Name _____ date _____ period _____

Physical Science **Unit 3 Work, Power & Machines** **Chapter 14**

Work and Power

1. Work – When a _____ causes an object to _____ work is done
2. Work = Force X _____ or W = _____
3. If the object does not _____ then no work is done. W = F x d if d = _____ any number times 0 is 0 so _____
4. Work also depends on _____ - The force has to be in the _____ direction as the motion or no work is done on the object. – Lifting the Books – Work _____ done - Carrying the Books – Work _____ done
5. The SI Unit for work is _____ (J) F = N d = m so W = _____
   1J = 1 kg x _____ = 1 _____
6. Work or Not Examples
   a. A scientist delivers a speech to an audience of his peers.
   b. A body builder lifts 350 pounds above his head.
   c. A mother carries her baby from room to room.
   d. A father pushes a baby in a carriage.
   e. A woman carries a 20 kg grocery bag to her car?
7. _____ **is the** transfer of _____ through _____ or _____ exerted through a _____
8. Work Examples
   a. Brett's backpack weighs 30 N. How much work is done on the backpack when he lifts it 1.5 m from the floor to his back?

Given	Equation	Solve

   b. If it takes 375 J of work to push a box 75 m what is the force used to push the box?

Given	Equation	Solve

   c. A dancer lifts a 40 kg ballerina 1.4 m in the air and walks forward 2.2 m. How much work is done on the ballerina during and after the lift?

Given	Equation	Solve

9. _____ - The rate at which work is done. Remember that a rate is something that occurs over _____
10. Power = _____ / time or P = _____ The SI unit for Power is _____(W)
11. A watt is the amount of power required to do _____ of work in _____
12. So P= W/t unit P = J/s Watts = _____
13. Power examples
    a. How much power is used to do 375 J of work in 15 seconds?

Given	Equation	Solve

    b. If 25 W of power is used to do 450 J of work how long did it take to do the work?

Given	Equation	Solve

Simple Machines

14. Machine – a device that makes doing _____ easier.
15. by _____ the force that can be _____ to an object (car jack)
16. by _____ the _____ over which the force can be applied (ramp)
17. by _____ the direction of the _____ force (opening the blinds)
18. Lever a _____ that is free to _____ pivot about a _____ _____ or fulcrum
    a. _____ arm is where you apply your force.
    b. _____ arm is where the work is done.
    c. Ideal Mechanical Advantage (IMA) assumes a _____ _____
    d. $IMA = \frac{L_e}{L_r} = \frac{Effort\ arm\ length}{resistance\ arm\ length}$
    e. _____ must be greater than _____ in order to multiply the force.
    f. First class lever
        i. The _____ is in the middle
        ii. Changes _____ of force. Examples: _____
    g. Second class lever
        i. The _____ is in the middle.
        ii. Always increases _____. Example: _____
    h. Third class lever
        i. _____ force is in the middle
        ii. Always _____ _____. Examples: _____
    i. Think FOIL
        F
        O
        I
        Levers
19. Pulley: grooved _____ with a _____ or chain running along the grove

a. equal to the number of _____ segments if pulling _____
b. Equal to one less than the number of rope segments minus 1 if pulling _____
c. Fixed Pulley the IMA = _____
   i. Does _____ increase force
   ii. Changes _____ direction of force
d. Movable Pulley the IMA = _____
   i. _____ force
   ii. _____ change direction
e. Block & Tackle is a combination of _____ and _____ pulleys
   i. _____ force (IMA= _____)
   ii. May or may NOT _____ direction

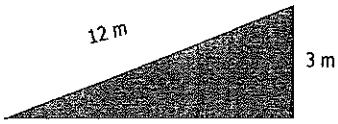
20. Wheel and Axle is _____wheels of _____ sizes that rotate _____
    a. A pair of _____ _____
    b. _____ force is applied to _____
    c. _____ moves less distance but with _____ _____
    d. $IMA = \frac{r_e}{r_r} = \frac{effort\ radius}{resistance\ radius}$
21. Inclined plane is a _____ _____ used to raise objects
    a. $IMA = \frac{l}{h} = \frac{length}{height}$
22. Screw is a _____ plane wrapped in a _____ around a _____
23. Wedge is a moving _____ plane with 1 or 2 _____ _____
24. Zipper: _____ lower wedges push teeth _____, and _____ upper wedge pushes teeth _____
25. How do machines make work easers?
    a. _____
    b. _____
    c. _____

Mechanical Advantage and Efficiency

26. _____ machines is the combination of _____ or more _____ machines
27. Rube Goldberg Machine
28. Work In - _____ force – F_e – The force applied _____ the machine. Work in – W_{in} – The work done by _____ on the machine.
29. Work Out - _____ force – F_r – The force applied _____ the machine to overcome resistance. Work out – W_{out} – The work done by the _____
30. Ideal Machine – $W_{in} = W_{out}$ – _____% energy transfer – There is no such thing as an ideal machine – you always _____ some _____ (through friction, air resistance, etc)
31. _____ - a measure of how much of the _____ put into a machine is changed into _____ output work by the machine. (less heat from _____)
32. efficiency = (W_____ / W_____) x 100% - W_{in} is always _____ than W_{out}
33. Mechanical Advantage – How much a machine _____ force or distance.
    MA = output force (____) / input force (____) or MA = _____ distance / _____ distance
34. Lever - MA = Length of _____ arm / Length of resistance arm
35. Inclined Plane -MA = _____distance / Resistance distance or Length of slope / _____ of slope
36. Mechanical Advantage
37. The number of times a force exerted on a machine is multiplied by the machine
38. Mechanical advantage (MA). $= \frac{resistance\ force}{effort\ force}$ or Mechanical advantage (MA) $= \frac{effort\ distance}{resistance\ distance}$

39. Mechanical Advantage Examples

a. What is the mechanical advantage of the following simple machine?



Given	Equation	Solve

b. Determine the mechanical advantage of an automobile jack that lifts a 9900 N car with an input force of 150 N.

Given	Equation	Solve

c. Calculate the mechanical advantage of a ramp that is 6.0 m long and 1.5 m high.

Given	Equation	Solve

d. A worker applies an effort force of 20 N to open a window with a resistance force of 500 N. What is the crowbar's MA?

Given	Equation	Solve

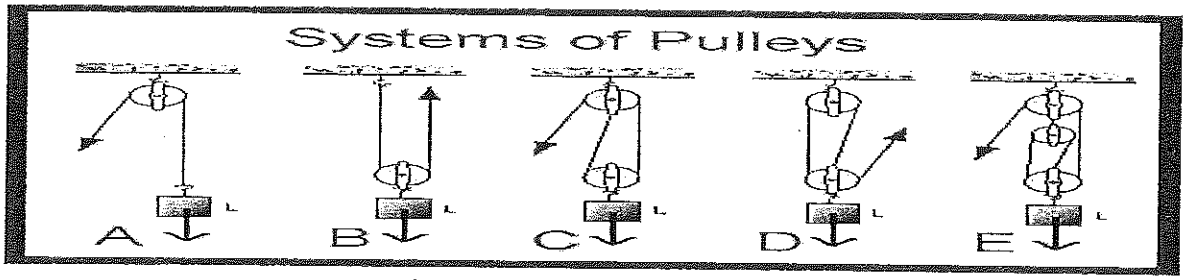
e. Find the effort force needed to lift a 2000 N rock using a jack with a mechanical advantage of 10.

Given	Equation	Solve

f. What is the mechanical advantage of the following simple machine?

Given	Equation	Solve

40. Mechanical Advantage of pulleys is very easy
    a. Count the number of rope segments visible
        i. If rope is pulling down subtract 1
        ii. If rope is pulling up do nothing
41. Pulley Examples



42. _____ is a measure of how completely _____ is converted to _____ _____
    a. $Efficiency = \frac{W_{out}}{W_{in}} \times 100$
    b. Always _____ than 100% due to _____
43. If a machine requires 26.0 J of work input to operate and produces 22.0 J of work output, what is it's efficiency?

Given	Equation	Solve