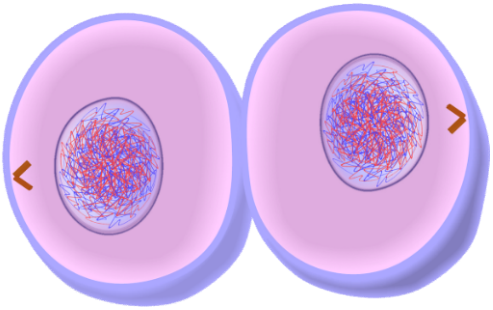
Name: Class:

Total Possible Marks: 15

Binary Fission



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1. Prokaryotic cells, such as bacteria, replicate by a type of simple cell division called binary fission in binary fission the cell makes copies of its genetic material before eventually splitting into 2 "daughter" cells.

   Put the steps of binary fission into the correct order:

   A. 1 The circular DNA and plasmids replicate.

   B. 2 The cell gets bigger and the circular DNA strands move to opposite sides/ends of the cell.

   C. 3 The cytoplasm begins to divide and new cell walls begin to form.

   D. 4 The cytoplasm completely divides and 2 daughter cells are produced, each daughter cell has one copy of the circular DNA but can have a variable number of copies of the plasmids.

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2. A biological container contains one cell which is about to undergo binary fission. At 14:00 hours there is just the one cell. At 15:00 hours scientists note that the biological container is "full", and the rate of binary fission is such that the number of cells doubles every second. Given this information, calculate the time at which the biological container was half full.

   This is a tricky question, it would be automatic to assume that the time would be 14:30 hours, but in fact it is 14:59 and 59 seconds.

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3. During a scientific study, scientists found that a certain strain of E. coli bacteria had a mean division time of 18 minutes. Starting an experiment at 6 PM on Day 1, and concluding it at the same time on Day 2, the scientists noted that the number of bacteria had now increased to 1,208,925,819,614,629,174,706,176.

   Using this information calculate the number of divisions which took place in this time period, choose from the following 4 options:

   * Although the number looks horrifying, 1,208,925,819,614,629,174,706,176 is in fact 2 raised the power of 80 which tells us that there were 80 divisions in the given 24 hour period. It is comment worthy to note that this sort of replication exemplifies the danger of such bacteria as E. coli

   (A) 120 (B) 60

   (C) 100 (D) 80

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4. The mean division time is just the average amount of time that it takes for one bacterial cell to divide into two.

___ 2 A. A bacterial cell has a mean division time of 30 minutes, how many cells will it have produced after 2 1/2 hours?

First of all make sure that you are working in the same units, so 2 1/2 hours would be converted to 150 minutes. The question tells us that the mean division time is 30 minutes so from this we calculate the number of "divisions" by dividing the total time by the mean division time, so in this case we have 150÷30 which equals 5. We have therefore 5 divisions so we can imagine ourselves dividing into 2, 4, 8, 16 and 32 over the 5 division periods. Another way of looking at it is by raising 2 to the number of divisions as a power, so 2^5=32.

___ 2 B. A bacterial cell divides by binary fission, with a mean division time of 24 minutes. How many cells will it have produced after 6 hours, give your answer to 2 significant figures.

Again, make sure you're working in the appropriate units, 6 hours is 360 minutes and so the number of divisions would be 360÷24 which is 15. Using the 2nd method of raising to a power, 2 raised to power 15 is 32,768, which to 2 significant figures is 33,000.

___ 2 C. Under certain conditions, a scientist has discovered that the Staphylococcus aureus has a mean division time of 30 minutes. Calculate how long it would take for one Staphylococcus aureus to produce a colony of 128 cells, stating your answer in hours.

The first thing we need to find out is the number of divisions. 2 raised to a power of 'X' equals 128, therefore from this we deduce "X" to be 7. This tells us that there are 7 divisions. As the mean division time is 30 minutes we can deduce that the time taken would be 7×30 which is 210 minutes or 3 1/2 hours.

___ 2 D. Under another set of conditions the same bacteria, Staphylococcus aureus produces 64 cells in 270 minutes. From this information calculate the mean division time and state your answer in minutes.

2 raised the power of 'X' is 64, from this we can deduce that 'X' is 6, this tells us that there are 6 divisions and we are given the total number of minutes for these as 270. The mean division time is therefore 270÷6 which equals 45 minutes.

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5. Bacterial cells divide and replicate by mitosis, is this true or false?

* This is false, bacterial cells divide and replicate by binary fission

(A) True

(B) False