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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF
EDUCATION

MOGALAKWENA DISTRICT

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

TERM 1 TOPIC TEST

PHYSICAL PROPERTIES

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Total: 40 marks **Time: 60 minutes**

INSTRUCTIONS AND INFORMATION

1. Answer ALL questions.

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QUESTION 1

1.1 The boiling points of branched alkanes are lower than those of straight alkanes containing the same number of carbon atoms because branched alkanes chain have……..

A larger molecular mass
B shorter chain length
C more electrons
D smaller effective molecular surface area

(2)

1.2 Which one of the following compounds will have the highest vapour pressure?

A $CH_3CH_2CH_2CH_2CH_3$
B $CH_3CH_2CH_2CH_2OCH_3$
C $CH_3CH_2CH_2CH_2CH_2OH$
D $CH_3CH_2CH_3$

(2)

1.3 Which one of the following compounds has hydrogen bonds between its molecules?

A pentanal
B pentan-2-one
C pentanoic acid
D methyl butanoate

(2)
(6)

QUESTION 2

The boiling points of some organic compounds are shown in the table below. The atmospheric pressure is 101,3 kPa.

	ORGANIC COMPOUND	BOILING POINT (°C)
A	$CH_3CH_2CH_2CH_2C\ell$	78
B	$CH_3CH(CH_3)CH_2C\ell$	46
C	$CH_3CH_2CH_2CH_2OH$	118
D	$CH_3CH_2CH_2CHO$	**X**

2.1 Define the term *boiling point*. (2)

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2.2 Which ONE of compounds **A**, **B** or **C** is mainly in the liquid phase at 100 °C?

(1)

2.3 Explain the difference in the boiling points of compounds **A** and **B**. (3)

2.4 Consider the boiling points below.

75 °C	120 °C	126

2.4.1 Which ONE of these values represents **X**, the boiling point of compound **D**? (1)

2.4.1 Fully explain the answer to QUESTION 3.4.1. (2)

[9]

QUESTION 3

3.1 The boiling points of straight chain aldehydes and straight chain carboxylic acids are compared. The table below shows the results obtained.

	INVESTIGATION 1	**INVESTIGATION 2**
Number of carbon atoms in the compound	**Boiling point of aldehydes (°C)**	**Boiling point of carboxylic acids (°C)**
1	-19	101
2	20	118
3	49	141
4	75	164

3.1.1 Define the term *homologous series*. (2)

3.1.2 Write down the:

(a) NAME of the FUNCTIONAL GROUP of the aldehydes (1)

(b) IUPAC NAME of the compound with the highest vapour

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pressure in this comparison (2)

3.1.3 For INVESTIGATION **2**:

(a) Write down the controlled variable. (1)

(b) Describe the trend in the boiling points. (1)

(c) Fully explain the answer to QUESTION 3.1.3(b). (2)

3.1.4 Write down the boiling point of butanal. (1)

3.2 The vapour pressures of compounds **A** and **B** are compared.

A	$CH_3CH_2CH_2CH_2CH_2OH$
B	$CH_3CH_2CH_2COOH$

How does the vapour pressure of compound **A** compare to that of compound **B**? Choose from HIGHER THAN, LOWER THAN or EQUAL TO.

Fully explain the answer. (4)

[14]

QUESTION 4

The vapour pressures of different organic compounds are determined at 20 °C. The vapour pressures of compounds **A**, **B** and **C** are NOT shown in the table.

COMPOUND	IUPAC NAME	MOLAR MASS ($g \cdot mol^{-1}$)	VAPOUR PRESSURE (kPa) AT 20 °C
A	Pentane	72	
B	2-methylbutane	72	
C	2,2-dimethylpropane	72	
D	Propanoic acid	74	0,32
E	Butanal	72	12,2

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4.1 Define the term *vapour pressure.* (2)

4.2 The vapour pressures of compounds **A**, **B** and **C** are given in random order below.

79 kPa	146 kPa	58 Pa

4.1.1 Write down the vapour pressure of compound **C**. (1)

4.2.2 Fully explain your answer to QUESTION 4.1.1. (3)

4.2 Compounds **D** and **E** are compared.

4.3.1 Which compound has the lower boiling point? (1)

4.3.2 Fully explain the difference in the vapour pressures between compounds **D** and **E**. (4)

[11]

TOTAL MARKS: 40

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QUESTION 1

1.1 B✓✓ (2)
1.2 D✓✓ (2)
1.3 C✓✓ (2)
(6)

QUESTION 2

2.1 The temperature at which the vapour pressure (of a substance) equals atmospheric pressure. ✓✓
(2)

2.2 C ✓
(1)

2.3 **Structure:**

Longer chain length/larger surface area (over which intermolecular forces act). ✓

- **Intermolecular forces:**
  Stronger/more intermolecular forces/Van der Waals forces/London forces/dipole-dipole forces. ✓
- **Energy:**
  More energy needed to overcome or break intermolecular forces/Van der
  Waals forces/dipole-dipole forces. ✓

(3)

2.4.1 75 (°C) ✓ (1)

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2.4.2

- **Intermolecular forces:**
  C ($CH_3CH_2CH_2CH_2OH$/butanol) has stronger intermolecular forces than D ($CH_3CH_2CH_2CHO$/butanal). ✓
- **Energy:**
  More energy needed to overcome or break intermolecular forces. ✓ Accept: Boiling point of C will be more (in relation to C and D/118°C vs 75°C).

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(2)

[9]

QUESTION 3

3.1.1 (A series of organic) compounds that can be described by the same general formula. ✓✓ **(2 or 0)**

(2)

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3.1.2

(a) Formyl (group) ✓ (1)

(b) Methanal✓✓ (2)

3.1.3

(a) Homologous series/Functional group/Type of intermolecular forces/Straight chain/Atmospheric pressure ✓

(1)

(b) The boiling points of the carboxylic acids increase with an increase in the chain length/the number of carbon atoms/surface area/molecular mass✓

(c)

As the number of C atoms/chain length/surface area/contact area/molecular mass increases

- The strength of intermolecular/London/dispersion forces increases. ✓
- More energy is needed to overcome intermolecular forces/London/ dispersion forces. ✓

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(2)

3.1.4 75 °C ✓ (1)

3.2

- Higher than ✓
- Compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Alcohol/Pentan-1-ol has (in addition to London forces and dipole-dipole forces) one site for hydrogen bonding between molecules and compound B/$CH_3CH_2CH_2COOH$/ Carboxylic acid/Butanoic acid has, (in addition to London forces and dipoledipole forces), more than one site (two) for hydrogen bonding between molecules. ✓
- Intermolecular forces in compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Alcohol/ Pentan-1-ol are weaker. ✓
- Less energy needed to overcome/break intermolecular forces in compound A/$CH_3CH_2CH_2CH_2CH_2OH$/Pentan-1-ol/Alcohol.

(4)
(14)

QUESTION 4

4.1 The pressure exerted by a vapour at equilibrium with its liquid in a closed system.✓✓ (2)

4.2

4.2.1 146 (kPa) ✓

(1)

4.2.2

- **Structure:**
  Compound C is more branched than compounds A and B/Shorter chain length/most compact most spherical/smallest surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
  Compound C has weaker/less intermolecular forces/Van der Waals forces/London forces than A and B. ✓
- **Energy:**
  Lesser energy needed to overcome or break intermolecular forces/Van der
  Waals force in compound C than A and B. ✓

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(3)

4.3

4.3.1 E/butanal✓ (1)

4.3.2

- Strongest intermolecular forces in compound D: Hydrogen bond. ✓
- Strongest intermolecular forces in compound E: Dipole-dipole forces. ✓
- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

(4)

(11)

TOTAL MARKS: 40