Math 120 D **Midterm: Part I** (50 minutes) Wednsday, November 5, 1997

Name: _____ **Student #:** _____ **Section:** _____

Instructions:

The midterm is closed book. **Please show your work** and indicate clearly your answers (e.g., by boxing them). You may use the back of a page for your work. There are **TWO** problems for a total of 24 points. Budget your time wisely. Some of the parts can be done independently of each other.

1	12pts	_____
2	12pts	_____

Failure? The possibility does not exist.

– Margaret Thatcher

1 (12 points). A ferris wheel, of radius 20 feet and 2 feet above ground, is supported through its center by two beams that are 22 feet apart on the ground. Bo is standing on one beam making repair to the ferris wheel. In frustration, Bo throws his wrench along a parabolic trajectory whose vertex is 8 feet above and 5 feet to the right of Bo. [Take the center of the ferris wheel as the origin.]

(a) Find an equation for the ferris wheel.

(b) Find an equation for the beam (a line) on which Bo stands.

(c) Find the location (x- and y-coordinates) of Bo.

(d) Find an equation for the trajectory of the wrench. [Hint: The point found in (c) satisfies this equation.]

(e) Find where (x- and y-coordinates) the wrench hits the ground.

(f) Suppose the horizontal speed of the wrench is 3 feet/second, i.e., the x-coordinate of the wrench increases by 3 feet every second. How long does it take for the wrench to hit the ground?

2 (12 points). On a particular winter day, the outdoor temperature T (in $^\circ$ Celsius) at x hour of the day is as graphed:

(a) Find a formula for T in terms of x during the first 16 hours of the day.

(b) Find a formula for T in terms of x during the last 8 hours of the day.

(c) For how many hours of the day is the temperature *below* 2° Celsius?

(d) Let $f(x)$ denote the formula for T (in $^\circ$ Celsius) in terms of x (in hour). Find $f(1)$ and $f(20)$.

(e) The formula for T (in $^\circ$ Fahrenheit) in terms of x (in hour) is given by $g(x) = \frac{9}{5}f(x) + 32$, where $f(x)$ is from (d). Sketch the graph of $g(x)$ versus x.

Math 120 D **Midterm: Part II** (50 minutes) Thursday, November 6

Name: _____ **Student #:** _____ **Section:** _____

Instructions:

The midterm is closed book. **Please show your work** and indicate clearly your answers (e.g., by boxing them). You may use the back of a page for your work There are **TWO** problems for a total of 26 points. Budget your time wisely.

3	16pts	_____
4	10pts	_____

Sometimes I tremble at the thought that God is just.

– Abraham Lincoln

3 (16 points). A fly is crawling clockwise along the circular rim of a cup of radius 5 mm. Its starting location is as pictured. The fly's angular speed is 0.05 rad/sec. A spider is waiting at the location shown.

(a) How fast (in mm/sec) is the fly crawling?

(b) When does the fly *first* cross the x-axis? How far has it crawled when this happens?

(c) Find formula for the x- and y-coordinates of the fly in terms of elapsed time t (in seconds).

(d) Where (x- and y-coordinates) is the fly located after 2 seconds?

(e) When does the (unfortunate) fly encounter the waiting spider?

4 (10 points). The altitude y of a satellite varies sinusoidally with time t, with a maximum altitude of 230 miles occurring at 2 AM and a minimum altitude of 210 miles occurring 6 hours later at 8 AM, and so on.

(a) Find a formula for y in terms of t.

(b) Over the interval $0 \leq t \leq 24$, how much time is spent by the satellite at altitude below 215 miles?