

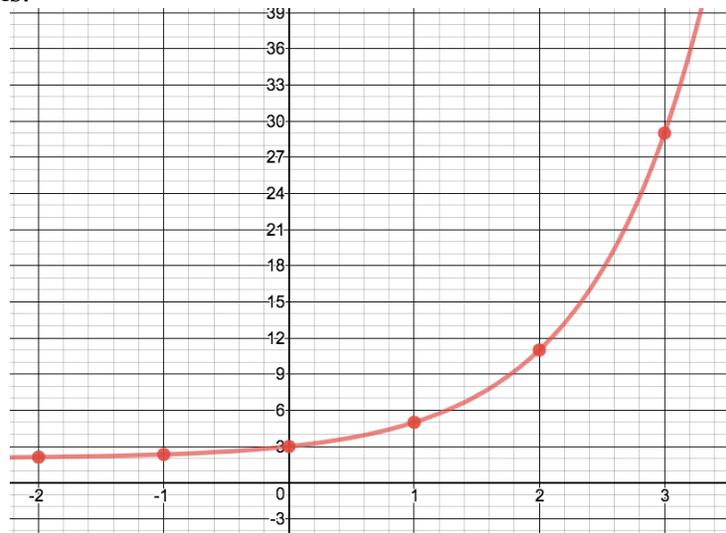
- (CI) Factor the following quadratic expressions: (a) $x^2 - 3x - 28$; (b) $5x^2 + 17x - 12$; (c) $9x^2 - 16$
- (CI) Simplify the expression $\frac{(2xy^{-2})^3(x^{-1}y)^{-2}}{32xy^{-3}}$. Your final answer should not have negative exponents.
- (CI) For the quadratic function, $f(x) = 2x^2 + 6x - 20$;
 - Factor $2x^2 + 6x - 20$.
 - Hence, find the x-intercepts of the function.
 - Hence, find the vertex of the parabola.
 - Find the y-intercept of the quadratic function.
 - Sketch the function, labelling all the information from Q(b), Q(c) and Q(d).
 - Mr. S now takes this parabola and reflects it across the x-axis and uses the translation vector $\begin{pmatrix} -3 \\ 5 \end{pmatrix}$ to move the parabola. Write the equation of the new parabola.
- (CI) Find the value of a given that 3, 0, a , a , 4, a , 6, a and 3 have a mean of 4.
- (CI) Solve the following equations: (a) $x^2 + 5x - 14 = 0$; (b) $2(x - 1)^2 - 6 = 0$; (c) $4x^2 - 9 = 0$
- (CA) Mr. Smith would like his IM1 class to solve the equation $4^{2x-1} = 7$. Show/explain **two** different ways that he could teach his IM1 class about solving this exponential equation. Finally, what is the solution to the equation?
- (CI) Simplify the expression $\frac{(2xy^{-1})^{-2}}{(8x^3)(4y^3)^{-1}}$. Your final answer should NOT have negative exponents.
- (CA) Here are Liam's results from last 5 tests in Math class: 66%, 65%, 72%, 96%, and 80%.
 - Liam has one more test to write and he would like to have a test average of 70% over the 6 tests. What should his test score be on his 6th test in order to get the test average to be 70%?
 - From his 6 class tests, what is the maximum test average he could get?
- (CI) Solve the following exponential equations. Show the key steps in your solutions.
 - $3^{1-x} = \frac{1}{9}$. [3]
 - $5^{x+1} = \left(\frac{1}{5}\right)^{2x+5}$
- (CI) Nicholas and Je-heon sell newly designed digital watches. The profit on the watches they sell is modeled by the function $P(n) = -2n^2 + 120n - 1000$, where P is profit in dollars and n is the number of watches sold.
 - What are the break-even points for Liam and Je-heon? [3]
 - What profit will they make if they sell 40 watches? [2]
 - What is the maximum profit they can earn? [2]
- (CI) Jana says that the range of the function $h(x) = -2x^2 + 16x - 20$ is infinite. Explain why she is wrong and then find the range for this function. [4]

12. (CA) Yousef is preparing for the math Semester Exam and is worried about his math grade. His current grade in Math is 78.3% and he would like to get a B in Math this year, so he wants at least an 82.5% average in Math this year. If the score on the Final Exam is weighted as 20% of the final course grade, what does Yousef need to score on his Final Exam to finish with at least an 82.5% as his course grade?
13. (CI) Write the equation of a quadratic, $h(x)$, where $h(-1) = h(11) = 0$ and the minimum value of $h(x)$ is -72 .
14. (CA) Mr. S has invested some money for his son Ian's university education. When Ian was born, I invested \$10,000 into an investment that has been growing exponentially by 8% every year.
- How much money is the investment worth, when Ian turns 20 years old? Show/explain the analysis that leads to your answer.
 - How long does it take for the money to double in value? Show/explain the analysis that leads to your answer.
15. (CI) 12 of 29 measurements are below 20 cm and 13 measurements are above 21 cm. Find the median if the other 4 measurements are 20.1 cm, 20.4 cm, 20.7 cm and 20.9 cm.
16. (CA) In this question, you will use graphing calculator to help you answer these questions about various features of the graphs of parabolas. Briefly, explain how you used the calculator to answer the question.
- Determine the vertex of the parabola $y = 2x^2 + 5x - 8$
 - Determine the equation of the axis of symmetry of the parabola $y = 3(x + 4)(x - 7)$
 - Write the equation $y = 3x^2 - x - 12$ in factored form.
 - Find the zeroes of the parabola $y = -0.5x^2 + 2x + 5$
17. (CA) Mr. Rawlings has compiled the following data set, wherein he keeps track of how many golf balls he loses every week he plays golf!!!

<i>Number of weeks played</i>	0	1	2	3	4	5
<i>Number of golf balls lost during that week</i>	68	55	44	36	29	23

- Show that the data is exponential.
 - Determine the decay **factor**.
 - Determine the decay **rate**.
 - Determine the algebraic rule that describes these data.
 - Will he ever go a week without losing a golf ball? Explain your answer.
18. (CI) Mehdi thinks he knows that the quadratic function $g(x) = \frac{1}{2}(x+1)(2-x)$ has a **maximum** point. Is he correct? Show/explain your reasoning.
19. (CI) Evaluate the following expressions: (a) $27^{\frac{2}{3}}$; (b) $16^{-\frac{5}{4}}$; (c) $f(2)$ where $f(x) = \frac{1}{4}(2)^{x-4} + 1$
20. (CI) Given the quadratic function $K(x) = -3x^2 - 14x - 15$,
- Find the zeroes of $K(x)$ by factoring. Show work.
 - Now use your TI-84 to solve the inequality $0 < -3x^2 - 14x - 15$. Include a sketch in your solution.

21. (CA) Easton eventually becomes a production manager for an eco-friendly farming company. The company runs some experiments to collect data on the effect of different amounts of natural fertilizers, x (measured in kilograms), on the amount of carrots grown, y (measured in tonnes). The regression equation he gets from his research data is as follows: $y = -0.5x^2 + 1.4x + 0.1$
- If they do not use any fertilizer, how many tonnes of carrots would the company grow?
 - What is the maximum point and what does it represent in the context of this question?
 - What are the zeroes and what do they present in this question?
 - What would the domain and range for this model be? Explain.
22. (CA) The following set of pulse rates (in beats per minute) was collected from ten students right before they took a math quiz: 58 74 75 66 63 72 65 67 67 73
- Find the mean, median and mode and the interquartile range of this data set.
 - If the 75 was replaced with a 90, would the following values increase, decrease, or stay the same? Explain your answers.
 - The mean.
 - The median.
 - The range.
 - The interquartile range (IQR)
23. (CI) Here is the graph of a function. Determine the equation of the function, showing/explaining the key steps of your analysis.



24. (CA) Mr. S. is kicking a ball off the roof of an apartment building and he determines that the relationship between the height of the ball and its time in flight is modelled by $h(t) = -5t^2 + 25t + 50$, where $h(t)$ is measured in meters and t is measured in seconds.
- State the window settings you used to view this quadratic function.
 - What is the height of the building from which he kicked the ball?
 - What was the maximum height of the ball and when did the ball reach this height?
 - In what domain interval was the height of the ball increasing?
 - When does the ball hit the ground?
 - State a reasonable domain and range for this function. Explain your reasoning.

25. (CI) Evaluate the following expressions. Express all final answers as reduced fractions where possible.

a. $32^{-\frac{3}{5}}$ b. $16^{-1} + \left(\left(\frac{1}{3} \right)^{-2} + 4^{-\frac{1}{2}} \right)^0$ c. $\log_4 8$.

26. (CI) Apply the distributive property to expand and simplify the following:
- $2(x - 4)(2x + 5)$
 - $-4(x + 6)^2 - 5$
27. (CA) Liam has become a world famous medical researcher who has developed a medicine to cure MATHITIS. Once the medicine is taken, it is used up as it kills the bacteria that cause MATHITIS. The mathematical model $A(t) = 50(0.85)^t$ can be used to describe the amount of medicine still left in the body, where t is the time in hours since the dose was taken and $A(t)$ is the amount of medicine left in the body measured in milligrams. Therefore a new dose of medicine is required every 8 hours.
- Given the equation used to model this problem, what is the amount of the initial dose taken by a patient?
 - Explain what the point $(3, 30.7)$ means in the context of this question.
 - How long does it take for HALF the medicine to get used up in the body? Show/explain your solution. (Round answer to the nearest tenth of an hour)
 - How much of the medicine is still in a patient's body after 8 hours (BEFORE they take their next dose?)
 - Ahmed takes a second dose exactly at 8 hours and a third dose, again after 8 hours. So 16 hours have passed. How much of the medicine remains in his body after a 24 hour time period? Show/explain the analysis that leads to your answer.
28. (CI) Mr. S. is trying to graph the following function $f(x) = -(2)^x + 4$, but needs your assistance
- Where does the graph of the function have its asymptote?
 - Determine the value of the y -intercept.
 - Evaluate $f(3)$ as well as $f(-2)$.
 - Determine the x -intercept of the function.
 - Sketch the function on the grid provided, labelling the information you determined in the previous questions.
 - State the domain and range of this function.
 - Mr. Rawlings wonder what this graph would look like, if it were reflected across the line $y = x$. Sketch it and explain to Mr. R. how you determined what the graph should look like.
29. (CA) Shown below are the scores 16 students received on a math quiz.
52, 60, 66, 66, 71, 72, 72, 73, 74, 75, 80, 80, 80, 91, 92, 98.
- What are the median and mean of this data set?
 - Find the **range** of the data set (defined as the difference between the largest data value and the smallest data value).
 - What is the median of the lower half of this data set
 - What is the median of the upper half of this data set
30. (CA) Given the equation $0 = 3x^2 + 6x - 7$;
- Solve this equation using the quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Record your final solutions, rounded to 2 decimal places.
 - Hence, or otherwise, convert the function $g(x) = 3x^2 + 6x - 7$ from standard form to factored form.

31. (CA) Mr. Santowski coached basketball this year and had been TRYING to help Liam learn how to make a basketball shot! In one practice, Mr Santowski recorded the following details about one of Liam's shot as he was trying to make a free throw:
- Liam released the ball from a height of 1.75 meters above the ground
 - after it traveled 2.5 meters forward, the ball reached a maximum height of 4 meters above the ground
 - after the ball traveled 4 meters forward, it reached a height of 3.19 above the ground.

We will define x to represent the distance the ball travels FORWARD and we will define h as the height of the ball ABOVE THE GROUND.

- List the three ordered pairs that correspond to the details that Mr S recorded about Liam's throw.
- Draw a picture of the path of the basketball that Liam has thrown, labelling the three points Mr S. has recorded in his data set.
- Determine the quadratic equation that models the flight to this basketball shot.

The basket is located at a location given by the coordinates of (4.57, 3.05)

- Explain what the coordinates of (4.57, 3.05) mean in the context of this problem.
- Does his shot make it into the basket? Show/explain the reasoning to your answer.

32. (CA) The following questions deal with investments that Mr. D. has recently made, in order to start saving for his retirement.
- He invested \$20,000 into an investment that earns 7% p.a., compounded quarterly. He would like to know how much **interest** he has earned from this investment in $10\frac{1}{2}$ years. Show/explain the analysis that leads to your final answer.
 - Today, he will invest some additional money so that he can purchase a house. The investment will earn 5% p.a. interest, compounded monthly. If he needs this new investment to be worth \$45,000 in 9 years, how much should he invest today? Show/explain the analysis that leads to your answer
33. (CI) Given the sequence of numbers-8,-3,4,13,24,37,52,
- How do you know the pattern is NOT linear?
 - How do you know the pattern is NOT exponential?
 - What are the next three terms of the sequence?
 - What are the 3 terms that came **before** -8?
34. (CA) Zounds Inc makes phones. Last year, they modeled the company's profits using the function $P(x) = -5x^2 + 60x - 135$, where P is profit in hundreds of thousands of dollars and x is the number of cell phones made (in hundreds of thousands). Over the course of the year, the CEO, Omar, decided to "restructure the company" and make the company more efficient by eliminating some jobs and reducing costs. This year, they modeled their profits using the model $P(x) = -7x^2 + 70x - 63$. Was Sounds Inc's restructuring effective? Provide at least two "evidences" to justify your answer.

35. (CI) Given the exponential function $f(x) = 25(0.95)^x$,
- Does this function represent a growth function or a decay function? Show/explain how you know.
 - At what rate does the function grow/decay?
 - What is the value of the y-intercept of this function?
- Mr. S. now writes a new equation as $g(x) = 25(0.95)^x + 20$
- Where does this new function have its y-intercept?
 - Where does the new function have its asymptote?
36. (CI) Given the function $f(x) = 2(x - 3)(x + 5)$,
- determine where the x-intercepts are.
 - find the y-intercept.
 - where is the axis of symmetry?
 - find the coordinates on the vertex.
 - which way does the parabola open? How do you know?
 - now, sketch the parabola, given the information you have just determined.
37. (CI) Mrs Knox is carefully monitoring a chemical spill that happened on Saturday in her science lab. She accidentally spilled radioactive milk and she knows that she can model the amount of radioactivity left in the lab using the model $A(t) = 32\left(\frac{1}{2}\right)^{\frac{t}{4}}$, where the amount of radioactivity, A , is measured in becquerels and t is time measured in hours since the accident happened.
- Explain how we know that the model she is using is a decay equation.
 - What is the half-life of the radioactive milk? (Half-life being defined as the time it takes for the amount of the substance to be halved.) Show/explain how you determined your answer.
 - If the spill occurred at noon (12:00pm), what amount of radioactivity is left at midnight (12:00am)?
 - Her classroom will be “safe” only when there is less than 0.5 becquerels of radioactivity in her classroom. What time of the day will her class first be “safe”?
38. (CI) Eight values are 6, a , 7, a , 4, b , 6 and 8, where a and b are single digit numbers and the mean is 7.
- Show that a and b have two possible values.
 - If there is a single mode, what is the median?
39. (CI) Kat knows that the quadratic function $f(x) = 3(x + 5)^2 + 4$ has NO x-intercepts. EXPLAIN how she knows that this is true.
40. (CI) Given the equation $3x^2 - x + 5 = 4x + 7$;
- Solve the equation.
 - To interpret the equation, Esther says that the equation $3x^2 - x + 5 = 4x + 7$ actually represents the intersection of two functions. Write the equation of these two intersecting functions and hence, find the intersection points.
41. (CA) Here is a simple data set. Use your TI-84 to graph a scatter-plot and determine a quadratic regression equation for the data set. Write the equation here on the quiz and show me the scatter-plot to get marks for preparing the scatter-plot.

x	-1	0	1	2	3	4
y	6	-1	-3	-1.5	5	10

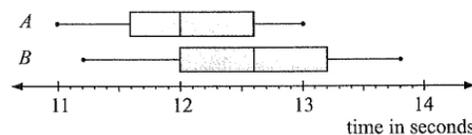
42. The hypotenuse of a right triangle is 6 cm more than the shorter leg. The longer leg is three cm more than the shorter leg. Find the length of the shorter leg. **Hint: Draw a right triangle and apply the Pythagorean Theorem.**

43. (CA) Mr. Dunham is doing a dice rolling experiment with his IM3 class. He starts the experiment with 150 dice and will remove any dice that shows a 2 or a 5. Listed below is the data set he compiled:

Trial #	0	1	2	3	4	5	6	7	8
# of dice remaining	150	98	76	56	40	27	19	12	9

- Mr. Dunham would like to use a linear function to model the data. Explain to him why he cannot use a linear model for this data set.
- Mr. Smith would like to use an exponential function to model this data set. Explain to him why he can use an exponential model for this data set.
- Mr. Rawlings now wants an equation for the data. Show/explain how you would determine an equation for this data set.
- What is the equation that models this data set?
- Mr Santowski believes that you know the **theoretical equation** for this problem (simply by understanding the context for how we got the data). So, without any reference to the data set, what should the equation be and why?

44. (CI) The given parallel box-plots represent the 100 m sprint times for the members of two athletic teams.



- Determine the 5 number summaries for both teams
- Determine the (i) range and (ii) inter-quartile range for each team.
- Record three observations about the performances of the two teams.

45. (CI/CA) Solve the equation $5x(x - 1) + 5 = 6 + x(1 - 2x)$ using any ALGEBRAIC method you wish. To verify your solution, EXPLAIN how you would use the TI-84 to verify that your solution was correct.

46. (CI) Given the following functions, predict whether or not they have x -intercepts. Briefly, show/explain your reasoning. (i) $a(x) = 2x^2 - 4x + 7$ (ii) $b(x) = 3x^2 - 5x + 1$

47. (CA) In the year 2030, Sakshi has become a leading industrial entrepreneur, working for the Tata Group in India and due to her awesomeness, the company's profit starts to increase, according to the equation $P(t) = 150(1.0955)^t$, where P represents the annual profit, in billions of US dollars and t represents the years since 2030.

- At what yearly rate does the Tata's Group profits increase? [1]
- What is the company's expected profit in 2050 (answer in billions of dollars)? [2]
- In what year will Tata Group's profits be \$200 billion? Show/explain the analysis that leads to your answer. [3]
- Sakshi introduces changes to the way the company operates. As a result, the company's yearly rate changes. She notices that the profits have increased from \$150 billion to \$225 billion in 5 years. Determine the company's new annual rate of growth

48. When Nicholas hits a baseball, its height, h , in meters, after t seconds since being hit is modeled by $h(t) = -5(t - 4)^2 + 81.3$, where h is the height of the ball, in meters, t seconds after the ball was hit. For this question, you are expected to present algebraic solutions in order to potentially earn full marks for your solutions.
- What is the height of the ball at the instant the ball is hit?
 - Find the maximum height of the ball and the time when this height is reached.
 - Je Heon is trying to catch the ball after Nicholas hits it. Can Je Heon catch the ball after its been in the air for 7.5s?
 - Determine the value(s) of the zeroes and interpret their meaning.

49. (CA) The lists below show the average grades of students in two different math classes:
 Class A: 15 26 29 39 55 60 63 66 66 67 67 72 72 73 73 74 80 81 88 90 92 96 97 98 98
 Class B: 52 61 63 65 67 67 68 70 70 71 72 72 72 73 74 76 78 78 80 81 85 96
- Draw a HISTOGRAM for the distribution of scores in Class A and in Class B
 - Compare the two distributions commenting on their shapes, centers, and spreads.

50. (CI) For the quadratic function $y = 2x^2 + 12x - 14$;
- Find the axis of symmetry and use it to find the vertex of the parabola.
 - Write the equation in vertex form.
 - Hence, use this vertex form to solve for the zeroes of the parabolas.

51. (CA) This *back to back stem plot* given represent the times for the 100m freestyle recorded by the CAC swim team.

- Find the mean, median, mode, range and IQR for the data set.
- Draw a histogram and box-whisker plot on your TI-84
- Complete the following table:

	Girls	Boys
outliers		
shape		
centre (median)		
spread (range)		

- Write an argument that supports the conclusion you have drawn about the girls' and boys' swimming times.

Girls	Boys
	32 1
4	33 0 2 2 7
7 6 3	34 1 3 4 4 8
8 7 4 3 0	35 0 2 4 7 9 9
8 8 3 3	36 7 8 8
7 6 6 6	37 0
6	38
0	39
	40
1	41 leaf unit: 0.1 sec