UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY
NATIONAL DIPLOMA: SOMATOLOGY

MODULE SCI101
SCIENCE I

CAMPUS **DFC**

NOVEMBER EXAMINATION

DATE: 19/11/2014 **SESSION: 08:30-11:30**

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DURATION: 3 HOURS **FULL MARKS: 160**
TOTAL MARKS: 163

NUMBER OF PAGES: 12 PAGES AND 3 ANNEXURES (PERIODIC TABLE AND PHYSICS FORMULA SHEET)

INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT).
ANSWER EACH SECTION IN A SEPARATE ANSWER SCRIPT.
THE QUESTION PAPER MUST BE HANDED IN WITH THE ANSWER SCRIPTS.

REQUIREMENTS: TWO UJ MULTIPLE CHOICE ANSWER SHEET.
TWO ANSWER SCRIPTS.

INSTRUCTIONS TO STUDENTS:

1. This paper consists of **two parts**:
   PART A: CHEMISTRY (Section 1: Multiple Choice Questions and Section 2: Long Questions).
   PART B: PHYSICS (Section 1: Multiple Choice Questions and Section 2: Long Questions).

2. You will receive **2 multiple choice answer sheets** – one for **Part A** and one for **Part B**. Please complete your personal information on the front of the multiple choice answer sheet and **clearly indicate** on the multiple choice answer sheet **if it is used for Part A or Part B.**

3. You will receive **two answer scripts** for answering the long questions – one for **Part A** and one for **Part B**. Please complete your personal information on the front of the script and **clearly indicate** on the script **whether it is used for Part A or Part B.**

4. **THE QUESTION PAPER MUST BE HANDED IN WITH THE TWO ANSWER SCRIPTS ALONG WITH THE MULTIPLE CHOICE ANSWER SHEETS.**

PART A: CHEMISTRY

SECTION 1

- *Answer the multiple choice questions on the supplied multiple choice answer sheet by shading the block corresponding to the correct option, preferably using a soft pencil.*

1. Suppose element "X" has an atomic number of 92 and an atomic mass of 216. An atom of this element then has _____ electrons, _____ protons and _____ neutrons.

   A. 216 electrons, 216 protons, 92 neutrons
   B. 124 electrons, 92 protons, 92 neutrons
   C. 92 electrons, 92 protons, 216 neutrons
   D. 92 electrons, 92 protons, 124 neutrons

2. If a mixture is non-uniform in composition and properties, but the constituents are clearly distinguishable, it would be called a …

   A. heterogeneous mixture
   B. compound mixture
   C. homogeneous mixture
   D. monogeneous mixture

3. Which subatomic particles are to be found in the atomic nucleus?

   A. Protons, electrons
   B. Electrons, neutrons
   C. Protons, neutrons
   D. Protons, neutrons, electrons

4. Group 2A of the Periodic Table are the_____, whereas the halogens are found in group _____.

   A. alkaline earth metals; 7A
   B. alkali metals; 5A
   C. alkaline earth metals; 6A
   D. transition metals; 7A

5. Which of the following are **all** characteristics of non-metals?

   A. They conduct heat and electricity, are shiny as well as malleable and ductile, and can be solid, liquid or gas at room temperature.
   B. They are good insulators, can be shaped and stretched without breaking and are solid at room temperature except for mercury.
   C. They are good insulators, are malleable and ductile and if they are solid at room temperature they are brittle and break easily.
   D. They are good insulators, are dull as well as brittle, and are all solid, liquids and gases at room temperature.

6. Which of the following **correctly** describes a pure substance?

   A. Its composition can vary and it can only be broken down into its components by chemical means.
   B. It has a specific composition, but it can be broken down into its components by physical means.
   C. It has a specific composition and cannot be broken down into its components by physical means.
   D. Its composition can vary and it cannot be broken down into its components by physical means.

7. Atoms that have lost electrons in the valence shell are known as

   A. cations
   B. anions
   C. isotopes
   D. ions

8. How does a magnesium atom form a bond with an oxygen atom?

   A. by giving one pair of electrons to the oxygen atom.
   B. by sharing one pair of electrons, both electrons provided by the magnesium atom.
   C. by sharing two pairs of electrons, both provided by the oxygen atom.
   D. by sharing two pairs of electrons, each atom donating one pair of electron.

9. Al^{3+} and SO_4^{2-} combine to form a salt with the formula.....

   A. $Al_2(SO_4)_3$
   B. Al_2SO_4
   C. $Al_3S_2O_4$
   D. $Al_2^{+}SO_4^{2-}$

10. The process by which water is broken down into hydrogen and oxygen is known as _____ and requires the application of _____.

A. distillation; heat
B. decomposition; heat
C. distillation; electric current
D. electrolysis; electric current

11. Heat capacity can be defined as the amount of heat that must flow into a substance in order to

A. lower its temperature by one degree Celsius.
B. raise its temperature by one degree Celsius.
C. raise its temperature to boiling point.
D. turn ice into liquid water.

12. Crystals that contain a definite proportion of water by weight are called

A. hydrolysed
B. aqueous
C. non-polar
D. hydrates

13. In the process called “recrystallisation”, solvents are used to

A. purify compounds that have different solubilities depending on temperature.
B. distribute a uniform layer of a substance on a surface due to their volatility.
C. remove grease because “like dissolves like”.
D. provide a medium for the atoms to collide and react.

14. The force of attraction between molecules of the same kind is called _____, while that between molecules of different kinds is called _____.

A. adhesion; cohesion
B. cohesion; viscosity
C. cohesion; adhesion
D. adhesion; surface tension

15. Osmosis is described as....

A. diffusion of solute molecules through a semi-permeable membrane from a region of low concentration of solute to one of high concentration of solute.
B. diffusion of solvent molecules through a semi-permeable membrane from a region of low concentration of solvent to one of high concentration of solvent.
C. diffusion of solvent molecules through a semi-permeable membrane from a region of low concentration of solute to one of high concentration of solute.
D. Diffusion of solvent molecules through a semi-permeable membrane from a region of high concentration of solute to one of low concentration of solute.

16. Solutions….

A. are heterogeneous mixtures of solute and solvents.
B. can be separated into their components by filtration.
C. have a fixed composition of solute and solvent.
D. are very often transparent.

17. Choose the **correct** statement concerning the structure of the water molecule.

A. The oxygen atom has a greater attraction for shared electrons than the hydrogen atom.
B. The oxygen atom carries a slight positive charge.
C. The hydrogen atom carries a slight negative charge.
D. The hydrogen atoms are ionically bonded to the oxygen atom.

18. What type of colloid is whipped cream?

A. Liquid in solid
B. Gas in liquid
C. Solid in liquid
D. Liquid in gas

19. The phenomenon used to differentiate between colloids and true solutions is called the _____ effect.

A. Van't Hoff
B. Raoult
C. Tyndall
D. Osmotic

20. Which one of the following statements on the colligative properties of solutions is **correct**?

A. The boiling point of a solution is always less than that of the pure solvent.
B. Osmosis is the diffusion of solute particles through a selectively permeable membrane.
C. Surface tension is the force that causes the surface of a liquid to expand.
D. Colligative properties depend only on the number of solute particles in a solution.

21. Which of the following combinations are immiscible?

A. Water and acetic acid
B. Water and chloroform
C. Water and ethanol
D. Water and ammonia

22. Which of the following is **true**?

A. Oxidation is the gain of oxygen.
B. Oxidation is the loss of oxygen.
C. Reduction is the loss of hydrogen.
D. Reduction is the loss of electrons.

23. Which of the following statements regarding the pH scale is **false**?

A. It is a measure of the relative acidity or basicity of a substance.
B. Acidity increases from 1 to 14, with each unit being ten times more acid than the previous.
C. The pH is arrived at by mathematically converting the concentration of H^+ ions to a value between 1 and 14.
D. The neutral point is 7, the pH of pure water.

24. Chlorobenzene belongs to the following family of hydrocarbons:

A. aliphatic hydrocarbons
B. cyclical hydrocarbons
C. aromatic hydrocarbons
D. saturated hydrocarbons

25. What is the structure of the product for the reaction between; CH_3-CH_2-CH=CH_2 and bromine (Br_2)?

A. CH_2-Br-CH_2-CH_2-CH_2Br
B. CH_2Br-CH_2-CHBr-CH_3
C. CH_3-CH_2Br-CH_2-CH_2Br
D. CH_3-CH_2-CHBr-CH_2Br

26. The process used to separate the different hydrocarbons occurring in petroleum is called

A. halogenation
B. solvent extraction
C. neutralization
D. fractional distillation

27. Carboxylic acids are formed by

A. oxidation of an inorganic acid
B. the addition of a strong base
C. oxidation of an aldehyde
D. reduction of alcohols

28. Alkanes are a homologous series of organic compounds. Which statement about alkanes is correct?

A. Their name always end with the suffix -ane.
B. Their general formula is C_nH_{2n}.
C. They are unsaturated hydrocarbons.
D. They take part in addition reactions.

29. Which compound would undergo an addition reaction with chlorine

A. C_2H_4
B. C_2H_6
C. C_2H_5OH
D. CH_3COOH

30. Esters are formed when an.....

A. alcohol is reduced .
B. alcohol reacts with a carboxylic acid.
C. alcohol reacts with sulphuric acid.
D. alcohol is oxidised.

31. Choose the **incorrect** statement. "In the commercial process of saponification …

A. esters are hydrolysed in presence of a long chain fatty acid.
B. esters are hydrolysed in presence of a base.
C. the products are the salt of a carboxylic acid and an alcohol.
D. glycerol is formed as a by-product.

32. Which of the following statements concerning synthetic detergents is **true**?

A. Cationic detergents are often used as fabric softeners because of their positive charge.
B. Anionic detergents are used for synthetic fabrics because they tend to be liquids.
C. Nonionic detergents have antiseptic properties because they contain ammonium salts.
D. Cationic detergents absorb water easily and are used for natural fabrics.

33. Hard water contains dissolved

A. ions of manganese and/or sodium and/or potassium.
B. fatty acids.
C. Glycerol.
D. ions of magnesium and/or calcium and/or iron.

34. Which of the following is **not** a monosaccharide?

A. Glucose
B. Maltose
C. Fructose
D. Galactose

35. Choose the **correct** statement regarding gels from the following.

A. When the force of attraction between the suspended colloidal particles and the dispersing medium is small, the system is called a gel.
B. A gel will pour easily.
C. When heated, a gel will turn into a sol but will revert back to a gel on cooling.
D. A typical example of a gel is a suspension of starch in water.

36. The scent of perfumes is said to be characterized by “notes”. This refers to

A. the rate of evaporation of its components.
B. the ratio of musky scents to floral scents.
C. the length of time that a perfume’s scent will last.
D. whether the perfume is of natural origin or synthetically produced.

37. Which of the following is an ingredient of an antiperspirant?

A. Zinc iodide
B. Aluminium salts
C. Zinc bromide
D. Zinc fluoride

38. Which of the following is **incorrect**?

A. Essential oils are mostly derived from plants.
B. Ambergris is obtained from the vomit of whales.
C. Many esters have fruity aromas.
D. Castor oil is an example of a fixative.

39. Hair is composed of a protein called keratin which

A. dissolves in alcohol.
B. consists of long strands of amino acids.
C. has sulphur atoms linked by hydrogen bonds.
D. is polar.

40. Which of the following statements concerning deodorants is **false**?

A. They generally contain salts of zinc as antibacterial agents.
B. They contain various fragrances that will mask offending aromas.
C. They may contain antibiotics.
D. They stop perspiration by blocking the pores.

41. Permanent changes to the shape of hair require

A. the loosening of the hydrogen bonds between the amino acid strands.
B. wetting the hair, shaping it, then drying it in the desired shape.
C. the breaking of the sulphur “bridges” between the amino acid strands.
D. oxidising the covalent bonds with thioglycolate.

42. Choose the **incorrect** statement from the following.

A. Naturally occurring resins can be obtained from the fluid that oozes from the wounds of certain plants.
B. Resins are soluble in water.
C. Resins can be used in the manufacturing of perfumes because they are often strongly fragranced.
D. Shellac is an example of a resin that is used in hair sprays.

[42 × 2 = 84]

SECTION 2

QUESTION 1

1.1 Explain the difference between an *element* and a *compound* and give an example in each. (4)

1.2 Describe what is meant by *covalent bonding* and give an applicable Lewis structure of a substance to illustrate your answer. (4)

1.3 Use a labelled diagram to describe what happens at a molecular level when NaCl dissolves in water. (4)

1.4 Balance the following chemical equations: (4)

a) $KClO_3$ (s) $\rightarrow$ KCl (s) + O_2 (g)
b) CH_4 (g) + O_2 (g) $\rightarrow$ CO_2 (g) + H_2O (g)

[16]

QUESTION 2

2.1 Define the term *base* and give an applicable example to illustrate your answer. (3)

2.2 Consider the following reaction; $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$**.** Identify the substance that is reduced and the substance that is oxidised. Motivate your answer. (4)

2.3 Use a diagram to illustrate the characteristics of a soap molecule. (3)

[10]

QUESTION 3

3.1 Give the origin and list <u>*two*</u> uses of agar-agar. (3)

3.2 Describe the '*Enfleurage'* process used for the extraction of floral oils. (3)

3.3 Distinguish between a *temporary* and *permanent hair dyes*. (4)

[10]

<u>MARKS PART A: 120</u>

PART B: PHYSICS

SECTION 1

- *Answer the multiple choice questions on the supplied multiple choice answer sheet by shading the block corresponding to the correct option, preferably using a soft pencil.*
- ***Clearly indicate** on the multiple choice answer sheet that this is the multiple choice answer sheet for **Part B: Physics**.*

1. Converting 15 km to m gives

   A. 15 000 m
   B 15 m
   C. 15 000 km
   D. 0.15 m

2. Which of the following is not an SI base unit?

   A. Kilogram
   B. Second
   C. Kelvin
   D. Milli-meter

3. Which of the following is the SI unit of temperature?

   A. Kilograms
   B. Centigrade
   C. Kelvin
   D. Joules

4. The following will occur by adding or removing heat from an object

   A. Change in shape or size
   B. Change in Temperature
   C. Change in phase
   D. Both A, B and C are correct

5. A mercury barometer is used as an instrument for measuring

   A. Density
   B. Atmospheric pressure
   C. RD of mercury
   D. Atmosphere

6. The SI unit for specific heat capacity is

   A. $J.\ {}^{0}C^{-1}$
   B. $J.\ kg^{-1}$
   C. $J.\ kg^{-1}.\ {}^{0}C^{-1}$
   D. Joule

7. The process whereby some solids change directly to gas is called

   A. Melting
   B. Condensation
   C. Sublimation
   D Boiling

8. One of the laws of reflection of light states that

   A. the incident ray is equal to the reflected ray
   B. the angle of incidence is equal to the angle of refraction
   C. the incident ray, normal and the refracted ray all lie in the same plane
   D. the angle of incidence is equal to the angle of reflection

[8 × 2 = 16]

SECTION 2

QUESTION 1

1.1 Define *area*. (2)

1.2 State one difference between mass and weight. (1)

1.3 The volume of a cylinder is 1540 cm^3. The radius of it is 7 cm. Calculate the height of the cylinder (in cm). (3)

1.4 An empty RD bottle has a mass of 20 g, filled with water 70 g and filled with spirits 64 g. Calculate the RD of spirits. (4)

1.5 State Pascal's principle. (2)

1.6 Convert the pressure of 650 mm Hg to a pressure in kPa. (3)

[15]

QUESTION 2

2.1 State the Law of Heat exchange. (2)

2.2 How much heat must be added to 3 kg of water to raise its temperature from 20 °C to 80 °C? (3)

2.3 State two properties of all electromagnetic waves (2)

2.4 State two differences between a *real image* and a *virtual image*. (2)

2.5 Determine the velocity of light in water of refractive index 4/3. (3)

[12]

TOTAL MARKS PART B: 43
FULL MARKS PART B: 40