National 5 Chemistry
Unit 2.1b Alkanes

	Lesson	Traffic Light		
		Red	Amber	Green

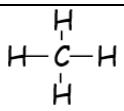
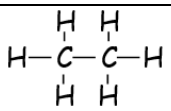
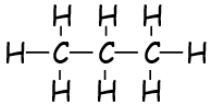
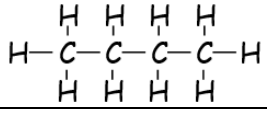
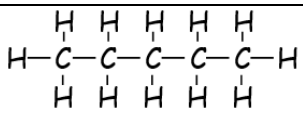
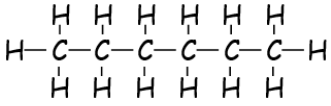
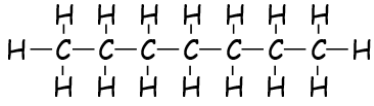
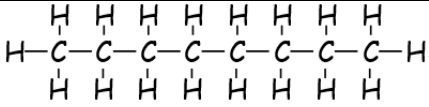
8

Alkanes are a homologous series of saturated hydrocarbons (saturated means single bonds only)

- are commonly used as fuels
- are insoluble in water
- can be represented by the general formula C_nH_{2n+2}

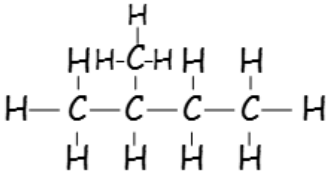
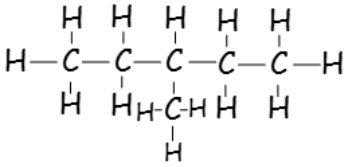
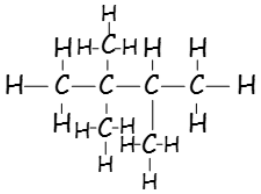
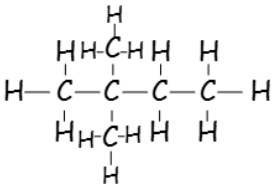
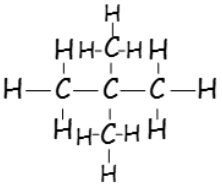
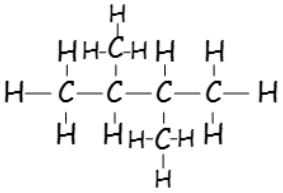
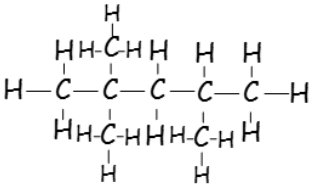
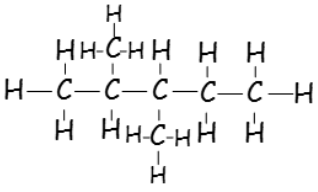
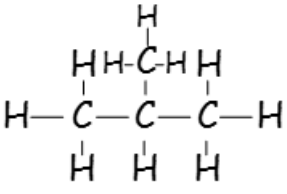
9a 10a

Alkanes with straight chains have the following structure:

Alkane	Molecular Formula	Shortened Formula	Structural Formula
Methane	CH_4	CH_4	
Ethane	C_2H_6	CH_3CH_3	
Propane	C_3H_8	$CH_3CH_2CH_3$	
Butane	C_4H_{10}	$CH_3CH_2CH_2CH_3$	
Pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$	
Hexane	C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$	
Heptane	C_7H_{16}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	
Octane	C_8H_{18}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	

9b 10b

Alkanes can also have a branched chain structure. Some examples include:

 2-methylbutane	 3-methylpentane	 2,2,3-trimethylbutane
 2,2-dimethylbutane	 2,2-dimethylpropane	 2,3-dimethylbutane
 2,2,4-trimethylpentane	 2,3-dimethylpentane	 2-methylpropane

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Past Paper Question Bank
Unit 2.1b Alkanes

JABchem

Outcome	Original Specimen Paper	New Specimen Paper	Nat5 2014	Nat5 2015	Nat5 2016	Nat5 2017	Nat5 2018	Nat5 2019	Nat5 2020	Nat5 2021						
8					mc10	mc10		L7b(i) L7b(ii)								
9a 10a																
9b 10b	mc8	mc8	mc10	mc12			L4b	mc14								

MC Qu	Answer	% Correct	Reasoning
2014 MC 10	B	83	☒A longest chain in structure is 4 carbons ∴ name must end in butane ☑B 2-methylbutane has 4 carbons in main chain and methyl CH_3- group on C_2 ☒C methyl CH_3- group is on C_2 from right hand side ∴ 2-methyl at start of name ☒D 2-methylpentane would contain 6 carbons in total
2015 MC 12	C	88	☒A longest chain has five carbons ∴name ends in pentane ☒B longest chain has five carbons ∴name ends in pentane ☑C 5 carbons in main chain (pentane), two methyl groups on C_2 and C_3 ☒D numbering of carbons from right to left to give side groups lower numbering
2016 MC 10	C	79	☒A C_4H_8 fits the general formula C_nH_{2n} but C_3H_8 fits the general formula C_nH_{2n+2} ☒B C_4H_8 fits the general formula C_nH_{2n} but C_3H_8 fits the general formula C_nH_{2n+2} ☑C both C_3H_8 and C_5H_{12} fit the general formula C_nH_{2n+2} ☒D C_5H_{10} fits the general formula C_nH_{2n} but C_3H_8 fits the general formula C_nH_{2n+2}
2017 MC 10	A	85	☑A C_7H_{16} gives a general formula of C_nH_{2n+2}. Alkanes have general formula C_nH_{2n+2}. ☒B C_7H_{14} gives a general formula of C_nH_{2n}. Alkanes have general formula C_nH_{2n+2}. ☒C C_7H_{12} gives a general formula of C_nH_{2n-2}. Alkanes have general formula C_nH_{2n+2}. ☒D C_7H_{10} gives a general formula of C_nH_{2n-4}. Alkanes have general formula C_nH_{2n+2}.
2019 MC 14	C	-	☒A Formula is C_6H_{12} so does not fit the general formula of alkanes C_nH_{2n+2} ☒B Formula is C_6H_{12} so does not fit the general formula of alkanes C_nH_{2n+2} ☑C C=C double bond between C_2 & C_3 (numbered from right) and methyl group on C_3 ☒D C=C takes the lower number system so Pent-3-ene should be pent-2-ene

Nat5	Answer	Reasoning
2018 4b	150-154°C	Alkane | Pentane | Hexane | Heptane | Octane | Nonane Boiling Point (°C) | 36 | 69 | 98 | 126 | - Difference: | | 33 | 29 | 28 | Prediction: 27 Prediction: | - | - | - | - | 153
2019 7b(i)	Alkane	The hydrocarbon $C_{25}H_{52}$ must belong to the alkane family as it fits the general formula of alkanes of C_nH_{2n+2}. In n=35 then 2n+2 = (2x25) +2 = 50+2 = 52 ∴ $C_{25}H_{52}$
2019 7b(ii)	$C_{35}H_{72}$	General Formula C_nH_{2n+2} where number of H atoms = 72. Hydrogen number 2n+2 = 72 ∴2n = 70 ∴ n=35 ∴ formula = $C_{35}H_{72}$

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Past Paper Question Bank
Unit 2.1b Alkanes

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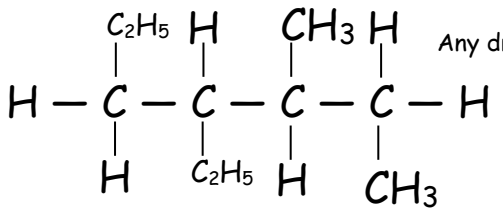
Outcome	Int2 2000	Int2 2001	Int2 2002	Int2 2003	Int2 2004	Int2 2005	Int2 2006	Int2 2007	Int2 2008	Int2 2009	Int2 2010	Int2 2011	Int2 2012	Int2 2013	Int2 2014	Int2 2015
8					mc12						mc12	mc12				
9a 10a																
9b 10b				L11b	mc11		L8a(i)		mc12					L8c	L7a(ii)	

Int2	Answer	% Correct	Reasoning
2004 MC 11	A	86	☑A 5 carbon main chain with $-CH_3$ methyl groups on carbons 2 and 3. ☒B molecule is numbered incorrectly and does not give lowest numbering system ☒C main chain has 5 carbons so is pentane not 3 carbon propane ☒D main chain has 5 carbons so is pentane not 3 carbon propane
2004 MC 12	C	75	C_3H_8 is called propane ∴ alkane with general formula C_nH_{2n+2} ☒A Molecule is cyclobutane C_4H_8 so is not an alkane with general formula C_nH_{2n+2} ☒B Molecule is but-2-ene C_4H_8 so is not an alkane with general formula C_nH_{2n+2} ☑C Molecule is 2-methylbutane C_5H_{12} is an alkane with general formula C_nH_{2n+2} ☒D Molecule is 2-methylbutene C_5H_{10} is not an alkane with general formula C_nH_{2n+2}
2008 MC 12	C	32	☒A Longest chain length incorrect (methyl side groups cannot be on Carbon no. 1) ☒B Longest chain length incorrect (ethyl side groups cannot be on Carbon no. 2) ☑C 2-methylbutane: methyl $-CH_3$ group on carbon no. 2 of a 4 carbon main chain ☒D Numbering system is incorrect as side group must have lowest number possible
2010 MC 12	D	82	☒A CH_4 fits into the general formula of C_nH_{2n+2} ∴ CH_4 is an alkane ☒B C_2H_6 fits into the general formula of C_nH_{2n+2} ∴ C_2H_6 is an alkane ☒C C_4H_{10} fits into the general formula of C_nH_{2n+2} ∴ C_4H_{10} is an alkane ☑D C_6H_{12} fits into the general formula of C_nH_{2n} ∴ C_6H_{12} is an alkene or cycloalkane
2011 MC 12	C	81	☒A cyclobutane C_4H_8 is in a different homologous series from propane C_3H_8 ☒B but-2-ene C_4H_8 is in a different homologous series from propane C_3H_8 ☑C 2-methylbutane C_5H_{12} is in the same homologous series as propane C_3H_8 ☒D 2-methylbut-1-ene C_5H_{10} is in a different homologous series from propane C_3H_8

Int2	Answer	Reasoning
2003 11b	Correct drawing of:	 Any drawing of 4-ethyl-3-methylheptane
2006 8a(i)	Methylpropane	2-methylpropane: $-CH_3$ methyl group on a 3 carbon main alkane chain. As methyl group can only be located on carbon number 2, methyl group does not require to be numbered.
2013 8c	2,3-dimethylbutane	1. Identify the longest chain: 4 carbons -butane 2. Identify the sidechains: 2 x $-CH_3$ -dimethylbutane 3. Lowest numbering system selected $-CH_3$ on C_2 and C_3 2,3-dimethylbutane
2014 7a(ii)	3-methylheptane	Longest chain in structure = 7 carbons ∴ name ends in ……heptane $-CH_3$ side group in structure ∴ name ends in … methylheptane Side group on carbon 3 from right ∴ name is 3-methylheptane

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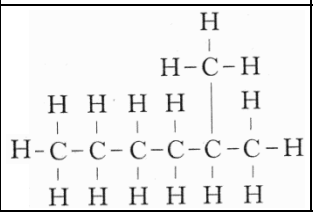
Past Paper Question Bank
Unit 2.1b Alkanes

Outcome	2000 Credit	2001 Credit	2002 Credit	2003 Credit	2004 Credit	2005 Credit	2006 Credit	2007 Credit	2008 Credit	2009 Credit	2010 Credit	2011 Credit	2012 Credit	2013 Credit		
8						12a										
9a 10a																
9b 10b									19a							

SG Credit	Answer	Reasoning
2005C 12a	C_nH_{2n+2}	Homologous Series: Alkanes | Alkenes | Cycloalkanes | Alcohols | Carboxylic Acids General Formula: C_nH_{2n+2} | C_nH_{2n} | C_nH_{2n} | $C_nH_{2n+1}OH$ | $C_nH_{2n+1}COOH$
2008C 19a		Each molecule has a CH_3- group sticking off the 2nd carbon atom from right hand side. This is the 2-methyl part of the name. The length of the main chain corresponds to the 2nd half of the name: **hex**ane means there are **6** carbons in the main chain. Carbons make 4 bonds and hydrogens make 1 bond each.

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Past Paper Question Bank
Unit 2.1b Alkanes

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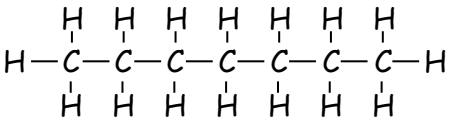
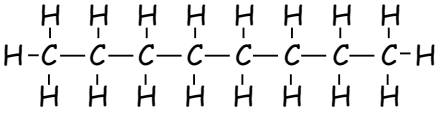
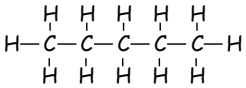
Outcome	2000 General	2001 General	2002 General	2003 General	2004 General	2005 General	2006 General	2007 General	2008 General	2009 General	2010 General	2011 General	2012 General	2013 General		
8				10b							17a		12b 12c			
9a 10a					16a			14a				20b				
9b 10b																

SG General	Answer	Reasoning
2003G 10b	alkanes	Homologous series are a family of compounds with the same chemical properties and a general formula. Homologous series include: Alkanes | Alkenes | Cycloalkanes | Alcohols | Carboxylic Acids
2004G 16a	diagram showing:	
2007G 14a	Diagram showing:	
2010G 17a	Alkanes	Homologous series are a family of compounds with the same chemical properties and a general formula. Alkanes | Alkenes | Cycloalkanes | Alcohols | Carboxylic Acids
2011G 20b		Pentane 5 carbons all C-C single bonds
2012G 12b	alkane	Alkanes, Alkenes and Cycloalkanes are all families of hydrocarbons
2012G 12c	$C_{20}H_{42}$	General Formula of Alkanes = C_nH_{2n+2} If n=20, 2n+2= (2x20)+2 = 40+2 = 42 ∴ Formula of eicosane = $C_{20}H_{42}$