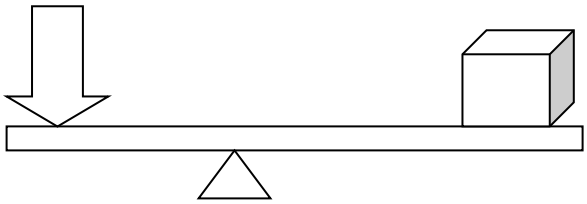
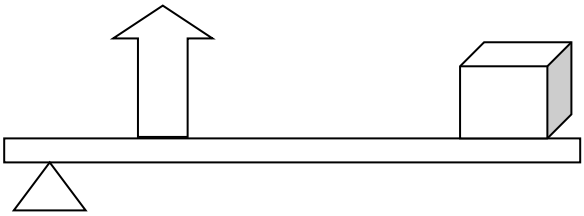
Worksheet Packet – Simple Machines

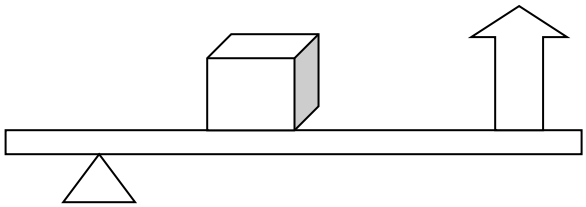
Identify the class of each lever shown below. Label the effort force, resistance force, and fulcrum.



1. _____



2. _____



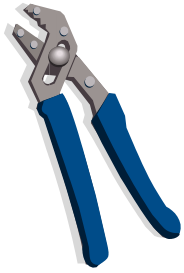
3. _____

4. _____

5. Which of the above levers would be the most efficient at lifting a heavy block of granite?_____

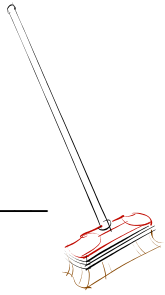
Identify the class of each level in the drawing. Draw a line to indicate the position of the fulcrum, resistance arm, and effort arm using the monikers F, R, and E.

6. Bottle Opener _____

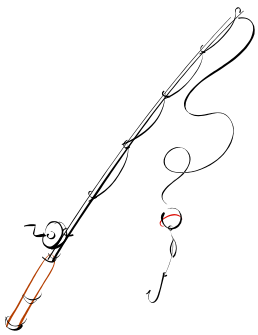


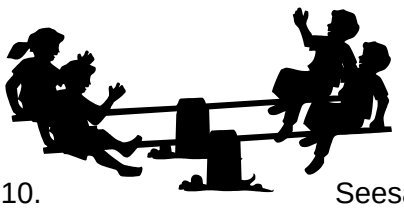
7. Pliers _____

8. Broom _____



9. Fishing Pole _____





10. Seesaw _____

11. Wheelbarrow _____

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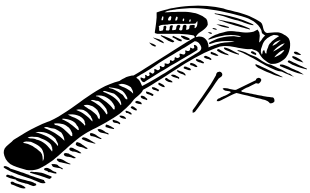
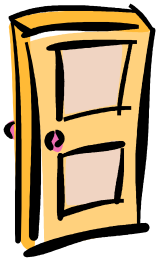
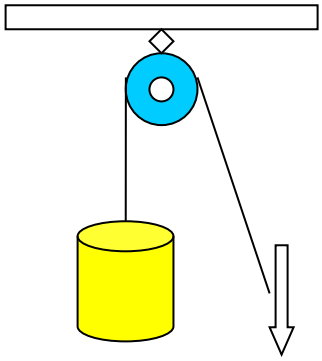
12. Baseball Bat _____ 13. Hammer _____ 14. Door _____

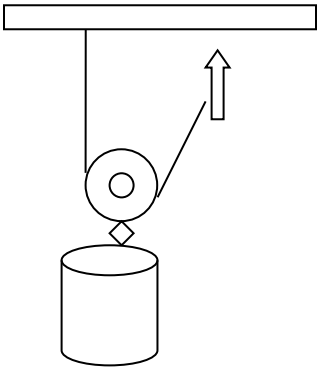




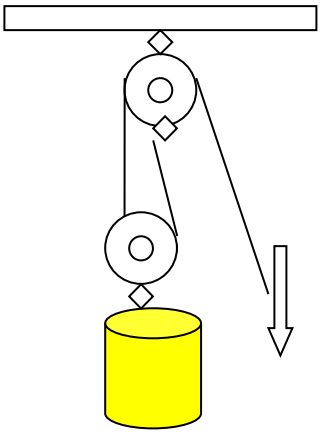
Label the mechanical advantage of each of the following pulley systems:



15. _____



16. _____



17. _____

Label the type of simple machine: (lever, pulley, ramp, screw, wheel, wedge)

18. Log Splitter _____ 19. Corkscrew _____

20. Zipper _____ 21. Doorknob _____

22. Stapler _____ 23. Staircase _____

24. Watch Gears _____ 25. Ski Run _____

Write WORK on the line provided if work is done, and NONE if no work is done:

26. _____ Jeff is sitting in a gaming rocker chair reading instructions for his new system.

27. _____ Jeff tilts the chair back while going off a jump in his Wii Game.

28. _____ The game makes a loud crashing noise as Jeff collides with a tree.

29. _____ The remote controller in Jeffs hands vibrates with the crashing sound.

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Use the formulas below to solve the following problems:

work = force x distance power = work done/time

30. How much work was done to kick a 6 N soccer ball 5 meters? _____ Joules

31. What power was used if it took 0.5 seconds? _____ Watts

32. Two football players each applied 100 N of force to sack the QB and move him 3 meters downfield. How much work was done? _____ Joules

33. Mechanical advantage is the number of times the input force is (divided / multiplied) by a machine.

34. An inclined plane allows you to lift a heavy load by using (more / less) force over a greater distance.

35. When you use a machine, the output work can never be (greater / less) than the input work.

36. A fixed pulley changes the (distance / direction) of the force you exert.

Bicycle Gears

The first bicycles did not have multiple gears for ease of riding. Cyclists worked hard to cover ground. They sat over the front wheel because the pedals were attached directly to the wheel's axle. Rotating the pedals once around moved the front wheel one complete revolution. The invention of the chain drive allowed the rider to sit in a safer, more balanced position between the front and back wheels.

Chain drives transfer the power from the rider's legs, which push down on the pedals attached to levers (the cranks), which turn the axle of the toothed wheel (front sprocket, or chain ring). The chain is a continuous loop attached to the chain ring and a rear sprocket. As the chain ring rotates, it moves the chain, which moves the rear sprocket, which turns the rear wheel's axle. Thus, the invention of the chain drive meant that a rider propelled the bike forward by moving the rear wheel, not the front one. If you think chain drives resemble pulley systems, you are right!

Later, the addition of gears with varying ratios made it easier to ride up steep inclines and pedal more efficiently. Gear ratios are figured by dividing the number of teeth in the front sprocket by the number of teeth in the rear sprocket. If there are 54 teeth in front and 27 in back, the ratio is 2 to 1 because 54 / 27 = 2. This means that the rear sprocket goes around twice each time the rider moves the chain ring one complete revolution. If the rear sprocket has 13 teeth, the ratio is about 4 to 1. One turn of the pedals will rotate the back sprocket four times. Bicycle riders use high gear ratios on downhill slopes or level ground to help increase their speed. However, it takes more effort to turn the pedals in a higher gear.

To pedal up a hill, a bicycle rider has to exert more force than the force needed to pedal along level ground. Less effort is needed to turn the pedals in a lower gear where the gear ratio is lower. So bike riders shift into lower gears as they climb hills. However, in a lower gear the rear wheel turns fewer times for each turn of the pedals.

Complete the table below by computing the gear ratios. Round to the nearest whole number.

Gear	# Teeth Rear Sprocket	# Teeth Front Sprocket	Gear Ratio
37. A	11	60	
38. B	22	54	
39. C	41	84	
40. D	60	54	