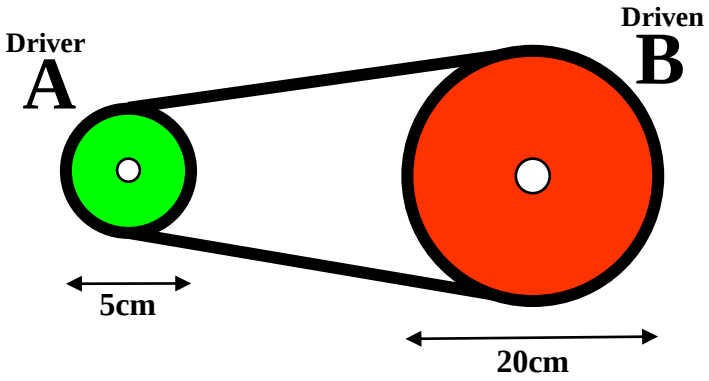
Speed Ratio

The speed ratio is dependent on the diameter for pulleys/friction gears

The speed ratio is dependent on the number of teeth in gears/sprockets

The Speed Ratio can be used to describe the speed change for a system:

$$\text{Speed Ratio} = \frac{\text{Diameter } \textit{or} \text{ Number if Teeth of A}}{\text{Diameter } \textit{or} \text{ Number if Teeth of B}}$$



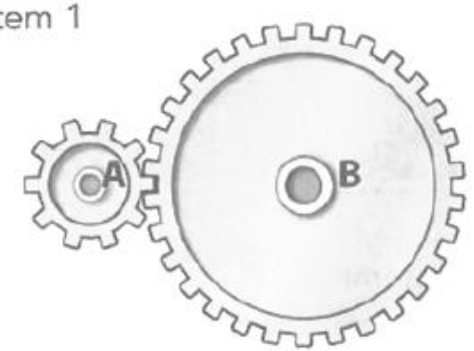
Speed Ratio: $\frac{5}{20} = \frac{1}{4}$

→ **Pulley B is moving 4 times slower than pulley A (B is moving at a forth of the speed of A)**

Activity:

1) a) Calculate the speed ratio of each situation.

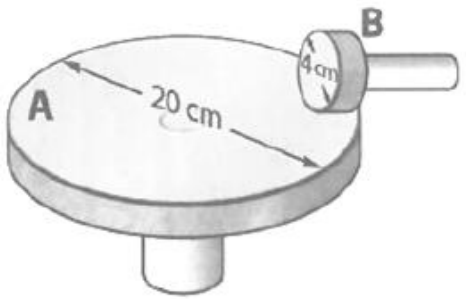
System 1



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

Gear A turns three times faster than gear B.

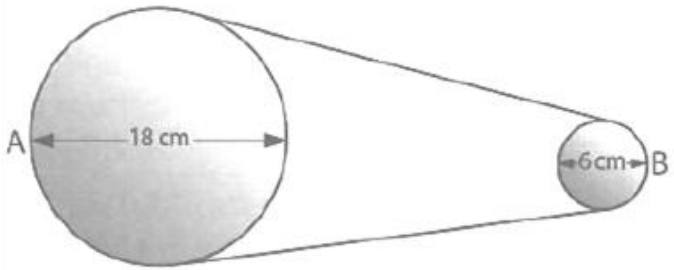
System 2



Speed ratio: $\frac{20 \text{ cm}}{4 \text{ cm}} = \frac{5}{1}$

Gear A turns five times more slowly than gear B.

System 3



Speed ratio: $\frac{18 \text{ cm}}{6 \text{ cm}} = \frac{3}{1}$

Pulley A turns three times more slowly than pulley B.

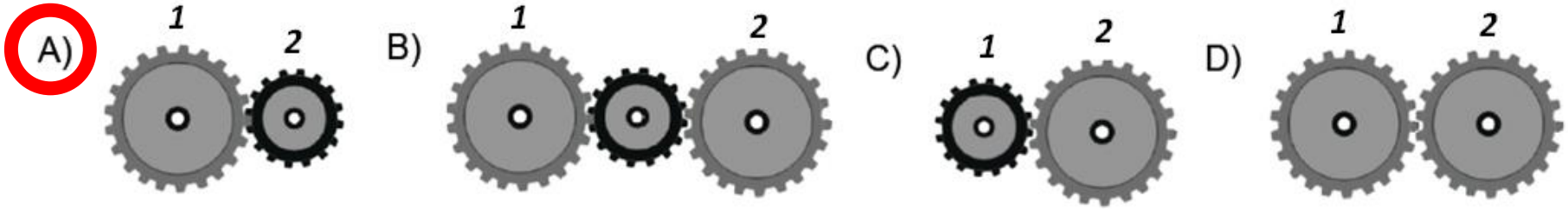
Activity:

1) b) Calculate the speed of the components from part (a) for each of the following situations (rpm = revolutions per minute)

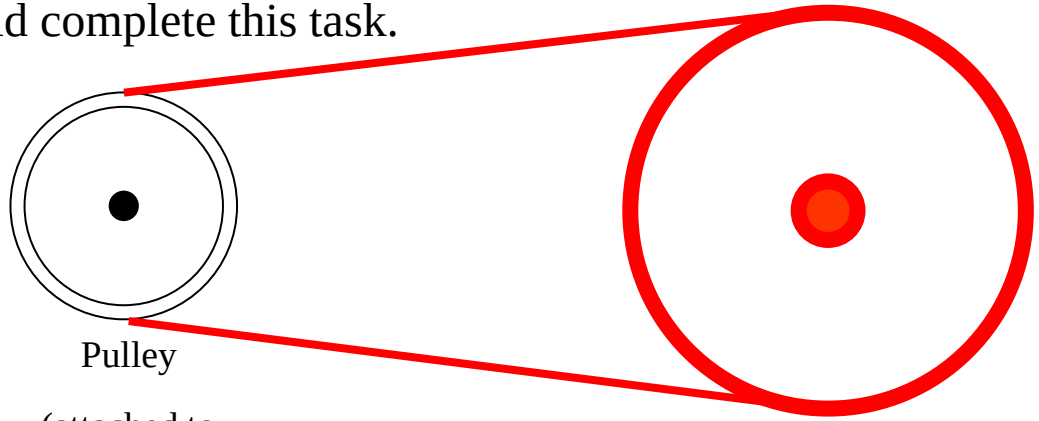
System	Speed of component A	Speed of component B
1	60 rpm	**20 rpm**
2	**75 rpm**	375 rpm
3	24 rpm	**72 rpm**
	12 rpm	36 rpm

Activity:

2) For which of the systems below will Gear 2 turn more quickly than Gear 1 ?



3) The following Pulley is attached to a motor (driver). You need the rotation to be slower and further than the motor? Complete an appropriate sketch of a transmission system that would complete this task.



Activity:

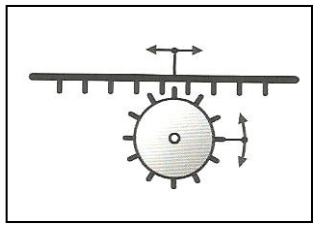
4) One of the gears in a chain and sprocket system has 48 teeth. How many teeth must the second gear have to turn eight times faster than the first gear.

Speed ratio:

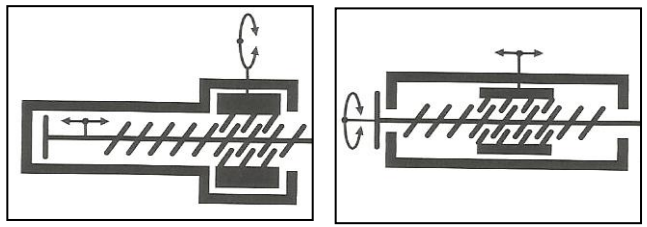
$$\frac{48 \text{ teeth}}{? \text{ teeth}} = 8 \qquad \frac{48}{8} = 6 \text{ teeth}$$

Answer: The second gear must have six teeth.

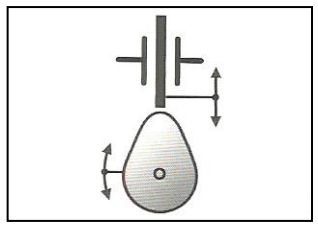
Design Plan / Principles Diagram Symbols:
(may vary slightly)



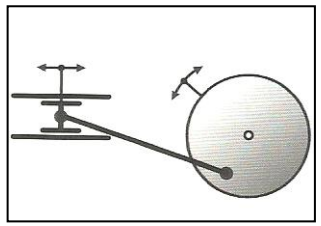
A) RACK & PINION SYSTEMS



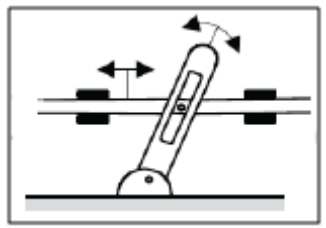
B) SCREW GEAR SYSTEMS



C) CAM & FOLLOWER SYSTEMS



D) SLIDER-CRANK MECHANISMS

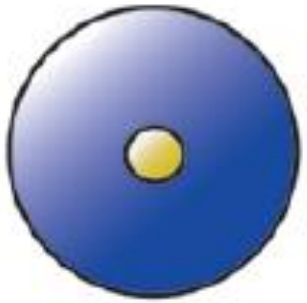


E) LEVER SLIDE MECHANISM

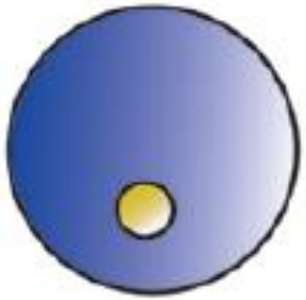
Activity:

1. A cam and follower system transforms the rotational motion of a cam into the reciprocating translational motion of a follower. Which cam below would not allow for both clockwise and counter-clockwise motion?

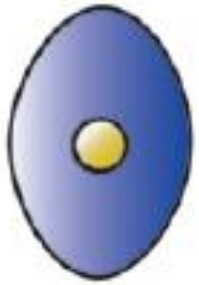
A)



B)



C)



D

Activity:

2. A student wishes to build a pull toy of a clown sitting in a cart in which a mechanism will cause the hat of the clown to move up and down as the cart is pulled.

   Which one of the systems below would not be suitable for a mechanism in this toy?

   A) Crank and slide

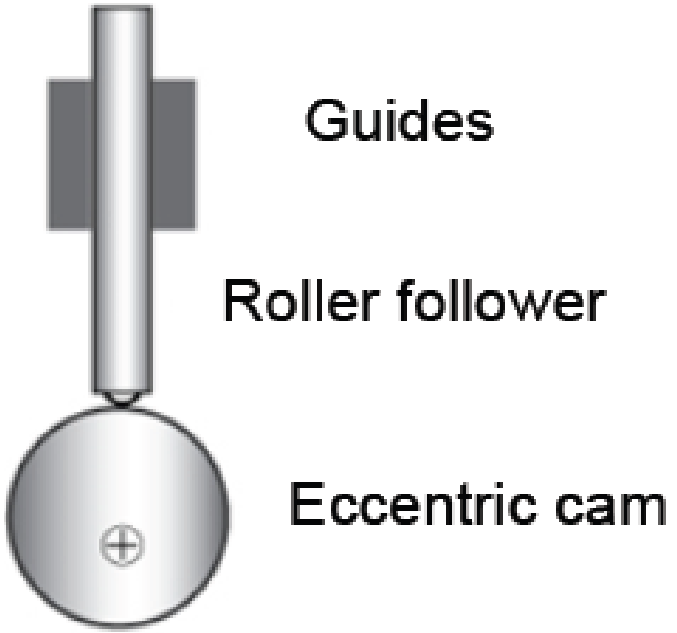
   B) Cam and follower

   C) Rack and pinion

   D) Crank, connecting rod, and slide

Activity:

3. Examine the cam and follower system illustrated below.



Describe two ways the rise of the follower could be increased.

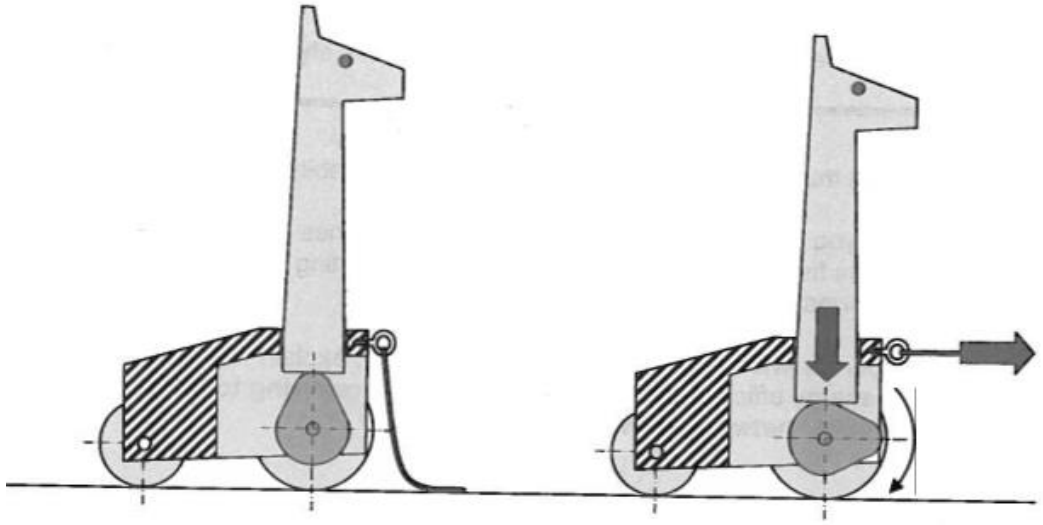
1) Move the center of rotation closer to the outside of the cam
2) Increase the size of the cam

Activity:

4.

Your little brother likes to play with his wooden giraffe because when he moves it forward or backward, its head moves up and down. However, he does not understand why he cannot move the giraffe by pushing down on its head.

Below are diagrams of the wooden giraffe.



The following statements are related to the mechanism that controls the giraffe's neck.

1- The mechanism that controls the giraffe's neck transforms rotational motion into translational motion.

2- The mechanism that controls the giraffe's neck transforms translational motion into rotational motion.

3- The mechanism that controls the giraffe's neck is a non-reversible motion transformation system.

4- The mechanism that controls the giraffe's neck is a reversible motion transformation system.

Which statements are TRUE?

A) 1 and 3 B) 1 and 4 C) 2 and 3 D) 2 and 4