PRACTICE QUESTIONS FOR HUMAN PHYSIOLOGY TOPICS

Q1. Adaptive immune responses show these four characteristics: (i) specificity, (ii) diversity, (iii) memory, and (iv) self- vs. non-self recognition. For each of the three items listed below, pick one of the given four characteristics that it is best associated with, and write a brief justification for your choice.

a) Clonal selection b) Autoimmune disease c) Rationale behind vaccination

Q2. Herpes simplex virus (HSV), the cause of cold sores, infects epithelia and spreads to sensory neurons serving the area of infection. After an effective immune response controls the epithelial infection, the virus persists in a latent state in the sensory neurons. Here, while the virus does not replicate and cause disease, it can also not be eliminated by the immune system. Such latent infections can reactivate and result in recurrent illness.

a) Which arm of specific immunity will be used to eliminate HSV infection in the epithelia, and how does it work to eliminate the infection?

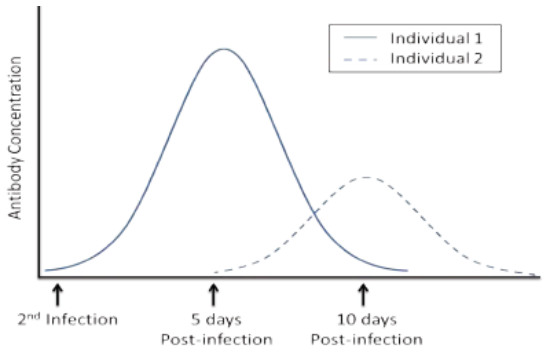
b) Why doesn't this immune response work against HSV during its latency?

Q3. ***Explain the physiological basis of each of the following scenarios*:**

a) A drug affects the process of exocytosis. The immune system is also affected by this.

b) A student has been regularly staying up late during the high-pressure, two-week comprehensive examination period. After the last exam is over and he reaches home, he develops those stuffy nose, sore throat and mild fever, the common symptoms of a viral/bacterial infection he must have picked up during the exam time.

c) One year after being vaccinated by a flu vaccine two individuals encounter a new form of flu virus. You assay their immune response specific to the flu virus and obtain the following profile. Explain why the immune response of Individual 1 to the flu virus differs from that of Individual 2? Refer to adjacent figure.



d) When the inter-ventricular septum (wall) of the heart gets damaged and becomes perforated (full of holes), ATP synthesis is also affected in the cells of such a person's body.

e) During a viva-voce oral examination that you are completely unprepared for, you find it difficult to focus and answer the questions posed by the instructor because your heart is racing, your stomach seems tied in a knot, you are breathing too quickly, and your mouth is dry! (Mention which type of nervous system is working here under which hormonal control.)

f) If antibiotics must be used (against infection), special care should be taken to consume probiotic foods and supplements, as well as to eat a diet with plenty of fermentable fibers from starch.

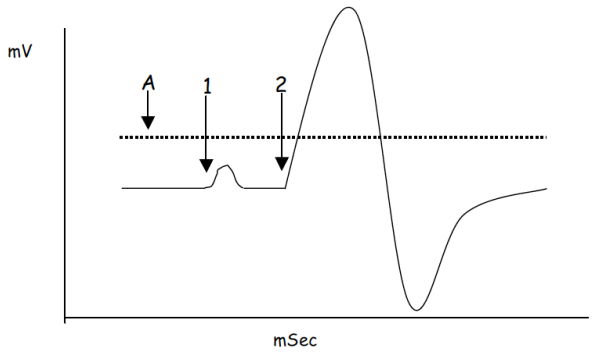
g) Alcohol hangover is marked by, among other symptoms, acute headache and uneasiness caused due to dehydration.

h) A pregnant woman neither ovulates nor menstruates.

i) Habitual users of drugs such as cocaine, besides developing a strong addiction to the drug, fail to feel happiness in some of the normal pleasurable things in life – a good meal, a smile from a friend or a hug from mother.

Q4. A person is exposed to a toxin that can cross the blood brain barrier and act on neurons. The toxin can irreversibly block voltage gated calcium channels. What would be the effect on neuronal conductivity? Be specific and support your answer with a labeled representative diagram only.

Q5. Inspired by your General Biology classes you decided to research on artificial intelligence and memory. You hence join a neurophysiology lab for your final thesis. Your supervisor wanted to check your basic knowledge of neuronal biology. He asks you to inject a small amount of Na^+ to the axon hillock region of a neuron (say, neuron, X). When you inject 1 ng of Na^+ at time point 1, you see a small change in membrane potential, but by just injecting twice as much at time point 2, you see a very large change.



a. What does "A" denote in the figure?

b. What can be the possible reason for the specific response observed at time point (1) compared to time point (2)?

c. Your supervisor wants to know why the nerve impulse generated (by 2) after reaching the axon terminal of neuron (X), is transferred to the next neuron (Y) only and not retrace its path. What two reasons will you state for this question?

Q6. "Most control systems, including physiological ones, have built-in redundancy, which ensures that when one system fails another takes over. For example, several hormones can elevate blood glucose. However, only insulin can reduce blood glucose."

a) Name two hormones that elevate blood glucose, and the glands that produce them.

b) Can you speculate a reason for the existence of just one hormone for reducing blood glucose, as against many that perform the opposite role?