

SSSS 2019
Machines - Div C

Part A: True/False (1 point each)

Select True or False for the following questions in this section.

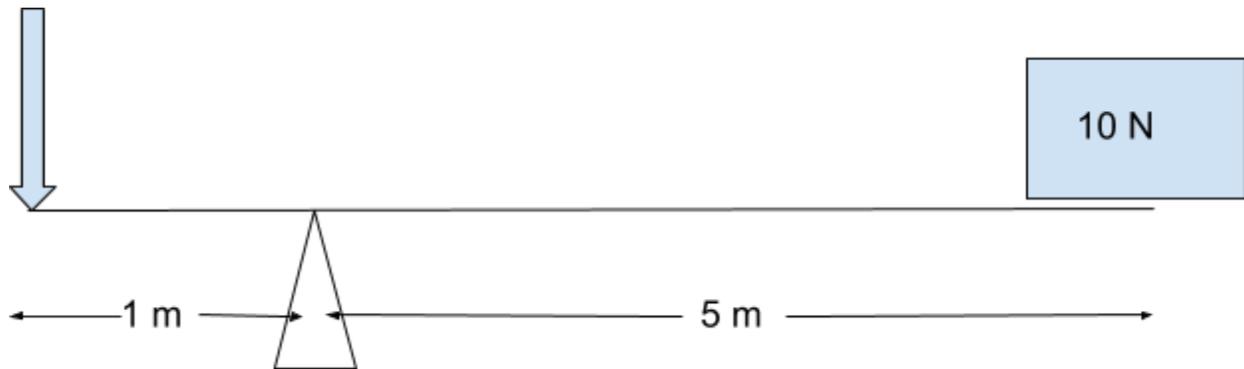
1. True or **False**: The ideal mechanical advantage of an inclined plane is equal to the sine of the incline angle.
2. True or **False**: A wheelbarrow is an example of a class 3 lever.
3. **True** or False: Conservation of Mechanical Energy applies only when there are no non-conservative forces acting on the system.
4. True or **False**: Increasing the width of a wedge will increase its mechanical advantage.
5. True or **False**: The kinetic coefficient of friction between two surfaces must always be less than 1.

Part B: Multiple Choice

Select the letter that best answers the question.

6. (1 point) A compound machine consisting of two simple machines, each having an IMA of 3, has an IMA of:
 - A. 3
 - B. 9**
 - C. 6
 - D. 1
7. (1 point) Which of the following is a base SI unit?
 - A. Gram
 - B. Newton
 - C. Coulomb
 - D. Mole**

8. (2 points)



A force of 75 Newtons applied 1.0 meter to the left of the fulcrum of the lever is required to balance the 10. Newton weight located 5.0 meters to the right of the fulcrum. What is the efficiency of the lever?

- A. **0.67**
 - B. 0.5
 - C. 1
 - D. 0.75
9. (2 points) A jackscrew combines a screw with this other type of simple machine:
- A. Pulley
 - B. **Lever**
 - C. Wedge
 - D. Wheel and Axle
10. (1 point) Torque has the same dimensions as:
- A. Linear Momentum
 - B. **Energy**
 - C. Force
 - D. Angular Momentum
11. (2 points) An object is given an initial velocity of 5 m/s and sent up an inclined plane. It travels 10m along the length of the plane and stops right as it reaches the top. What is the ideal mechanical advantage of the inclined plane? Neglect friction. Assume $g = 10$ N/kg.
- A. 12
 - B. 3
 - C. 5.5
 - D. **8**

12. (1 point) An individual fixed ideal pulley has a mechanical advantage of:

- A. 1
- B. 2
- C. 0
- D. -1

13. (1 point) An object in static equilibrium is:

- A. **At rest**
- B. Accelerating uniformly
- C. Moving at a constant velocity
- D. Moving at a constant speed

14. (2 points) Stress has the same dimensions as:

- A. Strain
- B. Force
- C. **Pressure**
- D. Torque

15. (1 point) The distance between adjacent threads on a screw is called the:

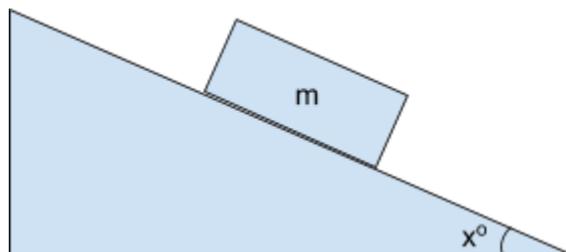
- A. Separation
- B. **Pitch**
- C. Depth
- D. Radius

Part C: Short Answer

Answer the following questions, being sure to include correct significant figures in your answer.

16. (2 points) What is the magnitude of the force of friction on the block of mass m if it is at rest? Let g be the acceleration due to gravity and μ be the coefficient of static friction.

$$F_f = mgsin(x)$$



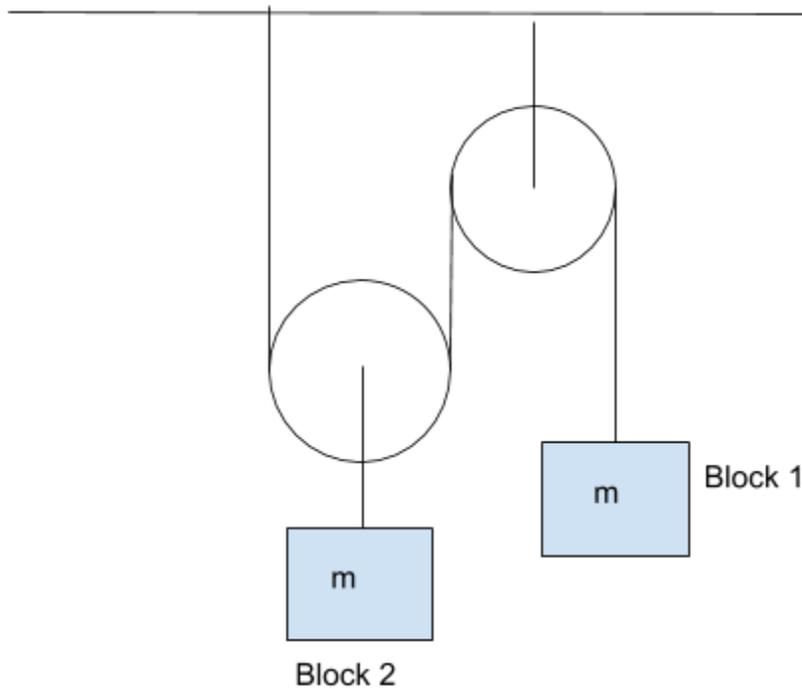
17. A. (3 points) What is the ideal mechanical advantage of a Chinese Windlass with two barrels, one of radius 5.0 meters and the other with radius 4.0 meters, and the distance from the crank handle to the center of the barrels is 2.0 meters?

4.0

B. (2 points) If the actual mechanical advantage is 1.0, what is the efficiency?

0.25

18. Answer the following questions with these assumptions: The pulleys are massless, the string is massless, and friction is negligible. Let g = the acceleration due to gravity. Express answers algebraically in terms of given values and universal constants.



A. (3 points) Find the acceleration of block 1.

$-\frac{2}{3}g$

B. (3 points) Find the acceleration of block 2.

$\frac{1}{3}g$ (Accept either positive or negative answers for parts A. and B., as long as they are opposite signs. If they are the same sign, take 1 point off from each part)

C. (2 points) Find the tension in the string.

$\frac{2}{3}mg$

19. (2 points) The human jaw is an example of a 3rd class lever.

20. (3 points) A machine has an efficiency of 0.50. If you put in 500.N to lift a 700.N box, what is the ideal mechanical advantage of the machine?

2.8

21. (Tiebreaker) Design a system of more than one type of simple machine that has an effective ideal mechanical advantage of 3.

Answers may vary. The product of the IMAs of each individual machine should equal 3.