



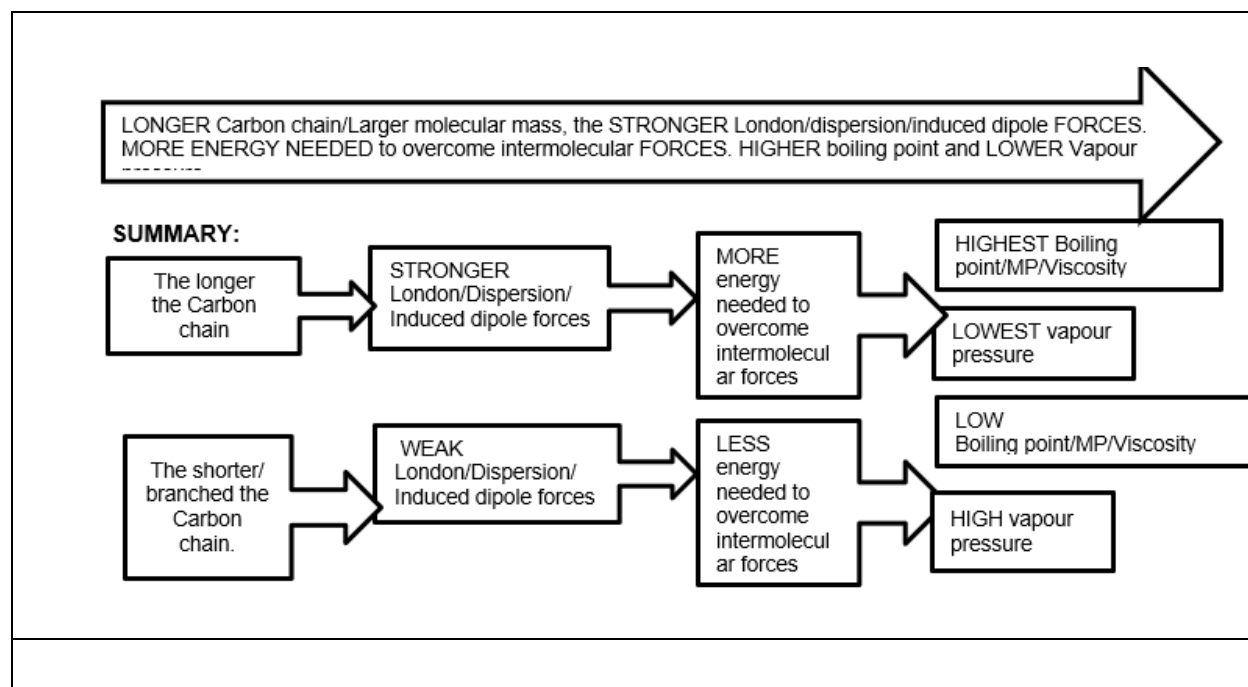
GRADE 12
TECHNICAL SCIENCES

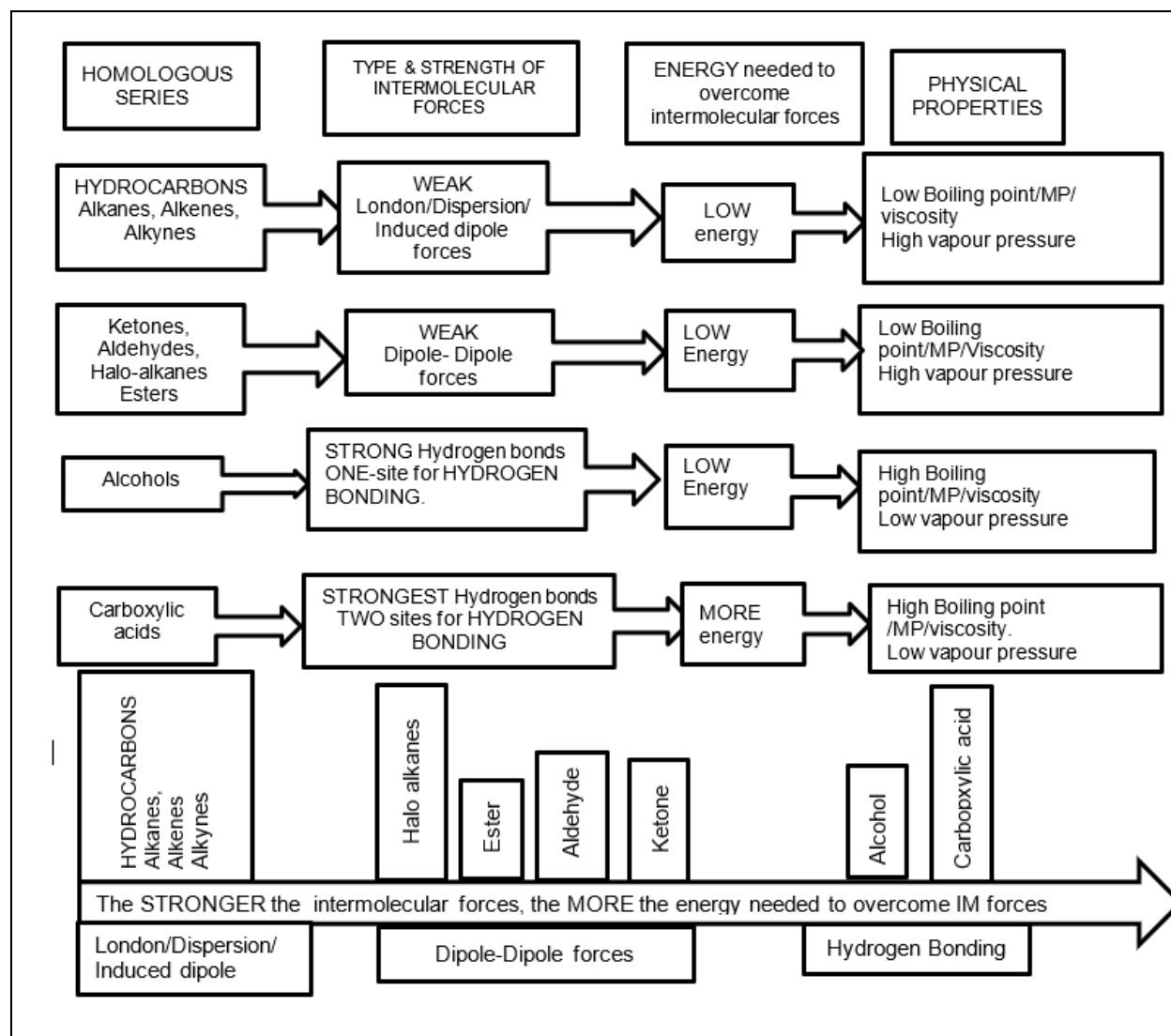
PHYSICAL PROPERTIES OF ORGANIC MOLECULES

TERM 2 2020

NAME:		
SCHOOL:		
TEACHER:		
PHYSICAL PROPERTIES AND INTERMOLECULAR FORCES: WORKSHEET 2		
Background information		
Concepts		
Boiling point: temperature at which the Vapour pressure is equal to the atmospheric pressure.		
Melting point: The temperature at which the solid and liquid phases of a substance are at equilibrium .		
Vapour pressure: The pressure exerted by a Vapour at equilibrium with its liquid phases of a substances are at equilibrium .		
Viscosity is the property of the fluid to oppose relative motion between the two adjacent layers .		
Factors affecting Physical Properties: intermolecular forces		
Induced dipole / dispersion/ London	Dipole-Dipole	Hydrogen bond
Alkanes	Halo-alkanes	Alcohols (1hydrogen site)
Alkenes	Aldehydes	Carboxylic acids (2 hydrogen sites)

Alkynes	Ketones	
	Esters	
RELATIONSHIP BETWEEN PHYSICAL PROPERTIES AND INTERMOLECULAR FORCES		
Physical Properties	Relationship to intermolecular forces	
BOILING POINT: The temperature at which vapour pressure of a substances equals the atmospheric pressure.	Increase with increase in Boiling Point.	
MELTING POINT: The temperature at which a solid and liquid phase of a substance are at equilibrium.	Increase with increase in Melting Point.	
VAPOUR PRESSURE: The pressure exerted by a Vapour at equilibrium with its liquid phases of a substances are at equilibrium.	Decrease with increase in Vapour Pressure.	
Viscosity is the property of the fluid to oppose relative motion between the two adjacent layers.	Increase with increase with viscosity.	





Worked example 1

The boiling points of straight chain alkanes are investigated and results are recorded in the table below

	Compounds	Boiling points (°C)
A	Methane	-162
B	Ethane	-89
C	Propane	-42

1.1		Which of the compounds in the table has the longest chain length?	(1)
1.2		Explain the increase in boiling points of alkanes, as indicated in the table, by referring to INTERMOLECULAR FORCES	(3)
1.3		Which ONE of COMPOUNDS A to C has the HIGHEST VAPOUR PRESSURE? Give a reason for the answer, using the data in the table	(2)
1.4		Which ONE of COMPOUNDS A to C has the HIGHEST Viscosity?	(2)

		Solution for worked example 1	
1.1		Alkanes ✓	(1)
1.2		FROM compound A to C - Chain length/molecular mass INCREASES ✓ - STRENGTH of intermolecular forces/London //Dispersion /Induced dipole forces increases. ✓ - More energy is needed to break the Intermolecular forces. ✓	(3)
1.3		A. ✓ LOWEST boiling point. ✓	(2)
1.4		C ✓ longest chain length ✓	(2)
			[8]

Worked example 2

Three compounds are used to investigate **ONE** of the factors that influences boiling point. The results obtained are shown in the table below

		COMPOUND	Molecular mass(g.mol ⁻¹)	Boiling point(°C)
	A	Butane	58	-0,5
	B	Propan-1-ol	60	98
	C	Ethanoic acid	60	118

2.1		Write down the type of intermolecular force found in each of the compounds A-C	(3)
2.2		Which ONE of compounds A , B or C has the HIGHEST vapour pressure? Give a reason for the answer by referring to the given data in the table.	(2)
2.3		Which ONE of compounds A , B and C has the HIGHEST boiling point? Explain the answer by referring to intermolecular forces present in EACH compound.	(4)
2.4		Which compound, BUTANE and BUTANAL has the higher Melting point? Explain the answer by referring to the intermolecular forces.	(4)

SOLUTIONS FOR WORKED EXAMPLE 2			
2.1		A- Dispersion/London/induced dipole intermolecular forces ✓	(1)
		B- Hydrogen Bond ✓	(1)
		C- Hydrogen Bond ✓	(1)
2.2		A ✓ / Butane. Lowest boiling point ✓ / Weakest intermolecular forces	(2)
2.3		From A to C	
		Compound A / Butane consist of LONDON forces/ DISPERSION forces/ INDUCED-DIPOLE FORCES. ✓ Compound B/propan-1-ol consist of ONE site for hydrogen bonding. ✓ Compound C/ ethanoic acid consist of TWO sites for hydrogen bonding. ✓ Strength of intermolecular forces INCREASE from A to C. ✓ OR Intermolecular forces in compound A/butane are the WEAKEST and intermolecular forces in compound C/ethanoic acid are the STRONGEST. ✓	(4)

		MORE energy is needed to overcome intermolecular forces in compound C/ethanoic acid . ✓	
2.4		Butane consist of LONDON forces/ DISPERSION forces/ INDUCED-DIPOLE FORCES. ✓ Butanal consist of DIPOLE-DIPOLE forces. ✓ DIPOLE - DIPOLE forces are STRONGER than London forces/ Dispersion forces/Induced-Dipole forces. ✓ MORE energy needed to overcome intermolecular forces in Butanal. ✓	(4)
			[13]
Activities			
Activity 1			
Learners investigate which factor influence the boiling points of straight-chain alkanes. The results are shown in the table below are are given in the table below:			
		Number of carbon atoms	Boiling points (°C)
	A	1	-162
	B	2	-89
	C	3	-42
	D	4	-0,5

1.1		Which compound (A-D) has the highest vapour pressure? Use the data in the table to explain the answer.	(2)
1.2		Explain the trend in boiling point of compounds A to D by referring to the intermolecular forces.	(4)
1.3		Write down the STRUCTURAL FORMULA of the CHAIN isomer of compound D .	(2)

1.4		How will the boiling point of 2-methyl propane compare to that of 2-methyl butane? Explain the answer by refering to intermolecular forces.	(4)
			[12]

Activity 2

Three compounds are used to investigate ONE of the factors that influence boiling point. The results are obtained are shown in the table below:

	Compounds	Boiling point(°C)
A	Butane	-0,5
B	Butan-1-ol	117,7
C	Butanoic acid	164

2.1		Is compound B a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for the answer.	(2)
2.2		Write down the NAME and FORMULA for the functional group of :	
	2.2.1		(2)

	2.2.2		(2)
2.3		Write down the STRUCTURAL FORMULA of a POSITIONAL ISOMER of compound B .	(2)
2.4		The boiling points increases from compound A to C .	
		Fully explain this trend by refeing to the intermolecular forces present in EACH compound.	(5)

2.5		Which compound, BUTANE or BUTANONE, has the higher boiling point? Explain the answer by referring to intermolecular forces.	(4)
			[17]
			[29]

TOTAL [29]**YOUR TOTAL**