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Charles Darwin University

Final Examination

Family Name						
Given Name/s						
Student Number						
Teaching Period	Semester 1, 2019					

SBI245 –Biochemistry	DURATION	
	Reading Time:	10 minutes
	Writing Time:	120 minutes

INSTRUCTIONS TO CANDIDATES

The examination has two sections:
Section A: Suggested Time: 60 min — Multiple Choice Questions: 25 questions
Total: 50 marks (2 mark each)
Section B: Suggested Time: 60 min — Short Answer Questions: Seven questions
Total: 50 marks
Section A must be answered on the multiple-choice answer sheet provided and must be handed in with your answer booklet.

Section B must be answered in the answer booklet.

EXAM CONDITIONS

<u>You may begin writing from the commencement of the examination session.</u> The reading time indicated above is provided as a guide only.

This is a CLOSED BOOK examination

Any non-programmable calculator is permitted

No handwritten notes are permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
No additional printed material is permitted	1 x 8 Page Book 1 x Scrap Paper College Multiple Choice Answer Sheet Graph paper Appendix 1

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Section A
Multiple Choice Questions
Total Number of Marks for this section: 50 Marks

This section should be answered in the Multiple Choice Answering Sheet provided.

Each question carries **TWO** marks.
Suggested Time allocation for Section A: **60 minutes**

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Section B
Case Study Based Questions
Total Number of Marks for this section: 50 Marks

This section should be answered in the Answer Booklet provided.

Marks for each question are indicated.
Suggested Time allocation for Section B: **60 minutes**

Question 1

In mammals, lysophosphoglycerides (1-monoacylglycerol-3-phosphates) are generated in small quantities in order to trigger physiologic responses. Hydrolysis of a fatty acyl group from the C-2 position of a glycerophospholipid yields a lysophosphoglyceride. The reaction is catalyzed by phospholipase A_2, whose activity is strictly regulated.

i. Draw a diagram of a general structure of glycerophospholipid, and show the action of the phospholipases A_2 on this molecule.

However, large quantities of phospholipase A_2 are found in snake venom, and the active venom enzyme can generate high concentrations of lysophosphoglycerides from membranes of snakebite victims.

ii. In their high concentrations, lysophosphoglycerides can disrupt membrane structure. Why?

(3+3 = 6 Marks)

Question 2

It is essential for spliceosomes to remove introns precisely, that is, between the terminal nucleotide of an intron and the first nucleotide of an exon. To see why, suppose that the sequence at the normal junction in a pre-spliced mRNA between an intron and an exon is

…UUAG GCUAACGG…

Intron Exon

Suppose further that a spliceosome occasionally miscleaves the pre-mRNA transcript between the C and U residues in the exon sequence to yield the following two splicing intermediates:

…UUAGGC UAACGG…

What would be the consequence of this cleavage (For genetic code chart please refer to Appendix 1)?

(2 Marks)

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Question 3

Suppose that the data shown below are obtained for an enzyme-catalyzed reaction in the presence and absence of inhibitor X or Y.

	V (µmol ml^{-1} min^{-1})		
[S](mM)	Without inhibitor	With X	With Y
0.2	5.0	3.0	2.0
0.4	7.5	5.0	3.0
0.8	10.0	7.5	4.0
1.0	10.7	8.3	4.3
2.0	12.5	10.7	5.0
4.0	13.6	12.5	5.5

i. From a double-reciprocal plot of the data, determine K_M and V_{max} of the enzyme (use the **graph paper**).

ii. Using double-reciprocal plots of the data, determine the types of inhibition that have occurred.

iii. Based on the plots, what type of inhibitors X and Y are (competitive or noncompetitive)? Explain.

(5+5+4 = 14 Marks)

Question 4

You want to design an experiment to determine the order of genes in the *lac* operon. You selectively block RNA polymerase before it transcribes each gene in the operon and then measure the protein levels of each of the genes transcribed by the *lac* operon. The results are in the table below

Gene Blocked	Permease Produced	Beta-galactosidase Produced	Transacetylase Produced
Gene 1	No	No	No
Gene 2	No	Yes	No
Gene 3	Yes	Yes	No

i. What is the correct sequence of proteins found in the lac operon?

ii. What is the benefit of the repressor being constitutively (constantly) produced?

iii. In the *lac* operon, the repressor protein exerts a negative effect on the expression of the structural genes in the absence of the inducer molecule. In the case of the *lac* operon, what is the inducer molecule?

iv. Why does *E.coli* have polycistronic messages?

v. What will happen when lactose is present as the sole energy source?

(2+1+1+1+1=6 Marks)

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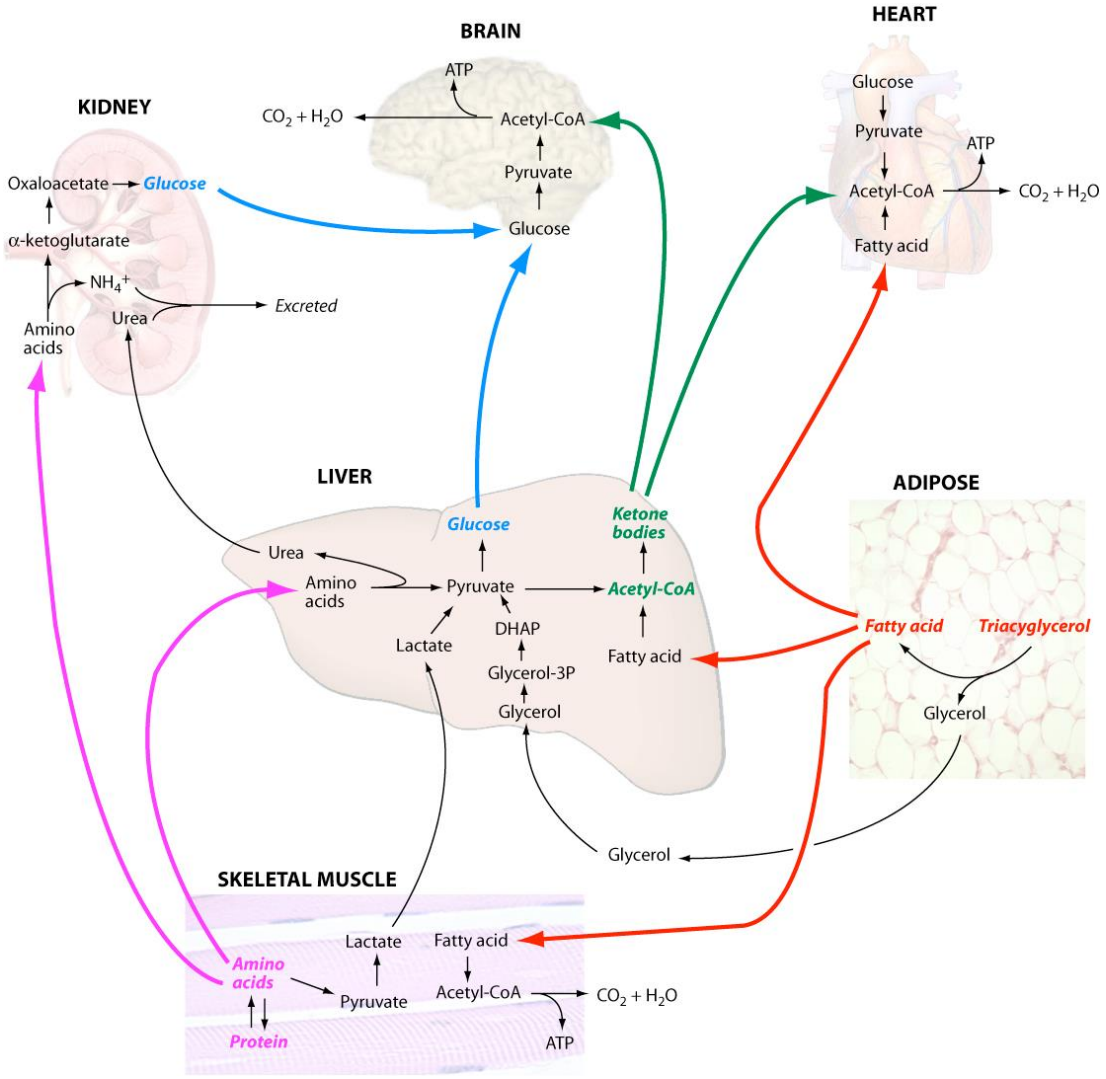
Question 5

Metabolite flux between major tissues and organs in the human body under starvation conditions is illustrated in the figure below:



Once glycogen stores are depleted (first 24 hours), there are four major alterations in metabolic flux that permit humans to survive long periods of time without food. Please give a summary of these **four** alterations.

(12 Marks)

Question 6

Blood glucose levels are under the control of the hormones insulin and glucagon. Describe the control of blood glucose levels in a (normal) individual following a carbohydrate meal.

(5 Marks)

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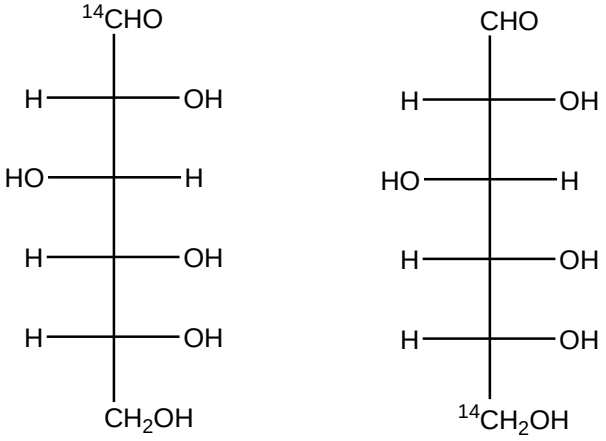
Question 7

A biochemist needs to determine whether a particular tissue homogenate has a high level of pentose phosphate pathway activity. She incubates one sample with ^{14}C-1 glucose, and another with ^{14}C-6 glucose. Then she measures the specific activity of radioactive CO_2 generated by each sample. Her measurements show that the specific activity of CO_2 from the experiment using glucose labeled at C-1 is much higher than that from the sample in which glucose labeled at C-6 was employed. What is her conclusion?



(5 Marks)

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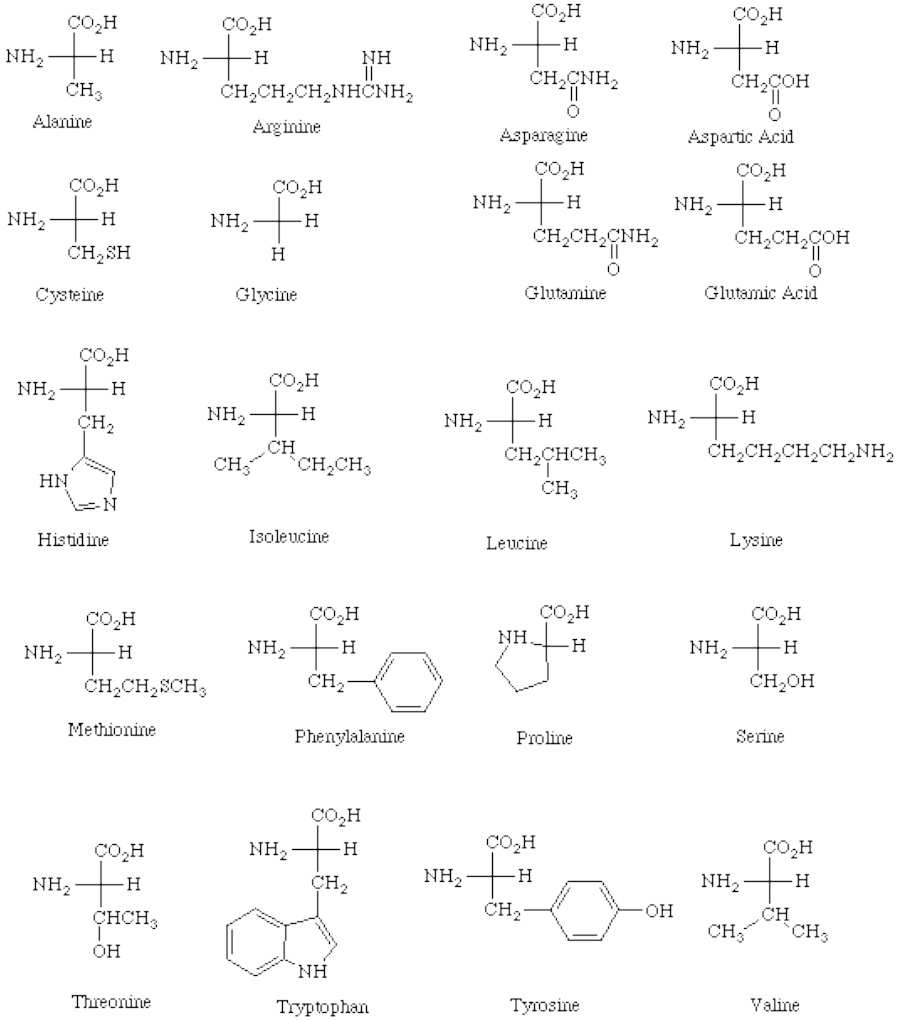
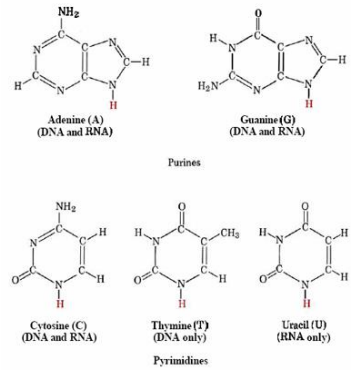
Appendix 1

Amino Acid Structures

The following amino acid structures are listed in alphabetical order. Ionizable groups are shown in their neutral form - this implies absolutely nothing about the predominant form at any particular pH.



Nucleic acids structures



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The following table gives the pKa values for the α-carboxylic acid group, the α-amino group, and any ionizable side chains.

Amino Acid	α-carboxylic acid	α-amino	Side chain
Alanine	2.35	9.87	
Arginine	2.01	9.04	12.48
Asparagine	2.02	8.80	
Aspartic Acid	2.10	9.82	3.86
Cysteine	2.05	10.25	8.00
Glutamic Acid	2.10	9.47	4.07
Glutamine	2.17	9.13	
Glycine	2.35	9.78	
Histidine	1.77	9.18	6.10
Isoleucine	2.32	9.76	
Leucine	2.33	9.74	
Lysine	2.18	8.95	10.53
Methionine	2.28	9.21	
Phenylalanine	2.58	9.24	
Proline	2.00	10.60	
Serine	2.21	9.15	
Threonine	2.09	9.10	
Tryptophan	2.38	9.39	
Tyrosine	2.20	9.11	10.07
Valine	2.29	9.72	

Equations:

Michaelis-Menten equation

$$V_0 = \frac{V_{MAX}[S]}{[S] + K_M}$$

Linewaver-Burk plot

Plot of 1/V versus 1/[S] (→ straight plot)

intercept $1/V_{MAX}$, $-1/K_M$

slope K_M/ V_{MAX}

$$\frac{1}{V} = \frac{1}{V_{MAX}} + \frac{K_M}{V_{MAX}[S]}$$

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Universal Genetic Code Chart

Messenger RNA Codons and Amino Acids for Which They Code

First base	Second base: U	Second base: C	Second base: A	Second base: G	Third base
U	UUU, UUC: PHE UUA, UUG: LEU	UCU, UCC, UCA, UCG: SER	UAU, UAC: TYR UAA: STOP UAG: STOP	UGU, UGC: CYS UGA: STOP UGG: TRP	U C A G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN AAA, AAG: LYS	AGU, AGC: SER AGA, AGG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

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