Learning Activity 2: **Direction of Motion, Gear Ratios, and Mechanical Advantage**

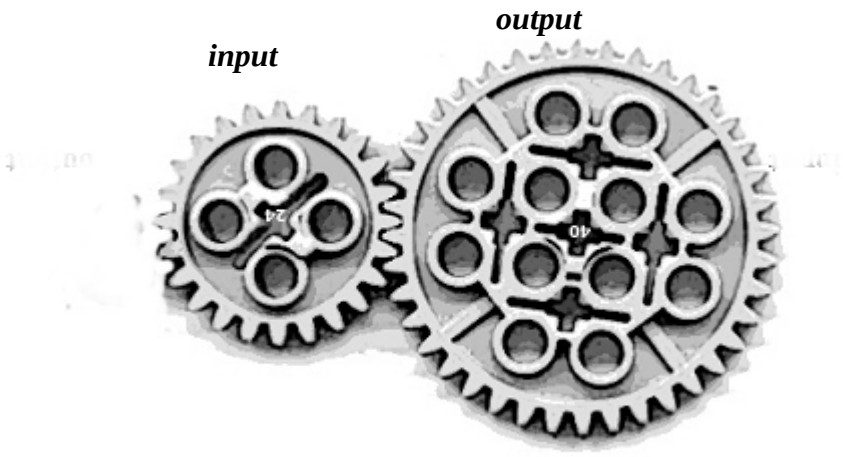
1. Instructions: For each of the following systems of gears,

(i) predict direction of the output gear

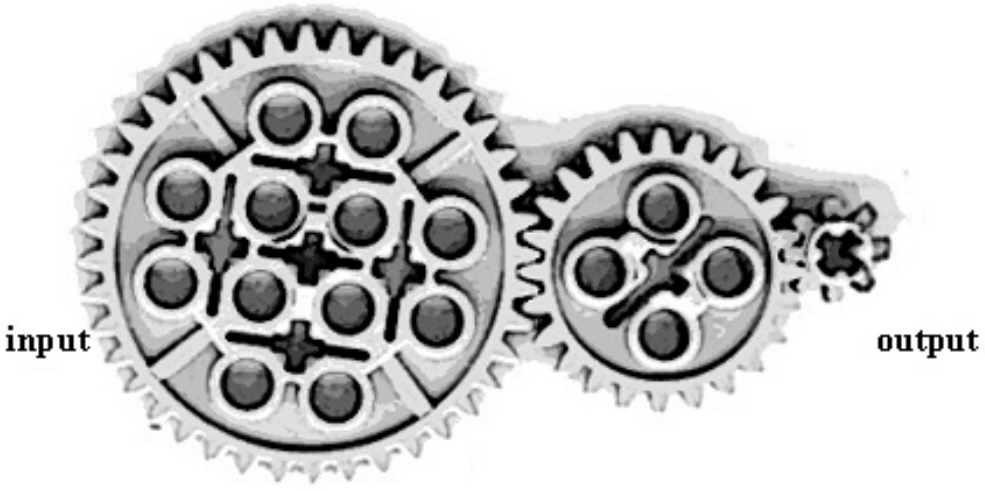
(ii) calculate the gear(velocity) ratio.

(iii) calculate the mechanical advantage(torque ratio).

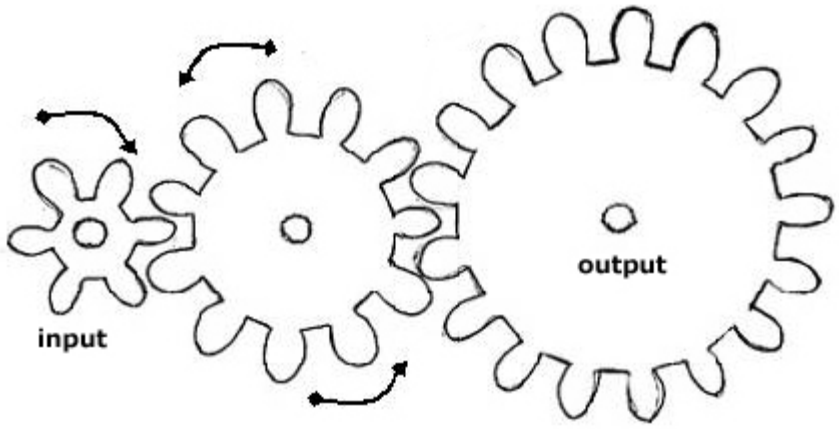
a.



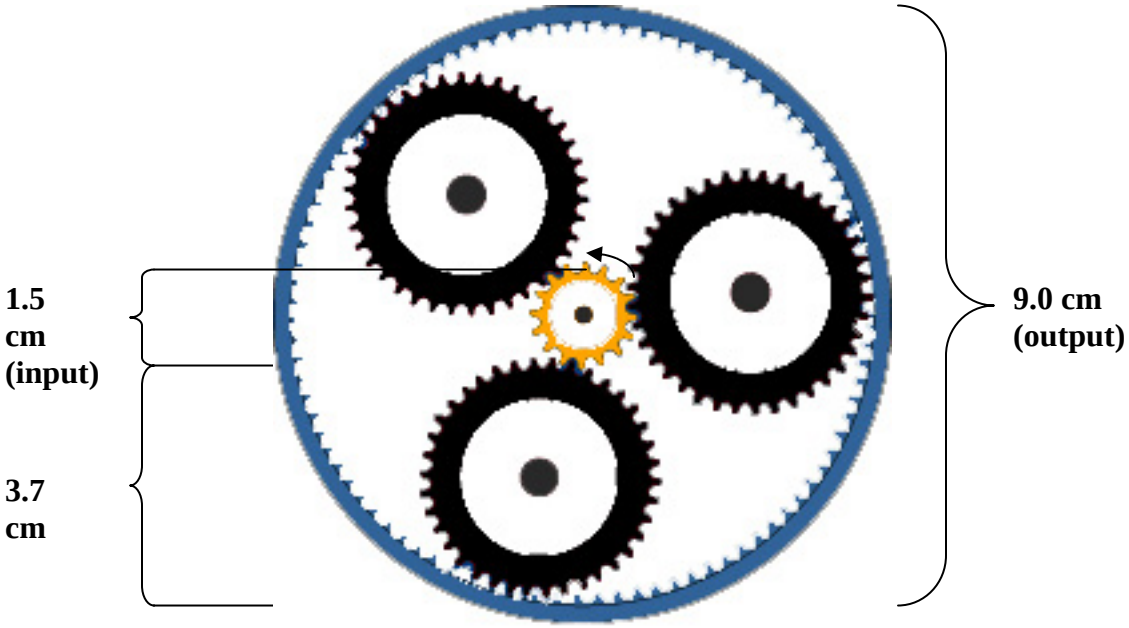
b.



c.



d. Careful: when trying to predict the direction of the output gear in this *planetary gear* system, notice that the teeth are on the *inside*. Imagine what will happen.

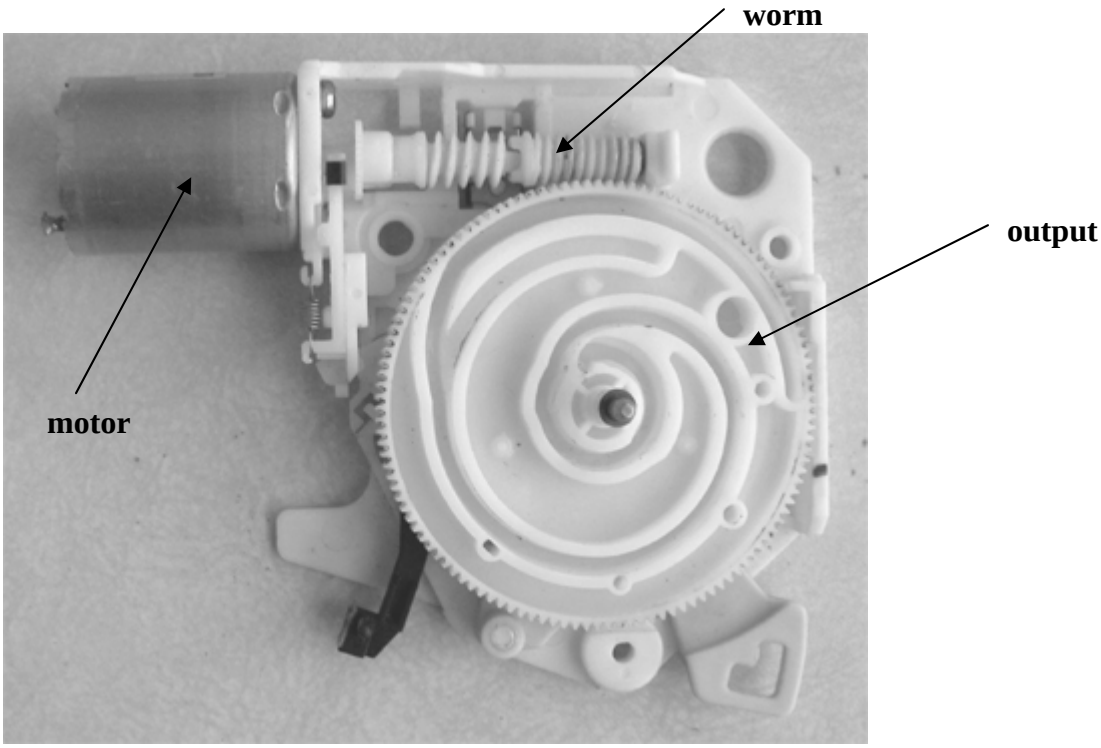


2. An input gear has 12 teeth. If the mechanical advantage is 3:1, how many teeth are on the output gear?

3. There are three gears available. One has 4 teeth. The second has 6, and the last has 8 teeth. Draw how they should be connected so that their gear (velocity) ratio is 2:1, and so that the output gear turns in the same direction as the input gear. Make sure that you label the input and out put gears.

4. You have a pair of 5 cm toothed gears and a pair of 10 cm toothed gears. You would like to create a gear(velocity) ratio of 4:1. How do you connect them? Draw the setup, and label the input and out put gears.

5.



The above, which was taken out of a VCR, is called a *wheel and worm-gear*. It is a type of gear which creates a surprisingly high mechanical advantage by connecting a cylinder with a spiral groove ("worm") to a regular toothed gear.

a. A student noticed that for every 31 turns of the worm, the output gear only made ¼ of a turn. What is the torque ratio (mechanical advantage) of this gear system?
b. When the student measured the diameters of the two gears, the student found a surprisingly lower ratio than what he calculated in part(a). The teacher told him that no mistake had been made in part(a), and that although the diameter formula does not apply to a worm, the ratio of gear teeth is still equal to the torque ratio.

   Based on this information, how many teeth does this(or any) worm gear have?