MATH 2250

Midterm Exam II – Special Zombie Edition

October 31, 2005

NAME (please print legibly): ⸻

Your University ID Number: ⸻

Please complete all questions in the space provided. You may use the backs of the pages for extra space, or ask me for more paper if needed. Work carefully, and try to complete the problems you find easier before going back to the harder ones. Good luck!

QUESTION	VALUE	SCORE
1	10	
2	10	
3	15	
4	15	
5	15	
6	10	
7	10	
TOTAL	85	

1. (10 points) A zombie steps off of a 35 foot wall by mistake, landing in the river below. How long will it take the zombie to fall?

ANSWER: _____

2. (10 points) The number of zombies in Pittsburgh n days after the dawn of the dead is given by the function $z(n)$. If $z'(n) = 3z(n)$, and there are 467 zombies in Pittsburgh when $n = 3$, use linear approximation (and your calculator) to estimate the number of zombies when $n = 3.1$.

You might get a fractional number of zombies, such as "7.2 zombies" and be concerned about the physical meaning of "0.2 zombies". Don't be. Unless you are an advanced zombie scholar, it is best not to think too hard about this sort of thing as the details are likely to be icky.

ANSWER: _____

3. (15 points) Defeating zombies requires just the right amount of firepower. Specifically, if f represents firepower, the optimum anti-zombie patrol is equipped with an amount of firepower which satisfies the equation

$$f^3 - 2f + 5 = 0. \tag{1}$$

Approximate a solution to this equation using at least 3 steps of Newton's method. Be sure to justify your initial guess, and state the number of digits of your answer which you believe to be correct.

ANSWER: _____

4. (15 points) It is wise to seek the high ground when battling zombies. Along a certain road, the height of the road is given (as a function of the distance x, in miles, from the city of Pittsburgh) by $h(x) = 3\sqrt{x} - 3x$. Use your calculator and your understanding of calculus to find the tallest point in the interval $[1/4, 3]$– or between $1/4$ mile and 3 miles from the city.

ANSWER: _____

5. (15 points) Fortifications can also be helpful in combatting the zombie menace. If you have 484 feet of electrified fence, give the length and width of the largest rectangular area that you can secure with this fencing material. Use calculus to justify your answer.

ANSWER: _____

6. (10 points) The number of zombies in the world n days after the "dawn of the dead" is roughly 0.001×2^n. The number of living people, on the other hand, is given by $5,000,000,000 \times n^{1.02}$. Find the horizontal asymptote, if there is one, of the "living/dead ratio function" $r(n)$:

$$r(n) = \frac{5,000,000,000 \times n^{1.02}}{0.001 \times 2^n}. \tag{2}$$

Please interpret your answer in terms of the future of humanity.

ANSWER: _____

7. (10 points) Zombies have very poor eyesight, and tend to trip and fall over when walking on hillsides that are concave **up**. A calculus student decides to take advantage of this in her battle against the zombie menace by retreating to a section of road whose height is given by the function $f(x) = cos(4x)$. On the interval $[0, 2\pi]$, where is this road concave up and where is it concave down?

ANSWER: _____