

PART 1 - CALCULATOR ACTIVE QUESTIONS

1. Given the polynomial $y = x^4 - 2x^3 - 8x^2 + 2x + 2$, use the TI-84 to produce a graph of the function.

(10 marks)

- a. State an appropriate window setting, such that all zeroes and extrema (max/mins) are clearly visible.

Xmin	
Xmax	
Ymin	
Ymax	

(2)

- b. Use your TI-84 to determine the zeroes of this quartic polynomial. Round your zeroes to 2 decimal places.

(2)

- c. Using your answer from (b), write the equation in factored form.

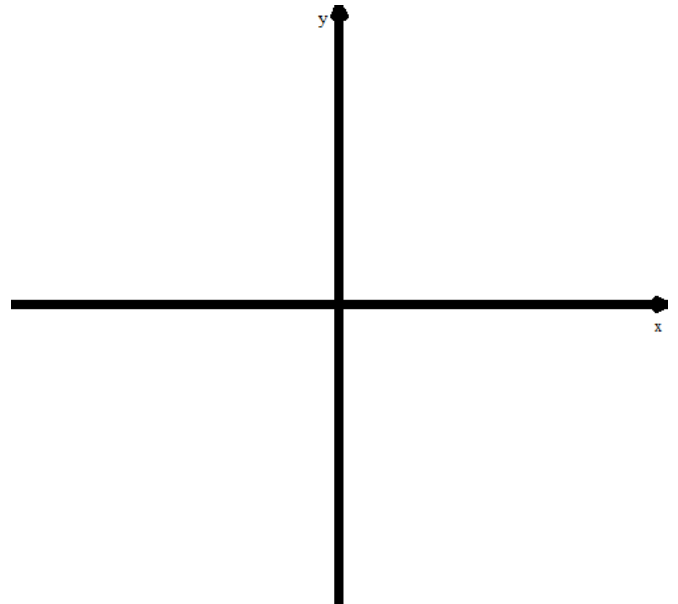
(2)

- d. Sketch the polynomial on the provided grid.

(2)

- e. Use your TI-84 to determine the co-ordinates of the ABSOLUTE MINIMUM (lowest point) of this polynomial (rounded to 2 decimal places)

(2)

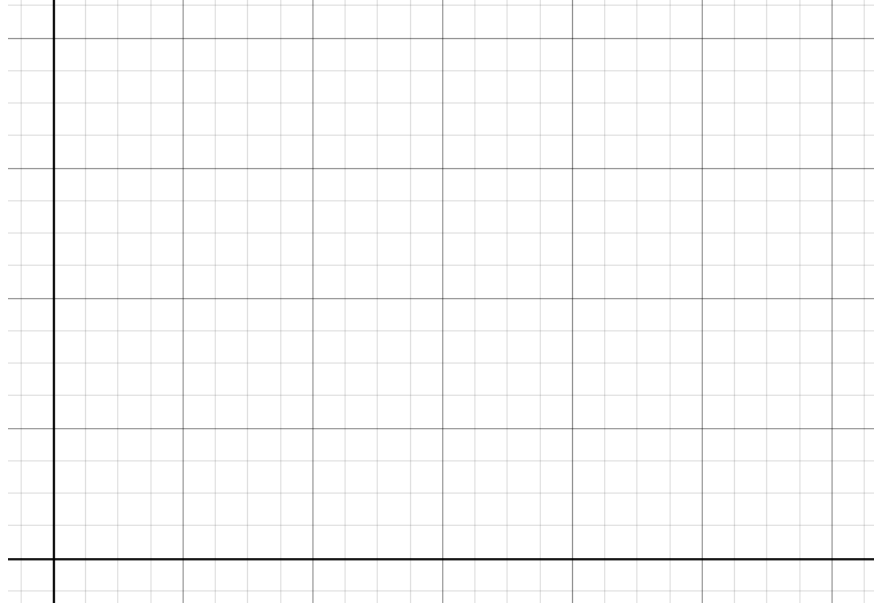


2. Mr. Santowski and Mr. Smith each have started up separate textbook publishing companies. For Mr. Santowski's company, the monthly revenues since January 1, 2015 are modeled by the equation

$R(t) = 12000 + 24000e^{-0.07t}$ and for Mr. Smith's company, the monthly revenues since January 1, 2015 are modeled by the equation $R(t) = 11000(1.0225)^t$.

(8 marks)

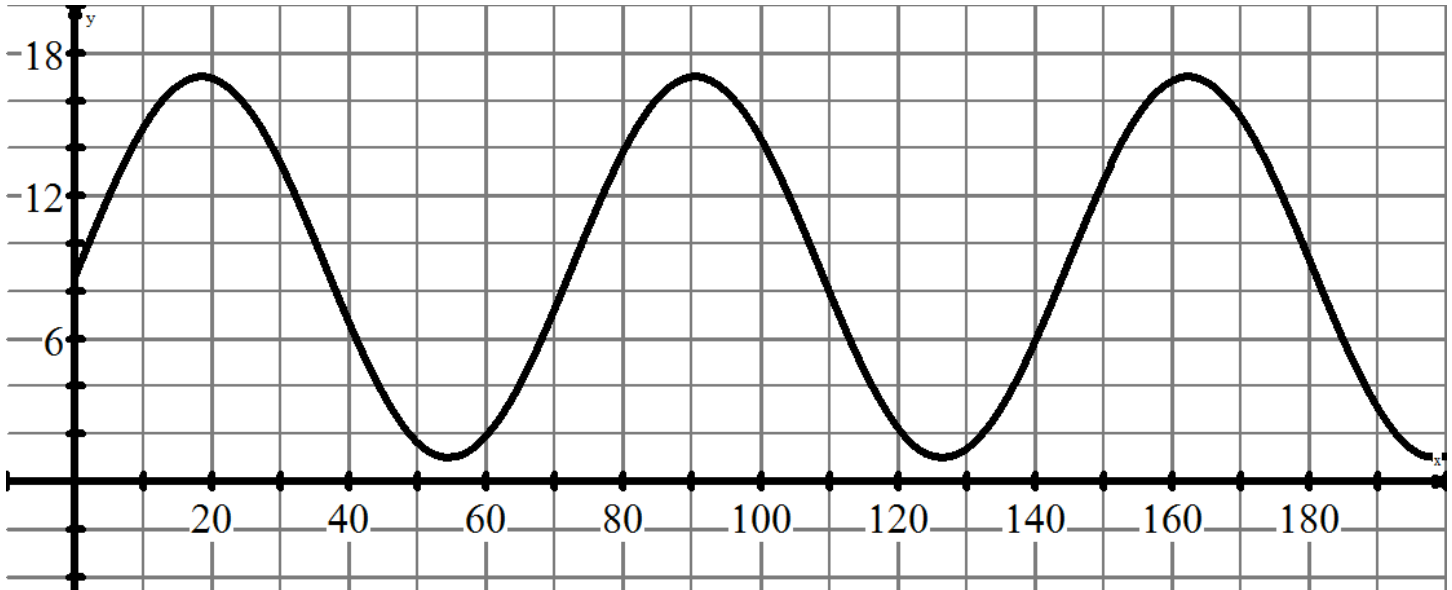
- a. Use your TI-84 to produce a graph given domain and range of $0 < t < 40$ and $0 < R(t) < 40000$ and **sketch** your graph here.



- b. Evaluate and interpret $R(6)$ for both companies.
- c. When do these companies have the same monthly revenue?

3. The height above the ground (h , in meters) of a rider on a Ferris wheel with a radius of 8 meters is modeled by the equation $h(t) = 8\sin(5(t - 3)) + 9$, where t is measured in seconds. The graph of the function is shown below. Use the graph or the equation, along with your calculator and your thinking skills, to answer the following questions. **Estimated answers from this graph will be given NO credit, so please show/explain key calculator OR algebra steps in your solutions.**

(10 marks)

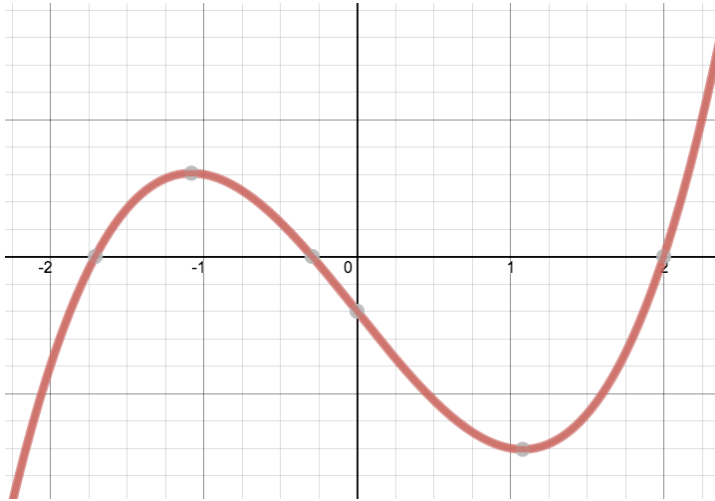


- (a) How long does it take for the wheel to make one revolution?
- (b) Find the height of the rider after 4 minutes.
- (c) At what times will the rider be farthest from the ground, in the first three minutes of the ride?
- (d) Find the first time the rider will reach a height of 12 meters.

4. Here is a graph of the cubic function, $y = 2x^3 - 7x - 2$.

(8 marks)

a. State the EXACT value of one zero of the cubic. (1)



b. Use the TI-84 to determine the approximate value of the other zeroes (rounded to three dp). (2)

c. This equation can be written in factored form as $g(x) = (Ax^2 + Bx + C)(x - D)$. Use your graph and answers from Qa to determine the values of A, B, C and D. (3)

d. ALGEBRAICALLY, confirm your answers to Qb using the quadratic function $Ax^2 + Bx + C$ from Qc. (2)

5. Let $N(t)$ represent the number of students attending CAC as a function of time, t , in years since 2012. The number of students is modeled by $N(t) = 1100 - Be^{rt}$.

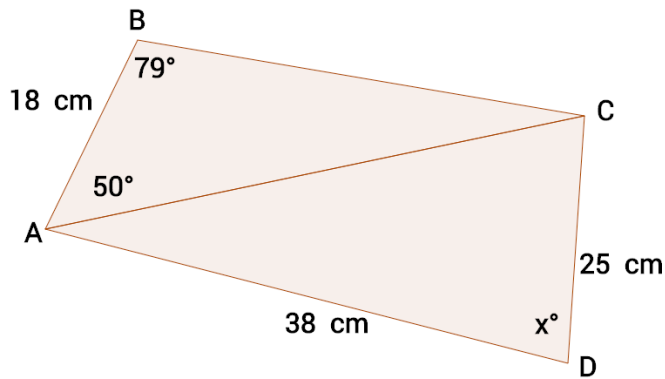
(10 marks)

- a. Given that $N(0) = 400$, show that the value of B is 700.
- b. If $N(4) = 850$ and knowing that $B = 700$, show that the value of r is .
- c. Given the values of B and r in Q7a and Q7b, evaluate and interpret $N(10)$.
- d. As time increases without bound, what happens to the number of students at CAC? Support your answer with a graph of the function **OR** an algebraic/mathematical explanation.
6. A game consists of rolling a fair six sided die with three red sides, two green sides and one blue side. A roll of red loses. A roll of green pays \$2. A roll of blue pays \$5. The charge to play is \$2.
- a. What is the “expected value” when playing the game many times?
- b. To make the game fair, Sophia will change the payout on the roll of green. What should the new payout be?
- Merel wants to make the game more complex, so she decides to incorporate 2 rolls of the dice. A roll of double red loses. A roll of double green pays \$2. A roll of double blue pays \$5. A roll of different colours pays \$1. The charge to play is \$ K .
- c. Determine the value of K such that the game is fair

7. Here is a diagram showing 2 triangles. Solve for the required angle (labelled as x in the diagram). Present a neat, easy to read solution & round your final answer to the nearest tenth of a unit.

(6 marks)

Solve for $\angle CDA$ (labelled x in the diagram)



8. The polynomial $g(x) = x^5 - 9x^4 + 27x^3 - 27x^2$ can be viewed in a standard view window (ZOOM 6) on your TI-84,

(6 marks)

- a. Determine the zeroes of $y = g(x)$ and state their multiplicities. Explain how you determined the multiplicities.
(HINT: it may help to make some WINDOW re-adjustments on your TI-84 and using your DATA TABLE!!)

(4)

- b. Write the equation of the polynomial in factored form.

(2)

9. You are told that the **half-life** of radium is 1690 years.

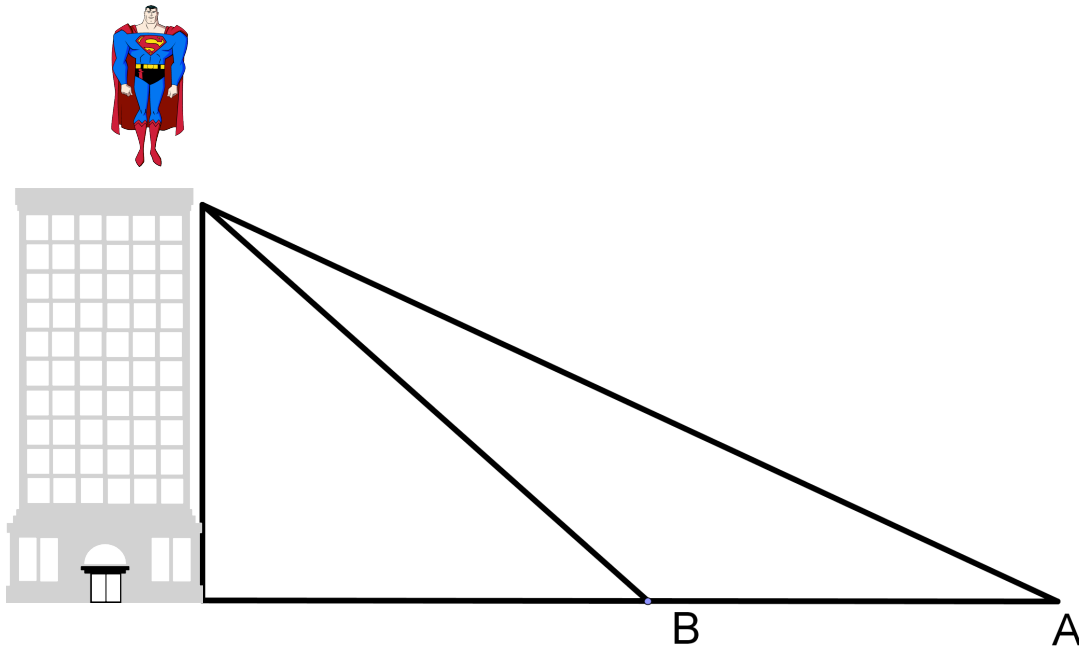
(6 marks)

a. If 25 grams are present now, how much will be present in 400 years?

b. How long will it take for 87.5% of the radium to disappear/decompose?

10. Mr. Smith (AKA Superman) is on a 40 meter tall building. He needs to determine the distance between two villains. He observes Villain A with an angle of depression of 26° and he notices Villain B with an angle of depression to now be 42° . Use this data to determine the distance between the two villains. (a partial diagram is provided and hints can be “purchased” for marks, though)

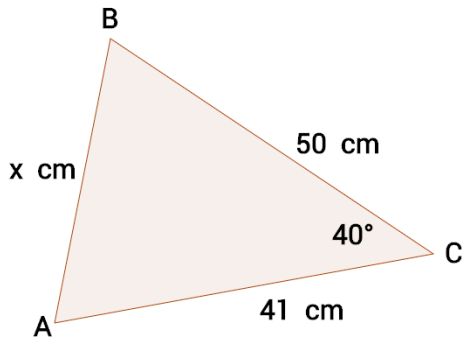
(6 marks)



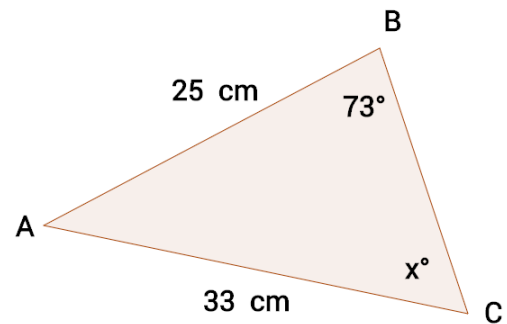
11. Solve for the unknown in each of the diagrams provided below. In terms of showing work, please show (i) key substitutions into appropriate formula(s) & (ii) final answer(s)

(6 marks)

(a) Solve for x (side c) in $\triangle ABC$



(b) Solve for $\angle BCA$ (angle X) in $\triangle ABC$



12. Mr. S is going to make an investment of \$30,000 into an account that offers interest at 8.5% per year.

- If the interest is to be compounded MONTHLY, how much INTEREST will he have earned in 14 years?
- If the interest is to be compounded CONTINUOUSLY, how much INTEREST will he have earned in 14 years?

c. Explain WHY the two amounts (from Q(a) and Q(b)) are **not** the same.

(7 marks)

13. The height of a basket on a water wheel at time t seconds is modelled by the equation $h(t) = 3\sin(5t)^\circ$, where t is time in seconds and h is the height above the water in meters.

(6 marks)

- a. What is the diameter of the water wheel? b. How high above the water is the basket at 14s? c. When will the basket first be 0.5 m under water?

14. Lama estimates that she has a 70% chance of passing Science and an 90% chance of passing Math. Assuming that {passing Science} and {passing Math} are independent events.

- a. Draw a tree diagram wherein EVENT #1 is Science and EVENT #2 is Math.
b. What is the probability that Lama will pass only one of these two subjects?
c. What is the probability that she does not pass both courses?

Now let's change these events to being dependent events

- d. What does "dependent events" mean?
e. Relabel the probabilities on your tree diagram to account for the fact that $P(\text{pass Math} \mid \text{fail English}) = 97\%$
f. What is the probability now of passing only one course?

15. Solve for the unknown in each of the equations given below. All final answers should be rounded to two decimal places.

(8 marks)

(a) $8^{x-4} = 75$

(b) $11 + 3e^{2-x} = 15$

(c) $\ln(2x + 5) = 3$

16. John is floating in a sailboat at a harbour. The sailboat rises and falls as the waves pass through the harbour. At a time of $t = 2$ second, John's sailboat reaches a minimum height of 4 m above the bottom of the harbour. At the time of $t = 11$ seconds, the sailboat reaches a minimum height of 12 m above the bottom of the harbour.

(14 marks)

(a) Complete the following data table:

Time (sec)	2	11	20	29	38	47
Height (m)	4	12				

(b) Use the data table to help sketch a graph which expresses John's height from the bottom of the pool with respect to time.



(c) Determine the period of the wave

(d) Determine the amplitude of the waves

(e) Determine the equation of the axis of the curve

(f) Write an equation (in terms of sine OR cosine) to represent John's position above the bottom of the pool as a function of time

(g) What is John's height above the bottom of the pool after 1 MINUTE?

(h) When does John reach a height of 7 meters for the THIRD time?

17. Ms. A invests \$25,000 for 8 years. She would like the investment to grow to a value of \$45,000 in those 8 years. What should be the annual interest rate (compounded continuously)?

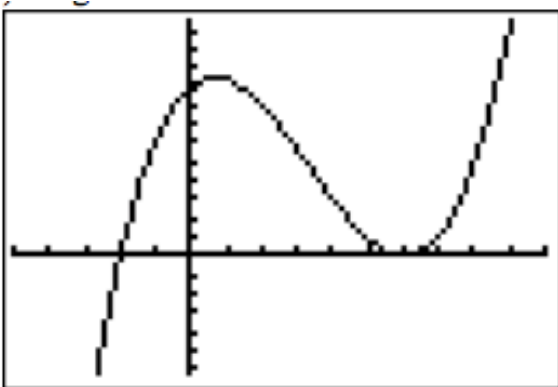
(3 marks)

18. Jar A has 4 red and 5 black candies. Jar B has 6 red and 2 black candies. A fair die is rolled and jar A is selected if a number divisible by 3 comes up, otherwise, Jar B is selected. One candy is drawn from the jar.

- What is the probability you selected Jar A and got a red candy?
- What is the probability you selected Jar B and got a red candy?
- What is the probability you got a red candy?
- Suppose a red candy is drawn, what is the probability it came from jar A?
- What is the probability Jar B was selected if a black candy is drawn?

19. The following graph was taken from Mr. S's TI-84 (where the x-scale and y-scales were each 1), write the function in factored and standard form. Show your working/reasoning in your solution.

(6 marks)

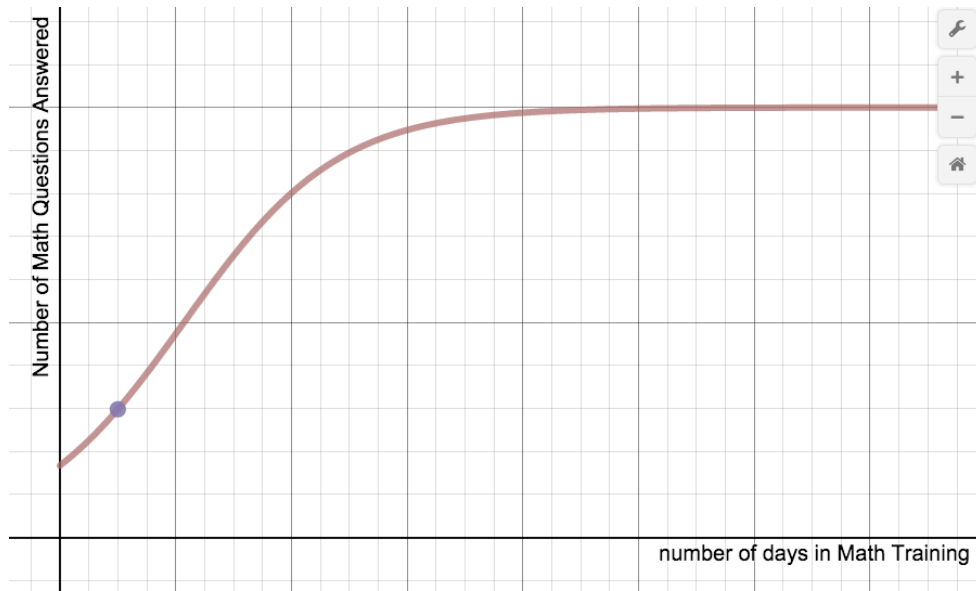


20. Tanya has just inherited a diamond ring valued at \$15000. If diamonds have **continuously** appreciated in value at an annual rate of 16%, what was the value of the ring 7 years ago when the ring was purchased?

(3 marks)

21. In your next year of IB Maths, Mr. S asks you to be part of a Math Contest team. First, however, you have to learn how to answer Math Contest questions. How quickly you learn and master the different types of questions can be modelled with a **learning curve** and we can use the equation $N(t) = \frac{500}{5 + 25e^{-0.11t}}$, where t is time in days since you began learning how to answer math contest questions and $N(t)$ is the number of questions you can answer per day, given t days of training. (For example, $N(5) = 25.75$, meaning that after 5 days of training, you can answer 25.75 (or 26) math contest questions per day). The graph is included below.

(8 marks)



Use your TI-84 to help answer the following questions. Values estimated from the graph will **NOT BE SCORED**.

- How many questions per day can you answer after training for 3 weeks? (round to the nearest integer)
- How long does it take before you can answer 60 questions per day? (round to the nearest integer)
- Mr. S wants you to answer a minimum of 90 questions per day by the time you've trained for 1 month. Show/explain whether or not this is a reasonable expectation.
- At what **limiting value** does the number of daily questions you can answer level off? Give a reason as to **why** there is a limit.