TUTORIAL_SUGGESTED ANSWERS

TOPIC : EXPRESSION OF BIOLOGICAL INFORMATION

<table>
<tr><th>Questions</th><th>Answers</th><th>Marks</th></tr>
<tr><td>MCQ</td><td>1. B 6. B
2. C 7. A
3. C 8. C
4. C 9. A
5. B 10. B</td><td>10</td></tr>
<tr><td>Structured
1. a)

b)
c)

d)
e)

f)</td><td>P : nitrogenous base
Q : deoxyribose (sugar)
R : phosphate (group)

- nucleotide
- Bond 1 : phosphodiester (bond)
- Bond 2 : hydrogen (bond)

- $^{3'}$ CTAG $^{5'}$
- As genetic material

<table><tr><th>DNA molecule</th><th>RNA molecule</th></tr><tr><td>- Has deoxyribose sugar</td><td>- Has ribose sugar</td></tr><tr><td>- Nitrogenous bases consist of adenine, cytosine, guanine, thymine</td><td>- Nitrogenous bases consist of adenine, cytosine, guanine, uracil</td></tr><tr><td>- Consists of 2 polynucleotide chain</td><td>- Consists of 1 polynucleotide chain</td></tr><tr><td>- Larger molecules / longer chain</td><td>- Smaller molecules / shorter chain</td></tr></table></td><td>1
1
1

1
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1

Any 2

Total : 10</td></tr>
<tr><td>2. a)

b) i.

ii.

c)

d)</td><td>A : Cytosine
B : Thymine
C : Adenine
D : Guanine

Nucleotide

Phosphate group, pentose sugar (deoxyribose)

- Phosphate group and deoxyribose
- Deoxyribose and nitrogenous base

- It contain ribose, (not deoxyribose) OR
- It contain uracil , (not thymine)</td><td>1
1
1
1

1

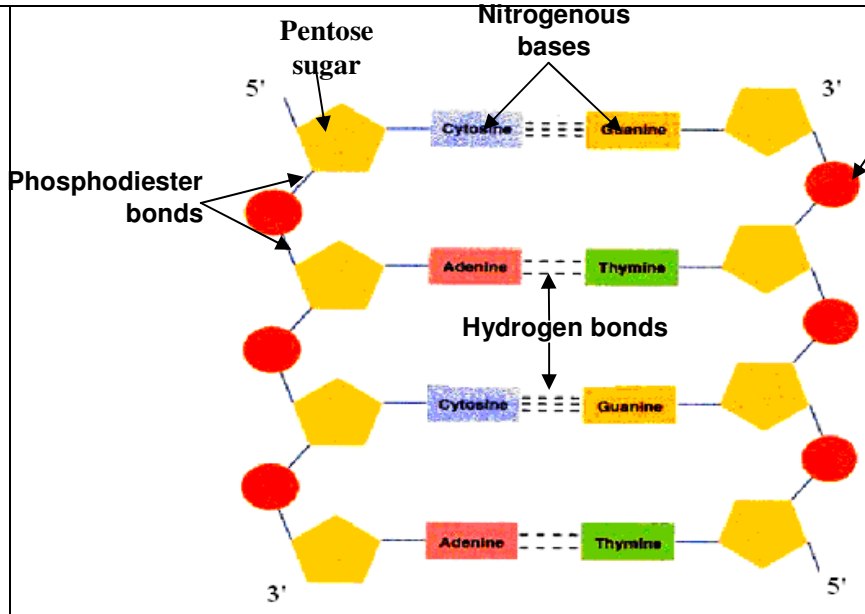
2

1
1

1

Total : 10</td></tr>
</table>

3. a)		
	DNA sense strand: TAC **CCT** **CAA** **CGA** GCA ATC	1
	Non-template strand: **ATG** GGA **GTT** **GCT** **CGT** **TAG**	1
	mRNA: **AUG** **GGA** GUU **GCU** **CGU** **UAG**	
	tRNA: **UAC** **CCU** **CAA** CGA **GCA** **AUC**	1
	Amino acid: Start codon/ Met, Gly, Val, Ala, Arg, Stop codon	1
b)	- a process of translating the genetic information	
	- coded in mRNA	1
	- into a sequence of amino acids	1
	- in a polypeptide chain/protein	1
		1
		Max : 3
c)	- by binding tRNA with amino acids	1
d)	- 3' end	1
e)	i) transcription and ii) translation	1
		Total : 10
4. a)	- Elongation	1
b)	- The triplets of bases on the mRNA	1
c)	- AUG	1
d)	- 3' CGA 5'	1
e)	- Attachment of amino acid	1
f)	- Ribosome move one codon ahead, UCU (codon B)	1
	- tRNA 2 is shifted to P site and tRNA 3 enters the A site	1
	- Peptide bond is formed between 2 amino acids (serine and isoleucine)	1
	- (A structure that consists of) many ribosomes that bind to a single mRNA strand	
g)	- Allows identical polypeptide chains to be formed at one time/ accelerates the production of protein/protein synthesis	1
		1
		Total : 10

Essay 1 a)	 **Correct diagram** **Complementary bases** **Anti parallel**	1 1 1 Max : 3
	• DNA molecule is a polymer of nucleotide • Nucleotide is the monomer • Each nucleotide is made up of a pentose/deoxyribose sugar, phosphate group and nitrogenous base • Nitrogenous base may be one of the purines (adenine (A) or guanine (G)) or pyrimidines (cytosine (C), or thymine (T)). • Each nucleotide is connected to another nucleotide by a phosphodiester bond • A DNA molecule is made of two strands of polynucleotide which are coiled to form a double helix. • The two strands are anti parallel, arranged in opposite directions. (5' to 3' and 3' to 5') • Both the polynucleotide strands are linked by hydrogen bonds • Adenine is linked by 2 hydrogen bonds to thymine • Cytosine is linked by 3 hydrogen bonds to guanine • Amount of G must be equal to C • Amount of A must be equal to T	1 1 1 1 1 1 1 1 1 1 1 Max : 7 **Total: 10**
b)	• Replication is the synthesis of a new DNA during cell division, where hereditary material is duplicated • The replication is semi-conservative • Enzyme helicase catalyses the unwinding of DNA double helix • The hydrogen bonds between the bases in DNA are broken • Synthesis of new DNA strand occurs in the direction of 5' to 3' • RNA primer is required to start the replication process • Catalysed by RNA primase • The free nucleotides pair with the complementary bases of both templates. • Base adenine pairs with Thymine • They are linked by 2 H bonds • Cytosine pairs with guanine.	1 1 1 1 1 1 1 1 1 1 1 1

<table>
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They are linked by 3 hydrogen bonds
The nucleotide are linked together by DNA polymerase to form DNA leading strand
In the synthesis of the lagging strand, the short Okazaki fragments are synthesized in the 5’ to 3’ direction
The enzyme DNA ligase catalyze the formation of linkage between the Okazaki fragments
2 identical molecules of the original DNA are formed

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<td>1
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1

Total : 16

Max : 10</td>
</tr>
<tr>
<td>2 a)

b)</td>
<td>
Differences:
<table>
<tr><th>Replication</th><th>Transcription</th></tr>
<tr><td>1. The bases A,T,C,G (and not uracil) are used to form DNA .</td><td>The bases A, U,C,G (and not thymine) are used to form RNA.</td></tr>
<tr><td>2. The whole length of the DNA is used as the template</td><td>Only a portion of DNA is used as the template (at one particular time)</td></tr>
<tr><td>3. Requires DNA polymerase for the formation of DNA strand</td><td>Requires RNA polymerase for the formation of RNA strand</td></tr>
<tr><td>4. 2 strands of DNA are used a template</td><td>1 strand of DNA is used a template</td></tr>
</table>
Similarities:
<table>
<tr><td>5. Produces a double stranded DNA</td><td>Produces a single stranded RNA</td></tr>
<tr><td>6. RNA primer is required</td><td>RNA primer is not required</td></tr>
<tr><td>7. Involve primase</td><td>Does not involve primase</td></tr>
</table>
8. Involve RNA polymerase and unwind the DNA
9. Both processes occur in nucleus
10. Both processes require DNA as template
Operon is regulation of a cluster of genes as a single unit.

In the absence of lactose, repressor protein binds to the operator
and covers part of the promoter.
Prevent the binding of RNA polymerase to the promoter.
Lactose operon system is deactivated / switched off.
No transcription occurs for the genes lac Z, lac Y and lac A
In the presence of lactose, a small amount is converted to its isomer allolactose which acts as an inducer.

</td>
<td>1/0
1/0
1/0
1/0

1/0
1/0
1/0

1
1
1

Total : 10
Max : 8

1
1
1
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1
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1</td>
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</table>

	• Allolactose binds to the repressor protein and alter the structure / conformation of repressor protein • The repressor protein cannot bind to the operator • RNA polymerase can now bind to the promoter • Transcription of genes takes place to form mRNA / Lactose operon is switched on • Translation of mRNA occurs. • The enzymes ß- galactosidase, permease and transacetylase are produced.	1 1 1 1 1 1 Total : 13 **Max : 12**