**C - Machines C - Rickards Invitational Div. C - 12-05-2020**

Hello there! Welcome to the Rickards Invitational. You have 50 minutes to complete the following test, good luck!

Use $g = 9.81\ m/s^2$ for all questions and assume air resistance is negligible unless stated otherwise. Follow the instructions given in each question for rounding your answers. Good luck!

# SECTION I: CONCEPTUAL

**1. (1.00 pts)** True or False: A simple machine can reduce the amount of work necessary to complete a task.

○ True ◉ False

**2. (1.00 pts)** True or False: A Class 3 lever magnifies the input force.

○ True ◉ False

**3. (1.00 pts)** Which of the following is an example of a Class 3 lever?

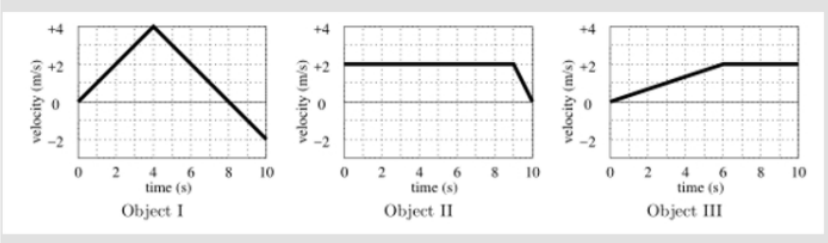
◉ A) Broom
○ B) Nutcracker
○ C) Door
○ D) Shovel

**4. (1.00 pts)** Which of the following is an example of a Class 1 lever?

○ A) Broom
○ B) Nutcracker
○ C) Door
◉ D) Shovel

**5. (1.00 pts)** Which of the following is an example of a Class 2 lever?

○ A) Broom
◉ B) Nutcracker
○ C) Door
○ D) Shovel




Rank the three objects (I, II, III) in increasing order by each of the following characteristics. If two objects have an equal value for the characteristic, put an equal sign. Otherwise, put < sign.

**6. (1.00 pts)** Distance traveled

**Expected Answer:** III < I < II

**7. (1.00 pts)** Displacement

**Expected Answer:** III = I < II

**8. (1.00 pts)** Average Acceleration

**Expected Answer:** I = II < III

**9. (1.00 pts)** Maximum speed

**Expected Answer:** II = III < I

**10. (1.00 pts)** True or False: In a wheel-and-axle system, the resistance force is usually exerted on the axle.

◉ True ○ False

**11. (2.00 pts)** Explain from a mechanical perspective why doorknobs are generally located near the edges of doors rather than in their centers.

**Expected Answer:** Longer moment arm means less force is necessary for the same torque, so door is easier to open.

**12. (1.00 pts)** Which of the following is a term for two or more gears working in tandem?

- A) Idler
- B) Transmission
- C) Worm Driver
- D) Miter Chain

**13. (1.00 pts)** Identify the gear:

**Expected Answer:** Miter Gear

**14. (1.00 pts)** Identify the gear:

**Expected Answer:** Bevel Gear

**15. (1.00 pts)** Identify the gear:

**Expected Answer:** Accept Double-Helical or Herringbone Gear.

**16. (1.00 pts)** Identify the gear:

**Expected Answer:** Rack and Pinion

**17. (1.00 pts)** Which type of gear has no load in the axial direction?

- A) Screw Gear
- B) Miter Gear
- C) Spur Gear
- D) Worm Gear

**18. (1.00 pts)** What is the speed ratio of a pair of miter gears?

- A) 1/2
- B) 1
- C) 2
- D) It depends on the twisting angle

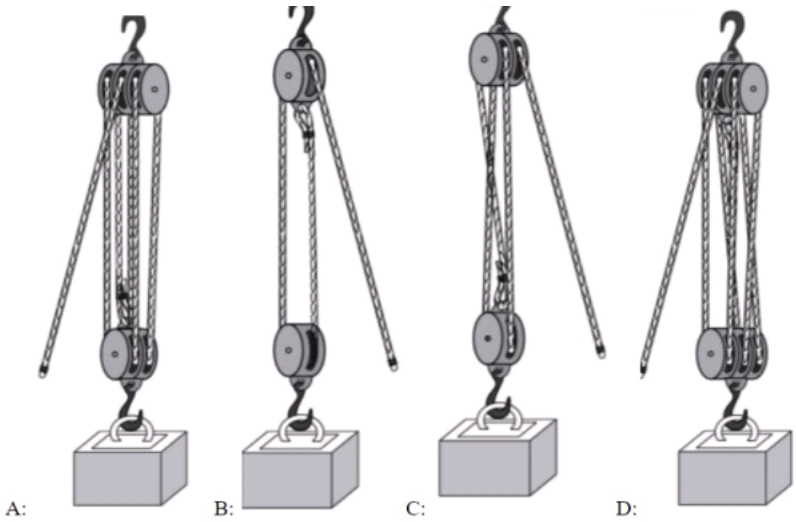
**19. (1.00 pts)** What is the twist angle of a screw gear?

- A) 0 degrees
- B) 45 degrees
- C) 90 degrees
- D) 180 degrees

**20. (1.00 pts)** What is the name for a spiral bevel gear with zero twisting angle?

**Expected Answer:** Zerol Bevel Gear (the L after "zero" is necessary!)

Consider the following 4 pulley systems:




**21. (1.00 pts)** What is the name of pulley system A?

Gyn Tackle

**22. (1.00 pts)** What is the name of pulley system B?

**Expected Answer:** Gun Tackle

**23. (1.00 pts)** What is the name of pulley system C?

**Expected Answer:** Luff Tackle

**24. (1.00 pts)** What is the name of pulley system D?

**Expected Answer:** Three-fold Purchase

**25. (1.00 pts)** If each of the 4 pulleys had the same input distance, order them by output distance from least to greatest. Separate the letters with commas and no spaces.

D,A,C,B

**26. (1.00 pts)** Which of the pulley systems has twice the IMA of one of the other pulley systems pictured?

- A) A
- B) B
- C) C
- D) D

**27. (1.00 pts)** What is the name of the pulley system whose IMA is equal to the average of the IMA's of pulley systems A and C?

**Expected Answer:** Two-fold Purchase or Double Tackle

**28. (1.00 pts)** Are the pulley systems each in rove-to-advantage or rove-to-disadvantage? Answer with Advantage or Disadvantage.

Disadvantage

**29. (2.00 pts)** Each pulley system is then switched to the alternate advantage form. Now answer question 26 again for these new systems. Answer with A, B, C, or D.

C

**30. (2.00 pts)** An object slides down a frictionless inclined plane. How does its acceleration change with time?

- A) Varies inversely with time
- B) Varies linearly with time
- C) Varies quadratically with time
- D) Does not change over time

**31. (1.00 pts)** An object slides down a frictionless inclined plane. How does its potential energy change with time?

- A) Varies inversely with time
- B) Varies linearly with time

- (●) C) Varies quadratically with time
- ( ) D) Does not change over time

**32. (1.00 pts)** Dylan pushes a block, moving it with constant speed across a horizontal floor. What is the minimum number of forces acting on the block during its motion?

- ( ) A) 1
- ( ) B) 2
- ( ) C) 3
- (●) D) 4

**33. (2.00 pts)** A tree in a lonely forest falls to the ground in a perfectly elastic collision. Why doesn't anyone hear it?

**Expected Answer:** A perfectly elastic collision releases no energy from the system, including in the form of sound waves.

**34. (2.00 pts)** What must happen to the tree from the previous question immediately after it hits the ground? (Assuming the ground does not move and the tree stays intact)

**Expected Answer:** The tree must rebound back to its original height, as all energy must be conserved

**35. (3.00 pts)**
Dylan swings a massless rope with a massive ball on the end in a horizontal circle above his head at constant speed. Assuming there is negligible air resistance, how does the powe he contributes to the system vary with respect to the length of the rope?

- ( ) A) Varies inversely with length
- ( ) B) Varies linearly with length
- ( ) C) Varies quadratically with length
- (●) D) Does not vary with length

## SECTION 2: SHORT ANSWER

**36. (1.00 pts)** If Bob lifts a 20N box up vertically by 5 meters, how much work did he do? Answer in J, but do not include the unit.

100

**37. (1.00 pts)**
A construction worker puts in 100 N of force into a machine, if the machine has an AMA of 2, how much Force would it output? Answer in N, but do not include the unit.

200

**38. (1.00 pts)** A machine has an IMA of 3, but when a Worker inputs 50 N of force into the machine, only 100 N of force is outputted. What is the AMA?

2

**39. (1.00 pts)** What is the efficiency of the Machine in the previous question? Answer as a percentage to the nearest whole number, but do not include the percentage sign.

67

**40. (1.00 pts)**
There's a 30 ft long lever with the fulcrum placed 10 feet from the left side. If there's a weight of 10 kg placed 20 ft to the right of the Fulcrum, what mass would you need to add 10 ft left of the fulcrum to ensure the lever is in equilibrium? Assume the weight of the lever itself is negligible. Answer in kg but do not include the unit.

20

**41. (1.00 pts)**
A frictionless ramp is used to transport a box of fruits onto a truck. The angle between the ramp and the ground is 60 degrees, if the horizontal distance from the point where the ramp touches the ground to where the ramp touched the truck is 6, what is the IMA of the ramp? Answer to 3 significant figures.

1.15

**42. (2.00 pts)**
From the previous question, if the box of fruits weighed 10 N, how much force would be needed to move the box of fruits up the ramp at constant speed? (Assume there's no friction) Answer in N to 3 significant figures, without the unit.

8.66

**43. (1.00 pts)** If the angle between a ramp and the ground is 30 degrees, what is the ramp's ideal mechanical advantage?

2

**44. (2.00 pts)** If the angle of the tip of a double wedge is 60 degrees, what is the wedge's ideal mechanical advantage? Answer to 3 significant figures.

0.866

**45. (2.00 pts)**
If the angle between the side and the base (not the point) of a double wedge is 75 degrees, what is the wedge's mechanical advantage? Answer to 3 significant figures.

1.87

**46. (2.00 pts)** If the angle of the tip of the single wedge is 5 degrees, what is the mechanical advantage of the wedge? Answer to 3 significant figures.

11.5

**47. (3.00 pts)**
A wheel and axle machine is used to lower a bucket into a well. The wheel is rotated by the user, causing the rope wrapped around the axle to either lower or raise. If you knov that the total length of the rope is 10 meters and that it's fully extended, the radius of the wheel is 50 cm, and the mechanical advantage is 25 (with effort force on the wheel), how many full rotations of the wheel (whole number) are needed to completely retract the rope?

80

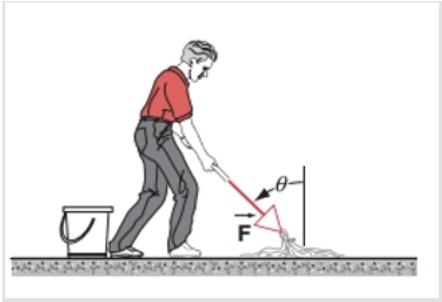
**48. (3.00 pts)**
A frictionless wheel and axle is used to lift a 13 kg load. If the load is tied to the 40 cm diameter inner wheel, what force must be applied to the 1 m radius outer wheel to lift the load? Answer in N to 3 significant figures, without the unit.

25.5

**49. (4.00 pts)**
A catapult launches a ball upward from ground height. It flies past a window in a time of 0.5 seconds. The height of the window is 1.7 meters. How high above the top of the window does the ball rise? Answer in m to 3 significant figures, without the unit.

0.0458

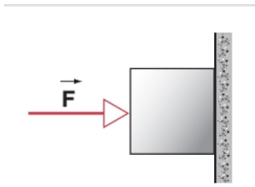
**50. (4.00 pts)**




As shown above, a mop makes an angle of theta with the vertical direction. The coefficient of static friction between the mop and the floor is 0.8. Find the minimum angle fron the vertical for it to be possible to slide the mop across the floor by applying force along the direction of the handle. Neglect the effect of the mop's weight on its normal force. Answer in degrees to 3 significant figures, without the unit

38.7

**51. (2.00 pts)**



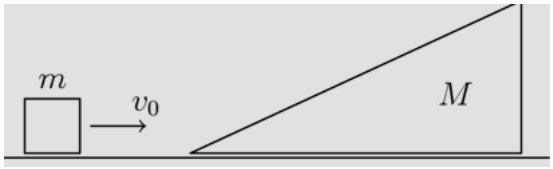

A 25 N force holds a block of mass 2 kg against a wall at rest, as shown in the figure above. What is the minimum coefficient of static friction between the block and the wall? Answer to 3 significant figures.

0.785

**52. (5.00 pts)**
A block is released from rest at the top of a smooth ramp (coefficient of kinetic friction 0.1), a height of 3 m above the base of the ramp. Once it reaches the bottom of the ramp, it slides across 2 m of rougher ground (coefficient of kinetic friction 0.2). Then, it reaches an even rougher ramp (coefficient of kinetic friction 0.3) and slides up to a maximum height of h. If the first ramp makes an angle of 30 degrees with the horizontal and the second makes an angle of 15 degrees, find h. Answer in m to 3 significant figures, without the unit.

0.981

**53. (5.00 pts)**



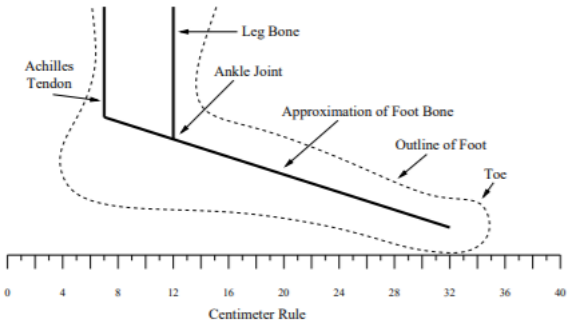

A block of mass 2 kg is sliding along a surface at initial velocity of 5 m/s. It then moves smoothly onto an inclined plane of mass 15 kg. The inclined plane is free to move on the surface. The block slides up the slope some distance, then turns around and slides back down, moving smoothly back onto the horizontal. Assuming that everything moves without friction, find the speed of the small block after it leaves the slope. Answer in m/s to 3 significant figures, without the unit. (Hint: Consider this situation as an elastic collision)

3.83

**54. (7.00 pts)**
A sphere has moment of inertia I = (13/5)mr^2 about an axis tangent to its surface. The sphere is released from the top of an inclined plane with IMA = 3, and rolls without slipping. How long does it take to reach the bottom? The sphere's radius is 0.1 m, and it travels through 20 rotations before reaching the bottom. Answer in seconds to 3 significant figures, without the unit. (Hint: Consider torque about the contact point)

4.47

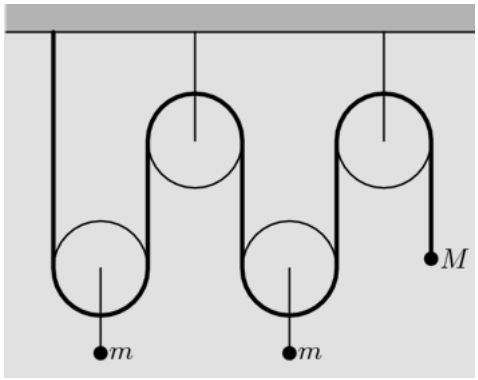
**55. (3.00 pts)**




Consider the simplified model of a foot shown above. Find the tension in the Achilles Tendon if a 60-kg person with this foot balances their entire weight on their toe without moving. Answer to 3 significant figures in N, without the unit.

2350

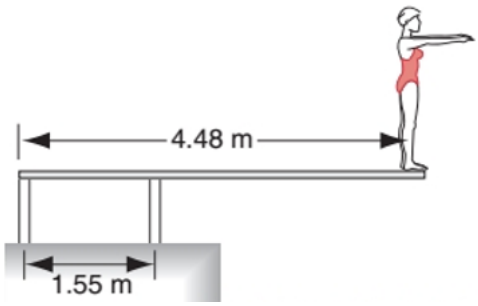
**56. (2.00 pts)**




Find the ratio of M/m for which the pulley system is at rest. Assume all pulleys and strings are massless. Answer to 3 significant figures.

0.500

**57. (1.00 pts)**




The diver in the above figure has a mass of 70 kg and the diving board has a mass of 300 kg. Does the leftmost support of the diving board experience tension or compression?

**Expected Answer:** tension

**58. (3.00 pts)** Using the values from the previous question, find the force in the leftmost support of the diving board. Answer in N to 2 significant figures, without the unit.

2600

**59. (3.00 pts)**

Dylan is trying to move a box with weight 10 N across a floor on which it has coefficients of static and kinetic friction of 0.5. However, he can only ever push with a force of magnitude 4.5 N. Can Dylan move the box? Explain why or why not. (Assume that the force of the push must always coincide with the box's center of mass, so there is no torque)

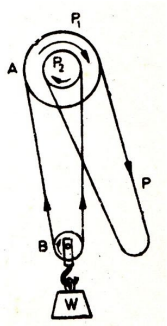
**Expected Answer:** Yes - even though the original force of static friction (10 * 0.5 = 5) is less than the amount by which Dylan can push, by angling the force vector he can decrease the normal force on the box, thus decreasing the maximum static friction force and allowing the horizontal component of his force to overcome it.

**60. (5.00 pts)**
Dylan goes to the gym and gets ripped, allowing him to push the box from the previous question with a force of maximum magnitude 5.5 N. Assuming that Dylan once again must push along the box's center of mass, what is the maximum acceleration he can provide the box? Answer in m/s^2 to 3 significant figures, without the unit. (Hint: The amplitude of the function asin(x) + bcos(x) is sqrt(a^2 + b^2))

1.13

## SECTION 3: FRQ

The radius of $P_1$ is 250 mm and the radius of $P_2$ is 75 mm, the mass W is 100 kg, and the efficiency of the differential pulley is 80%.




a. (3 points) What is the ratio of input velocity to output velocity? Answer to 3 significant figures.

b. (1 point) If Vishnav was pulling on P at a velocity of 10 m/s, at what velocity would the load be moving? Answer in m/s to 2 significant figures, without the unit.

c. (1 point) What is the AMA of the pulley system? Answer to 3 significant figures.

d. (1 point) What is the load force on the machine? Answer in N to 3 significant figures, without the unit.

e. (2 points) In order to lift the W, at least how much force needs to be applied to P? Answer in N to 3 significant figures, without the unit.

**61. (3.00 pts)** a)

2.86

**62. (1.00 pts)** b)

3.5

**63. (1.00 pts)** c)

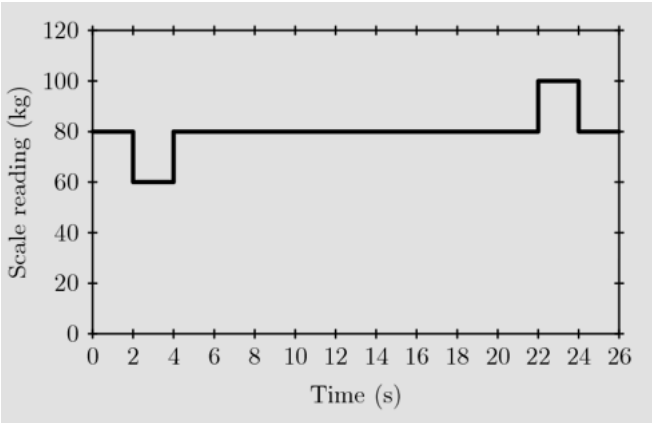
2.29

**64. (1.00 pts)** d)

981

**65. (2.00 pts)** e)

429




Dylan was interested in how artificial gravity would affect a scale reading, so he stood on a bathroom scale as an elevator traveled from the top of a building to the bottom, producing the above graph o the scale reading as a function of time.

a. (2 points) In what range of time was the elevator at maximum downward velocity? Explain.

b. (4 points) What is the magnitude of the maximum acceleration of the elevator? Answer to 3 significant figures in m/s^2, without the unit.

c. (4 points) How tall is the building? Answer in m to 3 significant figures, without the unit.

The elevator is attached via wheel-and-axle to a counterweight that rises as the elevator falls.

d. (1 point) The counterweight rises at a faster speed than the elevator falls. Which of the two components is attached to the axle of the system? Answer either “Counterweight” or “Elevator”.

e. (3 points) If, after the initial acceleration, the counterweight rises at a constant speed of 8 m/s, what is the IMA of the system (assuming the counterweight is the load)? Answer to 3 significant figures.

f. (5 points) Now assume that the system has 80% efficiency. If the mass of the elevator, scale, and Dylan is altogether 1600 kg, what must the mass of the counterweight be, assuming the system moves at constant speed? Answer in kg to 3 significant figures, without the unit.

**66. (2.00 pts)** a)

**Expected Answer:** From 4 to 22s. The decreased scale reading at the beginning indicates that the scale is experiencing a lower force from the person on it, meaning the experienced gravity is less than usual - in other words, the elevator is accelerating downward. However, once the scale reading stabilizes, gravity has returned to normal in an inertial reference frame at constant maximum velocity.

**67. (4.00 pts)** b)

2.45

**68. (4.00 pts)** c)

98.1

**69. (1.00 pts)** d)

Elevator

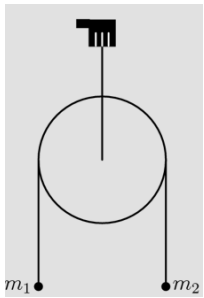
**70. (3.00 pts)** e)

0.613

**71. (5.00 pts)** f)

785

**72. (9.00 pts)**




The frictionless, massless pulley above has one mass on either side - m1 and m2.

a. (2 points) Find an expression for the acceleration of the system in terms of m1 and m2.

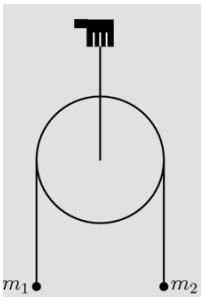
b. (3 points) Find an expression for the tension in the rope in terms of m1 and m2.

Vishnav is holding up this pulley with his hand at rest and his eyes closed such that he believes he is supporting a single mass M. Find M in each of the following cases. (Assume that if the masses are imbalance, they have not yet started to move on the pulley)

c. (4 points) Now find an expression for this "effective mass" in terms of m1 and m2.

**Expected Answer:** a) g(m1 - m2)/(m1 + m2) b g(2m1m2)/(m1 + m2) c) (4m1m2)/(m1 + m2)

**73. (14.00 pts)**




Each of m1 and m2 is replaced by another frictionless, massless pulley. One of the two "lower-level" pulley has masses m3 and m4 attached to it, while the other has masses m5 and m6 attached to it.

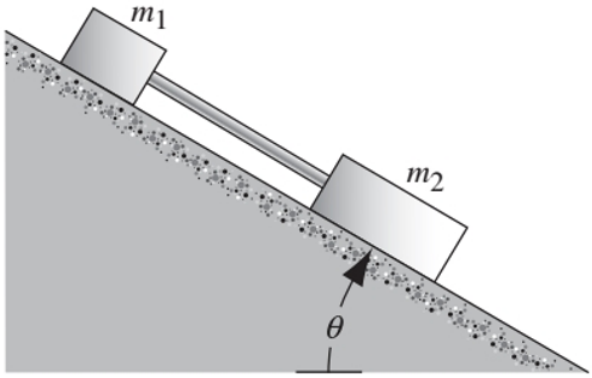
d. (5 points) Find the effective mass in terms of m3, m4, m5, and m6. (Hint: Express as a reciprocal of a sum of reciprocals)

The process of adding pulleys to each level is repeated until there are 1023 pulleys in the system. All but 1 of the lower-level masses are equal to 10 kg. The one outlier has mass 100 kg.

e. (6 points) Find the effective mass of the whole system. Answer in kg to the nearest whole number, without the unit.

f. (3 points) If the input force of the system is the amount of force Vishnav needs to hold the whole thing up, and the output force is the sum of the weights of all the masses, what is the mechanica advantage of the system for this particular configuration of masses? Answer to 3 significant figures.

**Expected Answer:** d) 16/(1/m3 + 1/m4 + 1/m5 + 1/m6) (or any equivalent form) e) 10249 f) 0.992




Two blocks with masses m1 = 1.8 kg and m2 = 3.1 kg, attached by a massless rod parallel to the inclined plane on which they both slide, travel down the plane with m1 trailing m2 as shown in the figure above. The angle of the incline is 34 degrees above the horizontal, the coefficient of kinetic friction between m1 and the incline is 0.25, and the corresponding coefficient for m2 is 0.13.

a. (4 points) Compute the common acceleration of the two objects. Answer in m/s^2 to 3 significant figures, without the unit.

b. (4 points) Find the tension in the rod. Answer in N to 3 significant figures, without the unit.

c. (4 points) How would the answers to parts a and b change if the positions of the two blocks were reversed? (e.g. m2 trails m1)

**74. (4.00 pts)** a)

4.07

**75. (4.00 pts)** b)

1.11

**76. (4.00 pts)** c)

**Expected Answer:** The acceleration would not change. The magnitude of the tension force would stay the same but its direction would be reversed - compression rather than tension, pushing out on the blocks rather than pulling in.

A ballistic pendulum consists of a wooden block attached to a rope of length 0.5 m. It is mounted such that the block is 0.7 m above the ground when the pendulum is at rest. The block has mass 10 kg and a 50 g bullet is fired into it by a rather violent physicist. Assume that the pendulum experiences no friction and the collision is perfectly inelastic

a. (3 points) The pendulum rises to a maximum angle of 20 degrees from the vertical. Find its speed immediately after being hit. Answer in m/s to 3 significant figures, without the unit.

b. (3 points) Find the initial speed of the bullet. Answer in m/s to 3 significant figures, without the unit.

Now the physicist wants to find the efficiency of the pendulum - in other words, the percent of the pendulum's energy that is dissipated after each period. (assume this percent is constant for all periods)

c. (6 points) After the pendulum is hit by the bullet, the physicist lets it swing back and forth 10 times (10 periods). Then he cuts the pendulum's rope at the bottom of its arc and lets the block fall to the ground. He finds that the block (still with the bullet lodged in it) travels a horizontal distance of 0.1 m before hitting the ground. What is the pendulum's efficiency? (as defined in the earlier statement). Answer as a percentage to 2 significant figures, without the percent sign.

d. (4 points) The physicist's reaction speed is a bit slow, and he ends up cutting the pendulum's rope exactly when it reaches its maximum angle and has no tangential velocity. How long does it take the block to fall to the ground? The pendulum has the same efficiency as it did in the previous problem. Answer in s to 3 significant figures, without a unit.

**77. (3.00 pts)** a)

0.769

**78. (3.00 pts)** b)

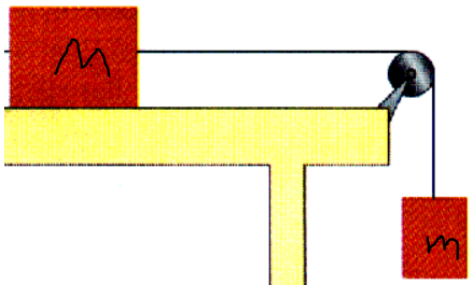
155

**79. (6.00 pts)** c)

81

**80. (4.00 pts)** d)

2.43




Consider the above figure of a pulley system on a table, with massless pulley. Block M has mass of 10 kg, and coefficients of static and kinetic friction of 0.3 with the table surface.

a. (2 points) What is the maximum mass m for which the system remains at rest? Answer in kg to the nearest whole number, without the unit.

b. (3 points) If m = 8 kg, find the acceleration of the system. Answer in m/s^2 to 3 significant figures, without a unit.

c. (4 points) With m = 10 kg, the system accelerates for 1.5 s before block M falls off the table. How many rotations does the pulley, with a radius of 0.1 m, complete in thi time? Answer to 3 significant figures.

Now let the pulley itself be modeled as a cylinder with mass 5 kg. The rope rolls along the pulley wheel without slipping.

d. (8 points) If m = 8 kg, find the acceleration of the system. Answer in m/s^2 to 3 significant figures, without the unit. (Hint: For the pulley, I = ½ mr^2)

e. (3 points) What is the maximum mass m for which the system remains at rest? Answer in kg to the nearest whole number, without the unit.

**81. (2.00 pts)** a)

3

**82. (3.00 pts)** b)

2.73

**83. (4.00 pts)** c)

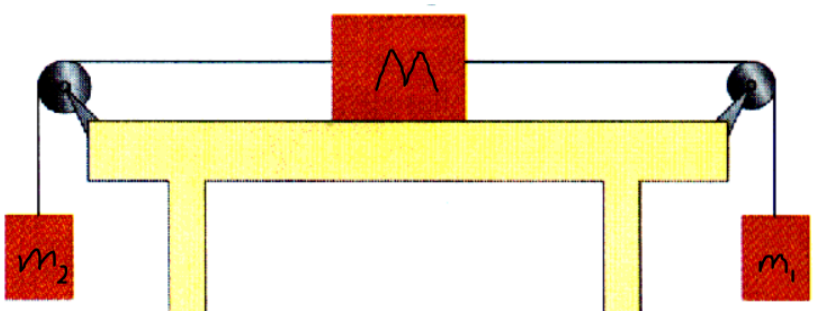
6.15

**84. (8.00 pts)** d)

2.39

**85. (3.00 pts)** e)

3




Now consider the modification to the system shown above, where a third block of mass m2 is attached to the other side of mass M. The coefficients of friction are still the same, and the pulleys are now massless once again.

a. (3 points) If m2 = 8 kg and M = 10 kg, find the minimum value of m1 for which the system accelerates in the rightward direction. Answer in kg to the nearest whole number, without the unit.

b. (4 points) If m2 = 6 kg, M = 10 kg, and m1 = 11 kg, find the tension in the string connected to m2. Answer in N to 3 significant figures, without the unit.

c. (3 points) Find the acceleration of the system for the conditions in part g. Answer in m/s^2 to 3 significant figures, without the unit.

**86. (3.00 pts)** a)

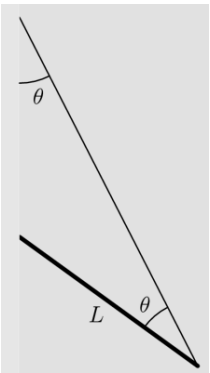
11

**87. (4.00 pts)** b)

63.2

**88. (3.00 pts)** c)

0.727




A uniform beam is suspended in static equilibrium by a hinge that attaches it to a vertical wall, and a rope at its other end that attaches it to the same wall, as shown in the figure above. The mass of the beam is 30 kg, it is 3 m long, and the angle theta is equal to 22 degrees.

a. (4 points) What is the tension in the rope? Answer in N to 3 significant figures, without the unit.

b. (6 points) What is the magnitude of the force that the hinge exerts upon the beam? Answer in N to the nearest whole number, without the unit.

c. (6 points) The rope is cut. At what speed is the beam's center of mass moving when it hits the wall? Answer in m/s to 3 significant figures, without the unit. (Hint: The Moment of Inertia of a rod of length L about an axis through one of its ends is I = ⅓ * ML^2)

**89. (4.00 pts)** a)

273

**90. (6.00 pts)** b)

110

**91. (6.00 pts)** c)

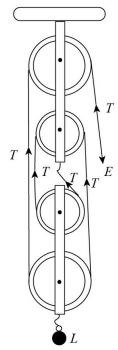
2.49

## SECTION 4: COMPOUND MACHINE QUESTIONS

**92. (2.00 pts)**
A screwdriver is being used to drill a screw into wood. The radius of the handle of the screwdriver is 10 cm and the radius of the shank is 2 cm. The radius of the screw head is 5 cm, and the screw's pitch is 1 cm. What is this compound machine's IMA? Answer to 3 significant figures.

157

Use the following diagram for questions 93-99. The efficiency of the machine is 40% and the load L is 10 kg.




**93. (3.00 pts)** If Dylan pulled E down 60 cm, what distance would the load move? Answer in cm to the nearest whole number, without the unit.

15

**94. (4.00 pts)** What force must be provided at point E to support the load? Answer in N to 3 significant figures, without the unit.

61.3

The 10 kg load is removed and placed at the center of a frictionless horizontal wooden plank of length 2.2 m. One end of the plank is attached to point E, while the other is attached to a frictionless hinge, forming a lever with the purpose of raising the 10 kg load.

**95. (1.00 pts)** What class of lever is being used here? (Answer 1, 2, or 3)

2

**96. (3.00 pts)** What new mass should be hung from point L to keep the system in static equilibrium? Answer in kg to the nearest whole number, without the unit.

32

**97. (2.00 pts)** Dylan pulls point L down 30 cm. What distance does the 10 kg load raise on the plank? Answer in cm to the nearest whole number, without the unit.

60

**98. (5.00 pts)**
Dylan holds point L in the position from the previous question, causing the plank to stay at an angle. How long does it take for the load to slide off the plank? Answer in s to 3 significant figures, without the unit.

0.641

**99. (5.00 pts)**
After the block has been sliding for 0.2 s, Dylan moves point L up, causing the plank to return to horizontal. What is the new AMA of the compound machine? Answer to 3 significant figures.

1.38

**100. (3.00 pts)**
Gears A, B, C, and D have 10, 30, 40, 80 teeth respectfully. If driver gear A is meshed with Gear B, Gear B is connected to Gear C on a shaft, and Gear C is meshed with Gear D, what is the mechanical advantage of this gear train? Answer to the nearest whole number.

6

**101. (1.00 pts)** What is the IMA of a screw with a diameter of 5 mm and a pitch of 0.5 mm? Answer to 3 significant figures.

31.4

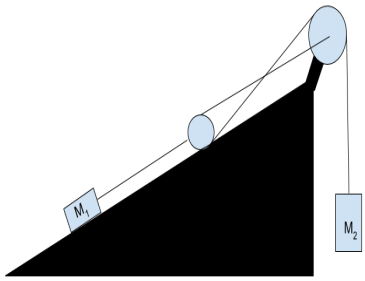
**102. (3.00 pts)**
Vishnav has a screw that he's screwing into a piece of wood, given that the MA of the screw is 4 and the radius of the head is 2 cm, if Vishnav rotates the head of the screw twice, how deep into the wood will the screw go? Answer in cm to 3 significant figures.

6.28

**103. (1.00 pts)** True or False: The efficiency of a screw is relatively high.

○ True ◉ False

**104. (4.00 pts)**




The angle of the ramp is 40 degrees, $M_1$ has a mass of 5 kg and $M_2$ also has a mass of 10 kg. What is the acceleration of this system? Answer in m/s^2 to 3 significant figures, without the unit.

6.59

Congratulations on finishing! Don't forget to check your answers. Once you do, feel free to submit. Good luck on your other events!