2 pts.

## PART 1

#1. Smoking tobacco (and the ammonia compounds added to cigarettes by some tobacco companies) has been a widely popular activity in this country for several decades.

The figure at right shows the data from an experimental study of smoking and lung cancer rate in rats. The control group ("not smoking") had a 0.12 rate of cancer and the experimental group ("smoking") had a cancer rate of 0.31, which is significantly higher.

Is the conclusion that:

# "smoking caused lung cancer in these rats" VALID or NOT VALID

{circle your choice}

Please explain your choice:





**NOT VALID** 

# "smoking caused lung cancer in these people"

VALID or {circle your choice}

Please explain your choice:

			•••	
	•	•	•••	
•	مر م موجد جر	•••	•	
*	· · · · ·	•		
		•		
		•		

- #3. Please state in a phrase what are the 3 major objectives of this course according to the syllabus? objective #1 objective #2 -
- objective #3 3 pts.

   #4. What kind of reasoning uses observations to create an hypothesis? {circle your choice} → inductive or deductive 1 pt.
- #5. Using what kind of reasoning does one predict the outcome of an experiment and thereby test an hypothesis?
   {circle your choice} → deductive or inductive 1 pt.
- #6. Solar physicists inform us that due to nuclear fusion reactions inside the core of stars, bydrogen atoms are fused to make beavier elements.

core of stars, hydrogen atoms are fused to make heavier elements (such as helium, carbon, oxygen, etc.), and that almost of all of the heavier atoms in our universe were originally produced in this way. Given the mass and intense gravity of stars, **how is it that these heavier elements get out of stars** so that these elements are available for the synthesis of the organic molecules upon which life is based? 2 pts.



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#7. Please list four different gasses that were major components of the atmosphere of the early Earth. 2 pts. 1 –

2 – 3 –

- 4 –
- #8. The figure at right depicts the surface of Jupiter's moon Europa. The moon has a veneer of ice beneath which is liquid water surrounding a geologically active rock and metal rich core.

Why is it the astronomers believe that life might be found on Europa? What conditions might be found there that are necessary for the evolution of life? Please list specific conditions.



					2 pts	
For the following 5 questions copy the BEST choice from the list at right to the line by each question:Hydrogen Bond Ionic BondCovaler none of						
#9. What type of bond involves the sharing of valence electrons?						
#10. W	Vhat type of bond accounts for why some molecule dissolve in water, whereas others do not?	es _			1 pt.	
#11. W	Vhat type of bond accounts for why some clay and surfaces can act as catalysts of polymerization rea	iron pyrite actions? _			1 pt.	
#12. W	Vhat type of bond is catalyzed to form among nucle during a nucleic acid polymerization reaction?	eic acids			1 pt.	
#13. W	Vhat type of bond is created inside the core of star Hydrogen nuclei to make Helium during a nuclear	s among fusion ever	nt?		_ 1 pt.	
#14. W	Vhat type of bond involves the transfer of electrons among the reacting atoms or molecules?	;			1 pt.	
#15. U re sy ae	Jse the axes at right and sketch the eaction diagram for a typical ynthesis reaction that has a high ictivation energy.	energy		after		
#16. <u>U</u> sa di w	(1 pt) <u>Jse a dotted line</u> and sketch on the ame graph at right what the reaction liagram would look like if a catalyst vere used.		before	- time		
	(1 pt)					
#17. A ai cc sy (a m a	At right is a drawing of the apparatus used by Miller and Urey to demonstrate that simple organic compounds called " <b>monomers</b> " could be easily ynthesized under the conditions of the early earth. a) What were these conditions, (b) what were these nonomers, and (c) how exactly did the Miller and U apparatus demonstrate their theory?	e rey		Water vapor	Electrode Condenser Condenser Condenser Condenser Condenser Condenser Condenser Condenser	
3	3 pts					

#18. At right is a drawing of the basic process by which a catalyst acts to catalyze an organic chemical polymerization.

> Please briefly explain this process and specifically comment on the role of hydrogen and covalent bond formation in this reaction. Where, when, and between which molecules do these bonds form?



### 3 pts

1 -

- #19a. Please list below what are the four major categories of organic **monomers** that were spontaneously synthesized by lightning etc. on Earth:
- #19b. Please list below what are the four major categories of organic **polymers** that were synthesized by catalysts (such as clay, iron pyrite, etc) from each of the four monomer types at left below (Note: each polymer below must correspond to its monomer at left)
- $\begin{array}{ccc} 2- & & \longrightarrow \\ 3- & & \longrightarrow \\ 4- & & \longrightarrow \end{array}$

4 pts

The following questions will assess your understanding of the Central Dogma of Molecular Biology. For each question, please use the appropriate terms from the following list (amino acid, codon, anti-codon, DNA, gene, ribosome, protein, transcription, translation, m-RNA, t-RNA):

1 –

20. The figure at right shows the first steps in protein synthesis. Please briefly explain what's going on in this figure. Use labels when needed.

3 pts

21. The figure at right shows the last steps in protein synthesis. Please briefly explain what's going on in this figure. Use labels when needed.



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The chart at right shows the abbreviated amino acid name corresponding to each of the possible combinations of nucleotide triplet codes used in protein synthesis.

Please refer this chart to answer the next several questions on protein synthesis.

#22. Exactly what happens if a code of CCU, CCC, CCA, or CCG is given?

#24. Please use the table above and write down what would be the

corresponding amino acid sequence for the following sequence

#23. Exactly what happens if a code of UAA, UAG, or UGA is given?

1 pt.

1 pt.

- uuu ucu UAU UGU Tyr Cys UUC UCC UAC UGC UUA UCA UAA Stop UGA Stop UUG UCG UAG Stop UGG Trp G CUU CCU CAU CGU CUC ccc CAC CGC CUA CCA CAA CUG CCG CAG AUU ACU AAU AUC ACC AAC ACA AAA AUG Met ACG AAG GUU GCL GAU υ GUC GCC GAC GGC C GUA GCA GAA GGA GUG GCG GAG G GGG
- of nucleic acids: 2.5 pts GUU GUG UAC AAU UGA #25. How many codons are present in this sequence? 0.5 pts #26. Please define the term "gene": 2 pts 27. The figure at right shows: {circle one} **DNA polymerase** (A). Translation Transcription (B). (C). DNA replication 1 pt. #28. Please write down the basic chemical equation for photosynthesis: 2 pts. light #29. Geologic evidence suggests that photosynthesis evolved approximately how many years ago? 1 pt. #30. Please write down the basic chemical equation for aerobic metabolism (anaerobic+aerobic): 2 pts. + + ATP
- #31. Approximately how many ATP's are generated by the complete oxidation of one molecule of glucose?

page 4

1 pt.

## PART 2.

Question #1. This question will assess your understanding of the scientific method.

(a). Please briefly explain the key differences between Inductive and Deductive reasoning in the scientific method. In addition, please use the figure below to illustrate your explanation.



8 pts.

(b). Comment specifically on the order of the "Steps of the Scientific Method" for these types of reasoning. Explain how this order differs for Inductive and Deductive reasoning.

4 pts.

- Question #2. This question will assess your understanding of **TWO of the FOUR** challenges for the first life to evolve. (note: this entire page counts as one question, and note: this question skips Challenges #2 and #4)
- (a) Challenge #1 Origin of the Cell. Please explain in either a single paragraph or an ordered list: (i) What were the principal molecules that comprised these earliest cell membranes and,
  - (ii) Where on the early earth did these membranes most likely form?
  - (iii) Diagram how did these membranes form?

(6 pts) (b) Challenge #3 – Origin of Cell Metabolism. Please explain in either a single paragraph or list: (i) What was the basic metabolic process that arose in the earliest cells to generate energy for

- biosynthesis, (ii) What was the short term energy carrier, and
- (iii) Diagram how did the network of enzymes needed to start this metabolism originally get "into" this cell?

Question #3. This question will assess your population understanding of evolution by natural selection. size

(a) Please briefly explain the concept of natural selection. Please use the figure below in your response.

6 pts.

- (b) The fact that phospholipids form the cell membranes of all living organisms on Earth today is powerful evidence that all life presently inhabiting Earth evolved and derived from the same bacterial cell line that originated and evolved between 4.5 and 3.5 billion years ago. Please list and briefly explain important details of at least 3 other major lines of evidence (i.e. specific features of cell structure or function that solve the challenges to the origin of life) that indicate that all life on Earth shares a common ancestry.
  - 1 2 pts. 2 – 2 pts.
  - 3 2 pts.



time

(6 pts)

Please use the figures below and explain exactly how a single change in the sequence of nucleic acids on the DNA can affect the function of the protein for which that DNA encodes.

Note that you will have to use the following terms in your response:

amino acid, codon, anti-codon, DNA, gene, ribosome, protein, transcription, translation, m-RNA, t-RNA,



DNA	
mRNA	
Protein	

				SECON	ID BASE					
	. 1	U	С	8		A	0	ì		
U	U		UCU	Ser	UAU		UGU	~	U	
		UUC	UCC		UAC	lyr	UGC	Cys	с	
	Ĩ		UCA		UAA	Stop	UGA	Stop Trp	A	
		UUG	UCG		UAG	Stop	UGG		G	
		CUU	CCU	Pro	CAU	His	CGU	1	U	
	~	cuc .	ccc		CAC		CGC	Arg	с	
E.	č	CUA	CCA		CAA		CGA		A	Bnd
		CUG	CCG_		CAG	Gin	CGG		G	THIRD BASE (3' (
BASE		AUU	ACU T	Thr	AAU	Asn Lys	AGU	Ser Arg	U	
RST		AUC lle	ACC		AAC		AGC		с	
с ·	^		ACA		AAA		AGA		A	
		AUG Met or start	ACG		AAG		AGG		G	
		GUU]	GCU	Ala	GAU	1.	GGU	Gly	U	
	6	GUC	GCC		GAC	Asp	GGC		c	
	3	GUA Val	GCA		GAA		GGA		A	
		GUG	GCG		GAG	Giù	GGG		G	

### 12 pts.

- Question #5. One of the most important events in the origin of life is the origin of autotrophy. Most likely the first autotrophs were iron reducing bacteria near hydrothermal vents.
- (a) Please refer closely to the figure at right (see steps #1, 2, and 3) and explain how the first chemoautotrophs functioned.
   What were the key structures, molecules, and functions of their metabolism that enabled them to synthesize their own food?



- (b). Please refer to the figure at right and explain how the ATP synthase enzyme works.
- 4 pts

Question #6. This question will assess your understanding of the evolution of photosynthesis.

(a). The general equation for autotrophy is at right:	carbon source	H <sup>+</sup> and + electron sources	energy source	carbohydrate (H⁺ and electron acceptor)	+	leftovers from H* and electron sources
for photosynthesis, what specific molecules correspond		+			+	
to each term in the equation:						2 pts

(b). Please briefly explain how adaptations to resist ultraviolet to radiation by ancient chemoatuotrophic bacteria could have led to the evolution of photosynthesis around 2.5 billion years ago. Please note that you must use sketches in your explanation.

6 pts

(c). Please state what is the geologic evidence that suggests that photosynthesis evolved at the time that it did (hint: what is "banded iron")?





- Question #7. Please explain the key steps involved in photosynthesis. Your explanation should be brief and concise, should refer to the figures, and should use the following key words correctly:
- ATP synthase, Calvin cycle, carbon fixation, chlorophyll, CO<sub>2</sub>, cytochrome, electron transport chain, glucose, hydrolysis of water, light reactions, oxygen O<sub>2</sub>, photosystems 1 and 2, proton pump, reaction center





## 12 pts

- Question #8. Please explain the key steps involved in aerobic respiration. Your explanation should be brief and concise, should refer to the figures, and should use the following key words correctly:
- ATP synthase, CO<sub>2</sub>, cytochrome, electron transport chain, glucose, glycolysis, Krebs cycle, formation of water, oxygen O<sub>2</sub>, proton pump (see figures),



pyruvate



12 pts

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