SAMPLE FINAL MAT 125 Spring 2004
FINAL IS MONDAY, MAY 16, 11:00am-1:30pm

room	sections
Gym	1-9,11-15
Dance Studio	10, ELC4

NO CALCULATORS OR NOTES ALLOWED ON THE FINAL. PLEASE BRING YOUR STUDENT ID. Both rooms are in Sports complex.

1. Differentiate the following functions: (1) $x^{3/4}$ (2) $\tan(x)$ (3) 2^x (4)$x\ln x$ (5) $\sin(x)/\ln(x)$ (6) $\cos(\sin(x))$ (7) $(2+x^2)^{50}(1+x)^{100}$ (8) $\cos(x^2\ln(x))$ (9) $\ln(\tan(e^x))$ (10) $x^{\sin(x)}$.

2. Place the letter corresponding to the correct answer in the box next to each question.

   (i) $\square$ Simplify $\log_2(4x^2 2^x)$ **(a)** $\ln 2+2\ln x+x$ **(b)** $\log_2 2+2\log_2 x+x$ **(c)** $\ln 4+2\ln x+x\ln 2$ **(d)** $2+2\ln x+x$ **(e)** $2+2\log_2 x+x$ **(f)** none of these.

   (ii) $\square$ The initial size of a bacteria colony is 1000. After 1 hour the bacteria count is 8000. Assuming exponential growth, the time it takes the colony to double in size is approximately **(a)** 5 minutes **(b)** 10 minutes **(c)** 15 minutes **(d)** 20 minutes **(e)** 30 minutes **(f)** none of these.

   (iii) $\square$ Suppose $\sin(t)>0$. Then at t the function cos must be **(a)** positive **(b)** negative **(c)** increasing **(d)** decreasing **(e)** zero **(f)** none of these.

   (iv) $\square$ What is the domain of $\frac{1}{x^2-x}$? **(a)** all x **(b)** all x except 0 **(c)** all x except 0 and 1 **(d)** all $x>0$ **(e)** $0\le x\le 1$ **(f)** none of these.

   (v) $\square$ Express the following function as an explicit formula: take a number and add 1 to it; then square the result and multiply by 4. **(a)** $f(x)=4(x+1)^2$ **(b)** $f(x)=(4x+1)^2$ **(c)** $f(x)=4x^2+1$ **(d)** $f(x)=(4x)^2+1$ **(e)** $f(x)=4(x^2+1)$ **(f)** none of these.

   (vi) $\square$ The minimum or maximum value of a quadratic function $f(x)=ax^2+bx+c$ occurs at $x=$ **(a)** $-b/2a$ **(b)** $b/2a$ **(c)** $-b/a$ **(d)** b/a **(e)** a/b **(f)** none of these.

   (vii) $\square$ A rectanglar box with a volume of 60 ft^3 has a square base. Find a function which models the surface area of the box as a function of x, the length of one side of the base. **(a)** $2x^2+4\frac{60}{x}$ **(b)** x^2+240x **(c)** $2x^2+2\frac{60}{x^2}$ **(d)** $x^2+\frac{60}{x}$ **(e)** $2x^2+\frac{4}{x^2}$. **(f)** none of these.

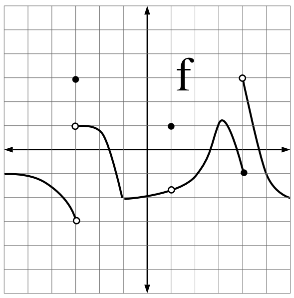
   (viii) $\square$ If $\sin(x)=1/\sqrt{2}$ then $\tan(x)=$? **(a)** 0 **(b)** 1/2 **(c)** $1/\sqrt{2}$ **(d)** 1 **(e)** either -1 or 1 **(f)** none of these.

   (ix) $\square$ Evaluate $\sec(\pi/3)$. **(a)** 0 **(b)** 1/2 **(c)** $\sqrt{3}/2$ **(d)** 1 **(e)** 2 **(f)** none of these.

(x) $\boxed{}$ Suppose f is given by the following table. Estimate the derivative of f at $x = 1$
(a) 1 **(b)** 2 **(c)** 3 **(d)** 4 **(e)** 6 **(f)** none of these.

x	0	.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0
f(x)	1	1.1	1.3	1.7	2.4	2.8	3.2	4.2	4.4	4.6	4.8

3. Answer each of the questions about the function f graphed below. Each box has unit size. In each question, list **ALL** the points a in $[-6, 6]$ so that

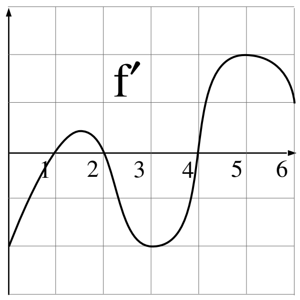


(i) $\lim_{x\to a} f(x)$ exists but does not equal $f(a)$.

(ii) f has a jump at a but $f(a)$ equals the left hand limit at a.

(iii) What is $\lim_{x\to -3^+} f(x)$?

4. Answer each of the following T (for true) or F (for false).



(i) f is increasing on the interval $(1, 2)$.

(ii) f has a local maximum at $x = 2$.

(iii) $f(4) > f(3)$.

(iv) f is concave up on the interval $(3, 5)$.

5. Compute the following using l'Hospital's rule. (i) $\lim_{x\to -1} \frac{x^2-1}{x+1}$ (ii) $\lim_{x\to\infty} \frac{\ln(\ln(x))}{x}$. (iii) $\lim_{x\to 0^+} x^{\sin(x)}$ (iv) $\lim_{x\to\infty}(\ln(x+5) - \ln(x))$ (v) $\lim_{x\to 0}(\frac{1}{x} - \csc(x))$.

6. Find the line through $(3, 5)$ that cuts off the least area from the first quadrant.

7. At noon, ship A is 100 km west of ship B. Ship A is sailing south at 35 km/hr and ship B is sailing north at 25 k/hr. How fast is the distance between the ships changing at 4 pm?

8. If we use Newton's method with intial guess $x_1 = 1$ to solve the equation $x^3 - 3 = 0$, what are the next two guesses x_2 and x_3?