Unit 1 and Unit 2 sample questions

- **Nucleic acids: Structure and function**
- **Cell structure and cell division**

Based on our understanding of Chargaff's Base pairing rules

Q1: If "GC", content in DNA of an organism is 60%, then find out the percentage of other bases (A, C, and T)?

Ans: "GC" content means; **G+C = 60%;**

and amount of G = C; in a given DNA molecule (According to Chargaff analysis);

therefore % G= 30 % or % C= 30 %

T= ? And A=?

If, (A+T)+(G+C) = 100 % ;

Then, A+T = 40%;

therefore, A= 20 % and T= 20%

A = 20%
T = 20%
G = 30%
C = 30%

Q.2) A sample of DNA of 90,000 nucleotides contains 20% Guanine. How many other bases are present and in what percent (explanation required for your calculations)?

Answer: G = 20 % of 90,000 = 18,000

C = 18,000; 20%

A+T= 90,000-36,000 = 54, 000

A = 27, 000; T = 27,000

To find values

A+T = 100-40 = 60 %
A = 30 %
T = 30%

30% of 90,000 = 27,000
A=27,000 and T = 27, 000

To find percentage and values of A and T

3) If in one strand of a double stranded DNA the rate of occurrence of G is 4 times of A in consecutive 11 base pairs. So how many G will be there in 121 base pairs of a DNA duplex? [Consider C=T in one strand].

Ans.) Two cases arises according to question; **4 'G' and 1 'A'** , or if **2 'A's, then 8 'G's**

- **Ist case**: If G = 4 times of A, and C=T, then in 11 bases, **there are 1A, 4G, 3C and 3T** in a single stranded DNA. Considering **11 base pairs, there will 4G in top strand of DNA** and **3G in bottom strand due to G and C complementary rule**. Therefore, in 11 base pairs we have **total 7 'G's**

Therefore, In 121 base pairs, 7x11=77 'G's present.

- **IInd case:** not applicable since C=T cannot be maintained according to question

4. If DNA molecule of any cell contain 25 cytosine bases, 25% of the total number of bases in the strand. How many phosphate groups are present in DNA?

a) 25

b) 50

c) 75

d) 100

5. Suppose that a portion of the coding strand in a given gene reads as follows:

5′GACGGTATTCACCG3′

What would the mRNA encoded by this gene read?

A. 5′GACGGUAUUCACCG3′
B. 5′CUGCCAUAAGUGGC3′
C. 5′CGGTGAATACCGTC3′
D. 5′CGGUGAAUACCGUC3′

6. What is the name of a deoxynucleotide in which the base is thymine?
I. Deoxythymidine monophosphate
II. Deoxythymidine diphosphate
III. Deoxythymine monophosphate
IV. Deoxythymine diphosphate

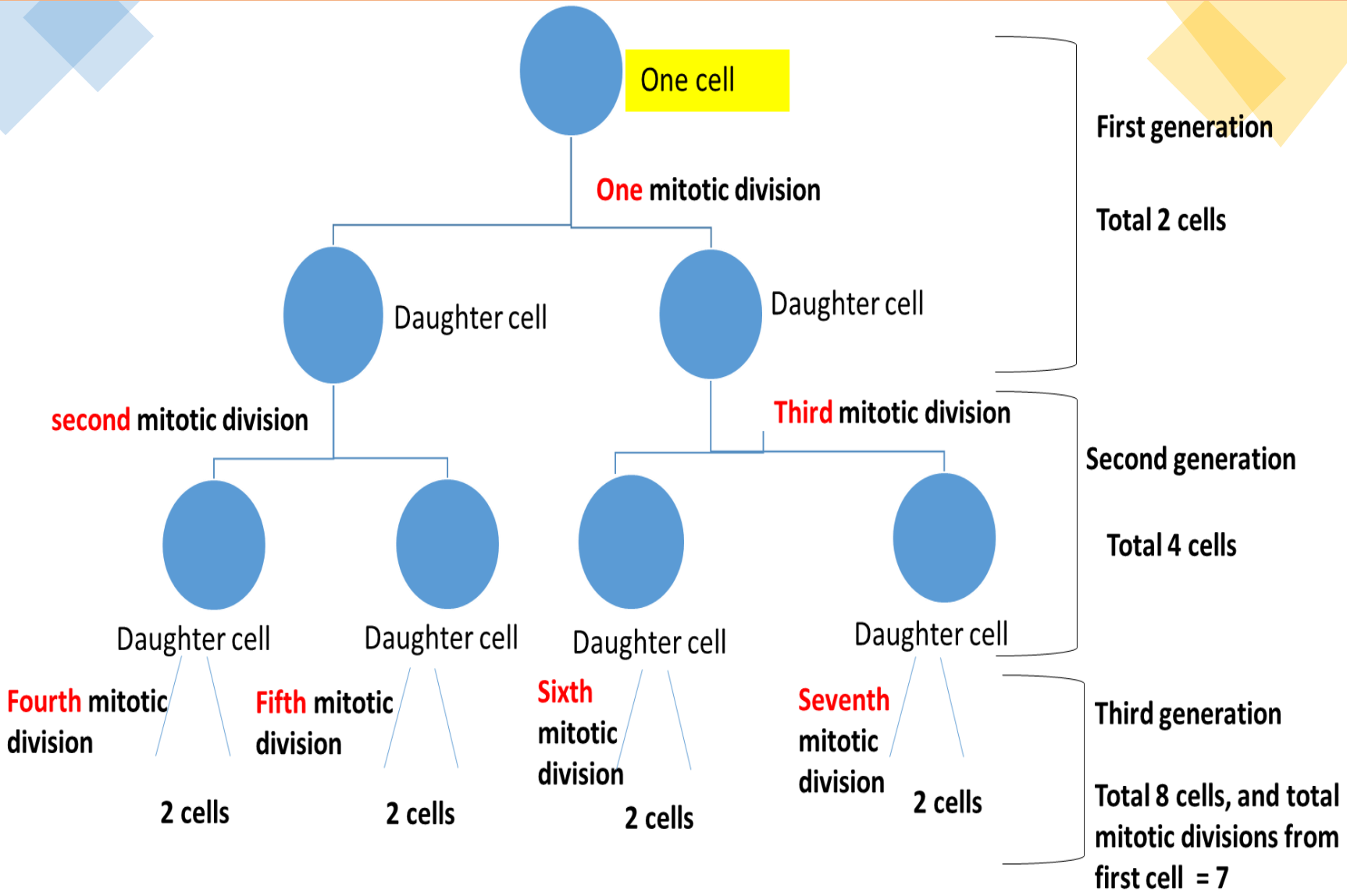
A. I and II
B. III and IV
C. I, II, and III
D. I, II, III, and IV

7. The sequence of nucleotides in non template, coding (+) strand of DNA is

5'ATGGTTCAAG3'

I. What would be the mRNA sequence?
II. What would be the sequence of antisense stand of DNA
III. What would be length of DNA in B, A and Z form?
IV. What would be the number of turns in B, A and Z forms, respectively.

Cell structure and cell division



To get 4 cells from one cell, number of mitotic divisions required = 4 – 1= 3 mitotic divisions

Conclusion is, If X is the total number of cells after mitotic divisions, the number of mitotic divisions starting from first cell will be X-1

Q. 1) How many generations of mitotic divisions are required to produce 8 cells from one single cell?

Answer: 2^n … where "n" is the number of generations.

Therefore, $\mathbf{2^3} = 8$

Or, $\mathbf{2^3} = 8$

Or **n = 3**

So, after **3 generations**, of mitosis, 8 cells are produced.

Q. 2) How many mitotic divisions are required to produce 8 cells from a single cell?

Answer:

First generation (one cell producing two daughter cells)……so one mitotic division.

Second generation (means two daughter cells again divide, one daughter cell ……one mitotic division and second daughter cell another mitotic division) ……2 mitotic division in second generation.

- One cell to total 4 cells (combining first and second generation) ……..**total 3 mitotic divisions.**

Therefore, to get 4 cells, total mitotic divisions required is **4 - 1= 3**

To get 8 cells, total mitotic divisions required is 8-1= 7

Q.3) How many generations of mitotic divisions must occur from a cell of the root tip to form 128 cells? Ans……2n where, n= number of generations.

a) 7
b) 8
c) 64
d) 127

Q. 4) How many mitotic divisions must occur from a cell of the root tip to form 128 cells?

a) 7
b) 8
c) 64
d) 127

Q.2) During which phase does the nuclear envelope begin to disappear?

a) Cytokinesis

b) Anaphase

c) Telophase

d) Prophase or Late prophase

Q.3) Spindle fibre get attached to centromere of the chromosome of the following stage:

a) Telophase

b) Anaphase

c) Prophase

d) Metaphase

Q.4) The replication of nuclear DNA occurs in

a) G1 / Gap1

b) S / Synthesis

c) G2 / Gap 2

d) Mitosis

Q. 5) A cell in G1 of interphase has 12 chromosomes how many chromatids will be found during metaphase two of meiosis

a) 6

b) 12

c) 18

d) 24

Nucleic acid lecture key points-----focus

- ✓ …… DNA…. What are the nitrogenous bases?
- ✓ ……RNA …. What are the nitrogenous bases?
- ✓ ….. What is 5’ (5 prime) and 3’ (prime) –meaning?
- ✓ ……. What is 5’-end and what is 3’-end? Which group you will find at the ends?
- ✓ …… DNA double helix orientation is antiparallel.
- ✓ ……. Base pair rule….. A pairs with T (two hydrogen bonds); G pairs with C (three hydrogen
- ✓ bonds) or vice versa
- ✓ ……..Hydrogen bonds; Phosphoester bond; Phosphodiester bond; N-glycosidic bond
- ✓ …….genetic messages is read in ….. **5’ to 3’ direction**, according to the addition of new

nucleotide to the 3’end of a polynucleotide chain

- ✓ Genetic messages are the specific base sequence…….AGTCGTCTAGGC…..of a DNA strand read in 5’-3’ direction
- ✓ DNA ligase….. What is it, and what does it do?….. Phosphodiester linkage
- ✓ RNA types… rRNA, tRNA and mRNA
- ✓ What is tRNA –charging or activation of tRNA?
- ✓ What is anticodon, codon , anticodon binding site, amino acid binding site?
- ✓ A-site, P-site, E-site in large subunit of ribosomes.
- ✓ Composition of ribosomes
- ✓ mRNA and DNA complementary sequence concept…….that is copying of genetic message from DNA for protein translation

- Structural parameters of B-DNA, A-DNA and Z-DNA for calculations questions
- Sense and antisense strand of DNA

Cell structure and cell division

Important topics

- ✓ Cell cycle stages
- ✓ Interphase phases (G1, S and G2)
- ✓ Autosomes and sex chromosomes
- ✓ Chromosomes, chromatids, centromere, sister and non-sister chromatids
- ✓ Somatic cells and germ (gametic cells)
- ✓ Haploid and diploid
- ✓ Homologous chromosomes
- ✓ Somatic and gametic cell division
- ✓ Equational and reduction division
- ✓ Cell division: Mitosis and meiosis-different stages and difference
- ✓ Spindle fibers and chromatids/chromosome separation
- ✓ Chromosome and chromatids number during cell division
- ✓ Synapsis and crossing over
- ✓ Male and female gametes: sperm and ovum(eggs)
- ✓ Oogenesis (egg) and spermatogenesis (sperm formation)
- ✓ Checkpoints of cell cycle- spindle assembly checkpoint
- ✓ Failure of spindle assembly checkpoint-non-disjunctions
- ✓ Effect of non-disjunctions of chromosomes in meiosis and mitosis
- ✓ Autosomal and sex chromosomes non-disjunction and syndromes