Section 2.0   An understanding of mechanical advantage and work helps in determining the efficiency of machines.

_____   _____
Student   **Class**

<div style="background:orange">**2.1 Machines Make Work Easier**</div>

1. Roads in the mountains have sections to help vehicles up a steep incline, by making sharp turns back and forth in opposite directions, after raising the vehicle a little higher in altitude. These roads are an example of a simple machine – the inclined plane, and are called …
 A reversals
 B switchbacks
 C zig zags
 D turnabouts

2. Your car has a flat tire, but you don't have a jack to lift it up, so you can change the tire. What machine could you make that would make it possible to lift the car …
 A lever
 B wedge
 C pulley
 D ramp

3. Mechanical advantage is the amount by which a machine can multiply a force. The force that the machine applies to the object is called the …
 A input force
 B output force
 C force ratio
 D Newton force

4. To calculate mechanical advantage, or force ratio, you divide the output force by the input force. A machine that is able to move an object that weighs 36 Newtons with 6 Newtons of force has a mechanical advantage of …
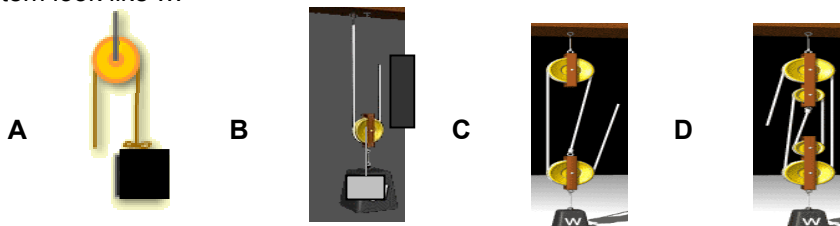 **A** 6
 B 30
 C 36
 D 42

5.   A pulley system can provide a mechanical advantage.

   Look at the illustration and identify what the mechanical advantage of this pulley system is.

   A   2   **B**   3   **C**   4   **D**   5

6. If it takes 45 N of force to lift a 180 N carton using a pulley system, what would the pulley system look like …

   A   **B**   **C**   **D**

7. Speed Ratio is calculated by dividing the …
   A Output distance by the input distance
   B Input distance by the output distance
   C Output force by the input distance
   D Input force by the output distance

8. To calculate the speed ratio of a pulley system, you count…
   A all the ropes
   B only the ropes supporting the load
   C only the ropes applying force
   D all ropes that are movable

9. In most machines, you don't get something for nothing. When you gain a mechanical advantage, you are gaining …
   A force
   B speed
   C distance
   D resistance

10. A bicycle is a useful machine because it gets us from place to place much faster than we could walk. As a machine it has a mechanical advantage of less than one, but what about speed ratio? The speed ratio of a bicycle is ...
    A 1
    B more than 1
    C less than 1
    D cannot be determined

11. What can account for the fact that mechanical advantage and speed ratio are different in real situations?
    A Improper calculations
    B Faulty equipment
    C Force of friction
    D Loss of energy

12. Efficiency is a measure of how well a machine does work. Dividing the mechanical advantage by the speed ratio and multiplying the result by 100 will determine the efficiency of the machine. A pulley system that has a speed ratio of 3 and a mechanical advantage of 2 has an efficiency of ....
    A 33%
   B 67%
    C 60%
    D 30%

2.2 The Science of Work

13. The scientific definition of work is … "Work is done when a force acts on an object to make the object move." Which statement below describes work being done.
    A Hank worked very hard to get all his homework done.
    B Doing math is hard work if you don't like numbers.
    C It was hard work for Sam to move the desk two meters.
    D It was hard work trying to move the car, but it wouldn't budge.

14. Work is calculated using the formula – W = F x d. If you lift a box onto your desk that is .4 meters off the floor, using 50 Newtons of force, how much work are you doing?
    A 20 Joules
    B 125 Joules
    C 50.4 Joules
    D 49.6 Joules

15. In a car, what provides the force (energy source) that makes work (the car moving) possible?
   A   engine
   B   transmission
   C   gasoline
   D   wheels

16. Using a machine does not mean that less work is done. This is because …
   A   Work input is never equal to work output
   B   Work input is equal to work output
   C   Less force means less distance
   D   More force means more distance

17. When determining the efficiency of a certain machine, the students found that 1600J of work were needed to get 1200J of work from the machine. The efficiency of this machine was …
   A   2800J
   B   400J
   C   75 %
   D   25%

2.3 The Big Movers - Hydraulics

18. A hydraulic system is able to move heavy loads because it uses this under pressure …
   A   air
   B   water
   C   liquid
   D   nitrogen

19. Hydraulic systems are used in many different applications. A hair stylist would use hydraulics in their shop to do this …
   A   mix chemicals and dyes
   B   operate electric shears
   C   run the neon signs
   D   raise and lower the chair

20. Pressure is the measure of the force applied to a specific area. The unit of measurement is named after Blaise Pascal who worked with fluids. The unit of measure is the …
   A   blaise
   B   pascal
   C   kilogram
   D   cubic centimeter

21. **Pascal's Law** states that pressure applied to an enclosed fluid is transmitted …
   A   to the walls of the container which double the pressure
   B   equally in all directions throughout the fluid
   C   by the transfer force in the fluid
   D   to the opposite piston where it increases the force

22. Pascal's law enables these types of systems to work very effectively – hydraulics, which use a liquid and pneumatics, which use …
   A   air
   B   oil
   C   water
   D   grease

23. A common application of the hydraulic system is the hydraulic jack, like the one shown here …
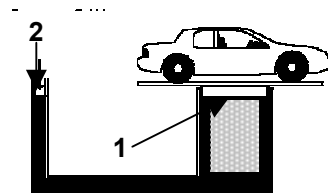

The piston identified by # 1 is the …

- **A** syringe piston
- **B** hoist piston
- **C** output piston
- **D** input piston

24. The mechanical advantage in a hydraulic system is provided by the …
- **A** small piston
- **B** large piston
- **C** flexible connection
- **D** pressure in the fluid

25. A good example of a hydraulic system at work inside the body is the …
- **A** Respiratory system
- **B** Digestive system
- **C** Circulatory system
- **D** Excretory system

26. The hydraulic jack, like the one shown here, identifies the input force piston and the output force piston …
    F_{in} = 50N
    F_{out} = 1500N
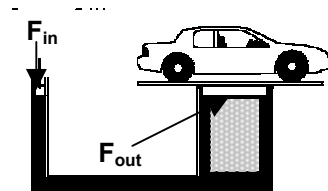
   The mechanical advantage of this hydraulic jack is …

- **A** 30
- **B** 300
- **C** 1000
- **D** 2000

27. If the area of the **input piston**, in the hydraulic lift shown in the question above, is 5cm^2, what would be the area of the **output piston**?
- **A** 10cm^2
- **B** 30 cm^2
- **C** 150 cm^2
- **D** 300 cm^2

28. The disadvantage of the hydraulic system is similar to the disadvantage of levers and pulleys. To increase the force on the output piston, the input piston has to …
- **A** have less fiction
- **B** create more pressure
- **C** move a greater distance
- **D** be attached to the load