

Correct answers are in **boldface**.

1: If the Nernst equation explains the membrane voltage required to balance ion concentration forces, why do we need the Goldman-Hodgkin-Katz (GHK) equation?

- (a) The GHK is necessary when there is an imbalance due to kidney failure or some other pathological condition.
- (b) The Nernst equation can only be used at during an action potential while the GHK can only be used during V_{rest} .
- (c) **The GHK takes into account the simultaneous contributions of multiple ions, for example, when both gated and non-gated channels are open.**
- (d) The Nernst equation is concerned with ion permeability whereas the GHK also takes into account ion concentration forces.

2: Graded potentials...

- (a) are always depolarizations.
- (b) are always hyperpolarizations.
- (c) **may be hyperpolarizations or depolarizations.**
- (d) are hyperpolarizations in the peripheral nervous system and depolarizations in the central nervous system.
- (e) are the same as action potentials, only with inverted polarity.

3: The limit to the amount of depolarization during the action potential is set by...

- (a) the time constant for calcium channels.
- (b) the amount of neurotransmitter released.
- (c) the potassium equilibrium potential (voltage)
- (d) **the sodium equilibrium potential (voltage)**
- (e) the sodium channel density.

- 4: A typical axon refractory period is 1.0 millisecond. This limits the rate of action potentials in the axon to:
- (a) 10 per second
 - (b) 50 per second
 - (c) **500 per second**
 - (d) 2000 per second 4000 per second
- 5: Increasing the diameter of an axon changes action potential conduction velocity...
- (a) **in both vertebrates and invertebrates.**
 - (b) only in vertebrates.
 - (c) only in invertebrates.
 - (d) only if there is no myelin.
- 6: Positive feedback during the action potential is due to...
- (a) reabsorption of neurotransmitter
 - (b) regenerative calcium entry
 - (c) accommodation flux
 - (d) **voltage-sensitive channels**
 - (e) threshold inactivation
- 7: In an axon the major factor slowing the internal spread of positivity is...
- (a) the time constant for calcium channels to open
 - (b) **membrane capacitance (Note: we did not talk about capacitance this year, so you would have had to dig on the web for this answer**
 - (c) the presence of myelin
 - (d) migration of synaptic vesicles

- 8:** Neurotransmitter molecules move across the synaptic cleft by...
- (a) active transport
 - (b) charge gradient
 - (c) **simple diffusion**
 - (d) calcium influx
 - (e) axonal transport
- 9:** Neurotransmitters are typically...
- (a) lipids
 - (b) large proteins
 - (c) carbohydrates
 - (d) a, b, and c
 - (e) **none of the above**
- 10:** In vertebrate eyes, light has to pass through four neuron cell layers before reaching the photoreceptors.
- (a) True
 - (b) **False Actually, this could be true - it depends on how you count. In lecture I said there are 5 layers, but one of them is the photoreceptor layer itself.**
- 11:** In a retina adapted for low-light conditions, you would expect...
- (a) mostly all cones and very few rods
 - (b) equal or higher acuity compared with a similar retina adapted for bright-light conditions
 - (c) photoreceptor cells with high concentrations retino-carotene
 - (d) **a tapetum**
 - (e) a carbacholized vitreous humour

12: Which of the following statements about hormones is true?

- (a) Hormones tend to be elaborate speciality compounds produced in large quantities, stored in paracrine glands, and released as necessary.
- (b) Most hormones are specific for a particular target tissue and it is rare for different tissues to have receptors for the same hormone
- (c) **Typically hormones are made by one or a few simple chemical substitutions from a common metabolite**
- (d) Hormones are found only in vertebrates, and the sex steroids found only in mammals
- (e) With the exception of a few compounds secreted from bismuth glands, hormones bind to trans-membrane protein receptors which in turn activate G-proteins.

13: What is the difference between a pheromone and a hormone?

- (a) Hormones are found only in vertebrates and pheromones are found only in invertebrates.
- (b) Pheromones are signals transmitted via a portal blood system.
- (c) Hormones are secreted by ducted glands while pheromones are secreted by ductless glands.
- (d) **Pheromones are broadcast via an external medium while hormones are blood-transported.**

14: What are releasing hormones?

- (a) any hormone that binds to a neuron
- (b) hormones that have target cells in the gonads
- (c) hormones that bind to target cells involved in triggering fixed action patterns
- (d) **a special class of pituitary hormones that stimulates production of other hormones**

- 15:** What is the fate of daughter cells from a primary spermatocyte?
- (a) three of four become polar bodies and one becomes a sperm cell
 - (b) two become sperm cells and the other two degenerate
 - (c) **all four become sperm cells**
 - (d) just before ejaculation the four daughter cells go through a mitotic division to form eight sperm cells
 - (e) the nuclei of each pair of daughter cells fuse to form standard polyploid sperm cells
- 16:** The gonadotropins FSH and LH are found in...
- (a) males only
 - (b) females only
 - (c) **males and females**
 - (d) males and females, but only during early embryonic development
 - (e) vegetarians only
- 17:** If fertilization does not take place, the luteal phase ends...
- (a) when the follicle ruptures
 - (b) **due to insufficient levels of chorionic gonadotropin**
 - (c) if progesterone level is too high
 - (d) at the morula stage
 - (e) because of programmed cerebellar estrogen secretion

18: In humans, fertilization typically takes place in the...

- (a) uterus
- (b) ovary
- (c) endometrium
- (d) **oviducts**
- (e) seminiferous tubules