POE – Test 1 (Unit 1.1 – Mechanisms)

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

1. Study the gear train in Figure 6. The purpose of the center gear is to
   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

2. 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
3. When used to pry open a can of paint, a screwdriver functions as

- a screw.
- an inclined plane.
- a wheel and axle.
- a lever.

4. Given the pulley configuration shown below, what is the Ideal Mechanical Advantage of the system?

- 1
- 2
- 5
- 10
5. A POE student is using the ramp shown in Figure 5 to raise an object 4 feet above the ground. The ideal mechanical advantage of the ramp is

\[ \text{Ideal Mechanical Advantage} = \frac{\text{Vertical Rise}}{\text{Horizontal Run}} = \frac{4 \text{ ft}}{12.65 \text{ ft}} \]

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

6. 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

\[ \text{RPMs of Pulley B} = \left( \frac{\text{Diameter of Pulley A}}{\text{Diameter of Pulley B}} \right) \times \text{RPMs of Pulley A} = \left( \frac{4}{16} \right) \times 60 = 15 \]

a. 4  
b. 64  
c. 240  
d. 15

7. 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
8. 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 

9. A wheelbarrow is an example of which class of lever?
   a. 1\textsuperscript{st} class 
   b. 2\textsuperscript{nd} class 
   c. 3\textsuperscript{rd} class 
   d. 4\textsuperscript{th} class 

10. Scissors are an example of which class of lever?
    a. 1\textsuperscript{st} class 
    b. 2\textsuperscript{nd} class 
    c. 3\textsuperscript{rd} class 
    d. 4\textsuperscript{th} class 

11. __________ is calculated by multiplying the force times the distance traveled.
    a. Effort 
    b. Mechanical Advantage 
    c. Load 
    d. Work 

12. 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.
    a. less than 
    b. less than or equal to 
    c. equal to 
    d. greater than or equal to 
    e. greater than 

13. Another name for an input force is ________.
    a. effort 
    b. resistance 
    c. load 
    d. Push
14. If the input (driver) gear is 15 teeth and the output (driven) gear is 60 teeth, what is the gear ratio?
   a. 5:6
   b. 4:1
   c. 1:4
   d. 1:2

15. A turning or twisting force is known as ____________.
   a. work.
   b. thrust.
   c. torque.
   d. leverage.

16. Given a second class lever with a distance of 5.00 feet from the fulcrum to the effort and a distance of 33.0 inches from the resistance to the fulcrum, what is the maximum amount of weight that can be lifted with 25.0lbs of effort?
   a. 165 lbs
   b. 13.8 lbs
   c. 45.5 lbs
   d. 3.79 lbs

17. Suppose a wheel with a 15.0 inch diameter is used to turn a water valve stem with a radius of 0.950 inches. What is the ideal mechanical advantage?
   a. 15.8
   b. 7.89
   c. 14.3
   d. 7.13
   e. none of these.

18. If a simple machine in a frictionless environment requires more effort force than resistance force, then the mechanical advantage value would be _________.
   a. one
   b. greater than one
   c. less than one
   d. zero

19. A ramp is used to raise an object 3.00 feet from the ground. The base of the ramp is 10.0 feet long.

19. The mechanical advantage of the ramp is _____.
   a. 1.044
   b. 3.33
   c. 3.48
   d. 0.958
   e. none of these
20. What is the effort needed to push a 75.0 pound weight up this ramp?
   a. 21.6 lbs
   b. 261 lbs
   c. 262 lbs
   d. 2.16 lbs
   e. none of these

21. 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.
   a. 10 lbs
   b. 20 lbs
   c. 30 lbs
   d. 40 lbs

22. 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 effort force is put on the axle.
   a. 0.25
   b. 0.33
   c. 2.0
   d. 3.0

23. A pulley with 3 supporting strands would require 30 lbs to lift how much weight in pounds?
   a. 10
   b. 33
   c. 90
   d. 270

24. The fixed point of rotation on a lever is a(n)
   a. fulcrum
   b. center point
   c. wedge
   d. pivot

25. What is the mechanical advantage of a 3/8” diameter screw with 20 threads per inch if a 1.5” diameter screwdriver is used to install the screw?
   a. 94
   b. 47
   c. 118
   d. 24
Problem (Show Work!)

26. A wheel barrow is used to lift a 150 lb load. The length from the wheel axle to the center of the load is 2.0 ft. The length from the wheel and axle to the effort is 6.0 ft.

a. What is the ideal mechanical advantage of the system?

b. Using static equilibrium calculations, calculate the effort force needed to overcome the resistance force in the system.

27. 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.

a. If the output is at C, what is the gear ratio?

b. If gear A rotates at 60 rpm, how fast is gear C rotating?

c. If the output of torque at gear C is 150 ftlb, what is the input torque at gear A?
Match the correct letter to each type of lever above.

___ 28. 1st Class
___ 29. 2nd Class
___ 30. 3rd Class

31. A wrench with a 1 1/2 inch handle is used to install a ¼ 20 UNC bolt into a robotic arm. What is the pitch of the screw?

31. ________________

32. What is the ideal mechanical advantage of the above situation?

32. ________________
A gear train is (shown below) composed of four gears, A, B, C, and D. Gear A has 10 teeth and is meshed with gear B. Gear B has 20 teeth and shares a shaft with gear C, which has 16 teeth. Gear C is meshed with gear D, the output gear which has 40 teeth.

33. Find the gear ratio of the gear train.

34. Describe why this is known as a compound gear train.
POE Test 1 (Unit 1.1 – Mechanisms)
Answer Section

MULTIPLE CHOICE

1. ANS: A PTS: 1
2. ANS: B PTS: 1
3. ANS: D PTS: 1
4. ANS: B PTS: 1
5. ANS: B PTS: 1
6. ANS: D PTS: 1
7. ANS: C PTS: 1
8. ANS: E PTS: 1
9. ANS: B PTS: 1
10. ANS: A PTS: 1
11. ANS: D PTS: 1
12. ANS: E PTS: 1
13. ANS: A PTS: 1
14. ANS: B PTS: 1
15. ANS: C PTS: 1
16. ANS: C PTS: 1
17. ANS: B PTS: 1
18. ANS: C PTS: 1
19. ANS: C PTS: 1
20. ANS: A PTS: 1
21. ANS: D PTS: 1
22. ANS: B PTS: 1
23. ANS: C PTS: 1
24. ANS: A PTS: 1
25. ANS: A PTS: 1

PROBLEM

26. ANS: a. 3 PTS: 2
   b. 50 lbs.
27. ANS: a. 2:1 PTS: 3
   b. 30 rpm’s
   c. 75 ft/lb.
28. B
29. C
30. A
31. 1/20
32. 188.4
33. 5:1
34. Two gears are located on the same axle, leaving it necessary to multiply 2 gear ratios to find total gear ratio