

Molecular Medicine Quiz

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1. Which sugar moiety is the backbone sugar component present in DNA (or select F)?

- A. dextrose
- B. 2-deoxyribose
- C. cellulose
- D. 3-deoxyribose
- E. ribulose
- F. none of the above are present

2. mRNA generation from primary RNA transcripts involves the removal of intron sequences. What is this process called (or select F)?

- A. RNA editing
- B. Transcription
- C. Plagiarism
- D. Recombination
- E. Splicing
- F: None of the above.

3. Which of the following *does not* happen to proteins post-translationally within the cell (or select F)?
- A. Sugar moieties may be attached at the side-chain oxygen of threonine
 - B. Disulphide bonds –S-S- may be created by oxidising pairs of -SH groups.
 - C. A phosphate may be added to the side-chain oxygen of threonine
 - D. A methyl group may be added to the side-chain nitrogen of lysine
 - E. A peptide bond may be hydrolysed by signalase
 - F. All of the above occur, post-translationally

4. Mentally trace a route along the main chain (the backbone) of a protein. Which of the following sequence of atoms forms the continuous chain?

- A. -N-C-N-C-
- B. -N-C-C-N-C-C-
- C. -N-C-C-O-N-C-C-O-
- D. -N-C-C-O-H-N-C-C-O-
- E. -N-H-C-C-O-N-H-C-C-O-
- F. None of the above are correct

5. Which of the following elements, as part of an amino acid, is rarely but correctly incorporated in human proteins during mRNA translation (or select F)?

- A. calcium in calcitonin
- B. mercury in merthiolate
- C. selenium in selenocysteine
- D. phosphorus in phosphotyrosine
- E. iron in haem
- F. None of the above is incorporated in translation

6. In each normal somatic (body, not germ cell) human cell, which of the following statements is true (or select F)?

- A. X-linked genes are absent in men.
- B. Y-linked genes in women are present in a single copy.
- C. X-linked genes in women *are present* in a single copy.
- D. The great majority of genes are present in two copies.
- E. Women's cells have two copies of all human genes.
- F. All the statements above are wrong.

7. Which of the following statements is more than ten-fold wrong?

- A. Humans have 250,000 protein encoding genes.
- B. A single copy of the human genome contains 3000 million basepairs of DNA.
- C. A single copy of a free-living bacterial genome contains 5 million basepairs.
- D. Free-living bacteria have 5000 protein encoding genes.
- E. The median size of an open reading frame in humans is 1500 basepairs.
- F. All of the above are fair estimates.

8. Which of the following statements are false under normal physiological conditions (or select F)?

- A. More than 90% of histidine (H/His) and arginine (R/Arg) side-chains are positively charged.
- B. Pairs of cysteine (C/Cys) side chains cross-link peptides.
- C. The side chains of proline (P/Pro) and valine (V/Val) are hydrophobic hydrocarbon groups.
- D. More than 90% of glutamic acid (E/Glu) and aspartic acid (D/Asp) side-chains are negatively charged.
- E. Serine (S/Ser) and Glutamine (Q/Gln) side chains are neutral but hydrophilic.
- F. Actually, all of the above are true

9. Which of the following molecules can diffuse efficiently and non-specifically through a biological membrane (or select F)?

- A. citrate
- B. glycine
- C. oxygen
- D. water
- E. phosphate
- F. None of the above

10. Which of the following is not required for a PCR reaction involving a thermophilic DNA polymerase (or select F)?

- A. A DNA template.
- B. A mechanism for separating the strands of double-stranded DNA.
- C. Divalent cations.
- D. DNA primer(s).
- E. Ribonucleoside triphosphates.
- F. All of the above are needed.

11. Which of the following statements indicate the direction of synthesis of a new strand of RNA or DNA in nature (or select F)?

- A. They proceed from the 2' end to the 5' end.
- B. They proceed from the 5' end to the 3' end.
- C. They proceed from the 5' end to the 2' end.
- D. They proceed from the 3' end to the 5' end.
- E. They proceed from the 5' end to the 5' end.
- F. All of the above are incorrect.

12. Which one of the following codons is read the same way in both the human cytoplasm and the human mitochondrion (or select F)?

A. AGA

B. UGG

C. AUU

D. UGA

E. AUA

F. All of these codons are translated the same in both systems.

13. Hybridisation *between nucleic acid molecules* means (or select F)?

- A. The molecular recognition of one single-stranded nucleic acid molecule by a closely similar molecule.
- B. The specific non-covalent association of complementary or partially complementary single-stranded nucleic acid strands.
- C. The covalent joining of two complementary single-stranded DNA or RNA molecules.
- D. The non-covalent association of similar double stranded nucleic acid molecules.
- E. Mixing and joining of complementary DNA or RNA from different species of organism.
- F. None of the above.

14. Mentally trace a route along the backbone of a DNA or RNA molecule. Which of the following sequence of atoms is connected (or select F)?

A. -O-P-O-P-

B. -O-P-O-C-O-P-O-C-

C. -O-N-H-C-C-O-N-H-C-C-

D. -O-P-O-C-C-C-O-P-O-C-C-C-

E. -O-P-O-C-N-C-C-O-P-O-C-N-C-C-

F. None of the above is correct

15. Which one of the following codons is read the same way in both the human cytoplasm and the bacterium *Escherichia coli* (or select F)?

A. AUA

B. UGG

C. AGA

D. UGA

E. AUU

F. All of these codons are translated the same in both systems.

16. Which answer correctly identifies a function that is performed by the following organelles in humans (or select F)?

- A. Chloroplasts harvest light energy to oxidise water and reduce NADP^+ for photosynthesis.
- B. Peroxisomes generate hydrogen peroxide in liver cells.
- C. Mitochondria absorb cytochrome c from the cytoplasm to prevent cell death.
- D. Nucleoli are the sites for ribosomal RNA synthesis.
- E. The Golgi body modifies proteins for redirection to the nucleoplasm.
- F. None of the above are true in humans.

17. Which of the following is not a sequence-specific DNA location where transcription factors bind and regulate gene expression in human cells (or select F)?

- A. A promoter
- B. A TATAA box
- C. A Shine-Dalgarno sequence
- D. A locus control element
- E. An enhancer
- F. All of the above are involved in transcriptional control

18. Which of the following statements about the endoplasmic reticulum (ER) is false (or select F)?

- A. Ribosomes are abundant in rough ER.
- B. Membrane-bound vesicles leave the ER to carry proteins into the Golgi apparatus.
- C. Rough ER is the site of the synthesis of secreted proteins.
- D. Rough ER is so named because it is densely decorated with particles when it is visualised in electron microscopy.
- E. Rough ER is the site of synthesis of membrane proteins.
- F. Actually, all of the above statements are true.

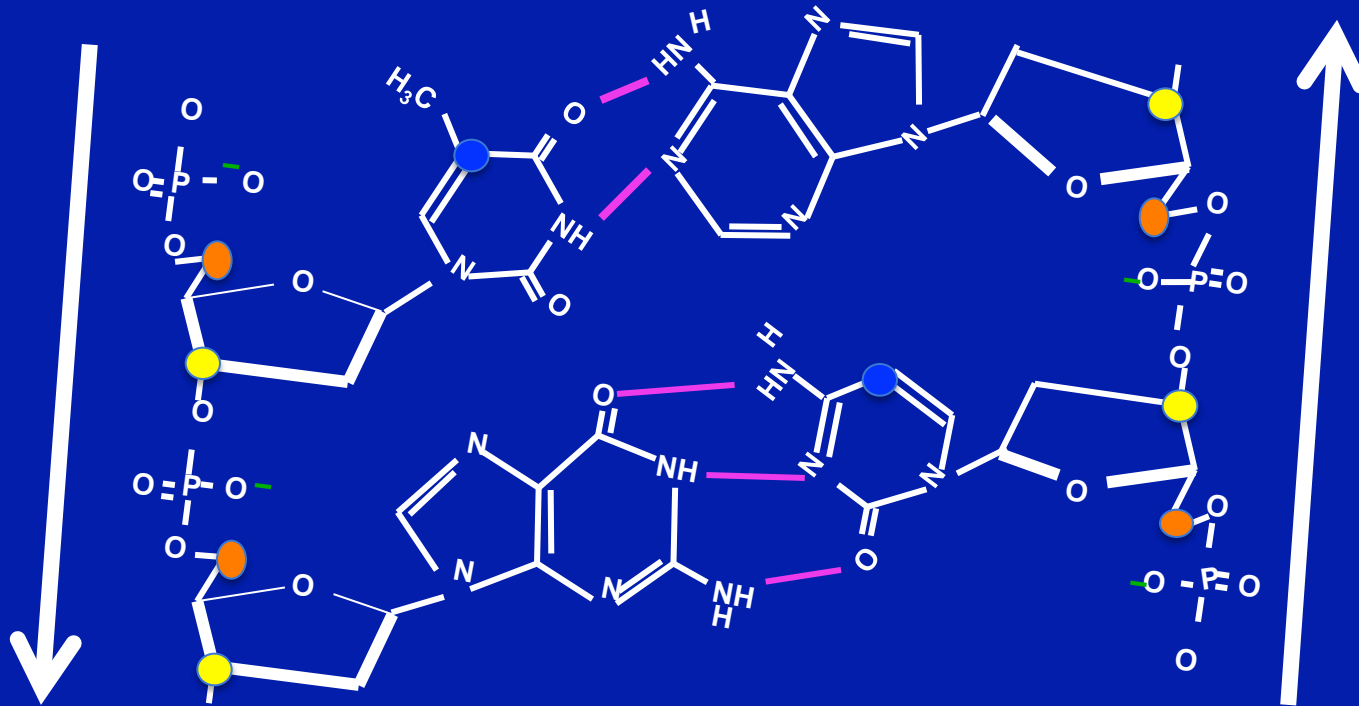
19. Which of the following organelles are not linked by the controlled transfer of lipid vesicles (or select F)?

- A. the Golgi apparatus
- B. endosomes
- C. the endoplasmic reticulum
- D. mitochondria
- E. the plasma membrane
- F. All of the above are linked by vesicular membrane transport.

20. Select which of the following statements is not true (or select F).

- A. Guanidine contains guanine.
- B. Nuclei contain nucleoli.
- C. Cytidine contains cytosine.
- D. Chromosomes contain chromatin.
- E. Splicesomes contain splicing factors.
- F. All of the above statements are false.

21. The diagram shows a two base-pair segment of a DNA double helix. Which of the following is true (or select F)?



- A. Accentuated bonds are at the back of the structure
- B. All atoms in the structure are shown
- C. The pink bonds represent (weak) hydrogen bonds, which dictate the pairing relationships of the double strand.
- D. The pink bonds represent base stacking interactions, which provide the stability of the double strand.
- E. The pink bonds represent covalent bonds between adjacent bases.
- F. None of the above are true

22. The diagram shows a two base-pair segment of a DNA double helix. Which of the following is **not true** (or select F)?



- The lower base pair is a G-C pair.
- The 5-carbons of the pyrimidine bases are marked with blue circles.
- The 5'-carbons are marked with orange ellipses.
- The rings of the 2-deoxyribose moieties contain yellow circles.
- The upper base-pair is an A-T pair
- Actually, all of the above are true.

23. Which of the following is not required for all known types of template-directed DNA synthesis *in vivo* (or select F)?

A. A primer

B. A DNA polymerase

C. A DNA template

D. dTTP

E. dATP

F. Actually, all of the above are required.

24. Estimate the proportion of total cytoplasmic RNA that is mRNA in an active but non-replicating human cell.

A. 2%

B. 10%

C. 20%

D. 50%

E. 90%

F. 99%

25. Which element is not present in mRNA (or select answer F)?

A. phosphorus (P)

B. nitrogen (N)

C. carbon (C)

D. sulphur (S)

E. oxygen (O)

F. Actually, all of the above are present

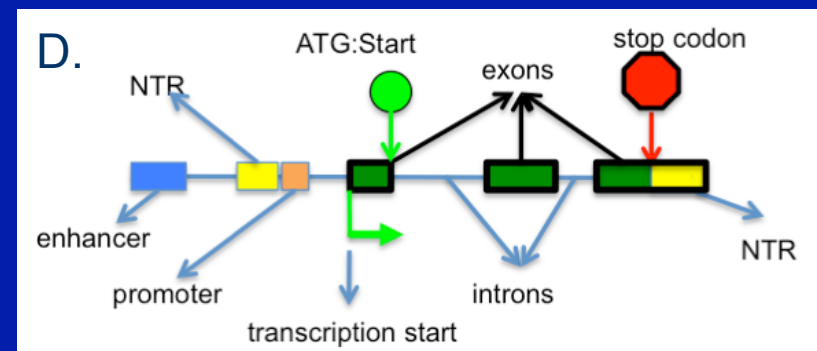
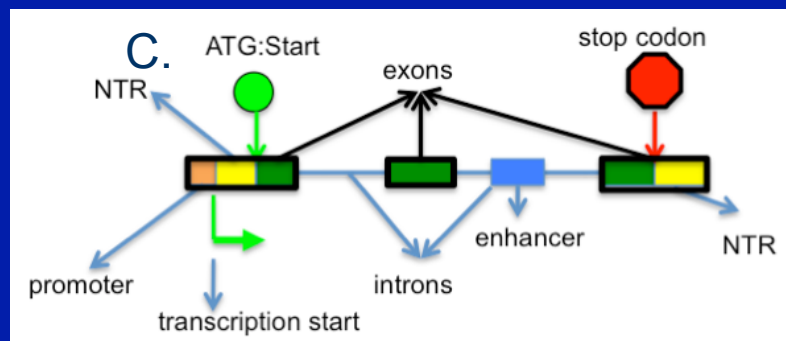
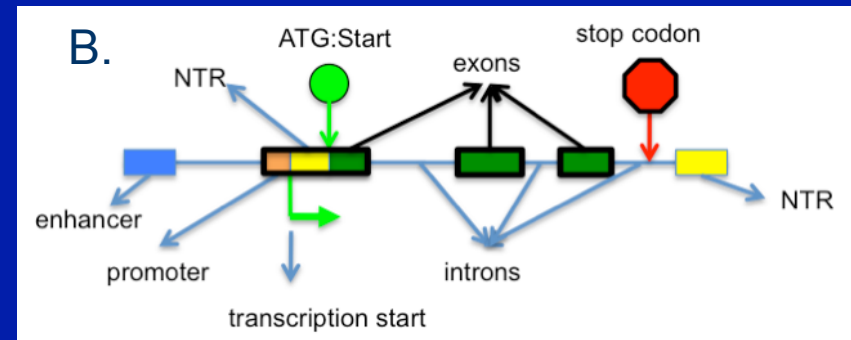
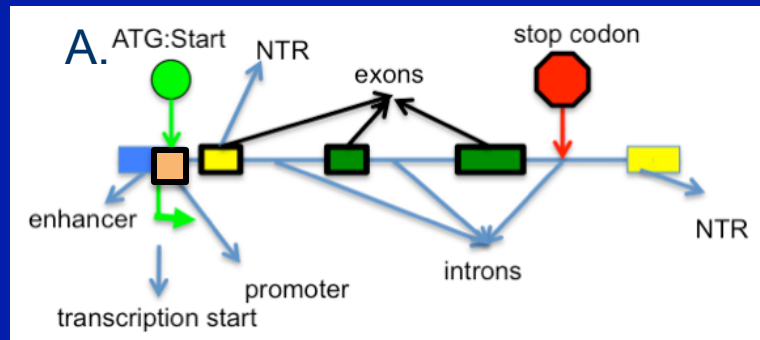
26. A transcription complex has pulled apart two strands DNA and is running along its template strand. The sequence of this strand, expressed in the conventional way is

AATCGCTCGACG (3 ')

Which of the following will be the sequence of the product strand (or select F)?

- A. CGTCGAGCGATT (3 ')
- B. AATCGAGCGACG (3 ')
- C. UUAGCGAGCUCG (3 ')
- D. AAUCGCUCGACG (3 ')
- E. CGUCGAGCGAUU (3 ')
- F. None of the above.

27. In a gene, a possible order of elements is correct in which of the figures below (or select E)? [NTR means non-translated region.]



E. None of the above could correctly represent a functional gene.

28. Which of the following pairs of amino acids both contain all of the same chemical elements in their side-chains (or select F)?

- A. asparagine (Asn, N) and arginine (Arg, R)
- B. cysteine (Cys, C) and serine (Ser, S)
- C. histidine (His, H) and glutamine (Gln, Q)
- D. tryptophan (Trp, W) and arginine (Arg, R)
- E. glutamine (Gln, Q) and glycine (Gly, G)
- F. The side-chains of all of the above pairs contain atoms of different elements from one another in their side-chains.

29. Which of the following statements is *not correct* (or select F)?

- A. Hydrolysis of ATP and GTP are often used in biological systems to drive unfavourable reactions, in metabolism and protein interactions, respectively.
- B. Pharmacologically important receptors are usually protein kinases, which use ATP to phosphorylate proteins.
- C. The overwhelmingly common class of cells surface receptors contain seven sequential alpha-helical domains that snake through the membrane.
- D. Ras, Rac and Rho are "small GTP-ases"
- E. Seven-transmembrane-domain receptors, for their activity associate with "large" GTP-binding proteins.
- F. Actually, all of the statements above are correct

30. Which one of the following enzymes catalyses mRNA synthesis in the eukaryotic nucleus (or select F)?

- A. RNA polymerase I
- B. T7 RNA polymerase
- C. RNA polymerase II
- D. RNA polymerase III
- E. AMV reverse transcriptase
- F. None of the above catalyse mRNA synthesis

31. Which of the following is not true of transcript processing in human cells (or select F)?

- A. The 5' nucleotide cap structure is added to all transcripts produced by RNA polymerase II.
- B. Introns can represent the greater part of a primary transcript.
- C. Introns are removed in the nucleus by splicing during and after transcription.
- D. The poly-A tail is added after the mRNA is complete and spliced.
- E. Loss of either the cap or the poly-A tail destabilises mRNA.
- F. Actually, all of the statements above are true.

32. Which of the following is false (or select F)?

- A. Deuterium, ^2H , is a heavy radioactive isotope of hydrogen that can be used to trace protein and nucleic acid metabolism *in vivo*.
- B. ^{35}S is a synthetic radioactive isotope of sulphur that can be used as a tracer for proteins synthesised in its presence.
- C. ^{15}N , a rare natural heavy stable isotope of nitrogen, was used as a heavy label for DNA in the original demonstration of semi-conservative DNA replication.
- D. ^{14}C is radioactive isotope of carbon that can be used to trace any organic compound in which it has been incorporated.
- E. ^{32}P is a radioactive isotope of phosphorus that can be used to trace nucleic acids that are synthesised to contain it.
- F. Actually, all of the above are true.

33. A small molecule approaches the plasma membrane of a cell from the exterior. Which type of macromolecular structure is it most likely to encounter first?

- A. nucleic acid
- B. polysaccharide
- C. polypeptide (protein)
- D. polychlorinated hydrocarbons
- E. cholesteryl esters
- F. phospholipid

34. In which of the following situations may the polymerase chain reaction occur?

- A. During a DNA-replication cycle of a thermophilic bacterium.
- B. During the replication of retroviruses.
- C. In a test tube in a thermocycler.
- D. During a replication cycle of mitochondrial DNA.
- E. In ancient DNA.
- F. None of the above.

35. Which of the following statements is most correct?

A codon is a sequence of three nucleotides...

- A. ...present in a tRNA molecule. Each codons associate with the mRNA on a ribosome during translation. A codon, in effect, specifies an individual amino acid according to the mRNA sequence, for insertion by the translational machinery into a growing polypeptide chain.
- B. ...present in mRNA. A particular codon specifies a unique amino acid for insertion by the translational machinery into a growing polypeptide chain.
- C. ...present in a mRNA molecule. A codon is involved in selecting a unique species of amino-acyl tRNA through its complementary anti-codon sequence for binding at the "A" site of a ribosome and thus specifies the amino acids that are inserted in a growing polypeptide chain.
- D. ...present in an exposed loop of each amino-acyl tRNA. The codon is used for recognising a complementary anti-codon of mRNA and thus specifying an individual amino acids for insertion by the translational machinery into a growing polypeptide chain.
- E. ...that is not correctly described by any of the statements above.