



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2019

TECHNICAL SCIENCES: PAPER II

Time: 3 hours

150 marks

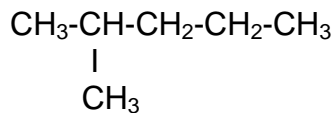
PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 12 pages and a Data Sheet of 4 pages (i–iv). Please check that your question paper is complete.
 2. This paper consists of TEN questions. Answer ALL the questions in the Answer Book.
 3. Please start each question on a new page of your Answer Book.
 4. Number your answers exactly as the questions are numbered in the question paper.
 5. Leave ONE line open between sub-questions, for example between QUESTION 2.2 and QUESTION 2.3.
 6. You may use a non-programmable calculator.
 7. You may use appropriate mathematical instruments.
 8. You are advised to use the attached DATA SHEET.
 9. Show ALL formulae and substitutions in ALL calculations.
 10. Round off your final numerical answers to a MINIMUM of TWO decimal places.
 11. Give brief motivations, discussions, etc. where required.
 12. Read the questions carefully.
 13. Do not write in the margin.
 14. It is in your own interest to write legibly and to present your work neatly.
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QUESTION 1

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Choose the correct answer and only write A, B, C or D next to the question number (1.1–1.10) in your Answer Book.

1.1 The IUPAC name for



- A 2-ethylbutane
- B 2-methylbutane
- C 2-methylpentane
- D 3-ethylbutane

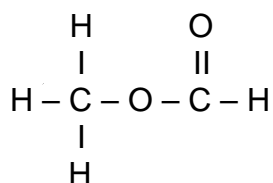
1.2 Which one of the following compounds has the molecular formula $\text{C}_4\text{H}_{10}\text{O}$?

- A 2-methylpropanone
- B 1,1-dimethylethanol
- C 2-butanol
- D 2-methylpropanal

1.3 Which one of the following belongs to the same homologous series as C_3H_8 ?

- A C_2H_2
- B C_3H_6
- C C_3H_4
- D C_4H_{10}

1.4 The following ester is produced by which substances?



- A Methanal and methanoic acid
- B Methanol and methanone
- C Methanol and methanoic acid
- D Methanal and methanone

1.5 The property of light where it changes direction when passing from a dense medium to a denser medium at an angle is ...

- A reflection.
- B diffraction.
- C refraction.
- D dispersion.

1.6 Two waves pass from one medium to another, they enter the second, denser medium at an angle. Wave A has a wavelength of 4,5 nm and wave B has a wavelength of 3,2 μm .

- A A will be refracted more than B
- B A and B will be equally refracted
- C B will be refracted more than A
- D Neither A nor B will be refracted

1.7 Light consists of photons, which are ...

- A packets of light.
- B packets of energy.
- C packets of ultraviolet rays.
- D packets of infrared rays.

1.8 A student sets up a Zn/Cu galvanic cell. The cathode ...

- A is the negative electrode.
- B is made out of copper.
- C attracts anions from the solution.
- D undergoes a mass decrease over time.

1.9 A student sets up a silver/zinc electrochemical cell. The most suitable solution for the salt bridge would be:

- A NaCl
- B KCl
- C NaNO_3
- D CCl_4

1.10 In the following cell



the oxidizing agent is:

- A Al
- B Al^{3+}
- C Fe^{2+}
- D Fe

[20]

QUESTION 2

The letters A to F in the table below represent six organic compounds. Use these compounds to answer the questions that follow.

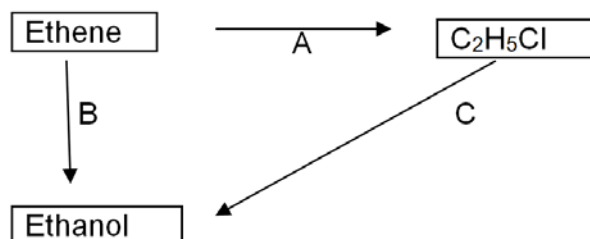
A	<pre> H H H O H H H - C - C - C - C - C - H H H H H H </pre>	B	<pre> H H H H H H - C = C - C = C - C - H H </pre>
C	2,3-dichloropentane	D	<pre> H H H O H - C - C - C - C - O - H H H H </pre>
E	2-Methylbutanal	F	C_3H_6

- 2.1 Define the term *homologous series*. (2)
- 2.2 Write down the letters of the two compounds that belong to the same homologous series. (2)
- 2.3 Draw the structural formula for the compound:
- 2.3.1 C (2)
- 2.3.2 E (2)
- 2.4 Write the IUPAC name of:
- 2.4.1 D (2)
- 2.4.2 F (2)
- 2.5 Write down the letter that represents an aldehyde. (2)
- 2.6 Define the term *positional isomer*. (2)
- 2.7 Draw a positional isomer for compound A and give the IUPAC name. (4)

[20]

QUESTION 3

Study the flow chart below and use it to answer the following questions.



- 3.1 Is ethene a saturated or an unsaturated compound? (1)
- 3.2 Name a substance that can be used in reaction A. (1)
- 3.3 What type of addition reaction takes place at A? (1)
- 3.4 A hydration reaction takes place at B. Name two reaction conditions for this type of reaction to take place. (2)
- 3.5 Give the name or formula of the substance that must be added at reaction C to produce ethanol from a haloalkane. (1)
- 3.6 What type of reaction takes place at C? (1)
- 3.7 Write down a balanced equation for the reaction at C, using structural formulae for organic reagents. (3)
- [10]**

QUESTION 4

- 4.1 Define *monomer*. (2)
- 4.2
- $$\begin{array}{cccccccc}
 \text{H} & \text{H} & & \text{H} & \text{H} & & \text{H} & \text{H} & \text{H} & \text{H} \\
 | & | & & | & | & & | & | & | & | \\
 \text{C} = \text{C} & + & \text{C} = \text{C} & \rightarrow & -\text{C} - \text{C} - \text{C} - \text{C}- \\
 | & | & & | & | & & | & | & | & | \\
 \text{H} & \text{H} & & \text{H} & \text{H} & & \text{H} & \text{H} & \text{H} & \text{H}
 \end{array}$$
- What process is depicted in the diagram above? (1)
- 4.3 Ethene can be used to make High-Density Polythene (HDPE) or Low-Density Polythene (LDP). Give two uses of HDPE in everyday situations. (2)
- [5]**

QUESTION 5

The following boiling points were recorded while doing an experiment.

Molecule	Boiling Point (°C)
Butane	-0,4
Butanone	79,64
Butene	-6,3
Butanol	117,7
Propanol	97

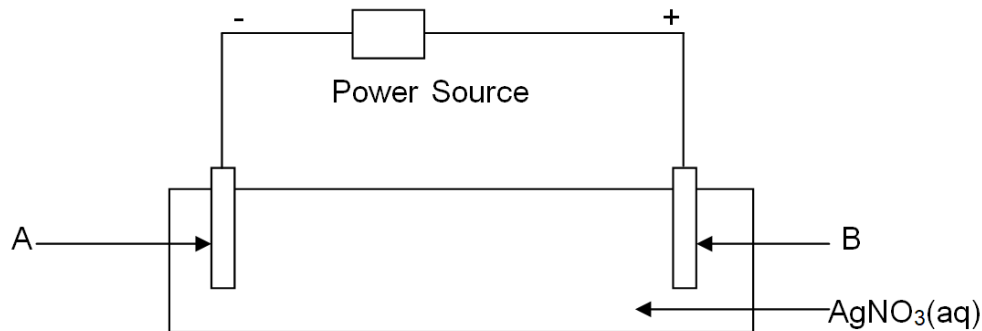
- 5.1 Define the term *boiling point*. (2)
- 5.2 Explain why the boiling point of butanol is higher than the boiling point of propanol. (2)
- 5.3 Name the intermolecular forces in:
- 5.3.1 butane (1)
- 5.3.2 butanone (1)
- 5.3.3 butanol (1)
- 5.4 What is the melting point of a substance? (1)
- 5.5 Which of the following should have the highest melting point, butanol or butanone? (1)
- 5.6 Explain your answer in Question 5.5. (2)
- 5.7 Which one of the substances in the table will have the lowest viscosity? Explain your answer by referring to intermolecular forces. (2)

[13]

QUESTION 6

In industry, silver plating is done for a variety of reasons. It holds up well against chemicals and acids and it protects against corrosion. It is an excellent conductor of electricity and heat. It adds to the visual impact of the product.

Consider the following electrochemical cell. AgNO_3 is in solution and two graphite rods are used as electrodes.

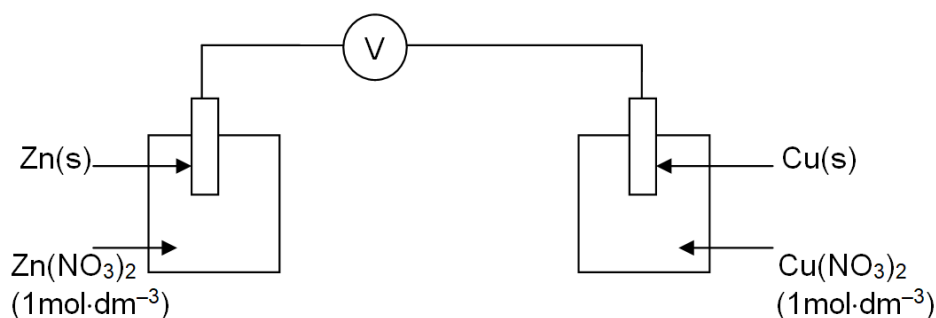


- 6.1 Give the definition of an *electrolytical cell*. (2)
- 6.2 What will you see at electrode A when the current has been flowing for a few minutes? (2)
- 6.3 What energy change takes place in this cell? (1)
- 6.4 At which electrode (A or B) does ... take place?
- 6.4.1 oxidation (1)
- 6.4.2 reduction (1)
- 6.5 Write down the half reaction which takes place at electrode A. (2)
- 6.6 Explain how electrolysis can be used for silver plating in the industry. (2)

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QUESTION 7

- 7.1 Consider the diagram below of a galvanic cell constructed under standard conditions.

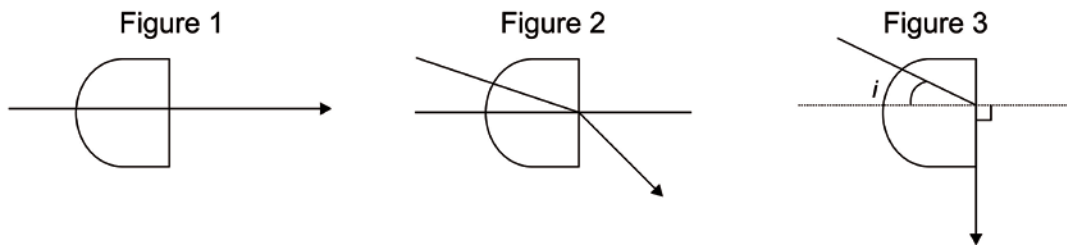


- 7.1.1 Will any current flow in the external circuit? Explain your answer. (2)
- 7.1.2 What energy conversion takes place in this galvanic cell? (1)
- 7.1.3 In which direction will the current flow in the external circuit? Zn to Cu or Cu to Zn? (1)
- 7.1.4 At which electrode does reduction take place? (1)
- 7.1.5 Write down the reduction half-reaction. (2)
- 7.1.6 Write down the net cell reaction when the cell delivers current. (3)
- 7.1.7 Give the standard cell notation for this cell. (3)
- 7.2 Two reactions take place:
- A: $\text{Fe} + 2\text{Ag}^+ \rightarrow \text{Fe}^{2+} + 2\text{Ag}$
- B: $\text{Hg} + \text{Mg}^{2+} \rightarrow \text{Hg}^{2+} + \text{Mg}$
- 7.2.1 Define *oxidation*. (2)
- 7.2.2 Use the redox table and calculate the EMF of reaction A and B. (5)
- 7.2.3 Use your answers in Question 7.2.2 to determine and explain which reaction will take place spontaneously. (2)
- 7.3 Eskom has announced a 9,3% increase in electricity tariffs for this year. Due to high electricity costs, people are looking for alternative sources of electricity.
- Two types of cells have been developed, a fuel cell and a photovoltaic cell.
- 7.3.1 Name an advantage of photovoltaic cells. (1)
- 7.3.2 Where can we use photovoltaic cells? (1)

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QUESTION 8

8.1 Light moves through a semi-circular glass prism as indicated below.

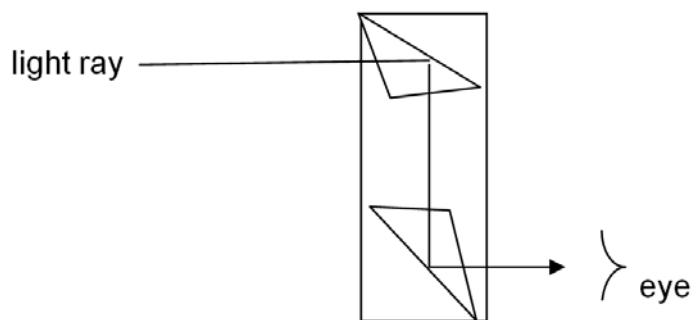


8.1.1 Identify the phenomena taking place in Figure 2. (1)

8.1.2 Explain why this phenomena takes place. (2)

8.1.3 What do we call angle i in Figure 3? (1)

8.2 In a submarine the captain uses a periscope to observe any movement above the water.

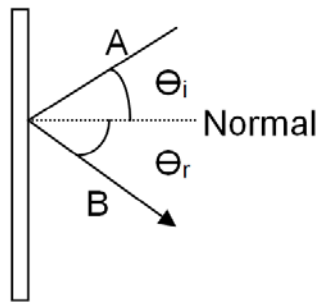


8.2.1 Name the phenomenon of light that is used in a periscope which makes this possible. (1)

8.2.2 Give two conditions for this phenomenon to occur. (2)

8.2.3 Give two more applications where this phenomenon is used in optical equipment. (2)

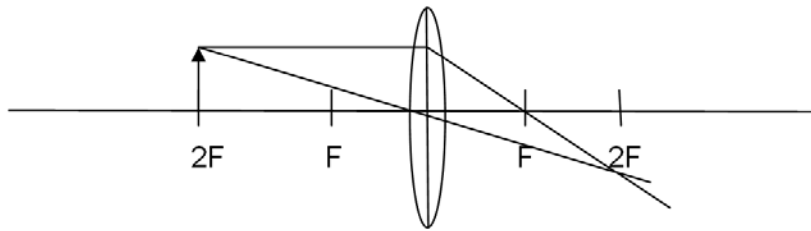
8.3 Consider the following diagram of reflection on a flat plane to answer the following questions.



- 8.3.1 Define the *normal*. (2)
- 8.3.2 Name lines A and B. (2)
- 8.3.3 If the magnitude of θ_r is 40° , what is the magnitude of θ_i ? (1)
- 8.3.4 A flower, 7 cm high, is placed 27 cm from the flat mirror.
- (a) How high is the image formed? (1)
- (b) How far is the image formed from the mirror? (1)
- (c) Is the image upright? (1)
- [17]**

QUESTION 9

9.1 The ray diagram below depicts an image placed at a distance of 2F from the focal point.



9.1.1 What type of lens is used? (1)

9.1.2 Choose words from the box below to describe the image that is formed.

<p>upright virtual inverted smaller bigger same size real</p>

(3)

9.1.3 When will you use a lens in this position? (1)

9.2 9.2.1 Use a sketch to show the movement of light through a concave lens. (3)

9.2.2 Describe the image that is formed when light shines through a concave lens. (3)

9.3 When it rains, a rainbow is formed when the sun breaks through the clouds.

9.3.1 What do we call this phenomenon? (1)

9.3.2 Give a definition for this phenomenon. (2)

9.3.3 A rainbow has seven colours. Which colour is refracted the most? (1)

9.3.4 Use different wavelengths to explain your answer to **Question 9.3.3.** (2)

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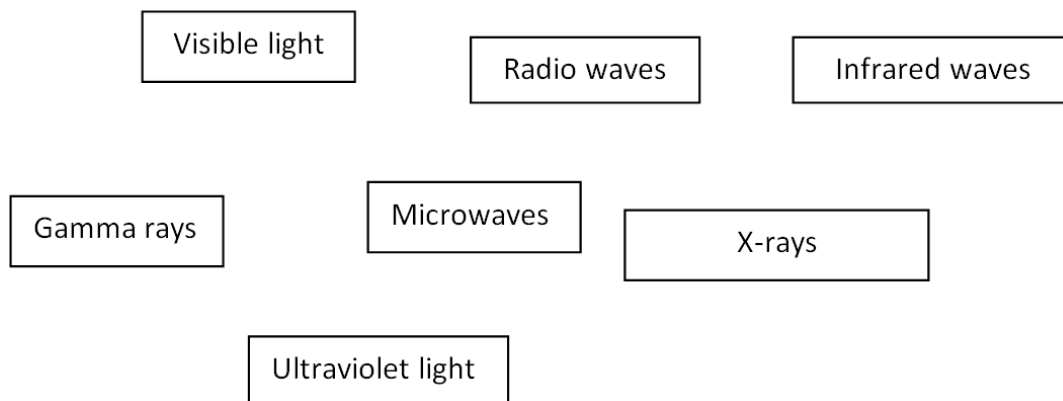
QUESTION 10

Electromagnetic radiation is a form of energy that is all around us. It takes many forms; sunlight is also a form of electromagnetic radiation.

10.1 Define *electromagnetic waves*. (2)

10.2 What is the difference between sound waves and electromagnetic waves? (2)

10.3 Arrange the following electromagnetic waves in ascending order of wavelength.



10.4 Identify the electromagnetic waves that would be used in the following situations: (4)

10.4.1 Used in security systems to detect hidden weapons. (1)

10.4.2 Used to sterilise medical equipment. (1)

10.5 Calculate the energy of a photon of an electromagnetic wave with a wavelength of 456 nm. (3)

[13]

Total: 150 marks