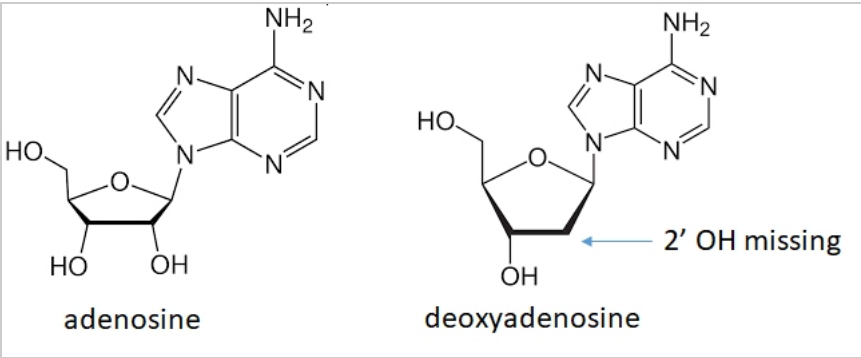
CHE 102 - Practice Exam - Nucleic Acids - S22 - ver 1 Score: _____/0

Name: _____ Class: _____ Date: _____

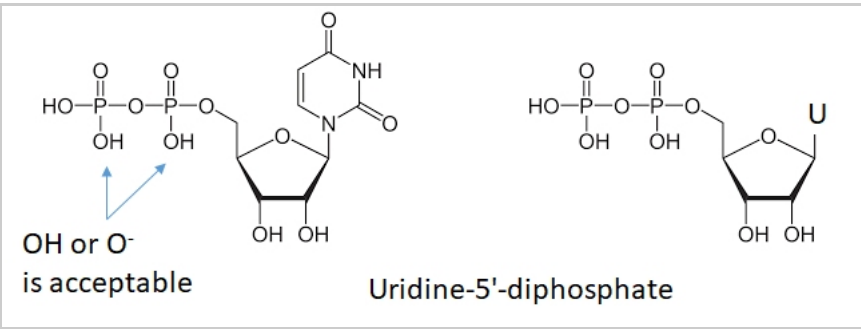
Read each question carefully. Some questions have multiple parts. Answer all questions with complete sentences.

1. Draw an example of each of the following molecules. Answer any additional questions given.

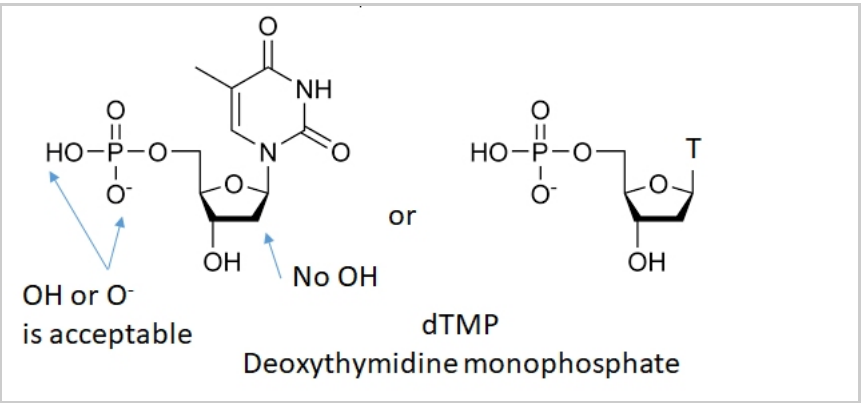
   (a) Draw a picture of Adenosine. What is the difference between Adenosine and Deoxyadenosine?



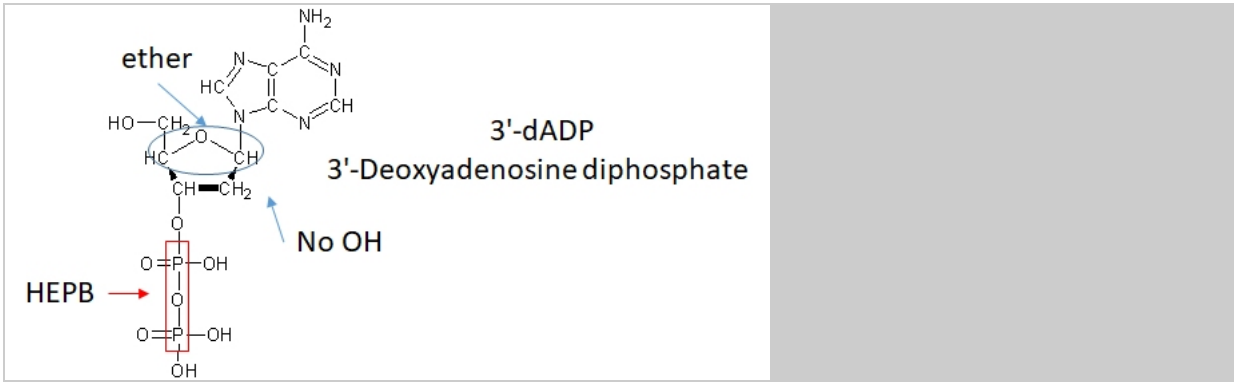
   (b) Uridine-5'-diphosphate (just draw a U for uridine)



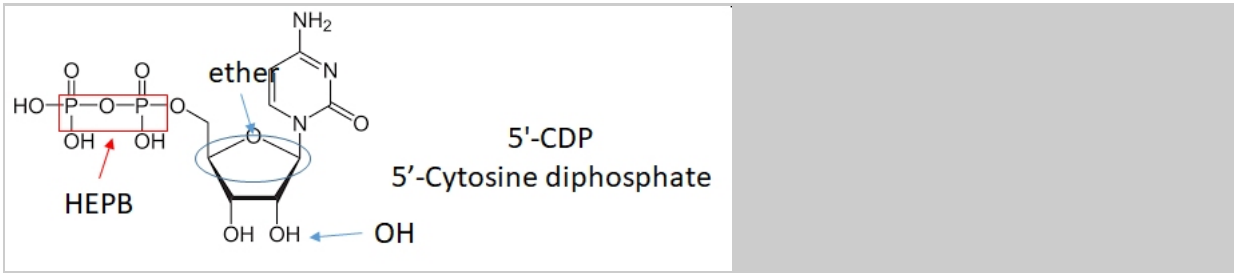
   (c) dTMP (just draw a T for thyamine)



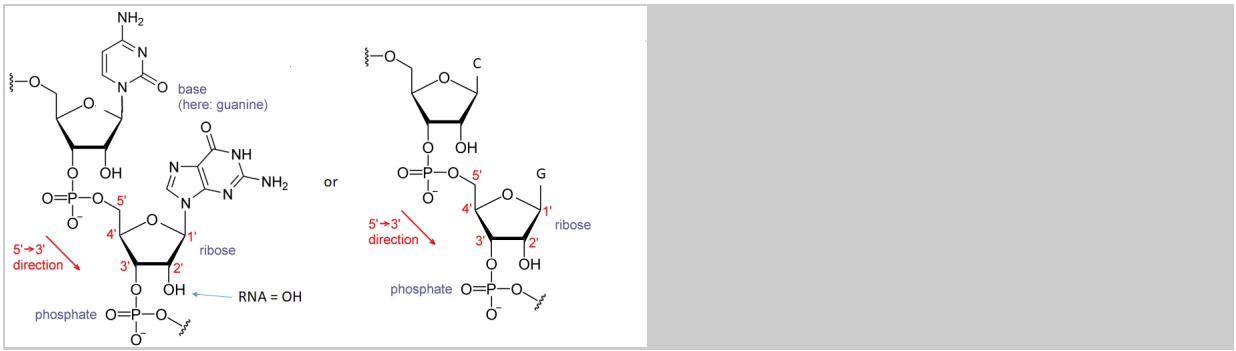
   (d) Draw a picture of 3'-dADP. Circle any ether bonds. Put a square around any high energy phosphate bonds.



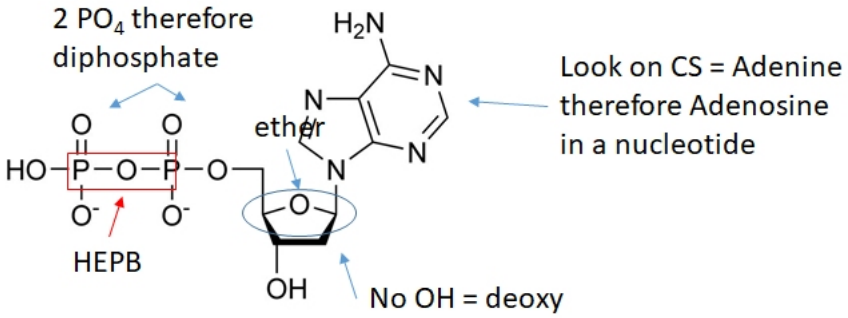
(e) Draw a picture of 5'-CDP. Circle any ether bonds. Put a square around any high energy phosphate bonds.



(f) Draw a RNA fragment consisting of C and G (just draw a C for cysteine and a G for guanine)



2. Answer the following questions about the molecule pictured below:



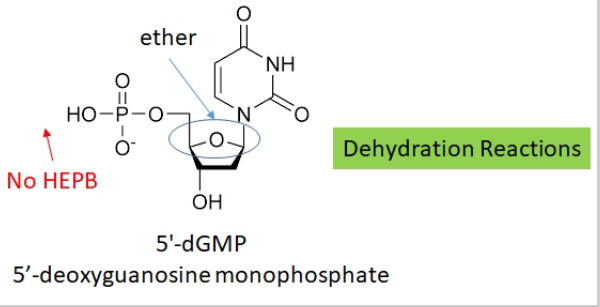
2(a) Give the full name for the molecule. 5'-deoxyadenosine diphosphate

2(b) Give the abbreviation for the molecule. 5'-dADp

2(c) Is this an example of a nucleoside or nucleotide? Explain. nucleotide - sugar + base + phosphates

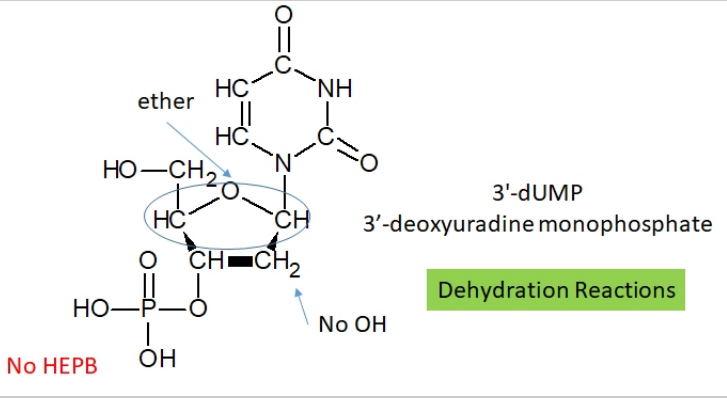
2(d) Circle the ether like bond(s). Place a square around the high energy phosphate bond(s) see above

3. Draw a picture of 5'-dGMP. Put a square around any high energy phosphate bonds. What type of reaction occurred to make the molecule from its parts?

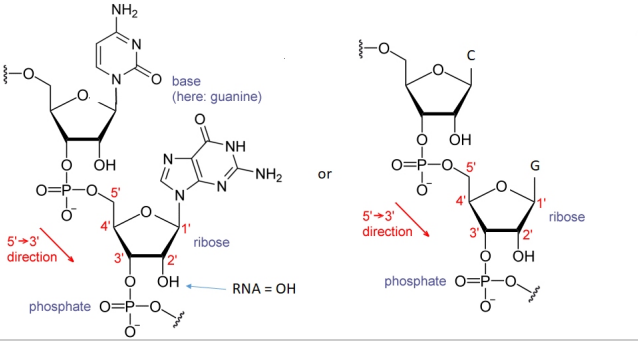


Proper connection Base/Sugar - 1 pt
Proper connection Sugar Phosphate - 1 pt
HEPB - 1 pt
Reaction = dehydration - 1 pt
Deoxy (missing 2' OH) - 1 pt

4. Draw a picture of 3'-dUMP. Circle any ether bonds. Put a square around any high energy phosphate bonds. What type of reaction occurred to make the molecule from its parts?

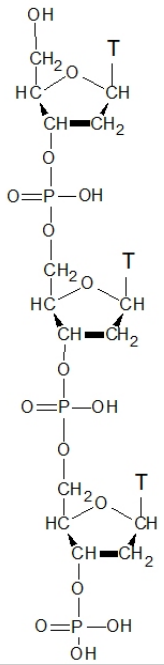


5. Sketch a portion of RNA showing the linkage between two base pairs.



6. Sketch a portion of DNA (including the backbone) showing the structure of TTT (you may abbreviate the bases as shown in class).

DNA because missing 2′ OH



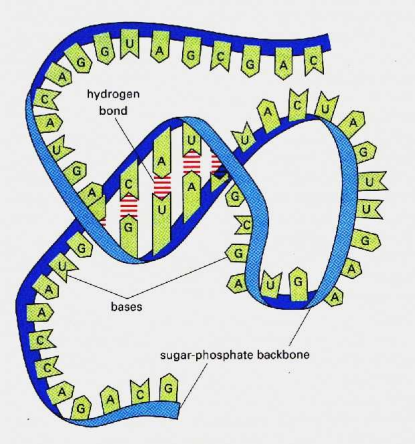
7. DNA forms a double helix. What holds the two strands together? Explain.

Hydrogen bonds between complementary base pairs causing the DNA strand to form a helix (very similar to how α-1,4 glycosidic bonds and how the Hydrogen bonds between amide groups in protein chains cause the helix structure to form.

8. What is meant by the term: "complementary" base pairs? Which base pairs are complementary? What makes them complementary? How does this effect the structure of DNA?

Complementary base pairs are formed between G/C and A/T (1 pts) and are caused by Hydrogen Bonds (2 pts)
They are responsible for the formation of the double helix structure and serve as an error checking mechanism for DNA replication. (2 pt)

9. Is the following a small portion of DNA or RNA? Explain.

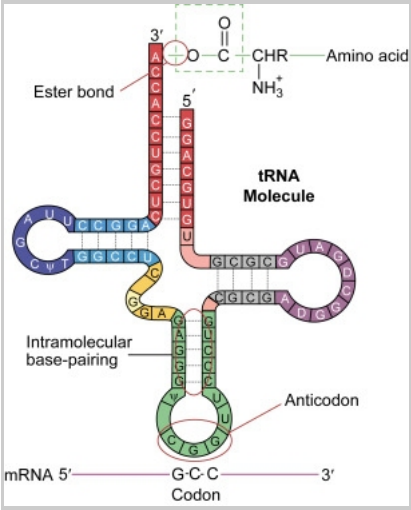


It must be RNA because it uses the base Uracil (which is not found in DNA)

10. How is the direction in which a protein is built controlled? (ie Why do we always build from the N-terminal end to the C-terminal end?)

In the Initiation step an aldehyde group is attached to the first AA, N-terminal end preventing the formation of an amide/peptide bond in that direction. Thus only the C-terminal end can react with the next AA to form a amide/peptide bond

11. Sketch a picture of tRNA and answer the following questions:
    (a) Its overall purpose.
    (b) What is responsible for its very specific structure.
    (c) How each part (3 total) of its structure supports the purpose.



(a) - Transfer RNA (abbreviated tRNA) is a small RNA molecule that plays a key role in protein synthesis. Transfer RNA serves as a link (or adapter) between the messenger RNA (mRNA) molecule and the growing chain of amino acids that make up a protein.

(b) Hydrogen bonds - The primary structure of tRNA allows extensive folding due to hydrogen bonding between he bases, resulting in a structure with an "idealized" cloverleaf structure with 4 main parts. Figure 31.12.

(c) The unique structure allows it to interact with a specific AA, the mRNA strand and the ribosome.

1. One end of the molecule terminates with sequence CAA and binds to AA

2. One end of the molecule has an anticodon triplet which is complementary to the mRNA strand which it binds too. For example if the mRNA sequence is UUC then the mRNA strand would be GGA which codes for glycine.

3/4. The remaining two portions of the tRNA bind to the ribosome and other specific enzymes required for transcription to occur. Figure 31.15 and Section 31.11

12. What is the general purpose for each of the following molecules:

    (a) DNA

    Information Storage - Architectural Drawing

    (b) mRNA

    Template for building proteins - Blueprints

    (c) tRNA

    Bind and Deliver AA - Dump Truck

    (d) rRNA

    Ribosome, Makes Proteins - Factory

13. What do the abbreviations DNA and RNA stand for, and what are (5) differences between DNA and RNA?

DNA - deoxyribonucleic acid	RNA - Ribonucleic Acid
Double Strand	Single Strand
T	U
Deoxyribose	Ribose
Information Storage	Build Proteins
Not modified	heavily modified
1 Type	3 types

14. What process (Replication, Transcription, or Translation) is best described by the following "reactions":

(a) DNA $\longrightarrow$ RNA Transcription

(b) DNA $\longrightarrow$ 2 DNA Replication

(c) RNA + AA $\longrightarrow$ Protein Translation

Table 31.3 The Genetic Code for Messenger RNA

First nucleotide	Second nucleotide	Third nucleotide and amino acid coded			
		U	C	A	G
U	U	Phe	Phe	Leu	Leu
	C	Ser	Ser	Ser	Ser
	A	Tyr	Tyr	TC*	TC*
	G	Cys	Cys	TC*	Trp
C	U	Leu	Leu	Leu	Leu
	C	Pro	Pro	Pro	Pro
	A	His	His	Gln	Gln
	G	Arg	Arg	Arg	Arg
A	U	Ile	Ile	Ile	Met
	C	Thr	Thr	Thr	Thr
	A	Asn	Asn	Lys	Lys
	G	Ser	Ser	Arg	Arg
G	U	Val	Val	Val	Val
	C	Ala	Ala	Ala	Ala
	A	Asp	Asp	Glu	Glu
	G	Gly	Gly	Gly	Gly

*Termination or nonsense codon

15. Translate the following mRNA strand (UUUCAUAAG) into 1) corresponding DNA strand 2) tRNA and 3) the resulting Amino Acid sequence.

    1) Reverse Transcription - AAA GTA TTC
    2) Complementary Bases - AAA - GUA - UUC
    3) Phe - His - Lys

16. What amino acid is coded for by the following: (a) DNA - TAT (B) mRNA - CAU.

    (a) DNA $\longrightarrow$ mRNA AUA $\longrightarrow$ ILE
    (b) Use the chart: HIS

17. What amino acid is coded for by the following:

    (a) DNA - TCC

    (b) mRNA - UCC

    (a) mRNA = AGG, use the chart - Arg
    (b) just use the chart - Ser

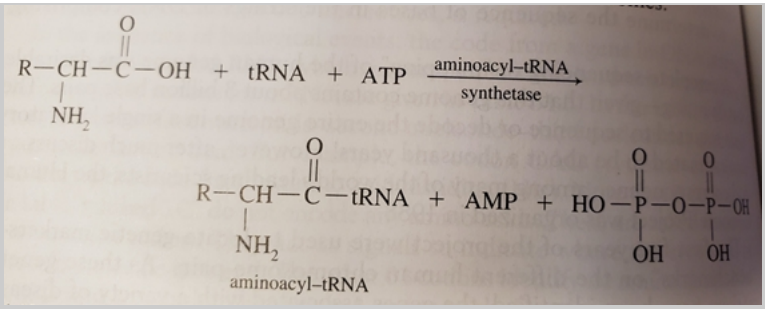
18. Translate the following DNA sequence: TAT-GCG-AAA-TTT
    (a) mRNA strand: AUA-CGC-UUU-AAA

    (b) Amino Acid sequence: Ile - Arg - Phe - Lys

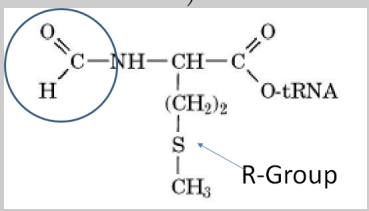
19. Describe the biosynthesis of proteins (Initiation, Elongation, and Termination.

    Read Sectin 31.11

    1. Preparation - DNA is converted to rRNA, mRNA and tRNA. The mRNA leaves the nucleus and travels to the cytoplasm where it binds t0 5 or more ribosomes. The tRNA binds to AA through the following reaction:



2. Initiation - AUG/GUG codons signal the start of protein synthsis, a special initiator tRNA binds to the ribosome. It has a N-formyl (aldehyde functional group is attached to the N-Terminal end of the AA) to control the direction of protein synthesis.



3. Elongation - Addition of AA to protein chain. Involves 3 steps.
   (a) Next AA-tRNA enters ribosome, attaches to mRNA by Hydrogen bond between complementary bases
   (b) Peptide bond is formed between 2 AA.
   (c) The ribosome moves to the next codon in the mRNA and ejects the tRNA that was used to make the peptide bond.
   (d) This process is repeated over and over again until...
4. Termination - the process stops when a "nonsense" or TC is reached on the mRNA, the last tRNA is hydrolyzed and the protein is complete.