"The greatest shortcoming of the human race is our inability to understand the exponential function" – Albert A. Bartlett

Scenario:

This year your YouTube channel has started to take off, and in order to reach more potential followers you've decided to start a blog.

After learning about exponential functions, you've realised how critical an understanding of exponential growth among the general population is to the future of our society.

With your audience also growing exponentially, this is your chance to make a difference!

To gain exposure to a different audience, you are going to create a long-form guest blog post and/or YouTube video (see Table 1 below for word count and video length guidance) on the hugely popular ISHCMC Mathematics Department blog, "Inside the Matrix".

Your guest post should be suitable for a peer audience and should use one or more real-life examples to explain exponential functions. We suggest choosing one of the following topics, but if you would like to post about something else, please seek approval from your teacher before drafting your post:

- Compound interest and appreciating assets
- Moore's Law and the so-called "technological singularity"
- Population growth
- Spread of disease
- Nuclear chain reactions
- Viral internet memes or videos

In order to be ranked highly by Google's search engine, please ensure that your guest post contains all of the following elements. The references in brackets (Ci, Dii, etc) refer to the specific strands of Criteria C and D. These are explained in Appendix A.

1. **Identify** and define all variables and data relevant to your chosen example (Di)

2. **Select** or develop an appropriate exponential function to model the relationship between the variables in your example (Dii). If you use a model that you found through research, be sure to justify why an exponential growth model is appropriate for your particular situation (Dv).

3. **Apply** your selected model by performing example calculations using typical values of the variables identified in Step 1 (Diii). You should explain all calculations and interpret your solutions in the context of <u>your</u> real-life situation and then verify that your solutions are correct using an alternative method, either by comparing your solution with real-world data or using technology to perform the same calculations (pro tip: this is a good point at which to include a graph). For best results, you should justify the choice of typical variable values (i.e. numbers) used in example calculations through research (Dv).

4. Given that most of the values used in your calculations will be estimates, round any numerical answers to an appropriate number of significant figures and **justify** your choice of rounding (the degree of accuracy of your solutions) using appropriate percentage error calculations (Div).

5. **Justify** how you know your solutions make sense in the context of your real-life situation and discuss possible situations when your solutions would not make sense (limitations).

Possible points to discuss (Dv):

- Is your answer consistent with real-life values found through research?
- At what point does your model begin to break down? Why?
- Are models other than exponential growth possible?

Criterion D Grading Rubric

Outline Template (more specific detail about each step above + links to examples and resources)

Finally, I'll be looking for writing that includes appropriate and correct use of mathematical language and forms of representation (Ci and Cii), reasoning that is complete, coherent and concise (Civ), and a logically organised structure with subheadings (Cv). Specifically, your guest post should contain the following elements:

- At least one example calculation of appropriate complexity (think minimum several lines of working, maximum around one A4 page) and formatted in an equation editor (Ci, iv)
- At least one appropriately labelled, digitally produced graph that *you* produced. A table of values that simply contains the same data as that presented on a subsequent graph is not necessary (and in fact would be considered as not concise); however, it should be obvious to the reader from your writing where the values on the graph came from (Cii)
- For best results, your post should also include appropriate and well-integrated use of other figures and tables that support your explanation (Ciii)

Criterion C Grading Rubric

The fine print

1. You will be required to submit your draft post and/or video to Managebac so that I can verify its appropriateness (and authenticity) before I allow you to publish on the website.
2. Formal MLA 9th edition formatting is not required, but you are required to acknowledge all sources at their point of use (and include a link to the original source in your citation where possible). You should still number your figures and tables (Figure 1, Table 1, etc.) and refer to them in your writing as usual. You should also type mathematics using an equation editor.
3. IMPORTANT: if you choose the video option, you still need to make sure it includes all the elements listed above. In that case, please prepare a list of links to all sources mentioned in your video to be posted below it on the website.

Read on for Table 1 and Appendix A…

Table 1

Blog post and video combination length guidance

Blog post length (approximate)		**Video length (approximate)**
800 words	and	No video
600 words	and	1 minute
400 words	and	2 minutes
200 words	and	3 minutes
No article	and	4 minutes

Here is an example of mathematical modelling in a blog post style by Mr Wallace (not exponential growth, but just an example of the kind of writing style you should aim for).

Appendix A: Criteria C and D strand descriptor clarifications

While Communicating students will: use mathematical terminology, symbols and notations, use different forms of representation correctly and move between them to clarify or communicate ideas effectively, communicate lines of reasoning for the methods or calculations in a complete and concise manner and structure the work in a logical and organized manner for ease of understanding		
Achievement level	**Descriptors for Criterion C - Communicating**	**Clarifications for Criterion C - Communicating**
	The student is able to:	You demonstrated the ability to:
1–2	i. use **limited** mathematical language ii. use **limited forms** of mathematical representation to present information iii. **communicate** through lines of reasoning that are **difficult to interpret.**	i. use **limited** mathematical language and terminology related to the mathematics of exponential growth and the particular topic of your blog post. *Mathematical communication was hindered and use of appropriate mathematical notation was not demonstrated, as you did not use an equation editor* ii. use **limited** forms of mathematical representation (figures, tables and equations) to communicate your findings, and you needed to use more of these in order to communicate your ideas clearly. The forms that were present were either inappropriate (for the purpose of communicating your findings) or frequently presented with missing and/or incorrect elements. *You did not use enough different graphs, tables and equations to be able to link these to each other in a way that would have helped clarify your mathematical ideas.* iii. **communicate** your findings through mathematical calculations that either lack written explanations or contain written explanations that are difficult to interpret and/or missing vital information. *Rarely structure work in a manner that is organized, with vital steps and mathematical reasons for the steps missing, thus it making it difficult to interpret the work*
3–4	i. use **some appropriate** mathematical language ii. use **appropriate forms** of mathematical representation to present information **adequately** iii. **communicate** through lines of reasoning that are **complete** iv. **adequately organize** information using a logical structure.	i. use **some appropriate** mathematical language and terminology related to the mathematics of exponential growth **and** the particular topic of your blog post. Use **some appropriate** mathematical notation (typed in an equation editor) to communicate mathematical ideas. ii. use **some appropriate** forms of mathematical representation (figures, tables and equations) to communicate your findings. These are **sometimes** presented **appropriately** (using legends, axis labels, headings, units etc.) but often with elements that are missing or incorrect. *Rarely use different graphs, tables and equations or link these to each other in a way that would have helped clarify your mathematical ideas.* iii. **communicate** your findings and ideas through mathematical calculations/working steps and word explanations, which include mathematical reasoning that is **complete**. iv. **adequately organize** your findings using a logical structure or flow of mathematical steps and written reasoning, graphs, tables etc. that can be followed with some effort.
5–6	i. **usually** use **appropriate** mathematical language ii. **usually** use **appropriate forms** of mathematical representation to present information **correctly** iii. **usually** move between different forms of mathematical representation iv. communicate through lines of reasoning that are **complete and coherent**	i. **usually** use **appropriate** mathematical language and terminology related to the mathematics of exponential growth **and** the particular topic of your blog post. **Usually** use **appropriate** mathematical notation (typed in an equation editor) to communicate mathematical ideas. ii. **usually** use **appropriate forms** of mathematical representation (figures, tables and equations) to communicate your findings. These are **usually** presented **appropriately** (using legends, axis labels, headings, units etc.) and **correctly.** iii. **usually** move between graphs, diagrams, equations, tables and word answers to link mathematical ideas.

	v. **present** work that is **usually organized** using a logical structure.	iv. communicate your findings through mathematical working steps and word explanations that are mostly **complete and coherent.** v. **present** your findings in a **usually organized** manner with some subheadings and a mostly logical flow between mathematical calculations, reasoning, written explanations, tables, graphs etc.
7–8	i. **consistently** use **appropriate** mathematical language ii. use **appropriate forms** of mathematical representation to **consistently** present information **correctly** iii. move **effectively** between different forms of mathematical representation iv. communicate through lines of reasoning that are **complete, coherent and concise** v. **present** work that is **consistently organized** using a logical structure.	i. **consistently** use **appropriate** mathematical language and terminology related to the mathematics of exponential growth **and** the particular topic of your blog post. **Consistently** use **appropriate** mathematical notation (typed in an equation editor) to communicate mathematical ideas. ii. **consistently** use **appropriate forms** of mathematical representation (figures, tables and equations) to communicate your findings. These are **consistently** presented **appropriately** (using legends, axis labels, headings, units etc.) and **correctly.** iii. **effectively** link between graphs, diagrams, equations, tables and word answers, such that the whole work is cohesive iv. communicate your findings through mathematical working steps that use an appropriate level of detail **and** word explanations that are **complete, coherent and concise** v. **present** your findings in a **consistently organized** manner with subheadings and a logical flow between mathematical calculations, reasoning, written explanations, tables, graphs etc.

While Applying mathematics in real-life contexts students will: identify various aspects of the real-life problem, select mathematical strategies to model the real-life situation, reach a correct solution, justify the accuracy of the solutions and justify why the solution would make sense in the context of the problem.		
Achievement level	**Descriptors for Criterion D – Applying mathematics in real-life contexts**	**Clarifications for Criterion D – Applying mathematics in real-life contexts**
	The student is able to:	You demonstrated the ability to:
1–2	i. identify **some** of the elements of the authentic real-life situation ii. apply mathematical strategies to **find a solution** to the authentic real-life situation, **with limited success.**	i. **identify** some *(leaving out others that may be appropriate)* of the aspects (*elements/variables*) of the situation that are relevant to the given problem and select the information *(data/values/units etc.)* related to these aspects for solving the problem. ii. Use mathematical strategies to **find a solution** to the problem **with limited success.** *(either the strategy is not suitable and/or the working is incorrect)*
3–4	i. identify the **relevant** elements of the authentic real-life situation ii. select, **with some success, adequate** mathematical strategies to model the authentic real-life situation iii. apply mathematical strategies to **reach a solution** to the authentic real-life situation iv. **discuss** whether the solution makes sense in the context of the authentic real-life situation.	**i. identify** all of the aspects (*elements/variables*) of the situation that are relevant to the given problem and select the information *(data/valuse/units etc.)* related to these aspects for solving the problem. ii. select **some mathematical strategies** that are appropriate for solving/modelling the problem/situation iii. **apply** the selected mathematical strategies to **reach a solution** to the problem *(The solution may be looking at the situation in parts and other aspects of real-life situation which were overlooked may hinder arriving at a valid solution)* *The use of rounding off or significant figures is either not appropriate or not explained, and no consideration of how changes in the values of the elements/variables identified in strand (i) might affect the degree of accuracy of the solution is present.* iv. **Discuss** how the numerical solution obtained is comparable to known real-life values of the variable being modelled, and/or list some of the assumptions and limitations of the mathematical model used (that might result in the solution not being valid or reasonable).

5–6	i. identify the **relevant** elements of the authentic real-life situation ii. select **adequate** mathematical strategies to model the authentic real-life situation iii. apply the selected mathematical strategies to **reach a valid solution** to the authentic real-life situation iv. **explain** the degree of accuracy of the solution v. **explain** whether the solution makes sense in the context of the authentic real-life situation.	**i. identify** all of the aspects (*elements/variables*) of the situation that are relevant to the given problem and select the information *(data/values/units etc.)* related to these aspects for solving the problem. ii. select **most** of the **mathematical strategies** that are appropriate for solving/modelling the problem/situation iii. **apply** the selected mathematical strategies; consider most of the aspects of the real-life situation and the valid range *(different possible minimum and maximum values*) of each aspect or variable to **reach a valid solution** to the problem. iv. Explain **the use of rounding off or significant figures used in mathematical calculations** used to create the solution. The solution as applied in the problem is discussed, with **qualitative** consideration of how changes in the variables/elements identified in strand i *(elements of the real-life situation)* may affect the solution and how the rounding off/significant figures choice is suitable. v. Explain how the values/data/units etc. used were appropriate such that the solution is what would be seen in a real-life situation. Explain *(with reasons*) the **assumptions used** to create the mathematical model. Explain using valid reasoning why the **solution is reasonable** in the context of the real-life situation.
7–8	The student is able to: i. identify the **relevant** elements of the authentic real-life situation ii. select **appropriate** mathematical strategies to model the authentic real-life situation iii. apply the selected mathematical strategies to **reach a correct solution** to the authentic real-life situation iv. **justify** the degree of accuracy of the solution v. **justify** whether the solution makes sense in the context of the authentic real-life situation.	**i. identify** all of the aspects (*elements/variables*) of the situation that are relevant to the given problem and select the information *(data/values/units etc.)* related to these aspects for solving the problem. ii. select **all** of the **mathematical strategies** that are appropriate for solving/modelling the problem/situation iii. **apply** the selected mathematical strategies; consider all of the aspects of the real-life situation and the valid range *(different possible minimum and maximum values*) of each aspect or variable to **reach a correct solution** to the problem. iv. Justify **the use of rounding off or significant figures used in mathematical calculations** used to create the solution. The solution as applied in the problem is discussed, with **quantitative** consideration of how changes *(for the range of likely values)* in the variables/elements identified in strand i *(elements of the real-life situation)* may affect the solution and how the rounding off/significant figures choice is suitable and within an acceptable degree of error. v. Justify how the values/data/units etc. used were appropriate such that the solution is what would be seen in a real-life situation. **Justify** the **assumptions used** to create the mathematical model using research and/or the relevant scientific/mathematical principles involved in developing the model. Justify with calculations why the **solution is reasonable** in the context of the real-life situation.

Notes:

1. **Adequate** (as opposed to **appropriate**) mathematical strategies might be oversimplified or incomplete, but could still result in a solution that is correct in limited situations
2. **Valid** solutions (as opposed to **correct** solutions) might be theoretically possible and/or reasonable (and usually not both) but will generally be inaccurate due to either errors in mathematical working, numerical calculation errors or the use of an oversimplified or inappropriate mathematical model.