1. Given info : N_0= 10,000, N=500,000, time = 3 hours. Asked for n.

$N=N_0(2^n)$; 500,000=10,000(2^n); 500,000/10,000=2^n; 50=2^n; log50= $\log 2^n$, log50=nlog2; log50/log2=n

n=5.6 doublings

2. Given N_0= 10,000, n = 5.6 (from previous). Asked for N at 24h.

$N=N_0(2^n)$; N= 10,000(2^n), need to find n for 24 h= (24/3)*5.6=44.8

N= 10,000($2^{44.8}$)=**3.1×10^{17} cells**

3. Given info : n for 3 hours= 5.6 (from previous). Asked for g

g=t/n= 180minutes/5.6= **32.1 minutes**

4. Given N_0= 10,000, t=6h; Need N for 6h

$N=N_0(2^n)$; N= 10,000(2^n), need to find n for 6 h

n for 6 h = t/g = 360min./32.1min. = 11.2

N= 10,000($2^{11.2}$)= 2.4×10^7 cells/mL

Diluted by 10^5, therefore (2.4×10^7 cells/mL)/ 10^5= 2.4×10^2 cells/mL

Plate 0.1 mL; therefore 2.4×10^2 cells/mL X 0.1ml = **24 Cells or CFU**

5. Given N_0= 10,000, t=2h; Need N for 2h

$N=N_0(2^n)$; N= 10,000(2^n), need to find n for 2 h

n for 6 h = t/g = 120min./32.1min. = 3.7

N= 10,000($2^{3.7}$)= 1.3×10^5 cells/mL

Need to find volume of one square; vol. of counting chamber = 0.2 *0.2*0.01cm = 0.0004cc=0.0004mL; therefore vol. of one square =0.0004/40=0.00001mL

Number of cells/sq= 0.00001mL * 1.3×10^5 cells/mL = **1.3 cells**

6. Given g= 3h, N= 81,920, t=42h; Asked for N_0

$N=N_0(2^n)$; $81,920=N_0(2^n)$; need to find n for 42h.

n=t/g = 42/3= 14

$81,920=N_0(2^{14})$; $N_0= (81,920/2^{14})$=**5 cells**

7. Given g= 1.5h, N_0= 6, N= 12,288; Asked for t

$N=N_0(2^n)$; $12,288=6(2^n)$; $(12,288/6) = 2^n$; $2048=2^n$; $\log2048=\log2^n$; $\log2048= n \log2$;

n= log2048/ log2; n= 11

t=ng=11x1.5=**16.5h**

8. Given µ= 0.00019cells/min, N_0= 500, N=56570; Asked for t

$56570=N_0(2^n)$; $56570=500(2^n)$;$(56570/500)= 2^n$; $113=2^n$; $\log113= n \log2$; $\log113/\log2=n$; n=6.82

g=ln2/ µ; g= 0.693/0.00019=3648min=2.5 days

t=ng=2.5 jours X 6.82 = **17.3d**

9. Given g = (g @4)/10, N_0= 500, N=56570; Asked for t

g @RT = 2.5j/10=0.25d

t=ng=6.82(according to previous) X 0.25d = **1.7d**

10. Given N_0= 5; g (Glucose) = 15 minutes, g (Lactose) = 20 min; t (glucose = 60 min., t (lactose = 120 min.) ; Asked for N 3hours or 180 min.

n for one hour (glucose) = t/g = 60/15 =4

N for one hour (glucose) = $N_0(2^n)=5(2^4)$= 80

n for two hours (lactose) = t/g = 120/20 =6

N for two hours (lactose) starting from N of glucose = $N_0(2^n)=80(2^6)$=**5120 bacteria**

11. 9×10^7

12. (cell number : t); (5×10^6 : t40) & (1×10^7 : t60); therefore **g= 20min**.

13. Time span represented by the line = 160 min.; n=t/g =160/20 = **8 doublings**

14. 300 minutes represents end of exponential phase. Therefore number of cells at this time point will be the same at 375 minutes.

Want N for 300 min. $N=N_0(2^n)$, Need to choose N_0: (arbitrarily chose 5×10^6 : t40)
Need time span (t): 300-40= 260min.
Need n for 260min. n=t/g=260/20=13
Therefore N for 300 min. = $(5 \times 10^6)(2^{13})$= **4.1×10^{10}**

15. Given N_0= O.D. of 0.25, N = O.D. of 1.0

Need to find n; $N=N_0(2^n)$; $1.0=0.25(2^n)$; n=2

Need to find time span: t=n*g=2*20=40min.

Therefore an O.D. of 1.0 will be reached 40min. after start point of 42 min.; **82 minutes**

16. Given N_0= O.D. of 0.25, Asked for N @ 124 min.

Need n for time span; Time span = 124-42=82min.; n=t/g = 82/20 = 4.1

$N=N_0(2^n)$, $N=0.25(2^{4.1})$ = **O.D of 4.3**

17. Need N for 100 min.; Need to choose N_0: (arbitrarily chose 5×10^6 : t40)

Need time span (t): 100-40= 60min.

Need n for 60min. n=t/g=60/20=3

Therefore N for 100 min. = $(5 \times 10^6)(2^3)= 4 \times 10^7$

Neisseria being diplococcus, one CFU = 2 cells; therefore $(4 \times 10^7)/2$= **2×10^7**

18. Need N_0 for 0 min.; Need to choose N: (arbitrarily chose 5×10^6 : t40)

Need time span (t): 40 - 0= 40min.

Need n for 40min. n=t/g=40/20=2

Therefore $N=N_0(2^n)$, $5 \times 10^6 = N_0 (2^2)$; $(5 \times 10^6)/4 = N_0$ = **1.25×10^6**

19. Need N for 92 min.; Need to choose N_0: (arbitrarily chose 5×10^6 : t40)

Need time span (t): 92-40= 52min.

Need n for 52min. n=t/g=52/20=2.6

Therefore N for 92 min. = $(5 \times 10^6)(2^{2.6}) = 3 \times 10^7$

μ in initial medium = ln2/g=ln2/20=0.035

μ in new medium is 2x lower, =0.035/2=0.017; g=ln2/ μ=ln2/0.017=40.8min.

N after 60 minutes in new medium:

$N_o=3 \times 10^7$ (@92 min.)

t= 60 min.

n=t/g=60/40.8=1.5

$N=N_0(2^n)$, $N = 3 \times 10^7 (2^{1.5})$ = **8.5×10^7**

20. Need N @40min and N @120, want N@120/N@40

N@40min= 5×10^6 ; N@120= 8×10^7; $8 \times 10^7/5 \times 10^6$ = **16X**