

Worksheet 4

1. Also do problems 9B, problem 59a-e and 9C, problem 58a-c. These are hard problems, so start them **tonight**.
2. Here are some estimates of the world's population from the US Census Bureau:

| Date | Population |
|----------|---------------------|
| 07/01/07 | 6.627×10^9 |
| 10/01/07 | 6.647×10^9 |
| 01/01/08 | 6.667×10^9 |
| 04/01/08 | 6.687×10^9 |
| 07/01/08 | 6.706×10^9 |

- (a) Use the data to find the quarterly growth rate of the earth's population, as a percentage. (Hint: Find the relative change in each quarter, then average the results.)
 - (b) What is the doubling time (in years) for the world's population?
 - (c) What will the population of the world be ...
 - i. ... in 50 years?
 - ii. ... in 100 years?
 - iii. ... in 1000 years?
3. Way back in 1798, Thomas Malthus shook up the study of economics by pointing out that while population grows *exponentially*, food supply grows *linearly*. In 2008, world grain production is expected to be about 2 billion tonnes. (A ton and a tonne are different units – a tonne is 1000 kilograms.) Here is a table of estimated world grain production over the last few years:

| Date | Production |
|------|---------------------|
| 2005 | 1.854×10^9 |
| 2006 | 1.895×10^9 |
| 2007 | 1.962×10^9 |
| 2008 | 2.004×10^9 |

- (a) What will production be ...
 - i. ... in 50 years?
 - ii. ... in 100 years?
 - iii. ... in 1000 years?
- (b) How many kilograms of grain will the average person have to eat in 1000 years?
- (c) Was there something odd about the number you got in 3b?

The reason you got such an odd answer in 3b is that the population growth rate isn't constant. Right now, much of the world's population has enough food to eat. In 1000 years, very few people will have enough to eat, so the death rate will increase. If the more people are dying, the population growth rate will decrease. Exponential growth is only an *approximation* of the way the Earth's population grows – that means that it will only make sense for a few centuries.

4. Many people put the *carrying capacity* of the Earth – the number of people it can support before seriously damaging its ability to support life – at 12 billion people. Draw a rough sketch of what a graph of the Earth's population should *really* look like over the next 1000 years. It should start out looking exponential, and then slow down. Your result shouldn't be exponential or linear.