Exam III Material Questions

Multiple Choice Choose A, B, C, D on your computer grid sheet and on this exam booklet. (2 pt. ea.)

Chapter 12

23. Which of the following effects of a low calorie diet (caloric restriction diet) may be responsible for its effect in prolonging lifespan: pg. 18 Notes

A) reduced SIRT1 activity as a result of reduced levels of NAD\(^+\) relative to NADH
B) reduced SIRT1 activity as a result of increased levels of NAD\(^+\) relative to NADH
C) increased SIRT1 activity as a result of reduced levels of NAD\(^+\) relative to NADH
D) increased SIRT1 activity as a result of increased levels of NAD\(^+\) relative to NADH x

24. Which of the following protein factors covalently modifies histones to generate a looser nucleosome that makes it more likely that the TATA-Binding Protein will be able to bind the TATA box of a promoter: pg. 17 Notes

A) HDAC
B) Swi/SNF x
C) HAT x
D) SUV39H1

25. Which of the following protein factors uses the energy of ATP hydrolysis to move nucleosomes in the vicinity of the TATA box to make it more likely that the TATA-binding factor will be able to bind the TATA box: pg. 17 Notes

A) HDAC
B) Swi/SNF x
C) HAT
D) SUV39H1

26. Which of the following protein factors would you expect to find in heterochromatin but not at an inactive euchromatic gene: pg. 4, 18 Notes

A) HDAC
B) Swi/SNF
C) HAT
D) SUV39H1 x
27. Which of the following protein factors would you expect to find both at inactive euchromatic genes and in heterochromatin: pg. 4, 18 Notes

A) HDAC  
B) Swi/SNF  
C) HAT  
D) SUV39H1

28. Which of the following proteins prevents eukaryotic mRNAs from being recruited to the ribosome prior to egg fertilization: pg. 21 Notes

A) eIF4G  
B) Poly A-binding protein (PABP)  
C) 7mG-cap binding protein  
D) Maskin x

29. Which of the following is required for constitutive heterochromatin assembly, but not for facultative heterochromatin assembly: pg. 10, 13 Notes

A) Polycomb  
B) histone H3 methylation (on either Lys 9 or Lys 27)  
C) RITS x  
D) A and B

30. Which of the following chromatin features are found on tissue-specific genes in terminally differentiated somatic cells of an adult but not in pluripotent ES cells: pg. 7, 17, 18 Notes

A) Polycomb or HP1 x  
B) Acetylated histones  
C) Swi/Snf  
D) TBP

31. Which of the following SIRT1 activities is important in prolonging life span as a result of Resveratrol treatment or restricted calorie diet: pg. 18 Notes

A) deacetylation of histones and transcription factors x  
B) acetylation of histones and transcription factors  
C) methylation of histones and transcription factors  
D) phosphorylation of histones and transcription factors
Chapter 13:

11. In the Meselson/Stahl experiment, which of the following results was observed in the CsCl₂ density sedimentation separation of the DNA replication products after ONE generation: pg. 25 Notes

A) a single band of intermediate density.  x
B) two bands, one of high density and one of low density.
C) two bands, one of high density and one of intermediate density.
D) two bands, one of low density and one of intermediate density.

12. If the products of replication after ONE generation in the Meselson/Stahl experiment had been denatured (H bonds between base pairs broken) in the CsCl₂ density sedimentation centrifugation, which of the following results would they have gotten: pg. 25 Notes

A) a single band of intermediate density.
B) two bands, one of high density and one of low density.  x
C) two bands, one of high density and one of intermediate density.
D) two bands, one of low density and one of intermediate density.

13. Which of the following activities of DNA polymerase I allows it to remove RNA primers during lagging strand synthesis: pg. 28 Notes

A) 5’ to 3’ exonuclease activity  x
B) 3’ to 5’ exonuclease activity
C) 5’ to 3’ polymerase activity
D) 3’ to 5’ polymerase activity

14. Which of the following activities of DNA polymerase I allows it to proofread its DNA synthesis during replication: pg. 35 Notes

A) 5’ to 3’ exonuclease activity
B) 3’ to 5’ exonuclease activity  x
C) 5’ to 3’ polymerase activity
D) 3’ to 5’ polymerase activity
15. Which of the following proteins is required for DNA polymerase III to be a processive enzyme (continue over a long distance once it gets started): pg. 28 Notes 29

A) primase  
B) β-clamp x  
C) SSB  
D) RPA

16. Telomerase activity would not be necessary in a eukaryotic cell if: pg. 31-33 Notes

A) Its chromosomes were circular. x  
B) The telomerase template was A/T-rich instead of G/C-rich.  
C) DNA polymerase synthesized DNA in a 3’ to 5’ direction instead of 5’ to 3’.  
D) Any of the above.

17. Based on what you know about how DNA polymerase incorporates deoxyribonucleotides into a growing nucleic acid strand, which of the following effects would you predict the nucleotide structure to the right to have on DNA replication: pg. 27 Notes

A) It could not be added to the growing DNA strand.  
B) It could be added to the growing DNA strand but would not allow the next nucleotide to be added to it. x  
C) It could be added to the growing DNA strand and would also allow the next nucleotide to be added to it.  
D) It could be added to the growing DNA strand and would allow the next nucleotide to be added to it, but it would have to be replaced by upstream DNA synthesis.

18. Which of the following classes of proteins are required for Nucleotide Excision Repair: pg. 38 Notes

A) XP proteins  
B) RAD proteins  
C) ERCC proteins  
D) All of the above; These are different names for the same proteins. x
19. Which of the following forms of DNA can serve as a template for DNA polymerase: **pg. 27 Notes**

A) fully double stranded DNA circle  
B) partially double stranded DNA circle  
C) single stranded linear DNA  
D) fully double stranded linear DNA

20. How does the DNA polymerase recognize an incorrectly paired nucleotide incorporated into the growing strand during DNA replication: **pg. 35 Notes**

A) TFIIH recognizes the incorrect base pair  
B) by the geometry of the incorrect base pair  
C) DNA glycosylases recognize the incorrect base pair  
D) by the methyl groups added to the incorrect nucleotide

**Chapter 14**

21. Which of the following types of cells would be most likely to constitutively progress into M phase. (Additional mutations might be required to get a full blown phenotype.) **pg. 42-46 Notes**

A) a cell that has a loss of function mutation in SCF  
B) a cell that has a loss of function mutation in Cdk  
C) a cell that has a loss of function mutation in p27  
D) a cell that has a loss of function mutation in wee1

22. Which of the following types of cells would **prevent** a cell from progressing into the S phase of the cell cycle: **pg. 42-46 Notes**

A) a cell that has a loss of function mutation in SCF  
B) a cell that has a loss of function mutation in wee1  
C) a cell that has a loss of function mutation in p27.  
D) a cell that has a loss of function mutation in wee1

23. Which of the following events of the cell cycle requires SCF activity: **pg. 44 Notes**

A) mitotic spindle assembly  
B) p27 degradation  
C) Cyclin B degradation  
D) sister chromatid separation
24. Which of the following mutations in a single copy of the Cdk gene would be most likely to predispose an individual to cancer: pg. 46 Notes

A) a mutation that changes its activating phosphorylation Thr site to Glu
B) a mutation that changes its activating phosphorylation Thr site to Ala
C) a mutation that changes its inactivating phosphorylation Thr site to Glu
D) a mutation that changes its inactivating phosphorylation Thr site to Ala

25. A loss of function mutation in both copies of which of the following genes would you predict to cause the mutant in question #24 to become cancerous: pg. 46 Notes

A) CAK
B) wee1
C) Cdc25
D) M Cyclin

26. Which of the following is a target of phosphorylation by the S phase cyclin-dependent Cdk complex: pg. 45, 49 Notes

A) lamins
B) cdc6
C) condensin
D) Mad2

27. Which of the following proteins is responsible for imposing a cell cycle arrest in response to the detection of DNA damage during G1 but not during G2: pg. 46 Notes

A) ATM
B) Chk1
C) Cdc25
D) p21

28. Which of the following proteins is released from eukaryotic origins after it becomes phosphorylated during S phase, making it unable to rebind until the next S phase: pg. 45 Notes

A) ORC
B) MCM
C) Cdc6
D) p27
29. Which of the following proteins functions both in holding sister chromatids together during mitosis and in holding chromosome homologues together during meiosis: pg. 48, 52, 54, 56 Notes

A) synaptonemal complex
B) cohesin x
C) condensin
D) MCM

30. Which of the following is involved in the movement of sister chromatids towards the spindle equator during metaphase: pg. 51-53 Notes

A) Kinesin motors
B) Dynein motors
C) Microtubule assembly and disassembly at the (+) ends
D) All of the above x

31. Which of the following proteins allows nucleotide excision repair to preferentially repair actively transcribed genes: pg. 38, 39 Notes

A) TFIIH x
B) Ku
C) DNA polymerase III
D) Uracil-DNA Glycosylase

32. Which of the following is a true statement about the requirement for DNA polymerases to synthesize in the 5’ to 3’ direction only: pg. 28, 37 Notes

A) The chemistry of a nucleophilic attack on a phosphodiester bond by a free OH can only occur by this mechanism.
B) DNA polymerases are able to synthesize in the 3’ to 5’ direction on the lagging strand only.
C) Only 5’ to 3’ synthesis allows proofreading activity during replication. x
D) All of the above

33. Which of the following is responsible for maintaining the oocytes of most invertebrates (sea urchins and Xenopus) in Metaphase II until fertilization: pg. 41-42 Notes

A) MPF
B) Cdk/Cyclin B
C) Both of the above X
D) Neither A nor B
34. Which of the following types of cells is not capable of entering the S phase of the cell cycle: pg. 40 Notes

A) a diploid cell with a single sister chromatid
B) a diploid cell with unreplicated chromosomes
C) a haploid cell with a pair of sister chromatids
D) a haploid with a single sister chromatid.

35. Which of the following events would occur in cells that are starved of nutrients: pg. 18, 63 Notes

A) Inhibition of Sirt1 activity by high NADH levels.
B) Increased autophagy
C) Activation of Cdk activity
D) All of the above

Chapter 15

1. cAMP is to Adenylyl Cyclase as ________ is to PI-Phospholipase C. pg. 65, 69 Notes

A) IP₃ and DAG
B) Ca²⁺
C) cGMP
D) NO

2. Which of the following is an example of an effector in a signal transduction pathway? pg. 67, 65, 62, 58-60 Notes

A) Protein Kinase A
B) Heterotrimeric G protein
C) IRS-1
D) Grb2 SH2 protein

3. Which of the following mutations in the Gαₛ subunit of the GPCR pathway for glycogen breakdown in the liver would prevent the cell from breaking down glycogen in response to adrenaline: pg. 65-67 Notes

A) One that prevents it from hydrolyzing GTP
B) One that prevents it from binding GTP
C) One that destroys its GTPase activity
D) One that causes it to constitutively (constantly) activate Phospholipase C
4. Which of the following effects does cholera toxin have on the \( \alpha_5 \) subunit regulating the activity of the CFTR ABC-transporter in moving \( H_2O \) into the intestinal passage: **pg. 68 Notes**

A) Inhibition of \( \alpha_5 \) subunit GTP-binding activity
B) Inhibition of \( \alpha_5 \) subunit GTP hydrolysis activity **x**
C) Activation of \( \alpha_5 \) subunit GTP hydrolysis activity
D) Inhibition of \( \alpha_5 \) subunit association with Adenylyl Cyclase

5. Which of the following results would you predict to occur with a mutation that changes the phosphorylatable Tyr of the Insulin Receptor to Glu or Asp: **pg. 64 Notes**

A) inability to take up glucose from the bloodstream
B) constant uptake of glucose from the bloodstream
C) upregulated protein synthesis needed for cell growth
D) B and C **x**

6. Which of the following results would you predict to occur with a mutation that changes the phosphorylatable Tyr of the Insulin Receptor to Ala: **pg. 64 Notes**

A) inability to take up glucose from the bloodstream **x**
B) constant uptake of glucose from the bloodstream
C) upregulated protein synthesis, causing upregulated cell growth and division
D) B and C

7. A mutation that destroys the activity of which of the following proteins might be found in a patient with Type II diabetes: **pg. 62 Notes**

A) a mutation that changes the phosphorylatable Tyr of the Insulin Receptor to Ala
B) a mutation that changes the phosphorylatable Tyr of the Insulin Receptor to Asp
C) a mutation that changes the phosphorylatable Ser of PI 3-kinase to Ala
D) either A or C **x**

8. The Grb2 SH2 domain protein is to the growth factor response pathway as __________ is to the extrinsic (receptor-mediated) cell death pathway. **pg 58, 62, 65, 67, 71 Notes**

A) TRADD **x**
B) Heterotrimeric G protein complex
C) IRS-1
D) Protein Kinase A
9. Which of the following proteins is required for the GLUT4 transporter to be localized on the plasma membrane for glucose uptake: pg. 62 Notes

A) Glycogen Synthase
B) PI3 kinase x
C) PI-PLC
D) Caspase-9

10. Which of the following proteins is inactivated by cAMP-activated Protein Kinase-A during glycogen breakdown in the liver: pg. 67 Notes

A) Glycogen Synthase x
B) Glycogen Phosphorylase
C) CREB
D) CFTR

11. Which of the following proteins is activated by cAMP-activated Protein Kinase-A during Cl- efflux from endothelial cells of the respiratory and intestinal passages: pg 68 Notes

A) Glycogen Synthase
B) Glycogen Phosphorylase
C) CREB
D) CFTR x

13. Which of the following protein domains would you expect to find on an adapter of a Receptor Tyrosine Kinase signal transduction pathway: pg 58, 62 Notes

A) SH2 domain
B) PTB domain
C) None of the above
D) Either A or B x
**Fill in the Blank Sentences:**

Use the list of terms in the table below to fill in the blanks in the following sentences. Each sentence is designed to use a single term from the list. You will not use all terms, but some terms could be used (but need not be used) in more than one sentence.

<table>
<thead>
<tr>
<th>Telomerase</th>
<th>Myc</th>
<th>DNA Pol δ</th>
<th>DNA Pol α</th>
<th>DNA Pol III</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERCC</td>
<td>Telomerase</td>
<td>RAD</td>
<td>SCF</td>
<td>PCNA</td>
</tr>
<tr>
<td>APC-Cdh-1</td>
<td>Ras</td>
<td>RPA</td>
<td>ORC</td>
<td>MCM</td>
</tr>
<tr>
<td>Cdc6</td>
<td>Lamins</td>
<td>ATM</td>
<td>Histone H3</td>
<td>Chk1</td>
</tr>
<tr>
<td>Chk2</td>
<td>Uracil Glycosylase</td>
<td>DNA ligase</td>
<td>Growth Factors</td>
<td>Cadherin</td>
</tr>
<tr>
<td>p53</td>
<td>Growth Factors</td>
<td>Condensin</td>
<td>SRP</td>
<td>Wee1</td>
</tr>
<tr>
<td>PH-domain</td>
<td>cAMP</td>
<td>DAG and IP3</td>
<td>RTK</td>
<td>Bcl2</td>
</tr>
<tr>
<td>CAK</td>
<td>Cdc25</td>
<td>XP</td>
<td>Insulin Receptor</td>
<td>TFIIH</td>
</tr>
</tbody>
</table>

1. **TFIIH** moves along the DNA template with RNA polymerase II during transcription. *Exam II Material*

2. **TFIIH** targets the Nucleotide Excision Repair machinery to actively transcribing genes. *pg 38 Notes*

3. **ORC** marks origins of DNA replication by binding them throughout the cell cycle and recruits **MCM** as a DNA replication licensing factor only during S phase. *pg 34 Notes*

4. **PCNA** is the eukaryotic functional equivalent of the prokaryotic β clamp. *pg 30*

5. **Uracil Glycosylase** recognizes chemically altered nucleotides in Base Excision Repair. *pg 39*

6. Mutations that destroy the GTPase activity of **Ras** are found in 25% of human cancers. *pg 61*

7. **APC-Cdh1** is responsible for marking Cyclin B for degradation by the proteasome at the end of M phase. *pg. 44*

8. **ATM (or Ku)** is found both at telomeres and at abnormal double-stranded breaks needing repair. *pg. 39*
9. DNA Pol α synthesizes a hybrid RNA/DNA primer for lagging strand synthesis. pg. 30

10. Growth Factors, Myc, Ras, telomerase, CAK, etc. belongs to the oncogene class of cancer-causing genes. pg. 75

11. Weel is responsible for phosphorylating Cdk at inactivating phosphorylation sites. pg. 46

12. Checkpoint kinase 1 (Chk1) induces cell cycle arrest in response to DNA damage sensed during G2 phase by phosphorylating Cdc25. pg. 46

13. p53 is a transcription factor that induces cell cycle arrest or apoptosis in response to DNA damage sensed during G1 phase and is mutated in 50% of human cancers. pg. 46, 75

14. Over-expression of telomerase in somatic cells causes lengthening of telomeres and cell immortalization. pg. 32, 75

15. ATM, p53, XP (RAD, ERCC), Chk2, cadherin, Wee1, etc. belongs to the tumor suppressor class of cancer-causing genes. pg 75

16. Loss of expression of cadherin is associated with increased cancer metastasis. pg 76

17. Nucleotide Excision Repair proteins were discovered by three different mechanisms, either as XP, ERCC, or RAD proteins. pg 38

18. RPA prevents single-stranded regions from re-annealing at DNA replication forks in eukaryotic cells. pg 30

19. The PH-domain (Plestrin Homology domain) of cytoplasmic kinases are stimulated to become membrane-associated upon binding of insulin to the Insulin Receptor, the RTK of the insulin signaling pathway. pg.62

20. condensin and cohesin belong to the SMC family of chromatin proteins. pg 48

21. The Growth Factor Receptor is an example of a Receptor Tyrosine Kinase, abbreviated as RTK. pg 62

22. DNA ligase is an enzyme that functions in DNA replication that is used in the synthesis of recombinant DNA molecules by molecular biologists. pg 28

23. DAG and IP3 are secondary messenger molecules in a signaling pathway involving cleavage of a lipid in the plasma membrane by a Phospholipase. pg. 71

24. cAMP is a secondary messenger molecule produced by Adenylyl Cyclase. pg. 66