Principles of Calculus Modeling: An Interactive Approach by Donald Kreider, Dwight Lahr, and Susan Diesel
Exercises for Section 2.1

1. (1 pt)
Here is the beginning of a table of values for some function g and some derived values.

t	g(t)	first derived (1)	second derived (2)
1	2.718282	2.719641	2.721002
1.001	2.721001	2.722362	2.723724
1.002	2.723724	2.725086	2.726449
1.003	2.726449	2.727813	2.729177
1.004	2.729177	2.730542	2.731908
1.005	2.731907	2.733274	2.734641
1.006	2.734641	2.736008	2.737377
1.007	2.737377	2.738746	2.740116
1.008	2.740115	2.741486	2.742857
1.009	2.742857	2.744229	—
1.01	2.745601	—	—

From your knowledge of derived tables as discussed in the textbook, what is $g(t)$?

_____

2. (1 pt)
This problem asks you to work backward to find the values of a distance function from the acceleration and speed.

Consider the following derived table of speeds and accelerations for a moving object.

time t (s)	distance (m)	speed (m/s)	acceleration (m/s/s)
0.1	14.3	3.98	9.8
0.2	14.698	4.96	9.8
0.3	15.194	5.94	9.8
0.4	15.788	6.92	9.8
0.5	16.48	7.9	9.8
0.6	17.27	8.88	9.8
0.7	???	9.86	9.8
0.8	???	10.84	9.8
0.9	???	???	9.8
1	???	???	9.8

Find the missing values.

_____

_____

_____ _____

_____ _____

3. (1 pt)
Imagine you ride your bike over three differing sections of trail and road. The first section takes 1.7 minutes, where you average 7 miles per hour. The second section takes 15 minutes, and you average 27 miles per hour. On the third section, you spend 14 minutes with an average speed of 40 miles per hour.

What is your total distance traveled?

_____ miles

What is your average speed over the entire ride?

_____ miles per hour

4. (1 pt)
Imagine you ride your bike over three differing sections of trail and road. The first section takes 13.5 minutes, where you average 24 miles per hour. The second section takes 4.5 minutes, and you average 6 miles per hour. On the third section, your average speed is 18 miles per hour.

How long must you ride on the third section until your average speed for the entire ride is 19.04 miles per hour?

_____ minutes

How far will you ride altogether?

_____ miles

5. (1 pt)
Consider the following derived table for a function $f(x)$.

x	f(x)	first derived	second derived
0	0	2.125	-0.347222222222223
0.24	0.51	???	-17.0138888888889
0.48	1	-2.04166666666667	-0.347222222222223
0.72	0.51	-2.125	???
0.96	0	-2.125	0.347222222222223
1.2	-0.51	-2.04166666666667	17.0138888888889
1.44	-1	2.04166666666667	???
1.68	-0.51	2.125	
1.92	0		

Fill in the missing values in the table (indicated by ???).

_____

_____

_____

For the next two questions, choose from the list of possible answers below.

Based on the information in the table, where is the function increasing the fastest? If there is more than one answer, enter the **smallest** value.

___

Where is it decreasing the fastest? If there is more than one one answer, enter the **largest** value.

___

A. x = 0
B. x = 0.24
C. x = 0.48
D. x = 0.72
E. x = 0.96
F. x = 1.2
G. x = 1.44
H. x = 1.68

I. x = 1.92

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6. (1 pt)
Consider the following derived table for the function $f(x) = x^3 - 4x$.

x	f(x)	first derived difference
-3	-15	18.75
-2.5	-5.625	11.25
-2	0	5.25
-1.5	2.625	???
-1	3	???
-0.5	1.875	???
0	0	???
0.5	-1.875	???
1	-3	???
1.5	-2.625	???
2	0	???
2.5	5.625	???

Fill in the missing values in the table (indicated by ???).

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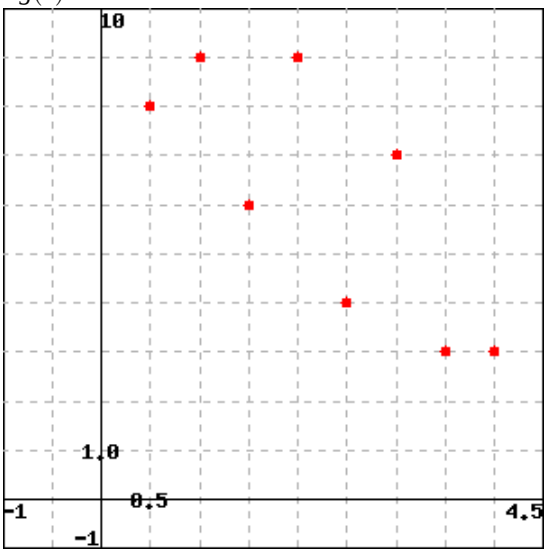
7. (1 pt)
Consider this graph of points, the values of some unknown function $g(x)$.



Over which interval does g increase most? If there is more than one answer give the smallest values of x.
From $x =$_____ to $x =$_____

Over which interval does g decrease the most? If there is more than one answer give the largest values of x.
From $x =$_____ to $x =$_____

What is the average change from $x = 0.5$ to $x = 4$?

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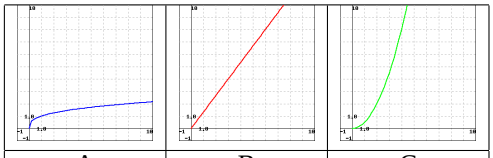
8. (1 pt)
The volume of a spherical water balloon is related to its radius by the formula

$$Volume = \frac{4}{3}\pi r^3$$

Suppose the balloon is filled with a constant stream of water; that is, its volume increases at a constant rate. Which graph below shows the change in the radius of the balloon?

___



A	B	C

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9. (1 pt)
Here is the beginning of a table of values for the function $-4x^4 + 6x^2$ and some derived values.

x	f(x)	first derived (1)	second derived (2)
0	0.000	0.596	11.440
0.1	0.060	1.740	10.000
0.2	0.234	2.740	7.600
0.3	0.508	3.500	4.240
0.4	0.858	3.924	-0.080
0.5	1.250	3.916	-5.360
0.6	1.642	3.380	—
0.7	1.980	—	—

Match the function from the list below that most closely fits the values in the appropriate column of the table.
first derived (1): ___
second derived (2): ___

A. $-96x$
B. $x^4 + x^2$
C. $-16x^3 + 12x$
D. $4x^3 + 2x$
E. $-48x^2 + 12$

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10. (1 pt)
You may want to graph the function to answer questions in this problem.

Consider the function $f(x) = e^x$. What is $f(0.5)$?

For the following small values of h, compute $\frac{f(0.5+h) - f(0.5)}{h}$. Simplify your answer.

$h = .2$: _____
$h = .1$: _____
$h = .01$: _____
$h = .001$: _____

11. (1 pt)

A race car driver needs to average 140 mph during the last two laps of a race in order to win. If she drives at 200 mph during her second-to-last lap, what must her average speed during the last lap be?

_____ miles per hour

12. (1 pt)

If a runner averages 8 m/s during the first 100m of a race, 4 m/s during the second 100m of a race, and 8 m/s during the third 100m of a race, what is his average pace during the first 300m of the race?

_____ m/s