2024 UT Austin Invitational

Microbe Mission B/C Answer

KEY

Notify the proctor IMMEDIATELY if you have this key, or you will be disqualified.

Notes:

- Write how to answer Multiple True/False on board.
- There are WORD LIMITS on long answers. I'm just looking for keywords. No need to use full sentences.
- Exams/Image Sheets are Class Sets. Don't turn over anything.
- Hints for Division B Competitors:
    - Bacteriostatic Antibiotics stop further bacterial growth, Bactericidal Antibiotics
    - The answer to Section 5, Question 6, Statement 1 is "F"
    - The answer to Section 6, Question 21, Statement 4 is "T"
    - The answer to Section 6, Question 30 is "Fluoroquinolones"

Section 1

Multiple Choice/Select and Short Answer …… (___/42)

1) C (+1)

2A) Flagella (+1)

2B) Cillia (+1)

2C) Capsule (+1)

2D) Cell Wall (+1)

2E) Cell Membrane (+1)

2F) Cytoplasm (+1)

2G) Nucleoid (+1)

2H) Ribosome (+1)

2I) Plasmid (+1)

6) B (+2)

7) Bacterophage (+2)

8) B (+1)

9) A (+1)

10) A (+2)

11) C (+2)

12) A (+2)

13) B (+2)

14) B (+2)

15) C (+2)

16) C (+2)

17) Plasmodium Falciparum (+4)

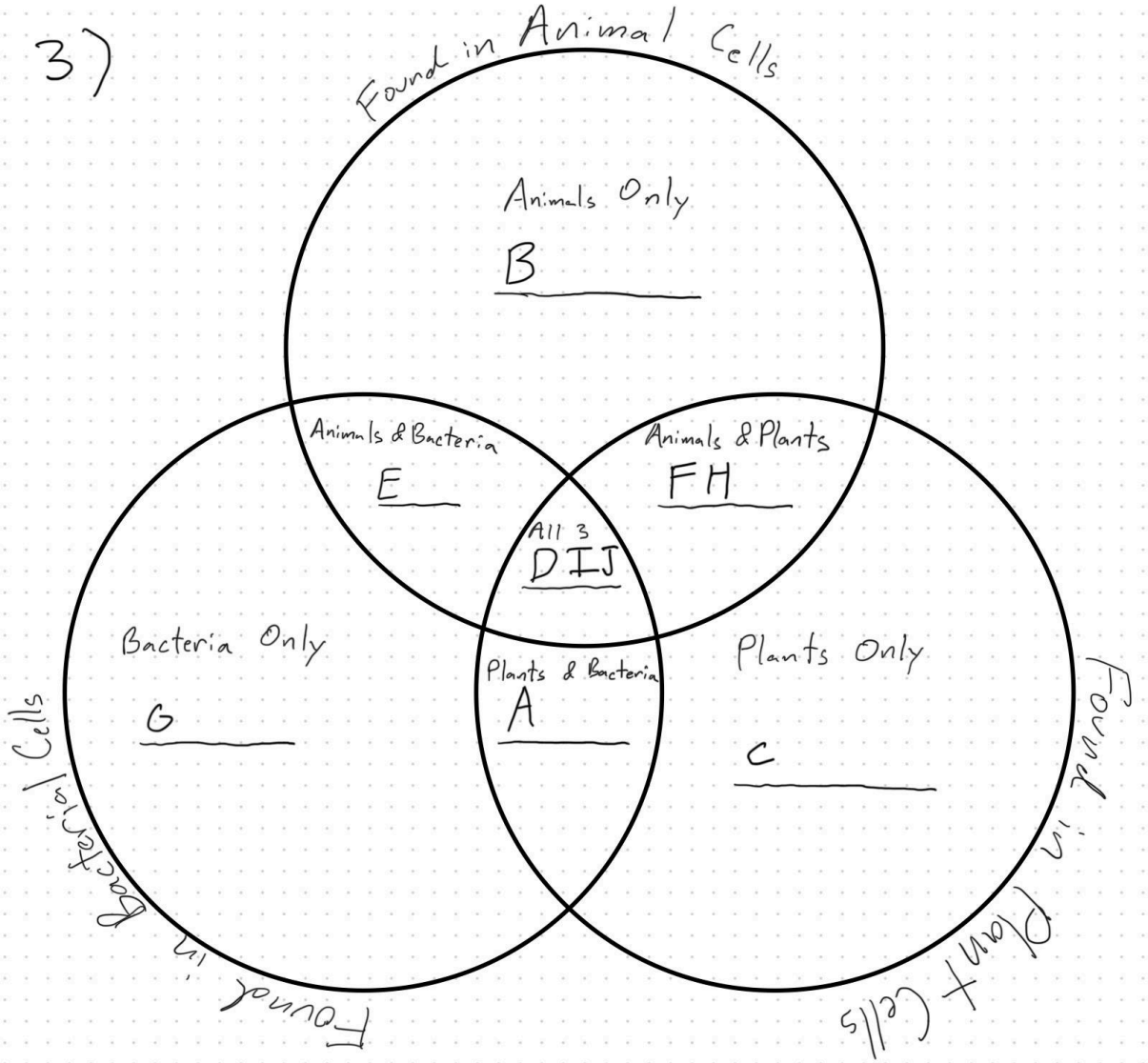
18) Malaria (+4)

19) Liver (+2)

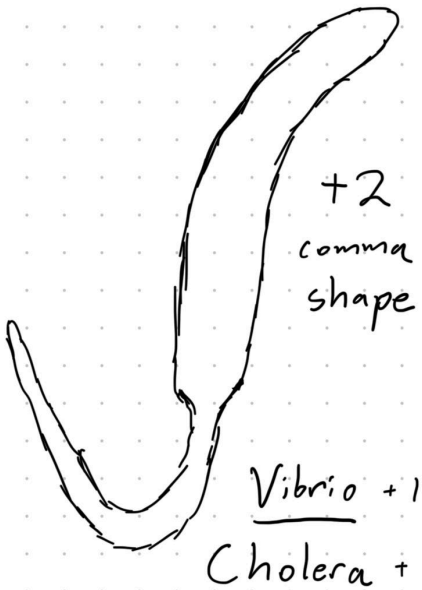
20) Anopheles (+2)

Long Answer …….. (___/18)

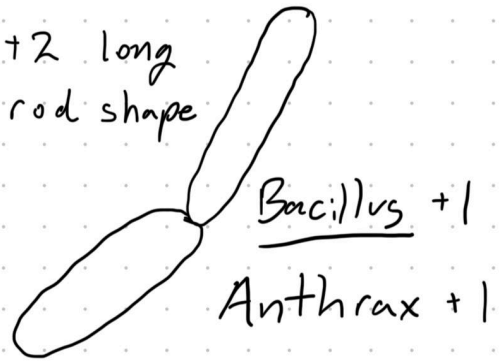
3)


Found in Animal Cells
Animals Only
B
Animals & Bacteria
E
Animals & Plants
FH
All 3
DIJ
Bacteria Only
G
Plants & Bacteria
A
Plants Only
C
Found in Bacterial Cells
Found in Plant Cells

4)


+2
comma
shape
Vibrio +1
Cholera +1

5)


+2 long
rod shape
Bacillus +1
Anthrax +1

Section 2

Multiple Choice/Select and Short Answer …… (___/35)

1) Chlorophyll (+1) a (+1)

2) FFTTFF (6)

3) TTFFTT (6)

4) Cellular Respiration/Oxidative Phosphorylation (+1)

5) Nitrogenase (+3)

6) 2 (+1)

7) 2/II (+1)

8) Cyclic electron flow/Cyclic Photophosphorylation (+2); NO (+1)

9) A (2)

10) C (2)

11) A (2)

13) Nannochloropsis (+4)

14) Chloroplast (+2) (*Plastid* +1 partial)

Long Answer …….. (___/8)

12) 10 Word Limit.

Eukaryotic and Prokaryotic ribosomes are structurally different/have very drastically different sequences (80S/70S) (+4)

15) 15 Word Limit.

This species has chloroplasts (+1) which through endosymbiosis (+1) are related to cyanobacteria (+2) (prokaryotes +1 partial)

Section 3

Multiple Choice/Select and Short Answer …… (___/46)

1) 4&2 only (1pt per correct step, _/4)

2) 1 only (1pt per correct step, _/4)

3) Serial (+2) Dilution (+2)

5) AEI (+3, one per letter)

6) BFK (+3)

7) DHL (+3)

8) CGJ (+3)

9) $1{:}10^{4}$, 10^{-4} (+3)

10) 2,000:1 (+5)

11) 37,000 (+5)

12) Colony Forming Unit (+1)

14) A (+2)

15) TTTFTT (+6)

Long Answer …….. (___/10)

4) 10 Word Limit.

Evenly Mix/Spread the bacteria through the liquid (+4)

13) 20 Word Limit.

Plate Counts: Leftmost Plate: 7400 0.5 points per correct

Plate 1: 3700 Plate 2: 370 Plate 3: (+0) Plate 4: 4

It has between 20-200 bacteria (+2) OR other plates have too few colonies to be accurate (+1) or too many colonies to count (+1)

Section 4

Multiple Choice/Select and Short Answer …… (___/21)

1) TTTFTT (+6)

2) FTFTTF (+6)

3) Death/Decline Phase (+2)

6) 8 minutes (+2)

7) Bacteriostatic (+1)

8A: Lag (+1)

8B: Log/Exponential (+1)

8C: Stationary (+1)

8D: Death/Decline (+1)

Long Answer …….. (___/31)

4) Plot points and draw the curve on the graph below. Be sure to mark scales on axes.

GRADING FOR THE PLOT (#4):

Allow +-0.2 numerical errors.

Full credit value; 75% credit value, full credit = 1 point each

1 minute: 3.3; 2
3 minutes: 3.7; 2.4
5 minutes: 4.3; 3.0
7 minutes: 4.85; 3.55
9 minutes: 4.95; 3.65
11 minutes: 4.95; 3.65
13 minutes: 4.95; 3.65
15 minutes: 4.9; 3.6

Curve is monotonically increasing before 9 minutes(+1)
Curve levels off after 9 minutes (+1)
Curve has somewhat sigmoidal shape (clear maximal slope in some interval) (+1)
Curve has maximal slope between 5 and 9 minutes (+1)

5) 10 Word Limit.

Doubling time is under 1 minute. Answers between 40-90 seconds (+2); Answers between 20-120 seconds (Partial +1). Very low doubling time. (+1)

9) 25 Word Limit.

Competition (+1), they have the same food source/they live in the same space/compete for nutrients/compete for space (+1)

One of the following:
Commensalism (+1); horizontal gene transfer (+1) benefits P. Esports
Ammensalism (+1); horizontal gene transfer eventually hurts A (+1)
Parasitism (+0); B benefits at the expense of A (+1); mentions that this is delayed/indirect form of parasitism (+1)

10) No Word Limit.

A stage: P. esports has a competitive advantage of A. pilliaus (+1), so it grows much faster (+1)

B stage: P. esports is affected by the antibiotic and doesn't grow/declines (+1); A. pilliaus is not affected/has a competitive advantage so it grows a lot (+1)

C stage: P. esports is declining in population (+1); A. pilliaus in in stationary phase/keeping a steady population (+1)

D stage: P. esports outcompetes A. pilliaus (+1), so P. esports grows and A. pilliaus dies out (+1)

Antibiotic is introduced between A and B stages (+1)
Horizontal gene transfer/Conjugation (+2) occurs between stages C and D (+1)

NOTE: Award 4 points for the following answer (or answers that contain it AND would have scored <4 points under the rubric above):

In A, A. pilliaus is growing slowly because there are few individuals in the culture (+1)
In B, A pilliaus is growing quickly because there are more individuals (+1)
In C, A pilliaus has reached carrying capacity (+1)
In D, A pilliaus is dying off. (+1)

Section 5

Multiple Choice/Select and Short Answer …… (___/25)

1) TTTTFF (+6)

2A: Eyepieces/Ocular Lenses (+1)

2B: Diopter Adjustment (+1)

2C: Eyepiece Tube (+1)

2D: Head (+1)

2E: Objective Lenses (+1)

2F: Stage (+1)

2G: Stage Clips (+1)

2H: Condenser (+1)

2I: Diaphragm (+1)

2J: Lamp (+1)

2K: Arm (+1)

2L: Coarse Adjustment Knob/Adjuster (+1)

2M: Fine Adjustment Knob/Adjuster (+1)

2N: Base (+1)

3) FFFTTF (+6)

5) FTTFTF (+6)

6) FTTTFF (+6)

9) TFTTTT (+6)

Long Answer …….. (___/28)

4) Box your numerical answer (with units!)

Approximates head as a sphere (volume of a sphere formula present) (+1)
Writes down a correct expression for volume (+1)
Converts to mL correctly (+1)
Answer between 10^{-14} and 10^{-20} (+1)

7) 20 Word Limit.

Electron microscopes use magnets for focusing (+1); magnets do not invert images/electron positions, while lenses do (+2)

8) 75 Word Limit.

Enables more specialized focusing of images (+1); Accounted for by coarse/fine adjustment knobs (+1) OR Deconvolution techniques (+1)

Allows for controlling magnification (+1); Accounted for by multiple different objectives on normal light microscopes (+1)

Creates a non-inverted image (+1); Some microscopes have a third additional lens to correct for this (+1) OR one's brain can adjust to this inversion, causing one to see non-inverted images in some cases (+1)

10) 10 Word Limit.

Award a point for each of the below (max 3). Do not count entries on the same row for additional points.

Condenser (+1)
Diaphragm/Added annular diaphragm/Added phase annulus (+1)
Lamp (+1)
Objective Lenses/ Added phase contrast microscopy objectives
Added phase plates/phase crystals/calcite/nomarski prism/Wollaston prism (+1)

Section 6

Multiple Choice/Select and Short Answer …….. (___/102)

1) TTFTTF (+6)

2) Ependymal/Respiratory tract/Sperm (+2)

3) Flagellin (+2)

4) B (+1)

5) Alpha Helix/Helix-Turn-Helix (+1)

6) sp2 (+2), sp3 (partial +1)

7) Amide (NOT: Amine) (+1)

8) Transpeptidase (+4)

9) Serine (+1)

10) Covalent (+1)

11) Fleming (+1), 1945 (+1)

13) Positive (+1)

14) FTFTTF (+6)

15) 65 micrometers (+4). Answers within 10 (Partial +3), Answers within 20 (Partial +2).

16) TFFTFF (+6)

17) MRSA/MethycillinResistant S.Aureus +4

18) TFFFFT (+6)

19) TFFTFT (+6)

20) Helicobacter pylori (+4)

21) TTFTFF (+6)

22) TFFTTF (+6)

23) A (+2)

24) DNA Unwinding Element (+2)

25) Origin of Replication (+2)

26) C (+4)

27) Increase (+2)

28) Bacteriostatic (+2)

29) Gyrase (+12) (Partial:Topoisomerase +6)

30) Quinolones/Fluoroquinolones (+4)

Long Answer …….. (___/4)
12) 20 Word Limit.

Penicillin kills bacteria, so you can't use bacteria to produce penicillin. (+4)

Bonus Section:

(Award 1 point to everyone)