Assignment 1

- 2018113003

Q1)

(a) A G C C G T C G T A

(b) A G C C G T A G T C

(c) A C G G G T C G T A

~~(d) A T G G~~

(d) A G T T C A C G T A

(e) A G C C G A G C A T

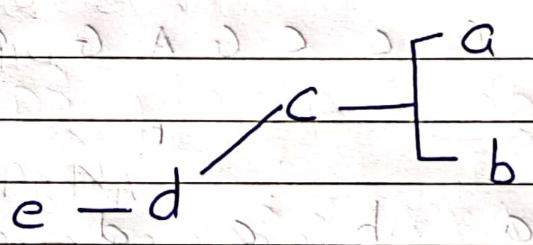
	a	b	c	d	e
a	-	2	3	4	5
b		-	5	6	5
c			-	5	8
d				-	7
e					-

	a/b	c	d	e
a/b	-	4	5	5
c		-	5	8
d			-	7
e				-

	(a/b)/c	d	e
(a/b)/c		5	6.5
d		-	7
e			-

	$[((a/b)/c]/d$	e
$[((a/b)/c]/d$	-	6.75
e		-

$\Rightarrow$ Phylogenic tree



Q2)

$\rightarrow$ $N_0 = 3.2 \times 10^6$

$t_2 = 30$ min

$\Rightarrow$ Every 30 min $N_{i+1} = 2N_i$

$\therefore$ After first 30 min $N_1 = 2N_0$

$= 6.4 \times 10^6$

After 60 min $N_2 = 2N_1$

$= 12.8 \times 10^6$

$\Rightarrow$ After 90 min $N_3 = 2N_2$

$= 25.6 \times 10^6$

$= 2.56 \times 10^7$ cells

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Q2>
→ Differences b/w prokaryotic & Eukaryotic cells

Prokaryotic cells	Eukaryotic Cells
Has a molecule size of 0.5 - 3 μm	Has a molecule size of 2-100 μm
Singular cell organism	Multicellular organism
Cell wall is present, composed of peptidoglycan or mucopeptice	Cell wall is usually absent, but if present composed of cellulose
Cell division by Binary fission	Cell division by Mitosis.
Mitochondria, ER, Lysosomes & Peroxisomes are absent	Mitochondria, ER, Lysosomes & Peroxisomes are present
DNA is circular & double stranded	DNA is Linear & Double stranded
Well defined nucleus is absent	Well defined nucleus is present
Eg: Bacteria	Eg: Plants

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Q4)

→ a) Formulae: $C_5O_2H_8N_1$

$r = 1\,\mu m$

% ~~m/m~~ w/~~w~~v = 15%

No of Amino acids / Protein = 300

$M = 5(12) + 2(16) + 8(1) + 1(14)$

$= 60 + 32 + 8 + 14$

$= 114$

$n = n_B N_A$;

$n_B \rightarrow$ no of moles

$N_A \rightarrow$ Avogadro no

$r = 1\,\mu m = 10^{-6}\, m = 10^{-4}\, cm$

$V = \frac{4}{3}\pi r^3$

$= \frac{4}{3}\pi \times 10^{-12}\, cm^3 = \frac{4}{3}\pi \times 10^{-12}\, ml$

$= \frac{4}{3}\pi \times 10^{-15}\, l$

→ Density of Cell is not given

Let density be ρ

$\therefore m = \rho V$

$= \frac{4}{3}\pi\rho \times 10^{-15}\, kg$

$= \frac{4}{3}\pi\rho \times 10^{-12}\, g$

~~$n_B = \frac{\frac{4}{3}\pi\rho \times 10^{-12}}{114} \times 6.023 \times 10^{23} = 2.21 \times 10^{10}$~~

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$\% \, w/w = 15\%$

$\therefore \frac{m}{m_c} = \frac{15}{100}$

$m = \frac{15}{100} \times \frac{4}{3}\pi\rho \times 10^{23}$

$n_B = \frac{m}{M}$

$n = \frac{15}{100}\left(\frac{\frac{4}{3}\pi\rho \times 10^{23}}{114} \times N_A\right)$

$= \frac{15}{100}\left(2.21 \times 10^{10}\rho\right)$

$= 33.51 \times 10^{8}\rho$

$= 3.35 \times 10^{9}\rho$

$\Rightarrow$ $3.35 \times 10^{9}\rho$ no of amino acids

$\therefore$ No of proteins $= \frac{3.35 \times 10^{9}\rho}{300}$

$= 1.117 \times 10^{7}\rho$

$t_2 = 30 \times 60 \, s$

$= 1.8 \times 10^{3} \, s$

$\frac{dN}{dt} = kN$

$N = N_0 e^{kt}$

$2N_0 = N_0 e^{kt_2}$

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$$\Rightarrow 2 = e^{k t_2}$$

$$k = \frac{\log 2}{t_2}$$

b) Every 30 min $1.117 \times 10^{7} f$ protein molecules formed

$$\therefore \langle \text{rate } (\alpha) \rangle = \frac{\text{No of molecules}}{\text{time}}$$

$$\Rightarrow \langle \alpha \rangle = \frac{1.117 \times 10^{7} f}{1.8 \times 10^{3}}$$

$$= 0.62 \times 10^{4} f$$

Q5)

→ $n_g = 2 \times 10^{4}$

$l = 10^{3}$ neucleotides

A T G C ...

⇒ For every neucleotide, 2 bits required to store their value (A, T, G, C ⇒ 4 values)

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$\therefore$ For every gene $10^3 \times 2$ bits required

$\therefore$ In an organism

bits required $= n_g \times l \times 2$

$= 2 \times 10^4 \times 10^3 \times 2$

$= 4 \times 10^7$ bits

$\Rightarrow$ No of bytes required $= \frac{4 \times 10^7}{8}$

$= 5 \times 10^6$ bytes

For storage of proteins:

$\rightarrow$ Every pair of 3 neucleotide corrospond to a single

$l_n = 10^3$

$\Rightarrow l_p = \frac{l_n}{3} = \frac{1}{3} \times 10^3$ proteins

For coding every protein $\log_2 20$ bits required [20 proteins exists]

$\therefore$ For an organism

$n_b = n_g \times l_p \times 2 \log_2 20$

$= \frac{1}{3} \times \log_2 20 \times 2 \times 10^7$

$= 2.88 \times 10^7$ bits $= 3.6 \times 10^6$ Bytes