

Total: 40 marks

Time: 60 minutes

INSTRUCTIONS AND INFORMATION

1. Answer ALL questions.

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 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OCH}_3$
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- D $\text{CH}_3\text{CH}_2\text{CH}_3$

(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	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$	78
B	$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$	46
C	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	118
D	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$	X

2.1 Define the term *boiling point*.

(2)

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
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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



3.1.3

pressure in this comparison

(2)

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	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

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 ($\text{g}\cdot\text{mol}^{-1}$)	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

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
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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)

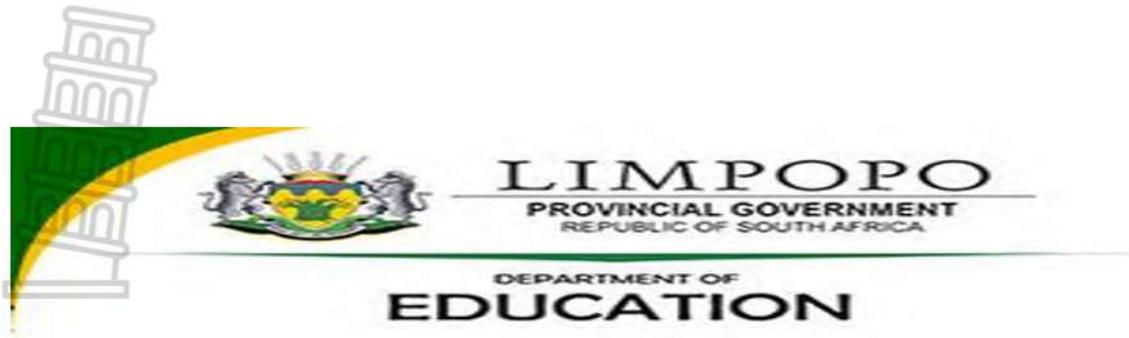
4.2 Compounds **D** and **E** are compared.

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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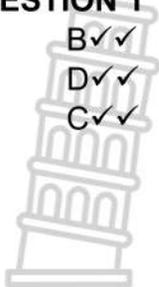
NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES
TERM 1 TOPIC TEST MEMORANDUM
PPHYSICAL PROPERTIES

QUESTION 1

- 1.1 B ✓✓
1.2 D ✓✓
1.3 C ✓✓



(2)
(2)
(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). ✓

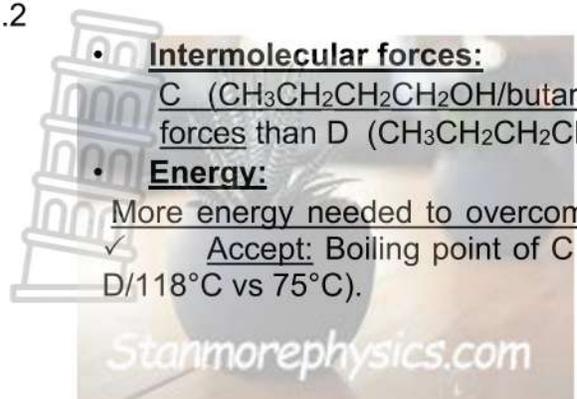
- **Intermolecular forces:**
Stronger/more intermolecular forces/Van der Waals forces/London forces/dipole-dipole forces. ✓
- **Energy:**
More energy needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces. ✓

(3)

2.4.1 75 (°C) ✓

(1)

2.4.2



- **Intermolecular forces:**
C ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ /butanol) has stronger intermolecular forces than D ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ /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).

(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)



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)

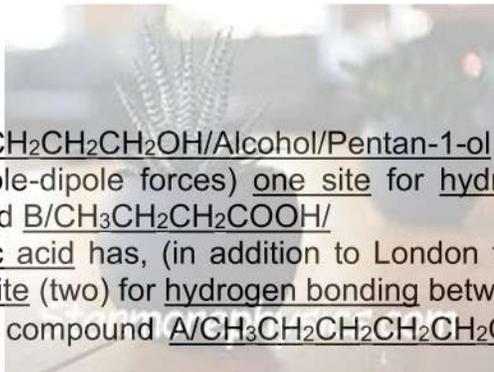
As the number of C atoms/chain length/surface area/contact area/molecular mass increases

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

3.1.4 75 °C ✓
3.2



- Higher than ✓
- Compound A/CH₃CH₂CH₂CH₂CH₂OH/Alcohol/Pentan-1-ol has (in addition to London forces and dipole-dipole forces) one site for hydrogen bonding between molecules and compound B/CH₃CH₂CH₂COOH/Carboxylic acid/Butanoic acid has, (in addition to London forces and dipole-dipole forces), more than one site (two) for hydrogen bonding between molecules. ✓
- Intermolecular forces in compound A/CH₃CH₂CH₂CH₂CH₂OH/Alcohol/ Pentan-1-ol are weaker. ✓
- Less energy needed to overcome/break intermolecular forces in compound A/CH₃CH₂CH₂CH₂CH₂OH/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. ✓

(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)

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