MICB 201 Example Final Exam Multiple Choice Questions

IMPORTANT! READ THIS!

Do **NOT** infer anything about the content emphasis of the final exam from this collection of questions. They are provided **ONLY** as **EXAMPLES** of the question types that can appear on the final exam. Further these questions are biased towards medium-level understanding (explain, apply, solve) and high-level understanding (generalize, analyze, evaluate) rather than low-level understanding (state, describe, define, provide, compare, distinguish). The actual final exam will have a larger proportion of low/basic level questions. Also check the iClicker Questions posted on VISTA. These questions are like those on the Final Exam.

Question #1 **(1 point)**

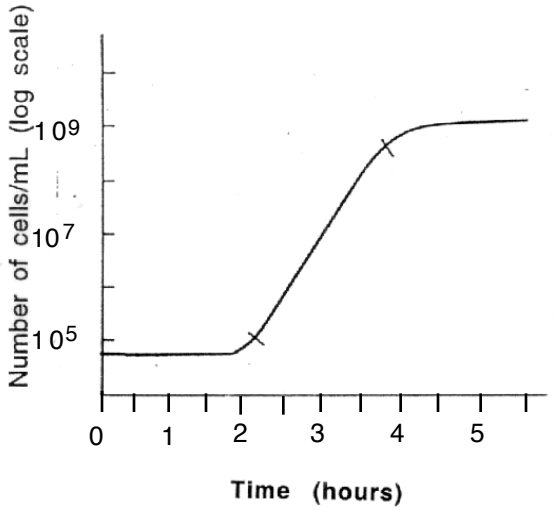
A colony composed of unicellular bacteria is added to 500 mL of liquid growth medium. After an incubation period of 22 hours, the population density in the liquid growth medium reaches 5×10^{10} cells/mL. Assuming exponential growth began immediately upon addition of the colony to the liquid medium, approximately how many cells did the bacterial colony contain if the growth rate of the population in the liquid medium was 0.8 $hour^{-1}$?

(a) 1.3×10^5 cells **(b)** 12×10^7 cells **(c)** 2.5×10^5 cells **(d)** 2.5×10^2 cells

(e) Cannot be determined unless the diameter of the colony is known.

Questions #2-5 **(4 x 0.25 points)**

Consider the following growth curve obtained for a unicellular bacterial population growing in 100 mL of liquid nutrient medium.



Indicate whether each of the following statements is **TRUE** or **FALSE** by marking **(a)** for **TRUE** or **(b)** for **FALSE** on the answer sheet.

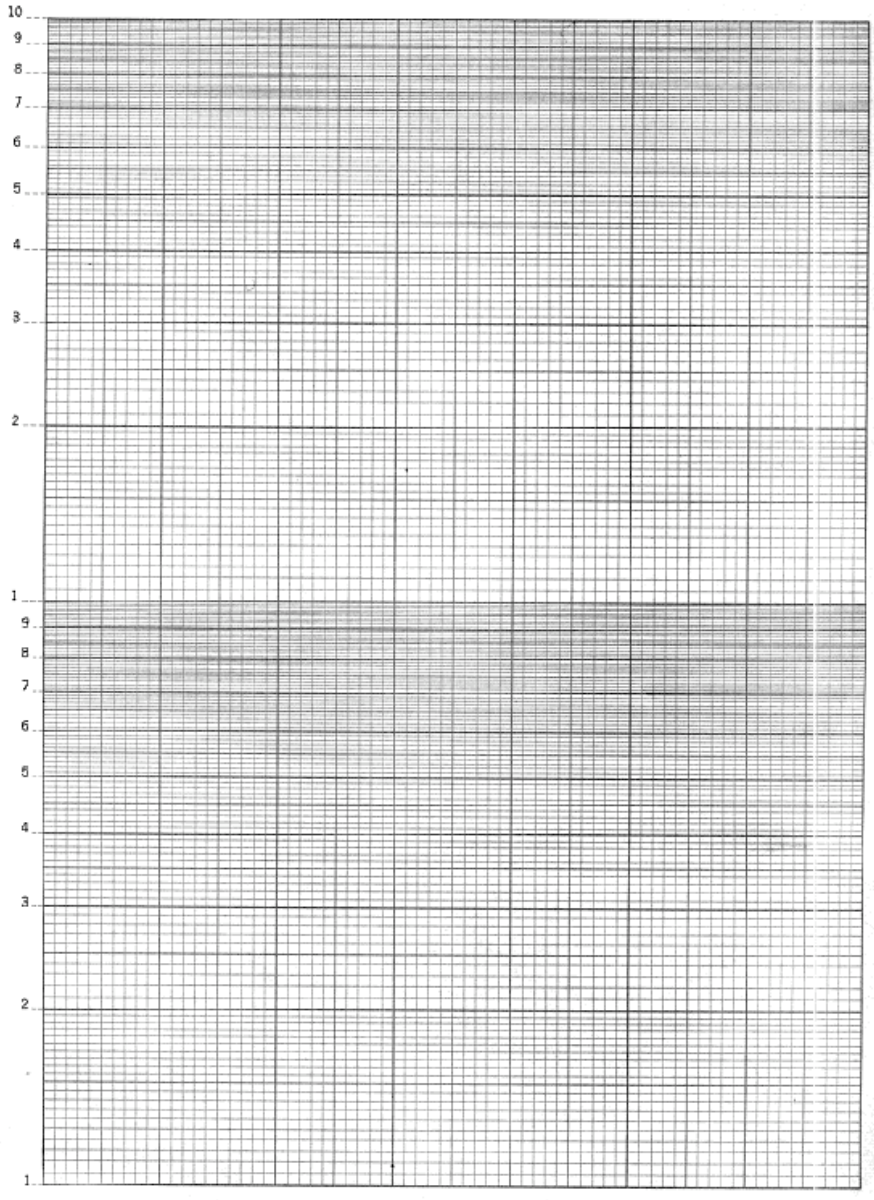
2. The cells present at 3 h are synthesizing proteins.
3. If the volume of the growth medium had been larger, the stationary phase population density would have been higher.
4. Cells sampled at t = 2.5 h are expected to possess a similar chemical composition to cells sampled at t = 3.5 h.
5. If the initial cell concentration (t = 0) had been lower the doubling time would have been longer.

Question #6 **(1 point)**

The following data were obtained for the growth of an ***E. coli*** population.

Time (min)	**Bacterial population density (10^6 organisms /mL)**
20	22.2
30	29.2
50	60.0
90	250.7
110	530.7

Estimate the growth rate (k) of the population.



(a) 1.0 h^{-1} **(b)** 2.0 h^{-1} **(c)** 3.0 h^{-1} **(d)** 4.0 h^{-1} **(e)** 5.0 h^{-1}

Question #7 **(1 point)**

If the spoilage level for hamburger is 1 x 10^7 aerobic bacteria /g how long does it take for a package of hamburger to spoil at refrigeration temperature (4ºC) if it initially contains 1 x 10^3 aerobic bacteria/g and the doubling time for the aerobic bacterial community in the hamburger is 0.8 days? Assume all bacteria are unicellular.

(a) 5 days
(b) 10 days
(c) 15 days
(d) 20 days

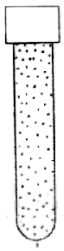
Question #8 **(1 point)**

Which of the following proteins important in cell division have so far only been found in the Archaea?

(a) Cdv
(b) MreB
(c) FtsZ
(d) CreS

Questions #9-12 **(4 x 0.25 points)**

The following growth pattern was obtained for a bacterium grown in a nutrient medium tube partially solidified with semi-solid agar and incubated under **AN**aerobic conditions. The results show the bacterium grows equally well at any position in the tube.



Indicate which of the following can be concluded with confidence about the bacterium by marking **(a)** for **YES** or **(b)** for **NO** on the answer sheet.

9. The bacterium lacks the gene specifying catalase.
10. The bacterium cannot use O_2 as a TEA.
11. The bacterium is motile.
12. The bacterium is some type of anaerobe.

Question #13 **(1 point)**

Consider the following statements about bacterial endospores.

(1) They are formed by all Gram-positive bacteria.
(2) Following production of one endospore, the mother vegetative cell can produce additional endospores.
(3) They contain fewer genes than the mother cell from which they were derived.
(4) They exhibit little or no metabolic activity.

Mark **(a)** if **ONE** of the above statements is **TRUE**.
(b) if **TWO** of the above statements are **TRUE**.
(c) if **THREE** of the above statements are **TRUE**.
(d) if **ALL** of the above statements are **TRUE**.
(e) if **NONE** of the above statements are **TRUE**.

Questions #14-17 **(4 x 0.25 points)**

Consider the following statements about operons and the environmental regulation of gene expression.

Indicate whether each statement is **True** or **False** by marking **(a)** for **True** or **(b)** for **False** on the answer sheet.

14. If a gene is the middle gene of a 3 gene operon, it cannot be transcribed without transcribing the first gene in the operon.
15. A gene for a regulatory protein is usually the first gene in the operon to whose operator the regulatory protein binds.
16. Before binding to DNA, a regulatory protein must first bind a small molecule (the effector).
17. Each protein-encoding gene of an operon possesses a nucleotide sequence encoding a translation termination codon.

Question #18 **(1 point)**

Consider the following statements about bacterial exotoxins.

(1) Some exotoxins are extracellular proteins.
(2) Exotoxin genes may be plasmid-bourne.
(3) Botulism exotoxin, a toxin which inhibits nerve transmission, can be inactivated by cooking temperatures.
(4) The exotoxin produced by ***S. aureus*** (staphylococcal food poisoning) binds to the cells of the small intestine causing release of water and diarrhea.

Mark **(a)** if **ONE** of the above statements is **TRUE**.
(b) if **TWO** of the above statements are **TRUE**.
(c) if **THREE** of the above statements are **TRUE**.
(d) if **ALL** of the above statements are **TRUE**.
(e) if **NONE** of the above statements are **TRUE**.

Question #19 **(1 point)**

Lysogenic phage have a role in some types of food poisoning. Consider the following statements about these phage.

(1) Lysogenic phage may replicate like a plasmid in the bacterial cytoplasm.
(2) Lysogenic phage may integrate into the bacterial chromosome.
(3) Lysogenic phage may change the phenotype of its bacterial host.
(4) Lysogenic phage are inactive, no phage genes are transcribed.

Mark **(a)** if **ONE** of the above statements is **TRUE**.
(b) if **TWO** of the above statements are **TRUE**.
(c) if **THREE** of the above statements are **TRUE**.
(d) if **ALL** of the above statements are **TRUE**.
(e) if **NONE** of the above statements are **TRUE**.

Question #20 **(1 point)**

When exposed to a temperature of 80°C a unicellular bacterial population declines from 10^8 cells/mL to 10^6 cells/mL in 4 min. The decimal reduction time is

(a) 2 min . **(b)** 4 min. **(c)** 6 min. **(d)**8 min.

Mark **(e)** if the decimal reduction time cannot be determined from the available information.

Question #21 **(1 point)**

Which one of the following treatments designed to kill or inhibit the growth of bacteria in the food industry are appropriately matched to their effect on bacterial cells?

	Treatment	**Effect**
(a)	Heat	thermal lysis
(b)	Chlorination	dehydration
(c)	Gamma rays	hydroxyl radical damage
(d)	Cold	membrane gelling
(e)	Salting	plasmolysis

Question #22 **(1 point)**

Pasteurization

(a) is a form of disinfection.
(b) refers to the practice of treating milk at boiling temperatures for a few seconds.
(c) is designed to kill only ***Mycobacterium tuberculosis***.
(d) destroys bacterial endospores.
(e) is a bacteriostatic treatment.

Questions #23-26 **(4 x 0.25 points)**

Some bacteria can grow in high sugar environments like jam and honey. Which of the following characteristics could help bacteria grow in such environments?

23. The ability to synthesize a capsule.
24. The ability to form endospores.
25. The ability to transport water out of the cytoplasm.
26. The ability to synthesize compatible solutes.

Indicate your answers by marking **(a)** for **YES** or **(b)** for **NO** on the answer sheet.

Question #27 **(1 point)**

Which of the following is **INCORRECTLY** matched with **SOME** of the major bioelements it is composed of?

	Component	**Major bioelements**
(a)	Enzyme	N, H, S
(b)	Ribosomes	C, O, P
(c)	Chromosome	C, N, H, S
(d)	Peptidoglycan	O, H
(e)	Cytoplasmic membrane	C, H, P

Questions #28 **(1 point)**

If a nutrient is reduced for the purpose of creating _____ across the cytoplasmic membrane then it is being used as a _____. If a nutrient is oxidized to reduce atoms during _____ then it donates its electrons to _____.

(a) $[H^+]$ gradient, TEA, $NADP^+$, biosynthesis
(b) $NADP^+$, biosynthesis, TEA, $[H^+]$ gradient
(c) biosynthesis, TEA, $NADP^+$, $[H^+]$ gradient
(d) $[H^+]$ gradient, $NADP^+$, TEA, biosynthesis

Mark **(e)** if the answer is **NONE** of the above.

Question #30 **(1 point)**

Consider the following water-based nutrient medium

Glucose
Ammonium chloride
Potassium dihydrogen phosphate
Complete trace element mixture (Iron as ferric iron)
Complete vitamin mixture

A population of prokaryotic organism "X" is growing in the presence of light and air in this nutrient medium. What could prokaryotic organism "X" be using as a source of **BOTH** energy and electrons?

(1) glucose
(2) ammonium
(3) ferric iron
(4) light
(5) molecular oxygen

Mark **(a)** if only **ONE** of the above can serve as a source of both energy and electrons.
(b) if **TWO** of the above can serve as a source of both energy and electrons.
(c) if **THREE** of the above can serve as a source of both energy and electrons.
(d) if **FOUR** of the above can serve as a source of both energy and electrons.
(e) if **ALL** of the above can serve as a source of both energy and electrons.

Questions #31-34 **(4 x 0.25 points)**

Consider the following water-based nutrient medium

$Ca(NO_3)_2$
KH_2PO_4
$MgSO_4$
Complete trace element and vitamin mixture (Fe as $FeCl_3$)

Based on the information presented in MICB 201, is there the potential for some prokaryotic organism to grow in this medium

31. if it was incubated in the absence of both light and air?
32. if it was incubated in the presence of both light and air?
33. if an organic molecule was added to the medium and it was incubated in the dark in the absence of air?
34. if H_2 was bubbled through the medium in the dark in the presence of air?

Indicate your answers by marking **(a)** for **YES** or **(b)** for **NO** on the answer sheet.

Questions #35-38 **(4 x 0.25 points)**

Molecular hydrogen can be reacted with molecular oxygen in the laboratory:

(1) $2\ H_2 + O_2 \xrightarrow{\text{Pd catalyst}} 2\ H_2O +$ LARGE AMOUNT OF HEAT ENERGY

A similar reaction is carried out by some prokaryotes to synthesize ATP.

(2) $2\ H_2 + O_2 \xrightarrow{\text{ADP + Pi} \rightarrow \text{ATP}} 2\ H_2O +$ SMALL AMOUNT OF HEAT ENERGY

In reaction **(2)** less energy appears as heat because the energy generated

35. has been used to transport H^+ into the periplasm.
36. has been "trapped" in ATP.
37. has been used to transport H^+ into the cytoplasm.
38. has been used to keep the organism warm.

Indicate your answer by marking **(a)** for **YES** or **(b)** for **NO** on the answer sheet.

Questions #39-46 **(8 x 0.25 points)**

A new bacterium is discovered capable of carrying out the following reaction using $S_2O_3^{-2}$ (thiosulfate) taken from the environment (The reaction is not balanced for H or O).

$$S_2O_3^{-2} + NADP^+ + \text{Energy} \longrightarrow 2\ SO_4^{-2} + NADPH$$

Indicate which of the following statements are **TRUE** or **FALSE** by marking **(a)** for **TRUE** or **(b)** for **FALSE** on the answer sheet.

39. In the reaction, the bacterium is using $S_2O_3^{-2}$ as an energy source.
40. The bacterium could be a phototroph.
41. The bacterium could be a lithotroph.
42. In the reaction, the bacterium is using $S_2O_3^{-2}$ as an electron source.
43. In the reaction, the bacterium is using $NADP^+$ as a TEA.
44. The reaction is called dissimilative thiosulfate reduction.
45. The reaction is part of catabolism.
46. The reaction is used to establish a $[H^+]$ gradient gradient across the cytoplasmic membrane.

Question #47 **(1 point)**

Which of the following statements about oxidative phosphorylation are **CORRECT**?

(a) Energy is required to transfer electrons from the energy source to the TEA.
(b) Electrons are transferred from the energy source to the TEA via sequential redox reactions involving phospholipid molecules.
(c) The process depends on the free permeability of the cytoplasmic membrane lipid bilayer to H^+.
(d) An energy source is oxidized and ADP is phosphorylated.

Mark **(e)** if the answer is **TWO** of the above.

Question #48 **(1 point)**

In both cyclic and non-cyclic photophosphorylation

(a) light is oxidized.
(b) light is reduced.
(c) an electron source is reduced.
(d) H^+ ions are oxidized.

Mark **(e)** if the answer is **NONE** of the above.

Question #49 **(1 point)**

Consider a bacterium carrying out the following metabolic reaction

$$3\,CO_2 + 3\,H_2O + 6\,NADPH + 6\,ATP \longrightarrow \underset{\textbf{Glyceraldehyde}}{C_3H_6O_3} + 6\,NADP^+ + 6\,ADP + 6\,Pi$$

Which one the following statements are **CORRECT**?

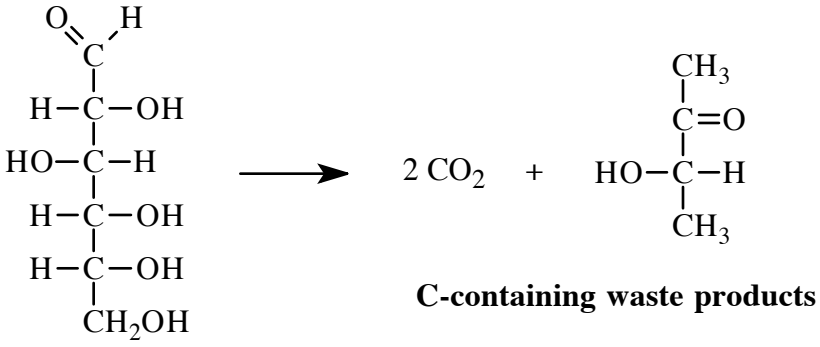
(1) The bacterium could be chemosynthetic or photosynthetic.
(2) NADPH is being used to reduce the carbon atoms in the C-source.
(3) ATP is being used to push/drive the reaction past its equilibrium position so more $C_3H_6O_3$ product is made.
(4) The purpose of the process is to build cellular organic molecules from an inorganic C-source.

Mark **(a)** if only **ONE** of the statements is **CORRECT**.
(b) if **TWO** of the statements are **CORRECT**.
(c) if **THREE** of the statements are **CORRECT**.
(d) if **ALL** of the statements are **CORRECT**.
(e) if **NONE** of the statements are **CORRECT**.

Question #50 **(1 point)**

A heterotrophic bacterium produces the following carbon-containing waste products of glucose catabolism:

Glucose



C-containing waste products

The bacterium could be engaged in which of the following modes of catabolism?

(1) Aerobic respiration
(2) Anaerobic respiration
(3) Fermentation without H_2 production
(4) Fermentation with H_2 production

Mark **(a)** if the answer is **ONE** of the above.
(b) if the answer is **TWO** of the above.
(c) if the answer is **THREE** of the above.
(d) if the answer is **ALL** of the above.
(e) if the answer is **NONE** of the above.

Question #51 **(1 point)**

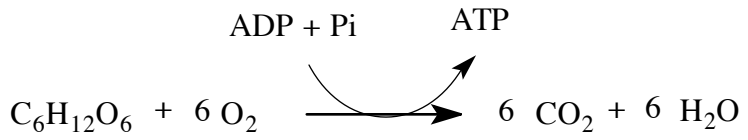
Some bacteria have no requirement for iron (Fe, Fe^{+2} or Fe^{+3}) under any environmental conditions. These bacteria must be

(a) facultative anaerobes
(b) obligate anaerobes
(c) aerotolerant anaerobes
(d) microaerophiles
(e) obligate aerobes.

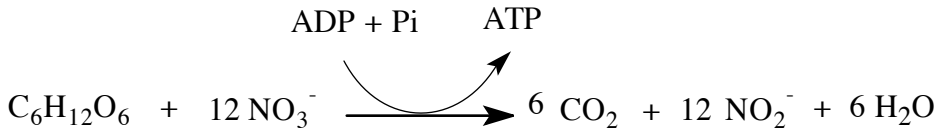
Questions #52-55 **(4 x 0.25 points)**

Facultatively anaerobic bacteria use either O_2 or NO_3^- as TEAs. For example, consider ***E. coli*** using glucose ($C_6H_{12}O_6$) as an energy source via aerobic **or** anaerobic respiration:

Aerobic respiration



Anaerobic respiration



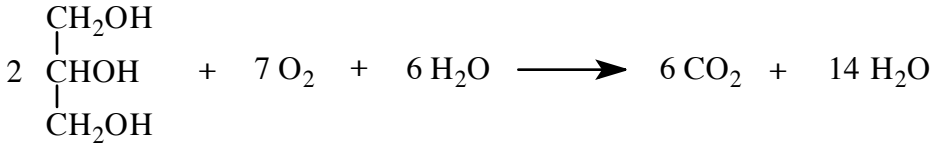
In the laboratory, populations of ***E. coli*** grow faster and reach higher stationary phase population densities if they catabolize glucose by aerobic respiration rather than by anaerobic respiration.

Indicate which of the following statements help to explain why this is so by marking **(a)** for **YES** and **(b)** for **NO** on the answer sheet.

52. The use of O_2 yields more energy than the use of NO_3^-.
53. The use of O_2 yields more ATP than the use of NO_3^-.
54. The use of O_2 allows for more complete oxidation of the C in glucose than the use of NO_3^-.
55. The use of O_2 allows for the transport of more H^+ across the cytoplasmic membrane than the use of NO_3^-.

Question #56 **(1 point)**

Glycerol is the molecule added to icing sugar to keep it soft. Some heterotrophic bacteria can use glycerol as an energy source by aerobic respiration.



Glycerol

Using the number of O_2-O reduced to H_2O-O, calculate how many ATP are made from the oxidation of the carbon in **2 glycerol** molecules. Assume 3 ATP are made from each NADH oxidized. **Note**: Ignore ATP made by SLP.

(a) 12 **(b)** 22 **(c)** 32 **(d)** 42 **(e)** 52

Question #57 **(1 point)**

Consider the following statements about denitrification.

(1) Denitrification refers to the loss of soil nitrogen as NO_3^- which washes into the ground water.
(2) Denitrification is intensified in water logged soils.
(3) Denitrification is associated with the mechanism of ATP synthesis called oxidative phosphorylation.
(4) Denitrification is linked to the mode of catabolism called "anaerobic respiration".

Mark **(a)** if **ONE** of the above statements is **TRUE**.
(b) if **TWO** of the above statements are **TRUE**.
(c) if **THREE** of the above statements are **TRUE**.
(d) if **ALL** of the above statements are **TRUE**.
(e) if **NONE** of the above statements are **TRUE**.

Question #58 **(1 point)**

You have the enviable job of sampling a cow's intestinal gases and you collect the following gases from the "back end" of the animal. The detection of which gas provides the strongest evidence that the cow's digestive system is an anaerobic environment?

(a) N_2
(b) CO_2
(c) H_2S
(d) CH_4
(e) H_2

Question #59 **(1 point)**

Which one the following activities of rumen microorganisms is carried out exclusively by Archaea?

(a) C-fixation
(b) N-fixation
(c) methane production
(d) cellulose degradation
(e) hydrogen production

Question #60 **(1 point)**

All of the following are important differences between purple bacteria and green sulfur bacteria **EXCEPT ONE**, which one?

(a) Mechanism of ATP synthesis.
(b) Presence of intracytoplasmic membranes.
(c) Reactions used to fix C.
(d) How energy is supplied to synthesize NADPH.
(e) How elemental sulfur is stored.

Question #61 **(1 point)**

The NH_4^+ which appears in the soil during the crop rotation method is the result of heterotrophic bacteria using plant protein as a(n)

(a) energy source.
(b) sulfur source.
(c) nitrogen source.
(d) carbon source.

Mark **(e)** if the answer is **TWO** of the above.

Questions #62-65 **(4 x 0.25 points)**

A heterotrophic bacterium grows on the following medium in the presence of air but fails to grow on the same medium in the absence of air.

Ingredient

starch
sodium nitrate
magnesium sulfate
potassium phosphate
vitamin solution
trace element solution
Water

Indicate which of the following could explain this result by marking **(a)** for **YES** and **(b)** for **NO** on the answer sheet.

The bacterium is genetically incapable of

62. assimilative nitrate reduction.
63. assimilative sulfate reduction.
64. dissimilative nitrate reduction.
65. amylase synthesis.

Questions #66-69 **(4 x 0.25 points)**

An obligately aerobic heterotrophic bacterium initially growing on Medium #1 is transferred to Medium #2.

Medium #1	**Medium #2**
Glucose	Beef extract
$MgSO_4$	Peptone
$NH_4H_2PO_4$	H_2O
Trace elements	
H_2O	

Indicate whether each of the following statements is **TRUE** or **FALSE** by marking **(a)** for **TRUE** or **(b)** for **FALSE** on the answer sheet.

66. To grow on Medium #2, the bacterium must have the ability to synthesize trace elements from vitamins.
67. Because the bacterium can grow on Medium #1, it is expected to grow on Medium #2.
68. If able to grow on Medium #2, the bacterium is expected to exhibit a longer doubling time as compared to growth on Medium #1.
69. If able to grow on Medium #2, the bacterium is expected to produce ammonia (um) as a waste product.

Question #70 **(1 point)**

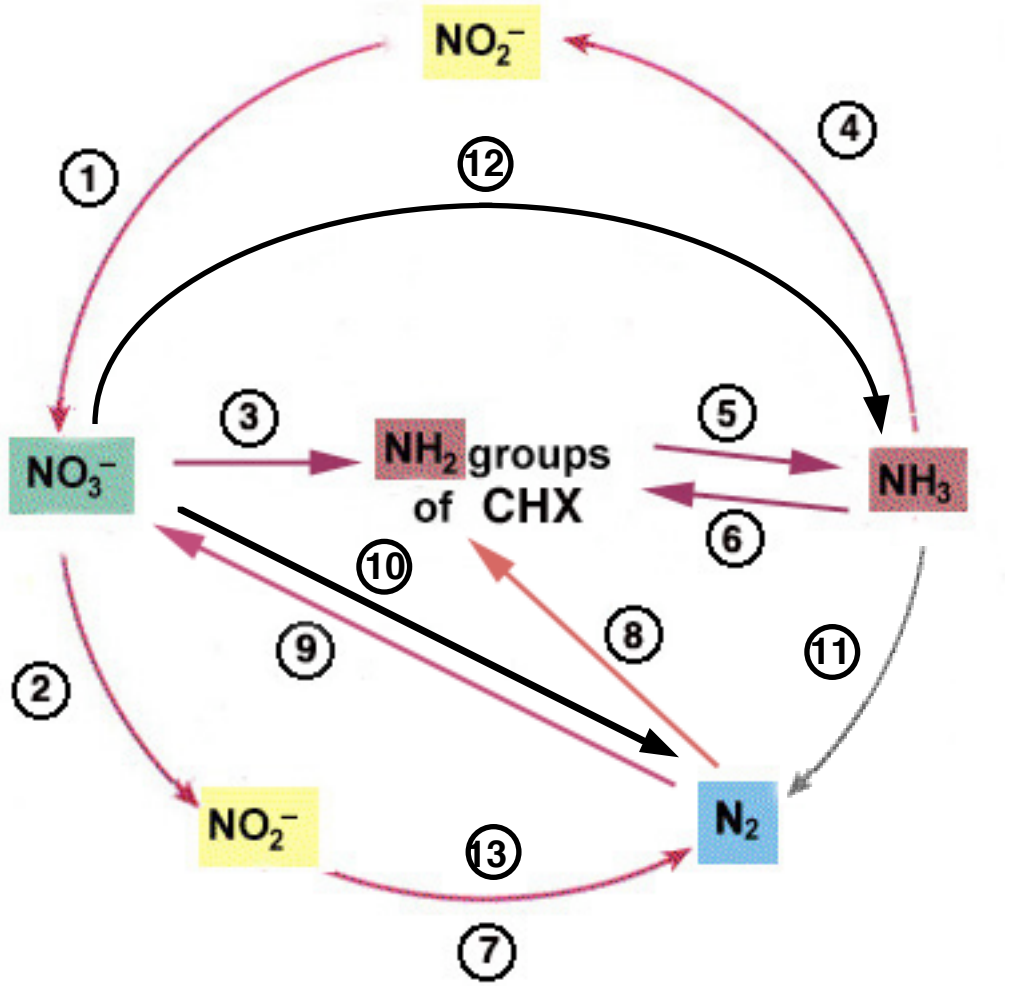
Consider the following statements about lithotrophic bacteria and their role in elemental cycling.

(1) They are central to the process of mineralization.
(2) They convert reduced inorganic forms of the elements to oxidized inorganic forms.
(3) They convert oxidized inorganic forms of the elements to reduced inorganic forms.
(4) They can fulfill the same primary producer role in some perpetually "dark" environments as phototrophs do in those environments exposed to sunlight.

Mark **(a)** if only **ONE** of the statements is **CORRECT**.
(b) if **TWO** of the statements are **CORRECT**.
(c) if **THREE** of the statements are **CORRECT**.
(d) if **ALL** of the statements are **CORRECT**.
(e) if **NONE** of the statements are **CORRECT**.

Question #71 **(1 point)**

Consider a representation of the N-cycle used in MICB 201. Note the reaction #s may not be the same ones used in the text.



Which reaction is carried by some heterotrophic bacteria, some lithotrophic bacteria and some phototrophic bacteria regardless of the O_2 status of the environment?

(a) 1 **(b)** 2 **(c)** 3 **(d)** 4 **(e)** 5