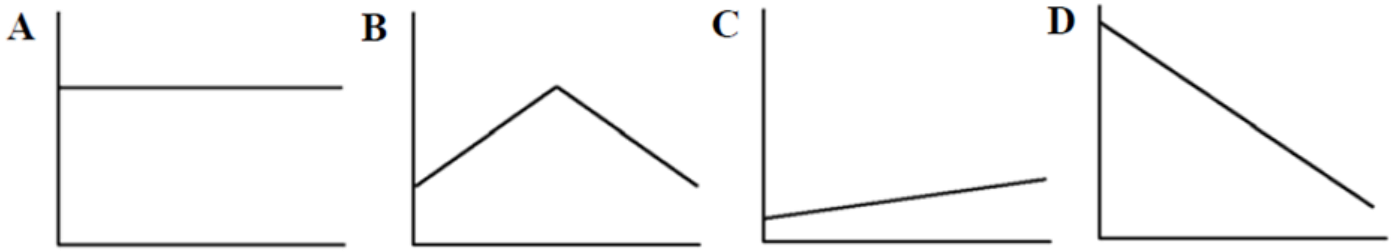
Name: _____ Date: _____ MAP 4C1

REVIEW – CHAPTER 5

5.1 – LINEAR MODELS

1. Which graph(s) appear to be **non-linear**?



2. Using the graphs above:

(a) Which graph shows a **positive** rate of change? _____

(b) Which graph shows a **negative** rate of change? _____

(c) Which graph shows a **zero** rate of change? _____

3. Siddha jogged at a constant speed travelling around **400 m** in **4 min**

(a) What is Siddha's **rate of change** of distance with respect to time, in *metres per minute*?

(b) If Siddha continued jogging at the same speed, how long would it take to jog around the track **5 times**?

4. Zoe, the manage of a home building centre, had a stock of 1600 sheets of plywood on the first day of April. She kept a graph of the number of sheets of plywood remaining for the first two weeks of April (the graph is on the **next page**)

(a) Describe the relationship between the number of sheets of plywood remaining and the time

(b) Use the graph to estimate the number of sheets of plywood remaining after **6 days**

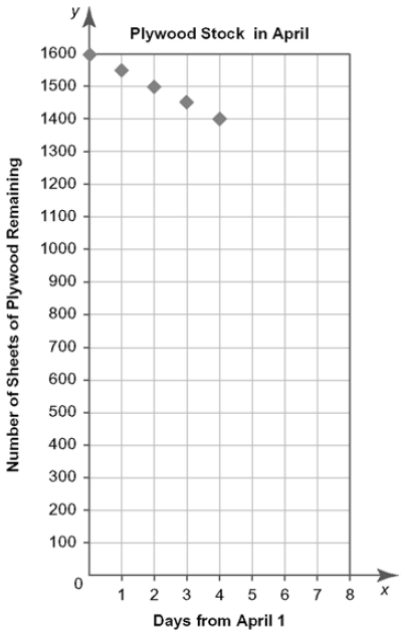
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(c) By how much does the number of sheets of plywood remaining decrease after **7 days?** _____ **8 days**? _____

(d) By how much does the number of sheets of plywood remaining decrease after each day in April?

(e) Is the rate of change of number of sheets of plywood remaining with respect to the number of days **increasing, decreasing** or **constant**? _____. Explain.



5. Concrete used to construct tall buildings must be pumped vertically up to where it is needed. The table shows the time needed to pump concrete to different heights

(a) Take a look the differences of the **time (min)**. Does the relationship between height and time appear to be **linear** or **non-linear?** _____. Explain.

Height (m)	Time (min)
100	60
120	67
140	73
160	79
180	86

(b) What is the **rate of change** of time with respect to height? (Don't forget to include the units)

6. As an airplane rises, the surrounding air temperature decreases by approximately **3.25°C** for every **500 m** in vertical height

(a) Complete the table on the right

(b) Is the relationship between height and surrounding air temperature **linear** or **non-linear?** _____. Explain

Height (m)	Temperature (°C)
0	15.00
500	
1000	
1500	
2000	
2500	
3000	

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5.2 – QUADRATIC MODELS

1. Use **first** and **second** differences to determine if the table shows in **linear** or **quadratic**.

(a)

x	*y*	*1st Diff.*	*2nd Diff.*
0	0		
1	6		
2	12		
3	18		
4	24		

Linear or Quadratic? _____

(b)

x	*y*	*1st Diff.*	*2nd Diff.*
0	0		
1	3		
2	8		
3	15		
4	24		

Linear or Quadratic? _____

2. Complete the table below so that the data shown represents a **quadratic** relation

x	*y*	First Differences	Second Differences
0	0		
1	2	2	
2			2
3	12	6	
4			2
5	30	10	

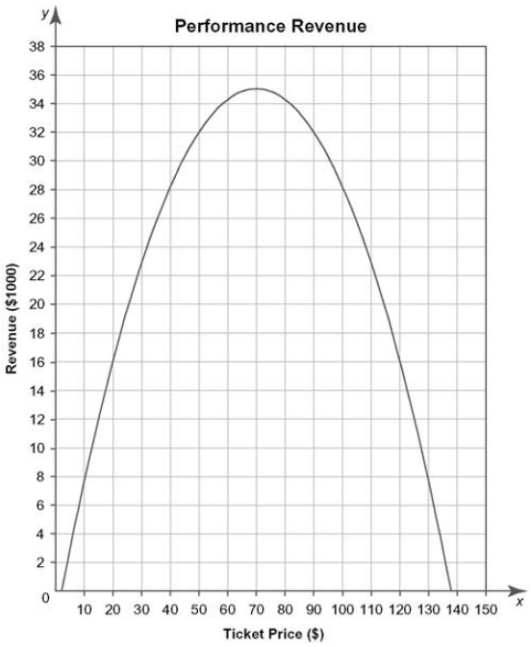
3. The Two Scary Masks Theatre company charges $50 per ticket. The average performance has an attendance of 600 people. If the price is increased, fewer people will attend the performance. The graph represents data collected by a market research company (graph is on the **next page**)

(a) Describe the relationship between ticket price and revenue

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(b) Use the graph to estimate the revenue for a ticket price of **$50** _____ and **$60** _____



(c) If the ticket price doubles, will the revenue also double? _____ Explain

(d) Consider the **rate of change** of revenue with respect to ticket price. What are the appropriate units for this rate of change?

(e) Is the rate of change of revenue with respect to ticket price **increasing, decreasing** or **constant**? _____ Explain

4. Jeff owns an Internet Café and charges patrons by the half hour for computer use. The table on the right shows the pricing plan.

Time (min)	***Cost ($)***	***1st Diff.***	***2nd Diff.***
30	5		
60	7		
90	11		
120	17		
150	25		
180	35		

(a) Does the **Time** column show equal intervals? _____

(b) Does the **Cost** column imply a **linear** relation? _____. Explain.

(c) Calculate the **1st Differences**. Does it imply an **increasing, decreasing** or **constant** rate of change of cost with respect to time? _____

(d) Calculate the **2nd Differences**. Does it imply a **quadratic** model? _____

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5.3 – EXPONENTIAL MODELS

1. The population of Jeanobile has been decreasing by **10%** each year**.** The current population of Jeanobile is **11000**

(a) Determine the population of Jeanobile after

(i) **1 year**

Population = $11000 \times (1 - 0.10)^1$
= _____

(ii) **2 years**

Population = $11000 \times (1 - 0.10)^2$
= _____

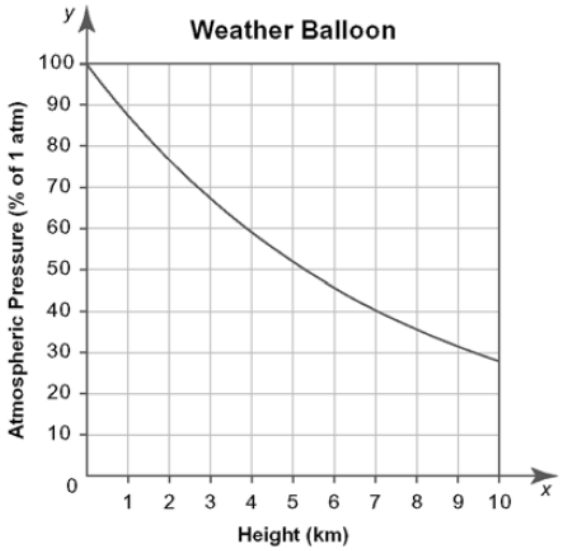
(b) Calculate the **ratios** between the starting population (11000) and the population after 1 year and 2 years. Does this imply that the decreasing population is an **exponential relation**? _____. Explain

2. Determine if each number sequence represents **exponential growth**. Do this by calculating the **ratios**

(a) 12, 24, 36, 48

(b) 3, 9, 27, 81

3. A weather balloon was launched and monitored by a meteorologist. He compared the atmospheric pressure at different heights with the standard atmosphere (atm), the atmospheric pressure at the Earth's surface. Use the graph to answer the questions below.



(a) Describe the relationship between atmospheric pressure and the height

(b) Use the graph to estimate thee atmospheric pressure at a height of

(i) **2 km** = _____ (ii) **4 km** =_____
(iii) **6 km** = _____

(c) Use your answers from Part (b) to calculate the **ratios**

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(d) What happens to the atmospheric pressure after every 2 km increase in height?

(e) Consider the rate of change of the atmospheric pressure with respect to the height. What are the suitable units for this rate of change?

(f) Is the rate of change of atmospheric pressure with respect to the height **increasing, decreasing** or **constant**? _____. Explain

4. Lacey bought a high-end cell phone five years ago. The yearly resale value of the cell phone is shown in the table

Year	Resale Value of Camcorder ($)
0	4800.00
1	3840.00
2	3072.00
3	2457.60
4	1966.08
5	1572.86

(a) Calculate the **1st** and **2nd Differences**. How do you know the relationship is **not linear** or **quadratic**?

(b) Calculate the **ratios**. Is the relation **exponential**? _____. Explain.

(c) What are the suitable units for the **rate of change** of resale value with respect to time?

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5.4 – ANALYSE GRAPHICAL MODELS

1. Aveline purchased several shares of stock in a growing company. She recorded the share value each day for a week.

Day	*Share value ($)*	*1st Diff.*	*2nd Diff.*
0	31.12		
1	32.25		
2	33.65		
3	34.89		
4	36.23		
5	37.51		
6	38.84		
7	41.26		

(a) Calculate the **1st Differences**. Why might Aveline suspect that this could be a **linear** model?

(b) Calculate the **2nd Differences**. Why might Aveline believe that this could be a **quadratic** model?

(c) Aveline performed regression analysis and determined that the **linear** model for this data was **y = 1.391x + 30.85** and that the **quadratic** model was **$y = 0.052x^2 + 1.030x + 31.2$,** where **x** represents the **Day** and **y** represents the **Share value.** Determine which model fits the situation best for **Day 10** by using the above models.

(i) $44.70 (ii) $46.70

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2. Two neighbouring towns both have an initial population of **12000**. *Town A's* population is growing at a rate of **1500 people per year**. *Town B's* population is growing at a rate of **10% per year** and is modelled by the equation $\mathbf{P = 12000(1 + 0.1)^t}$, where P represent the **Population** after **t years**.

Complete the table by calculating the population of both towns every year for **7 years**

Year	***Town A***	***Town B***
0	12000	12000
1		
2		
3		
4		
5		
6		
7		

3. A large company has grown consistently for the previous 7 years. The yearly number of people employed at this company is shown in the table

Year	***# of Employees***	***1st Diff***	***2nd Diff***
1	4160		
2	4328		
3	4500		
4	4680		
5	4868		
6	5060		
7	5264		

Year	***# of Employees***	***Ratios***
1	4160	
2	4328	
3	4500	
4	4680	
5	4868	
6	5060	
7	5264	

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(a) Calculate the **1st Differences** to show that a **linear model** could be used to represent the data

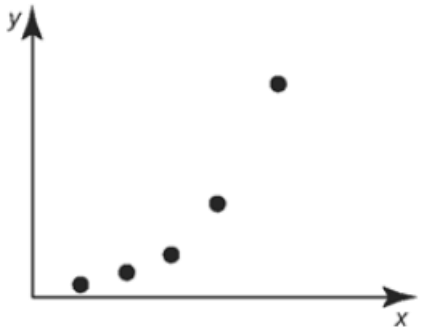
(b) Calculate the **2nd Differences** to show that a **quadratic model** could be used to represent the data

(c) Calculate the **ratios** to show that an **exponential model** could be used to represent the data

5.5 – SELECT A MATHEMATICAL MODEL

1. If the **2nd Differences** of a set of data are nearly constant, which model would be most appropriate to represent the data? _____ (linear, quadratic, exponential)

2. Which model seems most appropriate for the graph below? _____ (linear, quadratic, exponential)



3. The table shows the total operating revenue for gold courses and country clubs in Canada each year from 1998 to 2004.

Year	***# of Employees***	***1st Diff***	***2nd Diff***
1998	1.625		
1999	1.607		
2000	1.716		
2001	1.805		
2002	1.881		
2003	2.048		
2004	2.224		

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(a) Calculate the **1st and 2nd Differences**. How do you know that this model is **quadratic**?

(b) Performing quadratic regression generated the equation $\mathbf{y = 14.690x^2 + 13.429x + 1612}$, where **x** represents the **number of years after 1998** and **y** represents the **operating revenue**. Use the equation to predict the operating revenue in **2005**.

4. A telecommunications company recently launched a year long advertising campaign to promote their brand of cellular telephones. The monthly number of new cellular telephone subscribers is shown in the table on the **next page**

(a) Calculate the **1st Differences** and if necessary, calculate the **2nd Differences** and **Ratios**

(b) Based on the calculations, which model most suitable for the data? _____ (linear, quadratic, exponential). Explain

(c) Based on the suitable model for this data, which equation best represents this data?

$\mathbf{y = 5909x + 1.100}$ $\mathbf{y = 5909x^2 + 1.100x + 0}$ $\mathbf{y = 5909(1.100)^x}$

Using the appropriate equation which best models the data, determine the number of new subscribers in **Month 12**

Month	*# of New Subscribers*	*1st Diff*	*2nd Diff*
1	6500		
2	7150		
3	7870		
4	8650		
5	9520		
6	10470		
7	11520		
8	12670		

Month	*# of New Subscribers*	*Ratios*
1	6500	
2	7150	
3	7870	
4	8650	
5	9520	
6	10470	
7	11520	
8	12670	

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SOLUTIONS

5.1

1. B

2. (a) C (b) D (c) A

3. (a) 100 m/min (b) 20 min

4. (a) As time increases, number of sheets decreases (b) 1300 sheets
(c) 50 sheets, 50 sheets (d) 50 sheets
(e) Constant, sheets of plywood decreases by 50

5. (a) Linear, For every 20 m of height, time increases by approximately 7 min
(b) Approximately 0.35 min/m

6. (a)

(b) Linear, changes are equal over every interval of height and temperature

5.2

1. (a) Linear (b) Quadratic

2.

Height (m)	Temperature (°C)
0	15.00
500	**11.75**
1000	**8.50**
1500	**5.25**
2000	**2.00**
2500	**–1.25**
3000	**–4.50**

5.

3. (a) As price increases, revenue increases then decreases

(b) Approximately $32000, Approximately $34250

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4. (a) Yes (b) No, Cost going up by different amount each interval

(c) 2, 4, 6, 8, 10; increasing (d) 2; Yes

5.3

1. (a) (i) 9900 people (ii) 8910 people (b) 0.9; Yes, ratios constant

2. (a) No; 1st Differences constant, Linear (b) Yes; Ratios constant

3. (a) As height increases, atmospheric pressure decreases

(b) (i) 77% (ii) 59% (iii) 45% * all approximate

(c) 0.766, 0.763 (d) Pressure decreases approximately by a factor of 0.76

(e) Percent of one atmosphere/kilometre

(f) Increasing; 1st Differences become greater

4. (a) Not linear or quadratic; 1st and 2nd Differences not constant

(b) Yes, Ratios are constant (c) Dollars/year

5.4

1. (a) 1st Differences nearly constant (b) Yes, 2nd Differences nearly constant

(c) (i) Linear (ii) Quadratic

2.

Year	*Town A*	*Town B*
0	12000	12000
1	13500	13200
2	15000	14520
3	16500	15972
4	18000	17569
5	19500	19326
6	21000	21258
7	22500	23384

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3. (a) 1st Differences nearly constant, linear model would fit

(b) 2nd Differences nearly constant, quadratic would fit

(c) Ratios nearly constant, exponential model would fit

5.5

1. Quadratic

2. Exponential

3. (a) Quadratic; 2nd Differences nearly constant (b) $2 426 000 000

4. (a)

Month	Number of New Subscribers	First Differences	Second Differences	Ratios
1	6 500			
		650		
2	7 150		70	1.100
		720		
3	7 870		60	1.100
		780		
4	8 650		90	1.099
		870		
5	9 520		80	1.101
		950		
6	10 470		100	1.100
		1050		1.100
7	11 520		100	
		1150		1.100
8	12 670			

(b) Exponential; Ratios nearly constant (c) $y = 5909(1.100)^x$; 18545 subscribers

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