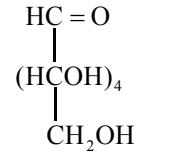
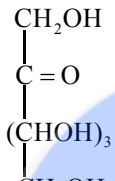
14 Biomolecules

CLASSIFICATION OF CARBOHYDRATES

1. **Monosaccharides:** These are the simplest sugars which do not hydrolyse. Among the monosaccharides the pentoses and hexoses sugars are most important from the stand point of occurrence and even between the two, the hexoses are more important glucose and fructose are the specific examples of an aldohexose and of a ketohexose respectively.



Glucose (aldose)



Fructose (ketohexose)

2. **Oligosaccharides :** These carbohydrates which yield a definite number of monosaccharides on hydrolysis.
   - **a)** **Disaccharides :** which yield two monosaccharides molecules on hdrolysis. Sucrose has glucose and fructose linked by ether linkage.
   - **b)** **Trisaccharides :** which yield three monosaccharides molecules on hydrolysis.
3. **Polysaccharides :** Polysaccharides are carbohydrates of high molecular weight which yield many monosaccharides molecules on hydrolysis.

ANOTHER CLASSIFICATION OF CARBOHYDRATES

1. **Reducing :** Those which reduce Tollen's reagent or Fehling's solution are called reducing carbohydrates or sugars, e.g. All mono saccharides and disaccharides except sucrose.
2. **Non-Reducing Sugar :** Those which do not reduce Tollen's or Fehling solution are called non-reducing carbohydrates or sugars.
   e.g. all polysaccharides (starch, cellulose glycogen, dextrins)

GLUCOSE (DEXTROSE GRAPE SUGAR)

Methods of Preparation of Glucose :

1. **From Sucrose (Cane Sugar) :** Glucose can be easily prepared in laboratory by the hydrolysis of an alcoholic solution of cane sugar with a 4 percent solution of HC1 in alcohol.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

2. **From Starch :** Commercially pure glucose is manufactured by the hydrolysis of starch with dilute mineral acids.

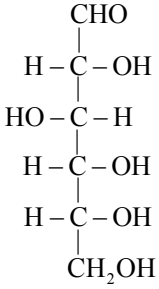
$$C_6H_{12}O + nH_2O \longrightarrow \underset{\text{Glucose}}{nC_6H_{12}O_6}$$

MUTAROTATION

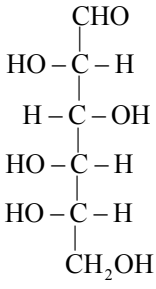
Glucose exists in two crystalline forms α and β. α – D glucose has m.p. 146^0 C and specific rotation + 112^0 however β – D glucose has m.p. $148^0 – 150^0$ C and specific rotation + 19^0. If either of the two form is dissolved in water and allowed to stand, specific rotation of the solution changes gradually until a final value of + 530 is reached. This change in optical rotation of a solution of either form of glucose until a constant value obtained, is called mutarotation.

Structure of Glucose :

Glucose has been assigned a straight chain structure. The Fischer projections for D - and L - glucose are shown



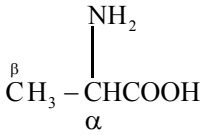
D-glucose



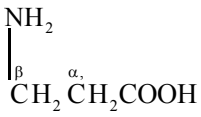
L-glucose

AMINO ACIDS

Amino acids are the compounds having one or more amino groups and one or more carboxyl groups in the same molecule. They are usually classified into α, β, χ., etc. according to the relative positions of the two functional groups. Only α-amino acids are important from biological view point.



α – A min o Pr opionic acid
(α – a min o acid)



β – Amino Propionic Acid
(β – amino acid)

CLASSIFICATION

Amino acids may also be classified into

(i) Neutral acidic

(ii) Basic amino acids.

Amino acids have also been classified as

(i) Non-essential amino acids :

Out of 20 amino acids required for protein synthesis, human body can synthesize only 10. These ten amino acids which the body can synthesize are called non-essential or dispensable amino acids.

1.	Glycine	2.	Alanine
3.	Serine	4.	Aspanticacid
5.	Asparagine	6.	Glutamine
7.	Tryosine	8.	Proline
9.	Cysteine	10.	Glutamic acid

ii) Essential or Indispensable Amino acids :

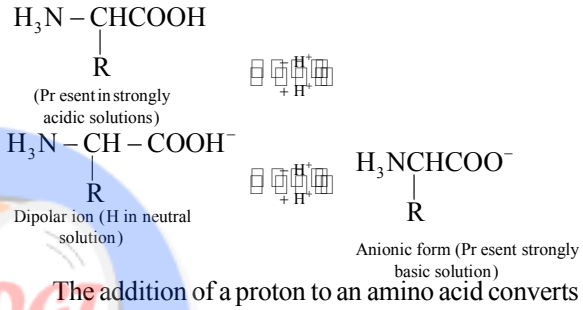
These are remaining ten amine acids, which the human body can not synthesize.

1.	Valine	2.	Leucine
3.	Isoleuinine	4.	Phenylalanine
5.	Methionine	6.	Fryptophe
7.	Threonine	8.	Leysine
9.	Arginine	10.	Histidine

A deficiency in any one of the essential amino acids prevents growth in young animals and may even cause death. Deficiency causes diseases such as KWASHIORKOR. Therefore there must be supplied in the humar diet.

Physical Properties of a Amino Acids

Amino acids are colourless, crystalline compound generally soluble in water, acids, alkalies, but sparingly soluble in organic solvents. These are high melting solids and behave like salts rather than simple amines or carbonylic. Since amino acids contain both a basic group ($-NH_2$) and an acidic group (– OOOH), they are amphoteric. In the dry solid state, they exist as dipolar ion (charged but electrically neutral). Such as ion as called **ZWITTERION**. In aqueous solution, an equilibrium exists between the dipolar ion and the anionic and the anionic and cationic forms of an amino acid



(Pr esent in strongly acidic solutions)

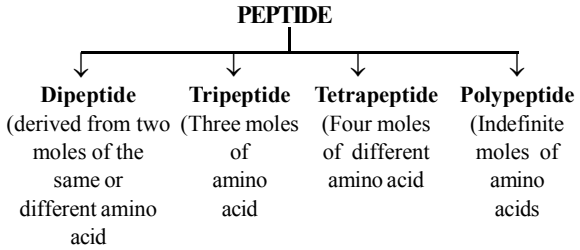
Dipolar ion (H in neutral solution)

Anionic form (Pr esent strongly basic solution)

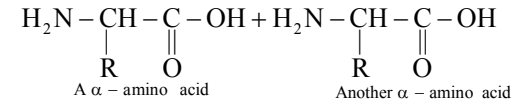
The addition of a proton to an amino acid converts it into a certain while the addition of a base converts it into an anion, hence it expected that at a definite pH value, the acidic and basic properties of the amino acid must be balanced and hence the amino acid at this particular pH should exist as a neutral dipolar ion (i.e. electrically neutral Zwitterion.) This pH at which there is no net charge on the amino acid molecule and which thus dose not migrate to any electrode under the influence of elective current is known as ***Isoelectric point.***

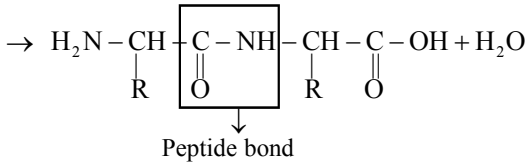
PEPTIDES

Peptide as a substance derived from two or more amino acids and united through peptide binds.



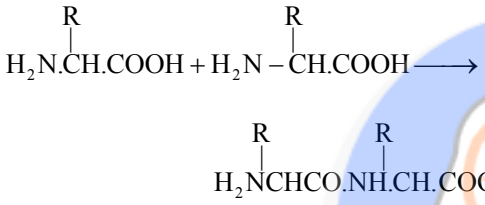
Proteins on hydrolysis break down into smaller **garments** called **peptides** which finally give a amino acid.





The $-\overset{O}{\overset{\|}{C}}-NH-$ Bond is called the **Peptide bond or the Peptide linkage.**

Polypeptides : An intermolecular reaction may take place between the carbonyl group of one amino acid and the amino group of another amino acid with elimination of a molecule of water.



Since the resulting molecule still has a free amino and a carboxyl group acids at either of the ends to give a higher molecular weight linear of condensation product. Products indicate that the every two amino acids are linked by means of a – CO – NH – group which is commonly known as peptide bond and hence the products arc known as peptides.

Properties of Polypeptides :

Polypeptides are amphoteric because of the presence of terminal ammonium and carboxylate ions as well as the ionized side chains of amino acid residues. Therefore they liferate as acid or bases and have an isoelectric point at which they are frequently least soluble.

Biological Function of Peptides :

The smaller peptides have important functions through their total content in tissues is small compared to proteins. Some of these are very potent. Most of the toxins (poisonous substances) in animal venoms and in plant sources are polypeptides. Minute amount of some oligopeptides with as few as three modified amino acids residues are effective as hormones. A derivatives ester (aspartame) is 160 times as sweet as sucrose and is used as sugar substitute.

MULTIPLE CHOICE QUESTIONS

1. An example of aldohexose
a) Ribose b) Fructose
c) Sucrose d) Glucose

2. Glycoside linkage is an
a) amide linkage b) ether linkage
c) ester linkage d) None of these

3. Glucose on reduction with sodium-amalgam in aqueous solution gives
a) mannitol
b) sorbitol
c) mannitol and sorbitol both
d) none of these

4. Glucose can be converted to fructose through
a) phenyl hydrozone formation
b) oxime formation
c) osazone formation, subsequent hydrolysis and reduction
d) none of these

5. Which of the following gives Fehling solution test?
a) Sucrose b) Glucose
c) Fats d) Proteins

6. A pyranose ring consists of a skeleton of
a) 5 carbon atoms and one oxygen atom
b) 6 carbon atoms
c) 6 carbon atoms and one oxygen atom
d) 4 carbon atoms and one oxygen atom

7. The sweetest carbohydrate is
a) Sucrose b) Glucose
c) Fructose d) Saccharine

8. Carbohydrates are stored in body as
a) glucose b) glycogen
c) starch d) monosaccharides

9. Hormone contains iodine is
a) thyroxine b) estrogen
b) adrenaline d) inslulin

10. Ascorbic acid is
a) Vitamin K b) Vitamin E
c) Vitamin B d) Vitamin C

11. A monosaccharide is
a) Glucose b) Fructose
c) Glyceraldehyde d) all of these

12. Hydrolysis of sucrose into (+) glucose and (–) fructose is known as
a) muta—rotation b) inversion
c) pyrolysis d) none of these

13. Which of the following enzymes hydrolyses triglycerides to fatty acids and glycerol ?
a) Amylase b) Maltase
c) Lipase d) Pepsin

14. A poor quality protein is
a) casein of milk b) Glutenin of wheat
c) albumin of egg d) fish

15. The vitamin which contains cobalt is
a) Vitamin B_6 b) Vitamin A
c) Vitamin B_{12} d) Vitamin E

16. Metabolic conversion of one mole of glucose to CO_2 and H_2O is accompanied by conversion of ..... mole of ADP to ATP.
a) 18 b) 19
c) 2 d) 38

17. The letter D in D-glucose signifies
a) dextro rotatory b) mode of synthesis
c) its configuration d) its diamagnetic nature

18. The first hormone synthesised in the laboratory was
a) andrenaline b) estrone and estradiol
c) cortisone d) insulin

19. Generally proteins contain more than
a) 50 α-aminoacids b) 100 α-aminoacids
c) 60 α-aminoacids d) 75 α-aminoacids

20. Which of the following is correct statement ?
a) Amylosc is a component of cellulose
b) Proteins are composed of only one type of amino acids
c) In cyclic structure of fructose, there are four carbon and one oxygen atom
d) Starch is a polymer of α-glucose

21. The linkage that holds monosaccharide units together in a polysaccharide is called
a) Peptide linkage
b) Glycoside linkage
c) Hydroxide linkage
d) Nucleoside linkage

22. Starch is polymer of
a) α-D-Glucose
b) β-D-Glucose
c) α-D-Glucose and β-D-Glucose
d) α-D-Fructorse

23. The approximate molecular weight of casein in amu is
a) 75000 b) 68000
c) 39000 d) 35100

24. In the stomach, proteins are hydrolysed by the operation of enzyme pepsin and H^+ to yield
a) Polypeptides b) peptones
c) proteoses d) a-aminoacids

25. For $-\overset{\overset{O}{\|}}{C}-\ddot{N}H-$ (peptide bond)
a) C — N bond length in proteins is longer than usual bond length of CN bond
b) spectroscopic analysis show planar structure of $-\overset{\overset{O}{\|}}{C}-NH-$ group
c) C — N bond length in proteins is smaller than usual bond length of C — N bond
d) none of these

26. A sucrose molecule on hydrolysis yields
a) Glucose
b) Fructose
c) Glucose and fructose
d) Glucose and galactose

27. In which of the following changes, maximum energy is released ?
a) ATP → ADP b) ADP → ATP
c) ADP → ATP d) AMP → ATP

28. Cod liver oil is rich in
a) Vitamin C b) Vitamin A
c) Vitamin B_6 d) Vitamin B_{12}

29. Which one of the following foods have a maximum calorific value for one gram of the material ?
a) Fats b) Oils
c) Proteins d) Carbohydrates

30. Which of the following does not reduce Fehling solution ?
a) Glucose b) Fructose
c) Sucrose d) Maltose

31. On heating with concentrated sulphuric acid, sucrose gives
a) CO and CO_2 b) CO and SO_2
c) CO, CO_2 and SO_2 d) None of these

32. Glucose contains
a) one—CHO group
b) one primary —OH group
c) four secondary —OH groups
d) all of these

33. Which one of the following elements is required for the formation of bones and cartilages ?
a) Iron b) Calcium
c) Iodine d) Cobalt

34. Interferon is
a) tonic b) virus
c) carbohydrate d) hormone

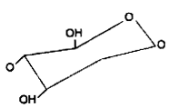
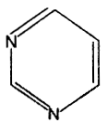
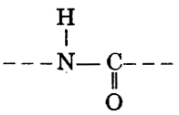
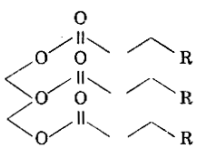
35. The base found in DNA not in RNA is
a) adenine b) cytosine
c) guanine d) thymine

36. Glucose on oxidation with bromine water gives
a) glyceric acid b) gluconic acid
c) saccharic acid d) pyruvic acid

37. The reagent which forms crystalline osazone derivative when reacted with glucose is
a) Fehling solutions b) Phenylhydrazine
c) Benedict solution d) Hydroxylamine

38. All protein that contain phosphorus is
a) casein b) egg albumin
c) hcamoglobin d) none of these

39. The disease xerophythalmia occurs due to the deficiency of vitamin
a) A b) B
c) C d) D

40. Chemical unit found in enzyme is
a) 
b) 
c) 
d) 

41. Glucose reacts with CH_3OH in the presence of dry HC1 to give
a) α-Methyl glucoside
b) β-methyl glucoside
c) both (a) and (b)
d) none of these

42. Which of the following compounds can reduce Tollen's reagent ?
a) Glucose b) Fructose
c) Maltose d) All of these

43. Night blindness is caused by the deficiency of vitamin
a) A b) Bt
c) B_{12} d) B_2

44. Xerosis desease is a/an
a) eye disease b) skin disease
c) liver disease d) lung disease

45. When some special substances like protein particles, blood corpuscles etc, are separated by a permeable membrane, the process is called
a) dialysis b) diffusion
c) endosmosis d) transpiration

46. Invert sugar is
a) a variety of cane sugar
b) optically inactive form of sugar
c) mixture of glucose and fructose in equimolar : proportion
d) mixture of glucose and galactose

47. The constituent units of sucrose are
a) lactose and glucose
b) glucose and fructose
c) galactose and glucose
d) glucose and maltose

48. Vitamin B_1 is also known as
a) riboflavin b) cobalamin
c) Thiamine d) pepsin

49. The enzyme present in saliva is
a) pepsin b) ptyalin
c) trypsin d) lipases

50. Which statement from the following are correct about enzymes ?
a) Enzyme lack in nucleophilic group
b) Enzymes are highly specific to add with chiral molecules and catalyze their reactions
c) Enzymes catalyze chemical reaction by reducing activation energy
d) Pepsin is a proteolytic enzyme

51. Amylopectin is a polymer of
a) β-D-glucose b) α-D-glucose
c) β-D-fructose d) α-D-fructose

52. Glucose gives silver mirror with Tollen's reagent, it shows the presence of a/an
a) alcoholic group b) keto group
c) aldehydic group d) acidic group

53. Vitamin B_6 is a mixture of
a) pryridoxalandpyridoxine
b) pyridoxal and pyridoxomine
c) aldehydic group
d) none of these

54. Disease scurvy is caused by the deficiency of Vitamin
a) A b B_6
c) C d) D

55. Peptide bond is an important characteristic in
a) polysaccharide b) protein
c) nucleotide d) vitamin

56. Which of the following can be used for detection of traces of iodine ?
a) Glucose in aqueous solution
b) Keto group
c) Aldehydic group
d) Acidic group

57. The main structural featured of proteins is
a) peptide linkage b) glycoside linkage
c) ether linkage d) all the these

58. Deficiency of vitamin B_6 causes
a) general nervousness
b) burning of eyes
c) scurvy
d) skin diseases

59. The diseases caused due to deficiency of vitamin C is
a) Scurvy b) Xerophthalmic
c) Sterility d) All of these

60. Disaccharide present in milk is
a cellulose b) sucrose
c) lactose d) maltose

61. Which of the following a-amino acids is not optically active ?
a) α-Alanine b) Glycylalanine
c) Phenylalanine d) All are optically active

62. The name of the dipeptide

is
a) Glycylglycine b) Glycylalanine
c) Glycine alanine d) Alanylglycine

63. Deficiency of vitamin B_{12} cause
a) loss of appetite
b) anaemia
c) pernicious anaemia
d) skin diseases

64. Deficiency of vitamin D causes
a) anaemia b) breast cancer
c) lung cancer d) rickets

65. The work of enzyme in living system is
a) to catalyse bio-chemical reaction
b) oxygen transfer
c) to provide immunity
d) to provide energy

66. β-pleated structure of proteins is
a) primary structure
b) secondary structure
c) tertiary structure
d) quaternary structure

67. The proteins with a prosthetic group are known as
a) complex proteins b) conjugated proteins
b) secondary proteins d) essential proteins

68. Deficiency of red blood corpuscles causes
a) beri-beri b) anaemia
c) typhoid d) loss of appetite

69. Insulin is used in the treatment of
a) anaemia b) breast cancer
c) lung cancer d) diabetes

70. The coupling between base units of DNA is through
a) electrostatic bonding
b) covalent bonding
c) vander waal's forces
d) hydrogen bonding

71. A test for proteins is
a) Molisch's test b) Beilstein test
c) Biuret test d) Benedict's test

72. The destruction of the biological nature and activity of proteins by heat or chemical agent is called
a) dehydration b) denaturation
c) denitrogenation d) deammination

73. The main harmful drug found in tobacoo is
a) chinchonine b) quinine
c) nicotine d) pipeline

74. Which one of the following vitamins contains nitrogen ?
a) B_1 b) C
c) D d) A

75. Which one is responsible for energy production in bio reaction ?
a) Thyroxine b) Adrenaline
c) Oestrogen d) Progestrone

76. At isoelectric point, the amino acid has
a) least viscosity
b) maximum surface tension
c) maximum solubility
d) all of these

77. α-Amino acids behave as crystalline ionic solids and have high melting point due to the presence of
a) —NH_2 group
b) —COOH group
c) Both — NH_2 and —COOH group
d) none of these

78. Vitamin containing colbalt is
a) B_1 b) B_2
c) B_6 d) B_{12}

79. Antirachitic vitamin is also known as
a) A b) B complex
c) C d) D

80. How many ATP will be formed by oxidation of 1 mole of glucose ?
a) 24 b) 32
c) 38 d) 40

81. An example of globular protein is
a) Myosin b) Collagen
c) Keratin d) Haemoglobin

82. An example of fibrous protein is
a) Insulin b) Haemoglobin
c) Fibroin d) Glucogen

83. The sex hormone is
a) parathormone b) gonadotrophins
c) hydrocortisone d) androsterone

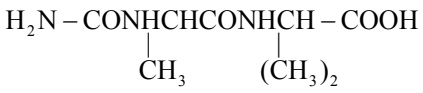
84. The digestive fat splitting enzymes are known as
a) lipases b) esteroses
c) deaminases d) proteolytic enzymes

85. Which of the following is steroid hormones ?
a) Progestrone b) Cholesterol
c) ACTH d) Adrenaline

86. The disease phenyl ketone urea is caused by the deficiency of
a) acetophenone
b) phenyl acetone
c) triosinase
d) phenylanime hydroxylase

87. Lecithin is an example of
a) a simple lipid b) waxes
c) phospholipids d) none of these

88. The structure of a peptide is



The name of the peptide is
a) gylcyl alanyl valine
b) glycyl valyl alanine
c) alonyl valyl glycine
d) valyl alanyl glycine

89. Which of the following is an ester ?
a) Kerosene oil b) Soap
c) Bees wax d) Peptoses

90. The ATP produced by lipid metabolism of the molecule of palmitic acid
a) 36 b) 56
c) 86 d) 130

91. Enzymes are
a) complex nitrogenous substances produced in living cells
b) steroids
c) living organisms
d) dead organisms

92. On heating with cone. HNO_3, proteins give yellow colour. This test is called
a) oxidizing test b) xanthoproteic test
c) biuret test d) acid base test

93. Pick out the wrong combination
a) $Mg^{2+} \rightarrow$ Photosynthesis
b) $Fe^{2+} \rightarrow$ Haemoglobin
c) $Se^{2+} \rightarrow$ Kreb's cycle
d) $CO^{2+} \rightarrow$ Vitamin B_{12}

94. Which one of the following is not present in RNA?
a) Uracil b) Thymine
c) Ribose d) Phosphate

95. The reaction of oxygen and carbon monoxide with haemoglobin yields
a) only oxygen-haem complex
b) only CO-haem complex
c) both, but O_2-haem complex is more stable
d) both but CO-haem complex is more stable

96. Pyrimidine bases present in RNA are
a) adenine and guanine
b) thymine and uracil
c) uracil and cytosine
d) thymine and cytosine

97. In AMP, the sequence is
a) sugar-base-phosphate
b) sugar-phosphate-base
c) phosphate-sugar-base
d) phosphate-base-sugar

98. Vitamin B deficiency leads to disease known as
a) blindness b) beri-beri
c) scurvy d) T.B

99. Which one of the following is present in DNA molecule ?
a) Glucose b) Deoxyribose
c) Ribose d) Fructose

100. The change in pH of blood is not significant by adding a little acid or base because blood
a) is easily coagulated
b) has serum protein which works as buffer
c) is a body fluid
d) has iron as a part of molecule

101. The sequence of bases on m-RNA molecule, synthesized on the GCATATGGA strand of DNA is
a) CGUAUACCU b) CGTATACCT
c) TACGCGATTC d) ATCGCGTTC

102. Corresponding to Guanine in DNA, the , complementary base in RNA is
a) Cytosine b) Thymine
c) Uracil d) Adenine

103. The hormone connected with the growth of animals is
a) pepsin b) pityalin
c) remine d) thyroxine

104. Which of the following is not normally a use of protein in the body for ?
a) fingernails and hair b) skin
c) skeletal muscles d) energy for metabolism

105. The oxidation of glucose in living cell is an important reaction. The number of ATP molecules produced from one molecules of glucose in cell is
a) 38 b) 28
c) 18 d) 12

106. A nucleotide is made up of
a) base and sugar
b) base and phosphoric acid unit
c) sugar and phosphoric acid unit
d) sugar, a base and a phosphoric acid unit

107. The relation between nucleotide triplets and the amino acids is called
a) Transcription b) Duplication
c) Genetic code d) Gene

108. Which of the following is not a component of a typical nucleotide ?
a) A sugar b) A protein
c) A nitrogen base d) Phosphoric acid

109. Which ion has important contribution in muscle contraction ?
a) K^+ b) Mg^{2+}
c) Na^+ d) Ca^{2+}

110. Glucose + x phenyl hydraisine → Osazone, x will be?
a) 2 b) 1
c) 4 d) 3

111. Relation between amino acids and proteins is similar to the one present between
a) nucleotides and nucleic acids
b) nucleosides and nucleic acids
c) RNA and DNA
d) glucose and fractose

112. Stearic acid, palmitic acid and linolenic acid are
a) α-Amino acids b) fatty acids
c) nucleic acid d) α-Hydroxy acids

● ● ● ●

Answer Key

1.(d)	2.(b)	3.(b)	4.(c)	5.(b)	6.(a)	7.(c)	8.(b)	9.(a)	10.(d)
11.(d)	12.(b)	13.(c)	14.(b)	15.(c)	16.(d)	17.(c)	18.(a)	19.(b)	20.(d)
21.(b)	22.(a)	23.(a)	24.(c)	25.(c)	26.(a)	27.(c)	28.(a)	29.(b)	30.(c)
31.(c)	32.(d)	33.(b)	34.(b)	35.(d)	36.(b)	37.(b)	38.(a)	39.(a)	40.(a)
41.(c)	42.(d)	43.(a)	44.(b)	45.(a)	46.(c)	47.(b)	48.(c)	49.(b)	50.(b)
51.(b)	52.(c)	53. (c)	54.(c)	55.(b)	56.(b)	57.(d)	58.(a)	59.(a)	60.(c)
61.(b)	62.(d)	63.(c)	64.(d)	65.(a)	66.(b)	67.(b)	68.(b)	69.(d)	70.(d)
71.(c)	72.(a)	73.(c)	74.(a)	75.(a)	76.(a)	77.(a)	78.(d)	79.(d)	80.(c)
81.(c)	82.(c)	83.(d)	84.(a)	85.(a)	86.(d)	87.(c)	88.(a)	89.(c)	90.(d)
91.(a)	92.(b)	93.(c)	94.(b)	95.(b)	96.(c)	97.(c)	98.(b)	99.(b)	100.(b)
101.(a)	102.(a)	103.(d)	104.(d)	105.(a)	106.(d)	107.(c)	108.(b)	109.(c)	110.(d)
111.(a)	112.(b)								


DGT