**ANSWERS: Properties of carbon compounds**

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| **2019** | **Expected coverage** | **Achievement** | **Merit** | **Excellence** |
| **1. (i)****(ii)****2.**  | As the number of carbon atoms increases, the boiling point increases.Referring to the table: for example butane with 4 carbon atoms has a boiling point of 0 °C, pentane with 5 carbon atoms has a boiling point of 36°C, and hexane with 6 carbon atoms has a boiling point of 69 °C, showing that as the number of carbon atoms increases so does the boiling point.For both alkanes and alkenes, as the number of carbon atoms increases, the boiling point increases.Alkanes with the same number of carbon atoms always have a higher boiling point than the corresponding alkene.Methanol and ethanol are both alcohols, whereas propene is an alkene.Both methanol and ethanol are soluble in water, as they contain an OH group. The attraction between the alcohol and water is greater than the attraction between the individual molecules, so it dissolves. Propene is insoluble in water, as it contains only C and H atoms.Methanol contains 4 hydrogen atoms, so produces 2 molecules of water, as water has 2 hydrogen atoms. Ethanol and propene both contain 6 hydrogen atoms, so produce 3 molecules of water.Students may use structures and / or equations to support their answer. | • Correct trend.• Either point correct.• One correct description of solubility or numberof molecules of waterproduced. | • Correct trend with reference to two alkanes.• One similarity and one difference linked to table.• Explains solubility with reference to OH group.• Explains number of molecules of waterproduced for 1compound | • Full comparison andcontrast. |

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| 1.2.  | Alkanes and alkenes both have covalent bonding between atoms. They are both made up of the non-metal atoms C and H, which share electrons. Alkanes are saturated hydrocarbons, they have only single bonds between C atoms, whereas alkenes are unsaturated and have at least one double bond between C atoms. (This means that alkanes have the general formula of CnH2n+2 and alkenes CnH2n.)Both alkanes and alkenes share the same trend in boiling points.As the number of carbon atoms increases in alkanes and alkenes, the boiling point increases. As the number of carbon atoms increases, the molecules also increase in size, resulting in a larger / stronger attractive force between the molecules. This results in more heat energy being required to separate the molecules to allow them to become gases. The boiling point of each alkene is very similar to that of the alkane with the same number of carbon atoms, however the alkene has a boiling point, which is slightly lower than the corresponding alkane. This is because each alkene has 2 fewer H-atoms (electrons) than thealkane with the same number of carbons and so the attractive forces between the molecules is smaller / weaker.A = ethanolB = propaneC = ethaneEthanol is an alcohol and contains an -OH group. The OH group of ethanol isattracted to water molecules. The attraction between the OH group on ethanol and water is greater than the attraction between ethanol molecules, so it dissolves.Propane and ethane are both alkanes containing only C-C and C-H bonds. Theattraction between propane / ethane and water is less than the attraction between the molecules themselves (or they do not form attractions with water) and so theycannot dissolve in it. Ethanol is the only soluble molecule of the three thereforesubstance A is ethanol.Propane is an alkane containing 3 C atoms and ethane has 2 C atoms. When alkanes are completely combusted in air / oxygen, all of the C atoms react with the oxygen to form CO2. Therefore, when propane reacts, it will form 3 CO2 molecules since it has 3 Cs and ethane will form 2 CO2 molecules since it has 2 C atoms.[candidates may justify using balanced equations] | • Describes bonding as covalent.• Single bonds in alkanes or double bond in alkene• Describes trend for both alkane and alkene• All three compoundscorrect.• Alcohols / ethanol issoluble, or alkanes / propane & ethane are not. | • Bonding in both is **covalent** however single bonds in alkanes and double bond in alkenes / different general formulae.ORLinks lower boiling point of alkene to smaller number of H’s.• Links greater number of carbons / higher molar mass to increased forces between molecules(intermolecular forces) to more energy required to overcome and hence a higher boiling point.• Links structure / attraction of ethanol tosolubility in water.ORLinks structure / attraction of alkanes tolack of solubility in water.• Links number of C atoms in alkanes tonumber of CO2 molecules formed incomplete combustion. | • Compares andcontrasts boiling pointsof alkanes and alkenes,with links to structureand bonding.• Fully justifies all three choices with reference to structure and properties of thefunctional groups. |

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