[1] Of all multicelluar animals that have nervous systems, voltage-gated ion channels are responsible for action potentials in the neurons.

a. True*
b. False

[2] Colonial flagellates, Sponges and Cnidarians all have recognizable neurons with long processes that are electrically excitable

a. True
b. False*

[3] Gastrulation is

a. Rapid cell divisions that occur after fertilization
b. Rearrangement of cells of the blastula into the blastocoel
c. Rearrangement of cells of the blastula into germ layers*
d. Cleavages of cells of the blastula into a hollow ball

[4] The mesoderm

a. Is an independent layer of cells in the embryo, not derived from the cells of any other layer
b. Is an independent layer of cells in the embryo derived from ectodermal cells
c. Is an independent layer of cells in the embryo derived from endodermal cells
d. Is an independent layer of cells in the embryo derived from either ectodermal or endodermal cells*

[5] The development of the nervous system properly begins

a. Before gastrulation
b. During gastrulation
c. After gastrulation*
d. Immediately after fertilization

[6] The division of animals into protostomes and deuterostomes can be based upon

a. Whether they form an archenteron or primitive gut
b. Whether their embryo has three cell layers
c. Where the mouth forms in relation to the blastopore*
d. When the nervous system begins to develop

[7] Chapter 1 of the textbook presents detailed examples of the embryology of nematodes, arthropods and vertebrates; these are all types of

a. Deuterostomes
b. Protostomes
c. Bilateria*
d. Cnidarians

[8] *Caenorhabditis elegans*, a nematode worm, is a useful animal for embryological research because

a. Their transparency allows lineage relationships of cells to be established*
b. Their several hundred neurons form networks analogous to jellyfish
c. Their neural and epidermal cells have different lineages and thus different fates
d. Their extended generation time slows the development of genetic mutants

[9] The biologist who found that nematode worms were good candidates for the application of modern techniques of molecular genetics to the development of metazoans was

a. Hans Spemann
b. Theodore Boveri
c. Sydney Brenner*
d. Theodore Dobzhansky

[10] Prior to the proliferation phase in *C. elegans*, most neurons will arise primarily from the ______ blastomere.

a. AB*
b. MS
c. E
d. C

[11] Prior to the completion of gastrulation in *C. elegans*, precursor cells for the hypodermis and the nervous system have spread out over the outside of the embryo.

a. True*
b. False

[12] The morphogenesis stage of development of *C. elegans* occurs ___________ the proliferation phase.

a. Prior to
b. After*

[13] During morphogenesis in *C. elegans* cells that will become the nervous system of the animal

a. Move from the inside to the surface of the embryo
b. Move from the surface to the inside of the embryo*
c. Remain in the position they were in at the end of gastrulation
d. Divide into a ventral and a lateral component, the former moving inside and the latter remaining in place

[14] In *Drosophila* development, characteristic of many arthropods but unlike the embryos of *C. elegans*,

a. The initial rounds of nuclear division are not accompanied by corresponding cell divisions*
b. The initial rounds of nuclear division are accompanied by corresponding cell divisions
c. Cellularization, the process by which nuclei are surrounded by plasma membranes, occurs after gastrulation
d. Cellularization, the process by which nuclei are surrounded by plasma membranes, occurs at the same time as gastrulation

[15] The site of neurogenesis in the embryo of *drosophila* is the

a. Dorsal furrow
b. Anterior furrow
c. Ventral furrow*
d. Posterior furrow

[16] The correct embryogenic sequence in the *drosophila* embryo is

a. Ventral nerve cord, neurogenic region then neuroblast
b. Neuroblast, ventral nerve cord then neurogenic region
c. Neurogenic region, ventral nerve cord then neuroblast
d. Neurogenic region, neuroblast then ventral nerve cord*

[17] With respect to the *drosophila* embryo, which is the correct statement?

a. The neurogenic region is part of the mesoderm
b. The neurogenic region is part of the ectoderm*
c. The neurogenic region forms after gastrulation
d. The neurogenic region forms after neurogenesis

[18] The best definition of *delamination* is:

a. Neuroblasts from the neurogenic region increase in size, undergo a change of shape and then squeeze out of the epithelium*
b. The mesoderm invaginates from the surface layer, then separates, forming a central core in the middle of the embryo
c. Cells in the cellular blastoderm, separated into and ectodermal layer, an endodermal layer and a mesodermal layer, begin to move away from each other during morphogenesis
d. Progenitor gut cells squeeze out of the mesoderm.

[19] In *Drosophila d*uring neurogenesis, neuroblasts first form ___________ which in turn generate ______________.

a. Ganglion mother cells; neurons or glia *
b. Neurons; ganglion mother cells or glia
c. Neurons or glia; ganglion mother cells
d. Neurons; glia

[20] Gastrulation in the embryos of amphibians, fish, birds and mammals is conserved.

a. True*
b. False

[21] After the process of ______________, the neurogenic region of the vertebrate embryo is known as the neural plate.

a. Neural induction*
b. Invagination
c. Cleavage
d. Delamination

[22] As the neural plate rolls up and fuses at its dorsal margins, a special group of cells unique to vertebrates form at the point of fusion; these cells are called

a. Neural crest*
b. Neural tube
c. Notochord
d. Neurons and glia

[23] The two opposite poles of amphibian and avian embryos early in development are called

a. Animal and vegetal*
b. Blastomere and blastopore
c. Ectoderm and mesoderm
d. Ventral and dorsal

[24] In, e.g., zebrafish embryos, when *epiboly* (the downward spread of cells from the blastomere over the surface of the yolk cells) reaches the 'equator' (about 50% complete) there is a transient pause as the process of __________ begins at the future dorsal margin, which at this point is called the *shield.*

a. Gastrulation*
b. Delamination
c. Invagination
d. Migration

[25] The *blastodisc* is a disc of cells floating on the animal pole of __________embryos.

a. Avian*
b. Fish
c. Amphibian
d. Mammalian

[26] In the chick embryo the invagination of the mesoderm occurs in the blastodisc through a blastopore-like structure known as

a. The primitive streak*
b. The area opaca
c. Hensen's node
d. The area pellucid

[27] The blastocyst of the human embryo contains a mass of inner cells and an outer layer of cells; the inner cell mass contributes to the formation of the placenta, the other layer, the embryo itself.

a. True
b. False*

[28] Avian and mammalian gastrulating embryos develop a primitive streak.

a. True*
b. False

[29] Early 20thC experiments by Spemann & Mangold demonstrated that dissected dorsal ectoderm of a frog embryo, cultured in isolation,

a. Prior to gastrulation, differentiated into neural tissue
b. Prior to gastrulation, failed to differentiate into recognizeable tissue
c. During gastrulation differentiated into epidermis
d. During gastrulation differentiated into neural tissue*

[30] In an experiment that led to a part of the embryo being called "the Spemann organizer", Spemann & Mangold demonstrated that dissected dorsal lip ectoderm of a frog embryo (donor), cultured in isolation in a host embryo, was able to

a. Induce neural tissue from part of the host embryo that would not normally give rise to a nervous system*
b. Induce neural tissue and other body tissues from that part of the host embryo that normally gives rise to a nervous system
c. Induce neural tissue from the donor embryo that would not normally give rise to a nervous system
d. Induce neural tissue and other body tissues from that part of the donor embryo that that normally gives rise to a nervous system

[31] In mid-20th century experiments, the chemical nature of the Spemann organizer, or neural inducer, was shown to survive freezing, boiling, and treatment by alcohol and acid, but not extreme heat above 150 degrees Celsius.

a. True*
b. False

[32] Experiments in the 1970's to the 1990's attempting to isolate neural inducers using frog embryos, first focused on the __________ assay .

a. Animal cap*
b. Vegetal cap
c. Mesodermal cap
d. Neural crest

[33] Indirect induction of neural tissue from animal cap ectoderm is distinguished from direct induction of neural tissue from animal cap ectoderm by

a. The initial induction of a mesodermal layer*
b. The presence of an inducer
c. The presence of a vegetal cap ectoderm
d. The presence of a mesodermal layer before induction takes place

[34] Studying the effects of the protein ________ that functions as a neural inducer, led to the observation that neural induction occurs by a process of inhibiting a neural inhibitor, which in turn led to the idea that neural tissue is the default state of the ectoderm.

a. Noggin
b. Chordin
c. Follistatin*
d. Activin

[35] Analysis of the amino acid sequence of __________ revealed a homology with the *Drosophila* gene called *Short gastrulation* or *Sog,* thereby demonstrating that some aspects of neural induction is conserved between vertebrates and invertebrates.

a. Noggin
b. Chordin*
c. Follistatin
d. Activin

[36] The dissected animal cap will differentiate into neurons

a. If left intact and treated with bone-morphogenic proteins
b. If dissociated and cultured*
c. If dissociated and cultured bone-morphogenic proteins
d. Only if reconnected to the vegetal cap and the mesodermal layer is allowed to develop

[37] With respect to the dorsal-ventral axis of fly and frog embryos:

a. Neural tissues are derived from the same end but use different mechanisms of neurogenesis
b. Neural tissues are derived from different ends and use different mechanisms of neurogenesis
c. Neural tissues are derived from the same end and use the similar mechanisms of neurogenesis
d. Neural tissues are derived from different ends and use the similar mechanisms of neurogenesis*

[36] Neural inducers work through the antagonism of bone-morphogenic protein signaling

a. True*
b. False

[37] Experiments have demonstrated that BMP inhibition by BMP antagonists, the *default model*,

a. Is all that is required for the development of much of the nervous system
b. Is required but other factors are likely involved for the development of much of the nervous system*

[38] Deleting or knocking out both *noggin* and *chordin* genes in the mouse causes

a. Failure of all neural induction
b. Minor effects on neural induction
c. Severe effects on neural induction*
d. No effects on neural induction

[39] In neural induction, ectodermal BMP stimulates a receptor to activate intracellular Smad proteins, which in turn activate the transcription of Zic1 which activates downstream neural progenitor genes.

a. True
b. False*

[40] In *Drosophila* deletion of the locus of the *achaete scute* gene complex results in

a. Absence of most of the neuroblasts in the central nervous system
b. Absence of the bristles, or chaete, of the fly
c. Absence of most of the neuroblasts in the peripheral nervous system
d. All of these are true*

[41] In Drosophila steps in the formation of neuroblasts from proneural clusters in the ectoderm are:

a. Before delamination, proneural genes code for the transcription factors bHLH that bind to E-boxes in the DNA of the promoters of target genes and activate their transcription*
b. After delamination, promoter genes code for the transcription factors bHLH that bind to the E-boxes in the DNA of proneural genese and activate their transcription
c. After delamination, proneural genes code for the transcription factors bHLH that bind to E-boxes in the DNA of the promoters of target genes and activate their transcription
d. Before delamination, promoter genes code for the transcription factors bHLH that bind to the E-boxes in the DNA of proneural genese and activate their transcription

[42] In Drosophila lateral inhibition during neuroblast segregation insures that

a. Only one neuroblast delaminates from each proneural cluster
b. Each proneural cluster may produce more neuroblasts if the first one is destroyed
c. Cells in the proneural cluster that do not delaminate into a neuroblast downregulate their expression of proneural genes
d. All of these are true*

[43] The unique signally pathway that underlies lateral inhibition in many regions of the *Drosophila* embryo, relies extensively on __________________

a. Notch and Delta*
b. MyoD
c. bHLH
d. acheate-scute

[44] Notch and Delta have been called *neurogenic genes* because

a. low Notch receptor activity in a cell in the neurogenic region causes it to adopt an epidermal fate
b. high Notch receptor activity in a cell in the neurogenic region causes it to adopt a neural fate
c. low Notch receptor activity in a cell in the neurogenic region causes it to adopt a neural fate*
d. in Notch and Delta mutants, nearly all cells in the neurogenic region become epidermal cells

[45] The sequence of events that lead to the formation of a transcription activation complex that will turn on downstream target genes in *Drosophila* neurogenesis, following the binding of Delta with Notch,

a. Notch-ICD forms a complex with MAM when SuH has been suppressed
b. Notch-ICD forms a complex with SuH and MAM*
c. SuH forms a complex with Notch-ICD when MAM has been suppressed
d. Both SuH and MAM have to be suppressed by neurogenic genes for Notch-ICD to turn on E(spl)s

[46] Of the several parallels and homologous features of proneural and neurogenic pathways,

a. *Drosophila* and vertebrates have about the same number of proneural genes
b. Vertebrate proneural genes have the same bHLH structure as those of *Drosophila**
c. Vertebrates do not have most of the components of the Notch pathway
d. *Drosophila* and vertebrates have a single Notch receptor expressed in various parts of the developing nervous system

[47] The Notch-Delta-proneural system is conserved in vertebrates in which it is critically involved in the segregation of neuroblasts from the ectoderm.

a. True
b. False*