

**UNIT 3 (Chapter 14): Work, Power & Machines Test Review – Answer Key**

SPS8. Students will determine relationships among force, mass, and motion.

e. Calculate amounts of work and mechanical advantage using simple machines.

Answer the following questions:

1. Define force.

**Force is a push or a pull on an object.**

2. What is the equation for force? (Identify each SI unit in the force equation)

**Force (N) = mass (kg) x acceleration (m/s<sup>2</sup>)**

3. Define work.

**Work is the product of force and distance in the same direction.**

4. What is the equation for work? (Identify each SI unit in the work equation)

**Work (J) = Force (N) x Distance (m)**

5. Define power.

**Power is the rate at which work is done.**

6. What is the equation for power? (Identify each SI unit in the power equation)

**Power (W) = Work (J) / time (s)**

7. What is mechanical advantage?

**MA is the number of times that a machine increases the input force.**

8. What are the six different simple machines?

**SAWLIP: Screw, Wheel and Axle, Wedge, Lever, Inclined Plane, and Pulley**

9. Give an example of each of the six simple machine:

- a. **Screw – bottle cap, bottom of a light bulb**
- b. **Wheel & Axle – steering wheel, wagon wheels**
- c. **Wedge – axe, zipper**
- d. **Lever – scissors, wheel barrow, broom**
- e. **Inclined plane - ramp**
- f. **Pulley – flag pole, window blinds**

10. What class of levers changes the direction of the force? **1<sup>st</sup> class levers**

11. What class of levers increases the distance of the force? **3<sup>rd</sup> class levers**

12. What class of levers increases the force? **2<sup>nd</sup> class levers**

13. What is the acronym used to memorize the three classes of levers? Define each letter and draw what each letter represents (please follow the example provided below).

F	O	I	L
fulcrum in the middle	output/resistance in middle	input/effort in the middle	Lever

14. What class of levers always has the output (resistance) in the middle? **2<sup>nd</sup> class levers**
15. What class of levers always has the input (effort) in the middle? **3<sup>rd</sup> class levers**
16. What class of levers always has the fulcrum in the middle? **1<sup>st</sup> class levers**
17. What strategy do you use to identify the Mechanical Advantage of a pulley system?

**Count the number of supporting rope sections;**

**if the rope is being pulled down subtract 1,**

**if the rope is being pulled up just count the supporting ropes**

18. For work to be done on the object, the object has to move.
19. Any part of a force that **does not** act in the direction of an object's motion does no work on an object.
20. A device that changes the size or direction of force used to do work is called a(an) machine.
21. The force that is exerted on a machine is called the effort force. (**Input**)
22. The force that is exerted by the machine is called the resistance force. (**output**)
23. Besides a reduction in friction, the only way to increase the amount of work output of a machine is to increase the work input.
24. The mechanical efficiency of any machine is always less than 100 percent, because of friction.
25. The fulcrum is always between the effort force and the resistance force in a(an) 1<sup>st</sup>-class lever
26. The effort force is always between the fulcrum and the resistance force in a(an) 3<sup>rd</sup>-class lever
27. The resistance force is always between the fulcrum and the effort force in a(an) 2<sup>nd</sup>-class lever
28. Two or more simple machines working together make up a(an) compound machine.
29. Explain if work is done when you lift a book? (*use the terms force, distance, direction and move*)

**Work is done when you lift a book because the force is applied in the same direction as the movement of the book.**

30. Explain if work is done when you carry a book? (*use the terms force, distance, direction and move*)

**Work is not done when you lift a book because the force applied is not in the same direction as the movement of the book.**

31. Why don't you do work as you hold a book motionless over your head?

**No work is done because the book is not moving.**

32. Why is the work output of a machine never equal to the work input?

**The work output of a machine is never equal to the work input because some of the input is lost to friction.**

**Answer the following questions. You MUST show your work!!! Draw a picture if needed to answer the question.**

33. If 25 N of force is used to push a rock 4.5 m how much work is done?

$$W = F \times D \rightarrow \quad \underline{\underline{112.5 J}}$$

34. A woman drives her car onto a ramp for repairs. The ramp is 3.2 m long and it raises the car 0.9 m. Calculate the mechanical advantage of the ramp.

$$MA = D_e/D_r \rightarrow \quad \underline{\underline{3.56}}$$

35. It takes 1780 N of force to lift an elevator 36 m. If this is done in 25 s, what is the power of the elevator during the process?

$$P = W/t \rightarrow \quad \underline{2563.2W}$$

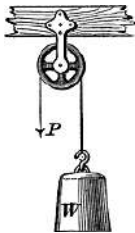
36. How high is the table if 68 J of work is used to lift a 3.4 N box from the floor to the table?

$$D = W/F \rightarrow \quad \underline{20m}$$

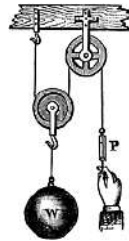
37. If it takes you 5.25 seconds to move a 450 N box 4.50 m, how much power do you use?

$$P = W/t \rightarrow \quad \underline{385.7W}$$

38. Find the MA of the pulleys shown below:



**MA = 1**



**MA = 2**

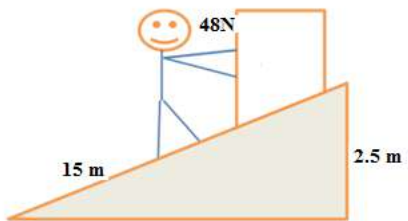
39. The bleachers are 150 m long and 60 m high, what is their mechanical advantage?

$$MA = l/h \rightarrow \quad 150/60 = \underline{2.5}$$

40. You apply 478 N of force to a jack to lift a 7850N car, what is the car's mechanical advantage?

$$MA = Fr/Fe \rightarrow \quad \underline{16.42}$$

41.



a. How much work is done in the illustration? **720J**

b. What is the mechanical advantage of the ramp? **MA = 6**

42. An apple weighing 1.25 N falls a distance of 3.25 m. How much work is done on the apple?

$$W = F \times D \rightarrow \quad \underline{4.0625J}$$

43. Write the name of the simple machine that makes up the following items. [Lever, pulley, screw, wedge, inclined plane or a wheel and axil] You may have more than one simple machine in some items.

1. Doorknob <b>screw</b>	17. Broom <b>lever</b>
2. Roof on a house <b>inclined plane</b>	18. Wagon wheels <b>wheel &amp; axle</b>
3. Rake <b>lever</b>	19. Light switch <b>lever</b>
4. Nail <b>wedge</b>	20. Hammer removing a nail <b>lever</b>
5. Screw driver <b>wheel &amp; axle, lever, wedge</b>	21. Loading ramp <b>inclined plane</b>
6. Bleachers <b>inclined plane</b>	22. Gas cap (on a car) <b>screw</b>
7. Elevator <b>pulley</b>	23. Hammer putting in a nail <b>lever</b>
8. Scissors <b>lever (blade = wedge)</b>	24. Bottle cap <b>screw</b>
9. Stapler <b>lever</b>	25. Stage curtains <b>pulley</b>
10. Slide <b>inclined plane</b>	26. Spiral stair case <b>screw</b>
11. Knife <b>wedge</b>	27. Fan belt in a car <b>pulley</b>
12. Shovel <b>lever</b>	28. Ceiling fan <b>wheel &amp; axle</b>
13. Toy car <b>wheel &amp; axle</b>	29. Ladder <b>inclined plane</b>
14. Flight of stairs <b>inclined plane</b>	30. Ferris wheel <b>wheel &amp; axle</b>
15. Escalator <b>inclined plane, pulley</b>	31. Jar lid <b>screw</b>
16. Staple remover <b>lever (blade=wedge)</b>	32. Yo-yo <b>pulley</b>