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B10 - 211

Assignment - 1

Solution 1

An e⁻ microscope magnify a cell to 10,000 folds (10^4)

So when viewing a eukaryotic cell i.e 50 μm diameter

magnified cells have diameter 50×10^4 μm

$= 500$ mm

≈ 19.685 inches

Solution 2.

~~Area of sphere~~

Volume of Sphere $= \frac{4}{3}\pi r^3 = \frac{4}{3}\pi \left(\frac{d}{2}\right)^3$

Diameter of muscle cell $= 50\ \mu m$

radius of muscle cell $= 25\ \mu m$

Vol. of muscle cells $= \frac{4}{3}\pi \left(25 \times 10^{-6}\right)^3$

$= 20.9 \times 10^3 \times 10^{-18}\ \pi$

$= 20.9 \times 10^{-15}\ \pi\ m^3$

Diameter of Actin molecule $= 3.6$ nm

radius of Actin molecule $= 1.8$ nm

Volume of Actin molecule $= \frac{4}{3}\pi (1.8 \times 10^{-9})^3$

$= \frac{4}{3} \times 1.8 \times 1.8 \times 1.8 \times 10^{-27} \pi$

$= 7.776 \times 10^{-27} \pi m^3$

No. of molecules muscle cell can hold $= \frac{\text{Vol. of muscle cell}}{\text{Vol. of Actin molecule}}$

$= \frac{20.9 \times 10^{-15}}{7.776 \times 10^{-27}}$

$\approx 2.68 \times 10^{12}$ molecules

2.68×10^{12} (approx.) molecules can be holded by muscle cell in absence of any other organelle

Solution 3

mass $= 3.0 \times 10^9$ Da

M.W of nucleotide pair $= 660$ Da

length of DNA molecule $= 0.34$ nm

(i) No. of nucleotide pairs $= \frac{3.0 \times 10^9}{660} = 4.5 \times 10^6$ bp

length of E. coli DNA molecule $= 4.5 \times 10^6 \times 0.34 \times 10^{-9}$

$= 1.53 \times 10^{-3}$ m

(i) Dimensions of typical E. coli cell

→ Rod shaped

About 2 μm long having 0.25-1.0 μm in diameter

molecular weight $= 3.1 \times 10^9$ g/mol

M.W of single pair $= 0.66 \times 10^3$ g/mol

No. of nucleotide pairs in DNA $= \frac{\text{M.W of DNA}}{\text{M.W of single pair}}$

$= \frac{3.1 \times 10^9 \text{ g/mol}}{0.66 \times 10^3 \text{ g/mol}}$

$= 4.7 \times 10^6$ bp

(iii) length per pair $= 0.34$ nm/pair

$= 4.7 \times 10^6 \times 0.34$ nm

$= 1.6$ mm

≈ 2 mm

$\frac{1}{3}$rd are codons $= \frac{4.7 \times 10^6}{3} = 1.6 \times 10^6$ codons

avg. proteins in E coli made of 360 AA

no. of proteins $= \frac{1.6 \times 10^6 \times (1 \text{ AA/codon})}{360 \text{ AA/protein}}$

$= 4444.44$ proteins

Solution 4

yeast cell spherical nucleus diameter = 2 μm

nucleus have contains 1.2×10^7 b/p of genome

8 histones make cylindrical core where 150 b/p wrapped

50 b/p space exist b/w 2 nucleosomes

If we take the no. of nucleosomes to be n

the eqn we get is,

$$150\,n + (n-1)\,50 = 1.2 \times 10^7$$

$$150n + 50n - 50 = 1.2 \times 10^7$$

$$200n - \underbrace{50}_{\text{negligible}} = 1.2 \times 10^7$$

$$n = \frac{1.2 \times 10^7}{200} \approx 6 \times 10^4 \text{ nucleosomes}$$

we get 6×10^4 no. of nucleosomes

Solution 5

Yeast cell enclosed by lipid bilayer

$SA = 80 \times 10^{-6}\ m^2$

$\frac{1}{2}$ as. covered by protein so $40 \times 10^{-6}\ m^2$

new SA left = $40 \times 10^{-6}\ m^2$

No. of lipid molecules we get = $2 \times \frac{40 \times 10^{-6}\ m^2}{0.25 \times 10^{-9}\ m^2}$

$$= \frac{80 \times 10^{-6}\ m^2}{25 \times 10^{-11}}$$

$$= 3.2 \times 10^5\ m^2$$

Solution-6 Concentration of Glucose in E. coli = 1m M

(i) $M = \frac{n}{V} = 1m\ M = \frac{1 \times 10^{-3}}{1L} \times \frac{180}{1}$

$= 0.18\ g/L$

$= 0.18\ mg/mL$

(ii) For no. of glucose molecules, as we know

$M = \frac{n}{V}$

$n = M \times V$

$n = 1 \times 10^{-3}$ mole

no. of molecules $= 1 \times (6.023 \times 10^{23})$

$n = M \times V$

$= 1 \times 10^{-15} \times 10^{-3}$

$n = 10^{-18}$ moles

no. of molecules $= 10^{-18} \times (6.023 \times 10^{23})$

$= 6.023 \times 10^{5}$ molecules

Solution 7 -

225 μM of bovine cytochrome c

$$M = \frac{n}{V} = 225\,\mu M = \frac{225 \times 10^{-6}}{1L} \times 12327$$

$$= 2.773\ g/L$$

$$= 2.773\ mg/mL$$

$$= 2.773\ \mu g/\mu L$$