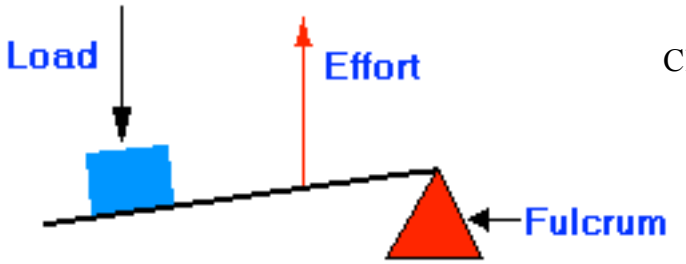
Compound Machines Test 2014 Key

1. Name the six types of simple machines
(6 points)
____lever_____ _____pulley_____ _____wheel and axle____

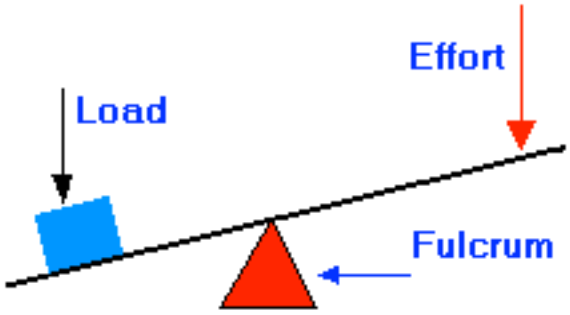
_____inclined plane____ _____screw_____ ____wedge_____

2. Identify each class of these levers: (3points)
a.



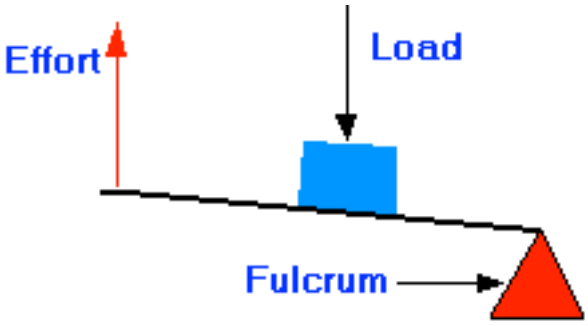
Class____3__

b.



Class ___1___

c.



Class___2___

(NOTE: On calculation problems, one point is given for correct number of significant digits and one point for correct unit if applicable.

3. What is the Ideal Mechanical Advantage (IMA) for the following situations? (4 points)

a. A rope through a system of pulleys is pulled 2.50 m down with a force of 20.0 N. The weight that is lifted moves 0.5 m.

IMA =2.50 m/0.5 m = 5

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b. A 12 kg box is pushed up a ramp that is 2.0 m long. The ramp is resting on a dock that is 0.75 m high. It took a force of 45 N to push it up the plane.

IMA=2.0 m/0.75 m =2.7

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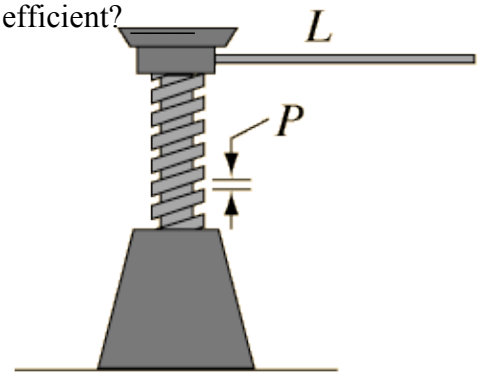
4. (4 points) A jack with a handle of 25 cm and a pitch of 0.8 cm is pictured below. What is the Actual Mechanical Advantage (AMA or MA) of the jack, if it is known to be 30% efficient?



Screw $IMA = \frac{2\pi L}{P}$

$$efficiency = \frac{MA}{IMA} \times 100\%$$

$$30 = \frac{MA}{\left(\frac{2\pi \cdot 0.25m}{0.008m}\right)} \times 100\%$$

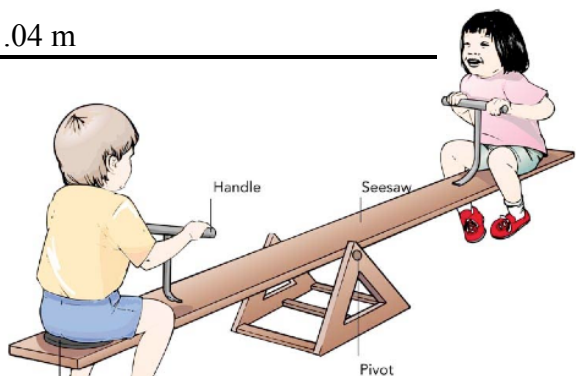
$$MA = 58$$

$$MA = 60 \ (1 \ \ significant \ \ digit)$$

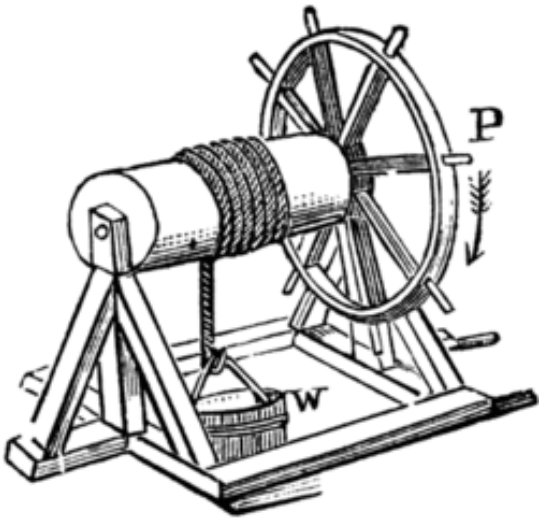
5. (1 point) A block and tackle is what type of simple machine? _____pulley_____

6. (4 points) A 25.0 kg child sitting on a seesaw invites a 30.0 kg child to join her. She sits 1.25 m from the pivot point. Where should the 30.0 kg child sit so that they are balanced on a horizontal position?

25 kg (9.8 m/s^2)(1.25 m) = 30.0 kg(9.8 m/s^2)(x) x=1.04 m



7. Anciently, a windlass was used to draw water from a well. The windlass is an example of what type of simple machine? (1 point)



_wheel and axle_____

8. A 5.0 kg block is pushed horizontally 3.0 m across a rough plank at a constant speed with a force of 42 N.

a. (5 points) Calculate the coefficient of friction. $\_\mu = \frac{F_k}{F_n} = \frac{42\ \ N}{12 \cdot 9.8\ \ N} = .36$ _____

b. (5 points)Then one end of the plank is lifted onto the crossbar of a scaffold, which is 1.5 m high. The same block is pushed 3.0 m up the plane with a force of 70 N. What is

$$efficiency = \frac{W_{out}}{W_{in}} \times 100\%$$

the efficiency of the plane? $eff = \frac{5.0kg(9.8m/s^2)1.5m}{3.0(70)J} \times 100\%$

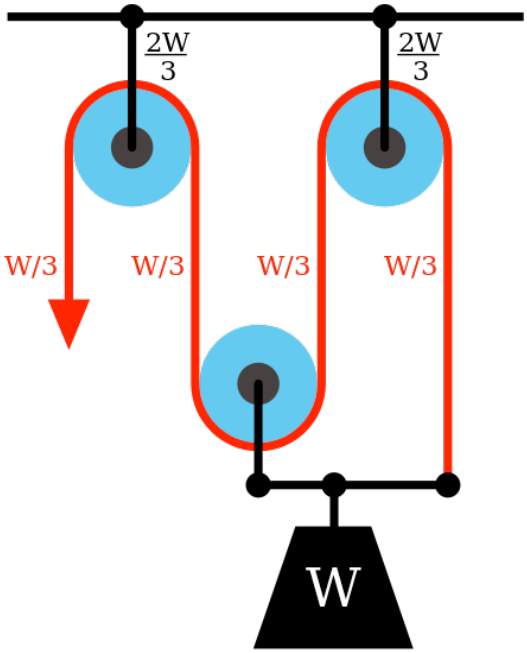
$$eff = 35\%$$

9. (1 point) Which ancient mathematician stated “Give me a place to stand, and I shall move the Earth with it” as a reference to the power of a lever?
___Archimedes_____

10. (1 point) Hero of Alexandria identified the __pulley___as one of the six simple machines.

11. (1 point) Recently in Rockville, UT, immense boulders fell from a cliff, destroying a home. Scientists say that a recent cold spell caused ice to form that split the boulders away from the cliff. In this case, the ice was acting as what type of simple machine? ___wedge_____

12. (1 point) What is the mechanical advantage of the pulley system illustrated below? _3



13. (4 points) Calculate the mechanical advantage of the head of a splitting maul that is 25 cm long and 1.0 x10^1 cm long. ___MA = 25 cm/10 cm= 2.5

14. a. (3 points) A compound machine is composed of two simple machines. One has an IMA of 3.0 and the other has an IMA of 2.0. What is the IMA of the compound machine?

2.0 (3.0) = 6.0

b. (5 points) If this complex machine is 60.0% efficient, how much effort must be applied to the first machine so that the second machine lifts a 540 N box?

$$efficiency = \frac{(F_r / F_e)}{IMA} \times 100\%$$

$$.60 = \frac{(540N / F_e)}{6}$$

$$F_e = \frac{540N}{3.6} = 150N$$

15. (1point) Multiple choice: (correct choice) C

A fork would be an example of what type of simple machine?

A: pulley

B: wedge

C: lever

D: screw