

WORKSHEET 21

1. My neighbors have a very loud stereo. The volume knob turns half a circle (angles θ between 0° and 180°) and the volume of the music (usually Prince) is given by the function $V(\theta) = 110 \sin(\theta/2)$ decibels (dB). One night at 3:30 in the morning I notice the lyrics “I wanna be your fantasy, and you can be mine...” increasing from a volume of 88 dB at a rate of 1 decibel per second! At what rate can I deduce that my neighbor is turning his volume knob?

(Note: Since the time I wrote this problem, my neighbors have been evicted.)

2. Art and Val are on their annual hunting trip. This time, however, **they** plan on outsmarting the deer! Val is sitting to Art’s right (east) when the perfect buck appears 40 meters to the north. Art aims the gun, but Val sneezes. The deer startles and takes off straight southeast at 30 meters per second. Art turns to keep the deer centered in his sight, but can’t get a clean shot. At the instant Art smacks Val in the head with the barrel of the gun, how fast was he rotating?

3. Brian got a new sand box over the weekend and took his “friends,” He-Man and Skeletor, out to play make-believe. Skeletor tied He-Man to a pole and began dumping sand on top of him at a rate of 4 cubic inches per second. He-Man is six inches tall. At the moment he is half buried, He-Man notices that the sand is rising at a rate of $1/2$ inch per second. How much longer does Bri... I mean He-Man have to come up with a way to escape before he is completely buried?

4. Eleanor and Regina operate a tour service for people who would like to travel from Austin to Shreveport to go riverboat gambling. The minimum size for a group is 50 people at \$200 per person (it includes food, transportation, and a seminar on the mathematics of gambling). For each additional person, up to a maximum of 80 people total, *everyone’s* fare is reduced by \$2. Given that it costs them \$6000 (a fixed cost for their offices, the busses, licenses, etc.) plus \$32 per person to conduct the tour, how many people does it take to maximize their profits?

What if property taxes increase, and their fixed costs rise to \$7000? What if that happens **and** the Louisiana state legislature puts an \$8 per person tax on gambling tours?

5. Max has decided to try to get on Dr. Davis’s good side by building a life-size origami statue of her as a gift. He begins with a sheet of paper that is 40’ long and 60’ wide, and wants the first fold to be particularly special. Specifically, the bottom right corner is to be folded to a point on the left side so that the length of the crease is a minimum. To what point should Max fold the corner to achieve this incredibly symbolic feat?

6. Brandie and Bat-Girl show up at Brian’s new sand box. Bat-Girl says that burying He-Man is boring and she would rather do Calculus! Help Bat-Girl and Skeletor do the following problem from one of Kathy’s old exams:

Let $f(x) = \sin x + \cos x$ on the interval $[0, 2\pi]$.

- 1) Differentiate and simplify.
 - 2) Find all points c where $f'(c) = 0$ or $f'(c)$ does not exist.
 - 3) Use the first derivative test to classify the above points.
 - 4) Find all local and global extremes.
7. Inspired by recently seeing “Saturday Night Fever” Melanie is redecorating her 16’x12’ dorm room in a disco theme. Her roommate opens the door and is shocked by the sight of a disco ball rotating once every 2 seconds from the center of the ceiling. Her horror is replaced by a trance-like state as she is hypnotized from tracking one of the spots of light spinning around the room. As this spot of light enters a corner going from a long wall to a short wall, how fast is it moving?