CHAPTER 16

Digestion and Absorption

16.1 Digestive System

1. Identify the correct statement with reference to human digestive system.
(a) Ileum opens into small intestine.
(b) Serosa is the innermost layer of the alimentary canal.
(c) IIeum is a highly coiled part.
(d) Vermiform appendix arises from duodenum.
(NEET 2020)

2. Match the following structures with their respective location in organs.

(A) Crypts of Lieberkuhn	(i) Pancreas
(B) Glisson's Capsule	(ii) Duodenum
(C) Islets of Langerhans	(iii) Small intestine
(D) Brunner's Glands	(iv) Liver

Select the correct option from the following:

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

(NEET 2019)

3. Which of the following terms describes human dentition?
(a) Thecodont, Diphyodont, Homodont
(b) Thecodont, Diphyodont, Heterodont
(c) Pleurodont, Monophyodont, Homodont
(d) Pleurodont, Diphyodont, Heterodont
(NEET 2018)

4. A baby boy aged two years is admitted to play school and passes through a dental check-up. The dentist observed that the boy had twenty teeth. Which teeth were absent?
(a) Canines (b) Pre-molars
(c) Molars (d) Incisors *(NEET 2017)*

5. Which cells of 'Crypts of Lieberkuhn' secrete antibacterial lysozyme?
(a) Paneth cells (b) Zymogen cells
(c) Kupffer cells (d) Argentaffin cells
(NEET 2017)

6. Which hormones do stimulate the production of pancreatic juice and bicarbonate?
(a) Angiotensin and epinephrine
(b) Gastrin and insulin
(c) Cholecystokinin and secretin
(d) Insulin and glucagon *(NEET-II 2016)*

7. Which of the following guards the opening of hepatopancreatic duct into the duodenum?
(a) Pyloric sphincter (b) Sphincter of Oddi
(c) Semilunar valve (d) Ileocaecal valve
(NEET-I 2016)

8. The primary dentition in human differs from permanent dentition in not having one of the following type of teeth.
(a) Molars (b) Incisors
(c) Canines (d) Premolars *(2015)*

9. Where do certain symbiotic microorganisms normally occur in human body?
(a) Caecum
(b) Oral lining and tongue surface
(c) Vermiform appendix and rectum
(d) Duodenum *(Mains 2012)*

10. For its activity, carboxypeptidase requires
(a) zinc (b) iron
(c) niacin (d) copper.
(Mains 2012)

11. One of the constituents of the pancreatic juice which is poured into the duodenum in humans is
(a) trypsinogen (b) chymotrypsin
(c) trypsin (d) enterokinase.
(Mains 2011)

12. Which one of the following correctly represents the normal adult human dental formula?
(a) $\frac{3}{3}, \frac{1}{1}, \frac{3}{2}, \frac{1}{1}$ (b) $\frac{2}{2}, \frac{1}{1}, \frac{3}{2}, \frac{3}{3}$
(c) $\frac{2}{2}, \frac{1}{1}, \frac{2}{2}, \frac{3}{3}$ (d) $\frac{3}{3}, \frac{1}{1}, \frac{3}{3}, \frac{3}{3}$
(Mains 2011)

13. Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of
(a) epiglottis (b) diaphragm
(c) neck (d) tongue. *(2011)*

14. Secretin and cholecystokinin are digestive hormones. They are secreted in
(a) pyloric stomach (b) duodenum
(c) ileum (d) oesophagus. *(2005)*

15. Duodenum has characteristic Brunner's gland which secrete two hormones called
(a) kinase, estrogen
(b) secretin, cholecystokinin
(c) prolactin, parathormone
(d) estradiol, progesterone. *(2004)*

16. Which part of body secretes the hormone secretin?
(a) Stomach (b) Oesophagus
(c) Ileum (d) Duodenum *(1999)*

17. Brunner's glands are present in
(a) stomach (b) oesophagus
(c) ileum (d) duodenum. *(1999)*

18. The layer of cells that secrete enamel of tooth is
(a) osteoblast (b) odontoblast
(c) dentoblast (d) ameloblast. *(1998)*

19. Which one of the factors are required for the maturation of erythrocytes ?
(a) Vitamin B_{12} (b) Vitamin C
(c) Vitamin D (d) Vitamin A *(1998)*

20. In vertebrates, lacteals are found in
(a) oesophagus (b) ear
(c) ileum (d) ischium. *(1998)*

21. Which one of the following vitamins can be synthesized by bacteria inside the gut?
(a) D (b) K
(c) B_1 (d) C *(1997)*

22. A polysaccharide which is synthesized and stored in liver cells is
(a) arabinose (b) glycogen
(c) lactose (d) galactose. *(1995)*

23. Kupffer's cells occur in
(a) spleen (b) kidney
(c) brain (d) liver. *(1993)*

24. Brunner's glands occur in
(a) submucosa of duodenum
(b) submucosa of stomach
(c) mucosa of oesophagus
(d) mucosa of ileum. *(1992)*

25. Pancreas produces
(a) three digestive enzymes and one hormone
(b) three types of digestive enzymes and two hormones
(c) two digestive enzymes and one hormone
(d) three digestive enzymes and no hormone. *(1991)*

26. Pancreatic juice and hormones of pancreas are produced by
(a) same cells
(b) same cells at different times
(c) statment is wrong
(d) different cells. *(1990)*

27. Secretin stimulates production of
(a) saliva
(b) gastric juice
(c) bile
(d) pancreatic juice. *(1990)*

28. Wharton's duct is associated with
(a) sublingual salivary gland
(b) parotid salivary gland
(c) submaxillary salivary gland
(d) Brunner's glands. *(1988)*

29. Duct leading from parotid gland and opening into vestibule is
(a) Haversian duct
(b) Stenson's duct
(c) Wolffian duct
(d) infra-orbital duct *(1988)*

30. Lamina propria is connected with
(a) acini (b) liver
(c) Graafian follicle (d) intestine. *(1988)*

16.2 Digestion of Food

31. The enzyme enterokinase helps in conversion of
(a) protein into polypeptides
(b) trypsinogen into trypsin
(c) caseinogen into casein
(d) pepsinogen into pepsin. *(NEET 2020)*

32. Identify the cells whose secretion protects the lining of gastro-intestinal tract from various enzymes.
(a) Duodenal cells
(b) Chief cells
(c) Goblet cells
(d) Oxyntic cells *(NEET 2019)*

33. Which of the following gastric cells indirectly help in erythropoiesis?
(a) Chief cells
(b) Mucous cells
(c) Goblet cells
(d) Parietal cells *(NEET 2018)*

34. Which of the following options best represents the enzyme composition of pancreatic juice?
(a) Amylase, Pepsin, Trypsinogen, Maltase
(b) Peptidase, Amylase, Pepsin, Rennin
(c) Lipase, Amylase, Trypsinogen, Procarboxypeptidase
(d) Amylase, Peptidase, Trypsinogen, Rennin
(NEET 2017)

35. In the stomach, gastric acid is secreted by the
(a) peptic cells
(b) acidic cells
(c) gastrin secreting cells
(d) parietal cells. *(NEET-I 2016)*

36. The enzyme that is not present in succus entericus is
(a) nucleosidase (b) lipase
(c) maltase (d) nuclease. *(2015)*

37. Gastric juice of infants contains
(a) pepsinogen, lipase, rennin
(b) amylase, rennin, pepsinogen
(c) maltase, pepsinogen, rennin
(d) nuclease, pepsinogen, lipase. *(2015 Cancelled)*

38. Which of the following statements is not correct?
(a) Oxyntic cells are present in the mucosa of stomach and secrete HCl.
(b) Acini are present in the pancreas and secrete carboxypeptidase.
(c) Brunner's glands are present in the submucosa of stomach and secrete pepsinogen.
(d) Goblet cells are present in the mucosa of intestine and secrete mucus. *(2015 Cancelled)*

39. The initial step in the digestion of milk in humans is carried out by
(a) lipase (b) trypsin
(c) rennin (d) pepsin. *(2014)*

40. A healthy person eats the following diet-5 gm raw sugar, 4 gm albumin, 10 gm pure buffalo ghee adultrated with 2 gm vegetable ghee (hydrogenated vegetable oil) and 5 gm lignin. How many calories he is likely to get?
(a) 126 (b) 164
(c) 112 (d) 144
(Karnataka NEET 2013)

41. Which enzymes are likely to act on the baked potatoes eaten by a man, starting from the mouth and as it moves down the alimentary canal?
(a) Pancreatic amylase → Salivary amylase → Lipases
(b) Disaccharidase like maltase → Lipases → Nucleases
(c) Salivary amylase → Pancreatic amylase → Disaccharidases
(d) Salivary maltase → Carboxypeptidase → Trypsinogen *(Karnataka NEET 2013)*

42. If for some reason our goblet cells are non-functional, this will adversely affect
(a) production of somatostatin
(b) secretion of sebum from the sebaceous glands
(c) maturation of sperms
(d) smooth movement of food down the intestine.
(2010)

43. If for some reason the parietal cells of the gut epithelium become partially non-functional, what is likely to happen?
(a) The pancreatic enzymes and specially the trypsin and lipase will not work efficiently.
(b) The pH of stomach will fall abruptly.
(c) Steapsin will be more effective.
(d) Proteins will not be adequately hydrolysed by pepsin into proteoses and peptones.
(Mains 2010)

44. Which one of the following pairs of food components in humans reaches the stomach totally undigested ?
(a) Starch and fat (b) Fat and cellulose
(c) Starch and cellulose (d) Protein and starch
(2009)

45. Which one of the following is the correct matching of the site of action on the given substrate, the enzyme acting upon it and the end product?
(a) Small intestine : Proteins $\xrightarrow{\text{Pepsin}}$ Amino acids
(b) Stomach : Fats $\xrightarrow{\text{Lipase}}$ Micelles
(c) Duodenum : Triglycerides $\xrightarrow{\text{Trypsin}}$ Monoglycerides
(d) Small intestine : Starch $\xrightarrow{\alpha\text{-Amylase}}$ Disaccharide (maltose)
(2008)

46. What will happen if the secretion of parietal cells of gastric glands is blocked with an inhibitor?
(a) In the absence of HCl secretion, inactive pepsinogen is not converted into the active enzyme pepsin.
(b) Enterokinase will not be released from the duodenal mucosa and so trypsinogen is not converted to trypsin.
(c) Gastric juice will be deficient in chymosin.
(d) Gastric juice will be deficient in pepsinogen.
(2008)

47. Hydrolytic enzymes which act on low pH are called as
(a) proteases (b) α-amylases
(c) hydrolases (d) peroxidases. *(2002)*

48. In mammals milk is digested by the action of
(a) rennin (b) amylase
(c) intestinal bacteria (d) invertase. *(2000)*

49. A person who is eating boiled potato, his food contains the component
(a) cellulose which is digested by cellulase
(b) starch which is digested
(c) lactose which is not digested
(d) DNA which can be digested by pancreatic DNase. *(2000)*

50. If pancreas is removed, the compound which remain undigested is
(a) proteins (b) carbohydrates
(c) fats (d) all of these. *(1997)*

51. What is common among amylase, rennin and trypsin?
(a) These are produced in stomach.
(b) These act at a pH lower than 7.
(c) These all are proteins.
(d) These all are proteolytic enzymes. *(1997)*

52. Choose the correct enzyme - substrate pair.
(a) Carbohydrate - Lipase
(b) Maltase - Lactose
(c) Rennin - Casein
(d) Protein - Amylase *(1996)*

53. Which of the following is the function of enterogastrone?
(a) It inhibits the secretion of gastric juice.
(b) It stimulates the secretion of digestive juices in the stomach.
(c) It stimulates the flow of pancreatic juice.
(d) It regulates the flow of bile. *(1994)*

54. Which of the following is correct pairing of site of action and substrate of rennin?
(a) Mouth - Starch
(b) Small intestine - Protein
(c) Stomach - Casein
(d) Stomach - Fat *(1994)*

55. Most of the fat digestion occurs in
(a) rectum (b) stomach
(c) duodenum (d) small intestine. *(1993)*

56. Secretion of gastric juice is stopped by
(a) gastrin (b) pancreozymin
(c) cholecystokinin (d) enterogastrone. *(1993)*

57. Where is protein digestion accomplished?
(a) Stomach (b) Ileum
(c) Rectum (d) Duodenum *(1991)*

58. In man the zymogen or chief cells are mainly found in
(a) cardiac part of stomach
(b) pyloric part of stomach
(c) duodenum
(d) fundic part of stomach. *(1990)*

59. Emulsification of fat is carried out by
(a) bile pigments
(b) bile salts
(c) HCl
(d) pancreatic juice. *(1990)*

60. Release of pancreatic juice is stimulated by
(a) enterokinase (b) cholecystokinin
(c) trypsinogen (d) secretin. *(1989)*

16.3 Absorption of Digested Products

61. Match the items given in column I with those in column II and choose the correct option.

Column I	Column II
A. Rennin	(i) Vitamin B_{12}
B. Enterokinase	(ii) Facilitated transport
C. Oxyntic cells	(iii) Milk proteins
D. Fructose	(iv) Trypsinogen

(a) A-iii, B-iv, C-ii, D-i
(b) A-iv, B-iii, C-i, D-ii
(c) A-iv, B-iii, C-ii, D-i
(d) A-iii, B-iv, C-i, D-ii *(Odisha NEET 2019)*

62. Fructose is absorbed into the blood through mucosa cells of intestine by the process called
(a) active transport
(b) facilitated transport
(c) simple diffusion
(d) co-transport mechanism. *(2014)*

63. Select the correct match of the digested products in humans given in column I with their absorption site and mechanism in column II.

Column I	Column II
(a) Glycerol, fatty acids	Duodenum, move as chylomicrons
(b) Cholesterol, maltose	Large intestine, active absorption
(c) Glycine, glucose	Small intestine, active absorption
(d) Fructose, Na^+	Small intestine, passive absorption

(NEET 2013)

64. Carrier ions like Na^+ facilitate the absorption of substances like
(a) amino acids and glucose
(b) glucose and fatty acids
(c) fatty acids and glycerol
(d) fructose and some amino acids. *(2010)*

65. A young infant may be feeding entirely on mother's milk which is white in colour but the stools which the infant passes out is quite yellowish. What is this yellow colour due to?
(a) Bile pigments passed through bile juice
(b) Undigested milk protein casein
(c) Pancreatic juice poured into duodenum
(d) Intestinal juice *(2009)*

66. Which one of the following statements is true regarding digestion and absorption of food in humans?
(a) Fructose and amino acids are absorbed through intestinal mucosa with the help of carrier ions like Na^+.
(b) Chylomicrons are small lipoprotein particles that are transported from intestine into blood capillaries.
(c) About 60% of starch is hydrolysed by salivary amylase in our mouth.
(d) Oxyntic cells in our stomach secrete the proenzyme pepsinogen. *(2009)*

67. Epithelial cells of the intestine involved in food absorption have on their surface
(a) pinocytic vesicles
(b) microvilli
(c) zymogen granules
(d) phagocytic vesicles. *(2005)*

68. During prolonged fastings, in what sequence are the following organic compounds used up by the body?
(a) First carbohydrates, next fats and lastly proteins
(b) First fats, next carbohydrates and lastly proteins
(c) First carbohydrates, next proteins and lastly lipids
(d) First proteins, next lipids and lastly carbohydrates *(2003)*

16.4 Disorders of Digestive System

69. Anxiety and eating spicy food together in an otherwise normal human, may lead to
(a) indigestion (b) jaundice
(c) diarrhoea (d) vomiting. *(2012)*

70. Jaundice is a disorder of
(a) excretory system (b) skin and eyes
(c) digestive system (d) circulatoy system. *(Mains 2010)*

71. When breast feeding is replaced by less nutritive food low in proteins and calories; the infants below the age of one year are likely to suffer from
(a) rickets (b) kwashiorkor
(c) pellagra (d) marasmus. *(2009)*

72. Which one of the following is a fat-soluble vitamin and its related deficiency disease?
(a) Retinol - Xerophthalmia
(b) Cobalamine - Beri-beri
(c) Calciferol - Pellagra
(d) Ascorbic acid - Scurvy *(2007)*

73. Examination of blood of a person suspected of having anaemia shows large, immature, nucleated erythrocytes without haemoglobin.
Supplementing his diet with which of the following is likely to alleviate his symptoms?
(a) Iron compounds
(b) Thiamine
(c) Folic acid and cobalamine
(d) Riboflavin *(2006)*

74. A patient is generally advised to specially consume more meat, lentils, milk and eggs in diet only when he suffers from
(a) scurvy (b) kwashiorkor
(c) rickets (d) anaemia. *(2005)*

75. Which group of three of the following five statements (1-5) contain all three correct statements regarding beri-beri?
1. A crippling disease prevalent among the native population of sub-Saharan Africa.
2. A deficiency disease caused by lack of thiamine (vitamin B_1).
3. A nutritional disorder in infants and young children when the diet is persistently deficient in essential protein.
4. Occurs in those countries where the staple diet is polished rice.
5. The symptoms are pain from neuritis, paralysis, muscle wasting, progressive oedema, mental deterioration and finally heart failure.

(a) 2, 4 and 5 (b) 1, 2 and 4
(c) 1, 3 and 5 (d) 2, 3 and 5 *(2005)*

76. The richest sources of vitamin B_{12} are
(a) goat's liver and *Spirulina*
(b) chocolate and green gram
(c) rice and hen's egg
(d) carrot and chicken's breast. *(2004)*

77. Which one of the following pairs is not correctly matched?
(a) Vitamin B_{12} - Pernicious anaemia
(b) Vitamin B_6 - Convulsions
(c) Vitamin B_1 - Beri-beri
(d) Vitamin B_2 - Pellagra *(2004)*

78. Which one of the following pairs is not correctly matched ?
(a) Vitamin C - Scurvy
(b) Vitamin B_2 - Pellagra
(c) Vitamin B_{12} - Pernicious anaemia
(d) Vitamin B_6 - Beri-beri *(2003)*

79. Stool of a person is whitish grey coloured due to malfunction of which of the following organ?
(a) Pancreas (b) Spleen
(c) Kidney (d) Liver *(2002)*

80. Continuous bleeding from an injured part of body is due to deficiency of
(a) vitamin A (b) vitamin B
(c) vitamin K (d) vitamin E. *(2002)*

81. Which one of the following is correctly matched?
(a) Vitamin E - Tocopherol
(b) Vitamin D - Riboflavin
(c) Vitamin B - Calciferol
(d) Vitamin A - Thiamine *(2001)*

82. Which food should be eaten during deficiency of rhodopsin in eyes?
(a) Carrot and ripe papayas
(b) Guava, banana
(c) Mango and potato
(d) None of the above *(2000)*

83. To which of the following families do folic acid and pantothenic acid belong?
(a) Vitamin C (b) Vitamin B complex
(c) Vitamin K (d) Vitamin A *(1999)*

84. Which of the following is mismatched?
(a) Vitamin A - Xerophthalmia
(b) Vitamin D - Rickets
(c) Vitamin K - Beri-beri
(d) Vitamin C - Scurvy *(1999)*

85. Which one of the following is a protein deficiency disease?
(a) Kwashiorkor (b) Night blindness
(c) Eczema (d) Cirrhosis *(1998)*

86. Pellagra disease is caused by the deficiency of
(a) niacin (b) tocopherol
(c) riboflavin (d) folic acid. *(1996)*

87. High cholesterol patients are advised to use
(a) ghee, butter and oils
(b) groundnut oil, margarine and vegetable oils
(c) fatty oil and butter
(d) cheese, dalda and ghee. *(1996)*

88. The haemorrhagic disease of new born is caused due to the deficiency of
(a) vitamin K (b) vitamin B_{12}
(c) vitamin A (d) vitamin B_1. *(1995)*

89. The vitamin C or ascorbic acid prevents
(a) scurvy (b) antibody synthesis
(c) rickets (d) pellagra. *(1995)*

90. Calcium deficiency in the body occurs in the absence of
(a) vitamin C (b) vitamin D
(c) vitamin B (d) vitamin E. *(1994)*

91. Prolonged deficiency of nicotinic acid causes
(a) pellagra (b) xerophthalmia
(c) osteomalacia (d) anaemia. *(1994)*

92. Which of the following pair is characterised by swollen lips, thick pigmented skin of hands and legs and irritability?
(a) Thiamine – Beri-beri
(b) Protein – Kwashiorkor
(c) Nicotinamide – Pellagra
(d) Iodine – Goitre *(1993)*

ANSWER KEY

1.	(c)	**2.**	(d)	**3.**	(b)	**4.**	(b)	**5.**	(a)	**6.**	(c)	**7.**	(b)	**8.**	(d)	**9.**	(a)	**10.**	(a)
11.	(a)	**12.**	(c)	**13.**	(a)	**14.**	(b)	**15.**	(b)	**16.**	(d)	**17.**	(d)	**18.**	(d)	**19.**	(a)	**20.**	(c)
21.	(c)	**22.**	(b)	**23.**	(d)	**24.**	(a)	**25.**	(b)	**26.**	(d)	**27.**	(d)	**28.**	(c)	**29.**	(b)	**30.**	(d)
31.	(b)	**32.**	(c)	**33.**	(d)	**34.**	(c)	**35.**	(d)	**36.**	(d)	**37.**	(a)	**38.**	(c)	**39.**	(c)	**40.**	(d)
41.	(c)	**42.**	(d)	**43.**	(d)	**44.**	(b)	**45.**	(d)	**46.**	(a)	**47.**	(a)	**48.**	(a)	**49.**	(b)	**50.**	(d)
51.	(c)	**52.**	(c)	**53.**	(a)	**54.**	(c)	**55.**	(d)	**56.**	(d)	**57.**	(b)	**58.**	(d)	**59.**	(b)	**60.**	(b,d)
61.	(d)	**62.**	(b)	**63.**	(c)	**64.**	(a)	**65.**	(a)	**66.**	(a)	**67.**	(b)	**68.**	(a)	**69.**	(a)	**70.**	(c)
71.	(d)	**72.**	(a)	**73.**	(c)	**74.**	(b)	**75.**	(a)	**76.**	(a)	**77.**	(d)	**78.**	(b,d)	**79.**	(d)	**80.**	(c)
81.	(a)	**82.**	(a)	**83.**	(b)	**84.**	(c)	**85.**	(a)	**86.**	(a)	**87.**	(b)	**88.**	(a)	**89.**	(a)	**90.**	(b)
91.	(a)	**92.**	(c)																

Hints & Explanations

1. (c) : Ileum opens into the large intestine. Serosa is the outermost layer of the alimentary canal. The vermiform appendix is a vestigial organ, arises from the caecum.

2. (d)

3. (b) : Majority of mammals including human beings erupt two sets of teeth during their lifetime, a set of temporary milk or deciduous teeth that is replaced by a set of permanent or adult teeth. This type of dentition is called diphyodont. An adult human has 32 permanent teeth which are of four different types (heterodont dentition), namely, incisors (I), canines (C), premolars (PM) and molars (M). Teeth are embedded in the sockets of the jaw bones which represents thecodont dentition.

4. (b) : Boy aged two years will have milk teeth. Milk teeth of man include 8 incisors, 4 canines, 8 molars. Premolars are absent.

5. (a) : Paneth cells, present in the bottom of crypts of Lieberkuhn, are rich in zinc and contain acidophilic granules. There is evidence that these cells secrete antibacterial lysozyme. Zymogen cells or peptic cells are present in stomach and secrete pepsinogen. Kupffer cells are present in liver. They are phagocytic in nature and engulf disease causing microorganisms, dead cells, etc. Argentaffin cells, found in crypts of Lieberkuhn, synthesise hormone secretin and 5- hydroxytryptamine.

6. (c) : Cholecystokinin pancreozymin (CCK-PZ) is a hormone secreted from small intestine. It stimulates the gall bladder to release bile and pancreas to secrete and release digestive enzymes in the pancreatic juice. Hormone secretin is secreted from duodenum and releases bicarbonates in the pancreatic juice. It also increases secretion of bile and decreases gastric secretion and motility.

7. (b) : The sphincter of Oddi is a muscular valve that controls the flow of digestive juices (bile and pancreatic juice) through the hepatopancreatic duct into the duodenum.

8. (d) : Milk/primary teeth of man include 8 incisors, 4 canines and 8 molars (premolars are absent). Molars of milk teeth are shed off and premolars of permanent teeth take their place. The permanent teeth are 8 incisors, 4 canines, 8 premolars and 12 molars. Thus 12 teeth (8 premolars and 4 molars) are monophyodont (teeth which grow only once in life). Dental formulae of milk teeth and permanent teeth of human are given below.

$\frac{2102}{2102} \times 2 = 20$ Milk teeth

$\frac{2123}{2123} \times 2 = 32$ Permanent teeth

9. (a)

10. (a) : Carboxypeptidase is an enzyme synthesized in pancreas and secreted into small intestine. It contains Zn (II) ions as a metal ion cofactor. This enzyme helps in protein digestion and becomes active in alkaline medium. It is mainly involved in the conversion of large peptides or polypeptides into dipeptides and amino acids.

11. (a) : Duodenum follows the stomach. It is somewhat C-shaped and about 25 cm. long. It receives the hepatopancreatic ampulla of the hepatopancreatic duct formed by the union of bile duct (from liver) and pancreatic duct (from pancreas) and whose opening is guarded by sphincter of Oddi. Pancreatic juice contains proenzymes—trypsinogen, chymotrypsinogen and procarboxypeptidase. In the presence of enterokinase (a protease of intestinal juice), inactive trypsinogen is converted to active trypsin. Trypsin then activates chymotrypsinogen and procarboxypeptidase into chymotrypsin and carboxypeptidase respectively. This enables simultaneous action of all pancreatic proteases for a rapid digestion of proteins.

12. (c) : An adult human has 32 permanent teeth which are of four different types (heterodont dentition) namely, incisors (I), canine (C), premolars (PM) and molars (M). Arrangement of teeth in each half of the upper and lower jaw in the order I, C, PM, M is represented by a dental formula which in human is $\frac{2123}{2123}$.

13. (a) : This coughing would have been due to improper movement of epiglottis. Epiglottis is present in the laryngopharynx, which is the lowest part of pharynx. Laryngopharynx possess two apertures - anterior slit-like glottis and posterior gullet. Glottis leads into trachea or windpipe, which is closed by bilobed leaf-like cartilage, the epiglottis, during the swallowing of food-bolus. Hence, during eating one may suddenly coughs due to opening of epiglottis and movement of some food particles in the trachea.

14. (b) : Brunner's glands are present in the duodenum region of small intestine. They secrete two hormones secretin and cholecystokinin. Secretin is secreted by cells in the duodenum when they are exposed to the acidic contents of the emptying stomach.
Cholecystokinin (CCK), a mixture of peptides, is secreted by cells in the duodenum when they are exposed to food.

15. (b) : *Refer to answer 14.*

16. (d)

17. (d) : Brunner's glands are branched tubular glands and are confined to the duodenum and are located in

the submucosa. They secrete alkaline watery fluid that neutralizes the acidic chyme leaving the stomach, a little enzyme and mucus. They are named after Swiss anatomist J.C. von Brunner.

18. (d) : Tooth is mainly made of ivory like substance called dentine. In crown part of the tooth, dentine is covered by enamel (hardest substance in the body). Enamel is smooth, white being rich in minerals containing calcium, especially apatite and secreted by cells of ectodermal origin called ameloblasts of the oral epithelium and protects the underlying dentine of the tooth. The pulp cavity of tooth is lined by dentine forming cells called odontoblasts. Osteoblasts are the bone forming cells.

19. (a) : Vitamin B_{12} (also called cyanocobalamine) is essential for the formation and maturation of erythrocytes. Vitamin B_{12} is manufactured only by microorganisms and natural sources are entirely of animal origin. One form of vitamin B_{12} functions as a coenzyme in a number of reactions, including the oxidation of fatty acids and the synthesis of DNA. It also works in conjunction with folic acid in the synthesis of the amino acid methionine and it is required for normal production of red blood cells. Vitamin A is required for maintenance of epithelia, growth and is a part of visual pigments. Vitamin C play a role in collagen formation. Vitamin D facilitates absorption of calcium and phosphorus by intestine and their retention in the body and deposition in bones.

20. (c) : Ileum is the part of small intestine. Its mucosa is raised into numerous microscopic projections called the villi. The villi contain a minute blind ended lymph vessel lacteals. From the lacteals, the lipoprotein chylomicrons are carried into the blood stream directly *via* thoracic lymphatic duct.

21. (c) : Vitamin B_1 is synthesized by symbiotic bacteria living inside the gut. This is evidenced by the fact that vitamin B deficiency occurs on taking antibiotics which in addition to killing harmful bacteria also kill useful bacteria forming vitamin B_1.

22. (b) : The polysaccharide which is synthesized and stored in the liver is glycogen. When there is a need of energy in the body, the glycogen is converted into glucose which is released into the blood to be reached to the target cell.

23. (d) : Kupffer cells are specialized macrophages that dispose of old blood cells and particulate matter. Kupffer cells, named after Karl Wilhelm von Kupffer (1829-1902), are found in the liver, attached to the walls of the sinusoids.

24. (a) : *Refer to answer 17.*

25. (b) : Pancreas secretes three types of digestive enzymes trypsinogen, chymotrypsinogen and procarboxypeptidase. These enzymes digest proteins. The two hormones secreted are insulin and glucagon that maintain glucose level in the blood.

26. (d) : The pancreas is a gland organ in the digestive and endocrine systems of vertebrates. It is both exocrine (secreting pancreatic juice containing digestive enzymes) and endocrine (producing several important hormones, including insulin, glucagon, and somatostatin). The beta cells produce insulin, alpha cells produce glucagon and delta cells produce somatostatin. There are two main types of exocrine pancreatic cells, responsible for two main classes of secretions. The centroacinar cells produce bicarbonate ions and basophilic cells secrete digestive enzymes.

27. (d)

28. (c) : The Wharton's ducts are associated with submaxillary glands that lie at the angles of the lower jaw. These ducts open under the tongue. Ducts of Rivinus are associated with sublingual salivary gland. Stenson's duct is associated with parotid gland. Brunner's glands are present in the intestine.

29. (b) : Parotid glands are the largest salivary glands. They lie on the sides of the face, just below and in front of the ears. The parotid ducts, also called Stenson's ducts, open into the vestibule opposite the upper second molar teeth.

30. (d) : It is the middle layer of 3 layered mucosa (outer muscularis mucosa, middle lamina propria and inner simple columnar epithelium) of intestine. It is made up of a highly vascular connective tissue containing lymphatic nodules.

31. (b) : Trypsinogen is activated by an enzyme, enterokinase, secreted by the internal mucosa into active trypsin.

32. (c) : Goblet cells or mucous cells are present throughout the epithelium of gastric glands and secrete mucus, which protects gastro-intestinal lining from enzymatic action.

33. (d) : Parietal or oxyntic cells secrete HCl and Castle intrinsic factor. HCl converts iron present in diet from ferric (Fe^{3+}) to ferrous (Fe^{2+}) form in which iron can be absorbed. Castle intrinsic factor is essential for the absorption of vitamin B_{12}. Iron, protein, vitamin B_{12} and folic acid are essential for the formation of RBCs and haemoglobin, hence parietal cells indirectly help in erythropoiesis.

34. (c) : The pancreatic juice contains sodium bicarbonate, three proenzymes; trypsinogen, chymotrypsinogen and procarboxypeptidase and some enzymes such as elastase, pancreatic α-amylase, DNase, RNase and pancreatic lipase. It helps in the digestion of starch, proteins, fats and nucleic acids.

35. (d) : Parietal cells are large cells present on the side walls of the gastric glands. They lie against the basement membrane. They secrete hydrochloric acid and Castle's intrinsic gastric factor that helps in the absorption of vitamin B_{12} in the ileum.

36. (d) : Succus entericus or intestinal juice (pH = 7.8) refers to the secretion of glands of small intestine. It contains many enzymes *viz* maltase, isomaltase, lipase, lactase, α-dextrinase, enterokinase, aminopeptidase, nucleotidase, nucleosidase, etc., for the digestion of carbohydrates, proteins, fats, nucleic acids etc. Enzyme nuclease is not a digestive enzyme. It is not present in any digestive juice.

37. (a) : The secretion of the cells of the gastric glands form gastric juice with pH 2 to 3.7. It contains two proenzymes, pepsinogen and prorennin and enzyme gastric lipase, mucous and hydrochloric acid. Rennin (chymosin) is responsible for clotting milk by acting on soluble milk protein caseinogen, and converting it into insoluble casein. This ensures that milk remains in stomach long enough to be acted on by protein digesting enzymes. Rennin's concentration is highest in young mammals (as their primary diet is milk) which reduces gradually with age.

38. (c) : The Brunner's glands are branched tubular glands which occur only in the duodenum. They secrete alkaline watery fluid, a little enzyme and mucus. They open into the crypts of Lieberkuhn.

39. (c) : Rennin is secreted by peptic cells present in epithelium of gastric glands. It is found in the gastric juice of human beings during infancy and in calf. In adults gastric juice is devoid of rennin. It converts milk protein casein into paracasein, leading to milk coagulation.

40. (d) : Physiological value is the energy produced by 1 gm of food on oxidation in the body. For carbohydrates it is 4.0 Kcal/g, for proteins it is 4.0 Kcal/g and it is 9.0 Kcal/g for fats. Lignin is a fibre that is present in plant cells but it does not produce energy. Hence,
5 g raw sugar will yield $5 \times 4.0 = 20.0$ Kcal
4 g albumin will yield $4 \times 4.0 = 16.0$ Kcal
(10 + 2) g of fat will yield $12 \times 9.0 = 108.0$ Kcal
Total yield = 144 Kcal.

41. (c) : Baked potatoes consist of starch which is a polysaccharide.
In oral cavity, the food is mixed with saliva. The saliva contains an enzyme called salivary amylase (also called ptyalin) which converts starch into maltose, isomaltose and small dextrins. Salivary amylase is activated in the saliva by the chloride ions.

$$\text{Starch} \xrightarrow[\text{amylase}]{\text{Salivary}} \text{Maltose + Isomaltose + α- Dextrins}$$

The pancreatic juice (present in small intestine) contains starch digesting enzyme, called pancreatic amylase which converts starch into maltose, isomaltose and α-dextrins.

$$\text{Starch} \xrightarrow[\text{α-amylase}]{\text{Pancreatic}} \text{Maltose + Isomaltose + α- Dextrins}$$

Further, disaccharidases such as maltase (present in intestinal juice in small intestine) breakdown disaccharides such as maltose into monosaccharides or simpler sugars.

42. (d) : The intestinal mucosal epithelium has goblet cells which secrete mucus. The mucus lubricates the food for an easy passage. Thus, if for some reason goblet cells become non-functional, it will adversely affect smooth movement of food down the intestine. It along with bicarbonates from the pancreas also protects the intestinal mucosa from acid as well as provide an alkaline medium for enzymatic activities.

43. (d) : Parietal or oxyntic cells secrete HCl (due to which pH of stomach is highly acidic) and intrinsic factor. Parietal glands also secrete pepsinogen to which hydrochloric acid acts to convert it into pepsin. Pepsin in return causes digestion of proteins. If parietal cells become non-functional it will directly affect protein digestion.

44. (b) : Saliva contains no lipase. The stomach also lacks any fat-emulsifying agents. Fat is largely digested in the small intestine. Cellulose is not digested in human beings.

45. (d) : In small intestine the food meets two juices : pancreatic and intestinal juice. Pancreatic juice contains starch digesting enzyme called pancreatic α-amylase which converts starch into maltose, isomaltose and α dextrins. Maltose and isomaltose are disaccharides.

$$\text{Starch} \xrightarrow[\text{α-amylase}]{\text{Pancreatic}} \text{Maltose + Isomaltose + α-dextrins}$$

46. (a) : The parietal or acid or oxyntic cells of gastric glands secrete HCl (hydrochloric acid). In the presence of HCl, pepsinogen (proenzyme) which is an inactive precursor of pepsin enzyme, gets converted to an active form, *i.e.*, pepsin. The activated pepsin by autocatalysis activates more pepsinogen to pepsin. This pepsin enzyme is the principle protease or proteolytic enzyme of the stomach.

$$\underset{\text{(Inactive form)}}{\text{Pepsinogen}} \xrightarrow{\text{HCl}} \underset{\text{(Active form)}}{\text{Pepsin}}$$

So, in the absence of HCl secretion, inactive pepsinogen is not converted into the active enzyme pepsin.

47. (a) : Stomach has low pH due to secretion of HCl. Protease, an enzyme for digesting protein acts in low pH *i.e.* in stomach. Amylase is a starch (carbohydrate) digesting enzyme and carbohydrate digestion does not occur in stomach. All digestive enzymes are hydrolases. Peroxidase is an iron containing enzyme, found mainly

in plants but also present in leucocytes and milk, that catalyses the dehydrogenation (oxidation) of various substances in the presence of hydrogen peroxide.

48. (a) : Rennin is the enzyme secreted by stomach. It hydrolyzes the soluble milk protein casein into paracasein and whey protein. Paracasein is spontaneously precipitated in the presence of calcium as insoluble calcium paracaseinate, forming coagulated milk. Amylase degrade starch, glycogen and other polysaccharides. Plants contain both α and β-amylases found in pancreatic juice and also in saliva. Intestinal bacteria help by digesting cellulose. Invertase acts on sucrose.

49. (b) : Boiled potatoes do not contain lactose; and cellulose which if present is not digested in man as he lacks cellulase. Starch is the major food component which is present in boiled potato and is broken down into maltose and isomaltose due to salivary amylase and is hence digested. DNA is broken down into purines, pyrimidines and sugars by pancreatic nuclease (such as DNase).

50. (d) : Pancreas secretes pancreatic juice that acts on all type of foods. It contains pancreatic amylase for the digestion of carbohydrates; trypsinogen, chymotrypsinogen and procarboxypeptidases for the digestion of proteins, pancreatic lipase for the digestion of fats and nuclease for nucleic acid.

51. (c) : Amylase, rennin and trypsin are enzymes and as all enzymes are proteins so these three are also proteins.

52. (c) : Rennin is the enzyme that acts on casein which is a milk protein. It is secreted by the gastric glands in an inactive form prorennin which is activated by HCl. Rennin converts caesinogen into calcium paracaesinate in the presence of calcium ions. This ensures that milk remains in the stomach as long as possible. The largest amount of rennin are present in the stomach of young mammals. Carbohydrate, maltose and protein are acted upon by carbohydrase, maltase and protease respectively.

53. (a) : Enterogastrone hormone is released from duodenum and it slows gastric contraction to delay emptying of stomach and stops secretion of gastric juice. Enterogastrone is released when the stomach contents pass into the small intestine.

54. (c)

55. (d) : Fat is largely digested in the small intestine. Bile salts of the bile break down fat droplets into many small ones by reducing the surface tension of fat droplets. This process is called emulsification. This increases lipase action on fat.

56. (d) : *Refer to answer 53.*

57. (b) : Protein digestion starts in the stomach with the action of enzyme pepsin. Then in the duodenum it is carried out by the action of trypsin, chymotrypsin and carboxypeptidases. Then it is done by aminopeptidases and dipeptidases, enterokinases in jejunum and then it ends in the ileum.

58. (d) : Zymogen or chief cells are present in the fundic part of stomach. Chief cells are usually basal in location and secrete gastric digestive enzymes as proenzymes or zymogens; pepsinogen and prorennin.

59. (b) : Bile contains no enzyme, and has no chemical action on food. However, it has salts, namely, sodium glycocholate and sodium taurocholate. These salts reduce the surface tension of large fat droplets and break them into many small ones. This process is called emulsification. They also form thin coating around tiny fat droplets to keep them from coalescing. This increases lipase action on fats.

60. (b,d) : Cholecystokinin (in fact it is cholecystokinin pancreozymin) is a hormone which is secreted by small intestine and stimulates pancreas to secrete and release digestive enzymes in pancreatic juice. Secretin causes the release of bicarbonates in the pancreatic juice. Enterokinase is an enzyme that converts trypsinogen (a proenzyme) into trypsin.

61. (d)

62. (b) : Fructose and mannose are absorbed through facilitated diffusion that is by the help of the carrier molecule. It is along the concentration gradient (higher concentration to low concentration).

63. (c) : Glycerol and fatty acids are absorbed in jejunum by diffusion into intestinal cells where they are converted into chylomicrons. Cholesterol is also absorbed by simple diffusion in small intestine. Maltose is broken into glucose and galactose which are absorbed by active transport into small intestine. Fructose is absorbed by facilitated diffusion. Amino acids are also absorbed in small intestine, some by active transport and some by facilitated diffusion.

64. (a) : The absorption of glucose and amino acids is mediated by carrier ions like Na^+. The concentration of Na^+ is higher in the intestinal lumen compared to mucosal cells. Na^+, therefore moves into the cells along its concentration gradient and simultaneously glucose is transported into the intestinal cells. Thus Na^+ diffuses into the cell and it drags glucose along with it. The intestinal Na^+ gradient is the immediate energy source. The mechanism for transport of amino acids is same as glucose.

Fructose absorption does not require energy and is independent of Na^+ transport.

65. (a) : The yellow colour is due to the presence of bile pigments (bilirubin-yellow). Bile pigments are excretory products. Bile is a bitter-tasting greenish-yellow alkaline fluid produced by the liver, stored in the gall bladder, and secreted into the duodenum of vertebrates. It assists the digestion and absorption of fats by the action of bile salts, which chemically reduce fatty substances and decrease the surface tension of fat droplets so that they are broken down and emulsified.

66. (a) : Glucose and galactose are absorbed by active transport. Sodium pump of the cell membrane helps in it active take up. Fructose is absorbed by facilitated diffusion that involves a specific transmembrane carrier. Amino acids are absorbed by active transport coupled with active sodium transport. They also enter the blood stream.

67. (b) : Microvilli are countless minute, closely - set projections from the free surface of the mucosal cells of the intestine. There may be about 500 microvilli on each cell. These are meant to increase the absorptive surface area of the intestine. Pinocytic vesicles are involved in intake of extracellular fluid. Phagocytic vesicles are involved in engulfing of large solid particles. Zymogen granules contain proteolytic enzymes in an inactive form.

68. (a) : During prolonged fasting, first carbohydrates are used up then fats and proteins are used at the last. Carbohydrate and fat metabolism can easily produce energy than protein and they follow a more or less simpler pathway to enter into TCA cycle. When all carbohydrates of the body are used up then fats are converted into carbohydrates and when all fats are used up then ultimately proteins of the body are converted into carbohydrates to be used up by the body.

69. (a) : Indigestion is the condition in which the food is not properly digested leading to a feeling of fullness. The causes of indigestion are inadequate enzyme secretion, anxiety, food poisoning, over eating and spicy food.

70. (c) : Jaundice is a disorder in which skin and eyes turn yellow due to the deposition of bile pigment. This happens when bile made in the liver fails to reach the intestine due to obstruction of the bile duct. As a result, the bile is absorbed into the blood instead of going to the duodenum and cause yellowing of eyes and skin.

71. (d) : Marasmus is common in infants under one year of age. It develops due to deficiency of proteins and calories. It can be cured by providing adequate proteins, fats and carbohydrates.

72. (a) : Retinol (vitamin A) and calciferol (vitamin D) are fat soluble vitamins but the pellagra is not the deficient disease of calciferol. Vitamin A cannot be synthesised by mammals and other vertebrates and must be provided in the diet. Green plants contain precursors of the vitamin, notably carotenes, that are converted to vitamin A in the intestinal wall and liver. The aldehyde derivative of vitamin A, retinal, is a constituent of the visual pigment rhodopsin. Deficiency affects the eyes, causing night blindness, xerophthalmia (dryness and thickening of the cornea), and eventually total blindness.

Pellagra is caused by the deficiency of vitamin B_3 or nicotinic acid or niacin.

Cobalamine and ascorbic acid (vitamin C) are water soluble vitamins. They are generally found together in the same foods with the exception of B_{12} (cobalamine). The deficient disorders related to cobalamine, vitamin C and calciferol are –

Cobalamine – Pernicious anaemia

Ascorbic acid (vitamin C) – Scurvy

Calciferol (vitamin D) – Rickets (in children) and osteomalacia in adults.

Beri-beri is caused by the deficiency of vitamin B_1 (Thiamine).

73. (c) : Anaemia is not a disease. It is a symptom of various diseases which may result from excessive blood loss, excessive blood cell destruction, or decreased blood cell formation. Folic acid is a part of coenzymes for protein and nucleic acid metabolism and is essential for growth and formation of RBCs. Its deficiency leads to anaemia, failure of RBCs to mature and sprue. Vitamin B_{12} or cyanocobalamine acts as a coenzyme for nucleic acid metabolism and is essential for formation of RBCs and myelin formation. Its deficiency leads to Pernicious (injurious) anaemia and malformation of RBCs.

74. (b) : Kwashiorkor is caused due to the deficiency of protein. Meat, lentils, milk and eggs are rich sources of proteins. Scurvy is caused due to deficiency of vitamin C whose sources are citrus fruit, tomatoes, peppers, leafy green vegetables. Deficiency of vitamin D (sources - milk, egg yolk and liver) leads to rickets. Anaemia is caused due to deficiency of folic acid (sources - yeast, liver, fish, green vegetables) or vitamin B_{12} (sources - liver, eggs, meat, fish) or iron (egg yolk, spinach).

75. (a) : Beri-beri which is caused due to the deficiency of vitamin B_1, is characterized by pain from neuritis, paralysis, muscle wasting, oedema, mental deterioration and finally heart failure. It occurs in those countries (coastal districts of A.P.) where the diet is based on polished rice, which lacks the thiamine-rich seed coat.

76. (a) : Goat's liver and *Spirulina* (a cyanobacterium) are the richest sources of vitamin B_{12}. Other sources are eggs, meat, fish, etc.

77. (d) : Deficiency of vitamin B_2 leads to inflammation of eyes, sores on the lips and skin diseases. Pellagra is caused due to deficiency of nicotinic acid or vitamin B_3. It is characterised by dermatitis (skin inflammation), diarrhoea and dementia (nervous disorder).

78. (b, d)

79. (d) : Bilirubin and biliverdin are the pigments present in the bile juice secreted from liver. They provide yellowish brown colour to the stool. So, malfunction of liver leads to appearance of whitish grey stool.

80. (c) : Vitamin K is necessary for the synthesis of prothrombin in the liver. Prothrombin is a factor which is required for blood clotting. Deficiency of vitamin K leads to slow rate of blood clotting. Vitamin A deficiency leads to night blindness, xerophthalmia and retarded growth. Vitamin B deficiency causes beri-beri, pellagra, anaemia etc. Deficiency of vitamin E leads to destruction of RBCs.

81. (a) : Vitamin E is known as tocopherol. It prevents breakage of red blood cells, may act as an antioxidant, prevents oxidation of certain materials and maintains normal membrane structure. Vitamin D and Vitamin A are known as calciferol and retinol respectively.

82. (a) : Deficiency of rhodopsin in eyes occurs due to deficiency of vitamin A. Carrot and ripe papayas are rich sources of vitamin A so these should be eaten in deficiency of rhodopsin in eyes.

83. (b) : Vitamin B complex is a group of water soluble vitamins that characteristically serve as components of coenzymes. Plants and many microorganisms can manufacture B-vitamins but dietary sources are essential for most animals. Heat and light tend to destroy B vitamins. The vitamin B complex consists of 8 different components - B_1, B_2, B_3, pantothenic acid, B_6, folic acid, biotin and B_{12}. Pantothenic acid functions as a part of coenzyme A in cell respiration while folic acid functions as part of coenzymes in protein and nucleic acid metabolism.

84. (c) : Deficiency of vitamin K causes haemorrhage, which is characterized by profuse bleeding. Beri-beri is caused due to deficiency of vitamin B_1.

85. (a) : Kwashiorkor is a protein deficiency disease. Its symptoms are underweight, stunted growth, poor brain development, loss of appetite, anaemia, protuding belly, slender legs and bulging eyes. Night blindness is the inability to see in dimlight or at night. It occurs due to deficiency of vitamin A. Eczema is a common itchy skin disease characterized by reddening and vesicle formation. Cirrhosis is a condition in which the liver responds to injury or death of some of its cell by producing interlacing strands of fibrous tissue between which are nodules of regenerating cells.

86. (a) : Niacin (nicotinic acid) is a vitamin that acts as a part of coenzymes (NAD, NADP) which serve as hydrogen acceptors and donors for many enzymes. Its deficiency in the body causes pellagra which is characterized by dermatitis (skin inflammation), diarrhoea and dementia (nervous disorder). Deficiency of tocopherol (vitamin E) leads to destruction of RBCs. Deficiency of riboflavin (vitamin B_2) causes inflammation of eyes, sores on the lips and skin diseases. Folic acid deficiency leads to anaemia and failure of RBCs to mature.

87. (b) : Cholesterol is a fat like material (a sterol) present in the blood and most tissues especially nervous tissue. Cholesterol is synthesised in the body from acetate, mainly in the liver and blood concentration is normally 140-300 mg/100 mL. It can exists as a free sterol or esterified with a long chain fatty acids. High cholesterol is harmful for the body. So, high cholesterol patients are advised to take groundnut oil, margarine and vegetable oils, as these contain polyunsaturated fatty acids that contain less cholesterol in them.

88. (a) : Haemorrhagic disease is characterised by profuse bleeding in the newborn. Deficiency of vitamin K, an anti-haemorrhagic factor causes delayed blood clotting in case of injuries.

89. (a) : Scurvy is characterised by bleeding gums and swollen joints as well as decreased resistance to common cold. This occurs due to the deficiency of vitamin C. Vitamin C is a water soluble vitamin with antioxidant properties that is essential in maintaining healthy connective tissues and the integrity of cell walls. It is essential for the synthesis of collagen. Rickets and pellagra are caused due to deficiency of vitamin D and vitamin B_3 respectively in the body.

90. (b) : Calcium is an important constituent of bones and teeth. It is present in the blood at a concentration of about 10 mg/100 mL, being maintained at this level by hormones - calcitonin and parathyroid hormone. Ca absorption is enhanced by vitamin D. Thus, deficiency of vitamin D hampers Ca absorption resulting in conditions such as rickets, osteoporosis and osteomalacia. A deficiency of calcium in the blood may lead to tetany.

91. (a) : *Refer to answer 86.*

92. (c) : Pellagra is a disease that occurs due to deficiency of vitamin nicotinamide. Its symptoms are swollen lips, diarrohea, thick pigmented skin of hands and legs and nervous disorder (irritability).