CHAPTER 7

Structural Organisation in Animals

7.1 Animal Tissues

1. Cuboidal epithelium with brush border of microvilli is found in
(a) lining of intestine
(b) ducts of salivary glands
(c) proximal convoluted tubule of nephron
(d) Eustachian tube *(NEET 2020)*

2. Goblet cells of alimentary canal are modified from
(a) squamous epithelial cells
(b) columnar epithelial cells
(c) chondrocytes
(d) compound epithelial cells. *(NEET 2020)*

3. The ciliated epithelial cells are required to move particles or mucus in a specific direction. In humans, these cells are mainly present in
(a) bronchioles and Fallopian tubes
(b) bile duct and bronchioles
(c) Fallopian tubes and pancreatic duct
(d) Eustachian tube and salivary duct. *(NEET 2019)*

4. Match the following cell structure with its characteristic feature.

(A)	Tight junctions	(i)	Cement neighbouring cells together to form sheet
(B)	Adhering junctions	(ii)	Transmit information through chemical to another cells
(C)	Gap junctions	(iii)	Establish a barrier to prevent leakage of fluid across epithelial cells
(D)	Synaptic junctions	(iv)	Cytoplasmic channels to facilitate communication between adjacent cells

Select correct option from the following.

	(A)	(B)	(C)	(D)
(a)	(ii)	(iv)	(i)	(iii)
(b)	(iv)	(ii)	(i)	(iii)
(c)	(iii)	(i)	(iv)	(ii)
(d)	(iv)	(iii)	(i)	(ii)

(Odisha NEET 2019)

5. Smooth muscles are
(a) involuntary, fusiform, non-striated
(b) voluntary, multinucleate, cylindrical
(c) involuntary, cylindrical, striated
(d) voluntary, spindle-shaped, uninucleate.
(NEET-II 2016)

6. Which type of tissue correctly matches with its location?

	Tissue	Location
(a)	Transitional epithelium	Tip of nose
(b)	Cuboidal epithelium	Lining of stomach
(c)	Smooth muscle	Wall of intestine
(d)	Areolar tissue	Tendons

(NEET-I 2016)

7. The function of the gap junction is to
(a) separate two cells from each other
(b) stop substance from leaking across a tissue
(c) performing cementing to keep neighbouring cells together
(d) facilitate communication between adjoining cells by connecting the cytoplasm for rapid transfer of ions, small molecules and some large molecules.
(2015)

8. Choose the correctly matched pair.
(a) Tendon - Specialized connective tissue
(b) Adipose tissue - Dense connective tissue
(c) Areolar tissue - Loose connective tissue
(d) Cartilage - Loose connective tissue *(2014)*

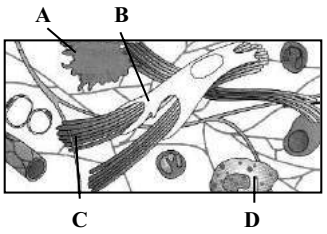
9. Choose the correctly matched pair.
(a) Inner lining of salivary ducts - Ciliated epithelium
(b) Moist surface of buccal cavity - Glandular epithelium
(c) Tubular parts of nephrons - Cuboidal epithelium
(d) Inner surface of bronchioles - Squamous epithelium
(2014)

10. Identify the tissue shown in the diagram and match with its characteristics and its location.
(a) Smooth muscles, show branching, found in the wall of the heart

(b) Cardiac muscles, unbranched muscles, found in the walls of the heart
(c) Striated muscles, tapering at both-ends, attached with the bones of the ribs
(d) Skeletal muscles show striations and are closely attached with the bones of the limbs

(Karnataka NEET 2013)

11. Given below is the diagrammatic sketch of a certain type of connective tissue. Identify the parts labelled A, B, C and D and select the right option about them.



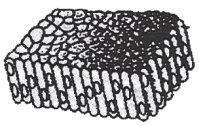
	A	B	C	D
(a)	Macrophage	Fibroblast	Collagen fibres	Mast cell
(b)	Mast cell	Macrophage	Fibroblast	Collagen fibres
(c)	Macrophage	Collagen fibres	Fibroblast	Mast cell
(d)	Mast cell	Collagen fibres	Fibroblast	Macro-phage

(Mains 2012)

12. The supportive skeletal structures in the human external ears and in the nose tip are examples of
(a) ligament (b) areolar tissue
(c) bone (d) cartilage.

(Mains 2012)

13. The four sketches (A, B, C and D) given below, represent four different types of animal tissues. Which one of these is correctly identified in the options given, along with its correct location and function?

(A) 
(B) 
(C) 
(D) 

	Tissue	Location	Function
(a)	(B) Glandular epithelium	Intestine	Secretion
(b)	(C) Collagen fibres	Cartilage	Attach skeletal muscles to bones
(c)	(D) Smooth muscle tissue	Heart	Heart contraction
(d)	(A) Columnar epithelium	Nephron	Secretion and absorption

(Mains 2012)

14. The ciliated columnar epithelial cells in humans are known to occur in
(a) Eustachian tube and stomach lining
(b) bronchioles and Fallopian tube
(c) bile duct and oesophagus
(d) Fallopian tube and urethra. *(2011)*

15. The cells lining the blood vessels belong to the category of
(a) smooth muscle tissue
(b) squamous epithelium
(c) columnar epithelium
(d) connective tissue. *(Mains 2011, 2010)*

16. Which one of the following is correct pairing of a body part and the kind of muscle tissue that moves it?
(a) Biceps of upper arm – Smooth muscle fibres
(b) Abdominal wall – Smooth muscle
(c) Iris – Involuntary smooth muscle
(d) Heart wall – Involuntary unstriated muscle

(2009)

17. The epithelial tissue present on the inner surface of bronchioles and Fallopian tubes is
(a) glandular (b) ciliated
(c) squamous (d) cuboidal. *(2009)*

18. The cell junctions called tight, adhering and gap junctions are found in
(a) connective tissue (b) epithelial tissue
(c) neural tissue (d) muscular tissue.

(2009)

19. The kind of tissue that forms the supportive structure in our pinna (external ears) is also found in
(a) nails (b) ear ossicles
(c) tip of the nose (d) vertebrae. *(2009)*

20. Which one of the following pairs of structures distinguishes a nerve cell from other types of cell?
(a) Vacuoles and fibres
(b) Flagellum and medullary sheath
(c) Nucleus and mitochondria
(d) Perikaryon and dendrites *(2007)*

21. In which one of the following preparations are you likely to come across cell junctions most frequently?
(a) Thrombocytes (b) Tendon
(c) Hyaline cartilage (d) Ciliated epithelium

(2007)

22. Areolar connective tissue joins
(a) bones with bones (b) fat body with muscles
(c) integument with muscles
(d) bones with muscles. *(2006)*

23. Mast cells secrete
(a) haemoglobin (b) hippurin
(c) myoglobin (d) histamine. *(2006)*

24. Four healthy people in their twenties got involved in injuries resulting in damage and death of few cells of the following. Which of the cells are least likely to be replaced by new cells?
(a) Liver cells (b) Neurons
(c) Malpighian layer of the skin
(d) Osteocytes *(2005)*

25. Mast cells of connective tissue contain
(a) vasopressin and relaxin
(b) heparin and histamine
(c) heparin and calcitonin
(d) serotonin and melanin. *(2004)*

26. Which one of the following contains the largest quantity of extracellular material?
(a) Striated muscle (b) Areolar tissue
(c) Stratified epithelium
(d) Myelinated nerve fibres *(2003)*

27. Collagen is
(a) fibrous protein (b) globular protein
(c) lipid (d) carbohydrate. *(2002)*

28. During an injury nasal septum gets damaged and for its recovery which cartilage is preferred?
(a) Elastic cartilage (b) Hyaline cartilage
(c) Calcified cartilage (d) Fibrous cartilage
(2001)

29. Which cells do not form layer and remains structurally separate?
(a) Epithelial cells (b) Muscle cells
(c) Nerve cells (d) Gland cells *(2001)*

30. Proteoglycan in cartilages which is a part of polysaccharide is
(a) chondroitin (b) ossein
(c) casein (d) cartilagin. *(2000)*

31. Characteristic of simple epithelium is that they
(a) are arranged indiscriminately
(b) make a definite layer
(c) continue to divide and help in organ function
(d) none of the above. *(2000)*

32. Ligament is a/an
(a) inelastic white fibrous tissue
(b) modified white fibrous tissue
(c) modified yellow elastic fibrous tissue
(d) none of the above. *(1999)*

33. Tendon is made up of
(a) yellow fibrous connective tissue
(b) modified white fibrous tissue
(c) areolar tissue
(d) adipose tissue. *(1999)*

34. In mammals, histamine is secreted by
(a) lymphocytes (b) mast cells
(c) fibroblasts (d) histiocytes. *(1998)*

35. Protein present in cartilage is
(a) cartilagin (b) ossein
(c) chondrin (d) none of these. *(1997)*

36. Basement membrane is made up of
(a) no cell product of epithelial cell
(b) epidermal cell only (c) endodermal cell
(d) both (b) and (c). *(1997)*

37. Stratum germinativum is an example of which kind of epithelium?
(a) Columnar (b) Squamous
(c) Cuboidal (d) Ciliated *(1997)*

38. An epithelial tissue which has thin flat cells, arranged edge to edge so as to appear like closely packed tiles, is found to be present at
(a) outer surface of ovary
(b) inner lining of Fallopian tube
(c) inner lining of stomach
(d) inner lining of cheeks. *(1994)*

39. Hair present in the skin are
(a) epidermal in origin and made of dead cells
(b) epidermal in origin and made of living cells
(c) dermal in origin and made of living cells
(d) dermal in origin and made of dead cells. *(1993)*

40. The layer of actively dividing cells of skin is termed as
(a) stratum compactum (b) stratum corneum
(c) stratum malpighii/stratum germinativum
(d) stratum lucidum. *(1993)*

41. Formation of cartilage bones involves
(a) deposition of bony matter by osteoblasts and resorption by chondroclasts
(b) deposition of bony matter by osteoclasts
(c) deposition of bony matter by osteoclasts only
(d) deposition of bony matter by osteoblasts only.
(1993)

42. Characteristics of smooth muscle fibres are
(a) spindle-shaped, unbranched, nonstriated, uninucleate and involuntary
(b) spindle-shaped, unbranched, unstriped, multinucleate and involuntary
(c) cylindrical, unbranched, unstriped, multinucleate and involuntary
(d) cylindrical, unbranched, striated, multinucleate and voluntary. *(1992)*

43. Haversian canals occur in
(a) humerus (b) pubis
(c) scapula (d) clavicle. *(1989)*

44. Histamine secreting cells are found in
(a) connective tissues (b) lungs
(c) muscular tissue (d) nervous tissue. *(1989)*

45. Mineral found in red pigment of vertebrate blood is
(a) magnesium (b) iron
(c) calcium (d) copper. *(1989)*

7.3 Earthworm

46. *Pheretima* and its close relatives derive nourishment from
(a) sugarcane roots
(b) decaying fallen leaves and soil organic matter
(c) soil insects
(d) small pieces of fresh fallen leaves of maize, etc. *(2012)*

47. One very special feature in the earthworm *(Pheretima)* is that
(a) fertilization of eggs occurs inside the body
(b) the typhlosole greatly increases the effective absorption area of the digested food in the intestine
(c) the S-shaped setae embedded in the integument are the defensive weapons used against the enemies
(d) it has a long dorsal tubular heart. *(2011)*

48. Which one of the following structures in *Pheretima* is correctly matched with its function?
(a) Clitellum - Secretes cocoon
(b) Gizzard - Absorbs digested food
(c) Setae - Defence against predators
(d) Typhlosole - Storage of extra nutrients *(Mains 2011)*

49. Consider the following four statements (A–D) related to the common frog *Rana tigrina*, and select the correct option stating which ones are true (T) and which ones are false (F).
Statements:
A. On dry land it would die due to lack of O_2 if its mouth is forcibly kept closed for a few days.
B. It has four-chambered heart.
C. On dry land it turns uricotelic from ureotelic.
D. Its life-history is carried out in pond water.

	A	B	C	D
(a)	T	F	F	T
(b)	T	T	F	F
(c)	F	F	T	T
(d)	F	T	T	F

(Mains 2011)

50. Which one of the following correctly describes the location of some body parts in the earthworm *Pheretima*?
(a) Four pairs of spermathecae in 4^{th}-7^{th} segments
(b) One pair of ovaries attached at intersegmental septum of 14^{th} and 15^{th} segments
(c) Two pairs of testes in 10^{th} and 11^{th} segments
(d) Two pairs of accessory glands in 16^{th}-18^{th} segments *(2009)*

51. If a live earthworm is pricked with a needle on its outer surface without damaging its gut, the fluid that comes out is
(a) coelomic fluid (b) haemolymph
(c) slimy mucus (d) excretory fluid. *(2009)*

52. Earthworms have no skeleton but during burrowing, the anterior end becomes turgid and acts as a hydraulic skeleton. It is due to
(a) gut peristalsis (b) setae
(c) coelomic fluid (d) blood. *(2008)*

53. Earthworms are
(a) ammonotelic when plenty of water is available
(b) ureotelic when plenty of water is available
(c) uricotelic when plenty of water is available
(d) uricotelic under conditions of water scarcity. *(2006)*

54. Primary function of enteronephric nephridia of *Pheretima* is
(a) osmoregulation
(b) excretion of nitrogenous wastes
(c) respiration (d) locomotion. *(2000)*

55. Earthworm possesses hearts
(a) 6 pairs (b) 4 pairs
(c) 2 pairs (d) 1. *(1991)*

56. Blood of *Pheretima* is
(a) blue with haemocyanin in corpuscles
(b) blue with haemocyanin in plasma
(c) red with haemoglobin in corpuscles
(d) red with haemoglobin in plasma. *(1990)*

57. *Pheretima posthuma* is highly useful as
(a) their burrows make the soil loose
(b) they make the soil porous, leave their castings and take organic debris in the soil
(c) they are used as fish meal
(d) they kill the birds due to biomagnification of chlorinated hydrocarbons. *(1990)*

58. Earthworms are
(a) useful (b) harmful
(c) more useful than harmful
(d) more harmful. *(1989)*

59. Photoreceptors of earthworm occur on
(a) clitellum (b) many eyes
(c) dorsal surface (d) lateral sides. *(1989)*

7.4 Cockroach

60. If the head of cockroach is removed, it may live for few days because
(a) the supra-oesophageal ganglia of the cockroach are situated in ventral part of abdomen
(b) the cockroach does not have nervous system

(c) the head holds a small proportion of a nervous system while the rest is situated along the ventral part of its body
(d) the head holds a 1/3rd of a nervous system while the rest is situated along the dorsal part of its body. *(NEET 2020)*

61. Select the correct sequence of organs in the alimentary canal of cockroach starting from mouth.
(a) Pharynx → Oesophagus → Ileum → Crop → Gizzard → Colon → Rectum
(b) Pharynx → Oesophagus → Crop → Gizzard → Ileum → Colon → Rectum
(c) Pharynx → Oesophagus → Gizzard → Crop → Ileum → Colon → Rectum
(d) Pharynx → Oesophagus → Gizzard → Ileum → Crop → Colon → Rectum *(NEET 2019)*

62. Which of the following features is used to identify a male cockroach from a female cockroach?
(a) Presence of a boat-shaped sternum on the 9th abdominal segment
(b) Presence of caudal styles
(c) Forewings with darker tegmina
(d) Presence of anal cerci *(NEET 2018)*

63. In male cockroaches, sperms are stored in which part of the reproductive system?
(a) Seminal vesicles (b) Mushroom glands
(c) Testes (d) Vas deferens *(NEET-II 2016)*

64. Which of the following features is not present in *Periplaneta americana*?
(a) Exoskeleton composed of N-acetylglucosamine
(b) Metamerically segmented body
(c) Schizocoelom as body cavity
(d) Indeterminate and radial cleavage during embryonic development *(NEET-I 2016)*

65. The body cells in cockroach discharge their nitrogenous waste in the haemolymph mainly in the form of
(a) urea (b) calcium carbonate
(c) ammonia (d) potassium urate. *(2015)*

66. The terga, sterna and pleura of cockroach body are joined by
(a) arthrodial membrane (b) cartilage
(c) cementing glue (d) muscular tissue. *(2015 Cancelled)*

67. What external changes are visible after the last moult of a cockroach nymph?
(a) Both forewings and hindwings develop
(b) Labium develops
(c) Mandibles become harder
(d) Anal cerci develop *(NEET 2013)*

68. Select the correct option with respect to cockroaches.
(a) Malpighian tubules convert nitrogenous wastes into urea.
(b) Males bear short anal styles not present in females.
(c) Nervous system comprises of a dorsal nerve cord and ten pairs of ganglia.
(d) The forewings are tegmina which are used in flight. *(Karnataka NEET 2013)*

69. Which one of the following is one of the paths followed by air or O_2 during respiration in the adult male *Periplaneta americana* as it enters the animal body?
(a) Spiracle in metathorax, trachea, tracheoles, oxygen diffuses into cells
(b) Mouth, bronchial tube, trachea, oxygen enters cells
(c) Spiracles in prothorax, tracheoles, trachea, oxygen diffuses into cells
(d) Hypopharynx, mouth, pharynx, trachea, tissues *(Karnataka NEET 2013)*

70. Select the correct statement from the ones given below with respect to *Periplaneta americana*.
(a) Nervous system located dorsally, consists of segmentally arranged ganglia joined by a pair of longitudinal connectives.
(b) Males bear a pair of short thread like anal styles.
(c) There are 16 very long Malpighian tubules present at the junctions of midgut and hindgut.
(d) Grinding of food is carried out only by the mouth parts. *(2012)*

71. Which of the following happens in the common cockroach?
(a) Malpighian tubules are excretory organs projecting out from the colon.
(b) Oxygen is transported by haemoglobin in blood.
(c) Nitrogenous excretory product is urea.
(d) The food is ground by mandibles and gizzard. *(2011)*

72. **Assertion (A) :** *Periplaneta americana* is nocturnal, omnivorous, household pest.
Reason (R) : It is because it acts as scavenger.
(a) A is true but R is false.
(b) A is false but R is true.
(c) Both A and R are true and R is correct explanation of A.
(d) Both A and R are true but R is not correct explanation of A. *(1992)*

73. Male and female cockroaches can be distinguished externally through
(a) anal styles in male (b) anal cerci in female
(c) anal style and antennae in females
(d) both (b) and (c). *(1991)*

7.5 Frog

74. Select the correct route for the passage of sperms in male frogs.

(a) Testes → Vasa efferentia → Kidney → Seminal vesicle → Urinogenital duct → Cloaca
(b) Testes → Vasa efferentia → Bidder's canal → Ureter → Cloaca
(c) Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca
(d) Testes → Bidder's canal → Kidney → Vasa efferentia → Urinogenital duct → Cloaca
(NEET 2017)

75. Frog's heart when taken out of the body continues to beat for sometime.
Select the best option from the following statements.
(1) Frog is a poikilotherm.
(2) Frog does not have any coronary circulation.
(3) Heart is "myogenic" in nature.
(4) Heart is autoexcitable.
(a) Only (4) (b) (1) and (2)
(c) (3) and (4) (d) Only (3) *(NEET 2017)*

76. Compared to those of humans, the erythrocytes in frog are
(a) without nucleus but with haemoglobin
(b) nucleated and with haemoglobin
(c) very much smaller and fewer
(d) nucleated and without haemoglobin. *(2012)*

77. Frogs differ from humans in possessing
(a) paired cerebral hemispheres
(b) hepatic portal system
(c) nucleated red blood cells
(d) thyroid as well as parathyroid. *(Mains 2011)*

78. Ureters act as urinogenital ducts in
(a) human males (b) human females
(c) both male and female frogs
(d) male frogs. *(Mains 2011)*

79. Which one of the following is the true description about an animal concerned?
(a) Rat - Left kidney is slightly higher in position than the right one
(b) Cockroach - 10 pairs of spiracles (2 pairs on thorax and 8 pairs on abdomen)
(c) Earthworm - The alimentary canal consists of a sequence of pharynx, oesophagus, stomach, gizzard and intestine
(d) Frog - Body divisible into three regions - head, neck and trunk *(2008)*

80. What happens if bone of frog is kept in dilute hydrochloric acid?
(a) Will become flexible (b) Will turn black
(c) Will break into pieces (d) Will shrink *(2000)*

81. The roof of the cranium of frog is formed by
(a) frontoparietal (b) orbitosphenoid
(c) parasphenoid (d) alisphenoid. *(1997)*

82. In frog, the surface of attachment of tongue is
(a) pterygoid (b) hyoid apparatus
(c) parasphenoid (d) palatine. *(1997)*

83. In frog, "fenestra ovalis" is
(a) the communication between the pharynx and the tympanic cavity
(b) the external opening of the tympanic cavity which is covered by the tympanic membrane
(c) the air filled cavity of the middle ear
(d) the opening in the auditory capsule which separates the middle ear from the internal ear. *(1997)*

84. The kidney of an adult frog is
(a) metanephros (b) opisthonephros
(c) pronephros (d) mesonephros. *(1997)*

85. Mucus helps frog in forming
(a) thick skin (b) dry skin
(c) smooth skin (d) moist skin. *(1993)*

86. Bullfrog of India is
(a) *Rana tigrina* (b) *R. sylvatica*
(c) *R. catesbeiana* (d) *R. esculenta.* *(1992)*

87. Addition of a trace of thyroxine or iodine in water containing tadpoles will
(a) keep them in larval stage
(b) hasten their metamorphosis
(c) slow down their metamorphosis
(d) kill the tadpoles. *(1990)*

ANSWER KEY

1.	(c)	**2.**	(b)	**3.**	(a)	**4.**	(c)	**5.**	(a)	**6.**	(c)	**7.**	(d)	**8.**	(c)	**9.**	(c)	**10.**	(d)
11.	(a)	**12.**	(d)	**13.**	(a)	**14.**	(b)	**15.**	(b)	**16.**	(b,c)	**17.**	(b)	**18.**	(b)	**19.**	(c)	**20.**	(d)
21.	(d)	**22.**	(c)	**23.**	(d)	**24.**	(b)	**25.**	(b)	**26.**	(b)	**27.**	(a)	**28.**	(b)	**29.**	(c)	**30.**	(a)
31.	(b)	**32.**	(c)	**33.**	(b)	**34.**	(b)	**35.**	(c)	**36.**	(a)	**37.**	(a)	**38.**	(d)	**39.**	(a)	**40.**	(c)
41.	(a)	**42.**	(a)	**43.**	(a)	**44.**	(a)	**45.**	(b)	**46.**	(b)	**47.**	(b)	**48.**	(b)	**49.**	(*)	**50.**	(c)
51.	(a)	**52.**	(c)	**53.**	(a)	**54.**	(a)	**55.**	(b)	**56.**	(d)	**57.**	(b)	**58.**	(a)	**59.**	(c)	**60.**	(c)
61.	(b)	**62.**	(b)	**63.**	(a)	**64.**	(d)	**65.**	(d)	**66.**	(a)	**67.**	(a)	**68.**	(b)	**69.**	(a)	**70.**	(b)
71.	(d)	**72.**	(d)	**73.**	(a)	**74.**	(c)	**75.**	(c)	**76.**	(b)	**77.**	(c)	**78.**	(d)	**79.**	(b)	**80.**	(a)
81.	(a)	**82.**	(b)	**83.**	(c)	**84.**	(d)	**85.**	(d)	**86.**	(a)	**87.**	(b)						

*None of the options is correct.

Hints & Explanations

1. (c) : The cuboidal epithelium is composed of a single layer of cube-like cells which is commonly found in ducts of glands and tubular parts of nephrons in kidneys and its main functions are secretion and absorption. The epithelium of proximal convoluted tubule (PCT) of nephron in the kidney has microvilli.

2. (b) : Certain cells of columnar epithelial cells contain muscles and are called goblet cells as they look like goblet. Such cells are present in alimentary canal.

3. (a) **4. (c)**

5. (a) : Smooth muscle fibres are elongated and spindle shaped (fusiform). Each fibre contains a single oval nucleus surrounded by cytoplasm (sarcoplasm). In cytoplasm, myofibrils are arranged longitudinally. These fibres lack striations and sarcolemma. However, are enclosed by plasma membrane.

6. (c) : Tip of nose has elastic cartilage. Simple columnar epithelium lines the stomach. Tendon is white fibrous connective tissue. Posterior part of intestine has single unit smooth muscle in which all fibres of muscle contract simultaneously as single unit.

7. (d) : Most cells in animal tissues (with the exception of a few terminally differentiated cells such as skeletal muscle cells and blood cells) are in communication with their adjoining cells *via* gap junctions. At the place where gap junction is present, membranes of two adjacent cells are separated by a uniform narrow gap of about 2-4 nm. The gap is spanned by channel forming proteins called connexins, which allow inorganic ions and other small water soluble molecules to pass directly from cytoplasm of one cell to cytoplasm of other cell.

8. (c) : Areolar tissue is the most widely distributed loose connective tissue in the body. Tendon is a type of dense connective tissue, adipose tissue is a fat-storing loose connective tissue and cartilage is a specialised connective tissue.

9. (c) :

Inner lining of salivary ducts	– Simple cuboidal epithelium
Moist surface of buccal cavity	– Non-keratinized stratified squamous epithelium
Inner surface of bronchioles	– Ciliated columnar epithelium

10. (d) : Locomotion (performed by limbs) in humans depends on the movements of muscle fibres. Skeletal muscles are attached to the bones by tendons and help in the movement of the parts of skeleton. These muscles are under the control of conscious mind and are called voluntary muscles. Under the microscope, these muscles show transverse stripes and hence are designated as striated muscles.

11. (a)

12. (d) : Cartilage is a semi-rigid supportive or skeletal connective tissue in which matrix is solid and made of mucoprotein or proteoglycan called chondrin. It is of four types - hyaline, fibrous, calcified and elastic. Yellow elastic fibrocartilage is found in pinna and external auditory canal of the ear, Eustachian tube, epiglottis and tip of the nose. Its matrix contains numerous yellow fibres which form a network by uniting with one another. Due to the presence of yellow fibres, the cartilage becomes more flexible. Hence, it provides flexibility to these organs.

13. (a) : Intestine is lined by glandular epithelium which is secretory in function. The glands found in intestine are exocrine and may be unicellular or multicellular. When unicellular glands secrete mucus, they are called mucous cells or goblet cells and are common in the columnar epithelium of intestine. When unicellular glands secrete a clear watery fluid, they are called serous cells which are also present in intestinal glands. On the other hand, multicellular glands consist of a duct and secretory portion, both formed of epithelial cells. They are further of two types: tubular and saccular. In tubular glands secretory portion is tube like, for example, Crypts of Lieberkuhn (a type of simple straight tubular glands found in intestine) and Brunner's gland (a type of simple branched tubular glands found in intestine).

14. (b) : The ciliated columnar epithelial cells in humans are present in the nasal passages, oviducts (Fallopian tubes), terminal bronchioles, ventricles of the brain and central canal of the spinal cord of the embryo. Columnar ciliated epithelium consists of columnar cells, which bear cilia on the free surface.

15. (b) : Simple squamous epithelium is composed of large flat cells whose edges fit closely together like the tiles in a floor, hence it is also called pavement epithelium. The nuclei of the cells are flattened and often lie at the centre of the cells and cause bulgings of cells surface. The epithelium lines the blood vessels, lymph vessels, heart, terminal bronchioles, alveoli of the lungs, walls of the Bowman's capsules, descending limbs of loop of Henle. In the blood vessels and heart it is called endothelium.

16. (b, c) : Smooth muscles are called as involuntary muscles as action of these muscles is controlled by autonomic nervous system *i.e.,* not under the control of animal's will. Iris of eyes consist of smooth involuntary muscles. Abdominal wall also have smooth muscles. Biceps of upper arm is made of skeletal muscles while heart wall consists of cardiac muscles.

17. (b) : The ciliated columnar epithelial cells in humans are present in the nasal passages, oviducts (Fallopian tubes) terminal bronchioles, ventricles of the brain and

central canal of the spinal cord of the embryo. Columnar ciliated epithelium consists of columnar cells, which bear cilia on the free surface.

18. (b) : Epithelial tissues consist of variously shaped cells closely arranged in one or more layers. The cells are held together by intercellular junctions like tight, adhering and gap junctions.

19. (c) : Yellow elastic fibrocartilage, a type of skeletal tissue, is found in the pinna, Eustachian tubes, epiglottis and tip of the nose. It is a type of cartilage and due to presence of yellow fibres, it becomes more flexible.

20. (d) : Neuron (nerve cell) is one of the basic functional units of the nervous system. Neuron is a cell specialized to transmit electrical nerve impulse and so carry information from one part of the body to another. Each neuron has an enlarged portion, the cell body (perikaryon), containing the nucleus; from the body extend several processes (dendrites) through which impulses enter from their branches. A longer process, the nerve fibre, extends outward and carries impulses away from the cell body. This is normally unbranched except at the nerve ending. The point of contact of one neuron with another is known as a synapse.

21. (d) : Cell junctions come across most frequently in the preparation of ciliated epithelium. A cell junction is a structure within a tissue of a multicellular organism. They consist of protein complexes and provide contact between neighbouring cells, between a cell and the extracellular matrix, or they built up the paracellular barrier of epithelia and control the paracellular transport.

22. (c) : Areolar tissue is a loose connective tissue comprised of a semifluid ground substance containing several kinds of loosely arranged fibres. Its function is to attach the skin to the underlying tissues, to fill the spaces between various organs and thus holds them in place, and surrounds and supports the blood vessels.

23. (d) : Mast cells are granulated wandering cells that are found in connective tissue. Their granules contain histamine which is a vasodilator. It causes running nose, sneezing and itching; and narrows the airways in the lungs. Their granules also contain heparin which is an anticoagulant and serotonin which acts as a mediator of inflammation and allergic reactions.

24. (b) : Neurons are least likely to be replaced by new cells as they have least regeneration power.

25. (b) : *Refer to answer 23.*

26. (b) : In areolar tissue, there is more intercellular space, so largest quantity of extracellular material is present in this tissue. It contains all cell types and fibres of connective tissue. There is a thin layer of extracellular fluid in stratified epithelium whereas striated muscle is attached with tendons and there is very less amount of extracellular fluid in myelinated nerve fibre.

27. (a) : Collagen is an insoluble fibrous protein found extensively in the connective tissue of skin, tendons and bone. Collagen accounts for over 30% of the total body protein of mammals. Globular proteins have compact rounded molecules and are usually water soluble. Lipid is a diverse group of organic compounds, that are insoluble in water but soluble in organic solvents. Carbohydrates are compounds of carbon, hydrogen and oxygen.

28. (b) : Nasal septum consists of hyaline cartilage. It is bluish-green and translucent in appearance. It has fewer very fine white fibres in the matrix. This type of cartilage gives flexibility and support at the joints. Elastic, calcified and fibrous cartilages occur in other parts of body.

29. (c) : Nerve cells are the highly excitable cells, specialized for impulse conduction. They originate from neural plate of embryonic ectoderm and serve as structural and functional units of nervous tissue.

30. (a) : Proteoglycans consist of polysaccharide attached with a protein chondroitin. It is present in cartilage as well as in extracellular material. Ossein is a protein present in matrix of bone. Casein is a milk protein.

31. (b) : Simple epithelium consists of a single layer of cells resting on a basement membrane. This makes a definite layer.

32. (c) : Ligament occurs in the form of cords in a modified yellow elastic fibrous tissue and connects bone with a bone. Modified white fibrous tissue is present in the tendons.

33. (b) : White fibrous tissue has two forms : cords and sheets. The white fibres run parallel to form cords, called tendons. Tendon attaches a muscle to a bone. It consists of collagen fibres and are therefore inelastic. They ensure that the force exerted by muscular contraction is transmitted to the relevant part of the body to be moved.

34. (b) : *Refer to answer 23.*

35. (c) : Chondrin is a protein present in the matrix of cartilage. It forms a constituent of a compound called chondrin sulphate. Chondrin sulphate consists of proteoglycans, that is protein chains bonded to long chains of disaccharide hyaluronic acid.

36. (a) : Basement membrane (basal lamina) is a thin sheet of fibrous proteins that underlies and supports the cells of an epithelium, separating this from underlying tissue. Basement membranes are components of the extracellular matrix (= the viscous watery fluid that surrounds cells in animal tissue) and help to regulate passage of materials between epithelial cells and adjacent blood vessels. Each consists of a framework of collagen fibrils within which are glycosaminoglycans (mucopolysaccharides) and laminins, which are proteins that bind the basement membrane to neighbouring cells *via* cell adhesion molecules.

37. (a) : Stratum germinativum (also stratum basale or basal cell layer) is the layer of keratinocytes that lies at

the base of the epidermis immediately above the dermis. It consists of a single layer of tall, simple columnar epithelial cells lying on a basement membrane. These cells undergo rapid cell division, mitosis to replenish the regular loss of skin by shedding from the surface. About 25% of the cells are melanocytes, which produce melanin which provides pigmentation for skin and hair.

38. (d) : An epithelial tissue which has thin flat cells, arranged edge to edge so as to appear like closely packed tiles is known as pseudostratified epithelium. It covers moist surfaces where there is little wear and tear by friction such as inner lining of cheeks.

39. (a) : Each hair is present in a tubular pit called hair follicle which is made up by sinking of epidermis. Living cells are present only at the base of hair *i.e.* in hair papilla, rest of the hair is dead and is divisible into outer cuticle, middle cortex and inner medulla.

40. (c) : Stratum malpighii/stratum germinativum is the innermost layer of the skin consisting of one celled thick columnar epithelial cells. It lies on the basement layer. Its cells are active and continuously produce new cells by mitotic division that is why called germinative layer.

41. (a) : Bone is an unusual tissue in that it is continually being reconstructed. The osteoblasts secrete bone matrix, whereas the large, much branched, motile, lysosome-rich, multinucleate cells, called osteoclasts, destroy bone matrix. The twin process of resorption and reconstruction enables a particular bone to remodel its structure to meet any change in the mechanical requirements of the animal during its development.

42. (a)

43. (a) : Long bones, such as the humerus and femur, have a cavity, the marrow cavity, at the centre. The substance of the bone is distinguishable into 3 regions : periosteum, matrix and endosteum. The matrix of bone along with the bone forming cells (osteoblasts) is arranged in concentric layers (lamellae) round the small canals which run parallel to the long axis (shaft) of the bone. These canals, called Haversian canals, are interconnected with one another *via* Volkmann's canals and contain a blood vessel, a nerve and a lymph vessel.

44. (a) : Mast cells are found in the matrix of areolar connective tissue and secrete histamine (vasodilator), serotonin (vasoconstrictor) and heparin (anticoagulant). These take part in allergic reactions and also help in a body defence.

45. (b) : Red pigment of vertebrate blood is haemoglobin. Haemoglobin is a conjugated protein. It consists of a basic protein globin joined to a nonprotein group heme, hence the name haemoglobin. Heme is an iron-porphyrin ring. A mammalian haemoglobin molecule is a complex of 4 heme molecules joined with 4 globin molecules.

46. (b) : *Pheretima* (earthworm) and related organisms feed upon the decaying organic matter found in the soil. They also feed on the bits of plants and animal matter. Thus, they are omnivorous.

47. (b) : In *Pheretima*, next to stomach is the intestine. It is a long, wide and thin walled tube extending from 15th segment to the last. Second or middle part of the intestine lies between 27^{th} segment upto 23–25 segments in front of anus. This is characterised by the presence of a highly glandular and vascular longitudinal ridge, arising as a median in-growth of the dorsal aspect of the intestinal cavity. This is called the typhlosole. The typhlosole greatly increases the effective absorption area of the digested food in the intestine.

48. (a) : In a mature earthworm, segments 14^{th} - 16^{th} are covered by a prominent dark band of glandular tissues called clitellum which secretes cocoon where fertilization and development takes place. In alimentary canal, muscular gizzard (8^{th} - 9^{th} segments) helps in grinding the soil particles and decaying leaves, etc. The characteristic feature of the intestine between 26^{th} - 35^{th} segments is the presence of internal median fold of dorsal wall called typhlosole. This increases the effective area of absorption in the intestine. In each body segment, except the first, last and clitellum, there are rows of S-shaped setae, embedded in the epidermal pits in the middle of each segment. Setae can be extended or retracted. Their principal role is in locomotion.

49. None of the options is correct.

Frog respires in three different manners; cutaneous or skin respiration; buccopharyngeal respiration; pulmonary or lung respiration. Lungs are poorly developed in frog, the inadequate supply of O_2 obtained through lungs is supplemented through moist skin and buccal cavity. Hence, first statement is false. Heart of frog has three chambers, two atria and one ventricle. Hence, second statement is false. The frog excretes urea and thus is a ureotelic animal. The elimination of nitrogenous wastes is carried out by a well developed excretory system. The excretory system consists of a pair of kidneys, ureters, cloaca and urinary bladder. Frog do not change into uricotelic animal in any condition. Hence, third statement is false. In frog, fertilization is external and takes place in water. Within two weeks, fertilized eggs or zygotes develop into free-swimming aquatic larvae, called tadpoles, which undergo metamorphosis to become adult terrestrial frogs.

50. (c) : In *Pheretima*, two pairs of testis sac are situated in the tenth and eleventh segments. Each testis sac of the tenth segment encloses a testis and a seminal funnel. Each testis sac of the eleventh segment encloses a testis, a seminal vesicle and a seminal funnel.

51. (a) : Coelom or body cavity of earthworm is filled with coelomic fluid. It lies between body wall and alimentary canal. So if a live earthworm is pricked with a needle on its outer surface without damaging the gut then only coelomic fluid will come out.

52. (c) : Hydraulic skeleton is the system of support found in soft bodied invertebrates, which relies on the incompressibility of fluids contained within the body cavity. In earthworms the coelomic fluid is under pressure within the coelom and therefore provides support for internal organs. Due to hydraulic skeleton, during burrowing, the anterior end becomes turgid and aids in relaxation of longitudinal muscles.

53. (a) : Earthworm has excretory organ called nephridia. Ammonia is the chief excretory waste when water is available and hence it is ammonotelic in water and terrestrial earthworm is ureotelic.

54. (a) : Pharyngeal nephridia and septal nephridia are enteronephric as they discharge excretory matter into the gut. Discharge of waste matter *via* gut is an adaptation to conserve water by its reabsorption in the gut. Integumentary nephridia are exonephric, as they discharge waste matter to the exterior.

55. (b) : In each of the segments 7, 9, 12 and 13 is found a pair of large, thick, muscular and rhythmically contractile vertical vessels, called hearts. They pump blood from dorsal to ventral vessel, while flow in opposite direction is prevented by internal valves. Hearts of 7^{th} and 9^{th} segments connect dorsal and ventral vessels only and are called lateral hearts. Those of 12^{th} and 13^{th} segments connect both dorsal and supra-oesophageal vessels with ventral vessel, and are designated as latero-oesophageal hearts.

56. (d) : Circulatory or blood vascular system of earthworm is a closed system consisting of blood vessels and capillaries which ramify to all parts of the body. Blood is composed of a fluid plasma and colourless corpuscles, physiologically comparable to the leucocytes of the vertebrates. The red respiratory pigment, haemoglobin (or erythrocruorin) occurs dissolved in plasma. It gives a red colour to blood and aids in the transportation of oxygen for respiration.

57. (b) : *Pheretima posthuma* is highly useful and beneficial in agriculture. Its habit of burrowing and swallowing earth makes it porous and increases the soil fertility in many ways. Their burrows permit penetration of air and moisture in porous soil and their excretory wastes and other secretions also enrich soil by adding nitrogenous matters to the soil.

Pheretima posthuma is not used as fish meal. Whereas a small white earthworm (*Enchytraeus albidus*) is often grown in soil and used to feed aquarium fish.

58. (a) : Earthworms are very useful. All over the world they are used as bait for fishing. Earthworms are in general beneficial to agriculture. Their habit of burrowing and swallowing earth increases fertility of soil in many ways. Their burrows permit penetration of air and moisture in porous soil, improve drainage and make easier the downward growth of roots. Excretory wastes and other secretions of worms also enrich soil by adding nitrogenous matters that form important plant food. Earthworms were used variously as medicines in the past. Earthworms were used to cure stones in bladder, yellowness of jaundice, pyorrhoea, piles, rheumatism or gout, diarrhoea. Earthworms are easily obtained and are of convenient size for dissections. They are, therefore, universally employed for class studies and for investigations in general and comparative physiology.

59. (c) : Photoreceptors restricted only to dorsal surface, are more numerous on prostomium and peristomium of earthworm and gradually reduce in number towards posterior end of body. They are totally absent in clitellum. Each photoreceptor consists of a single ovoid cell, with a nucleus and clear cytoplasm containing a network of neurofibrillae and a small transparent L-shaped lens or optic organelle or phaosome, made up of a hyaline substance. Photoreceptors enable worms to judge the intensity and duration of light.

60. (c) : The head holds a bit of a nervous system of cockroach while the rest is situated along the ventral (belly-side) part of its body. So, if the head of a cockroach is cut off, it will still live for as long as one week.

61. (b)

62. (b) : Male cockroach bears a pair of short thread-like anal/caudal styles which are absent in females. They project backwardly from the sides of 9^{th} abdominal segment in male cockroach.

63. (a) : Seminal vesicles are numerous small sacs present on ventral surface of anterior part of the ejaculatory duct which store sperms.

64. (d) : In insect, cleavage is superficial.

65. (d) : In cockroach, Malpighian tubules extract metabolic wastes like potassium and sodium urate, water and carbon dioxide from the blood. In the Malpighian tubules bicarbonates of potassium and sodium, water and uric acid are formed. A large amount of water and bicarbonates of potassium and sodium are reabsorbed by the cells of Malpighian tubules and then transferred to the blood (haemolymph). Uric acid is carried to the alimentary canal of the insect and is finally passed out through anus.

66. (a) : Arthrodial membrane is a tough, flexible cuticle that joins the skeletal elements of cockroach and other arthropods. It connects terga, pleura and sterna of cockroach body.

67. (a) : Cockroach undergoes paurometabolous development. The nymph moults about 6-7 times to reach the adult form. The next to last nymphal stage has wing pads but only adult cockroaches have wings.

68. (b) : Malpighian tubules are the main excretory structures in cockroach. They extract nitrogenous wastes and water from haemolymph and reabsorb certain salts resulting in precipitation of uric acid. So, cockroach is uricotelic. Males have paired anal styles on 9^{th} abdominal sternite which are absent in females.

69. (a) : The respiratory system is well developed in a cockroach in order to compensate the poorly developed

circulatory system. It consists of tracheae, tracheoles and spiracles. The main tracheal trunks open to the exterior on body surface through 10 pairs of segmentally arranged apertures termed spiracles or stigmata. Two pairs of spiracles are thoracic, one between pro and mesothorax and the other between meso and metathorax. Haemocoel contains a network of elastic, closed and branching air tubes or tracheae. The ultimate finer branches of tracheae are called tracheoles which come in contact with the individual body cells. The elaborate tracheal system carries oxygen directly to all the body cells.

70. (b) : The posterior segment of cockroaches bear appendages named as anal cerci. These are found in both male and female. But male cockroach can be distinguished by female ones by the presence of an extra pair of accessory appendages named as anal styles. It assists during copulation.

71. (d) : Mouth part of cockroach contains two mandibles, which bear teeth. When both the mandibles work simultaneously in a horizontal plane, the food matter is cut and masticated into fine and smaller pieces. Gizzard is a part of alimentary canal. It bears six muscular folds which are covered by chitinous conical plates, the teeth, used for grinding the food.

72. (d) : Cockroaches are found in places where there is warmth, dampness and plenty of organic food to devour. Indoors, they are a common pest in kitchens, latrines, hotels, restaurants, godowns, storerooms, board ships, etc. Cockroaches are nocturnal creatures. During daytime, they remain inactive and hiding. During night, they show much activity and run here and there in search of food. Being omnivorous and scavengerous in diet, they devour any animal or vegetable substance etc., causing great loss.

73. (a) : In male cockroach, 9th sternum bears a pair of short, unjointed thread-like anal styles which are absent in female. Anal cerci and antennae are present in both male and female cockroaches.

74. (c) : The correct route for transport of sperms in male frog is

Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca.

75. (c) : Frog's heart is myogenic, *i.e.*, heartbeat originates from muscles of heart. Hence, it is autorhythmic. Wave of contraction originates from sinus venosus and spreads to wall of sinus venosus and both auricles. This compels the heart to beat. Due to this reason, frog's heart will continue to beat as long as it gets supply of ATP.

76. (b) : Human erythrocytes are enucleated, discoidal while in frogs erythrocytes are large, oval and biconvex nucleated cells. Erythrocytes are the carriers of haemoglobin.

77. (c) : *Refer to answer 76.*

78. (d) : In male frogs, two ureters act as urinogenital duct which open into the cloaca. They run backwards from the kidneys and open into the cloaca. In female ureters carry urine alone, while in male both sperms and urine are carried. Hence, are called urinogenital ducts.

79. (b) : There are 10 pairs of spiracles in cockroach. Two pairs are thoracic in which first pair is known as mesothoracic, lying infront of the mesothorax between the bases of first and second pair of legs and are the largest. The second pair is called metathoracic. Abdominal spiracles are eight pairs. The first pair is dorsal in position and lies on the lateral margins of the first abdominal tergum. The remaining are situated on the sides of their corresponding segments on the pleura between the terga and sterna.

80. (a) : Main component of bone is collagen which is a complex combination of amino acids. When frog's bone is treated with HCl, these compounds are broken down and the bone becomes flexible.

81. (a) : Fronto-parietals are a pair of long, broad, flattened and membranous bones. They are united along the mid-dorsal line and form the whole roof of cranium. In larval frog, each fronto-parietal occurs into separate frontal and parietal parts, but in adult frog, they become fused to form a single frontoparietal. The entire floor of cranium is covered and strengthened by a large parasphenoid bone.

82. (b) : In adult frog, gills disappear and their skeletal framework is also reduced to form hyoid apparatus. It lies below tongue in the floor of mouth and provides surface of attachment to the tongue.

83. (c) : The bony partition between tympanic cavity (cavity of middle ear) and auditory capsule (internal ear) is perforated by a small window-like oval aperture, the fenestra ovalis, which remains closed by a membrane and a cartilaginous nodule, the stapedial plate.

84. (d) : Mesonephros kidney is present in both adult as well as embryo of frog. A mesonephros develops from the middle part of intermediate mesoderm, posterior to each pronephros soon after its degeneration.

85. (d) : Mucus helps frog in forming moist skin as skin is its respiratory organ.

86. (a) : The common Indian bull frog *Rana tigrina* lives in or near permanent freshwater lakes, ponds and streams. It lives in the water most of the time. It lives near water mainly for two reasons : (i) To keep skin moist to carry on cutaneous respiration and (ii) To immediately jump or slip into water to escape from enemies.

87. (b) : In 1912, Gudernatsch discovered that metamorphosis in frog's tadpole is increased by the thyroxine hormone which has the iodine as the main constituent. If thyroxine or iodine is added in water having tadpoles in it, then it increases the rate of metamorphosis in tadpole.

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