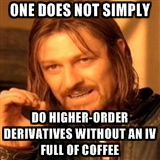
**WORKSHEET VII**

**Higher-Order Derivatives**



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

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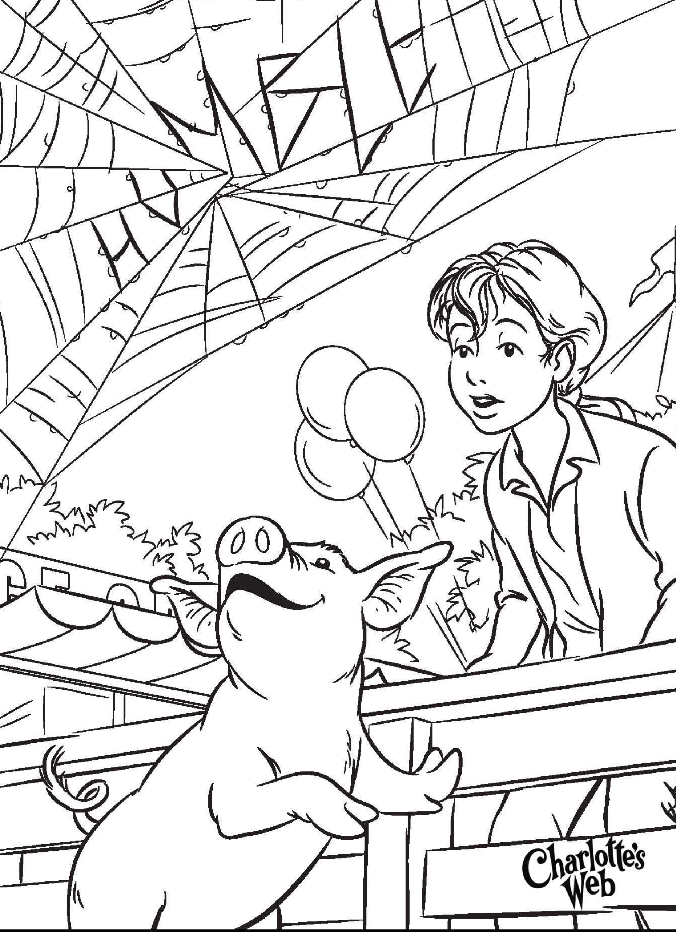
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2. (A) If (d/dx)e4x = 4e4x, find (d199/dx199) e4x.

(B) If (d/dx) sin 5x = 5 cos 5x, and (d/dx) cos 5x = - 5 sin 5x, find (d2017/dx2017) sin 5x.

3. If f(x) = x1/2, find f(4)(x).

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. Be sure it is clear how you obtain your answer.
  2. Estimate . Again, be sure that it is clear how you obtain your answer.
  3. Estimate being sure your work is clear.
  4. Based on your work in (a) and (b), is your estimate in (c) 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 below 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. for *x <* 1 and *>* 0 for *x >* 1; 0 for *x <* 1 and (*x*) *>* 0 for *x >* 1; and *f*(*x*) is continuous everywhere except at *x* = 1.
   2. *>* 0 for all *x* < 1; (*x*) *<* 0 for all *x* > 1 ; and *f*(*x*) is differentiable everywhere except at *x* = 1.
   3. *<* 0 for all *x* < 1; *<* 0 for *x <* 1 and *>* 0 for *x >* 1; and *f* (*x*) *<* 0 for all *x* = 1.
   4. *<* 0 for *x <* 1 and  for *x >* 1; *<* 0 for *x <* 1 and 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.**

−

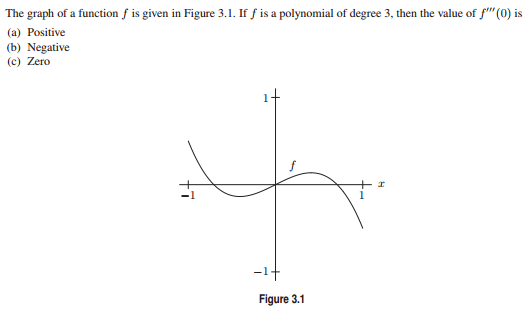
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1

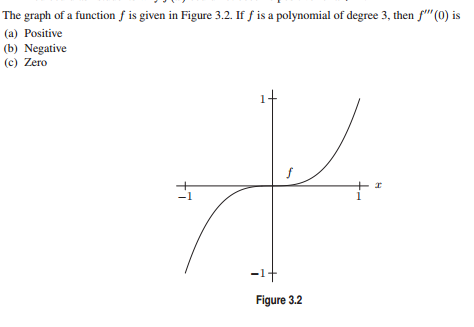
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2

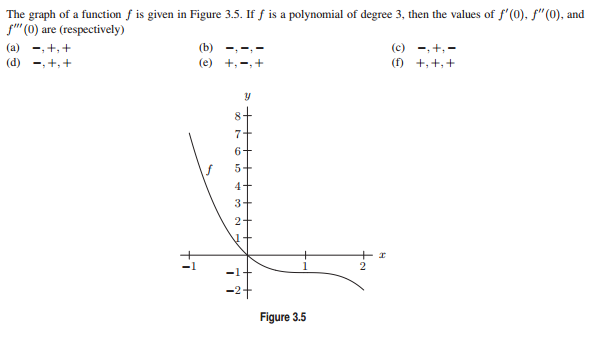
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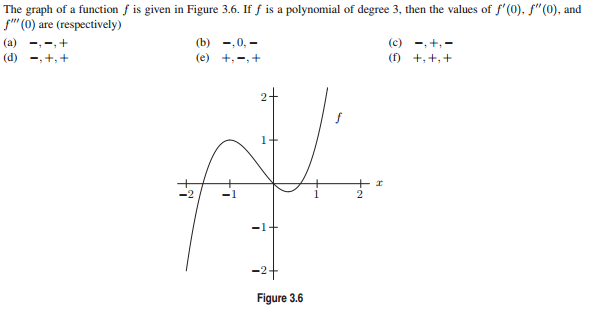
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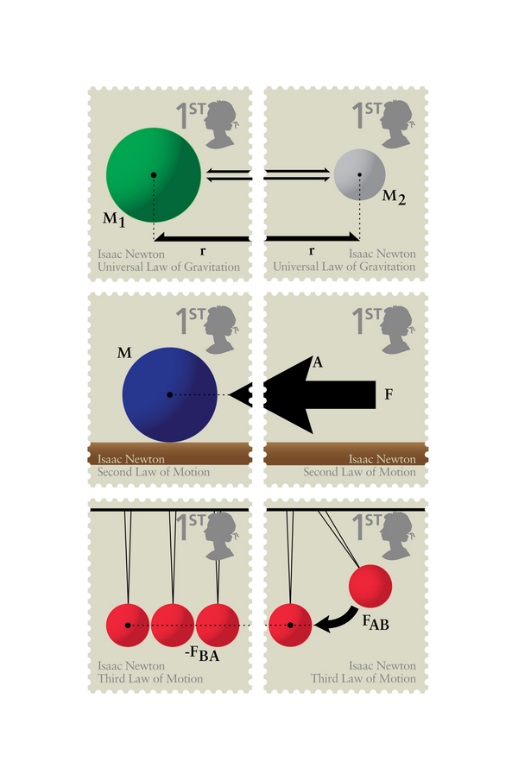


12.



13.





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