Example questions for USABO Semifinal exams:

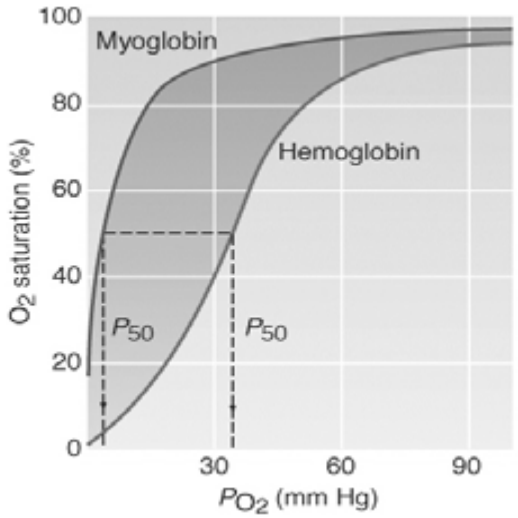
Example of Type A questions:

Consider the following data:

The maximum rate of photosynthesis of a green plant is about 20 mg glu/dm^{-2}/hr^{-1}.
The heat of combustion of glucose is approximately 686 Kc/mole
The gram molecular weight of glucose is 180 gm.

1. **Given the above information how much energy (Kcal/m) could be made over a 12 hour lighted period by a green plant having a total leaf surface area of 2000 dm^{-2}?**
   A. 183.2 Kc
   B. 1832 Kc
   C. 1524.4 Kc
   D. 916 Kc
   E. 9.16 Kc

   The graph shows the dissociation curves for hemoglobin and myoglobin.



2. **Based on data presented in the graph, which of the following statements is appropriate?**
   A. The high affinity of myoglobin for O_2 at low partial pressures of O_2 prevents hemoglobin from unloading O_2 to the muscle.
   B. Myoglobin binds single molecules of O_2 that unloads to the active muscle prior to hemoglobin unloading.
   C. Myoglobin helps hemoglobin bind as much O_2 as possible in the lungs.
   D. Hemoglobin binds O_2 tightly thus preventing O_2 from being made available to skeletal muscle.
   E. The high affinity of hemoglobin for O_2 at low partial pressures of O_2 prevents myoglobin from unloading O_2 in to muscle.

Example of a Type B series of questions:

Question 3 to 7 relate to the following data:

A confluent layer of macrophage cells are grown in two (2) 25 cm^2 tissue culture flasks with appropriate medium containing 10% plasma serum. For the experiment all medium is removed from the flask and the cells are washed with appropriate buffers to remove all traces of serum and media. *E. coli* bacteria suspended in serum free media are then added or "fed" to the macrophages. The process of *E. coli* death from phagocytosis was then studied.

3. It is necessary in a phagocytosis study to remove the serum because:

A. the complement proteins would have independently killed the bacteria.
B. the B cells would have independently killed the bacteria.
C. the natural killer cells would have independently phagocitized the bacteria.
D. serum proteins would have inhibited the membrane attack complex (MAC).
E. serum proteins would have inhibited the MHC complex.

After 30 minutes the cells in tissue culture flask one (1) and two (2) are washed with appropriate buffers to remove all *E. coli*. Serum free media is added and the flasks incubated.

4. The macrophage cell notifies other cells of this immunological invader by:

i. up-regulating expression of MHC I molecules upon activation.
ii. up-regulating expression of MHC II molecules upon activation.
iii. interacting with the complement system.
iv. acting as an antigen presenting cell.
v. inactivating viruses once they enter the macrophage.
vi. decreasing enzymatic production
vii. increasing enzymatic production

A. i, iii, iv, and vi
B. i. iv, v, and vii
C. ii, iii, iv, and vii
D. ii, iii, iv, and v
E. i, ii, iv, and vi

5. During incubation the macrophage and microbe are "at war." Which of the following statements is(are) acceptable?

A. The macrophage digests the *E. coli* through the oxidative burst.
B. The *E. coli* protects itself through the oxidative burst.
C. The oxidative burst is characterized by an increased production of hydrogen peroxide.
D. The oxidative burst results in the formation of a membrane attack complex.
E. Both A and C are acceptable.

The macrophages are then lysed by adding ice cold water. The lysed macrophages and water are centrifuged and the bacteria isolated from the macrophage debris. The bacteria are suspended, diluted and plated on agar. After 90 minutes the same procedure was followed for tissue culture flask 2 and the bacteria were again plated. Bacterial plates 1 and 2 were incubated for 24 hours.

6. **Why were the macrophages lysed with a brief exposure to ice cold water and not the E coli?**
   A. Rapid cold-shock results in osmotic lysis.
   B. Gram positive bacteria are impervious to osmotic insult.
   C. The membrane lipid bilayer is impermeable to water.
   D. Lysis occurs only to eukaryotic cells.
   E. Cell walls limit osmotic lysis.

7. **When you compare the bacterial growth on plate 1 (45 minutes) and bacterial growth on plate 2 (90 minutes) you would predict:**
   A. approximately equal number of colonies on plate 1 and 2.
   B. no colonies on plate 1.
   C. no colonies on plate 2.
   D. more colonies on plate 1 then plate 2.
   E. more colonies of plate 2 then plate 1.

Type B: Multiple Answer in Botany

8. **There is a large difference in pH across the thylakoid membrane between the thylakoid compartment and the stroma. From the list given below choose those that are appropriate in explaining the difference (choose A, B, C, or D as your answer)**

   i. The transport of protons into the thylakoid compartment by the electron transport system
   ii. The transport of protons out of the thylakoid compartment into the stroma by the electron transfer system
   iii. Protons splitting from water remaining in the thylakoid compartment
   iv. Protons splitting from water exiting the thylakoid compartment
   v. The removal of hydrogen from the stroma during the reduction of NADP to NADPH
   vi. The retention of hydrogen in the stroma during the reduction of NADP to NADPH

   A. i, iv and vi only
   B. ii, iv and vi only
   C. i, iv and v only
   D. i, iii and v only
   E. iii, iv and v only

9. **In angiosperms a spore differs from a seed in a variety of ways. Given below is a list of possible differences. (Choose A, B, C, D or E as your answer)**

   i. a spore is haploid a seed has both haploid and diploid tissue
   ii. a spore is diploid a seed is haploid
   iii. a spore is the consequence of meiosis a seed is generally the consequence of fertilization
   iv. a spore produces a gametophyte a seed produces a new sporophyte
   v. a spore produces a sporophyte a seed produces a new gametophyte
   vi. a spore may be unicellular a seed is multicellular
   vii. a spore contains little or no stored food a seed contains stored food

A. ii, iii, v, vi and vii only
B. i, iii, v, vi and vii only
C. i, ii, v and vi only
D. ii, vi, vi and vii only
E. i, iii, iv, vi and vii only

Type B – A/U

For questions 10 - 14, select A if the statement is an ACCEPTABLE conclusion to the sentence, and B if the statement is an UNACCEPTABLE conclusion to the sentence.

In an effort to maximize your USABO taxonomic skills you take a walk through the woods. You discover an unidentified furry creature in a state of rigor mortis. You instantly recognize that the:

10. tropomyosin has putrified.
11. actin-myosin crossbridges are engaged.
12. myosin ATPase has no substrate.
13. muscle cell concentration of ATP is depleted.
14. A band is shortened.

ANS:

10. B
11. A
12. A
13. A
14. B

Type C – Fill in the blank or short answer.

15. Some zoologists have placed the sponges into the subkingdom Parazoa. Provide below two valid reasons they might have for doing so. 2 points

---

ANS:

No true tissues
Do not produce germ layers *these three get at the same point –*
Cellular level of organization *accept only one*

Unique feeding system (no "mouth")