

Sample problems for MMG 301

These samples were taken from exam questions in prior years. You need to choose the best answer.

The ultimate downfall of the theory of spontaneous generation was the result of work by:

- A. Pasteur
- B. Koch
- C. Hooke
- D. Leeuwenhoek
- E. Watson/Crick

A Pasteur flask has a(n):

- A. double neck so two substances may be added at the same time.
- B. swan neck to prevent airborne particles from entering into the main body of the flask
- C. secondary opening at the base to allow for drainage.
- D. inverted upper edge to prevent spillage while swirling.
- E. none of the above.

If the magnification of an ocular lens of a particular microscope is 10X and the magnification of the objective lens on the same microscope is 47X, the total magnification achieved is

- A. 4.7X
- B. 57X
- C. 470X.
- D. 4,700X.
- E. none of the above.

An organism of the genus *Staphylococcus* will be _____, while an organism of the genus *Spirochaeta* will be _____.

- A. spherical / rod-shaped.
- B. rod-shaped / coiled.
- C. coiled / spherical.
- D. spherical / coiled.
- E. club / ellipsoid

Morphology is a term that refers to the _____ of the organism.

- A. size
- B. shape
- C. appendage
- D. attachment site
- E. Gram's reaction

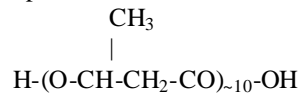
All microorganisms contain the following component in their membranes:

- A. Proteins.
- B. Lipopolysaccharides.
- C. Fatty acids in ester linkage to phosphorylated glycerol.
- D. Isoprenoid chains in ether linkage to glycerol.
- E. Sterols.

The small size of bacteria relates to a balance between the desired high metabolic rate of the microorganism and the need to take up nutrients and expel toxic wastes through its membrane. A key parameter limiting cell size is:

- A. The surface area to volume ratio.
- B. The cell radius.
- C. The length of cellular DNA.
- D. Whether the organism has flagella.
- E. The nutrient used for providing energy.

The following compound:



- A. Is one structure of teichoic acid
- B. Is a type of polyisoprenoid found in Archaeal lipids
- C. Is found in metachromatic granules
- D. Is used as a carbon and energy source by many microbes (and is a biodegradable plastic)
- E. Is polymerized to form the cell walls in *Sulfolobus*

Which of the following statements is true regarding fungi?

- A. Their cell walls generally consist of cellulose.
- B. They include the chloroplast-free Euglenoids.
- C. They include the Slime Molds.
- D. They are responsible for many human diseases including ringworm.
- E. Some species possess hydrogenosomes for energy production.

The high-temperature limit to life is probably governed by:

- A. The rate of protein denaturation (precipitation).
- B. The decomposition (hydrolysis) of nucleotides such as ATP.
- C. The unraveling of double-stranded DNA.
- D. Disintegration of the cell walls.
- E. Thermal instability of the nuclear membrane.

One species of this protozoan causes a sexually transmitted disease with an incidence of 25-50% in sexually active woman (leading to vaginal discharge and painful urination) and found in 5% of sexually active men (asymptomatic).

- A. *Enamoeba*
- B. *Giardia*
- C. *Plasmodium*
- D. *Trichomonas*
- E. *Trypanosoma*

The overall shape of a prokaryote is governed by:

- A. The cell wall.
- B. The cytoplasmic membrane.
- C. The type of Lipopolysaccharide.
- D. Microtubules and other internal filaments.
- E. The protoplast.

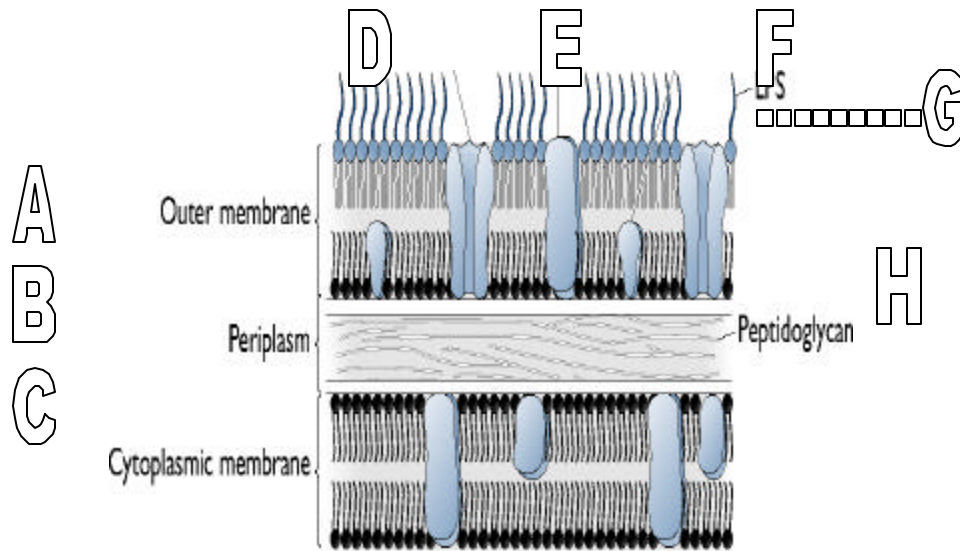
The Archaea are:

- A. Only present in "extreme" environments (very hot, very salty, etc.).
- B. Living examples of microorganisms that existed when life originated.
- C. Among the most prevalent human pathogens.
- D. A small group of physiologically similar prokaryotes.
- E. Defined on the basis of their 16 S sequences.

In which decade was the first complete bacteria DNA sequence obtained?

- A. 1930s
- B. 1950s
- C. 1970s
- D. 1990s
- E. This remarkable event should happen within the next few years.

For the following question, refer to the cartoon shown below:



The region or component marked with (A) is:

- A. Peptidoglycan
- B. Periplasm
- C. Porin
- D. Outer membrane
- E. Teichoic acid

This individual was the first person to see bacteria using a simple microscope:

- A. Louis Pasteur
- B. Aristotle
- C. Robert Koch
- D. Antoni van Leeuwenhoek
- E. Albert Jan Kluyver

Endospores:

- A. Represent a dormant cell stage resistant to heat, dessication, and many chemicals.
- B. Allow cells to float or position themselves in a water table.
- C. Are formed in conidia that develop in fruiting bodies arising out of a mycelial mass.
- D. Are made up predominantly of water.
- E. Function in cellular replication.

Which of the following is not considered part of a prokaryotic cell?

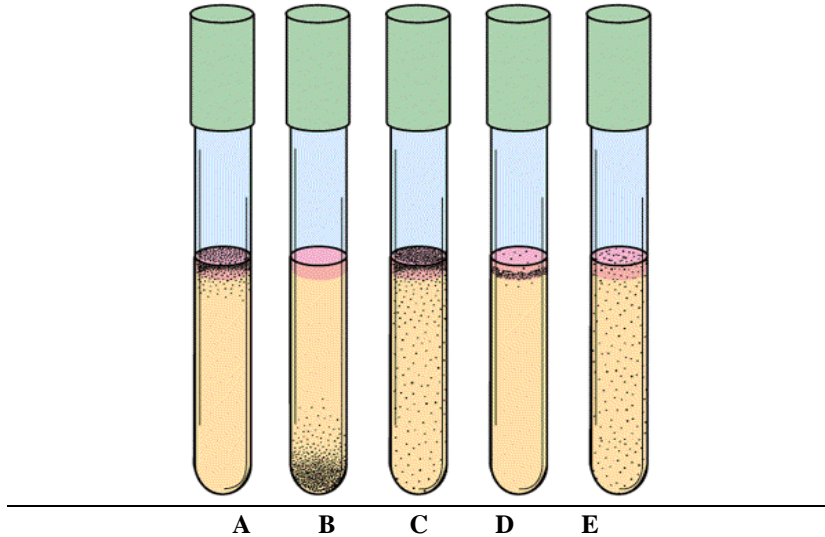
- A. cell wall
- B. cell membrane
- C. nuclear membrane
- D. ribosome
- E. flagella

Evidence for endosymbiosis in the evolution of mitochondria and chloroplasts does not include -

- A. the ribosomes of mitochondria and chloroplasts are similar to prokaryotic ribosomes
- B. the structure of internal cilia of mitochondria and chloroplasts is the same as prokaryotes
- C. the antibiotic sensitivity of the mitochondria and chloroplast ribosomes is similar to prokaryotic ribosomes and different from eukaryotic ribosomes
- D. phylogeny derived from comparative sequence analysis of 16S rRNAs
- E. the circular form of the mitochondrial and chloroplast genomes is similar to well-described prokaryotic genomes

Aerobic respiration by yeast (*Saccharomyces cerevisiae*) results in net production of:

- A. Pyruvic acid
- B. Carbon dioxide and ethanol
- C. Carbon dioxide
- D. Propionic acid
- E. Acetic acid



The pattern of growth you would expect from a microaerophile is shown in which tube?

The pattern of growth expected from a facultative aerobe is shown in which tube?

Which of the following molecules is an electron carrier that carries both protons and electrons?

- A. Non-heme iron-sulfur proteins
- B. Cytochromes
- C. Carotenoids
- D. Phycobilins
- E. Quinones

The Adler capillary assay was a way of detecting and quantitating the chemotactic response of bacteria. Adler quantitated the response by

- A. determining the change in the electric current (resistance) during the experiment
- B. determining the increase in protein concentration over time
- C. determining the change in surface tension over time
- D. determining the change in weight of the capillary over time
- E. counting the bacteria in the capillary tube over time

Living in the presence of oxygen can have toxic consequences. Bacteria have evolved several enzyme systems to overcome damaging oxygen radicals. These include

- A. catalase, superoxide dismutase, and peroxidase
- B. peroxidase, β lactamase, and monooxygenase
- C. catalase, β lactamase, and dioxygenase
- D. superoxide dismutase, transacetylase, and dioxygenase
- E. monooxygenase, dioxygenase and β lactamase

A pharmaceutical company has hired you to test several of their newly developed antibiotics. You grow your favorite friendly pathogen in Brain-Heart infusion (BHI) broth and when the cells are in exponential phase, you use this healthy culture to inoculate a series of test tubes containing BHI broth at a uniform concentration. You also establish in the tubes a concentration series of the new antibiotic ranging from 0 through 100 $\mu\text{g/ml}$ as follows: tube 1 = 0, tube 2 = 500 ng/ml, tube 3 = 1 $\mu\text{g/ml}$, tube 4 = 5 $\mu\text{g/ml}$, tube 5 = 10 $\mu\text{g/ml}$, tube 6 = 20 $\mu\text{g/ml}$, tube 7 = 40 $\mu\text{g/ml}$, tube 8 = 80 $\mu\text{g/ml}$ and tube 9 = 100 $\mu\text{g/ml}$. You monitor the tubes spectrophotometrically and perform a viable cell count at 4 hour intervals through 24 hours (doubling time of the friendly pathogen in BHI is 22 minutes). After inoculation, tubes 2 through 6 showed an increase in turbidity comparable to your control with zero Ab-Q (tube 1). The remaining tubes showed a slight increase in turbidity immediately after inoculation and then leveled off with no change in turbidity for the remainder of the experiment. The viable counts of tubes 2 through 6 were the same as the control while the remaining tubes showed a small increase in viable count at the 4 hour time point and no change after that. In a separate line of investigation you demonstrate that protein synthesis ceases nearly immediately after adding the antibiotic at concentrations above the minimal inhibitory concentration. Your report to the company concludes;

The minimal inhibitor concentration of Ab-Q for the friendly pathogen is

- A. 5 $\mu\text{g/ml}$
- B. 10 $\mu\text{g/ml}$
- C. 20 $\mu\text{g/ml}$
- D. 40 $\mu\text{g/ml}$
- E. 100 $\mu\text{g/ml}$

The action of the antibiotic against the friendly pathogen is that of a

- A. bacteriolytic agent
- B. bacteriocidal agent
- C. bacteriostatic agent
- D. respiratory poison
- E. inhibitor of substrate level phosphorylation

The citric acid cycle:

- A. Is the most common method used by microorganisms to convert glucose to pyruvate
- B. Is primarily used by cells that decompose citric acid in the environment as a nutrient
- C. Is particularly important in photosynthesis
- D. Functions in cells to produce citric acid that is then incorporated into new cellular material (proteins, nucleic acids, lipids, peptidoglycan, etc.)
- E. Reduces 4 NAD and 1 FAD, while also making one GTP, per pyruvate oxidized

The microorganism associated with anthrax is:

- A. *Anthracycline deadlii*
- B. *Bacillus anthracis*
- C. A virus
- D. A eukaryotic microorganism
- E. A member of the archaea

In the β -oxidation of fatty acids, two carbons are repeatedly cut from the carboxyl end of the fatty acid chain. An essential component in this reaction that allows the two carbons to be used in the tricarboxylic acid cycle is

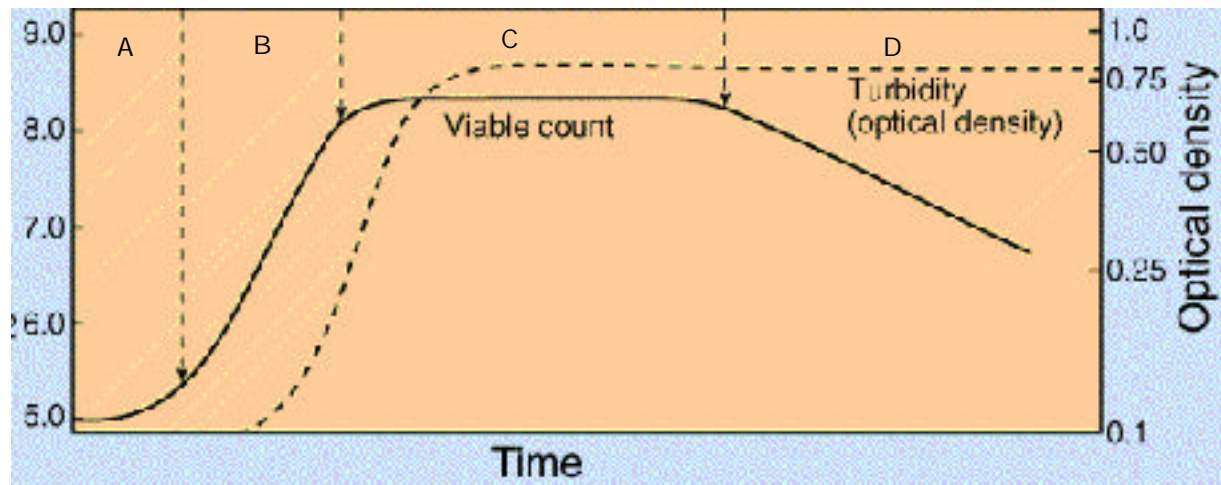
- A. NAD and NADH
- B. bacteriochlorophyll a
- C. Coenzyme Q
- D. FAD and FADH
- E. Coenzyme A

You have been performing experiments with two strains of bacteria that you isolated from the same environment. In a medium designed to cultivate oligotrophs (bacteria adapted to a nutrient-poor habitat), you have measured the doubling time of each species separately and report that species 1 doubles every 68 minutes and species 2 every 105 minutes. You go on to perform an experiment where you mix and grow the two strains together in the same oligotrophic broth. Starting with 5×10^6 cells/ml for each isolate (a total of 10^7 cells/ml), you incubate the mixed culture for 3 hours at which point you determine that both species have increased in number and that the total cell concentration (both strains summed) is 1.08×10^8 cells/ml. From this you conclude

- The mixed culture has grown in a manner that is consistent with your estimates based on growth rates for the isolated strains
- The mixed culture, while clearly showing growth, did not increase as rapidly as you estimated based on growth rates for the isolated strains, suggesting that one or both of the strains, when grown together, have a decreased generation time
- The mixed culture increased in number more rapidly than you would have predicted based on the individual growth rates, suggesting that the two strains interacted in a manner that increased the generation time of one or both of the strains.
- This question is entirely too complicated for me to answer
- I have decided not to become a microbiologist

Escherichia coli can grow on glucose using aerobic respiration, anaerobic respiration, or fermentation. Which bioenergetic mechanism provides the most energy to this microorganism?

- Fermentation
- Aerobic respiration
- Anaerobic respiration
- Anoxygenic photosynthesis
- Oxygenic photosynthesis



The above is figure 5.4 from your text. Please identify the following parts of the curve. Section A is referred to as

- death phase
- exponential phase
- stationary phase
- lag phase
- none of the above

When growing photosynthetically, the purple bacteria:

- Reduce NAD to produce NADH by cyclic electron flow
- Produce light with a wavelength of 870 nm using the P870 reaction center
- Utilize the “reverse citric acid cycle”
- Produce oxygen from water using a $(Mn)_4$ site
- Require an external electron donor to provide electrons for NAD reduction