CELL CHEMISTRY ANSWERS

1. (a) An autotrophic organism such as a plant can convert simple compounds such as water and carbon dioxide into more complex compounds such as sugars.

1. (b) Autotrophic organisms may be photosynthetic (obtaining energy from the sun e.g. plants) or chemosynthetic (obtaining energy from a simple chemical e.g. bacteria on the Titanic's hull use the iron as their energy source).

2. Heterotrophs take in complex compounds and convert them to simpler compounds. For example, consumers (organisms that eat) take in food containing complex carbohydrates, proteins and lipids. Consumers may be predators, scavengers or parasites. Other heterotrophs are decomposers such as bacteria and fungi which obtain their nutrients from dead matter or wastes such as faeces.

3. An element is a substance with only one type of atom (e.g. oxygen, nitrogen). A compound is a substance containing different types of atoms bonded together (e.g. water, carbon dioxide).

4. (a) An atom is the smallest building block of matter.

4. (b) An ion is a positively-charged or a negatively-charged atom. Salts such as sodium chloride are made from ions bonded together.

4. (c) pH is the measure of hydrogen ions in acids. A pH equal to 7 is neutral (e.g. of water). A pH less than 7 is acidic. A pH more than 7 is basic.

4. (d) Acids have a pH less than 7, have a sour taste, are corrosive, and are neutralised by bases. Examples of acids are uric acid in urine, acetic acid in vinegar, citric acid in oranges and lemons, and hydrochloric acid in stomach juice.

4. (e) Bases or alkalis have a pH more than 7, have a soapy feel, are corrosive, and are neutralised by acids. Examples of bases are the pancreatic juice secreted into the small intestine to neutralise stomach acid, and some cleaning agents.

5. A Chemical Reaction is a change which produces a new substance with a different chemical composition to the reactant chemicals (e.g. respiration, photosynthesis).

6. Water can dissolve many compounds such as salts, sugars and gases. It is also fluid and has the ability to carry large cells like red blood cells. Therefore water is a fluid in which many substances can be transported from one place to another, and it can readily mix chemicals to speed up chemical reactions within cells.

7. Organic means “containing carbon atoms”. Carbohydrates, lipids, proteins and nucleic acids all contain carbon atoms.

8. A macromolecule is a very large molecule. Macromolecules are often made of many smaller molecules bonded together in long chain-like structures. Examples are carbohydrates, proteins and nucleic acids (DNA, RNA).

9. Carbohydrates may be Monosaccharides (simple sugars such as glucose), Disaccharides (double-sugars such as sucrose) or Polysaccharides (many-sugars such as starch, cellulose or chitin in crustacean shells).

10. Carbohydrates are made of small repeated units called simple sugars or monosaccharides.

11. * Monosaccharides - Glucose, Fructose (fruit sugar), Ribose (the sugar in RNA) .

* Disaccharides - Sucrose (table sugar), Lactose (milk sugar), Maltose (malt sugar).

* Polysaccharides - Starch (in potato bread and pasta), Cellulose (in plant cell walls), Chitin (in crustacean shells).

12. Sugar is transported in animals in the form of glucose (a monosaccharide), and in plants in the form of sucrose (table sugar which is a disaccharide).

13. The larger the molecule, the less soluble it becomes. For example, glucose dissolves more readily in water than sucrose, but starch doesn’t dissolve readily at all.

14. * Starch Test - Add a few drops of orange-brown Iodine Solution, and a food containing starch will turn purplish-brown.

* Glucose Test - Add a small amount of blue Benedict’s Solution, heat it for less than a minute, and a food containing glucose will change to orange.

15. The main function of carbohydrates is as a source of energy in the respiration process. Some carbohydrates have a structural role.

16. Lipids include fats, oils, waxes and steroids.

17. Lipids are small molecules made of 1 molecule of glycerol bonded to 3 molecules of fatty acid.

18. Hydrophobic means “water-hating”. Lipids are substances that do not dissolve in water. They do not attract water molecules.

19. Some functions of lipids are as a structural material (e.g. all membranes are half lipid and half protein), as a protective or insulating material (e.g. whale blubber), and an energy source (after carbohydrates).

20. * Oils - sunflower oil, peanut oil.

*Fats - whale blubber, protective fat around kidneys.

* Waxes - beeswax.

*Steroids - Vitamin D, cholesterol, and some hormones such as the human male and female sex hormones.

21.The three different types of proteins are fibrous proteins, globular proteins and conjugated proteins.

22. An example of species identification - The proteins in the cells of a chimpanzee differ slightly from the proteins in the cells of humans. They are both markedly different from the cells of a horse. Scientists have used this fact as evidence for the evolutionary theory.

Another example of human blood type - Antibodies are proteins in our blood which differ from one human to the next, and are identified in blood typing.

23. No. Different protein sequences have different combinations of some of the possible amino acids. A protein may have multiples of any amino acid.

24. The essential amino acids are those which humans cannot manufacture within their bodies from other chemicals. Therefore we must eat them in our food.

25. Some of the many functions of proteins are enzymes (which speed up chemical reactions e.g. protease helps break down proteins), hormones (e.g. insulin), structure (e.g. in cell membranes), transport (e.g. haemoglogin carries oxygen in red blood cells), and defence (e.g. antibodies).

26. Nucleic acids (DNA, RNA) are composed of nucleotides. Each nucleotide is composed of a nitrogen-containing base, a phosphate group, and a sugar.

27. No. Most DNA is found in the nucleus, although very small amounts of inactive DNA have been found in mitochondria and chloroplasts. RNA is found in the nucleus where it is made from DNA, and in the cytoplasm, mainly in ribosomes.

28. DNA (Deoxyribonucleic Acid) and RNA (Ribonucleic Acid).

29. Each nucleotide in either DNA or RNA is composed of a nitrogen base, a phosphate group, and a sugar.

(a) The nitrogen bases in DNA are Adenine and Thymine, and Guanine and Cytosine. The sugar in DNA is deoxyribose, ribose without an oxygen atom.

(b) The nitrogen bases in RNA are Adenine and Uracil, and Guanine and Cytosine. The sugar in RNA is ribose.

30. *DNA - double-stranded structure

- nitrogen bases are adenine and thymine, guanine and cytosine, & sugar is deoxyribose
- found in the nucleus

*RNA - single-stranded structure

- nitrogen bases are adenine and uracil, and guanine and cytosine, and the sugar is ribose
- found in both the nucleus and in the cytoplasm, particularly in ribosomes