**Math 161 Class discussion**

**1 October**

* **The Game of Antiderivatives: A first look at the method of “judicious guessing.”**

Find an antiderivative for each of the following functions
(a) cos x (b) 2018 (c) 6x5 + 5x4 + e5 (d) sec2 x (e) x9 + 7x3 + 1

(f) 5ex + sec x tan x (g) 19 sin x (h) x – cos x + 5

**Higher-Order Derivatives**



1. Find the first *three* derivatives of each of the following functions.

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*(Here assume that the shortcut for differentiating xn is valid for negative values of n.)*

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$$\left(F\right) y= x^{101}$$

2. (a) If (d/dx)e4x = 4e4x, find (d199/dx199) e4x.

(b) If (d/dx) sin 5x = 5 cos 5x, and (d/dx) cos 5x = - 5 sin 5x, find (d2018/dx2018) sin 5x.

3. If f(x) = x1/2, find f(4)(x). *(Here assume that the shortcut for differentiating xn is valid for rational n.)*

4. If *x(t) = 3t3 – 4t + 1* is the position (measured in meters) of Charlotte on the x-axis at time *t* (measured in hours), find Charlotte’s *velocity* and *acceleration* at time t = 2 hrs.

5. If *F(x) = xm*, find F(m)(x). (Assume that *m* is a positive integer.)

6. Let y = ln x. Given that dy/dx = 1/x, find d4y/dx4. Can you find d10y/dx10 ?

7. *(University of Michigan)*  Consider the following table giving values, rounded to three decimal places, of a function *f*(*x*).

|  |  |  |  |
| --- | --- | --- | --- |
| *x* | 0 | 0.5 | 1 |
| *f*(*x*) | 0 | 0.247 | 0.841 |

* 1. Estimate$f'(1)$. Be sure it is clear how you obtain your answer.
	2. Estimate $f(1.25)$ being sure your work is clear.
	3. Estimate $f''(1)$. Again, be sure that it is clear how you obtain your answer.
	4. Based on your work in (a) and (c), is your estimate in (b) an over- or underestimate? Explain.
1. *(University of Michigan)* A paperback book (definitely not a valuable calculus textbook, of course) is dropped from the top of Mertz hall (which is 40 m high) towards a very large, upward pointing fan. The average velocity of the book between time *t* = 0 and later times is shown in the table of data below (in which *t* is in seconds and the velocities are in m/s).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  **between *t* = 0 seconds and *t* =** | **1** | **2** | **3** | **4** | **5** |
| **the average velocity is** | **−5** | **−10** | **−11*.*67** | **−9** | **−7*.*2** |

* 1. Fill in the following table of values for the height *h*(*t*) of the book (measured in meters). Show how you obtain your values.

|  |  |
| --- | --- |
| ***t*** |  **0 1 2 3 4 5** |
| ***h*(*t*)** |  **40**  |

* 1. Based on your work from (a), is *h*′′(1) *>* 0, *<* 0, or = 0? Is *h*′′(3) *>* 0, *<* 0, or = 0? Explain.
1. For each of the descriptions of a function *f* that follow, indicate which of the graphs match the description. For each description there may be no, one, or several graphs that match; write **none** if no graphs match the description. You may need to use a graph more than once. In each case, you should assume that *f* is defined only on the domain [0*,* 2].
	1. $f^{''}\left(x\right)<0 $for *x <* 1 and $f^{''}\left(x\right)$ *>* 0 for *x >* 1; $f^{'}\left(x\right)<$0 for *x <* 1 and $f^{'}$(*x*) *>* 0 for *x >* 1; and *f*(*x*) is continuous everywhere except at *x* = 1.
	2. $f^{''}\left(x\right) $*>* 0 for all *x* < 1; $f^{''}$(*x*) *<* 0 for all *x* > 1 ; and *f*(*x*) is differentiable everywhere except at *x* = 1.
	3. $f^{''}\left(x\right) $*<* 0 for all *x* < 1; $f^{'}\left(x\right)$*<* 0 for *x <* 1 and $f^{'}\left(x\right) $*>* 0 for *x >* 1; and *f* (*x*) *<* 0 for all *x* = 1.
	4. $ f^{''}\left(x\right) $*<* 0 for *x <* 1 and $f^{''}\left(x\right)>0$ for *x >* 1; $f^{'}\left(x\right)$*<* 0 for *x <* 1 and $f^{'}\left(x\right)>0$for *x >* 1; and *f*(*x*) is differentiable everywhere except at *x* = 1.

**A.**

−

1

1

2

1

**B.**

−

1

1

2

1

**C.**

−

1

1

1

2

**D.**

−

1

1

2

1

**E.**

−

1

1

2

1

**F.**

−

1

1

1

2

1. The graph of a function *f* is given in the Figure below. If *f* is a polynomial of degree 3, then the value of $f^{'''}\left(0\right) is$
2. Positive (b) Negative (c) Zero

 

**11.**



**12.** The graph of a function *f* is given below. If f is a polynomial of degree 3, then the values of $f^{'}\left(0\right), f^{''}\left(0\right), and f^{'''}\left(0\right)are (respectively)$





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