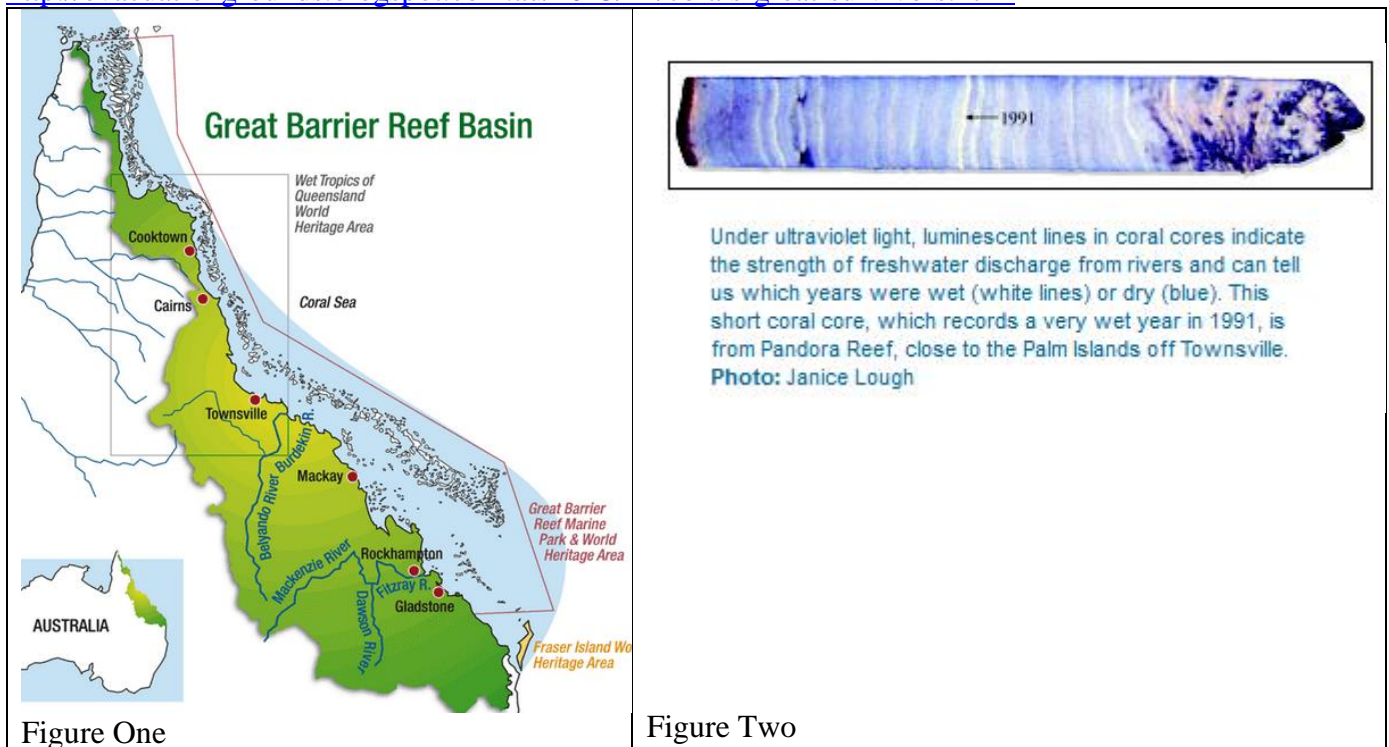


# Year 10 Advanced Maths. Linear Graphs and Indices Analysis Task

Name:	Date:	Marks: Out of 61
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## Analysis Task One : HOW OLD IS THE AUSTRALIA'S GREAT BARRIER REEF?

Reference: <http://creation.mobi/age-great-barrier-reef>  
<http://www3.aims.gov.au/docs/publications/waypoint/003/headlines-03.html>  
<http://evacuationgrounds.blogspot.com.au/2013/12/corals-great-survivors.html>



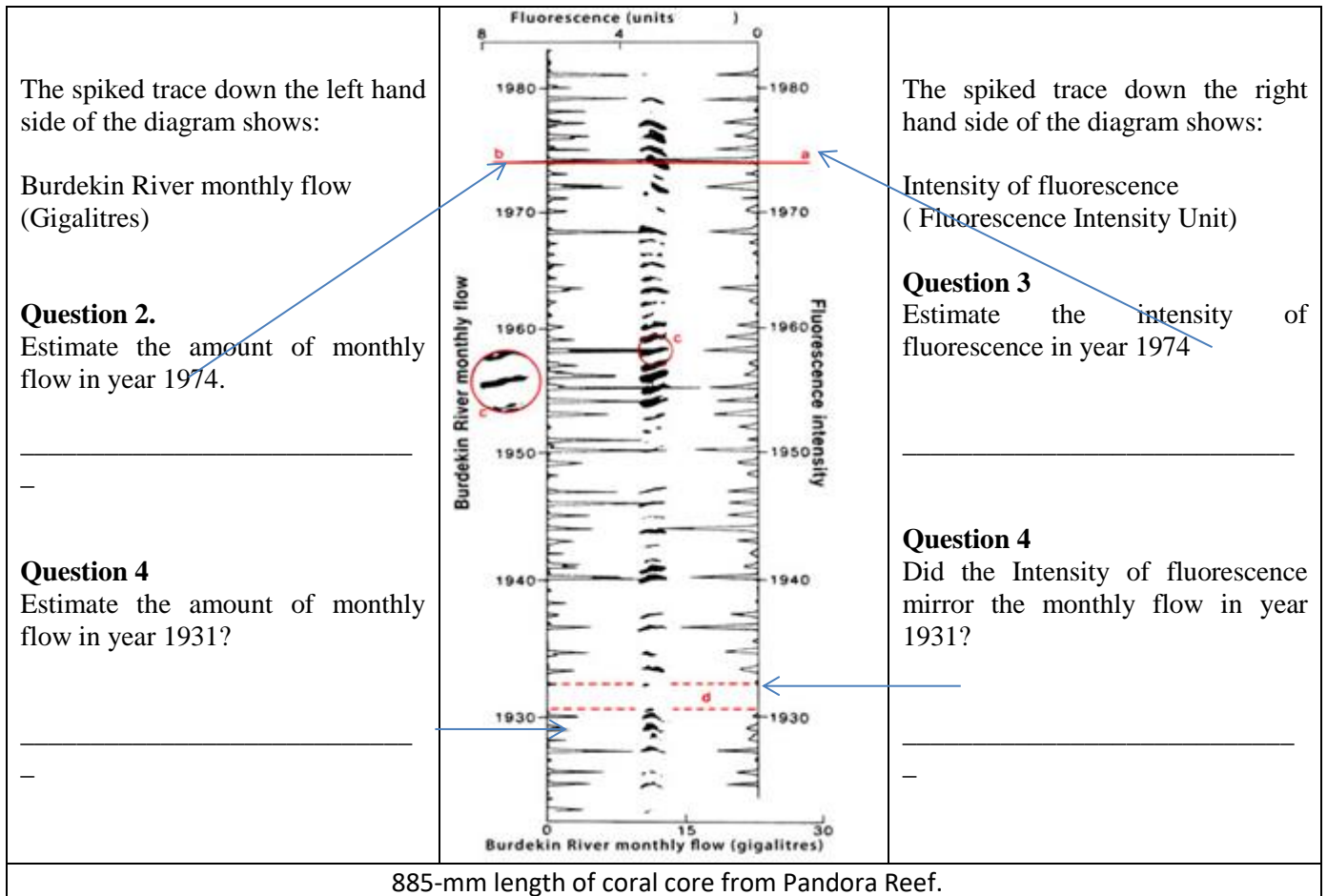
**Question 1.** How old do you think The Great Barrier Reef is? \_\_\_\_\_

At the Australian Institute of Marine Science (A.I.M.S.), Cape Ferguson, 50 km south of Townsville, Queensland, a **relationship** has been found between the **rates** at which the **corals grow** and the seasonal high freshwater runoff or **floods** from nearby land. This fascinating discovery was made after a drilling rig had been set up on the small Pandora Reef, off the coast of Queensland near the mouth of the Burdekin River. The Pandora Reef is a part of the Great Barrier Reef. Researchers drilled into the structural part of this reef to a depth of 10 metres, and recovered complete drill-core records of the growth of the coral colonies that make up the reef.

When the drill core was placed under ultraviolet light, he observed a remarkable phenomenon—the coral displayed bright bands of yellow-green fluorescence in an irregular pattern-of varying intensities. (Ref Figure Two) The frequency and intensities of these fluorescent bands were continuously measured down the whole vertical depth (1.8m) of one coral colony and then recorded in graphical form.

It was evident that increased river flow during floods strongly influences the coral growth. It affected not only seasonal but annual rates of growth. The resulting bands produced in the coral are like tree rings, with denser fluorescent bands formed during periods of high freshwater runoff.

This record of the coral's fluorescent bands was then compared with records of flooding from the nearby Burdekin River, and it showed a near perfect correlation (see Figure three below).



**Question 5**

What do you think had happened in year 1931?

On analysis of the coral core, further data collected are shown in the following table

Let Year 1920 be Time 0, Year 1921 be Time 1, Year 1922 be Time 2 ...

Time (Year)	0	10	20	30	40	50	60
Height of coral (mm)	0	148	295	440	590	735	890

**Question 6**

What are the two variables being studied in this case?  
Which one is the explanatory? Which one is the response?

1 mark

### Question 7

Using the table of data, plot a graph showing the relationship between Time ( $t$ ) and Height of coral ( $H$ ).

Marks will be awarded based on

- Correct labelling of axes
- Correct scaling of axes
- Clear showing of co-ordinates and points
- Draw a line of “best-fit” across all points
- Graph is draw with pencil and ruler in a neat and clear manner

5 marks

### Question 8

Why would we use the abbreviations  $t$  and  $H$  in the formulae instead of using height and the number of years in the formulae?

1 mark

### Question 9

Find the gradient of the line of “best-fit” of your graph.  
Show all working out.

2 marks

### Question 10

Hence, interpret the meaning of the value of the gradient in question 9 using correct units. (i.e. explain the answer in context)

2 marks

**Question 11**

Which type of graph is this line? (exponential/linear?)

1 mark

**Question 12**

(a) Find the equation of the linear line in terms of  $t$  and  $H$ . See your teacher before proceeding any further.

1 mark

(b) Use your formulae to calculate the amount of growth for a 250-year period.  
Show all working out.

1 mark

(c) The depth of drilling was to a depth of 10m (or 10,000mm).  
How old was the reef at a depth of 10m (be careful of what units of measurement to use)?

2 marks

**Question 13**

Some reefs in the Great Barrier Reef are 55m in height! How old would your estimate of these reefs be? 2 marks

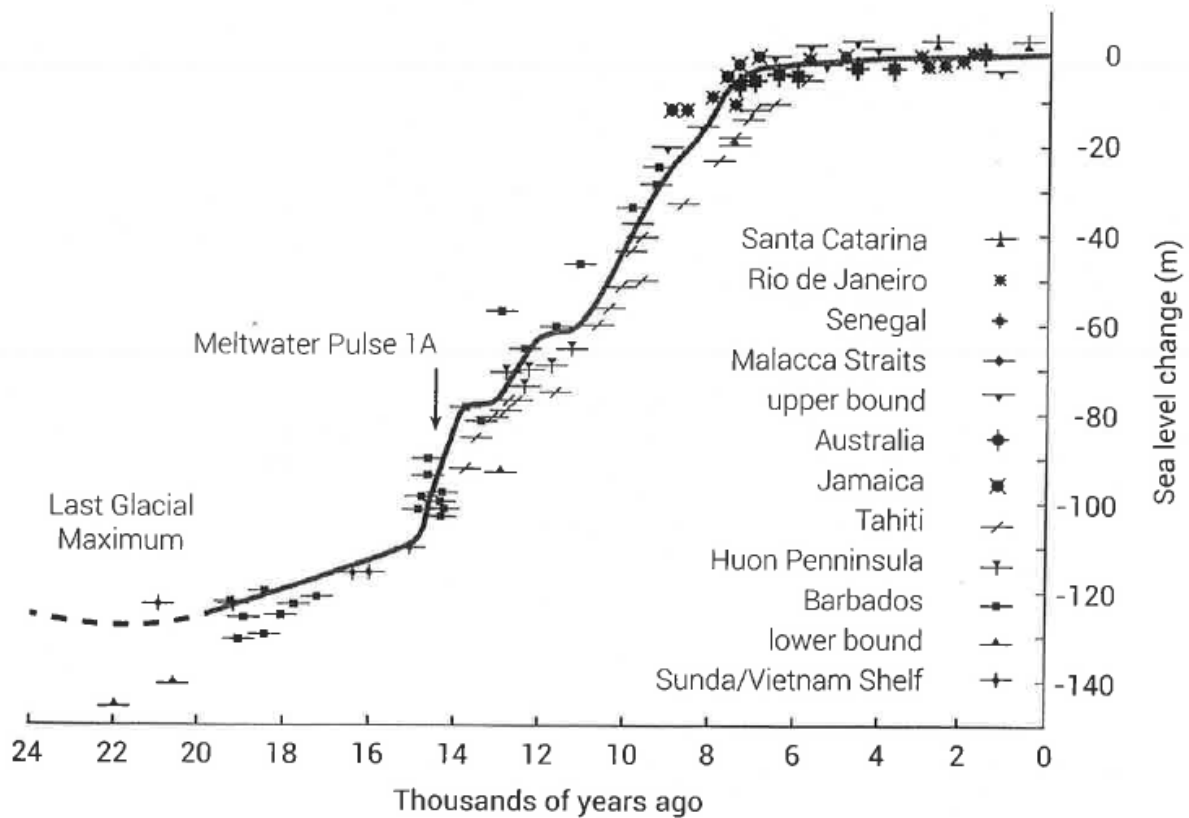
**Question 14**

How does your result compare with your answer from question 1?

Is there any limitations to how high a reef can grow?

What things did you learn from this activity?

3 marks



**Figure 1.** Long-age uniformitarian sea-level curve for the post-glacial-maximum period (after Rohde<sup>2</sup>).

**Question 15**

Refer to the above graph, what is the problem with the Great Barrier Reef being older than 10,000 years?

[1 mark]

**Question 16**

Comment on the accuracy of the horizontal axis as shown in the above graph and any assumptions that have been made.

[2 marks]

## **Analysis Task Two: POPULATIONS GROWTH**

Reference: [http://www.census.gov/population/international/data/worldpop/table\\_population.php](http://www.census.gov/population/international/data/worldpop/table_population.php)

The following are historical world populations from 1900 to 1980.

1900	1,608 million
1920	1,834 million
1940	2,216 million
1960	3,039 million
1980	4,400 million

### **Question 1**

- (a) How long ago do you estimate that Korie people (aboriginal) first came and settled in Australia?
- (b) How long ago do you estimate that humans first came into existence?

To analyse population growth rate, the following formula is used

$$P = P_o \cdot (1 + r)^n$$

### **Question 2**

State what does  $P$ ,  $P_o$  and  $n$  represent in this case study.

3 marks

If the population annual growth rate is 1.000000, i.e.  $(1 + r) = 1.000000$ , populations are neither increasing nor decreasing.

### **Question 3**

Using a rate of growth per year of 1.00475, what is the percentage increase per year?

1 mark

Show all working out.

### **Question 4**

Using the above data (and the formulae  $P = P_o \cdot (1 + r)^n$ ), from 1900 to 1920, find the rate of increase per year and the percentage rate of increase per year.

2 marks

Show all working out.

### Question 6

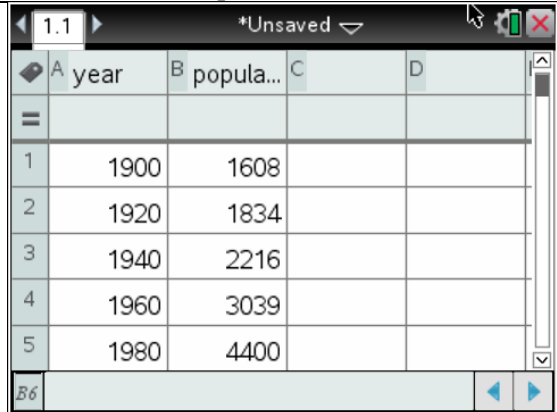
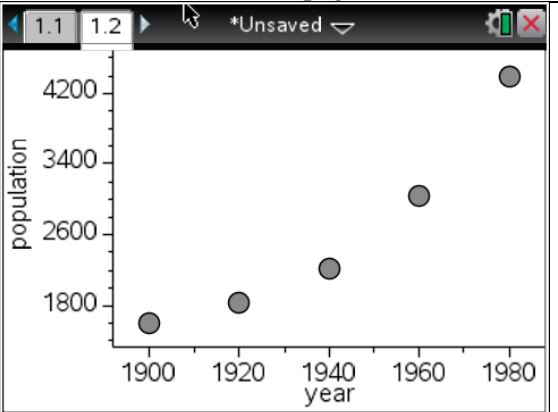
What is the percentage increase per year (use the table on the previous page and the formulae  $P = P_o \cdot (1 + r)^n$ )

4 marks

- from 1920 to 1940?
- from 1940 to 1960 ?
- from 1960 to 1980 ?
- from 1900 to 1980 ?

### Question 7

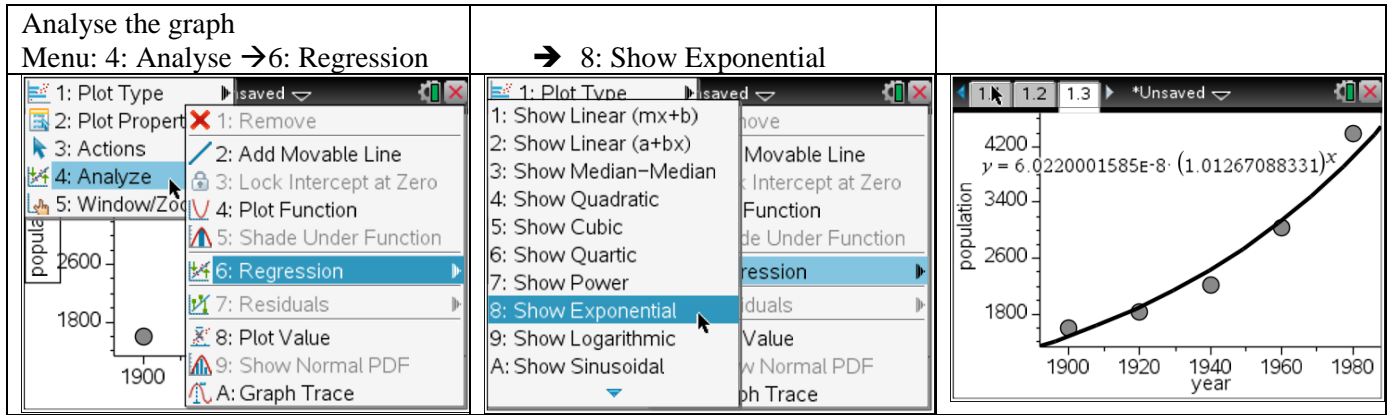
Compute the given data in CAS:

Use list and spreadsheet page Put the data in respective column	Construct a scatterplot Add "Data and statistics" page
	

Show your teacher the above working on your CAS

2 marks

### Question 8(a)



Show your teacher the above working on your CAS

2 marks

(b) Could we fit a linear equation/line on the graph in 8(a)? Why or why not?

2 marks

### Question 9

Find the number of years to double the world population, use the compound interest formulae  $P = P_0 \cdot (1 + r)^n$ .

2 marks

Show all working out

### Question 11

What would be a difficulty (cause of greater error) of using earlier data (i.e. data earlier than say 1800 AD) to model our world rate of population growth?

### Question 12

(a) Which 20 year period had the slowest rate of growth?

(b) What was the major cause of deaths during this period?



**Question 13**

Using a slower rate of growth i.e. 0.475%,  $r = 0.00475$ , and the compound interest formulae  $P = P_o \cdot (1 + r)^n$

(a) What would be the population of aboriginal people by the year 1788?

Assume there were 8 people arriving in Australia 50 000 years before the arrival of the first fleet in 1788.

2 marks

(b) Comment with respect to your estimated value in question 1a.

1 marks

**Question 14**

Most people (including scientists) believe that humans have been on planet earth hundreds of thousands/millions of years. Investigate this mathematically:

(a) Assume a very slow rate of growth, e.g. 0.1% per year. (i.e.  $r = 0.001$ ), what would the nowadays population be if there were only 10 people 100,000 years ago?

2 marks

(b) Comment with respect to your estimated value in question 1(b).

1 mark

**Question 15**

According to the BIBLE, there were 8 people after the flood. (Noah, his wife, his three sons and their wives)  
As per the BIBLE time line, this happened 4350 years ago.

(a) Use the population rate of growth from question 3, what would the population be today?

2 marks

(b) How does that compare with the actual value of about 7 billion people?

1 mark

### Question 16

In Genesis 12, God called Abraham in about 1921 BC, and he later had a child named Ishmael (through Hagar, the Egyptian maidservant (see Genesis 16)).

Ishmael was to become the father of the Arab people, who's population is now said to number about 200 million people.

(a) Find the population now, using a growth rate of 0.475% per year, starting with 2 people, at the time God called Abraham. Show all working out. 2 marks

(b) Comment your result with the information given. 1 mark

Not long after Abraham had Ishmael, Abraham had another child called Isaac (with Sarah who was both Abrahams wife and sister, see Genesis 21).

(c) Given that there are about 18 million Jews in the world today, find the rate of growth, starting off with 2 people at the time God called Abraham. Show all working out.

2 marks

(d) Does this rate of growth seem reasonable? Why (justify your answer)?

(Jewish people have undergone a tremendous amount of persecution and slaughter over the centuries.

Hitler had over 6 million Jews murdered in concentration camps alone during the second world war, there was the captivity of the Jews by the Babylonians and the Assyrians and the destruction of Jerusalem in 70 AD).

2 marks

Most Bible believing Christians believe that the Nation of Israel came down to Egypt with 70 people (Acts 7:14). About 430 years later there were about 2.7 million people who left Egypt (Exodus 12:37-38) to go back to the promised land.

(e) Given that the population growth of some countries are 4.5% per annum, comment (showing appropriate calculations) on whether or not the number of people leaving Egypt is a reasonable number.

2 marks

Write down 3 things you have learnt doing this task.

1/ \_\_\_\_\_

\_\_\_\_\_

2/ \_\_\_\_\_

\_\_\_\_\_

3/ \_\_\_\_\_

\_\_\_\_\_

Analysis Task B: Total 36 marks