

**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
  - (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
- 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