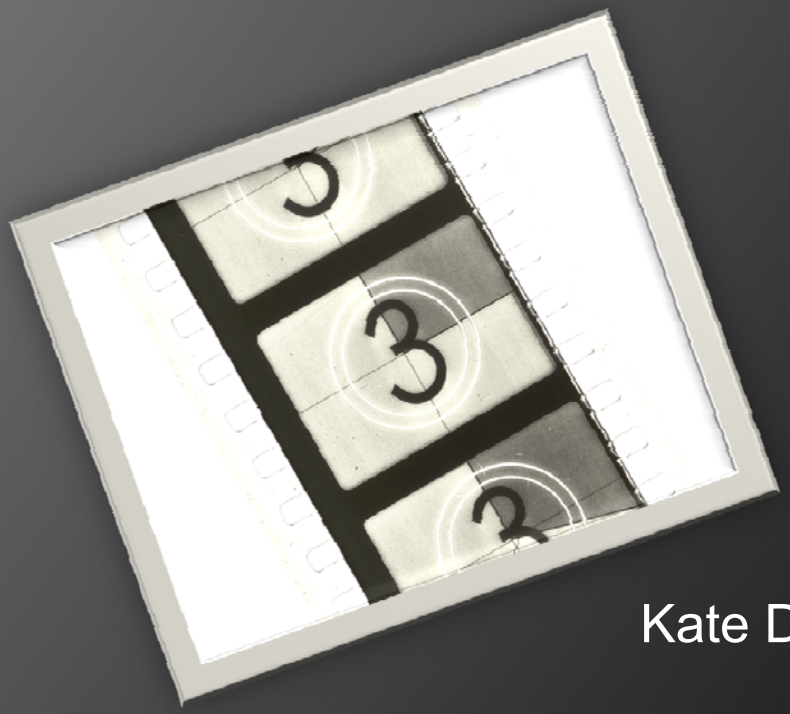
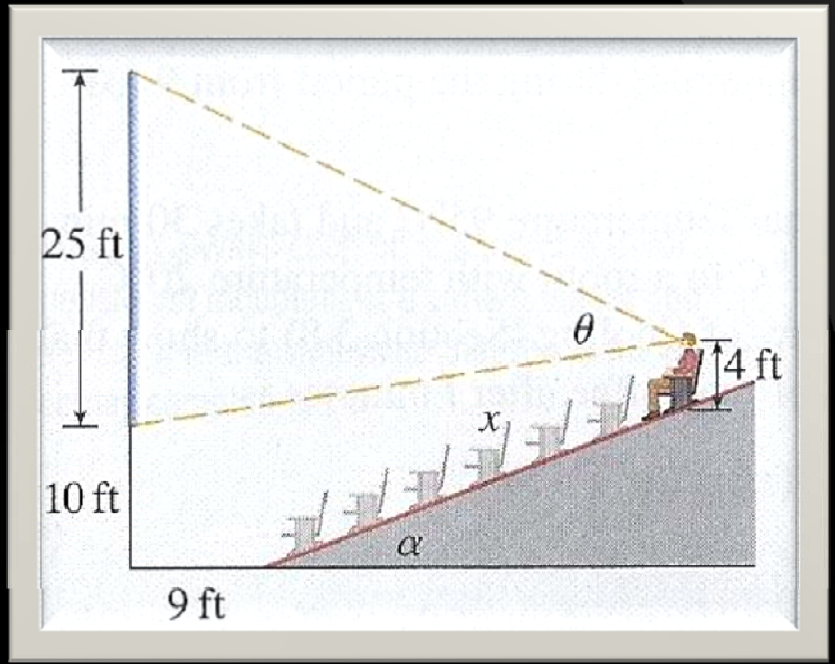


Kate Daniels & Renee Leonardi

APPLIED PROJECT
WHERE TO SIT AT THE MOVIES?

Objective

- Find the seat in the movie theatre that provides optimal viewing pleasure
  - Pg 446 in textbook



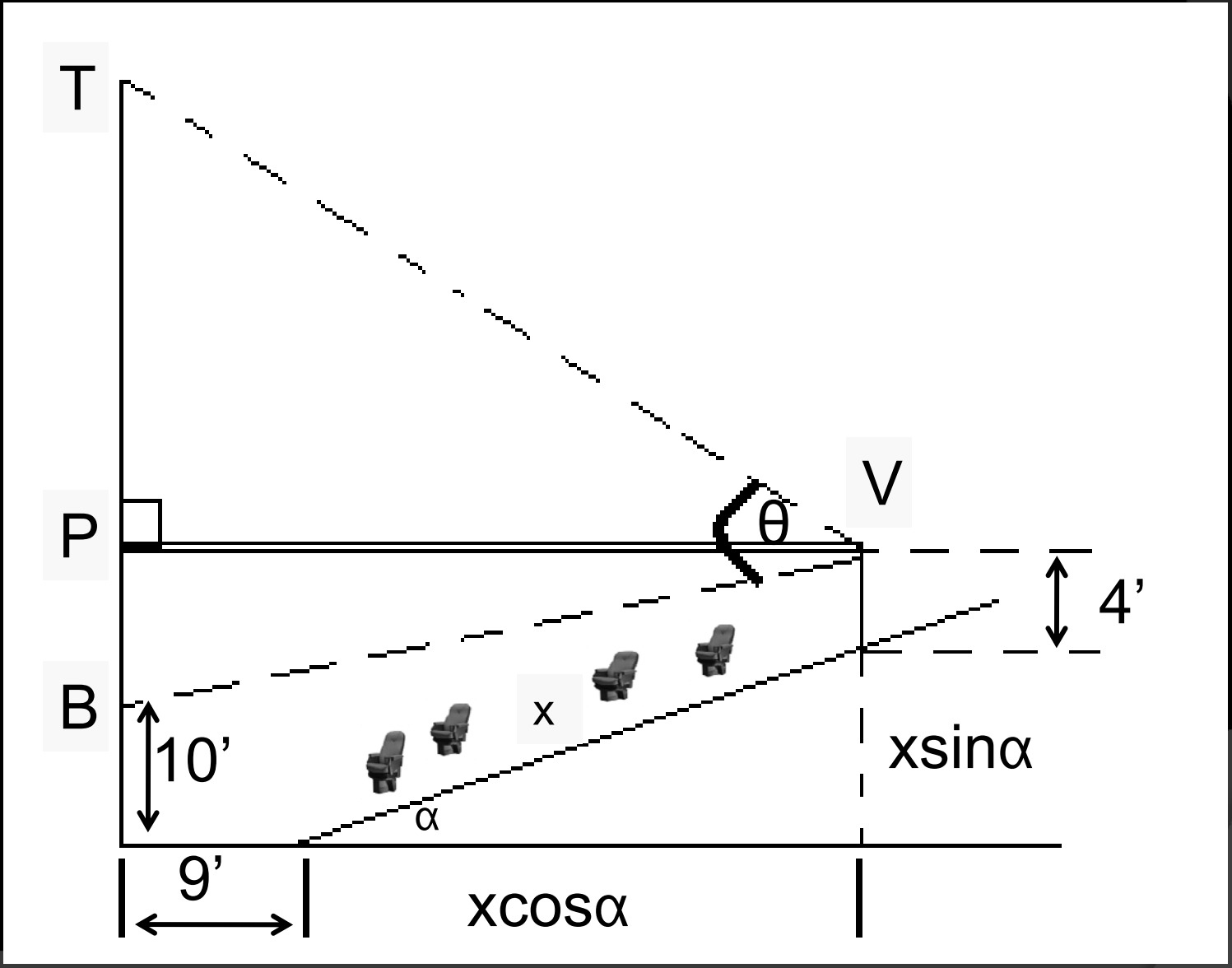
Known

- Screen is 10 ft off the floor, 25 ft high
- First row of seats is 9 feet from screen
- Floor of the seating area is inclined at an angle of $\alpha = 20°$
- The theatre has 21 rows so $0 \leq x \leq 60$

Known contd . . .

- You decided best place was to sit where angle θ subtended by the screen is a maximum
- Your eyes are 4 feet above the floor

Diagram



Problem 1

- Show that:

$$\Theta = \arccos\left(\frac{a^2 + b^2 - 625}{2ab}\right)$$

- Where:

$$a^2 = (9 + x\cos\alpha)^2 + (31 - x\sin\alpha)^2$$

$$b^2 = (9 + x\cos\alpha)^2 + (x\sin\alpha - 6)^2$$

From our diagram we can see that . . .

$$|VP| = 9 + x\cos\alpha$$

$$|PT| = 35 - (4 + x\sin\alpha) = 31 - x\sin\alpha$$

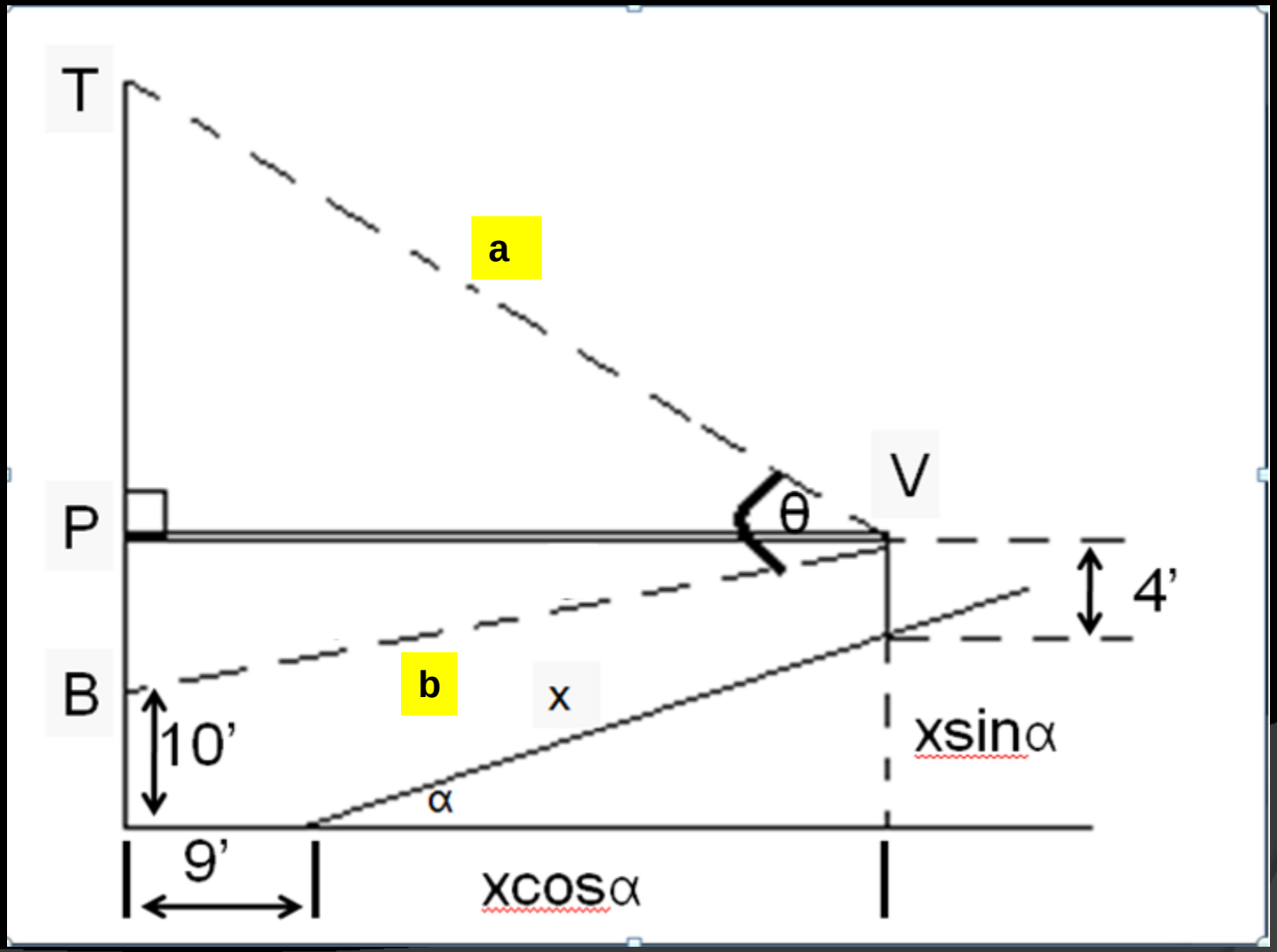
$$|PB| = (4 + x\sin\alpha) - 10 = x\sin\alpha - 6$$

Using the Pythagorean Theorem. . .

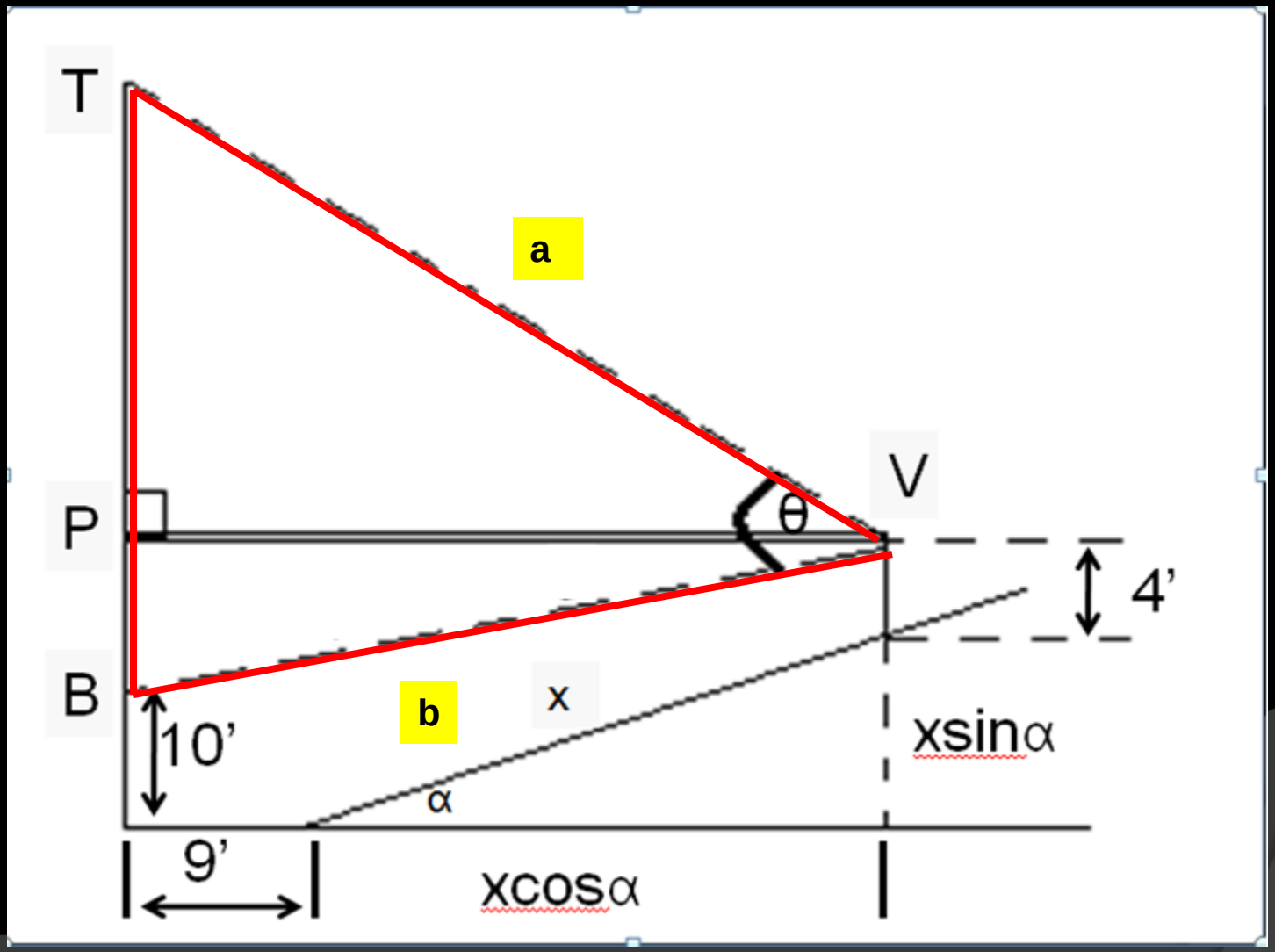
$$|VT| = \sqrt{|VP|^2 + |PT|^2} = \sqrt{(9 + x\cos\alpha)^2 + (31 - x\sin\alpha)^2} = a$$

$$|VB| = \sqrt{|VP|^2 + |PB|^2} = \sqrt{(9 + x\cos\alpha)^2 + (x\sin\alpha - 6)^2} = b$$

Diagram



Using the Law of Cosines . . .



Using the Law of Cosines . . .

ΔVBT

$25^2 = a^2 + b^2 - 2ab\cos\theta$

$2ab\cos\theta = a^2 + b^2 - 625$

$\cos\theta = \left(\frac{a^2 + b^2 - 625}{2ab}\right)$

$\theta = \cos^{-1}\left(\frac{a^2 + b^2 - 625}{2ab}\right)$

$$\Theta = \arccos\left(\frac{a^2 + b^2 - 625}{2ab}\right)$$

Problem 2

- Use the graph of θ as a function of x to estimate the value of x that maximizes θ. In which row should you sit?

$$\Theta = \arccos\left(\frac{a^2 + b^2 - 625}{2ab}\right)$$

$$a^2 = (9 + x\cos\alpha)^2 + (31 - x\sin\alpha)^2$$

$$b^2 = (9 + x\cos\alpha)^2 + (x\sin\alpha - 6)^2$$

Graph

- The value of x that maximizes θ appears to be x ≈ 8.25 ft. The row closest to this value is row 4 at x = 9 ft.
- Check this value

by setting the prime of θ = 0.

x ≈ 8.253062 ft