**MEDICAL DEGREE program, Athens Medical School, NKUA**

**Biochemistry II course**

Multiple choice questions

1. **DNA repair mechanisms**
2. How does the mismatch repair system distinguish between the parental (i.e. correct) DNA strand and the newly synthesized strand containing the mismatched base?
3. Thymine in the parental strand of the helix is methylated at GATC
4. Thymine in the new strand of the helix is methylated at GATC
5. Guanine in the parental strand of the helix is methylated at GATC
6. Guanine in the new strand of the helix is methylated at GATC
7. All of the following are true about nucleotide excision repair except?
8. Removal of the damaged bases occurs on only one DNA strand
9. It removes thymine dimers generated by UV light
10. It involves the activity of an excision nuclease, which is an endonuclease
11. Only the damages nucleotides are removed
12. Which of the following is the name of the human genetic disorder resulting from defects in nucleotide excision repair?
13. Hereditary nonpolyposis colorectal cancer
14. Xeroderma pigmentosum
15. Lynch syndrome
16. Diabetes
17. The excision repair of UV-induced DNA damage is defective in individuals suffering from
18. Crohn’s disease
19. Classical xeroderma pigmentosum
20. Hereditary nonpolyposis colorectal cancer
21. Xeroderma pigmentosum variant
22. Monofunctional DNA glycosylase is an enzyme involved in base excision repair and its function is
23. Cleavage of the sugar-phosphate backbone
24. Glycosylation of the damaged base
25. Cleavage of the N-glycosidic bond
26. Cleavage of the phosphodiester bond
27. The main difference between base excision repair (BER) and nucleotide excision repair (NER) is
28. In NER double strand breaks are repaired whereas in BER single strand breaks are repaired
29. NER is a light-dependent reaction whereas BER is a light-independent process
30. In NER the phosphodiester bond backbone is first cleaved whereas in BER the phosphodiester backbone is cleaved later
31. All of the above
32. Homologous recombination
33. Requires that a specific DNA sequence be present
34. Requires that one of the duplexes undergoing recombination be nicked in both strands
35. Occurs only between two segments from the same DNA molecule
36. May result in strand exchange by branch migration

Answers: 1d, 2d, 3b, 4d, 5c, 6c, 7c

1. **Eukaryotic transcriptional control**
2. What would be the outcome of a mutation that prevented DNA bending proteins from being produced?
3. Decreased transcription because transcription factors would not bind to transcription binding sites
4. Decreased transcription because enhancers would not be able to bind to transcription factors
5. Increased transcription because repressors would not be able to bind to promoter regions
6. Increased transcription because RNA polymerase would be able to increase binding to promoter regions
7. The immunoglobulin genes are expressed in B-cells, and the beta-globin gene is expressed in red blood cells. What manipulations might be carried out to get the beta-globin gene to be expressed in B-cells?
8. The coding region of an immunoglobulin gene could be combined with the cis-regulatory region of the beta-globin genes, and this artificial gene would then express beta-globin in B-cells
9. The cis-regulatory region of the beta-globin gene could be inserted into B-cells, which would then express their own version of the beta-globin gene
10. The cis-regulatory region of an immunoglobulin gene could be combined with the coding region of the beta-globin genes, and this artificial gene would then express beta-globin in B-cells
11. The transcription factors GATA-1 and GATA-2 (which activate the b-globin gene in erythrocytes) could be introduced into B-cells, which would then express their own copy of the beta-globin gene
12. Changing the colony stimulating factors present in the medium in which B-cells are growing could be manipulated in a way that would cause the B-cells to reverse their differentiation, become erythrocytes, and express beta-globin
13. Imagine that in an attempt to get the beta-globin gene to be expressed in B-cells, the transcription factors (GATA-1 and GATA-2) known to control the beta-globin gene in erythrocytes were introduced into B-cells, yet the beta-globin gene was not expressed. What is a likely explanation for this result?

a) The erythrocyte transcription factors are degraded rapidly in the B-cell, and so cannot act on the beta-globin gene

b) The beta-globin gene in the B-cells is packaged into heterochromatin, and the erythrocyte transcription factors are insufficient to remodel that chromatin into an active state

c) Erythrocyte transcription factors cannot interact with their target DNA sequences in B-cells, even though those sequences are present and accessible

d) Even though the necessary erythrocyte-specific transcription factors are now present in the B-cells, the general transcription factors required for beta-globin gene expression would not be present

e) The cis-regulatory regions for the beta-globin gene are present only in erythrocytes, and not in B-cells, so the erythrocyte transcription factors would be meaningless in a B-cell

1. Which of the following help to turn genes on so that they are expressed?
2. A high level of condensation (coiling around histones)
3. Histone acetylation
4. DNA methylation
5. Histone methylation
6. Helix-turn-helix motifs, zinc finger motifs and leucine zipper motifs are examples of
7. Structural elements within coding genes that bind to transcription factors
8. Structural elements within regulatory regions that bind to transcription factors
9. Domains in transcription factors that bind to specific nucleotide sequences
10. Domains in transcription factors that bind to specific activators
11. Domains in transcription factors that bind to proteins of the basal transcriptional complex
12. Transcriptional activators consist of how many functional domains?
13. 1
14. 2
15. 3
16. 4
17. All regulatory proteins have common DNA binding motifs that allow them to interlock with the
18. Minor groove of the DNA helix
19. Major groove of the DNA helix
20. Outside groove of the DNA helix
21. Inside groove of the DNA helix

Answers: 1b, 2c, 3b, 4b, 5c, 6b, 7b

1. **Cell cycle regulation & apoptosis**
2. In order to enter the cell cycle a cell must be stimulated from outside. Which molecule provides this stimulation?
3. Cyclins
4. Cyclin-dependent kinases
5. Cytokine growth factors
6. Tyrosine kinases
7. The role of p21 is to
8. Bind and activate G1/S-CDK and S-CDK complexes
9. Bind and inactivate G1/S-CDK and S-CDK complexes
10. Bind and inactivate G1/S-Cyclin and S-cyclin
11. Bind and inactivate G1/S-CDK only
12. The passage of a cell through the cell cycle stages is controlled by protein kinases which phosphorylate many different proteins at appropriate times. What are these protein kinases called?
13. Cyclin-dependent kinases
14. Cyclins
15. Cdk activating kinases
16. Protein kinase Wee 1
17. Which of the following is NOT a characteristic of the cyclins involved in the cell cycle?
18. Appropriate cyclins are synthesized at the start of each cell cycle phase and are destroyed by proteolysis at the end of that phase.
19. Cyclins bind to and activate cyclin-dependent kinases.
20. Cyclins are the sole controllers of cyclin-dependent kinase activity.
21. Cyclins influence the substrate proteins which cyclin-dependent kinases phosphorylate.
22. Which cellular organelles are involved in the initiation of the intrinsic pathway of apoptosis?
23. Nucleus
24. Mitochondria
25. Endoplasmic reticulum
26. Lysosomes
27. Which of the following proteins is NOT part of the apoptosome which initiates apoptosis by the intrinsic pathway?
28. Apaf-1
29. Bcl-2
30. Cytochrome c
31. Procaspase 9
32. Which of the following are killed by the extrinsic apoptosis pathway?
33. Virus infected cells
34. Cells with damaged DNA
35. Developing neurons which fail to make profitable connections
36. Irradiated cells
37. Which of the following proteins is a death receptor which triggers the extrinsic pathway of apoptosis?
38. Caspase 8
39. FADD
40. Fas ligand
41. Fas

Answers: 1c, 2b, 3a, 4c, 5b, 6b, 7a, 8d