

B - Machines - December 19 SO Practice - 12-19-2020

The Test

You will be completing a written test on Simple Machines. You will have 50 minutes to complete the test during the hour. At the end of your time, the test will be shut down. If you have technical difficulties, please notify the event supervisor through the chat.

Partners can work on different sections of the test at the same time. Students should click outside the writing boxes periodically to save their work. If you notice your work is not saving refresh the page and this should resolve the issue.

1. (1.00 pts)

What type of simple machine is shown in this picture?



- A) 1st Class Lever
- B) 2nd Class Lever
- C) 3rd Class Lever
- D) Pulley
- E) Wedge
- F) Inclined Plane

2. (1.00 pts)

What type of simple machine is shown in the picture?



- A) 1st Class Lever
- B) Second Class Lever
- C) 3rd Class lever
- D) Pulley
- E) Wedge
- F) This is not a simple machine

3. (1.00 pts)

What type of simple machine is shown in this picture?



- A) 1st Class Lever

- B) 2nd Class Lever
- C) 3rd Class Lever
- D) Inclined Plane
- E) Wedge
- F) This is not a simple machine

4. (1.00 pts)

What type of simple machine is shown in this picture?



- A) 1st Class Lever
- B) 2nd Class Lever
- C) 3rd Class Lever
- D) Pulley
- E) Wheel & Axle
- F) This is not a simple machine

5. (1.00 pts)

What type of simple machine is shown in this picture?



The oars

- A) 1st Class Lever
- B) 2nd Class Lever
- C) 3rd Class Lever
- D) Wheel & Axle
- E) Incline Plane
- F) Pulley

6. (1.00 pts)

What type of simple machine is shown in this picture?



(Mark **ALL** correct answers)

- A) 1st Class Lever
- B) 2nd Class Lever
- C) Wheel & Axle
- D) Inclined Plane
- E) Pulley

F) Wedge

7. (1.00 pts) What is the efficiency of a machine?

- A) (work input)/ (work output)
- B) (power input) / (power output)
- C) AMA/IMA
- D) All of the above
- E) None of the Above

8. (1.00 pts) Which type of wedge gives more mechanical advantage?

- A) Shorter, thinner wedge
- B) Shorter, wider wedge
- C) Longer, thinner wedge
- D) Longer, wider wedge
- E) Width of the wedge does not impact mechanical advantage
- F) Length of the wedge does not impact mechanical advantage

9. (1.00 pts) The bigger the mechanical advantage, the _____ force you need, but the _____ the distance you have to use that force.

- A) Less, greater
- B) Less, smaller
- C) More, greater
- D) More, smaller

10. (1.00 pts) Two children of different weights are riding a seesaw. How do they position themselves with respect to the fulcrum so they are balanced?

- A) Both children sit equal distance from the fulcrum
- B) Since they have different weights, they will never be in balance
- C) The heavier child sits closer to the fulcrum
- D) The heavier child sits further from the fulcrum

11. (1.00 pts) If the friction of an object against an inclined plane increases, the actual mechanical advantage _____ and the efficiency _____.

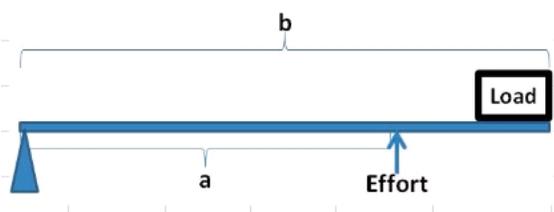
- A) Increases, increases
- B) increases, decreases
- C) decreases, increases
- D) decreases, decreases

12. (1.00 pts)

Gerald's backpack, with all of his textbooks, was on the floor of his bedroom. It was too heavy for him to lift so he created a pulley to lift the heavy backpack to the edge of a table. Then he slid the backpack to the middle of the table so it would not fall to the floor. When was the least gravitational potential energy stored between the backpack and the Earth assuming the mass of the backpack didn't change.

- A) When the backpack was on the floor in his bedroom.
- B) When the backpack was moving up the pulley
- C) When the backpack was placed on the edge of the table
- D) When the backpack was sitting in the middle of the table.

13. (1.00 pts)



The lever seen here has $a=240\text{cm}$ and $b=400\text{cm}$. The load on the lever is 75N . The ideal mechanical advantage is _____.

- A) 1.667
- B) 0.6
- C) 125N
- D) 45N
- E) 160
- F) 0.468

14. (1.00 pts)

Which part is the fulcrum on this simple machine?



wheel

15. (1.00 pts)

Where is the effort in this simple machine?



The handles

Applied to the Handles

16. (1.00 pts) Name the historical figure who stated that "magnitudes are in equilibrium at distances reciprocally proportional for their weights" in his Law of Levers

Expected Answer: Archimedes

17. (1.00 pts)

Aristotle taught that heavier objects fall faster than lighter objects but this scientist did not agree. So, he completed experiments that revealed that objects of different masses move down ramps at the same acceleration independent of their mass. He also was the first to understand that simple machines transform energy rather than create it. Who was this scientist ?

Galileo Galilei

Galilei

18. (1.00 pts) What is the Law of Conservation of Energy?

Expected Answer: Energy cannot be created or destroyed, but it can be changed from one form to another

19. (1.00 pts) This scientist was most famous for his discovery of the law of the inclined plane, which he demonstrated with the wreath of spheres.

Simon Stevin

Stevin

20. (3.00 pts) A measure of the force amplification by using a tool, mechanical device or machine system is _____.

mechanical advantage

21. (3.00 pts)

Scientists developed the three laws of dry friction in the 15th and 18th centuries. Write these three laws and the scientist whose name is linked with each law. (1/2 point for each law and 1/2 point for each correct scientist)

Expected Answer: Amonton's First Law: The force of friction is directly proportional to the applied load Amonton's Second Law: The force of friction is independent of the apparent area of contact Coulomb's Law of Friction: Kinetic friction is independent of the sliding velocity.

22. (2.00 pts) Explain how a pulley is similar to a lever with regards to force.

Expected Answer: It magnifies force in a similar way as a lever (1). It can create more force if you use that force over a longer distance (2). In a lever, you lift heavier items by moving further away from the fulcrum than the heavy item. With a pulley, you pull the rope a further distance to lift a heavier weight.

23. (2.00 pts) A machine's ability to do work is measured by what do factors?

Expected Answer: mechanical advantage and efficiency

24. (1.00 pts) A machine cannot increase the amount of work you put into it.

True False

25. (1.00 pts) Some levers exert a large force to a short effort arm which results in a greater force acting greater distance at the end of the resistance arm.

True False

26. (1.00 pts) The efficiency of a simple machine is always less than 100 percent because some small fraction of the input work is always converted to heat energy due to friction.

True False

27. (1.00 pts) In a system of pulleys in a system, you can increase the mechanical advantage by increasing the number of pulleys and lengths of rope that supports the load.

True False

28. (1.00 pts)

If you have a single pulley system, the machine not only allows you to pull down on the rope instead of up (which is easier) but it also reduces the amount of force you exert by about 10%.

True False

29. (1.00 pts) By increasing the mechanical advantage of a simple machine, you reduce the amount of work.

True False

30. (1.00 pts) A wheel and axle is actually a form of lever differing in that the effort arm can rotate in a complete circle around the fulcrum.

True False

31. (1.00 pts) In order for an object to achieve static equilibrium only needs to reach translational equilibrium where it has a net force of zero.

True False

32. (1.00 pts) Static friction is weaker than sliding friction.

True False

33. (1.00 pts) Energy is conserved in a simple machine because a machine cannot do more work than the energy put into it.

True False

34. (1.00 pts) A fixed pulley is a pulley that doesn't move with the load and can be thought of as a 2nd class lever.

True False

35. (1.00 pts) Early Greek knowledge of simple machines included input and output forces and the dynamics of forces (e.g., work)

True False

36. (1.00 pts)

Leonardo da Vinci discovered the classic rules of sliding friction that were later rediscovered by Guillaume Amontons who developed the concept of sliding versus rolling friction.

True False

37. (4.00 pts)

A 8 kg block begins to slide down a 25 degree inclined plane starting from rest. The coefficient of kinetic friction is 0.20. What is the acceleration of the block? **SHOW EQUATION AND WORK**

Expected Answer: Acceleration= $9.8 \sin 25 - 0.20 (9.8) \cos 25$ Acceleration = 4.142-1.776 Acceleration= 2.366 m/s² (1 point showing work, 2 point correct answer and 1 point correct units)

38. (4.00 pts)

A 8 kg block begins to slide down a 25 degree inclined plane starting from rest. The coefficient of kinetic friction is 0.20. You calculated acceleration in the previous question. Now, calculate how far will the block travel after 15 seconds starting from rest? **SHOW EQUATION AND WORK**

Expected Answer: $d = v_0 t + \frac{1}{2} a t^2$ $d = 0 (15) + \frac{1}{2} (2.366) (15s)^2$ $d = 1.183(225)$ $d = 266.2m$ (2 point answer, 1 pt units, 1 point equation and show work)

39. (12.00 pts) A wheelbarrow load has a perpendicular lever arm of 7.50cm, while the hands have a perpendicular lever arm of 1.02m. **SHOW EQUATIONS AND WORK**

Part 1. What upward force must you exert to support the wheelbarrow and its load if the combined mass is 45.0kg . Show your work.

Part 2. What force does the wheelbarrow exert on the ground?

Part 3. What is the Mechanical Advantage in this problem?

Expected Answer: Part 1. $F_i = (45.0\text{kg})(9.80\text{ m/s}^2) = 441\text{N}$ $0.075\text{m}/1.02\text{m} = 0.0735$ - 2 point answer , correct units (1), and 1 point show work) Part 2. $N = (45.0\text{kg})(9.80\text{m/s}^2) - 32.4\text{N} = 409\text{N}$ 2 point answer with correct units (1), and 1 point show work) Part 3. $MA = 1.02/0.075 = 13.6$ 2 point answer with correct units (1), and 1 point show work)

40. (6.00 pts)

You have a 20 kg box that you need to move. You are pulling this box-system by dragging it straight behind you, so that the rope is parallel to the ground. You pull the rope, and therefore the box, with a force of 80 Newtons, while you move it 10 meters at a velocity of 3m/s. **SHOW WORK AND EQUATIONS**

Part 1. How much work did you do on the box?

Part 2. How much kinetic energy would you say the box had?

Expected Answer: Part 1. $W = F \times d$ $W = (80\text{N})(10\text{m})$ $W = 800\text{ J}$ or 800 Newton-meters (2 point answer and units and 1 point for showing work) Part 2. $KE = (1/2\text{mass}) (\text{velocity})^2$ $KE = (1/2)(20\text{kg})(3\text{ m/s})^2$ $KE = (10)(9)$ $KE = 90\text{J}$ (2 point for correct answer with correct units and 1 point for showing work)

41. (5.00 pts)

A doorstop is a simple machine. Identify the type of simple machine it is. Describe the main function of this type of simple machine. Describe what happens to the force used to push the doorstop under the door and how it is used to keep the door open.

Expected Answer: : Door stop is a wedge (1pt) Function of a wedge is to change the direction of the input force (2pts) The force used to push the doorstop under the edge of the door is transferred downward (1pt), resulting in frictional force(1pt) that resists sliding across the floor (1pt).

42. (6.00 pts)

A hand winch uses spur gears to lift and pull heavy loads. The smaller gear has 15 teeth and the larger gear has 60 teeth. The efficiency of the winch is 85%. **SHOW EQUATIONS AND WORK**

Part 1. If the input gear is turned at 12 revolutions per minute, how fast does the output gear turn.

Part 2. If a torque of 25Nm is applied to the input gear, what is the output torque.

Expected Answer: Part 1. $RPM_{OUT} = N_{IN} / N_{OUT} \times RPM_{IN}$ $RPM_{OUT} = 15 / 60 \times 12$ $RPM_{OUT} = 3\text{rpm}$ Correct Answer with units (2) pts . Showed equation and work (1) Part 2. $Torque_{OUT} = (Eff) \times N_{OUT} / N_{IN} \times Torque_{IN}$ $Torque_{OUT} = 0.85 \times 60 / 15 \times 25\text{Nm}$ $Torque_{OUT} = 85\text{Nm}$ Correct Answer with units (2) pts . Showed equation and work (1)

43. (5.00 pts)

The input force of 11 N acting on the effort arm of a lever moves 0.4m, which lifts a 40N weight resting on the resistance arm a distance of 0.1m. What is the efficiency of the machine?

SHOW EQUATIONS AND WORK

Expected Answer: $W_i = F_i d_i = (11)(0.4) = 4.4 \text{ J}$ (1 point) $W_o = F_o d_o = (40)(0.1) = 4.0 \text{ J}$, (1 point) % efficiency = $W_o / W_i \times 100 = 4.0 / 4.4 \times 100 = 91\%$ (1 point) Show all work and equations 2 points

Thank you for participating in this event today! We wish you Good Luck in all your events today!