

ENGR 122 EXAM 1 Name: _____

Closed book, closed notes.

Honor Statement: On my honor, I promise that I have not received any outside assistance on this exam (I didn't look at another student's paper, I didn't view any unauthorized written materials, I didn't talk or listen to another student). I also promise not to discuss the exam with students in other sections until after all sections have taken the exam.

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1. (3 points) Fill in the missing Steps in the IDEO design process shown below.

1. Understand
2. _____
3. Visualize
4. _____
5. _____

2. (2 points) The 10 Faces of Innovation can be divided into 3 main groups; fill in the missing two below.

1. Organizing Personas
2. _____
3. _____

3. (2 points) There are three Organizing Personas, fill in the missing two below.

1. The Hurdler
2. _____
3. _____

4. (2 points) The PING sensor emits a(n) _____ burst in order to measure the distance between the sensor and an object.

5. (2 points) The effective range of the PING sensor is 0.8 inches to _____ inches.

6. (2 points) If you wanted to measure the degree to which an object was tilted from horizontal, the best sensor to use would be a(n) _____.

7. (2 points) The abbreviation RFID stands for _____.

8. (2 point) If you want to bend a sheet of metal like we did in class, you would use a _____.

9. (2 point) If you wanted to cut a sheet of metal like we did in class, you would use a _____.

10. (2 point) The image below shows a collection of _____.



11. (2 point) In order to collect your ideas in one diagram, we discussed drawing a _____.

12. (2 point) In order to organize concepts in one diagram, we discussed drawing a _____.

13. (3 points) In order to fully define a force, you need 3 pieces of information, these are:

14. (2 points) The forces that make up a concurrent force system in static equilibrium must sum to zero. What must also be true if the force system can be classified as a concurrent force system?

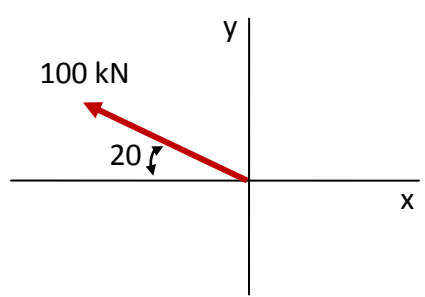
15. (2 points) The equation, $\sum M_A = 0$, means that the body is not _____ about point A.

16. (2 points) The equations of equilibrium for a 2-D concurrent force system are: (write them)

17. (1 point) If a gear ratio causes a gear to spin at a higher RPM, then the torque transmitted by that gear (INCREASES or DECREASES) – circle the correct answer.

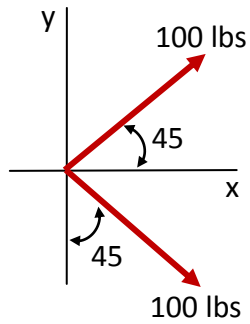
18. (5 points) The y-component of the force depicted below is closest to . . .

- a. 9.8 kN
- b. 26.3 kN
- c. -26.3 kN
- d. 34.2 kN
- e. -34.2 kN
- f. 41.8 kN



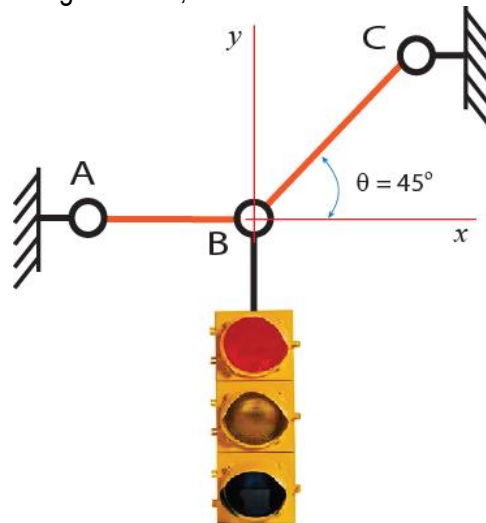
19. (5 points) The resultant of the system of two forces shown below is closest to . . .

- a. 70 lbs
- b. 92 lbs
- c. 112 lbs
- d. 141 lbs
- e. 200 lbs



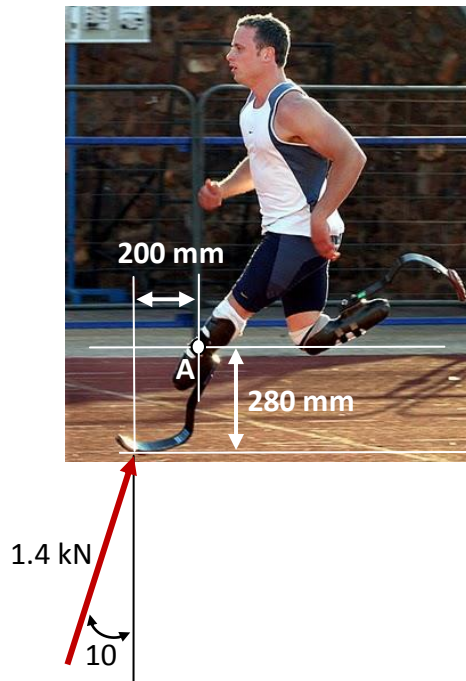
20. (5 points) If the traffic light weighs 80 lbs, then the tension in cable BC is closest to . . .

- a. 60 lbs
- b. 83 lbs
- c. 93 lbs
- d. 103 lbs
- e. 113 lbs



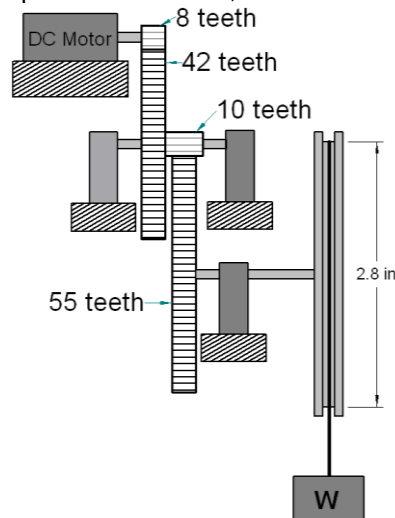
21. (5 points) A runner with prosthetic legs experiences a 1.4 kN force at a 10 degree angle from vertical when his foot strikes the track. The net moment produced by the 1.4 kN force about point A (the center of the attachment between the runner and the prosthetic) is closest to . . .

- a. 0.21 kN-m
- b. 0.29 kN-m
- c. 0.35 kN-m
- d. 0.51 kN-m
- e. 2.71 kN-m



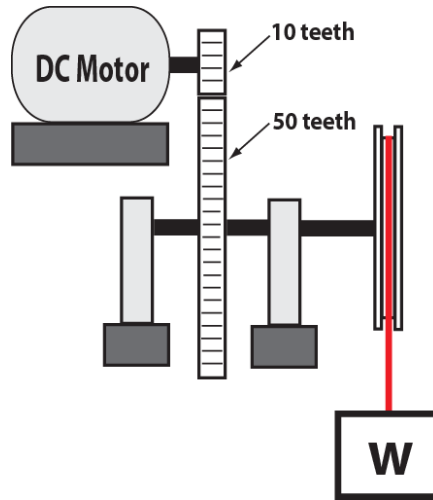
22. (5 points) If the DC motor spins at 3600 RPM, then the rate of rotation of the gear with 42 teeth is closest to . .

- a. 368 RPM
- b. 420 RPM
- c. 686 RPM
- d. 1290 RPM
- e. 9080 RPM



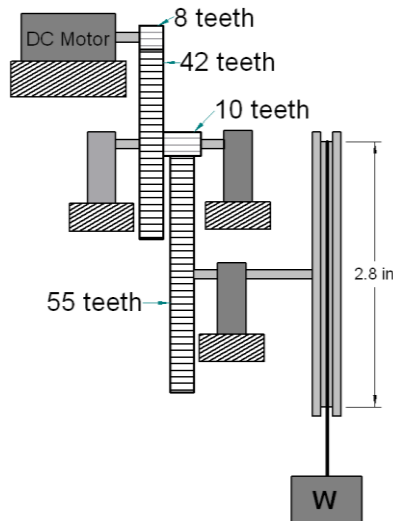
23. (5 points) The weight W of 100 Newtons moves upward at 2 meters per second as the cord to which it is attached winds around the 15 inch diameter pulley. If the efficiency of the motor / gearbox system is 70%, then the current that the 24V DC motor draws is closest to . . .

- a. 7.2 A
- b. 11.9 A
- c. 14.1 A
- d. 19.3 A
- e. 29.1 A
- f. 39.1 A



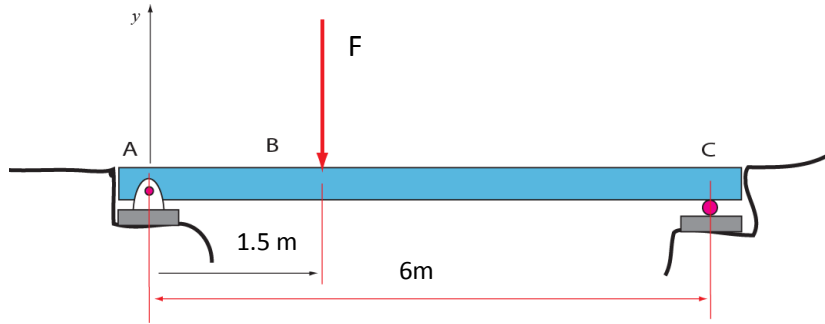
24. (5 points) The DC motor outputs a torque of 5 in-lbs while rotating at 5000 RPM. The torque transmitted to the pulley which lifts the weight W is closest to . . .

- a. 77 in-lbs
- b. 84 in-lbs
- c. 91 in-lbs
- d. 122 in-lbs
- e. 134 in-lbs
- f. 144 in-lbs



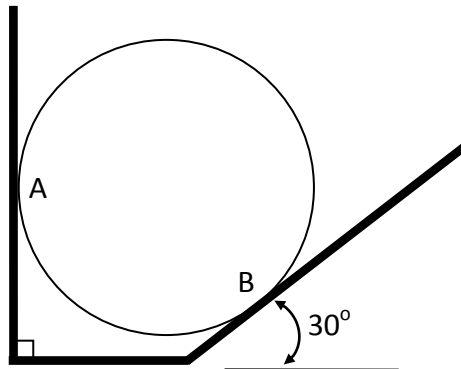
25. (5 points) If the reaction at point C is 50 kN, then the force F applied at B is closest to . . .

- a. 50 kN
- b. 180 kN
- c. 200 kN
- d. 210 kN
- e. 290 kN



26. (5 points) Assume frictionless contact at points A and B for the problem below. If the circular barrel weighs 100 lbs, then the force applied at point A is closest to . . .

- a. 50 lbs
- b. 57.7 lbs
- c. 82.8 lbs
- d. 91.8 lbs
- e. 115 lbs



Computer Portion: Allowed materials include calculator and computer, pen or pencil.

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_____signature

Please raise your hand after finishing each problem.

1. Solve the following equations using Mathcad. Note that this equation has two roots; you will get full credit for using Mathcad to find either of the roots. **You must utilize a solve block in your solution.**

$$\begin{aligned}2x^2 + 3y^2 &= 9 \\ 2x - y &= 1\end{aligned}$$

(5 points) The equations are correctly entered into Mathcad in a way that "should" work.

(5 points) The answers are correct.

2. Consider the following function:

$$y(x) = 4x + 20$$

$$z(x) = 2x^2 + 3x + 1$$

Enter these functions into Mathcad with x ranging from -5 to 5 in increments of 0.1.

(3 points) The functions are correctly entered.

(3 points) The range variable is correctly entered.

(4 points) The two curves for $y(x)$ and $z(x)$ are plotted on the same plot.