

MECHANICS OF SOLIDS
TUTORIAL 1 – Free Body Diagrams

***** In all of the following, do not draw 'the inertial forces'. *****

*1. Draw the free body diagram of the following components from the given picture.

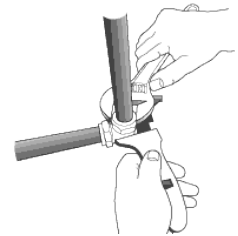
- a) back wheel
- b) front wheel
- c) pedal and gear assembly (chain not included)
- d) chain alone



*2. The picture shows that a person trying to break a piece of chalk. Draw the free body diagram of the chalk alone.



3. Draw the free body diagram of the spanner which is in the right hand of the holder



4. Draw the free body diagram of the pen alone.



5. Draw the free body diagram of the arm of the crane if there is load acting in the hook shown by arrow.



6. Draw the free body diagram of the stapler shown in the picture.

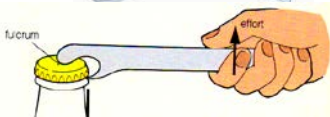
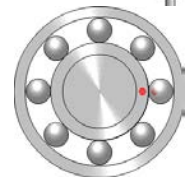


*7. Water is flowing through the bend pipe shown in the picture with flow direction by arrows. Draw the free body diagram of the pipe.



*8. Draw the free body diagram of the door of the refrigerator.

9. Draw the free body diagram of the casing alone for the roller bearing shown in figure.



10. Draw the free body diagram of the opener given in the figure.

*11. (a) Draw the free body diagram of the pair of scissors
 (b) Draw the free body one arm of the pair of scissors.



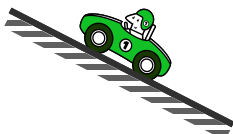
*12. Draw the free body of the upper part of the balloon membrane alone (leave out the air) cut by the dotted line.



13. Draw the free body diagram of the tree branch alone demarcated by the polygonal domain drawn.

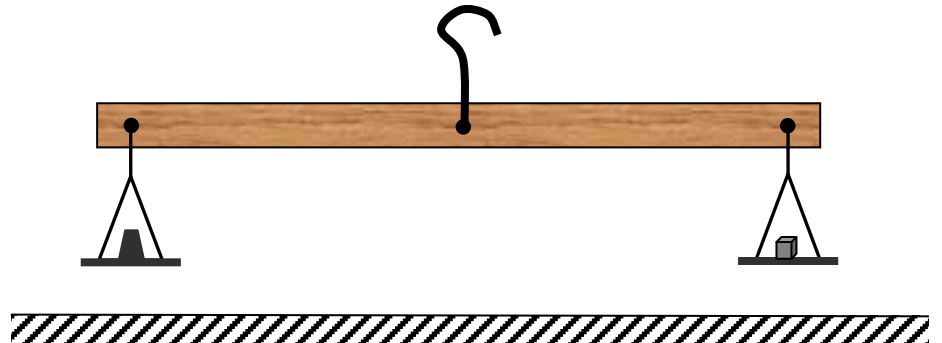


14. The green colored car is parked on an incline as shown. Draw the free body diagram of the car.



*15. A person takes a bicycle tube, in a standing posture, puts one side of the loop under the foot and pulls the other side with his/her hand with a force F so that the loop stretches vertically along the front of the person. Draw the free body diagram of the entire person in that loop stretched position.

16. A weighing balance is made as shown. It consists of a rod, hung at the center of gravity of rod by a hinged link and two pans one on each side hung at points at equal distance from the center (See Figure below). Spot the mistake in the design and correct it.



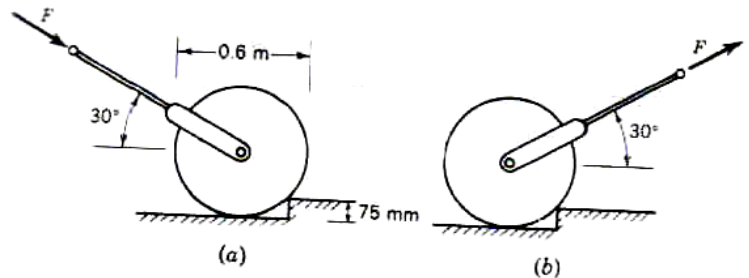
17. Why do they generally have small axles for wheels?

18. I need to preserve a rubber ball on which an art work is painted. Suggest a method of preserving it.

19. Many times it is a problem putting the main stand for a scooter. Any ideas?

20. If I consider a flexible body, I need to consider an infinite system of particles. For each particle to be in equilibrium, I will end up with infinite number of equations! How do I tackle this situation?

21. Compare the forces F required to just start the 900-N lawn roller over a 75 mm step when (a) the roller is pushed and (b) the roller is pulled.



22. A window air conditioning unit is supported by a rod as shown. For what angle θ will be required cost of the rod be a minimum?

