

Name: \_\_\_\_\_

Group members: \_\_\_\_\_

## TAM 210/211 - Worksheet 10

### Distributing Household Supplies on a Shelf

#### Introduction

Bradley owns a small store that sells household supplies. He planned to redecorate the store this year by installing a new shelving system that can help him better display the household supplies. For this purpose, Bradley hired a shelving company that can design a shelving system for his store.

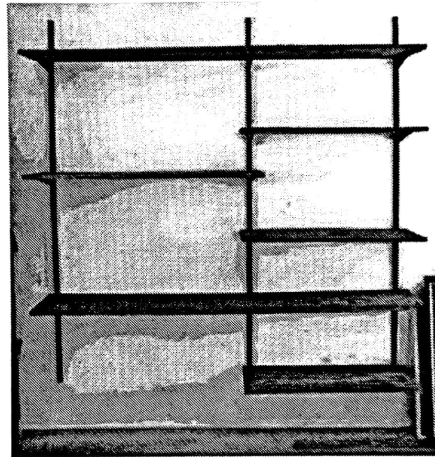


Figure 1: Shelves

#### The Problem

While installing the shelving system in Bradley's store, Bradley told one of the shelf engineers that he wants to display three books and a radio on one of the installed shelves. Bradley asked the engineer for his recommendations regarding the distribution of these supplies on the shelf so that it does not bend or break.

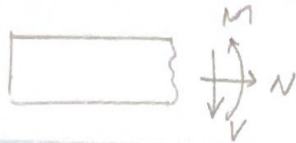
#### Your Task

As a team, your job is to use the **Supplementary Materials** to perform calculations that can help you come up with one recommended distribution and one prohibited distribution of the three books and the radio on the shelf in Bradley's store.

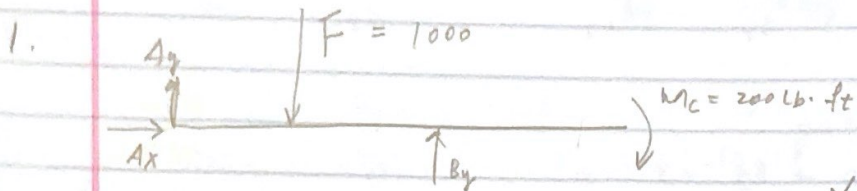
You also need to be able to explain why you recommended one distribution and prohibited the other one.

Shear bending moment

W11



1. Find support reactions
2. Split into sections



$$A_x = 0$$

$$\sum F_y = A_y + B_y - F = 0$$

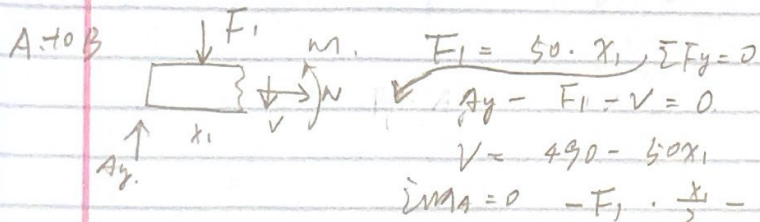
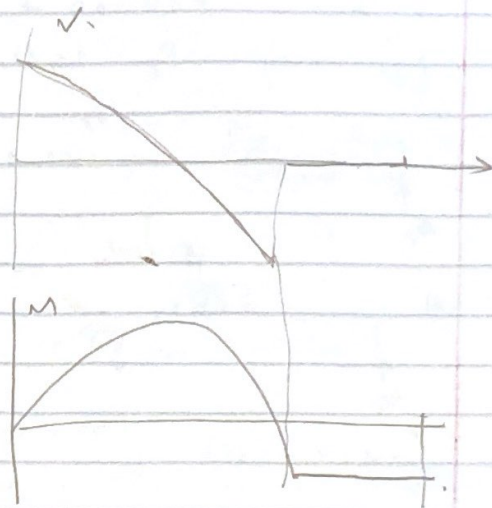
$$A_y + B_y = 1000$$

$$\sum M_A = 0$$

$$-1000 \cdot 10 + B_y \cdot 20 - 200 = 0$$

$$B_y = 510 \text{ lb}$$

$$A_y = 490 \text{ lb}$$



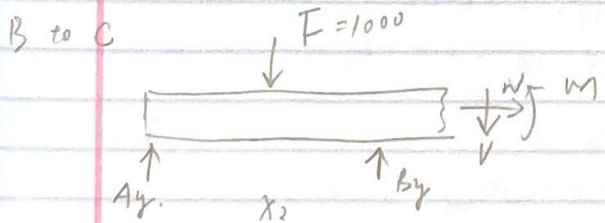
$$F_1 = 50 \cdot x_1, \quad \sum F_y = 0$$

$$A_y - F_1 - V = 0$$

$$V = 490 - 50x_1 \quad (0 \leq x_1 \leq 20)$$

$$\sum M_A = 0 \quad -F_1 \cdot \frac{x_1}{2} - V x_1 + M = 0$$

$$M = 50x_1 \cdot \frac{x_1}{2} + (490 - 50x_1)x_1$$



$$\sum F_y = 0$$

$$A_y + B_y - 1000 - V = 0$$

$$V = 0$$





$$\sum M_A = 0$$

$$-1000 \cdot 10 + 510 \cdot 20 + M = 0$$

$$M = -200$$

$$20 \leq x \leq 30$$

## Supplementary Materials

Household Supply	Picture	Weight (N)	Width (m)	Height (m)
Book 1		4	0.04	0.10
Book 2		12	0.06	0.16
Book 3		16	0.08	0.20
Radio		30	0.30	0.10

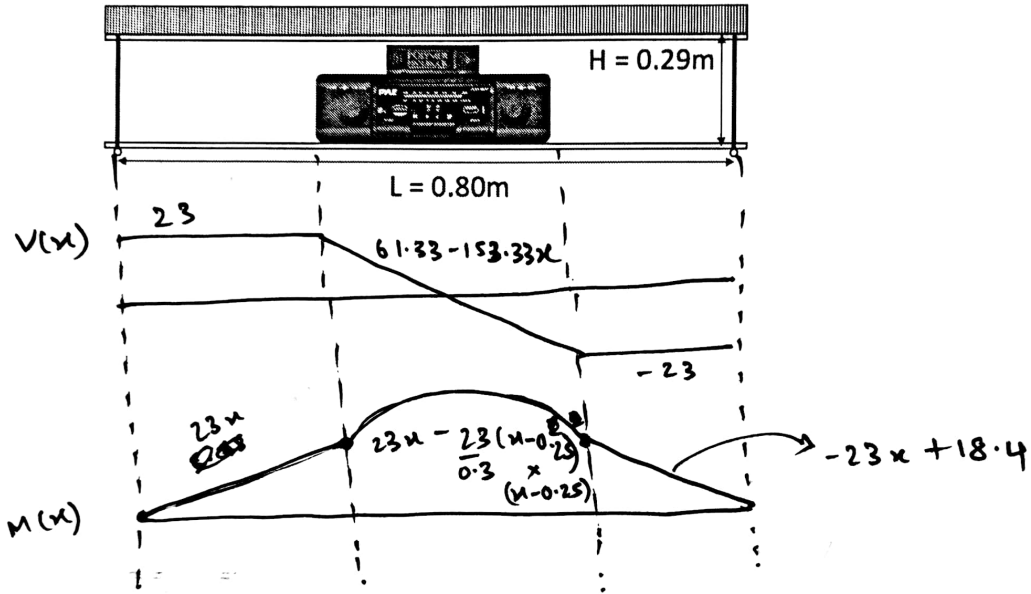
### General information about the shelf

Maximum Internal Force	50 N
Maximum Internal Moment	15 N·m
<p>In case your team decided to stack the objects on top of each other, you may only stack smaller objects on top of bigger ones</p>	

## Preliminary Case Studies

For the two sample arrangements below with Book 3 and the radio on the shelf, draw the corresponding free body, shear force, and bending moment diagrams and determine whether the arrangement is within maximum loading limits (force and moment). Remember to treat all objects as distributed loadings on the shelf. Assume the shelf is supported by rollers on both ends.

Sample arrangement 1 (Centered Book 3 on top of the radio)



Sample arrangement 2 (The radio and Book 3 at the two ends of the shelf)

