

**Campbell's Biology, 9e (Reece et al.)**  
**Chapter 34 The Origin and Evolution of Vertebrates**

A little more than 40% of the questions in Chapter 34 are scenario- or art-based or a combination thereof. There are two new sets of scenario questions, one pertaining to the air sacs of birds and the other to a devastating disease of bats in the eastern United States and Canada, thought to be caused by a fungus new to science. The new set of art questions pertains to swim bladders.

**Multiple-Choice Questions**

1) Chordate pharyngeal slits appear to have functioned first as

- A) the digestive system's opening.
- B) suspension-feeding devices.
- C) components of the jaw.
- D) gill slits for respiration.
- E) portions of the inner ear.

Answer: B

Topic: Concept 34.1

Skill: Knowledge/Comprehension

2) Which of the following statements would be *least* acceptable to most zoologists?

- A) The extant lancelets are contemporaries, not ancestors, of vertebrates.
- B) The first fossils resembling lancelets appeared in the fossil record around 530 million years ago.
- C) Recent work in molecular systematics supports the hypothesis that lancelets are the most recent common ancestor of all vertebrates.
- D) The extant lancelets are the immediate ancestors of the fishes.
- E) Lancelets display the same method of swimming as do fishes.

Answer: D

Topic: Concept 34.1

Skill: Synthesis/Evaluation

3) Which extant chordates are postulated to be *most* like the earliest chordates in appearance?

- A) lancelets
- B) adult tunicates
- C) amphibians
- D) reptiles
- E) chondrichthyans

Answer: A

Topic: Concept 34.1

Skill: Knowledge/Comprehension

4) A new species of aquatic chordate is discovered that closely resembles an ancient form. It has the following characteristics: external armor of bony plates, no paired lateral fins, and a suspension-feeding mode of nutrition. In addition to these, it will probably have which of the following characteristics?

- A) legs
- B) no jaws
- C) an amniotic egg
- D) endothermy

Answer: B

Topic: Concept 34.2

Skill: Application/Analysis

5) How many of the following statements about craniates is (are) correct?

1. Craniates are more highly cephalized than are noncraniates.
2. Craniates' genomic evolution includes duplication of clusters of genes that code for transcription factors.
3. The craniate clade is synonymous with the vertebrate clade.
4. Pharyngeal slits that play important roles in gas exchange originated in craniates.
5. The two-chambered heart originated with the early craniates.

- A) one of these
- B) two of these
- C) three of these
- D) four of these
- E) five of these

Answer: D

Topic: Concept 34.2

Skill: Application/Analysis

6) What do all craniates have that earlier chordates did *not* have?

- A) brain
- B) vertebrae
- C) cartilaginous pipe surrounding notochord
- D) partial or complete skull
- E) bone

Answer: D

Topic: Concept 34.2

Skill: Knowledge/Comprehension

7) Lampreys differ from hagfishes in

- A) lacking jaws.
- B) having a cranium.
- C) having pharyngeal clefts that develop into pharyngeal slits.
- D) having a notochord throughout life.
- E) having a notochord that is surrounded by a tube of cartilage.

Answer: E

Topic: Concepts 34.2, 34.3

Skill: Knowledge/Comprehension

8) The feeding mode of the extinct conodonts was

- A) herbivory.
- B) suspension feeding.
- C) predation.
- D) filter feeding.
- E) absorptive feeding.

Answer: C

Topic: Concept 34.3

Skill: Knowledge/Comprehension

9) The earliest known mineralized structures in vertebrates are associated with which function?

- A) reproduction
- B) feeding
- C) locomotion
- D) defense
- E) respiration

Answer: B

Topic: Concept 34.3

Skill: Knowledge/Comprehension

10) A team of researchers has developed a poison that has proven effective against lamprey larvae in freshwater cultures. The poison is ingested and causes paralysis by detaching segmental muscles from the skeletal elements. The team wants to test the poison's effectiveness in streams feeding Lake Michigan, but one critic worries about potential effects on lancelets, which are similar to lampreys in many ways. Why is this concern misplaced?

- A) A chemical poisonous to lampreys could not also be toxic to organisms as ancestral as lancelets.
- B) Lamprey larvae and lancelets have very different feeding mechanisms.
- C) Lancelets do not have segmental muscles.
- D) Lancelets live only in saltwater environments.
- E) Lancelets and lamprey larvae eat different kinds of food.

Answer: D

Topic: Concepts 34.1, 34.3

Skill: Application/Analysis

11) The lamprey species whose larvae live in freshwater streams, but whose adults live most of their lives in seawater, are similar in this respect to certain species of

- A) chondrichthyans.
- B) actinopterygians.
- C) lungfishes.
- D) coelacanth.
- E) hagfishes.

Answer: B

Topic: Concept 34.4

Skill: Knowledge/Comprehension

12) Jaws first occurred in which extant group of fishes?

- A) lampreys
- B) chondrichthyans
- C) ray-finned fishes
- D) lungfishes
- E) placoderms

Answer: B

Topic: Concept 34.4

Skill: Knowledge/Comprehension

13) Which of these might have been observed in the common ancestor of chondrichthyans and osteichthyans?

- A) a mineralized, bony skeleton
- B) opercula
- C) bony fin rays
- D) a spiral valve intestine
- E) a swim bladder

Answer: A

Topic: Concept 34.4

Skill: Knowledge/Comprehension

14) To which of the following are the scales of chondrichthyans most closely related in a structural sense?

- A) osteichthyan scales
- B) reptilian scales
- C) mammalian scales
- D) bird scales
- E) chondrichthyan teeth

Answer: E

Topic: Concept 34.4

Skill: Knowledge/Comprehension

15) Which of these statements accurately describes a similarity between sharks and ray-finned fishes?

- A) The skin is typically covered by flattened bony scales.
- B) They are equally able to exchange gases with the environment while stationary.
- C) They are highly maneuverable due to their flexibility.
- D) They have a lateral line that is sensitive to changes in water pressure.
- E) A swim bladder helps control buoyancy.

Answer: D

Topic: Concept 34.4

Skill: Knowledge/Comprehension

16) Which group's members have had both lungs and gills during their adult lives?

- A) sharks, skates, and rays
- B) lungfishes
- C) lancelets
- D) amphibians
- E) ichthyosaurs and plesiosaurs

Answer: B

Topic: Concept 34.4

Skill: Knowledge/Comprehension

17) There is evidence that ray-finned fishes evolved

- A) in response to a crisis that wiped out the chondrichthyans.
- B) directly from lampreys and hagfish.
- C) early in the Cambrian period.
- D) directly from lancelets.
- E) the swim bladder from a lung.

Answer: E

Topic: Concept 34.4

Skill: Knowledge/Comprehension

18) The swim bladder of ray-finned fishes

- A) was probably modified from simple lungs of chondrichthyans.
- B) developed into lungs in saltwater fishes.
- C) first appeared in sharks.
- D) provides for regulation of buoyancy.
- E) Two of the options listed are correct.

Answer: D

Topic: Concept 34.4

Skill: Knowledge/Comprehension

19) Which of the following belongs to the lobe-fin clade?

- A) chondrichthyans
- B) ray-finned fishes
- C) lampreys
- D) hagfishes
- E) tetrapods

Answer: E

Topic: Concept 34.4

Skill: Knowledge/Comprehension

20) Arrange these taxonomic terms from most inclusive (most general) to least inclusive (most specific).

1. lobe-fins
2. amphibians
3. gnathostomes
4. osteichthyans
5. tetrapods

A) 4, 3, 1, 5, 2

B) 4, 3, 2, 5, 1

C) 4, 2, 3, 5, 1

D) 3, 4, 1, 5, 2

E) 3, 4, 5, 1, 2

Answer: D

Topic: Concepts 34.4, 34.5

Skill: Knowledge/Comprehension

21) A trend first observed in the evolution of the earliest tetrapods was

A) the appearance of jaws.

B) the appearance of bony vertebrae.

C) feet with digits.

D) the mineralization of the endoskeleton.

E) the amniotic egg.

Answer: C

Topic: Concept 34.5

Skill: Knowledge/Comprehension

22) What should be true of fossils of the earliest tetrapods?

A) They should show evidence of internal fertilization.

B) They should show evidence of having produced shelled eggs.

C) They should indicate limited adaptation to life on land.

D) They should be transitional forms with the fossils of chondrichthyans that lived at the same time.

E) They should feature the earliest indications of the appearance of jaws.

Answer: C

Topic: Concept 34.5

Skill: Knowledge/Comprehension

23) Which of these are amniotes?

A) amphibians

B) fishes

C) egg-laying mammals

D) placental mammals

E) More than one of these is correct.

Answer: E

Topic: Concept 34.6

Skill: Knowledge/Comprehension

24) Why is the amniotic egg considered an important evolutionary breakthrough?

- A) It has a shell that increases gas exchange.
- B) It allows deposition of eggs in a terrestrial environment.
- C) It prolongs embryonic development.
- D) It provides insulation to conserve heat.
- E) It permits internal fertilization to be replaced by external fertilization.

Answer: B

Topic: Concept 34.6

Skill: Knowledge/Comprehension

25) Which era is known as the "age of reptiles"?

- A) Cenozoic
- B) Mesozoic
- C) Paleozoic
- D) Devonian
- E) Cambrian

Answer: B

Topic: Concept 34.6

Skill: Knowledge/Comprehension

26) Which of these characteristics added most to vertebrate success in relatively dry environments?

- A) the shelled, amniotic egg
- B) the ability to maintain a constant body temperature
- C) two pairs of appendages
- D) bony scales
- E) a four-chambered heart

Answer: A

Topic: Concept 34.6

Skill: Knowledge/Comprehension

27) Which of the following is characteristic of most extant reptiles and most extant mammals?

- A) ectothermy
- B) diaphragm
- C) shelled eggs
- D) keratinized skin
- E) conical teeth that are relatively uniform in size

Answer: D

Topic: Concept 34.6

Skill: Knowledge/Comprehension

28) At the end of which era did most dinosaurs and pterosaurs become extinct?

- A) Cretaceous
- B) Permian
- C) Devonian
- D) Ordovician
- E) Triassic

Answer: A

Topic: Concept 34.6

Skill: Knowledge/Comprehension

29) Which of the following are the only extant animals that descended directly from dinosaurs?

- A) lizards
- B) crocodiles
- C) snakes
- D) birds
- E) tuataras

Answer: D

Topic: Concept 34.6

Skill: Knowledge/Comprehension

30) Examination of the fossils of *Archaeopteryx* reveals that, in common with extant birds, it had

- A) a long tail containing vertebrae.
- B) feathers.
- C) teeth.
- D) Three of the options listed are correct.
- E) Two of the options listed are correct.

Answer: B

Topic: Concept 34.6

Skill: Knowledge/Comprehension

31) Why is the discovery of the fossil *Archaeopteryx* significant? It supports the

- A) phylogenetic relatedness of birds and reptiles.
- B) contention that birds are much older than we originally thought.
- C) claim that some dinosaurs had feathers well before birds had evolved.
- D) idea that the first birds were ratites.
- E) hypothesis that the earliest birds were ectothermic.

Answer: A

Topic: Concept 34.6

Skill: Knowledge/Comprehension

32) During chordate evolution, what is the sequence (from earliest to most recent) in which the following structures arose?

1. amniotic egg
2. paired fins
3. jaws
4. swim bladder
5. four-chambered heart

- A) 2, 3, 4, 1, 5
- B) 3, 2, 4, 1, 5
- C) 3, 2, 1, 4, 5
- D) 2, 1, 4, 3, 5
- E) 2, 4, 3, 1, 5

Answer: A

Topic: Concepts 34.3—34.6

Skill: Knowledge/Comprehension



33) Among extant vertebrates, a sheet of muscle called the diaphragm is found in

- A) birds.
- B) monotremes.
- C) marsupials.
- D) placentals.
- E) Three of the options listed are correct.

Answer: E

Topic: Concept 34.7

Skill: Knowledge/Comprehension

34) Which of these would a paleontologist be most likely to do in order to determine whether a fossil represents a reptile or a mammal?

- A) Look for the presence of milk-producing glands.
- B) Look for the mammalian characteristics of a four-chambered heart and a diaphragm.
- C) Because mammals are eutherians, look for evidence of a placenta.
- D) Use molecular analysis to look for the protein keratin.
- E) Examine the teeth.

Answer: E

Topic: Concept 34.7

Skill: Application/Analysis

35) Which of the following represents the strongest evidence that two of the three middle ear bones of mammals are homologous to certain reptilian jawbones?

- A) They are similar in size to the reptilian jawbones.
- B) They are similar in shape to the reptilian jawbones.
- C) The mammalian jaw has fewer bones than does the reptilian jaw.
- D) These bones can be observed to move from the developing jaw to the developing middle ear in mammalian embryos.
- E) Mammals can hear better than reptiles.

Answer: D

Topic: Concept 34.7

Skill: Synthesis/Evaluation

36) Female birds lay their eggs, thereby facilitating flight by reducing weight. Which "strategy" seems most likely for female bats to use to achieve the same goal?

- A) lay shelled eggs
- B) limit litters to a single embryo
- C) refrain from flying throughout pregnancy (about 6 weeks long)
- D) give birth to underdeveloped young, and subsequently carry them in a pouch that has teats
- E) feed multiple embryos internally using placentas

Answer: B

Topic: Concept 34.7

Skill: Application/Analysis

37) In which vertebrates is fertilization exclusively internal?

- A) chondrichthyans, osteichthyans, and mammals
- B) amphibians, mammals, and reptiles
- C) chondrichthyans, osteichthyans, and reptiles
- D) reptiles and mammals
- E) reptiles and amphibians

Answer: D

Topic: Concepts 34.5—34.7

Skill: Knowledge/Comprehension

For the following items, match the extant vertebrate groups with the descriptions.

38) Their scales most closely resemble teeth in both structure and origin.

- A) amphibians
- B) nonbird reptiles
- C) chondrichthyans
- D) mammals
- E) osteichthyans

Answer: C

Topic: Concepts 34.4—34.7

Skill: Knowledge/Comprehension

39) Internal fertilization, leathery amniotic egg, and skin that resists drying are characteristics of

- A) amphibians.
- B) nonbird reptiles.
- C) chondrichthyans.
- D) mammals.
- E) birds.

Answer: B

Topic: Concepts 34.4—34.7

Skill: Knowledge/Comprehension

40) Which of the following are the most abundant and diverse of the extant vertebrates?

- A) ray-finned fishes
- B) birds
- C) amphibians
- D) nonbird reptiles
- E) mammals

Answer: A

Topic: Concepts 34.4—34.7

Skill: Knowledge/Comprehension

41) What is the single unique characteristic that distinguishes extant birds from other extant vertebrates?

- A) endothermy
- B) feathers
- C) an amniotic egg
- D) flight
- E) a four-chambered heart

Answer: B

Topic: Concepts 34.6—34.7

Skill: Knowledge/Comprehension

42) Arrange the following taxonomic terms from most inclusive (most general) to least inclusive (most specific).

- 1. apes
- 2. hominins
- 3. *Homo*
- 4. anthropoids
- 5. primates

A) 5, 1, 4, 2, 3

B) 5, 4, 1, 2, 3

C) 5, 4, 2, 1, 3

D) 5, 2, 1, 4, 3

E) 5, 2, 4, 1, 3

Answer: B

Topic: Concept 34.8

Skill: Knowledge/Comprehension

43) Which of these traits is most strongly associated with the adoption of bipedalism?

- A) fingerprints
- B) enhanced depth perception
- C) shortened hind limbs
- D) opposable big toe
- E) repositioning of foramen magnum

Answer: E

Topic: Concept 34.8

Skill: Knowledge/Comprehension

44) Which of the following statements about human evolution is correct?

- A) Modern humans are the only human species to have evolved on Earth.
- B) Human ancestors were virtually identical to extant chimpanzees.
- C) Human evolution has occurred within an unbranched lineage.
- D) The upright posture and enlarged brain of humans evolved simultaneously.
- E) Fossil evidence indicates that early anthropoids were arboreal and cat-sized.

Answer: E

Topic: Concept 34.8

Skill: Knowledge/Comprehension

45) Which of the following are considered apes?

- A) lorises
- B) New World monkeys
- C) Old World monkeys
- D) orangutans
- E) tarsiers

Answer: D

Topic: Concept 34.8

Skill: Knowledge/Comprehension

46) Which of these species was the first to have been adapted for long-distance bipedalism?

- A) *Australopithecus garhi*
- B) *H. erectus*
- C) *H. ergaster*
- D) *H. habilis*
- E) *H. sapiens*

Answer: C

Topic: Concept 34.8

Skill: Knowledge/Comprehension

47) Which of these species was apparently the first to craft stone tools?

- A) *Australopithecus garhi*
- B) *H. erectus*
- C) *H. ergaster*
- D) *H. habilis*
- E) *H. sapiens*

Answer: A

Topic: Concept 34.8

Skill: Knowledge/Comprehension

48) Which of these species was the first to have some members migrate out of Africa?

- A) *Australopithecus garhi*
- B) *H. erectus*
- C) *H. ergaster*
- D) *H. habilis*
- E) *H. sapiens*

Answer: B

Topic: Concept 34.8

Skill: Knowledge/Comprehension

49) Which of these species is currently thought to have coexisted (at the same time and places) with *H. neanderthalensis*?

- A) *H. erectus*
- B) *H. ergaster*
- C) *H. habilis*
- D) *H. sapiens*

Answer: D

Topic: Concept 34.8

Skill: Knowledge/Comprehension

50) Which of these species had members who moved out of Africa?

- A) *H. erectus*
- B) *H. ergaster*
- C) *H. habilis*
- D) *H. sapiens*
- E) both *H. sapiens* and *H. erectus*

Answer: E

Topic: Concept 34.8

Skill: Knowledge/Comprehension

51) With which of the following statements would a biologist be *most* inclined to agree?

- A) Humans and apes represent divergent lines of evolution from a common ancestor.
- B) Humans evolved directly from Old World monkeys.
- C) Humans represent the pinnacle of evolution and have escaped from being affected by natural selection.
- D) Humans evolved from chimpanzees.
- E) Humans and apes are the result of disruptive selection in a species of chimpanzee.

Answer: A

Topic: Concept 34.8

Skill: Application/Analysis

52) Which of these statements about human evolution is correct?

- A) The ancestors of *Homo sapiens* were chimpanzees.
- B) Human evolution has proceeded in an orderly fashion from an ancestral anthropoid to *Homo sapiens*.
- C) The evolution of upright posture and enlarged brain occurred simultaneously.
- D) Different species of the genus *Homo* have coexisted at various times throughout hominin evolution.
- E) Mitochondrial DNA analysis indicates that modern humans are genetically very similar to Neanderthals.

Answer: D

Topic: Concept 34.8

Skill: Knowledge/Comprehension

53) The oldest fossil remains of *Homo sapiens* found so far date from about

- A) 6 million years ago.
- B) 1.6 million years ago.
- C) 195,000 years ago.
- D) 60,000 years ago.
- E) 16,000 years ago.

Answer: C

Topic: Concept 34.8

Skill: Knowledge/Comprehension

- 54) Which of the following statements is correct in regard to *Homo erectus*?
- A) Their fossils are not limited to Africa.
  - B) On average, *H. erectus* had a smaller brain than *H. habilis*.
  - C) *H. erectus* had a level of sexual dimorphism less than that of modern humans.
  - D) *H. erectus* was not known to use tools.
  - E) *H. erectus* evolved before *H. habilis*.

Answer: A

Topic: Concept 34.8

Skill: Knowledge/Comprehension

- 55) Which of the following is the most inclusive (most general) group, all of whose members have foramina magna centrally positioned in the base of the cranium?

- A) hominoids
- B) *Homo*
- C) anthropoids
- D) hominins
- E) primates

Answer: D

Topic: Concept 34.8

Skill: Knowledge/Comprehension

- 56) Which of the following is the most inclusive (most general) group, all of whose members have fully opposable thumbs?

- A) apes
- B) *Homo*
- C) anthropoids
- D) hominins
- E) primates

Answer: C

Topic: Concept 34.8

Skill: Knowledge/Comprehension

- 57) Which of the following is the most specific group that includes both the Old World monkeys and the New World monkeys?

- A) apes
- B) *Homo*
- C) anthropoids
- D) hominins
- E) primates

Answer: C

Topic: Concept 34.8

Skill: Knowledge/Comprehension

58) At least one of these has been found in all species of eumetazoan animals studied thus far.

A) *Hox*

B) *Dlx*

C) *Otx*

D) *FOXP2*

E) more than one of these

Answer: A

Topic: Concepts 34.1—34.8

Skill: Knowledge/Comprehension

59) Which of the following is a cluster of genes coding for transcription factors involved in the evolution of innovations in early vertebrate nervous systems and vertebrae?

A) *Hox*

B) *Dlx*

C) *Otx*

D) *FOXP2*

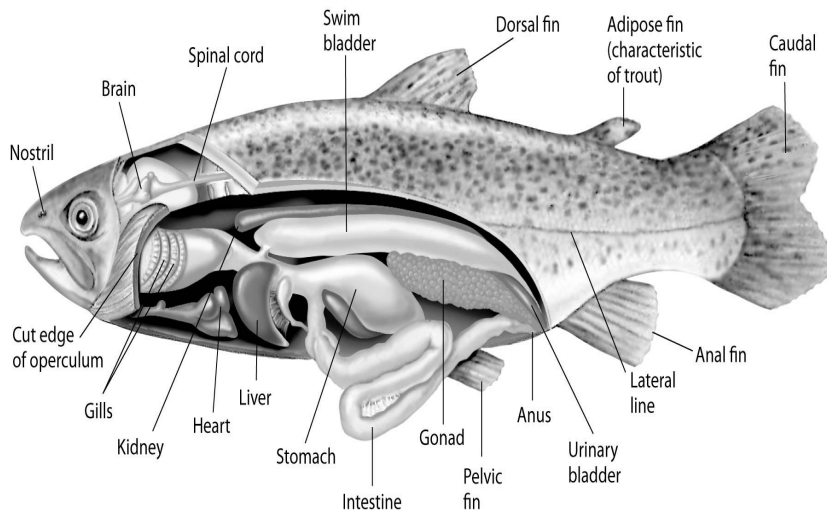
E) more than one of these

Answer: B

Topic: Concepts 34.1—34.8

Skill: Knowledge/Comprehension

## Art Questions



**Figure 34.1**

Fishes that have swim bladders can regulate their density and, thus, their buoyancy. There are two types of swim bladder: physostomus and physoclistus. The ancestral version is the physostomus version, in which the swim bladder is connected to the esophagus via a short tube (Figure 34.1). The fish fills this version by swimming to the surface, taking gulps of air, and directing them into the swim bladder. Air is removed from this version by "belching." The physoclistus version is more derived, and has lost its connection to the esophagus. Instead, gas enters and leaves the swim bladder via special circulatory mechanisms within the wall of the swim bladder.

60) The presence of a swim bladder allows the typical ray-finned fish to stop swimming and still

- A) effectively circulate its blood.
- B) be highly maneuverable.
- C) use its lateral line system.
- D) use its swim bladder as a respiratory organ.
- E) not sink.

Answer: E

Topic: Concept 34.4

Skill: Knowledge/Comprehension

61) Rank the following fish, from most to least, in terms of the amount of energy it must use to maintain its position (depth) in the water column over the long term.

- 1. physoclistus fish
- 2. physostomus fish
- 3. chondrichthyan fish

A) 1, 2, 3

B) 2, 3, 1

C) 2, 1, 3

D) 3, 1, 2

E) 3, 2, 1

Answer: E

Topic: Concept 34.4

Skill: Synthesis/Evaluation



62) If a physoclistus fish removes gas from its swim bladder, this fish's density cannot actually change until that gas arrives at the

- A) mouth.
- B) gills.
- C) skin.
- D) heart.
- E) anus.

Answer: B

Topic: Concept 34.4

Skill: Synthesis/Evaluation

63) Which shark structure is most analogous to a swim bladder full of gas?

- A) its lateral line system
- B) its spiral valve
- C) its liver
- D) its dead-end nostrils
- E) its gills

Answer: C

Topic: Concept 34.4

Skill: Application/Analysis

64) When a shark stops swimming, it does which of the following?

- 1. sinks
- 2. quickly dies
- 3. oxygenates its blood less effectively

- A) 1 only
- B) 2 only
- C) 3 only
- D) 1 and 3
- E) 1, 2, and 3

Answer: D

Topic: Concept 34.4

Skill: Application/Analysis

65) We should expect the inner wall of the swim bladder to be lined with tissue that is derived from

- A) ectoderm.
- B) endoderm.
- C) mesoderm.
- D) mesoglea.
- E) neurectoderm.

Answer: B

Topic: Concepts 32.3, 34.4

Skill: Application/Analysis

66) Regarding its position in the water column, the same thing that happens to a shark when it stops swimming also happens to a

A) physostomus fish when it gulps air.

B) physoclistus fish when it moves gas from the blood into the water.

C) physoclistus fish when it moves gas from the swim bladder into the blood.

D) physoclistus fish when it moves gas from the blood into the swim bladder.

Answer: B

Topic: Concept 34.4

Skill: Application/Analysis

67) In coelacanth, a swim bladder is present, but the swim bladder is full of adipose tissue (fat), which is there on a fairly permanent basis. If such a swim bladder is used by coelacanth to affect buoyancy, then it does so in much the same way as does the

A) liver of a shark.

B) physoclistus swim bladder.

C) physostomus swim bladder.

D) lung of a lungfish.

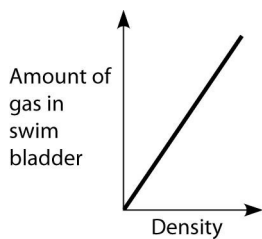
Answer: A

Topic: Concept 34.4

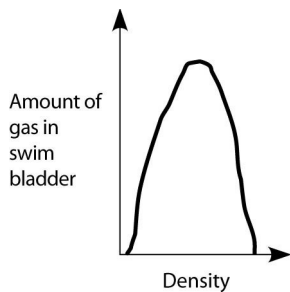
Skill: Application/Analysis

68) Which graph properly depicts the relationship between the amount of gas in the swim bladder and the density of the fish?

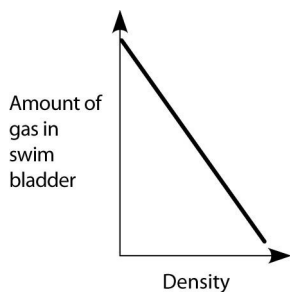
A)



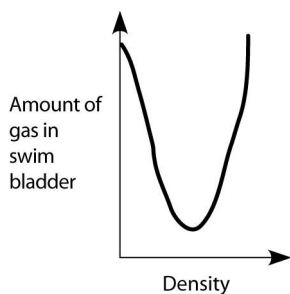
B)



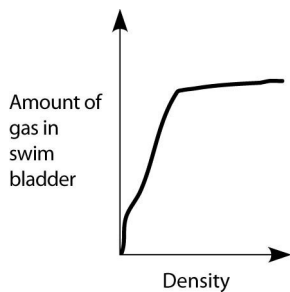
C)



D)



E)



Answer: C

Topic: Concept 34.4

Skill: Synthesis/Evaluation

69) If a ray-finned fish is to both hover (remain stationary) in the water column and ventilate its gills effectively, then what other structure besides its swim bladder will it use?

- A) its heart
- B) its pectoral fins
- C) its lateral line system
- D) its caudal (tail) fin
- E) its opercula

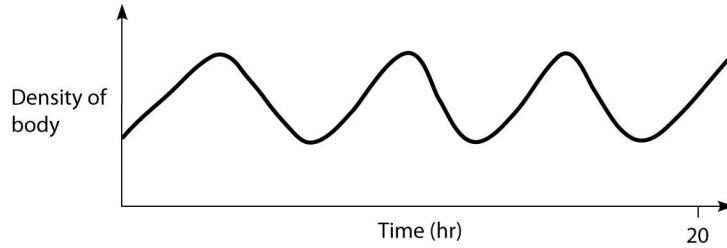
Answer: E

Topic: Concept 34.4

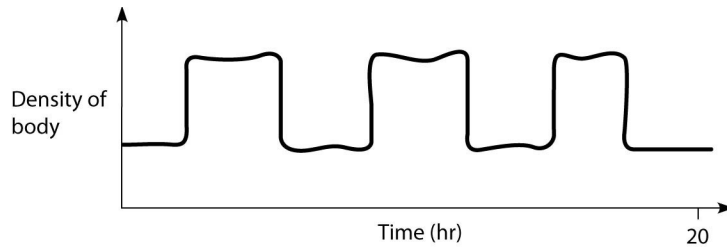
Skill: Knowledge/Comprehension

70) Which graph below best represents the way that density changes over time in a physoclistus fish and in a physostomus fish, respectively?

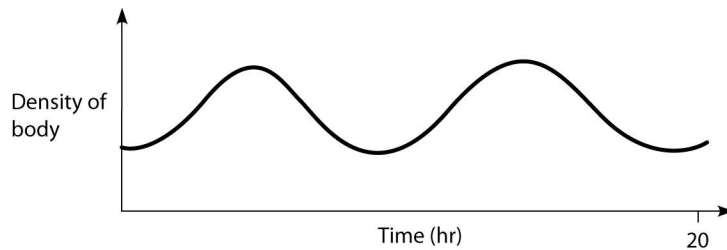
A)



B)



C)



D)



A) A and B

B) B and A

C) B and C

D) C and B

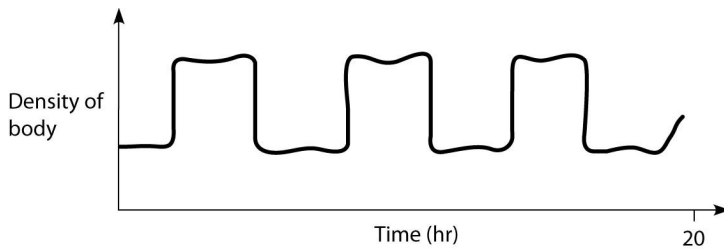
E) D and B

Answer: D

Topic: Concept 34.4

Skill: Synthesis/Evaluation

71) At 5, 10, and 15 hours in the graph below, which of the following statements should be true?



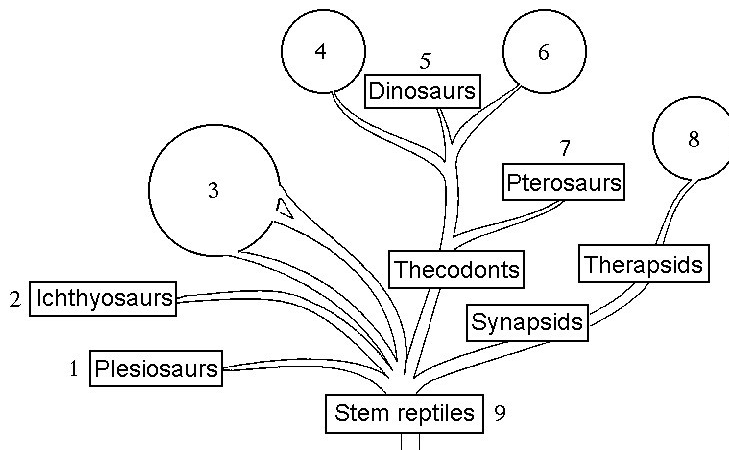
- A) This fish is in the process of adding gas to its swim bladder.
- B) This fish is in the process of removing gas from its swim bladder.
- C) This fish has a swim bladder that is relatively full of gas.
- D) This fish has a swim bladder that contains relatively little gas.

Answer: D

Topic: Concept 34.4

Skill: Synthesis/Evaluation

The following questions refer to the phylogenetic tree shown in Figure 34.2.



**Figure 34.2**

72) Which number represents the birds?

- A) 3
- B) 4
- C) 6
- D) 8
- E) 10, if it were at the end of a branch emerging from the dinosaurs

Answer: E

Topic: Concept 34.6

Skill: Application/Analysis

73) Which pair of numbers represents extinct reptiles that had returned to an aquatic life?

- A) 1 and 2
- B) 3 and 4
- C) 5 and 7
- D) 6 and 8
- E) 7 and 9

Answer: A

Topic: Concept 34.6

Skill: Application/Analysis

74) If circle 3 includes all of the extant reptiles that are ectotherms, then what do circles 4 and 6 represent?

- A) crocodiles and birds
- B) turtles and birds
- C) ratites and carinates
- D) mammals and birds
- E) There is not enough information to say.

Answer: E

Topic: Concept 34.6

Skill: Application/Analysis

75) Which number represents the closest relative to the parareptiles?

- A) 1
- B) 2
- C) 3
- D) 9
- E) It is not possible to say.

Answer: D

Topic: Concept 34.6

Skill: Application/Analysis

76) Which of these numbers represents ectotherms that were able to fly?

- A) 1
- B) 2
- C) 7
- D) 8
- E) It is not possible to say.

Answer: C

Topic: Concept 34.6

Skill: Application/Analysis

77) Whose DNA would have had the most sequence homologies with amphibian DNA?

- A) 5
- B) 6
- C) 7
- D) 8
- E) 9

Answer: E

Topic: Concept 34.6

Skill: Application/Analysis

78) In order for the four-chambered hearts of birds and mammals to be homologous, which other organisms would have to have had four-chambered hearts?

- A) dinosaurs
- B) thecodonts
- C) plesiosaurs
- D) synapsids
- E) stem reptiles

Answer: E

Topic: Concept 34.6

Skill: Application/Analysis

79) The organisms represented by number 8 are

- A) birds.
- B) mammals.
- C) nonbird, terrestrial reptiles.
- D) aquatic reptiles.
- E) all mammals except humans.

Answer: B

Topic: Concepts 34.6, 34.7

Skill: Application/Analysis

### Scenario Questions

The following questions refer to the description below.

Terry catches a ray-finned fish from the ocean and notices that attached to its flank is an equally long, snakelike organism. The attached organism has no external segmentation, no scales, a round mouth surrounded by a sucker, and two small eyes. Terry thinks it might be a marine leech, a hagfish, or a lamprey.

80) Which feature excludes the organism from possibly being a leech?

- A) elongated shape
- B) lack of scales
- C) lack of external segmentation
- D) round mouth
- E) anterior sucker

Answer: C

Topic: Concept 34.2

Skill: Application/Analysis



81) Terry detaches the snakelike organism from the fish and uses a knife to cut off its head. In doing so, its brain slides out onto the deck of the boat. Terry peers into the cut end of the head and notices that the brain had lain in a sort of panlike structure that only partially surrounded the brain. What is the structure Terry is observing, and what is it made of?

- A) skull, made of bone
- B) cranium, made of bone
- C) cranium, made of cartilage
- D) vertebral column, made of bone
- E) vertebral column, made of cartilage

Answer: C

Topic: Concept 34.2

Skill: Application/Analysis

82) Terry takes the body of the snakelike organism and slices it open along its dorsal side. If it is a hagfish, what should Terry see?

- A) a well-developed series of bony vertebrae surrounding the spinal cord
- B) a well-developed series of cartilaginous vertebrae surrounding the spinal cord
- C) a tube of cartilage (surrounding the notochord) with dorsal projections on both sides of the spinal cord
- D) a notochord, located underneath the spinal cord

Answer: D

Topic: Concept 34.2

Skill: Application/Analysis

83) The snakelike organism turned out to be a hagfish. Consequently, why should Terry throw the fish to which the hagfish was attached overboard, rather than having it for dinner?

- A) It has mucus on its skin.
- B) If it had an ectoparasite, then it must also have endoparasites.
- C) The bite of the hagfish introduces paralytic neurotoxins, which Terry wants to avoid.
- D) It was already sick or dying; otherwise, the hagfish would probably not have attacked it.

Answer: D

Topic: Concept 34.2

Skill: Application/Analysis

84) Having caught and handled a hagfish, what will Terry's shipmates most likely require Terry to do before returning to further fishing?

- A) Wash his hands and then don gloves to prevent the spread of harmful microbes that live only on hagfish skin.
- B) Clean the bucketsful of hagfish slime from the deck of the boat.
- C) Dispose of the fishing tackle that had been poisoned by coming into contact with the hagfish.
- D) Cut up the remaining hagfish and share pieces of this highly sought-after baitfish.

Answer: B

Topic: Concept 34.2

Skill: Application/Analysis

85) Terry saved some of the tooth-like objects within the hagfish's round mouth to analyze their composition in his mentor's biochemistry research lab. Terry will find that they are composed of the same protein found in tetrapod

- A) skin.
- B) teeth.
- C) bones.
- D) cartilage.
- E) muscles.

Answer: A

Topic: Concepts 34.2, 34.6

Skill: Application/Analysis

The following questions refer to the description below.

While on an intersession course in tropical ecology, Kris pulls a large, snakelike organism from a burrow (the class was granted a collecting permit). The 1-m-long organism has smooth skin, which appears to be segmented. It has two tiny eyes that are hard to see because they seem to be covered by skin. Kris brings it back to the lab at the field station, where it is a source of puzzlement to the class. Kris says that it is a giant oligochaete worm; Shaun suggests it is a legless amphibian; Kelly proposes it belongs to a snake species that is purely fossorial (lives in a burrow).

86) The class decided to humanely euthanize the organism and subsequently dissect it. Having decided that it was probably not a reptile, two of their original hypotheses regarding its identity remained. Which of the following, if observed, should help them arrive at a conclusive answer?

- A) presence of a closed circulatory system
- B) presence of moist, highly vascularized skin
- C) presence of lungs
- D) presence of a nerve cord
- E) presence of a digestive system with two openings

Answer: C

Topic: Concept 34.5

Skill: Application/Analysis

87) The organism was found to have two lungs, but the left lung was much smaller than the right lung. Kelly added that the herpetology instructor had said that in most snakes, the same condition exists. If the size difference between the lungs in this organism is *not* a shared ancestral characteristic with its occurrence in snakes, then its existence in this organism is explained as which of the following?

- 1. a result of convergent evolution
  - 2. an example of homologous structures
  - 3. a similar adaptation to a shared lifestyle or body plan
  - 4. a result of having identical *Hox* genes
  - 5. a homoplasy
- A) 3 only
  - B) 1 and 5
  - C) 1, 3, and 5
  - D) 2, 3, and 5
  - E) 3, 4, and 5

Answer: C

Topic: Concept 34.5

Skill: Synthesis/Evaluation

88) The adaptation of the body shape of snakes has resulted in one of their lungs becoming vestigial. Another adaptation (to a fossorial lifestyle) is snakes' absence of limbs. If the "mystery organism" has also become adapted to a fossorial lifestyle, though its ancestors moved about on the surface, then which structures should one expect to find upon dissecting the organism?

1. reduced or absent pelvic and/or pectoral girdles
2. metanephridia
3. hydrostatic skeleton

- A) 1 only
- B) 1 and 2
- C) 1 and 3
- D) 2 and 3
- E) 1, 2, and 3

Answer: A

Topic: Concept 34.5

Skill: Application/Analysis

89) Which one of these, if found, should clear up any remaining doubt as to the identity of the organism?

- A) vestigial pelvic girdle
- B) blood vessels carrying oxygenated blood from both the skin and the functional lung to the heart
- C) closed circulatory system
- D) ability to produce toxins from glands located on the skin, or that empty into the mouth
- E) two-chambered heart

Answer: B

Topic: Concept 34.5

Skill: Application/Analysis

Due to its system of nine air sacs connected to the lungs, the respiratory system of birds is arguably the most effective respiratory system of all air-breathers. Upon inhalation, air first flows into posterior air sacs, then into the lungs, and then into anterior air sacs on the way to being exhaled. Thus, there is one-way flow of air through the lungs, along thousands of tubules called parabronchi.

90) If the inner lining of the air sacs is neither thin nor highly vascularized, then what can be inferred about the air sacs?

- A) They must not belong to the respiratory system.
- B) They cannot be derived from endoderm.
- C) They cannot be sites of gas exchange between air and blood.
- D) They must obtain nutrition from some source other than the bloodstream.
- E) They cannot effectively moisturize the air before it reaches the lungs.

Answer: C

Topic: Concept 34.6

Skill: Application/Analysis

- 91) Some bird bones are hollow rather than honeycombed. The hollow bones mostly contain air sacs. The replacement of bone marrow with air sacs is properly understood as an adaptation to
- A) reduce the weight of the bird.
  - B) facilitate flight.
  - C) eliminate the functions that marrow performs.
  - D) All three of the options listed are correct.
  - E) Only two of the options listed are correct.

Answer: E

Topic: Concept 34.6

Skill: Application/Analysis

- 92) Birds generate a lot of heat, especially during flight. Yet the adipose tissue under their skin and the feathers atop their skin make it difficult to eliminate excess heat across the skin. Which of the following alternatives can absorb body heat and eliminate it from the bird most effectively?

- A) air in the air sacs
- B) lymph in the lymphatic vessels
- C) blood in the vessels
- D) blood in the heart
- E) urine in the bladder

Answer: A

Topic: Concept 34.6

Skill: Application/Analysis

- 93) If *Archaeopteryx* had air sacs, then which of its features would have had the opposite effect on enabling *Archaeopteryx* to fly long distances from that provided by air sacs?

- 1. teeth
- 2. contour feathers
- 3. wing claws
- 4. long tail with many vertebrae

- A) 1 and 2
- B) 1 and 4
- C) 2 and 3
- D) 1, 2, and 4
- E) 1, 3, and 4

Answer: E

Topic: Concept 34.6

Skill: Application/Analysis

- 94) Which feature of some carinates has the same effect on weight as the presence of air sacs?

- A) presence of a large, heavily keratinized beak
- B) absence of a urinary bladder
- C) presence of a carina (keel)
- D) number of chambers in the heart
- E) presence of large pectoral muscles

Answer: B

Topic: Concept 34.6

Skill: Knowledge/Comprehension

95) The movement of air along parabronchi is *most* similar to the movement of

- A) air in the lungs of other amniotes.
- B) food/waste in a gastrovascular cavity.
- C) food/waste in a digestive system with separate mouth and anus.
- D) the frog tongue during feeding.
- E) air in lungs of terrestrial amphibians.

Answer: C

Topic: Concepts 33.3, 34.6

Skill: Application/Analysis

96) Which type of bird is *most* likely to need air sacs to reduce its weight?

- A) birds that migrate long distances
- B) waterfowl that float on water, but do not dive
- C) birds that spend much of their time underwater
- D) ratites

Answer: A

Topic: Concept 34.6

Skill: Application/Analysis

97) The one-way flow of air along parabronchi makes what type of exchange mechanism possible, at least theoretically?

- A) the same as that occurring in fish gills
- B) the same as that occurring in insect tracheae
- C) the same as that occurring in mammalian lungs
- D) the same as that occurring in echinoderm skin gills

Answer: A

Topic: Concepts 33.4—34.6, 42.5

Skill: Synthesis/Evaluation

In the United States and Canada, bats use one of two strategies to survive winter: They either migrate south, or they hibernate. Recently, those that hibernate seem to have come under attack by a fungus, *Geomyces destructans* (Gd), an attack that is occurring from Missouri to southern Canada. Many infected bats have a delicate, white filamentous mat on their muzzles, which is referred to as white-nose syndrome (WNS). The fungus invades the bat tissues, causes discomfort, and awakens the bat from its hibernation. The bat fidgets and wastes calories, using up its stored fat. The bat then behaves abnormally, leaving its cave during daytime in winter to search for food. Their food, primarily insects, is scarce during the winter, and the bats ultimately starve to death. Since 2007, it is estimated that up to 1 million bats have perished from WNS.

98) The Gd mat on the fur of the bats should be expected to consist of

- A) hyphae.
- B) haustoria.
- C) arbuscules.
- D) yeasts.
- E) basidia.

Answer: A

Topic: Concepts 31.1, 34.7

Skill: Application/Analysis

99) Gd is a cold-loving fungus. Thus, which characteristics of normal bat behavior can be *most* expected to favor the growth of this fungus?

- A) southward migration during the winter
- B) communal roosting in tightly packed clusters during hibernation
- C) reliance on fat reserves for calories during hibernation
- D) much-reduced metabolic rate during hibernation
- E) hibernating in parts of the cave that are farthest away from the mouth of the cave

Answer: D

Topic: Concept 34.7

Skill: Application/Analysis

100) Gd is a cold-loving fungus. Thus, which characteristics of *abnormal* bat behavior can be *most* expected to favor the growth of this fungus?

- A) shifting roosting location to the mouth of the cave during winter
- B) searching for food during winter
- C) searching for food during the day
- D) All three of the options listed are correct.
- E) Only two of the options listed are correct.

Answer: D

Topic: Concept 34.7

Skill: Application/Analysis

101) Gd is a cold-loving fungus. Thus, which characteristics of normal bat behavior can be *most* expected to favor the spread of this fungus to uninfected bats?

- A) southward migration during the winter
- B) communal roosting in tightly packed clusters during hibernation
- C) reliance on fat reserves for calories during hibernation
- D) much-reduced metabolic rate during hibernation
- E) hibernating in parts of the cave that are farthest away from the mouth of the cave

Answer: B

Topic: Concept 34.7

Skill: Application/Analysis

102) Almost all North American bats are insectivores, with one notable exception being a bat that bites and then laps blood from the wound. The blood-lapping bats are limited to the warm, southwestern United States. Thus, if WNS continues to decimate bat populations in the United States and Canada, then we can expect

- A) livestock bites from vampire bats to increase in frequency.
- B) plant diseases that are spread by insects to increase in frequency.
- C) plant diseases directly caused by insect feeding to increase in frequency.
- D) human and livestock diseases that are spread by insects to increase in frequency.
- E) all but one of these are correct.

Answer: E

Topic: Concept 34.7

Skill: Application/Analysis

103) Which feature(s) allow(s) hibernating bats to conserve heat without using calories?

- A) shivering
- B) fur
- C) fat layer below the skin
- D) All three of the options listed are correct.
- E) Two of the options listed are correct.

Answer: E

Topic: Concept 34.7

Skill: Application/Analysis

#### End-of-Chapter Questions

The following questions are from the end-of-chapter “Test Your Understanding” section in Chapter 34 of the textbook.

104) Vertebrates and tunicates share

- A) jaws adapted for feeding.
- B) a high degree of cephalization.
- C) the formation of structures from the neural crest.
- D) an endoskeleton that includes a skull.
- E) a notochord and a dorsal, hollow nerve cord.

Answer: E

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

105) Some animals that lived 530 million years ago resembled lancelets but had a brain and a skull. These animals may represent

- A) the first chordates.
- B) a "missing link" between urochordates and cephalochordates.
- C) early craniates.
- D) marsupials.
- E) nontetrapod gnathostomes.

Answer: C

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

106) Which of the following could be considered the most recent common ancestor of living tetrapods?

- A) a sturdy-finned, shallow-water lobe-fin whose appendages had skeletal supports similar to those of terrestrial vertebrates
- B) an armored, jawed placoderm with two pairs of appendages
- C) an early ray-finned fish that developed bony skeletal supports in its paired fins
- D) a salamander that had legs supported by a bony skeleton but moved with the side-to-side bending typical of fishes
- E) an early terrestrial caecilian whose legless condition had evolved secondarily

Answer: A

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

107) Unlike eutherians, *both* monotremes and marsupials

- A) lack nipples.
- B) have some embryonic development outside the uterus.
- C) lay eggs.
- D) are found in Australia and Africa.
- E) include only insectivores and herbivores.

Answer: B

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

108) Which clade does *not* include humans?

- A) synapsids
- B) lobe-fins
- C) diapsids
- D) craniates
- E) osteichthyans

Answer: C

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

109) As hominins diverged from other primates, which of the following appeared first?

- A) reduced jawbones
- B) language
- C) bipedal locomotion
- D) the making of stone tools
- E) an enlarged brain

Answer: C

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension