

## Chapter 2: Practice/review problems

The collection of problems listed below contains questions taken from previous MA123 exams.

## Average rates of change (Word Problems)

- [1]. A train travels from  $A$  to  $B$  to  $C$ . The distance from  $A$  to  $B$  is 10 miles and the distance from  $B$  to  $C$  is 40 miles. The average velocity from  $A$  to  $B$  was 20 miles per hour and the average velocity from  $B$  to  $C$  was 40 miles per hour. What was the average velocity from  $A$  to  $C$  in miles per hour?
- (a)  $180/5$       (b)  $90/3$       (c)  $100/3$       (d)  $180/3$       (e)  $100/5$
- [2]. A train travels from city  $A$  to city  $B$ . It leaves city  $A$  at 10:30 am and arrives at city  $B$  at 1:30 pm. The distance between the cities is 150 miles. What was the average velocity of the train in miles per hour?
- (a) 60      (b) 150      (c) 50      (d) 75      (e) 130
- [3]. A train travels from city  $A$  to city  $B$  to city  $C$ . The distance from  $A$  to  $B$  is 20 miles. The distance from  $B$  to  $C$  is 45 miles. The train took 1 hour for the trip from  $A$  to  $B$ , stopped at city  $B$  for 30 minutes, and then went from  $B$  to  $C$  at an average velocity of 30 miles per hour. What was the average velocity of the train for the entire trip (in miles per hour)?
- (a) 65      (b) 25      (c)  $\frac{65}{2}$       (d) 50      (e)  $\frac{65}{3}$
- [4]. A train travels from  $A$  to  $B$  to  $C$ . The distance from  $A$  to  $B$  is 30 miles and the distance from  $B$  to  $C$  is 80 miles. The train leaves  $A$  at 10:00 AM and arrives at  $C$  at 3:00 PM. The average speed from  $A$  to  $B$  was 30 miles per hour. What was the average speed from  $B$  to  $C$  in miles per hour?
- (a) 20      (b) 25      (c) 30      (d) 35      (e) 40
- [5]. A train travels from city  $A$  to city  $B$ . The cities are 600 miles apart. The distance from city  $A$  at  $t$  hours after the train leaves  $A$  is given by  $d(t) = 50t + t^2$ .  
What is the average velocity of the train in miles per hour during the trip from  $A$  to  $B$ ?  
(Hint: First find how long it takes for the train to get from  $A$  to  $B$ .)
- (a) 50      (b) 55      (c) 60      (d) 65      (e) 70
- [6]. John leaves at 9:00 am and drives from Lexington to Ashland arriving at 11:00 am. He stops for two hours since his girlfriend Mary is not yet ready. Then they drive together from Ashland to Columbus arriving at Columbus after a three-hour drive. The distance from Lexington to Ashland is 110 miles and the distance from Ashland to Columbus is 130 miles. Find the average velocity of John's car in miles per hour for the entire trip (including the two hour stop) correct to two decimal places.
- (a) 33.81      (b) 33.42      (c) 35.00      (d) 34.29      (e) 34.47

**Average rates of change**

- [7]. If  $g(x) = (x - 1)^2$  what is the average rate of change of  $g(x)$  with respect to  $x$  as  $x$  changes from  $-3$  to  $3$ ?  
(a)  $-4$        (b)  $-2$       (c)  $0$       (d)  $2$       (e)  $4$
- [8]. Suppose that  $h(t) = \frac{2}{t}$ . Find the average rate of change of  $h(t)$  from  $t = 5$  to  $t = 10$ .  
(a)  $-.05$        (b)  $-.04$       (c)  $.05$       (d)  $.04$       (e)  $.02$
- [9]. Find the average rate of change of the function  $R(t) = \sqrt{2t + 7}$  as  $t$  changes from  $1$  to  $9$ .  
(a)  $\frac{1}{3}$       (b)  $\frac{1}{2}$        (c)  $\frac{1}{4}$       (d)  $4$       (e)  $2$
- [10]. If  $g(x) = |x - 7|$  what is the average rate of change of  $g(x)$  with respect to  $x$  as  $x$  changes from  $-3$  to  $3$ ?  
(a)  $-2$        (b)  $-1$       (c)  $0$       (d)  $1$       (e)  $2$
- [11]. Find the average rate of change of the function  $G(t) = |t^2 - 1|$  as  $t$  changes from  $-1$  to  $2$ .  
(a)  $0$        (b)  $1$       (c)  $2$       (d)  $3$       (e)  $4$
- [12]. Let  $g(s) = s^2 - 3s + 1$ . Find a value  $A \geq 0$  such that the average rate of change of  $g(s)$  from  $0$  to  $A$  equals  $8$ .  
(a)  $0$       (b)  $8$        (c)  $11$       (d)  $15$       (e)  $22$
- [13]. Suppose  $f(t) = t^3 + 1$ . Find a value  $A$  greater than  $0$  such that the average rate of change of  $f(t)$  from  $0$  to  $A$  equals  $2$ .  
(a)  $1$        (b)  $\sqrt{2}$       (c)  $\sqrt{3}$       (d)  $2$       (e)  $\sqrt{5}$

**Difference quotients**

- [14]. Compute  $\frac{f(2+h) - f(2)}{h}$  where  $f(x) = 3x^2 + 1$ .  
(a)  $12$       (b)  $12 + h$       (c)  $12 + 2h$        (d)  $12 + 3h$       (e) None of the above
- [15]. What is the average rate of change of  $g(s) = s^2 - 4$  as  $s$  changes from  $1$  to  $1 + h$ ?  
(a)  $6 + 3h$        (b)  $2 + h$       (c)  $4 + 2h$       (d)  $2$       (e)  $h$
- [16]. Let  $f(x) = 2x^2 - 3x$ . Find the average rate of change of  $f(x)$  from  $x = 3$  to  $x = 3 + h$ .  
(a)  $9 - h$       (b)  $9 + h$       (c)  $9$       (d)  $9 - 2h$        (e)  $9 + 2h$

[17]. Let  $g(t) = (t - 5)^2 + 1$ . What is the average rate of change of  $g(t)$  as  $t$  changes from 4 to  $4 + h$ ?

- (a)  $h^2 - 2h$       (b)  $h + 2$       (c)  $h^2 + 2h$        (d)  $h - 2$       (e) 1

[18]. If  $f(t) = 3t^2 + 4$  then

$$\frac{f(1+h) - f(1)}{h} =$$

- (a)  $4 + 3h$       (b)  $3 + 4h$        (c)  $6 + 3h$       (d)  $8 + 3h$       (e)  $8 + 4h$

[19]. If  $f(t) = 1/t$  then

$$\frac{f(t+h) - f(t)}{h} =$$

- (a)  $1/(h^2)$       (b)  $1/(t(t+h))$        (c)  $-1/(t(t+h))$   
(d)  $1/(t(t-h))$       (e)  $-1/(t(t-h))$

**Instantaneous rates of change**

[20]. Consider a triangle with base  $x$  and height  $2x$ . Find the instantaneous rate of change of the area of the triangle with respect to  $x$  when  $x = 5$ .

- (a) 1      (b) 2      (c) 5       (d) 10      (e) 20

[21]. Find the instantaneous rate of change of the function  $H(t) = t^3$  at  $t = 2$ .

- (a) 2      (b) 3      (c) 8       (d) 12      (e) 27

In what follows, you may use the following formula for the derivative of a quadratic function.

$$\text{If } p(x) = Ax^2 + Bx + C, \text{ then } p'(x) = 2Ax + B.$$

[22]. If  $g(s) = 3s^2 + s - 2$  what is the value of  $g(s)$  when the instantaneous rate of change of  $g(s)$  with respect to  $s$  equals 1?

- (a) -2      (b) -1      (c) 0      (d) 1      (e) 2

[23]. If  $g(s) = 3s^2 + 2s - 2$  what is the value of  $s$  for which the instantaneous rate of change of  $g(s)$  with respect to  $s$  equals 8?

- (a) -2      (b) -1      (c) 0       (d) 1      (e) 2