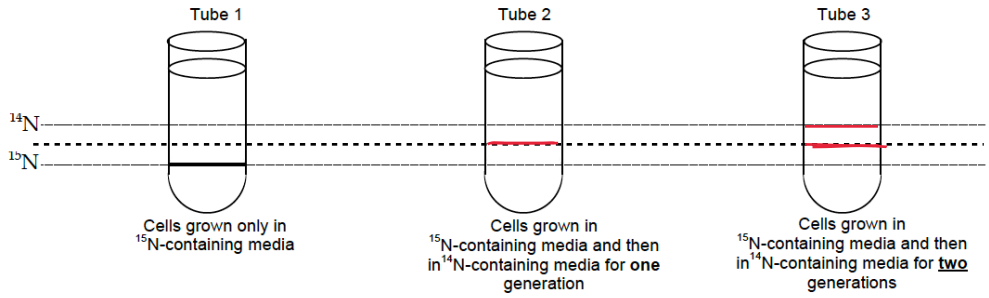
BIOL 367 (Midterm Exam #1)

STUDENT NAME _____	**STUDENT ID#** _____
COURSE	**Biology NUMBER 367**
EXAMINATION	**Midterm Exam # 1 DATE September 23, 2019**
INSTRUCTOR	**Aashiq H Kachroo**
MATERIALS ALLOWED	**Class notes and textbooks**
MATERIALS NOT ALLOWED	**Laptops, tablets or phones**
CALCULATORS ALLOWED	**Yes**

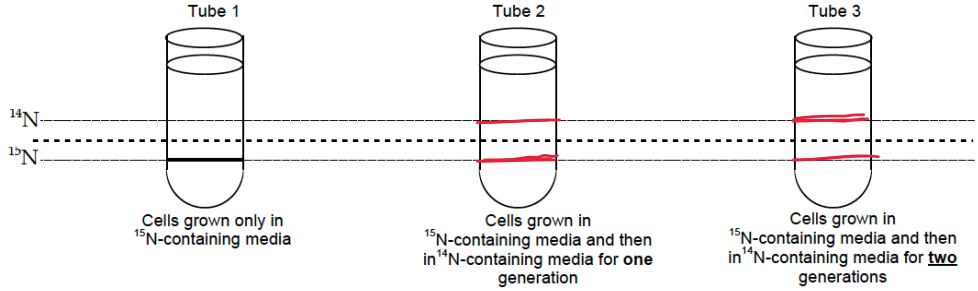
SPECIAL INSTRUCTIONS: Total Marks out of 100. Marks for each question are indicated. Place all answers on the exam sheets. Write your names on all the sheets. Maximum time = 60 minutes.

15 **1. The Meselson-Stahl experiment suggested that DNA replicates in a semi-conservative manner. *E. coli* cells were grown for several generations in media with ^{15}N. These *E. coli* cells were then transferred into a ^{14}N media and allowed to replicate their DNA. DNA was extracted from the cells grown in ^{14}N-containing media and separated by cesium chloride density centrifugation. In tube 1 below, you see the band formed by the DNA isolated from cells grown exclusively in ^{15}N media.**

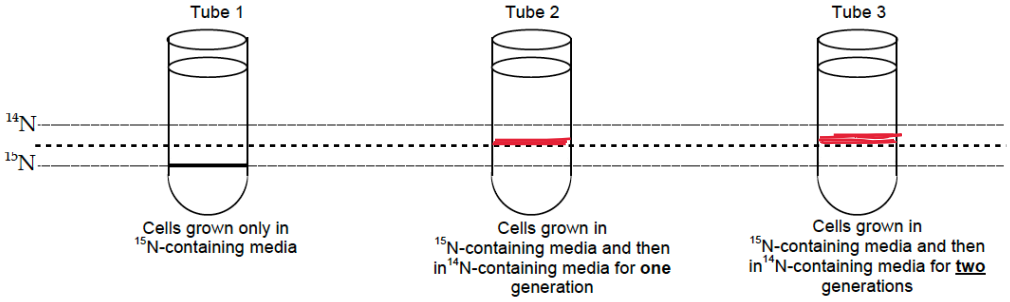
a) On the schematic below, draw the band(s) that you would expect in tubes 2 & 3 if the DNA duplex is copied by a <u>semi-conservative mode</u> of replication.



b) On the schematic below, draw the band(s) that you would expect in tubes 2 & 3 if the DNA duplex is copied by a <u>conservative mode</u> of replication.



c) On the schematic below, draw the band(s) that you would expect in tubes 2 & 3 if the DNA duplex is copied by a <u>dispersive mode</u> of replication.



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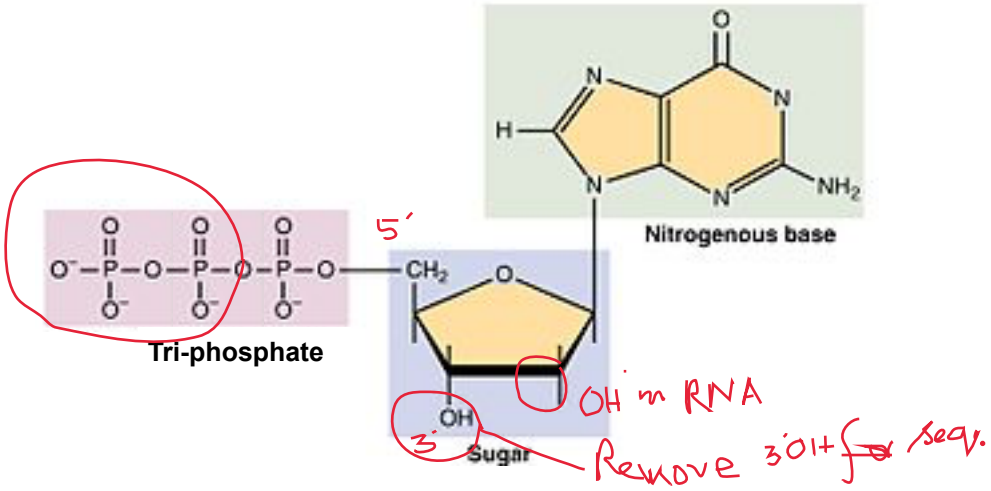
2. Following is a chemical structure of a deoxynucleotide triphosphate.

i. Precisely circle the region that doesn't attach to the newly replicated DNA strand.

ii. Label 5′ and the 3′ ends of the nucleotide by drawing the structure below:



iii. Briefly explain the part of the nucleotide shown above that is different in RNA. What is that modification?

RNA possess a 2' OH in the sugar compared to DNA.

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3. Fill in the blanks with DNA or RNA:

(a) DNA polymerase is DNA **-dependent** DNA **polymerase.**
Provide a brief 1 line explanation for your answer:

DNA polymerase uses DNA as a template to make DNA.

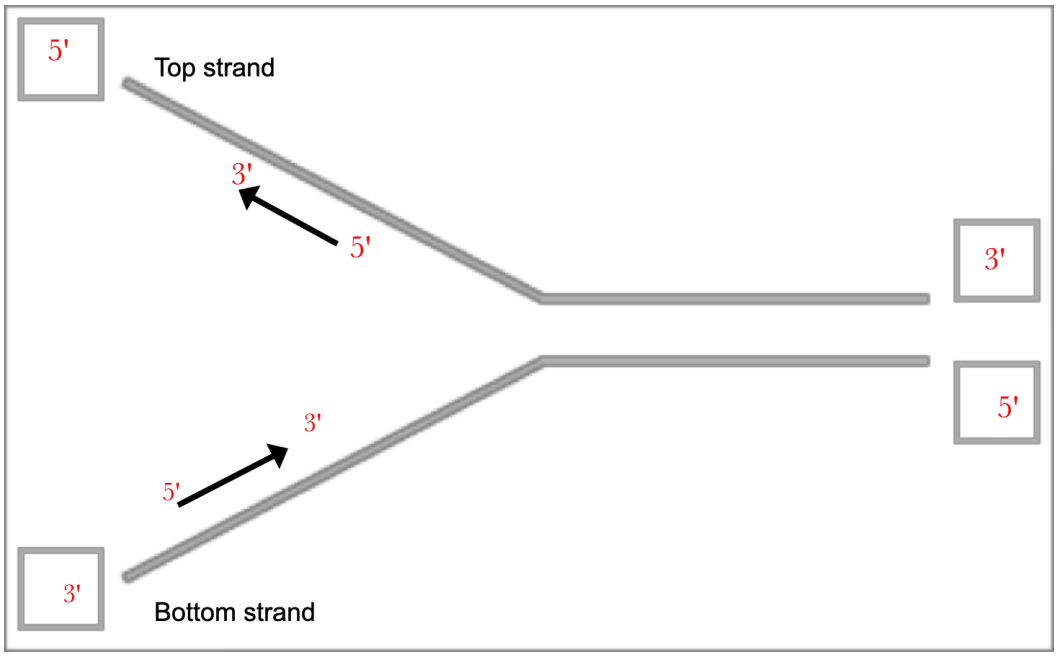
(b) RNA polymerase is DNA **-dependent** RNA **polymerase.**
Provide a brief 1 line explanation for your answer:

RNA polymerase uses DNA as a template to make RNA.

(c) Primase is DNA **-dependent** RNA **polymerase.**
Provide a brief 1 line explanation for your answer:

Primase uses DNA as a template to make RNA.

(d) Shown below is a DNA replication fork. The arrows indicate the direction of the replication. Label the ends of DNA in the boxes (use 5' or 3') based on the information provided.



(e) Which of the above strand's is a leading and a lagging strand?

Top strand > Lagging Strand **Botton strand >** Leading Strand

f) What activity of DNA polymerase makes it an excellent replicating enzyme such that (a) it incorporates correct bases and (b) proofread and correct mismatches. LIST ALL THAT APPLY.

Active site of DNA polymerase **5' to 3' polymerase activity**

3' to 5' exonuclease activity **5' to 3' exonuclease activity**

25 **4. In 1928, Griffith performed a series of experiments where he infected mice with two different strains of pneumonia-causing bacteria (*S. pneumonia*): the *smooth/virulent*, disease causing S strain and the harmless *rough/ non-virulent* R strain. In 1944, Avery *et al.* through a series of experiments, showed the true nature of the genetic material.**

(a) If you performed these experiments using the following conditions. What are the likely outcomes? [HINT: First experiment is filled in for your help]. Use "Dead or Alive" to represent the condition of mice and "S, R or S & R" to show the strains isolated from that animal after infection.

Exp #	Strains and treatments	Condition of mice	Strained obtained after injection in mice
1	S strain heat inactivated combined with R strain	***Dead***	***S & R strains***
2	S strain heat inactivated only	Alive	None
3	S strain-DNA & DNase treatment	Alive	None
4	S strain-DNA & proteinase combined with R strain	Dead	S & R
5	S strain-DNA treated with DNase combined with R strain	Alive	R
6	R strain only	Alive	R

b) What did the above experiments prove in terms of the nature of the genetic material?

That the genetic material is:

1. Heat stable 2. Can transform into the cells 3. DNA is the genetic material and sensitive to DNase treatment 4. DNA can undergo recombination

c) According to Chargaff's rule, let us assume that %A=%T=N and %G=%C=M. Would the values for N or M be similar or different in different tissues of the same organism? Briefly explain your answer (2-3 sentences).

N & M will stay same across various tissues of the same organism since the genetic makeup of the organism stays same in every cell.

(d) Would the values for N or M be similar or different among different species? Briefly explain your answer (2-3 sentences).

N & M will be different in different species since the genetic makeup of the each species is different.

10 **5. (Circle the correct answer/s)**

(a) Which of the following proteins/enzymes can "directly" change the topology of the DNA inside the cells.

Histones	Topoisomerase	DNA polymerase	Helicase
Primase	DNA ligase	Exonuclease	Ribosome

(b) Which of the following proteins/enzymes can relax an overwound DNA inside the cells.

Histones	Topoisomerase I	DNA polymerase	Helicase
Primase	DNA ligase	Exonuclease	DNA gyrase

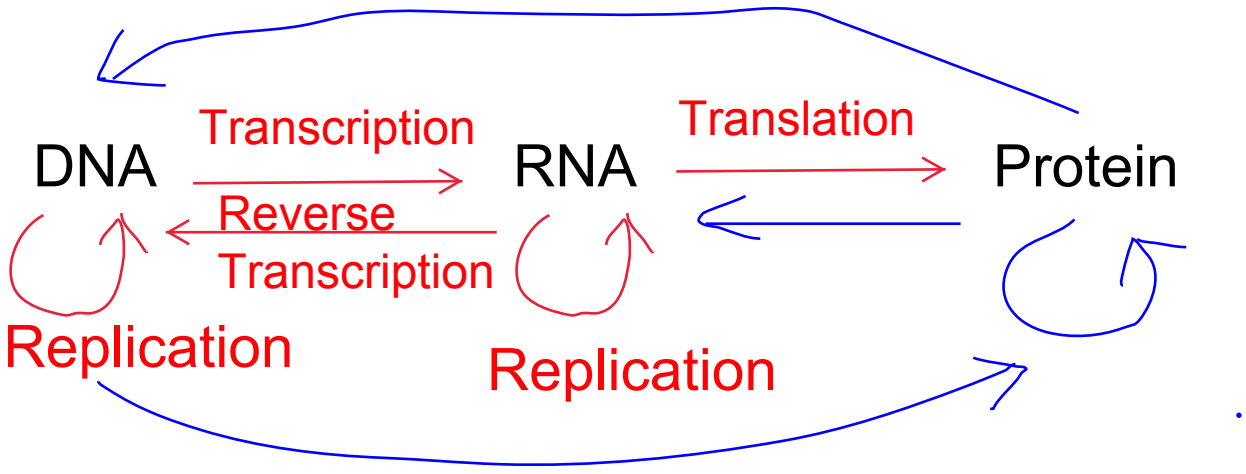
(c) Which of the following proteins/enzymes only bind to single-stranded DNA inside the cells. [HINT: DNA:Primer hybrids are not considered single-stranded DNAs]

Histones	Topoisomerase I	DNA polymerase	Helicase
Primase	ssDNA binding proteins	Ribosomes	DNA gyrase

15 **6. Which of these statements are TRUE or FALSE (draw a circle).**

TRUE	**FALSE**	In RNA, glycosidic bond is between a deoxyribose and a nucleotide base.
TRUE	**FALSE**	During DNA synthesis, Okazaki fragments are comprised of both ribo- and deoxyribo-nucleotides
TRUE	**FALSE**	Topoisomerase disentangle DNA by breaking hydrogen bonds between bases
TRUE	**FALSE**	In DNA replication, DNA ligase plays an important role during lagging strand synthesis only
TRUE	**FALSE**	In eukaryotes, DNA replication starts at a single origin of replication
TRUE	**FALSE**	In Transcription, template strand is also called the coding strand of DNA.
TRUE	**FALSE**	DNA replicates via conservative mode of replication.
TRUE	**FALSE**	DNA polymerase possesses 5' - 3' exonuclease activity & 3' - 5' polymerase activity.
TRUE	**FALSE**	Supercoiled plasmids do not run true to size in an agarose gel.
TRUE	**FALSE**	Linking number of the DNA changes when it is twisted.

7. <u>A truly bonus question.</u> *Schematically illustrate the "Central Dogma" of Biology with appropriate labels of the processes that allow information copy and flow. Also, indicate the directions genetic information cannot flow.*



Arrows indicated in Blue are the directions in which information flow does not happen.

Do not write below this line

Question 1 _____ **Question 2 _____** **Question 3 _____**
Question 4 _____ **Question 5 _____** **Question 6 _____**
Question 7 _____