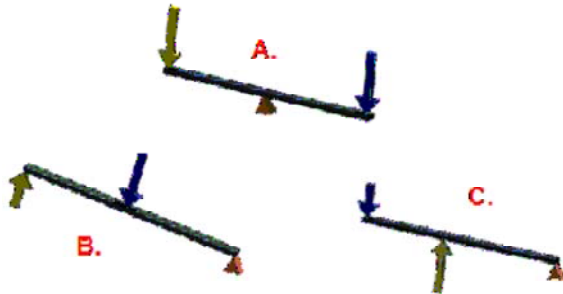


## POE Practice Test - Simple Machines

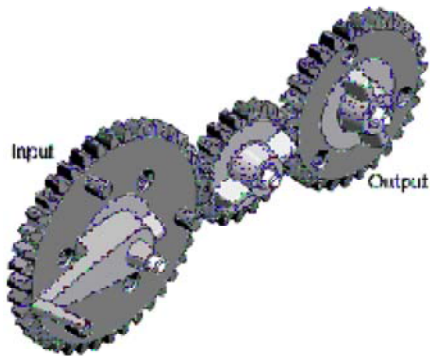
### Multiple Choice

Identify the choice that best completes the statement or answers the question.

1. What type of engineer would focus with vibration analysis, lubrication, gears and bearings?
  - a. Aeronautical Engineering
  - b. Mechanical Engineering
  - c. Civil Engineering
  - d. Environmental Engineering
2. Which of the levers pictured is a first class lever?



- a. A
  - b. B
  - c. C
3. Study the gear train in Figure 6. The purpose of the center gear is to



**Figure 6**

- a. allow the drive and driven gear to rotate in the same direction.
- b. allow the drive and driven gear to rotate in opposite directions
- c. increase the output RPM's of the driven gear
- d. increase the output torque of the driven gear

4. In a third class lever, the distance from the effort to the fulcrum is \_\_\_\_\_ the distance from the load/resistance to the fulcrum.
  - a. less than or equal to
  - b. less than
  - c. greater than
  - d. greater than or equal to
5. When used to pry open a can of paint, a screwdriver functions as



- a. a screw.
- b. an inclined plane.
- c. a wheel and axle.
- d. a lever.

6. Given the pulley configuration shown in Figure 4, how many pounds of effort force would a user have to exert on the rope to lift the 60 lb load



Figure 4

- a. 25 lbs  
 b. 15 lbs  
 c. 20 lbs  
 d. 30 lbs
7. A POE student is using the ramp shown in Figure 5 to raise an object 4 feet above the ground. The mechanical advantage of the ramp is

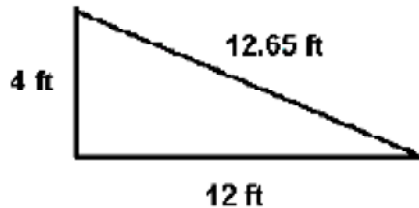


Figure 5

- a. 0.316  
 b. 3.163  
 c. 1.05  
 d. 3.0

8. Figure 7 represents a belt driven system. Pulley B, which has a diameter of 16 inches, is being driven by pulley A, which has a diameter of 4 inches. If pulley A is spinning at 60 RPMs, then pulley B is spinning at \_\_\_\_\_ RPMs

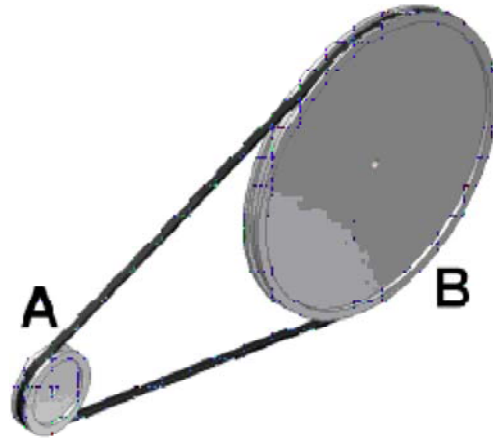
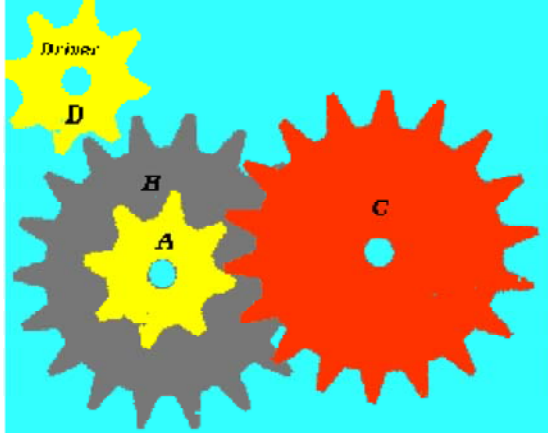


Figure 7

- a. 4  
 b. 64  
 c. 240  
 d. 15
9. If a simple machine requires an effort force that is less than the force of the load being moved, then that simple machine exhibits \_\_\_\_\_
- a. mechanical advantage.  
 b. rotary motion.  
 c. linear motion.  
 d. static equilibrium.
10. When calculating gear ratio, which of the following has an indirect relationship to the others?
- a. Torque  
 b. Diameter of the gear  
 c. Angular velocity  
 d. number of teeth
11. In a 2nd class lever the distance from the effort to the fulcrum is \_\_\_\_\_ the distance from the load to the fulcrum.
- a. less than  
 b. less than or equal to  
 c. equal to  
 d. greater than or equal to  
 e. greater than

12. A wheelbarrow is an example of which class of lever?
- 1<sup>st</sup> class
  - 2<sup>nd</sup> class
  - 3<sup>rd</sup> class
  - 4<sup>th</sup> class
13. Scissors are an example of which class of lever?
- 1<sup>st</sup> class
  - 2<sup>nd</sup> class
  - 3<sup>rd</sup> class
  - 4<sup>th</sup> class
14. \_\_\_\_\_ is calculated by multiplying the force times the distance traveled.
- Effort
  - Mechanical Advantage
  - Load
  - Work
15. According to the following thread note what does 3/8 mean?
- Pitch
  - Diameter of the screw
  - Threads per inch
  - Length of the screw
16. A force of 50 lbs is applied to a 1-foot diameter wheel. The wheel is turning a .25" diameter axle. How much mechanical advantage does the wheel provide?
- 24
  - 48
  - 4
  - 12.5
17. If friction is included in a simple machine, the amount of effort required to move a load will be \_\_\_\_\_ what is calculated using the formulas for simple machines.
- less than
  - less than or equal to
  - equal to
  - greater than or equal to
  - greater than
18. Another name for an input force is \_\_\_\_\_.
- effort
  - resistance
  - load
  - push
19. If the input (driver) gear is 15 teeth and the output (driven) gear is 60 teeth, what is the gear ratio?
- 5:6
  - 4:1
  - 1:4
  - 1:2
20. What can a gear train do?
- Change out put direction
  - Change force
  - Change speed
  - All of the above
  - None of the above
21. A turning or twisting force is known as \_\_\_\_\_.
- work.
  - thrust.
  - torque.
  - leverage.
22. Given a second class lever with a distance of 5 feet from the fulcrum to the effort and a distance of 33 inches from the resistance to the fulcrum, what is the maximum amount of weight that can be lifted with 25lbs of effort?
- 165 lbs
  - 13.75 lbs
  - 45.45 lbs
  - 3.79 lbs
23. Suppose a wheel with a 15 inch diameter is used to turn a water valve stem with a radius of .95 inches. What is the Mechanical Advantage?
- 15.8
  - 7.89
  - 14.25
  - 7.125
  - none of these.



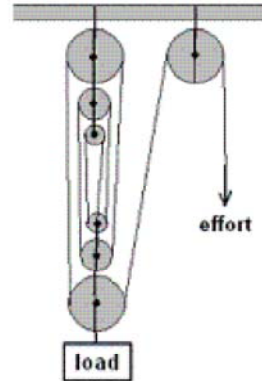
24. If gear A turns 4 times how many times will gear C turn?
- 9 times
  - 1.78 times
  - 56 times
  - 0.45 times
25. If the Driver (D) turns clockwise, which direction will gear C turn?
- Clockwise
  - Counter clockwise
  - need more information
26. If a simple machine in a frictionless environment requires more effort force than resistance force, then the mechanical advantage value would be \_\_\_\_\_
- one
  - greater than one
  - less than one
  - zero
27. The wheel of a bicycle makes one full revolution. The radius of the wheel is 10". Assuming no sliding or slip between the wheel and the road, the distance traveled by the bicycle is \_\_\_\_\_ inches.
- 628
  - 62.8
  - 314
  - 31.4
  - none of these
28. A ramp is used to raise an object 3 feet from the ground. The base of the ramp is 10 feet long. The mechanical advantage of the ramp is \_\_\_\_\_.
- 1.044
  - 3.33
  - 3.48
  - 0.958
  - none of these
29. What is the effort needed to push a 75 pound weight up this ramp?
- 21.00 lbs
  - 261.00 lbs
  - 261.55 lbs
  - 21.55 lbs
  - none of these
30. A gear train has consists of 3 gears, A, B, and C in that order. Gear A has 10 teeth, gear B has 18 teeth, and gear C has 16 teeth. The middle gear, gear B, will turn counter clockwise at what rate if gear A is moving at 60 RPM
- 333.33 RPM
  - 108.00 RPM
  - 108.33 RPM
  - 33.33 RPM
  - none of these
31. What is the overall gear ratio for the ABC gear train?
- 5:8
  - 8:9
  - 8:5
  - 9:5
32. If 15 lb-ft of torque is applied at the drive gear, what is the output at the driven gear?
- 9.375 lb-ft
  - 24 lb-ft
  - 160 lb-ft
  - 0.625 lb-ft
  - none of the above
33. What is the weight (resistance) you could lift using a first-class lever if you apply 20 lbs of effort? The effort arm is 10 feet and the resistance arm is 5 feet.
- 10 lbs
  - 20 lbs
  - 30 lbs
  - 40 lbs

34. Find the mechanical advantage of a wheel and axle system if the wheel has a radius of 1.5 feet and the axle has a radius of 6 inches if the force is put on the axle.
- 0.25
  - 0.33
  - 2.0
  - 3.0
35. Vehicles have an engine that uses a small axle (effort) to turn a much larger wheel against the ground (load). In this scenario, which of the following best describes the mechanical advantage?
- A value less than 0
  - A value equal to 0
  - A value between 0 and 1
  - A value equal to 1
  - A value greater than 1
36. If the pulley system shown in Figure 5 is lifting a 50 lb. load, what is the minimum amount of effort that must be applied to the system?



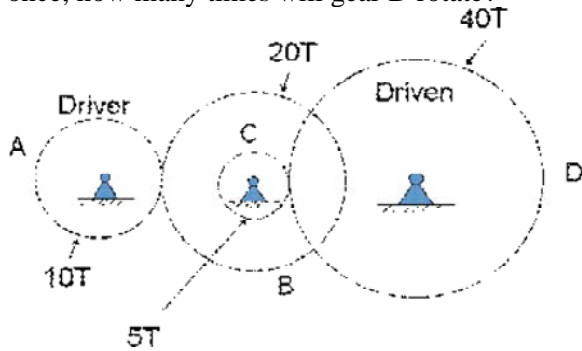
- 1 lb
- 8.33 lbs
- 10 lbs
- 50 lbs

37. Determine the mechanical advantage of the pulley system shown in the diagram to the right.



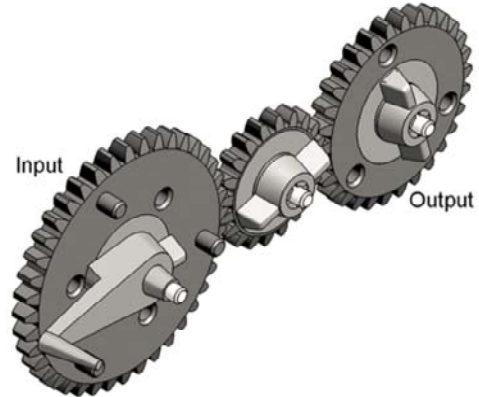
- 3
  - 6
  - 7
  - 8
  - none of these
38. A pulley with 3 supporting strands would require 30 lbs to lift how much weight in pounds?
- 10
  - 33
  - 90
  - 270
39. The fixed point of rotation on a lever is a(n)
- fulcrum
  - center point
  - wedge
  - pivot
40. If a 20-toothed gear rotates 6 times, how many times will a 40-toothed gear rotate?
- 3 times
  - 6 times
  - 9 times
  - 12 times
41. What is the mechanical advantage of a  $\frac{3}{8}$ " diameter screw with 20 threads per inch if a 1.5" diameter screwdriver is used to install the screw?
- 94
  - 47
  - 118
  - 24

42. A compound gear train above consists of 4 gears with teeth as marked. A is the driver gear and gears B and C share the same shaft. If gear A rotates once, how many times will gear D rotate?



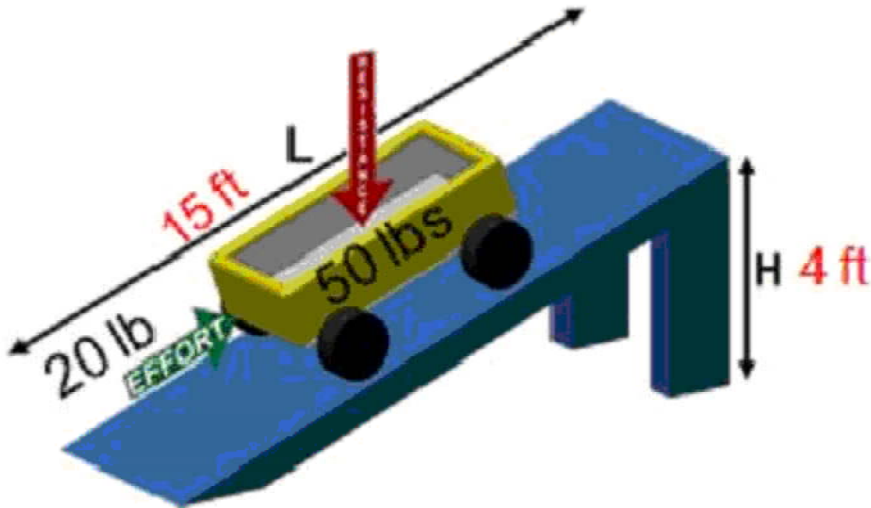
- a. 1/16
- b. 4
- c. 1/4
- d. 1/2

43. The gear train below consists of a 40-tooth (input), 20-tooth, and 30-tooth (output) gear. If the input gear rotates 10 times, how many times will the output gear rotate?



- a. 7.5 times
  - b. 15 times
  - c. 13.3 times
  - d. 20 times
44. The wheels on a bicycle have a 10" radius. If the bike must travel exactly 2000", how many revolutions are required? Assume that no sliding or slipping occurs between the wheel and the road.
- a. 31.8
  - b. 62.8
  - c. 314
  - d. 31.4

45. Calculate the work needed to move the cart to the top of the inclined plane.

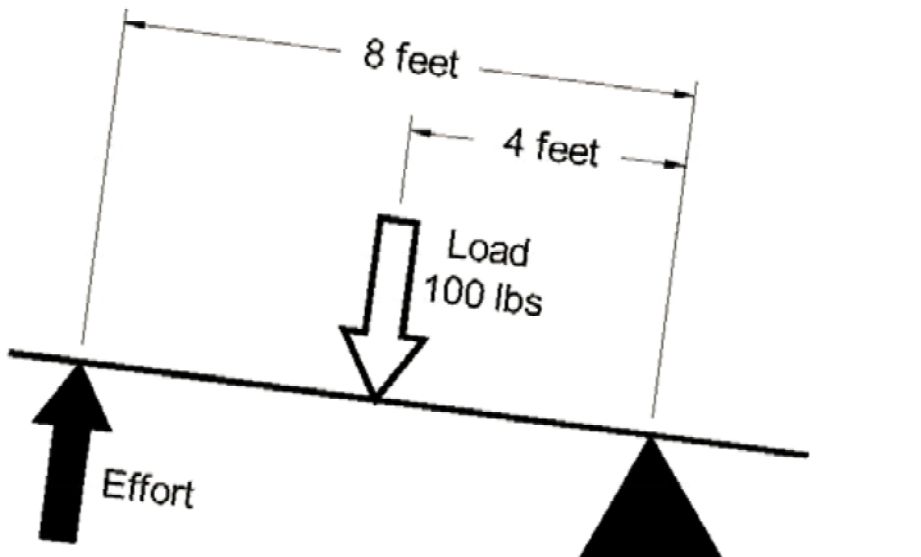


- 100 ft•lb
  - 500 ft•lb
  - 200 ft•lb
  - 80 ft•lb
  - none of these.
46. Calculate the efficiency of the inclined plane pictured above.
- 66.7%
  - 50%
  - 100%
  - 33.3%
  - none of these

### Problem

- A wheel barrow is used to lift a 150 lb load. The length from the wheel axle to the center of the load is 2 ft. The length from the wheel and axle to the effort is 6 ft.
  - What is the ideal mechanical advantage of the system?
  - Using static equilibrium calculations, calculate the effort force needed to overcome the resistance force in the system.
- An industrial water shutoff valve is designed to operate with 10 lb of effort force. The valve will encounter 100 lb of resistance force applied to a 2 in. diameter axle.
  - What is the required actual mechanical advantage of the system?
  - What is the required wheel diameter to overcome the resistance force?

49. A worker on a zip line crew lifts participants weighing approximately 200 lb several times during a day from the ground 20 feet below. A block and tackle system with 50 lb of effort force is designed to lift the materials.
- What is the required actual mechanical advantage?
  - How many supporting strands will be needed in the pulley system?
50. A simple gear train is composed of three gears. Gear A is the driver and has 10 teeth, gear B has 8 teeth, and gear C has 20 teeth.
- If the output is at C, what is the gear ratio?
  - If gear A rotates at 60 rpm, how fast is gear C rotating?
  - If the output of torque at gear C is 150 ftlb, what is the input torque at gear A?
- 51.



- What class of lever is shown in the figure? Justify your answer (How do you know?)
- How much effort force is needed to balance the 100 lb load?