Compound Machines Division C

School Name_____

Team Number _____

Directions: Answer the questions as they are written. DO NOT assume a question meant

something other than what it reads. All wording and numbers are deliberate.

Use the correct number of significant figures and keep track of all units.

Partial credit may be awarded for any question. Point values are listed, so prioritize your work.

You have **30 MINUTES**. Good ~~luck~~ skill!

Part 1: Matching (TIEBREAKER ONLY)

1) Work   a. The force that a simple machine is attempting to overcome

2) Effort   b. The ratio of output work to input work

3) IMA   c. Not a simple machine: Can be used as a pulley wheel

4) Load   d. The grooved wheel of a pulley

5) AMA   e. The dot product of force and distance

6) Efficiency   f. Last recognized simple machine

7) Windlass   g. The force applied to a simple machine that gets multiplied

8) Inclined Plane   h. Not a simple machine: Toothed wheels connected by a belt

9) Gear   i. Two or more pulleys in blocks

10) Sprocket   j. The ratio of output force to input force

11) Block and Tackle   k. Type of wheel and axle using a cable and a crank

12) Deadeye   l. Ratio of input distance to output distance

13) Sheave   m. Not a simple machine: Toothed wheel

Part 2: Identification of Simple Machines

Directions: For each of the following devices, name one simple machine that is present within the device (1 point) and where it is found, if any (1 point). Name the class of any levers; "lever" alone will score no points. If the machine is wrong, you cannot earn the point for its location (EXCEPT: an incorrect class of lever loses one point for naming the machine but can still earn the point for location). There are many possible answers.

14) Bicycle

15) Stapler

16) Mousetrap

17) Pencil Sharpener

18) Violin and bow

19) Bicycle Pump

20) Human Arm

21) Grandfather Clock

22) Castle Drawbridge

Part 3: Free Response

23) Two physics students are holding opposite ends of a simple pulley. One has a mass of 65kg and is standing on a scale on the floor. The other has a mass of 55kg and is above the ground. If the 55kg student begins to climb up the pulley, will the scale read more, less, or the same weight? Why? (2 points)

24) When and why is IMA irrelevant? (3 points)

25) What is the unique advantage of a block and tackle system? (2 points)

26) In as much detail as possible, what is torque? (1 point per distinct detail, up to 4)

27) When was the inclined plane recognized as a simple machine? (1 points)

28) Who invented the first "vending machine"? How did it work? (2 points)

29) What was Archimedes's famous quotation about levers? (2 points)

Part 4: Calculations

30) Calculate the IMA of each of the following devices (1 point each)

a.   b.
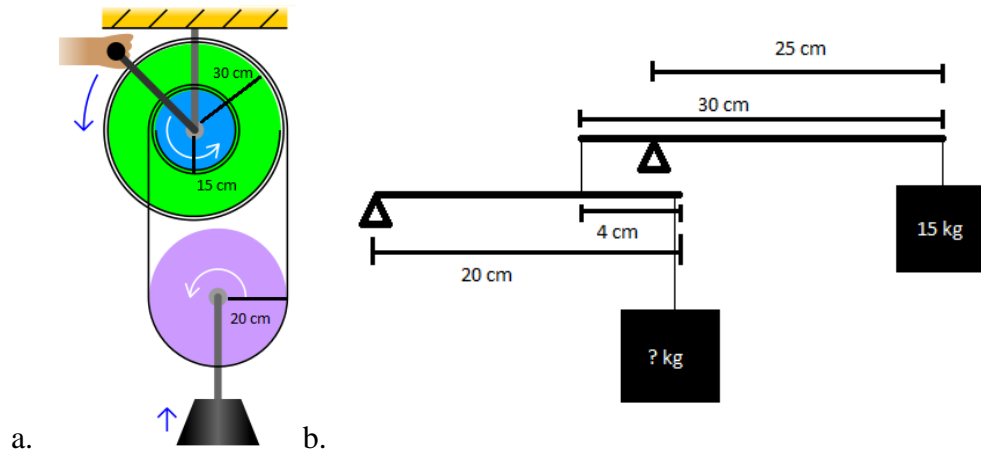
31) The top of a triple start screw has a radius of 0.50 cm. Its pitch is 1.0 mm. A student

turns the screw with a screwdriver with a handle radius of 2 cm and a head radius of 0.40

cm. What is the IMA of the system? (2 points)

32) What is the IMA of a symmetrical wedge with an angle of separation of $15°$? What is its

efficiency if its AMA is 1.4? (2 points)

33) Solid aluminum has a density of 2.70 g/cm^3. A uniform square aluminum bar has side

lengths of 1.00 cm and a beam length of 50.0 cm. A fulcrum is attached 10.0 cm from

one end. If a 20 g mass is placed 30.0 cm from the same end as the fulcrum, what volume

of aluminum could be used to balance the beam and where? (4 points)