Math 201

21 October 2008
Second Midterm

NAME (Print!): _____

Check one: (1pm): _____
(2pm): _____

Problem	Points	Score
1	20	
2	20	
3	30	
4	20	
5	10	
Total	100	

Problem 1 (20 points): Newton's Law of Gravitation states that the magnitude F of the force exerted by a body of mass m on a body of mass M is

$$F = \frac{GMm}{r^2}$$

where G is the gravitational constant and r is the distance between the two bodies.

(a) Find $\frac{dF}{dr}$ and explain its meaning. What does the minus sign indicate?

(b) Suppose that it is known Earth attracts an object with a force that decreases at the rate of 2 N/km when $r = 20,000$ km. How fast does this force change when $r = 10,000$ km.

Problem 2 (20 points): At noon ship A is 100 km west of ship B. Ship A is sailing south at 35 km/h and Ship B is sailing north at 25 km/h. How fast is the distance between the ships changing at 4:00 pm.

Problem 3 (30 points): Find $\frac{dy}{dx}$ for each of the following:

(a) $\tan(x-y) = \frac{y}{1+x^2}$

(b) $y = 2^{3^{x^2}}$

(c) $y = x^{e^x}$

Problem 4 (20 points): Prove the following differentiation rules:

(a) Using the limit definition of the derivative, prove $\frac{d}{dx}\sqrt{x} = \frac{1}{2\sqrt{x}}$.

(b) Show that for any real number n we have $\frac{d}{dx}x^n = nx^{n-1}$.

Problem 5 (10 points): Find an equation of the tangent line to the curve $y = 4\sin^2(x)$ at the point $(\pi/6, 1)$.

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